arihant

2022-23
EDITION

Pathfinder

CDS

Combined Defence Services

ENTRANCE EXAMINATION

More than
8000 MCQs

Complete Coverage of Syllabus

Chapterwise Division of
Previous Years' Questions

2022-23
EDITION

Pathfinder

CDS

Combined Defence Services

ENTRANCE EXAMINATION

Compiled & Edited by
Arihant 'Expert Team'

arihant
ARIHANT PUBLICATIONS (INDIA) LIMITED

Pathfinder
CDS

arihant

ARIHANT PUBLICATIONS (INDIA) LIMITED

All Rights Reserved

© Publisher

No part of this publication may be re-produced, stored in a retrieval system or by any means, electronic, mechanical, photocopying, recording, scanning, web or otherwise without the written permission of the publisher. Arihant has obtained all the information in this book from the sources believed to be reliable and true. However, Arihant or its editors or authors or illustrators don't take any responsibility for the absolute accuracy of any information published and the damage or loss suffered thereupon.

All disputes subject to Meerut (UP) jurisdiction only.

Administrative & Production Offices

Regd. Office

'Ramchhaya' 4577/15, Agarwal Road, Darya Ganj, New Delhi -110002
Tele: 011- 47630600, 43518550

Head Office

Kalindi, TP Nagar, Meerut (UP) - 250002
Tel: 0121-7156203, 7156204

Sales & Support Offices

Agra, Ahmedabad, Bengaluru, Bareilly, Chennai, Delhi, Guwahati, Hyderabad, Jaipur, Jhansi, Kolkata, Lucknow, Nagpur & Pune.

ISBN 978-93-25798-01-4

PO No : TXT-XX-XXXXXXX-X-XX

Published by Arihant Publications (India) Ltd.

For further information about the books published by Arihant, log on to www.arihantbooks.com or e-mail at info@arihantbooks.com

Follow us on

Pathfinder CDS

CONTENTS

Pathfinder
CDS

CDS

Combined Defence Service

SOLVED PAPER 2021 (II)

PAPER I Elementary Mathematics

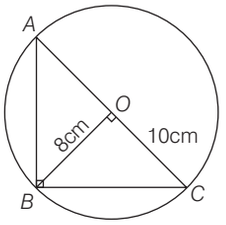
1. The radius of circum-circle of a right angled triangle is 10 cm and the altitude drawn to the hypotenuse is 8 cm. What is the area of the triangle?

(a) 60 cm^2 (b) 80 cm^2

(c) 100 cm^2 (d) 120 cm^2

(b) Given,

Radius of circumcircle of right angled triangle = 10 cm



In the right angled triangle, the hypotenuse is the diameter of the circumcircle and its centre is the mid-point of the hypotenuse.

i.e., $OA = OC = 10$ cm

$\therefore$ Hypotenuse

$= AC = 2 \times (10) = 20$ cm

The altitude drawn to the hypotenuse $= BO = 8$ cm

$\therefore$ Area of the right angled triangle

$$= \frac{1}{2} \times AC \times BO$$

$$= \frac{1}{2} \times 20 \times 8 = 80 \text{ cm}^2$$

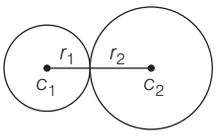
Hence, area of the triangle is 80 cm^2.

2. Two circles touch externally. The sum of their areas is 41π square cm. If the distance between their centres is 9 cm, then what is difference between their diameters

(a) 1 cm (b) 1.5 cm

(c) 2 cm (d) 4 cm

(c) Let the centre of the two circles be c_1 and c_2, then $c_1c_2 = 9$ cm (given)



If r_1 and r_2 denotes the radii. Then,

$\pi r_1^2 + \pi r_2^2 = 41\pi$

$\Rightarrow \quad r_1^2 + r_2^2 = 41 \quad \ldots$ (i)

Also $\quad r_1 + r_2 = 9 \quad \ldots$ (ii)

Put $r_2 = 9 - r_1$ into Eq (i), we get

$\Rightarrow \quad r_1^2 + (9 - r_1)^2 = 41$

$\Rightarrow r_1^2 + 81 + r_1^2 - 18r_1 = 41$

$\Rightarrow \quad 2r_1^2 - 18\, r_1 + 40 = 0$

$\Rightarrow \quad r_1^2 - 9r_1 + 20 = 0$

$\Rightarrow r_1^2 - 4r_1 - 5r_1 + 20 = 0$

$\Rightarrow r_1(r_1 - 4) - 5(r_1 - 4) = 0$

$\Rightarrow \quad (r_1 - 4)(r_1 - 5) = 0$

$\therefore r_1 = 4$ or 5

When $r_1 = 4$

$\Rightarrow r_2 = 9 - r_1 = 9 - 4 = 5$ cm

When $r_1 = 5$

$\Rightarrow r_2 = 9 - r_1 = 9 - 5 = 4$ cm

For, $r_1 = 4$ cm and $r_2 = 5$ cm

$\Rightarrow d_1 = 2 \times 4 = 8$ cm

and $d_2 = 2 \times 5 = 10$ cm

$\therefore d_2 - d_1 = 10 - 8 = 2$ cm

Similarly, for $r_1 = 5$ cm and $r_2 = 4$ cm, the difference between the diameters is 2 cm.

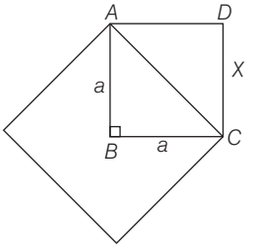
3. Let p be the area of the square X and q be the area of the square formed on the diagonal of the square X. What is the value of $\frac{p}{q}$?

(a) $\frac{1}{8}$ (b) $\frac{1}{4}$

(c) $\frac{1}{3}$ (d) $\frac{1}{2}$

(d) Let length of the side of the square X be a unit.

Then, $p = (a)^2 = a^2 \quad \ldots$ (i)



The length of the side of the bigger square

= The length of diagonal of square X

$= \sqrt{2a}$

$\therefore \quad q = (\sqrt{2}\, a)^2 = 2a^2 \quad \ldots$ (ii)

Now, $\frac{p}{q} = \frac{a^2}{2a^2}$ [from Eq. (i) and Eq. (ii)]

$$\frac{p}{q} = \frac{1}{2}$$

4. The area of a rhombus is 336 sq cm. If the length of one of its diagonals is 48 cm, then what is the perimeter of the rhombus?

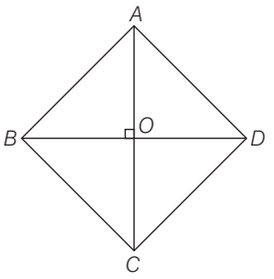
(a) 200 cm (b) 120 cm

(c) 100 cm (d) 90 cm

› ***(c)*** Given,

Area of rhombus $ABCD = 336\ cm^2$

Length of one of its diagonal = 48 cm



We know, the area of rhombus

$$= \frac{1}{2}(d_1 \times d_2)$$

Where, d_1 and d_2 are the lengths of the diagonals.

Therefore, $336 = \frac{1}{2} \times (48)$

$\times$ (length of other diagonal)

The length of other diagonal

$$= \frac{336}{24} = 14\ cm$$

We know that, diagonals of rhombus bisect each other at right angle.

$\because AO = \frac{1}{2} \times 14 = 7$ cm and

$BO = \frac{1}{2} \times 48 = 24$ cm

$\therefore$ In ΔABO,

$AB^2 = OA^2 + OB^2$

$AB^2 = 7^2 + 24^2$

$AB = \sqrt{49 + 576} = 25$ cm.

Length of side of rhombus = 25 cm

Perimeter of rhombus = 4×25 cm = 100 cm.

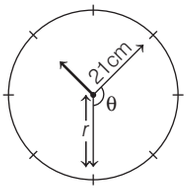
5. The minute hand of a clock is 21 cm long. What is the area on the face of the clock described by the minute hand between 10:10 am and 10:30 am? (take $\pi = \frac{22}{7}$)

(a) 231 cm^2 (b) 331 cm^2

(c) 462 cm^2 (d) 492 cm^2

› ***(c)*** Given, the length of minute hand of the clock = 21 cm

Time for calculating the area is 10:10 am to 10:30 am.



Time interval from 10:10 am to 10:30 am = 20 min

In 1 min, angle by minute hand = 6°

In 20 min, angle by minute hand = $20 \times 6 = 120°$

$\because$ The area of sector of circle $= \frac{\theta}{360°} \times \pi r^2$

$\therefore$ Required area $= \frac{120°}{360°} \times \pi(21)^2$

$$= \frac{1}{3} \times \frac{22}{7} \times 21 \times 21$$

$$= 22 \times 21$$

$$= 462\ cm^2$$

Hence, the required area is 462 cm^2.

6. The length and breadth of a room are 21 m and 16 m respectively. If the length of the longest rod that can be placed in the room is 29 m, then what is the height of the room ?

(a) 10 m (b) 11 m

(c) 12 m (d) 13 m

› ***(c)*** Given, length of the room,

$l = 21$ m

breadth of the room, $b = 16$ m

and the length of the longest rod that can be placed in the room = 29 m

We know that, the length of the longest rod that can be placed in the room is the diagonal of the room (cuboid).

We know, diagonal of a cuboid

$$= \sqrt{l^2 + b^2 + h^2}$$

$\Rightarrow \quad 29 = \sqrt{(21)^2 + (16)^2 + h^2}$

$\Rightarrow (29)^2 = 441 + 256 + h^2$

$\Rightarrow \quad 841 = 697 + h^2 \Rightarrow h^2 = 144$

$\Rightarrow \quad h = 12$ cm

Hence, height of the room is 12 cm.

7. A hemispherical bowl of internal radius 18 cm contains a liquid. The liquid is filled in small cylindrical bottles of internal radius 3 cm and internal height 4 cm. What is the number of bottles used to empty the bowl?

(a) 54 (b) 81

(c) 108 (d) 135

› ***(c)*** Given, internal radius of hemispherical bowl, $r_1 = 18$ cm

Internal radius of cylindrical bottle, $r_2 = 3$ cm

and internal height of cylindrical bottle, $h = 4$ cm

Let n number of bottles are used to empty the bowl.

The bowl will be completely empty, when Volume of n number of cylindrical bottles = Volume of hemispherical bowl.

$\Rightarrow n \times V_{\text{one bottle}} = V_{\text{bowl}}$

$\Rightarrow \quad n \times \pi r_2^2 h = \frac{2}{3}\pi r_1^3$

$\Rightarrow \quad n \times (3)^2(4) = \frac{2}{3} \times (18)^3$

$\Rightarrow \quad n \times 9 \times 4 = \frac{2}{3} \times 18 \times 18 \times 18$

$\Rightarrow \quad n = \frac{2 \times 6 \times 18 \times 18}{9 \times 4}$

$= 6 \times 18 = 108$

Hence, 108 number of bottles are used to empty the bowl.

8. A hollow spherical shell is made of a metal of density 7 g/cm^3. If its internal and external radii are 3 cm and 6 cm respectively, then what is the mass of the shell ? (Take $\pi = \frac{22}{7}$)

(a) 2772 g (b) 3322 g

(c) 4433 g (d) 5544 g

› ***(d)*** Given, density of metal of spherical shell = 7 g / cm^3

Internal radius, $r_1 = 3$ cm

External radius, $r_2 = 6$ cm

Volume of the hollow spherical shell

$$= \frac{4}{3}\pi(r_2^3 - r_1^3)$$

$$= \frac{4}{3} \times \frac{22}{7} \times (6^3 - 3^3)$$

$$= \frac{4}{3} \times \frac{22}{7} \times (216 - 27)$$

$$= \frac{88}{21} \times 189$$

$= 88 \times 9 = 792\ cm^3$

$\because$ Mass = Density $\times$ Volume

$\therefore$ Mass of the shell = $7 \times 792 = 5544$ g

Hence, mass of the shell is 5544 g.

9. A cone of height 16 cm and diameter 14 cm is mounted on a hemisphere of same diameter. What is the volume of the solid thus formed? (Take $\pi = \frac{22}{7}$)

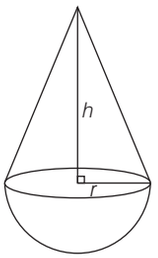
(a) 1540 cm^3 (b) 1078 cm^3

(c) 1048 cm^3 (d) 770 cm^3

› ***(a)*** Given, height of the cone, $h = 16$ cm

diameter of the cone = 14 cm

$\therefore$ Radius of the cone, $r = \frac{14}{2} = 7$ cm



And diameter of hemisphere = 14 cm

∴ Radius of hemisphere,

$r = \frac{14}{2} = 7$ cm

Volume of the solid formed = Volume of the cone + volume of hemisphere

$= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$

$= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 16$

$+ \frac{2}{3} \times \frac{22}{7} \times 7 \times 7 \times 7$

$= \frac{22 \times 7 \times 16}{3} + \frac{2 \times 22 \times 7 \times 7}{3}$

$= \frac{22 \times 7}{3}(16 + 14)$

$= \frac{154}{3} \times 30 = 1540 \text{ cm}^3$

Hence, the volume of the solid formed is 1540 cm^3.

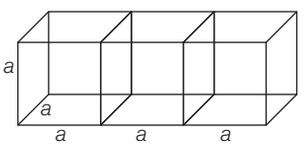
10. 3 cubes each of volume 343 cm^3 are joined end to end. What is the total surface area of the resulting cuboid?

(a) 343 cm^2 (b) 350 cm^2

(c) 686 cm^2 (d) 700 cm^2

(c) Given, volume of one cube = 343 cm^3

Let the length of the side of the cube be *a* unit.



When cubes are joined end to end, length of the resulting cuboid will be 3*a* but breadth and height will be the same.

In cuboid, $l = 3a$, $b = a$ and $h = a$

Total surface area of cuboid $= 2(lb + bh + hl)$

$= 2(3a \times a + a \times a + a \times 3a)$

$= 2(3a^2 + a^2 + 3a^2)$

$= 2(7a^2) = 14a^2$ … (i)

Since, cuboid is formed using 3 cubes.

Therefore, volume will remain same.

$\therefore V_{\text{cuboid}} = 3 \times V_{\text{Cube}}$

$\Rightarrow l \times b \times h = 3 \times 343$

$\Rightarrow 3a \times a \times a = 3 \times 343$

$\Rightarrow a^3 = 343 \Rightarrow a = 7$ cm

Putting, $a = 7$ cm into Eq. (i), we get

Total surface area of cuboid

$= 14 \times (7)^2 = 686 \text{ cm}^2$

11. A cubical block of side 14 cm is surmounted by a hemisphere of radius 7 cm. What is the total surface area of the solid thus formed? (Take $\pi = \frac{22}{7}$)

(a) 1330 cm^2 (b) 1306 cm^2

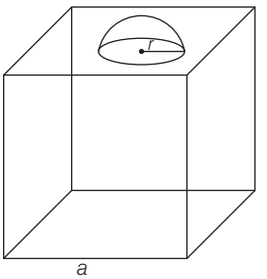
(c) 1296 cm^2 (d) 1256 cm^2

(a) Given, length of side of cubical block, $a = 14$ cm

Radius of hemisphere, $r = 7$ cm

Total surface area of the solid so formed

= total Surface area of cube + curved Surface area of hemisphere – circular base area of hemisphere.



$= 6 \times (a)^2 + 2\pi r^2 - \pi r^2$

$= 6 \times 14^2 + \pi r^2$

$= 6 \times 196 + \frac{22}{7} \times 7 \times 7$

$= 1176 + 154 = 1330 \text{ cm}^2$

12. How many silver coins, 3.5 cm in diameter and of thickness 4 mm, must be melted to form a cuboid of dimensions 21 cm × 11 cm × 7 cm?

(a) 420 (b) 210 (c) 200 (d) 168

(a) Given, dimensions of silver coins (cylindrical shape)

Thickness (h_1) = 4 mm

$= \frac{4}{10}$ cm = 0.4 cm

Diameter = 3.5 cm

∴ Radius, $r = \frac{3.5}{2} = 1.75$ cm

And dimensions of cuboid are

21 cm × 11 cm × 7 cm

i.e., $l = 21$ cm, $b = 11$ cm and $h_2 = 7$ cm

Let *n* number of coins are melted to form a cuboid.

In such case, volume will remain same.

∴ Volume of *n* coins = Volume of cuboid

$\Rightarrow n \times V_{\text{one coin}} = V_{\text{cuboid}}$

$\Rightarrow n \times \pi r^2 h_1 = l \times b \times h_2 \Rightarrow n = \frac{l \cdot b \cdot h_2}{\pi r^2 h_1}$

$\Rightarrow n = \frac{21 \times 11 \times 7}{\frac{22}{7} \times (1.75 \times 1.75) \times 0.4}$

$\Rightarrow n = \frac{21 \times 7 \times 7}{2 \times \left(\frac{7}{4} \times \frac{7}{4}\right) \times \left(\frac{4}{10}\right)}$

$n = \frac{21 \times 4 \times 4 \times 10}{2 \times 4}$

$= 21 \times 2 \times 10 = 420$

Hence, 420 silver coins must be melted to form a cuboid.

13. A tub is in the shape of a frustum of a cone. The radii of two circular ends of the tub are 105 cm and 42 cm. If the vertical height of the tub is 16 cm, what is its slant height

(a) 63.5 cm (b) 65 cm

(c) 73.5 cm (d) 75 cm

(b) Given, dimension of the frustum are :

radius of one circular part, $r_1 = 42$ cm

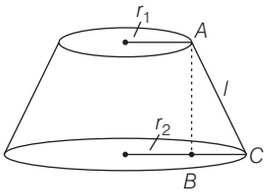
radius of another circular part, $r_2 = 105$ cm

Vertical height, $h = 16$ cm

In ΔABC,

$(AC)^2 = AB^2 + BC^2 \Rightarrow l^2 = h^2 + (r_2 - r_1)^2$

$l^2 = (16)^2 + (105 - 42)^2$



$= 256 + (63)^2 = 256 + 3969 = 4225$

$l = \sqrt{4225} = 65$ cm

Hence, the slant height is 65 cm.

14. *ABC* is a triangle right angled at *B* with $AB = 8$ cm and $BC = 6$ cm. It is made to revolve about its side *BC*. What is the approximate total surface area of the cone so formed?

(Take $\pi = \frac{22}{7}$)

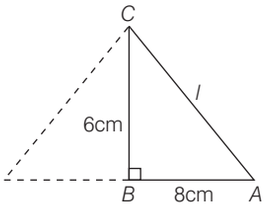
(a) 452 cm^2 (b) 440 cm^2

(c) 432 cm^2 (d) 420 cm^2

› ***(a)*** In right angled triangle ABC given that,

$AB = 8$ cm

$BC = 6$ cm



When the triangle is revolved about its side BC,

the height of the cone so formed, $h = 6$ cm

the radius of the cone so formed, $r = 8$ cm

Therefore, total surface area of the cone formed $= \pi r^2 + \pi rl$ … (i)

In ΔABC,

$AC^2 = AB^2 + BC^2$

$l^2 = 8^2 + 6^2$

$l^2 = 100$

$\Rightarrow l = 10$ cm

From Eq. (i), we have

Total surface area of the cone $= \pi r(r + l)$

$$= \frac{22}{7} \times 8 \times (8 + 10)$$

$$= \frac{22 \times 8 \times 18}{7}$$

$$= \frac{3168}{7}$$

$$\approx 452 \text{ cm}^2$$

Hence, the required approximate total surface area of the cone formed is 452 cm^2.

15. A solid rod consists of a cylinder of height 20 cm and radius 7 cm. It is surmounted by another solid cylinder of height 10 cm and radius 3.5 cm. If 1 cubic metre of rod weights 10000 kg, what is the mass of the rod ? (Take $\pi = \frac{22}{7}$)

(a) 34.65 kg (b) 31.56 kg

(c) 3.465 kg (d) 3.156 kg

› ***(a)*** Given,

Dimensions of cylinder 1 :

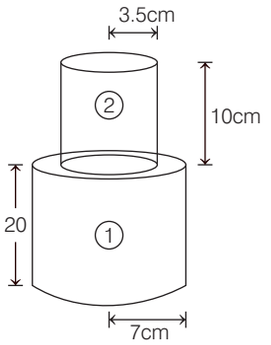
Radius (r_1) = 7 cm

Height (h_1) = 20 cm

Dimensions of cylinder 2 :

Radius (r_2) = 3.5 cm

Height (h_2) = 10 cm



Volume of the solid rod = Volume of cylinder 1 + Volume of cylinder 2.

$= \pi r_1^2 h_1 + \pi r_2^2 h_2$

$$= \frac{22}{7} \times (7 \times 7 \times 20 + 3.5 \times 3.5 \times 10)$$

$$= \frac{22}{7}(7 \times 140 + 3.5 \times 35)$$

$= 22(140 + 3.5 \times 5)$

$= 22(140 + 17.5)$

$= 22(157.5) = 3465 \text{ cm}^3$

$$= \frac{3465}{100 \times 100 \times 100} \text{ m}^3$$

$\therefore$ Mass of rod

$$= \frac{3465}{100 \times 100 \times 100} \times 10000 \text{ kg}$$

$= 34.65$ kg

Hence, mass of the rod is 34.65 kg.

16. What are distinct prime factors of the number 26381?

(a) 29, 17, 37 (b) 31, 17, 47

(c) 19, 37, 13 (d) 23, 31, 37

› ***(d)*** Given number is 26381.

Factors of the number :

23	26381
31	1147
37	37
	1

$26381 = 23 \times 31 \times 37$

Hence, distinct prime factors of the given number are 23, 31 and 37.

17. Which one of the following is a factor of the polynomial

$(x - 1)(x - 2)(x - 4) - 90$?

(a) x + 14 (b) x – 14

(c) x – 6 (d) x – 7

› ***(d)*** Let the polynomial represented by $f(x)$.

$\therefore f(x) = (x - 1)(x - 2)$

$(x - 4) - 90$ … (i)

In the options given factors are $(x + 14)$, $(x - 14)$, $(x - 6)$ and $(x - 7)$.

We know that $(x - a)$ is a factor of the polynomial $f(x)$, if $f(a) = 0$

Factor $(x + 14)$

Put $x + 14 = 0$ or

$x = -14$ into $f(x)$, we get

$f(-14) = (-14 - 1)(14 - 2)(-14 - 4) - 90$

$= (-15)(-16)(-18) - 90$

$= -4320 - 90$

$= -4410 \neq 0$

Factor $(x - 14)$:

Put $x - 14 = 0$ or $x = 14$ into $f(x)$, we get

$f(14) = (14 - 1)(14 - 2)(14 - 4) - 90$

$= (13)(12)(10) - 90 = 1560 - 90 \neq 0$

Factor $(x - 6)$:

Put $x - 6 = 0$ or $x = 6$ into $f(x)$, we get

$f(6) = (6 - 1)(6 - 2)(6 - 4) - 90$

$= 5 \times 4 \times 2 - 90 = 40 - 90 \neq 0$

Factor $(x - 7)$:

Put $x - 7 = 0$

or $x = 7$ into $f(x)$, we get

$f(7) = (7 - 1)(7 - 2)(7 - 4) - 90$

$= 6 \times 5 \times 3 - 90$

$= 90 - 90 = 0$

Hence, $(x - 7)$ is a factor of the given polynomial.

18. What is the square root of $23 - 4\sqrt{15}$?

(a) $\sqrt{6} - 3\sqrt{2}$

(b) $7 - 3\sqrt{5}$

(c) $\sqrt{3} - 2\sqrt{5}$

(d) $\sqrt{5} - 4\sqrt{3}$

› ***(c)*** $23 - 4\sqrt{15} = 3 + 20 - 4\sqrt{15}$

$= (\sqrt{3})^2 + (2\sqrt{5})^2 - 2 \times \sqrt{3} \times 2\sqrt{5}$

$= (\sqrt{3} - 2\sqrt{5})^2$

$\therefore \sqrt{23 - 4\sqrt{15}}$

$= \sqrt{(\sqrt{3} - 2\sqrt{5})^2}$

$= \sqrt{3} - 2\sqrt{5}$

19. What is the remainder after dividing the number 37^{1000} by 9?

(a) 1 (b) 3

(c) 7 (d) 9

› ***(a)*** $37^{1000} = 37^{1000} - 1^{1000} + 1$

We know that $x^n - a^n$ is divisible by $x - a$.

$\therefore 37^{1000} - 1^{1000}$ is divisible by

$(37 - 1 =) 36$.

The number is divisible by 36, it is divisible by 9.

$\therefore 37^{1000} - 1^{1000}$ is divisible by 9.

$\therefore$ Required remainder = 1

20. The sum of LCM and HCF of the numbers is 536 and the difference between LCM and HCF is 296. If one of the numbers is 104, then what is the other number?

(a) 420 (b) 480 (c) 484 (d) 506

(b) Let the LCM and HCF of two numbers be x and y respectively.

Now, according to the question,

$x + y = 536$ … (i)

$x - y = 296$ … (ii)

Adding Eq. (i) and Eq. (ii), we get

$2x = 832 \Rightarrow x = 416$

From Eq. (i),

$416 + y = 536$

$\Rightarrow \quad y = 536 - 416 = 120$

LCM = $x = 416$

and HCF = $y = 120$

We know,

Product of LCM and HCF = Product of two numbers.

Let the other number be P.

$\therefore 416 \times 120 = 104 \times P$ [$\because$ one of the numbers is 104]

$\Rightarrow P = \frac{416 \times 120}{104} = 480$

Hence, the other number is 480.

21. 20 men are supposed to complete a work in 10 days after working for 5 days they realise that only one fourth of the work is done. How many more men they need to employ to finish the work on time?

(a) 40 (b) 30 (c) 20 (d) 15

(a) Here, $M_1 = 20$

$D_1 = 5 \Rightarrow W_1 = \frac{1}{4}$

Let x more men are employeed.

$\therefore M_2 = 20 + x$

$D_2 = 5$

$W_2 = 1 - \left(\frac{1}{4}\right) = \frac{3}{4}$

We know that, $\frac{M_1D_1}{W_1} = \frac{M_2D_2}{W_2}$

$\Rightarrow \quad M_1D_1W_2 = M_2D_2W_1$

$\Rightarrow 20 \times 5 \times \frac{3}{4} = (20 + x) \times 5 \times \frac{1}{4}$

$\Rightarrow \quad 20 \times 3 = (20 + x)$

$\Rightarrow \quad 60 = 20 + x$

$\Rightarrow \quad x = 40$

Hence, 40 more men need to be employed to finish the work on time.

22. If x is a negative real number, then which of the following are not correct?

1. There is some natural number k such that $kx > 0$
2. $x^2 + x > 0$ always
3. $2x < x < -x$
4. x^2 is always a rational number

Select the correct answer using the code given below:

(a) 1, 2 and 3 (b) 1, 2 and 4

(c) 1, 3 and 4 (d) 2, 3 and 4

(b) Given, x is a negative number.

1. "There is some natural number k such that $kx > 0$".

When a negative number (x) is multiplied by a natural number (k), then the resulting number will be negative.

$\therefore kx > 0$ is not correct.

2. "$x^2 + x > 0$ always".

For $x = -\frac{1}{2}$

$\Rightarrow x^2 + x = \left(-\frac{1}{2}\right)^2 + \left(-\frac{1}{2}\right)$

$= \frac{1}{4} - \frac{1}{2} = -\frac{1}{4} < 0$

$\therefore x^2 + x > 0$ is not always correct.

3. "$2x < x < -x$"

$\Rightarrow 2x < x$

and $x < -x$

$\Rightarrow 2 \times$ (negative number) $<$ (same negative number) and negative number $<$ positive number [$\because -x$ is positive]

$\therefore 2x < x < -x$ is always correct.

4. "x^2 is always a rational number".

Let $x = -(2)^{1/4}$

then, $x^2 = [-(2)^{1/4}]^2$

$= +2^{1/4 \times 2} = 2^{1/2} = \sqrt{2}$,

which is irrational.

$\therefore x^2$ is always a rational number is an incorrect statement.

Hence, 1, 2 and 4 are not correct.

23. What is the sum of the linear factors (in x and y) of the expression $2x^2 + xy - 3y^2$?

(a) 2x – 3y

(b) 3x – 2y

(c) 3x + 2y

(d) 2x + 3y

(c) Given expression is

$= 2x^2 + xy - 3y^2$

$= 2x^2 + 3xy - 2xy - 3y^2$

$= x(2x + 3y) - y(2x + 3y)$

$= (2x + 3y)(x - y)$

Linear factors (in x and y) are $(2x + 3y)$ and $(x - y)$.

Their sum = $2x + 3y + x - y$

$= 3x + 2y$

Hence, sum of linear factors of the given expression is 3x + 2y.

24. Which one of the following equations does not have real roots?

(a) $2x^2 + 16x + 3 = 0$

(b) $2x^2 + 10x - 1 = 0$

(c) $x^2 - 8x + 1 = 0$

(d) $4x^2 + 9x + 6 = 0$

(d) In a quadratic equation $ax^2 + bx + c = 0$,

The discriminant, $D = b^2 - 4ac$

if $b^2 - 4ac < 0$

then the equation does not have real roots.

A. $2x^2 + 16x + 3 = 0$

$b^2 - 4ac = (16)^2 - 4(2)(3)$

$= 256 - 24 = 232 > 0$

(gives real roots)

B. $2x^2 + 10x - 1 = 0$

$b^2 - 4ac = (10)^2 - 4(2)(-1)$

$= 100 + 8 = 108 > 0$

(gives real roots)

C. $x^2 - 8x + 1 = 0$

$b^2 - 4ac = (-8)^2 - 4(1)(1)$

$= 64 - 4 = 60 > 0$

(gives real roots)

D. $4x^2 + 9x + 6 = 0$

$b^2 - 4ac = (9)^2 - 4(4)(6)$

$= 81 - 96 = -15 < 0$

(gives imaginary roots or not real)

Hence, option (d) has the quadratic equation with no real roots.

25. The sum and the product of the roots of a quadratic equation are 7 and 12 respectively. If the bigger root is halved and the smaller root is doubled, then what is the resulting quadratic equation?

(a) $x^2 - 6x + 12 = 0$

(b) $x^2 - 8x + 12 = 0$

(c) $x^2 + 8x + 12 = 0$

(d) $x^2 - 10x + 12 = 0$

(b) Let roots of the quadratic equation be a and b. Then,

$a + b = 7$ … (i)

$a \cdot b = 12$ … (ii)

Put $b = 7 - a$ into Eq.(ii), we get

$a(7 - a) = 12$

$\Rightarrow 7a - a^2 = 12$

$\Rightarrow a^2 - 7a + 12 = 0$

$\Rightarrow a^2 - 3a - 4a + 12 = 0$

$\Rightarrow a(a - 3) - 4(a - 3) = 0$

$\Rightarrow (a - 3)(a - 4) = 0$

$a = 3$ or 4

When, $a = 3$, $b = 7 - 3 = 4$

When, $a = 4$, $b = 7 - 4 = 3$

So, the smaller root is 3 and the bigger root is 4.

According to the question,

New roots are $\frac{1}{2} \times (4)$ and $2 \times (3)$ i.e., 2 and 6.

The resulting quadratic equation :

x^2 – (sum of roots) x + (product of roots) = 0

$\Rightarrow x^2 - (2 + 6)x + 2 \times 6 = 0$

$\Rightarrow x^2 - 8x + 12 = 0$

Hence, the required quadratic equation is $x^2 - 8x + 12 = 0$

26. For which values of k, does the equation $x^2 - kx + 2 = 0$ have real and distinct solutions ?

(a) $-2\sqrt{2} < k < 2\sqrt{2}$

(b) $k < -2\sqrt{2}$ only

(c) $k > 2\sqrt{2}$ only

(d) $k < -2\sqrt{2}$ or $k > 2\sqrt{2}$

(d) Given, quadratic equation is $x^2 - kx + 2 = 0$.

In a quadratic equation $ax^2 + bx + c = 0$,

if the discriminant, $D = b^2 - 4ac > 0$, then the quadratic equation will have real and distinct solutions.

For $x^2 - kx + 2 = 0$

$a = 1, b = -k$ and $c = 2$

$\therefore b^2 - 4ac = (-k)^2 - 4(1)(2)$

$= k^2 - 8$

Put $b^2 - 4ac > 0 \Rightarrow k^2 - 8 > 0$

$\Rightarrow k^2 - (2\sqrt{2})^2 > 0$

$\Rightarrow (k - 2\sqrt{2})(k + 2\sqrt{2}) > 0$

$\therefore k < -2\sqrt{2}$ or $k > 2\sqrt{2}$

Hence, the quadratic equation will have real and distinct solutions for $k < -2\sqrt{2}$ or $k > 2\sqrt{2}$.

27. If $\alpha + \beta + \gamma = \alpha\beta + \beta\gamma + \gamma\alpha$, then what is $(1 - \alpha)(1 - \beta)(1 - \gamma)$ equal to

(a) $1 - \alpha\beta\gamma$

(b) $1 + \alpha\beta\gamma$

(c) $\alpha^2 + \beta^2 + \gamma^2$

(d) $(\alpha - \beta)(\beta - \gamma)(\gamma - \alpha)$

(a) Given,

$\alpha + \beta + \gamma = \alpha\beta + \beta\gamma + \gamma\alpha$

$\Rightarrow 0 = \alpha\beta + \beta\gamma + \gamma\alpha - (\alpha + \beta + \gamma)$

$\Rightarrow \alpha\beta + \beta\gamma + \gamma\alpha - (\alpha + \beta + \gamma) = 0$ … (i)

$\therefore (1 - \alpha)(1 - \beta)(1 - \gamma)$

$= (1 - \alpha - \beta + \alpha\beta)(1 - \gamma)$

$= 1 - \alpha - \beta + \alpha\beta) - \gamma + \alpha\gamma + \beta\gamma - \alpha\beta\gamma$

$= 1 - \alpha - \beta - \gamma + \alpha\beta + \beta\gamma + \gamma\alpha - \alpha\beta\gamma$

$= 1 + \alpha\beta + \beta\gamma + \gamma\alpha - (\alpha + \beta + \gamma) - \alpha\beta\gamma$

$= 1 + 0 - \alpha\beta\gamma$ [from Eq. (i)]

$= 1 - \alpha\beta\gamma$

28. If $\log_{10} x + \log_{10} x^2 = 2\log_{10} x + 1$ then what is the value of x

(a) 1 (b) 2

(c) 5 (d) 10

(d) $\log_{10} x + \log_{10} x^2 = 2\log_{10} x + 1$

$\log_{10} x + 2\log_{10} x = 2\log_{10} x + 1$ [$\because \log x^m = m \log x$]

$\Rightarrow \log_{10} x + 2\log_{10} x - 2\log_{10} x = 1$

$\Rightarrow \log_{10} x = 1$

$\Rightarrow x = (10)^1$

$\Rightarrow x = 10$

$\therefore$ The value of x is 10.

29. The LCM of two prime numbers p and q is 2231, where $p > q$. What is the value of $p - q$?

(a) 67 (b) 70

(c) 74 (d) 81

(c) Given, LCM of two prime numbers p and q is 2231, where $p > q$.

We know, LCM of two prime numbers = Product of the numbers

$\Rightarrow 2231 = p \times q$

$\Rightarrow p \times q = 2231$

$\Rightarrow p \times q = 23 \times 97$

$\therefore p = 97$ and $q = 23$ ($\because p > q$)

Now, $p - q = 97 - 23 = 74$

Hence, the value of $p - q$ is 74.

30. Three runners are running in a circular track, and they complete one round in 20, 30 and 35 minutes respectively. when will they next meet at the starting point?

(a) After 3 hour 30 minutes

(b) After 4 hour 30 minutes

(c) After 3 hour

(d) After 7 hour

(d) The time interval when they will meet next at the starting point is the LCM (20, 30 and 35).

Thus, the prime factorisation of 20, 30 and 35 is

$20 = 2 \times 2 \times 5 = (2)^2 \times (5)^1$,

$30 = 2 \times 3 \times 5 = (2)^1 \times (3)^1 \times (5)^1$

and $35 = 5 \times 7 = (5)^1 \times (7)^1$

LCM (20, 30, 35)

$= (2)^2 \times (3)^1 \times (5)^1 \times (7)^1$

$= 12 \times 35$

$= 420$ min

$= \frac{420}{60}$ h $= 7$ h

Hence, all three runners will next meet after 7 h at the starting point.

31. What is the minimum value of $\cos^3\theta + \sec^3\theta$ where $0° \le 90°$?

(a) 0 (b) 1

(c) 2 (d) None of these

(c) Given expression :

$\cos^3\theta + \sec^3\theta$ where, $0° \le \theta \le 90°$

In the interval $0° \le \theta \le 90°$, $\cos\theta$ and $\sec\theta$ are positive.

On applying AM-GM on $\cos^3\theta$ and $\sec^3\theta$, we get

$\frac{\cos^3\theta + \sec^3\theta}{2} \ge \sqrt{\cos^3\theta \cdot \sec^3\theta}$

$\Rightarrow \cos^3\theta + \sec^3\theta \ge 2$

Hence, the minimum value of $\cos^3\theta + \sec^3\theta$ is 2.

32. If $14\sin^2\theta + 10\cos^2\theta = 11$ where $0° < \theta < 90°$ then what is the value of $\tan\theta + \cot\theta$?

(a) $\frac{4}{\sqrt{3}}$ (b) $\frac{2}{\sqrt{3}}$

(c) $\sqrt{3}$ (d) $2\sqrt{3}$

(a) Given, $14\sin^2\theta + 10\cos^2\theta = 11$

Where, $0° < \theta < 90°$,

$14\sin^2\theta + 10\cos^2\theta = 11$

$\Rightarrow 4\sin^2\theta + 10\sin^2\theta + 10\cos^2\theta = 11$

$\Rightarrow 4\sin^2\theta + 10(\sin^2\theta + \cos^2\theta) = 11$

$\Rightarrow 4\sin^2\theta + 10 \times 1 = 11$

[$\because \sin^2\theta + \cos^2\theta = 1$]

$\Rightarrow 4\sin^2\theta = 1 \Rightarrow \sin^2\theta = \frac{1}{4}$

$\Rightarrow \sin\theta = \pm\frac{1}{2}$

$\because \theta$ is in I-quadrant.

$\therefore \sin\theta$ cannot be negative.

Therefore, $\sin\theta = \frac{1}{2}$

$\Rightarrow \quad \theta = 30°$

Now, $\tan\theta + \cot\theta$

$= \tan 30° + \cot 30°$

$= \frac{1}{\sqrt{3}} + \sqrt{3} = \frac{1+3}{\sqrt{3}}$

$= \frac{4}{\sqrt{3}}$

33. What is the

$$\frac{\sin^3\theta + \cos^3\theta}{\sin\theta + \cos\theta} + \frac{\sin^3\theta - \cos^3\theta}{\sin\theta - \cos\theta}$$

equal to?

(a) 0 (b) 1

(c) 2 (d) 4

(c) Given expression,

$$\frac{\sin^3\theta + \cos^3\theta}{\sin\theta + \cos\theta} + \frac{\sin^3\theta - \cos^3\theta}{\sin\theta - \cos\theta}$$

$$\Rightarrow \frac{\sin^3\theta + \cos^3\theta}{\sin\theta + \cos\theta} + \frac{\sin^3\theta - \cos^3\theta}{\sin\theta - \cos\theta}$$

$$= \frac{(\sin\theta + \cos\theta)(\sin^2\theta + \cos^2\theta - \sin\theta\cos\theta)}{(\sin\theta + \cos\theta)}$$

$$+ \frac{(\sin\theta - \cos\theta)(\sin^2\theta + \cos^2\theta + \sin\theta\cos\theta)}{(\sin\theta - \cos\theta)}$$

$$\left[\begin{array}{l}\because a^3 + b^3 = (a+b)(a^2 + b^2 - ab) \\ \text{and } a^3 - b^3 = (a-b)(a^2 + b^2 + ab)\end{array}\right]$$

$= 1 - \sin\theta\cos\theta + 1 + \sin\theta\cos\theta$

$[\because \sin^2\theta + \cos^2\theta = 1]$

$= 1 + 1$

$= 2$

34. A ladder 10 m long reaches a point 10 m below the top of a vertical flagstaff. From foot of the ladder, the elevation of top of the flagstaff is 60°. What is the height of flagstaff ?

(a) 12 m (b) 15 m

(c) 16 m (d) 20 m

(b) Let OQ be a ladder.

$\therefore OQ = 10$ m

Some part of Flagstaff $QR = 10$ m

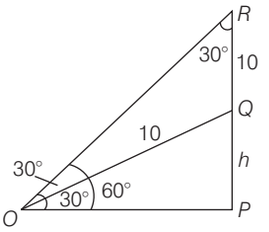
Now, $QR = QO = 10$ m

So, In $\Delta OPR \Rightarrow \angle R = 30°$

$\because OR = OQ$

$\Rightarrow \angle ROQ = \angle ORQ$

Let $PQ = h$



$\because \tan 60° = \frac{PR}{OP}$

$\Rightarrow \quad \sqrt{3} = \frac{10 + h}{OP}$

$\Rightarrow \quad OP = \frac{10 + h}{\sqrt{3}}$ … (i)

$\because \tan 30° = \frac{h}{OP}$

$\Rightarrow \quad OP = \frac{h}{(1/\sqrt{3})} = \sqrt{3}h$ … (ii)

From Eq. (i) and Eq. (ii), we get

$\frac{10 + h}{\sqrt{3}} = \sqrt{3}h \Rightarrow 10 + h = 3h$

$\Rightarrow 10 = 2h$

$\Rightarrow h = 5$ m

Height of flagstaff

$= h + 10 = 5 + 10 = 15$ m

Hence, the height of the flagstaff is 15 m.

35. What is the maximum value of

$1 + 2\sin^2\theta\cos^2\theta - \sin^4\theta - \cos^4\theta$

where $0° < \theta < 90°$?

(a) 1 (b) 2 (c) 3 (d) 4

(a) Given expression :

$1 + 2\sin^2\theta\cos^2\theta - \sin^4\theta - \cos^4\theta$

Where,

$0° < \theta < 90°$

$\Rightarrow 1 + 2\sin^2\theta\cos^2\theta - \sin^4\theta - \cos^4\theta$

$= 1 - [\sin^4\theta + \cos^4\theta - 2\sin^2\theta\cos^2\theta]$

$= 1 - [(\sin^2\theta)^2 + (\cos^2\theta)^2 - 2\sin^2\theta\cdot\cos^2\theta]$

$= 1 - [(\cos^2\theta - \sin^2\theta)^2]$

$[\because a^2 + b^2 - 2ab = (a-b)^2]$

$= 1 - [(\cos 2\theta)^2]$

$[\because \cos 2x = \cos^2 x - \sin^2 x]$

$= 1 - \cos^2 2\theta = \sin^2 2\theta$

$[\because \sin^2 A + \cos^2 A = 1]$

For maximum value $\sin^2 2\theta = 1$

$\Rightarrow \sin 2\theta = 1 \Rightarrow 2\theta = 90°$

$\Rightarrow \quad \theta = 45°$

$\therefore$ Maximum value

$= 1 + 2\sin^2 45°\cos^2 45° - \sin^4 45° - \cos^4 45°$

$= 1 + 2\cdot\frac{1}{2}\cdot\frac{1}{2} - \frac{1}{4} - \frac{1}{4}$

$= 1 + \frac{1}{2} - \frac{1}{2} = 1$

36. From an aeroplane flying about a river at an altitude of 1200 m, it is observed that the angles of depression of opposite points on the two banks of a river are 30° and θ. If the width of the river is 3000 m, then which one of the following is correct ?

(a) $\theta < 30°$ (b) $30° < \theta < 45°$

(c) $45° < \theta < 60°$ (d) $60° < \theta < 90°$

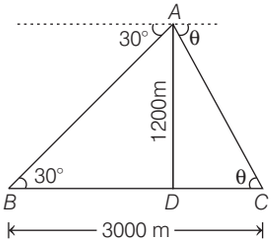
(c) Given, altitude of aeroplane is 1200 m.

and the width of the river is 3000 m.

So, we have,

$BC = 3000$ m, $AD = 1200$ m,

$\angle B = 30°$ and $\angle C = \theta$,



In ΔABD,

$\tan 30° = \frac{AD}{BD}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{1200}{BD}$

$\Rightarrow BD = 1200\sqrt{3}$

$\therefore DC = BC - BD = 3000 - 1200\sqrt{3}$

In ΔACD,

$\cot\theta = \frac{DC}{AD}$

$= \frac{3000 - 1200\sqrt{3}}{1200}$

$= \frac{30 - 12\sqrt{3}}{12} = \frac{5 - 2\sqrt{3}}{2}$

$\cot\theta = 2.5 - 1.732 = 0.77$

We know, $\cot\theta$ is a decreasing function in first quadrant.

$\cot 45° = 1$

and $\cot 60° = \frac{1}{\sqrt{3}} = \frac{\sqrt{3}}{3} = \frac{1.732}{3} \approx 0.6$

$\therefore \cot 45° > \cot\theta > \cot 60°$

$\therefore \theta \in (45°, 60°)$

Hence, option (c) is correct.

37. If $\frac{\cos^2\theta - 3\cos\theta + 2}{\sin^2\theta} = 1$

Where $0° < \theta < 90°$ then what is $\sin^2\theta + \cos\theta$ equal to

(a) $\frac{5}{4}$ (b) $\frac{3}{2}$ (c) $\frac{7}{4}$ (d) 2

(a) Given, $\frac{\cos^2\theta - 3\cos\theta + 2}{\sin^2\theta} = 1$

Where, $0° < \theta < 90°$

$\Rightarrow \cos^2\theta - 3\cos\theta + 2 = \sin^2\theta$

$\Rightarrow \cos^2\theta - 3\cos\theta + 2 = 1 - \cos^2\theta$

$[\because \sin^2 A + \cos^2 A = 1]$

$\Rightarrow 2\cos^2\theta - 3\cos\theta + 1 = 0$

$\Rightarrow 2\cos^2\theta - 2\cos\theta - \cos\theta + 1 = 0$

$\Rightarrow 2\cos\theta(\cos\theta - 1) - 1(\cos\theta - 1) = 0$

$\Rightarrow (\cos\theta - 1)(2\cos\theta - 1) = 0$

$\Rightarrow \cos\theta = 1$ or $\cos\theta = \frac{1}{2}$

$\because$ In the given interval $\theta \neq 0 \Rightarrow \cos\theta \neq 1$

$\therefore \cos\theta = \frac{1}{2}$ (only)

$\sin\theta = \sqrt{1 - \cos^2\theta}$

$= \sqrt{1 - \frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2}$

Now, $\sin^2\theta + \cos\theta$

$= \left(\frac{\sqrt{3}}{2}\right)^2 + \frac{1}{2} = \frac{3}{4} + \frac{1}{2}$

$= \frac{3}{4} + \frac{2}{4} = \frac{5}{4}$

Hence, $\sin^2\theta + \cos\theta = \frac{5}{4}$.

38. Consider the following

1. $\sin^4\theta - \sin^2\theta = \cos^4\theta - \cos^2\theta$
2. $\sin^4\theta + \cos^4\theta = 1 + 2\sin^2\theta\cos^2\theta$
3. $\tan^4\theta + \tan^2\theta = \sec^4\theta - \sec^2\theta$

Which of the above are identities?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

(c) Considering the given identities

1. $\sin^4\theta - \sin^2\theta = \cos^4\theta - \cos^2\theta$

$\Rightarrow \sin^2\theta(\sin^2\theta - 1) = \cos^2\theta(\cos^2\theta - 1)$

$\Rightarrow \sin^2\theta(-\cos^2\theta) = \cos^2\theta(-\sin^2\theta)$

$[\because \sin^2 A + \cos^2 A = 1]$

$\Rightarrow -\sin^2\theta \cdot \cos^2\theta = -\sin^2\theta \cdot \cos^2\theta$

Which is true.

2. $\sin^4\theta + \cos^4\theta = 1 + 2\sin^2\theta\cos^2\theta$

LHS $= (\sin^2\theta)^2 + (\cos^2\theta)^2$

$= (\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta \cdot \cos^2\theta$

$[\because a^2 + b^2 = (a + b)^2 - 2ab]$

$= 1 - 2\sin^2\theta \cdot \cos^2\theta$

$\neq$ R.H.S.

3. $\tan^4\theta + \tan^2\theta = \sec^4\theta - \sec^2\theta$

$\Rightarrow \tan^2\theta(\tan^2\theta + 1) = \sec^2\theta(\sec^2\theta - 1)$

$\Rightarrow \tan^2\theta \cdot \sec^2\theta = \sec^2\theta \cdot \tan^2\theta$

$[\because 1 + \tan^2 A = \sec^2 A]$

Which is true.

Hence, 1 and 3 are the identities.

39. What is the value of $\sin 24° \sin 66° - \cos 24° \cos 66° + \tan 24° \tan 66° - \cot 24° \cot 66°$?

(a) 0 (b) 1 (c) 2 (d) 3

(a) $\sin24°\sin66° - \cos24°\cos66° + \tan24°\tan66° - \cot24°\cot66°$

$\Rightarrow \sin(90° - 66°)\sin(90° - 24°) - \cos24°\cdot\cos66° + \tan(90° - 66°)\tan(90° - 24°) - \cot24°\cot66°$

$= \cos24°\cdot\cos66° - \cos24°\cos66° + \cot24°\cdot\cot66° - \cot24°\cot66°$

$[\because \sin(90° - \theta) = \cos\theta$ and $\tan(90° - \theta) = \cot\theta]$

$= 0 + 0 = 0$

40. If $x = p\sin A\cos B$, $y = p\sin A\sin B$ and $z = p\cos A$, then what is the value of $x^2 + y^2 + z^2$?

(a) $-p^2$ (b) 0
(c) p^2 (d) $2p^2$

(c) Given,

$x = p\sin A\cos B$, $y = p\sin A\sin B$

and $z = p\cos A$

$x^2 + y^2 + z^2$

$= (p\sin A\cos B)^2 + (p\sin A\sin B)^2 + (p\cos A)^2$

$= p^2\sin^2 A\cos^2 B + p^2\sin^2 A\sin^2 B + p^2\cos^2 A$

$= p^2[\sin^2 A\cos^2 B + \sin^2 A\sin^2 B + \cos^2 A]$

$= p^2[\sin^2 A(\cos^2 B + \sin^2 B) + \cos^2 A]$

$= p^2[\sin^2 A \times 1 + \cos^2 A]$

$[\because \sin^2\theta + \cos^2\theta = 1]$

$= p^2[\sin^2 A + \cos^2 A]$

$= p^2 \times 1 = p^2$

Hence, $x^2 + y^2 + z^2 = P^2$

41. If $x = m\sec A + n\tan A$ and $y = m\tan A + n\sec A$, then what is $x^2 - y^2$ equal to ?

(a) $m^2 - n^2$
(b) $m^2 + n^2$
(c) $m^2 + n^2 - mn$
(d) $m^2 - n^2 + mn$

(a) Given,

$x = m\sec A + n\tan A$

and $y = m\tan A + n\sec A$

$x^2 - y^2$

$= (m\sec A + n\tan A)^2 - (m\tan A + n\sec A)^2$

$= m^2\sec^2 A + n^2\tan^2 A + 2mn\sec A\tan A - m^2\tan^2 A - n^2\sec^2 A - 2mn\tan A\sec A$

$= m^2\sec^2 A + n^2\tan^2 A - m^2\tan^2 A - n^2\sec^2 A$

$= m^2(\sec^2 A - \tan^2 A) + n^2(\tan^2 A - \sec^2 A)$

$= m^2(\sec^2 A - \tan^2 A) - n^2(\sec^2 A - \tan^2 A)$

$= m^2 \times 1 - n^2 \times 1$

$[\because 1 + \tan^2\theta = \sec^2\theta]$

$= m^2 - n^2$

Hence, $x^2 - y^2 = m^2 - n^2$

42. If for some θ lying between $0°$ and $90°$, $\tan\theta = 1$, then what is the value of $\sin^2\theta - 2\sin\theta\cos\theta$?

(a) -1 (b) 0 (c) $\frac{1}{2}$ (d) $-\frac{1}{2}$

(d) Given, $\tan\theta = 1$, where

$0° < \theta < 90°$.

$\tan\theta = 1 \Rightarrow \theta = 45°$

Now, $\sin^2\theta - 2\sin\theta\cos\theta$

$= \sin^2 45° - 2\sin45°\cos45°$

$= [\sin45°]^2 - 2\sin45°\cdot\cos45°$

$= \left[\frac{1}{\sqrt{2}}\right]^2 - 2 \cdot \frac{1}{\sqrt{2}} \cdot \frac{1}{\sqrt{2}}$

$= \frac{1}{2} - 2 \cdot \frac{1}{2}$

$= \frac{1}{2} - 1 = -\frac{1}{2}$

Hence, $\sin^2\theta - 2\sin\theta\cos\theta = -\frac{1}{2}$

43. What is $\frac{2\sin^3\theta - \sin\theta}{\cos\theta - 2\cos^3\theta}, (0° < \theta < 90°)$ equal to

(a) $\sin\theta$ (b) $\cos\theta$
(c) $\tan\theta$ (d) $\cot\theta$

(c) Given expression,

$$\frac{2\sin^3\theta - \sin\theta}{\cos\theta - 2\cos^3\theta}, \text{ where } 0^\circ < \theta < 90^\circ$$

$$= \frac{\sin\theta(2\sin^2\theta - 1)}{\cos\theta(1 - 2\cos^2\theta)}$$

$$= \tan\theta \cdot \frac{[-1(1 - 2\sin^2\theta)]}{[-(2\cos^2\theta - 1)]}$$

$$= \tan\theta \cdot \frac{[\cos 2\theta]}{[\cos 2\theta]}$$

$[\because \cos 2A = 2\cos^2 A - 1 = 1 - 2\sin^2 A]$

$$= \tan\theta \times 1 = \tan\theta$$

Hence, $\frac{2\sin^3\theta - \sin\theta}{\cos\theta - 2\cos^3\theta} = \tan\theta$

44. If A, B and C are int4rior angles of a triangle ABC, then what is $\tan\left(\frac{B+C}{2}\right) + \sin\left(\frac{B+C}{2}\right) - \cot\left(\frac{A}{2}\right) - \cos\left(\frac{A}{2}\right)$ equal to ?

(a) 0

(b) $\frac{1}{2}$

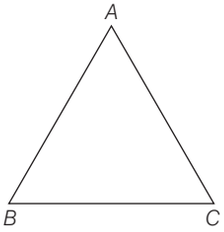
(c) $\sin\left(\frac{A+B+C}{4}\right)$

(d) $\tan\left(\frac{A+B+C}{4}\right)$

(a) Given expression,

$$\tan\left(\frac{B+C}{2}\right) + \sin\left(\frac{B+C}{2}\right) - \cot\left(\frac{A}{2}\right) - \cos\left(\frac{A}{2}\right)$$

We know that the sum of all three interior angles of a triangle is 180°. i.e., in ΔABC, $A + B + C = 180^\circ$



$$= \tan\left(\frac{180^\circ - A}{2}\right) + \sin\left(\frac{180^\circ - A}{2}\right) - \cot\left(\frac{A}{2}\right) - \cos\left(\frac{A}{2}\right)$$

$[\because A + B + C = 180^\circ]$

$$= \tan\left(90^\circ - \frac{A}{2}\right) + \sin\left(90^\circ - \frac{A}{2}\right) - \cot\left(\frac{A}{2}\right) - \cos\left(\frac{A}{2}\right)$$

$$= \cot\frac{A}{2} + \cos\frac{A}{2} - \cot\frac{A}{2} - \cos\frac{A}{2}$$

$[\because \tan(90^\circ - \theta) = \cot\theta$ and $\sin(90^\circ - \theta) = \cos\theta]$

$= 0$

Hence, the given expression results zero.

45. In a triangle ABC, right angled at B, $AB + BC = 10(1 + \sqrt{3})$ cm length of the hypotenuse is 20 cm. What is the value of $\tan A + \tan C$?

(a) $\frac{4}{\sqrt{3}}$

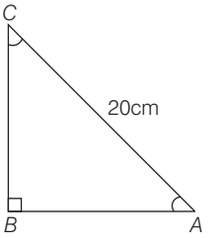
(b) $\frac{2}{\sqrt{3}}$

(c) $\sqrt{3}$

(d) $2\sqrt{3}$

(a) In a right angled triangle ABC, it is given that,

$AB + BC = 10(1 + \sqrt{3})$, $\angle B = 90^\circ$ and $AC = 20$ cm



In ΔABC,

$AB^2 + BC^2 = AC^2$

$AB^2 + BC^2 = 20^2$

$AB^2 + BC^2 = 400$ … (i)

Now, $AB + BC = 10(1 + \sqrt{3})$

Squaring on both sides, we get

$(AB + BC)^2 = [10(1 + \sqrt{3})]^2$

$\Rightarrow AB^2 + BC^2 + 2 \cdot AB \cdot BC$

$= 100(1 + 3 + 2\sqrt{3})$

$\Rightarrow 400 + 2AB \cdot BC = 100(4 + 2\sqrt{3})$ [From Eq. (i)]

$\Rightarrow 2AB \cdot BC = 400 + 200\sqrt{3} - 400$

$\Rightarrow AB \cdot BC = 100\sqrt{3}$ … (ii)

Now, $\tan A + \tan C$

$$= \frac{BC}{AB} + \frac{AB}{BC}$$

$$= \frac{BC^2 + AB^2}{AB \cdot BC}$$

$$= \frac{400}{100\sqrt{3}} = \frac{4}{\sqrt{3}}$$

Hence, $\tan A + \tan C = \frac{4}{\sqrt{3}}$

Directions (Q.Nos. 46-48) *Consider the following for the next three questions that follow.*

A solid consisting of a right circular cone of radius x and height $2x$ standing on a hemisphere of radius x (take $\pi = \frac{22}{7}$)

46. The volume of the solid is equal to that of a

(a) Sphere of radius x

(b) sphere of diameter x

(c) cylinder of radius x

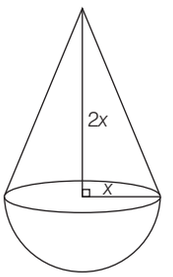
(d) cylinder of radius $\sqrt{2}$x

(a) Given dimensions :

Cone : radius $(r_1) = x$

height $(h) = 2x$

Hemisphere : radius $(r_2) = x$



∴ Volume of the solid = Volume of cone + Volume of hemisphere

$$= \frac{1}{3}\pi r_1^2 h + \frac{2}{3}\pi r_2^3$$

$$= \frac{1}{3}\pi \cdot x^2 \cdot (2x) + \frac{2}{3}\pi \cdot (x)^3$$

$$= \frac{2}{3}\pi x^3 + \frac{2}{3}\pi x^3 = \frac{4}{3}\pi x^3$$

Hence, the volume of the solid is equal to that of a sphere of radius x.

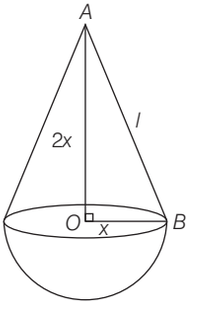
47. What is the approximate total surface area of the solid

(a) 11.2x^2 (b) 12.5x^2 (c) 13.3x^2 (d) 15.1x^2

(c) We have,

Cone : $r_1 = x$ and $h = 2x$

Hemisphere : $r_2 = x$



Total surface area of solid

= curved surface area of cone + curved surface area of hemisphere

$= \pi r_1 l + 2\pi r_2^2$

$= \pi \cdot x \cdot AB + 2\pi x^2$ … (i)

In right angled triangle ABC,

$AB^2 = OA^2 + OB^2$

$\Rightarrow AB^2 = (2x)^2 + x^2$

$= 4x^2 + x^2 = 5x^2$

$\Rightarrow AB = \sqrt{5}x$

Put $AB = \sqrt{5}x$ into Eq (i), we get

Total surface area of solid

$= \pi \cdot x \cdot \sqrt{5}x + 2\pi x^2$

$= 3.14 \times 2.23\, x^2 + 6.28x^2$

$= 7.0022x^2 + 6.28x^2$

$= 13.2822x^2 \simeq 13.3x^2$

Hence, the approximate total surface area of the solid is $13.3x^2$.

48. The solid is placed upright in a right circular cylinder full of water such that it touches the bottom. If the internal radius of cylinder is x and height is $3x$, what is the approximate volume of water left in the cylinder?

(a) $5.04x^3$ (b) $5.09x^3$

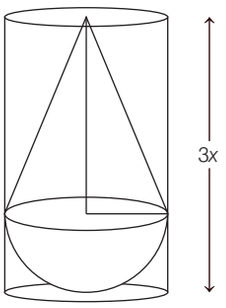
(c) $5.14x^3$ (d) $5.24x^3$

(d) We are given the dimensions as

Cone : $r_1 = x$ and $h_1 = 2x$

Hemisphere : $r_2 = x$

Cylinder : $r_3 = x$ and $h_2 = 3x$



When the solid is placed into the cylinder then the water equal to the volume of solid will be emptied.

Hence, water left in the cylinder

= Volume of cylinder – Volume of solid

$= \pi r_3^2 h_2 - \frac{4}{3}\pi x^3$

[∵ obtained in question (46)]

$= \pi \cdot x^2 \cdot (3x) - \frac{4}{3}\pi x^3$

$= 3\pi x^3 - \frac{4}{3}\pi x^3$

$= \pi x^3\left(3 - \frac{4}{3}\right) = \pi \cdot x^3 \cdot \frac{5}{3} = \frac{5\pi}{3}x^3$

$= \frac{5 \times 3.14}{3}x^3 = \frac{15.7}{3}x^3 \simeq 5.24x^3$

Hence, the approximate volume of water left in the cylinder is $5.24\, x^3$.

Directions (Q.Nos. 49 and 50) *Consider the following for next two question that follow.*

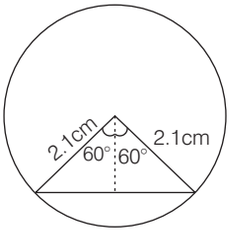
The chord of a circle of radius 2.1 cm is inclined the angle of 120° on the centre of circle.

(Take $\pi = \frac{22}{7}$ and $\sqrt{3} = 1.732$)

49. What is the approximate area of minor segment of the circle ?

(a) 2.71 cm^2 (b) 2.42 cm^2

(c) 1.91 cm^2 (d) 1.71 cm^2



(a) Given, Radius (r) of the circle = 2.1 cm; $\angle AOB = \theta = 120^\circ$

Area of minor segment of circle

= Area of minor sector – Area of triangle formed

$= \frac{\theta}{360^\circ}\pi r^2 - \frac{1}{2} \times \left(2r\sin\left(\frac{\theta}{2}\right)\right) \times r\cos\left(\frac{\theta}{2}\right)$

$= \frac{\theta}{360^\circ}\pi r^2 - r^2\sin\left(\frac{\theta}{2}\right)\cos\left(\frac{\theta}{2}\right)$

$= \frac{120^\circ}{360^\circ} \times \frac{22}{7} \times (2.1)^2 - (2.1)^2 \sin\left(\frac{120^\circ}{2}\right)\cos\left(\frac{120^\circ}{2}\right)$

$= \frac{1}{3} \times \frac{22}{7} \times \frac{21}{10} \times \frac{21}{10} - \frac{21}{10} \times \frac{21}{10} \times \sin 60^\circ \cos 60^\circ$

$= \frac{462}{100} - \frac{441}{100} \times \frac{\sqrt{3}}{2} \times \frac{1}{2}$

$= \frac{1}{100}(462 - 110.25 \times 1.732)$

$= \frac{1}{100}(462 - 190.953)$

$= \frac{271.047}{100} \approx 2.71\ \text{cm}^2$

Hence, approximate area of minor segment of the circle is 2.71 cm^2

50. What is the approximate area of major segment of the circle?

(a) 10.05 cm^2

(b) 10.15 cm^2

(c) 11.05 cm^2

(d) 11.15 cm^2

(d) The approximate area of major segment of circle = Area of circle – area of minor segment of circle

$= \pi r^2 - 2.71$

[obtained in question (49)]

$= \frac{22}{7} \times 2.1 \times 2.1 - 2.71$

$= 22 \times 0.3 \times 2.1 - 2.71$

$= 13.86 - 2.71$

$= 11.15\ \text{cm}^2$

Hence, the approximate area of major segment of the circle is 11.15 cm^2.

Directions (Q.Nos. 51-53) *Consider the following for the next three questions that follow.*

ABC is a triangle with sides $AB = 6$ cm, $BC = 10$ cm and $CA = 8$ cm. With vertices A, B and C as centres, three circles are drawn each touching the other two externally.

51. What is the sum of the radii of the circles?

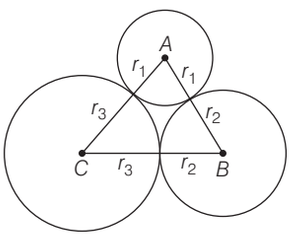
(a) 10.4 cm (b) 11.2 cm

(c) 12 cm (d) 13 cm

(c) In ΔABC it is given that

$AB = 6$ cm, $BC = 10$ cm

and $CA = 8$ cm



Let radius of circles A, B and C be r_1, r_2 and r_3.

We have,

$AB + BC + CA = 6 + 10 + 8$

$\Rightarrow (r_1 + r_2) + (r_2 + r_3) + (r_3 + r_1) = 24$

[from the above figure]

$\Rightarrow 2r_1 + 2r_2 + 2r_3 = 24$

$\Rightarrow 2(r_1 + r_2 + r_3) = 24$

$\Rightarrow r_1 + r_2 + r_3 = 12$ cm

Hence, sum of the radii of the circles is 12 cm.

52. What is the length of the altitude of the triangle drawn from vertex A on BC ?

(a) 2.4 cm (b) 3 cm
(c) 4 cm (d) 4.8 cm

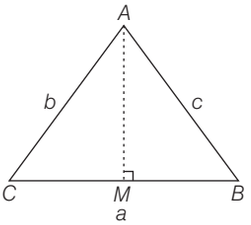
(d) In ΔABC it is given that

$AB = c = 6$ cm,

$BC = a = 10$ cm

and

$CA = b = 8$ cm



$$s = \frac{a + b + c}{2}$$

where s is semi perimeter

$$= \frac{10 + 8 + 6}{2}$$

$$= \frac{24}{2} = 12 \text{ cm}$$

$\therefore$ Area of triangle

$$= \sqrt{s(s-a)(s-b)(s-c)}$$

$$\Rightarrow \frac{1}{2} \times BC \times AM$$

$$= \sqrt{12(12-10)(12-8)(12-6)}$$

$$\Rightarrow \frac{1}{2} \times 10 \times AM = \sqrt{12 \times 2 \times 4 \times 6}$$

$$\Rightarrow$$

$$5 \times AM = \sqrt{4 \times 3 \times 2 \times 4 \times 2 \times 3}$$

$$\Rightarrow 5 \times AM = 2 \times 3 \times 2 \times 2$$

$$\Rightarrow \quad AM = \frac{24}{5}$$

$$\Rightarrow \quad AM = 4.8 \text{ cm}$$

Hence, the length of the required altitude is 4.8 cm.

53. If P, Q and R are the areas of sectors at A, B and C within the triangle respectively, then which of the following is/are correct

1. $P = \pi \text{cm}^2$
2. $9Q + 4R = 36\pi \text{cm}^2$

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

(c) $\because \ r_1 + r_2 + r_3 = 12$

(from Q.No. 51)

and $r_1 + r_2 = 6$, $r_2 + r_3 = 10$, $r_1 + r_3 = 8$

$\therefore \ r_1 = 2$ cm, $r_2 = 4$cm, $r_3 = 6$cm

1. $P = \frac{1}{4} \pi r_1^2 = \frac{1}{4} \times \pi \times (2)^2 = \pi \text{ cm}^2$

2. $9Q + 4R = 9 \times \frac{\theta_1}{360^\circ} \times \pi r_2^2 + 4 \times \frac{\theta_2}{360^\circ} \times \pi r_3^2$

$$= 9 \times \frac{\theta_1}{360^\circ} \times \pi (4)^2 + 4 \times \frac{\theta_2}{360^\circ} \times \pi (6)^2$$

$$= \frac{144}{360^\circ} \pi\theta_1 + \frac{144}{360^\circ} \pi\theta_2$$

$$= \frac{144}{360^\circ} \pi(\theta_1 + \theta_2)$$

$$= \frac{144}{360^\circ} \pi \times 90^\circ \quad [\because \theta_1 + \theta_2 = 90^\circ]$$

$$= 36\pi \text{ cm}^2$$

Hence, both 1 and 2 are correct.

Directions (Q.Nos. 54 and 55) *Consider the following next two questions that follow.*
ABC is triangle in which $AB = AC$ and D is any point on BC.

54. Which one of the following is correct?

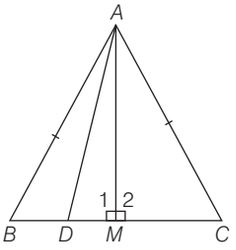
(a) $AB^2 - AD^2 = AD \times BD$
(b) $AC^2 - AD^2 = BD \times CD$
(c) $AB^2 - AD^2 = 2AD \times BD$
(d) $AC^2 - AD^2 = 2BD \times CD$

(b) Given,

ABC is a triangle in which

$AB = AC$ and D is any point on BC

Draw $AM \perp BC$



In ΔABM and ΔACM,

$AB = AC$ (given)

$\angle 1 = \angle 2$ (90°)

and $AM = AM$ (common)

$\Rightarrow \Delta ABM \cong \Delta ACM$

$\therefore \ BM = CM$ [$\because$CPCT] ... (i)

Now, $AB^2 = AM^2 + BM^2$ ... (ii)

Also, $AD^2 = AM^2 + DM^2$ ... (iii)

$AB^2 - AD^2 = (AM^2 + BM^2) - (AM^2 + DM^2)$

$= AM^2 + BM^2 - AM^2 - DM^2$

$= BM^2 - DM^2 = (BM + DM)(BM - DM)$

$= (CM + DM)(BM - DM)$ (from Eq. (i))

$= CD \times BD$

Hence, $AB^2 - AD^2 = CD \times BD$ Or

$AC^2 - AD^2 = CD \times BD$

[since, $AB = AC$]

55. If $AD = 5$ cm, $BD = 4$ cm and $CD = 6$ cm, then what is AB equal to ?

(a) 7 cm (b) 6.5 cm (c) 6 cm (d) 5.5 cm

(a) Given,

$AD = 5$ cm, $BD = 4$ cm and $CD = 6$ cm

We have,

$AB^2 - AD^2 = CD \times BD$

[obtained in question (54)]

$\Rightarrow AB^2 - (5)^2 = (6) \times (4)$

$\Rightarrow \ AB^2 - 25 = 24$

$\Rightarrow \quad AB^2 = 24 + 25 = 49$

$\Rightarrow AB = \sqrt{49} = 7$ cm

Hence, AB is equal to 7 cm.

Directions (Q.Nos. 56-58) *Consider the following for next three questions that follow.*
ABC is a triangle with $AB = 1.6$ cm, $BC = 6.3$ cm and $CA = 6.5$ cm. Let P and Q be the mid-points of AB and BC respectively.

56. What is $AB^2 + 4BQ^2$ equal to ?

(a) 41.25 cm^2 (b) 42.25 cm^2
(c) 43.75 cm^2 (d) 44.25 cm^2

(b) Given,

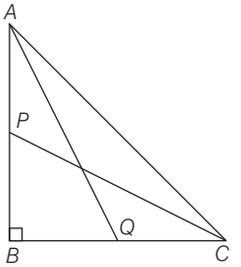
In ΔABC, $AB = 1.6$ cm, $BC = 6.3$ cm and $CA = 6.5$ cm

$\because \ P$ is mid-point of AB.

$\therefore \ AP = BP$ ... (i)

$\because Q$ is mid- point of BC.

$\therefore \ BQ = QC$ ... (ii)



$AB = 1.6$

$\Rightarrow AP + PB = 1.6$

$\Rightarrow PB + PB = 1.6 \quad [\because AP = BP]$

$\Rightarrow 2PB = 1.6$

$\Rightarrow PB = 0.8 \quad \ldots$ (iii)

$BC = 6.3$

$\Rightarrow BQ + QC = 6.3$

$\Rightarrow BQ + BQ = 6.3 \quad [\because BQ = QC]$

$\Rightarrow 2BQ = 6.3$

$\Rightarrow BQ = \frac{6.3}{2} = 3.15 \quad \ldots$ (iv)

Now, $AB^2 + 4BQ^2$

$= (1.6)^2 + 4(3.15)^2 = 2.56 + 4(9.9225)$

$= 2.56 + 39.69 = 42.25 \text{ cm}^2$

Hence, $AB^2 + 4BQ^2 = 42.25 \text{ cm}^2$

57. What is $AQ^2 + CP^2$ equal to?

(a) AC^2 (b) $12AC^2$

(c) $1.25AC^2$ (d) $1.5AC^2$

(c) $AQ^2 + CP^2$

$= AB^2 + BQ^2 + BP^2 + BC^2$

$= AC^2 + PQ^2 = AC^2 + \frac{AC^2}{4}$

$= AC^2 + 0.25AC^2 = 1.25AC^2$

58. What is $4(CP^2 - AQ^2)$ equal to?

(a) 101.39 cm^2 (b) 111.39 cm^2

(c) 121.39 cm^2 (d) 131.39 cm^2

(b)

Now, in ΔABQ,

$AQ^2 = AB^2 + BQ^2 = (1.6)^2 + (3.15)^2$

[from Eq. (iv) of question (56)]

$= 2.56 + 9.9225$

$= 12.4825 \text{ cm}^2 \quad \ldots$ (v)

In ΔBCP,

$CP^2 = BC^2 + PB^2 = (6.3)^2 + (0.8)^2$

[from Eq. (ii) of qusestion (56)]

$= 39.69 + 0.64$

$= 40.33 \text{ cm}^2 \quad \ldots$ (vi)

$4(CP^2 - AQ^2)$

$= 4 [40.33 - 12.4825]$

$= 4 [27.8475]$

$= 111.39 \text{ cm}^2$

Hence, $4(CP^2 - AQ^2)$ equal to 111.39 cm^2.

Directions (Q.Nos. 59 and 60) *Consider the following for the next two questions that follows.*

AB is a diameter of a circle with centre O. Radius OP is perpendicular to AB. Let Q be any pont on are PB.

59. What is $\angle BAP$ equal to ?

(a) 30° (b) 40°

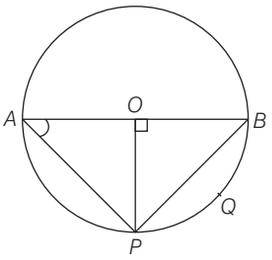
(c) 45° (d) 60°

(c) Given,

AB is a diameter of a circle with centre O.

Radius OP is perpendicular to AB and Q is any point on arc PB.

Since, chord PB makes $\angle BOP$ at the centre and $\angle BAP$ at A.



$\therefore \angle BAP = \frac{1}{2}\angle BOP$

[since, angle made by a chord at a point present on the circle is half of the angle made by chord on the centre]

$\angle BAP = \frac{1}{2} \times 90° = 45°$

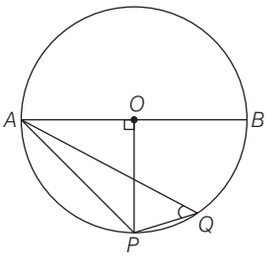
Hence, $\angle BAP$ is equal to 45°.

60. What is $\angle AQP$ equal to?

(a) 30° (b) 40°

(c) 45° (d) 60°

(c) Since, chord AP makes $\angle AOP$ at the centre and $\angle AQP$ at Q.



$\therefore \angle AQP = \frac{1}{2}\angle AOP$

$= \frac{1}{2} \times 90° = 45°$

Hence, ∠AQP is equal to 45°.

61. 5 pencils, 6 notebooks and 7 erasers cost ₹ 250; whereas 6 pencils, 4 notebooks and 2 erasers cost ₹ 180. What is the cost of 2 notebooks and 4 erasers?

(a) ₹ 90 (b) ₹ 75 (c) ₹ 60 (d) ₹ 40

(b) Let the cost of one pencil, one notebook and one eraser be x, y and z respectively.

Then, according to the question,

$5x + 6y + 7z = 250 \quad \ldots$ (i)

and $6x + 4y + 2z = 180 \quad \ldots$ (ii)

$6 \times$ Eq. (i) $- 5 \times$ Eq. (ii)

$30x + 36y + 42z = 1500$

$30x + 20y + 10z = 900$

$- \quad - \quad - \quad -$

$16y + 32z = 600$

dividing the equation by 8, we get

$2y + 4z = 75$

Hence, the cost of 2 notebooks and 4 erasers is ₹ 75.

62. How many zeros are there in the product $1^{50} \times 2^{49} \times 3^{48} \times \ldots \times 50^1$?

(a) 262 (b) 261

(c) 246 (d) 235

(a) Given product :

$1^{50} \times 2^{49} \times 3^{48} \times \ldots \times 50^1$.

We know one zero is created by multiplication of 2 and 5 i.e., one pair of 2 and 5 in multiplication gives one zero.

In the given multiplication, we will find $(2 \times 5)^n$.

Here, n represents the number of zeros in the expression.

We know that, power of 2 will be more than power of 5.

Hence, we will find $(2 \times 5)^n$ with the help of 5^n only. Because all 5, n number of times will be paired with 2.

$\therefore$ Number of 5 in product

$= 5^{46} \times 5^{41} \times 5^{36} \times 5^{31} \times (5^2)^{26}$

$\times 5^{21} \times 5^{16} \times 5^{11} \times 5^6 \times (5^2)^1$

$= 5^{46 + 41 + 36 + 31 + 52 + 21 + 16 + 11 + 6 + 2}$

$= 5^{262} = 5^n$

$n = 262$

Hence, there will be 262 zeros in the given product.

63. If p and q $(p > q)$ are the roots of the equation $x^2 - 60x + 899 = 0$ then which one of the following is correct?

(a) $p - q - 1 = 0$

(b) $p - 2q + 27 = 0$

(c) $2p - q - 30 = 0$

(d) $3p - 2q - 43 = 0$

(b) Given quadratic equation,

$x^2 - 60x + 899 = 0$

Roots of the equation are p and q, where $p > q$

$$x^2 - 60x + 899 = 0$$
$$\Rightarrow x^2 - 31x - 29x + 899 = 0$$
$$\Rightarrow x(x - 31) - 29(x - 31) = 0$$
$$\Rightarrow (x - 31)(x - 29) = 0$$
$$x = 31 \text{ or } 29$$

Here, $p = 31$ and $q = 29$

$[\because p > q]$

(a) $p - q - 1 = 0$

$p - q - 1 = 31 - 29 - 1$

$= 2 - 1 = 1 \neq 0$

(b) $p - 2q + 27 = 0$

$p - 2q + 27 = 31 - 2 \times 29 + 27$

$= 31 - 58 + 27 = 58 - 58 = 0$

Hence, (b) is the correct option.

64. If the roots of the equation $x^2 - 4x - \log_{10} N = 0$ are real, then what is the minimum value of N?

(a) 0.1 (b) 0.01

(c) 0.001 (d) 0.0001

(d) Given equation,

$x^2 - 4x - \log_{10} N = 0$

Roots of the equation will be real only, when the discriminant $(D) \geq 0$.

For $ax^2 + bx + c = 0, D = b^2 - 4ac$

For $x^2 - 4x - \log_{10} N = 0$

$a = 1, b = -4$ and $c = -\log_{10} N$

$\therefore b^2 - 4ac \geq 0$ [$\because$ roots are real (given)]

$\Rightarrow (-4)^2 - 4(1)(-\log_{10} N) \geq 0$

$\Rightarrow 16 + 4\log_{10} N \geq 0$

$\Rightarrow 4\log_{10} N \geq -16$

$\Rightarrow \log_{10} N \geq -4$

$\Rightarrow N \geq (10)^{-4}$ [on taking anti-logarithm]

$\Rightarrow N \geq \frac{1}{10000}$

$\Rightarrow N \geq 0.0001$

Hence, the minimum value of N is 0.0001.

65. If $5^{x-1} = (2.5)^{\log_{10} 5}$, then what is the value of x ?

(a) 1 (b) $\log_{10} 2$

(c) $\log_{10} 5$ (d) $2\log_{10} 5$

(d) Given, $5\log_{10}{}^{(2.5)} = (2.5)\log_{10} 5$

$\Rightarrow 5^{x-1} = (5)^{\log_{10}(2.5)}$

$[\because a^{\log(b)} = b^{\log(a)}]$

On comparing LHS and RHS, we get

$x - 1 = \log_{10}(2.5)$

$$x - 1 = \log_{10}\left(\frac{25}{10}\right)$$

$$x - 1 = \log_{10} 25 - \log_{10} 10$$

$$\left[\because \log\left(\frac{m}{n}\right) = \log m - \log n\right]$$

$x - 1 = \log_{10} 5^2 - 1$ $[\because \log_a a = 1]$

$x = \log_{10} 5^2$

$x = 2\log_{10} 5$

$[\because \log a^m = m\log a]$

Hence, the value of x is $2\log_{10} 5$.

66. If $96 - 64a^3 + \frac{8}{a^6} - \frac{48}{a^3} - t^3 = 0$, then what is $a^2t + 4a^3$ equal to?

(a) 0 (b) 1

(c) 2 (d) 3

(c) Given,

$96 - 64a^3 + \frac{8}{a^6} - \frac{48}{a^3} - t^3 = 0$

$\Rightarrow \frac{8}{a^6} - 64a^3 - \frac{48}{a^3} + 96 = t^3$

$\Rightarrow \left(\frac{2}{a^2}\right)^3 - (4a)^3 - 3\left(\frac{2}{a^2}\right)^2 \times 4a + 3 \times \frac{2}{a^2} \times (4a)^2 = t^3$

$\Rightarrow \left(\frac{2}{a^2} - 4a\right)^3 = t^3$

$\Rightarrow t = \frac{2}{a^2} - 4a \Rightarrow t = \frac{2 - 4a^3}{a^2}$

$\Rightarrow a^2t = 2 - 4a^3$

$\Rightarrow a^2t + 4a^3 = 2$

Hence, $a^2t + 4a^3 = 2$

67. If $A + B = \frac{x^2 - 8}{x + 2}$ and $A - B = \frac{-x^2 + 2x + 4}{x + 2}$, then what is B equal to ?

(a) $\frac{x^2 - 4}{x^2 + 4x + 4}$ (b) $\frac{x^2 - 4}{x^2 - 4x + 4}$

(c) $\frac{2x^2 - 7x + 3}{2x - 1}$ (d) $\frac{2x^2 + 7x - 3}{2x - 1}$

(c) Given,

$A + B = \frac{x^2 - 8}{x + 2}$ ... (i)

and $A - B = \frac{-x^2 + 2x + 4}{x + 2}$ ... (ii)

By Eq. (i) – Eq. (ii), we get

$(A + B) - A - B)$

$= \frac{x^2 - 8}{x + 2} - \frac{(-x^2 + 2x + 4)}{x + 2}$

$\Rightarrow 2B = \frac{x^2 - 8 - (-x^2 + 2x + 4)}{x + 2}$

$\Rightarrow 2B = \frac{x^2 - 8 + x^2 - 2x - 4}{x + 2}$

$\Rightarrow 2B = \frac{2x^2 - 2x - 12}{x + 2}$

$\Rightarrow B = \frac{x^2 - x - 6}{x + 2}$

$= \frac{x^2 - 3x + 2x - 6}{x + 2}$

$= \frac{(x - 3)(x + 2)}{(x + 2)} = x - 3$

Option (c) is $\frac{2x^2 - 7x + 3}{2x - 1}$,

On solving this further, we get

$= \frac{2x^2 - 6x - x + 3}{2x - 1}$

$= \frac{2x(x - 3) - 1(x - 3)}{(2x - 1)}$

$= \frac{(2x - 1)(x - 3)}{(2x - 1)} = x - 3$

Since, value of B and option (c) represents the same value.

Hence, B is equal to $\frac{2x^2 - 7x + 3}{2x - 1}$.

68. What is $\frac{x^4}{(x^2 - y^2)(x^2 - z^2)} + \frac{y^4}{(y^2 - x^2)(y^2 - z^2)} - \frac{z^4}{(z^2 - x^2)(z^2 - y^2)}$ equal to?

(a) –1 (b) 0

(c) 1 (d) $x^2 + y^2 + z^2$

(c) Given expression,

$\frac{x^4}{(x^2 - y^2)(x^2 - z^2)} + \frac{y^4}{(y^2 - x^2)(y^2 - z^2)} + \frac{z^4}{(z^2 - x^2)(z^2 - y^2)}$

$= \frac{x^4}{(x^2 - y^2)(x^2 - z^2)} - \frac{y^4}{(x^2 - y^2)(y^2 - z^2)} + \frac{z^4}{(x^2 - z^2)(y^2 - z^2)}$

$$= \frac{x^4(y^2 - z^2) - y^4(x^2 - z^2) + z^4(x^2 - y^2)}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{x^4(y^2 - z^2) - y^4x^2 + y^4z^2 + z^4x^2 - z^4y^2}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{x^4(y^2 - z^2) - y^4x^2 + z^4x^2 + y^4z^2 - z^4y^2}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{x^4(y^2 - z^2) - x^2(y^4 - z^4) + y^2z^2(y^2 - z^2)}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{x^4(y^2 - z^2) - x^2(y^2 - z^2)(y^2 + z^2) + y^2z^2(y^2 - z^2)}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{(y^2 - z^2)[x^4 - x^2y^2 - x^2z^2 + y^2z^2]}{(x^2 - y^2)(x^2 - z^2)(y^2 - z^2)}$$

$$= \frac{[x^4 - x^2z^2 - x^2y^2 + y^2z^2]}{(x^2 - y^2)(x^2 - z^2)}$$

$$= \frac{x^2(x^2 - z^2) - y^2(x^2 - z^2)}{(x^2 - y^2)(x^2 - z^2)}$$

$$= \frac{(x^2 - z^2)(x^2 - y^2)}{(x^2 - y^2)(x^2 - z^2)}$$

$= 1$

Hence, the given expression is equal to 1.

69. If $(2ab - b^2) : (6a^2 - ab) = 1 : 6$, then what is $(a + b) : (a - b)$ equal to?

(a) 3 only
(b) 5 only
(c) –3 or 3
(d) –5 or 5

(d) $\frac{2ab - b^2}{6a^2 - ab} = \frac{1}{6}$

$\Rightarrow 12ab - 6b^2 = 6a^2 - ab$

$\Rightarrow 6a^2 - 13ab + 6b^2 = 0$

$\Rightarrow 6a^2 - 9ab - 4ab + 6b^2 = 0$

$\Rightarrow 3a(2a - 3b) - 2b(2a - 3b) = 0$

$\Rightarrow (2a - 3b)(3a - 2b) = 0$

$\frac{a}{b} = \frac{3}{2}, \frac{a}{b} = \frac{2}{3}$

$\frac{a + b}{a - b} = \frac{3 + 2}{3 - 2}$

or $\frac{a + b}{a - b} = \frac{2 + 3}{2 - 3}$

$= 5$ or -5

Hence, $\frac{a + b}{a - b}$ is equal to – 5 or 5.

70. If $\frac{x}{b + c - a} = \frac{y}{b - c - a} = \frac{z}{a + b - c} = k$ then what is $x^2 + y^2 + z^2 - 2xy - 2yz + 2zx$ equal to ?

(a) $k^2(a^2 + b^2 + c^2)$
(b) $k^2(a^2 - b^2 + c^2)$
(c) $k^2(a + b + c)^2$
(d) $k^2(a - b + c)^2$

(c) Given,

$\frac{x}{b + c - a} = \frac{y}{b - c - a} = \frac{z}{a + b - c} = k$

$\Rightarrow x = k(b + c - a)$, … (i)

$y = k(b - c - a)$ … (ii)

and $z = k(a + b - c)$ … (iii)

$x^2 + y^2 + z^2 - 2xy - 2yz + 2zx = (y - x - z)^2$

$= k(b - c - a) - k(b + c - a) - k(a + b - c)]^2$]

[from Eq. (i), Eq. (ii) and Eq. (iii)]

$= k^2[b - c - a - (b + c - a) - (a + b - c)]^2$

$= k^2[b - c - a - b - c + a - a - b + c]^2$

$= k^2[b - b - b - c - c + c - a + a - a]^2$

$= k^2[- b - c - a]^2$

$= k^2(a + b + c)^2$

Hence, $x^2 + y^2 + z^2 - 2xy - 2yz + 2xz = k^2(a + b + c)^2$

71. If three positive numbers are in the ratio 2 : 3 : 5 and the sum of their squares is 1368, then what is sum of the numbers?

(a) 30 (b) 45
(c) 60 (d) 75

(c) Given, the ratio of three positive numbers is 2 : 3 : 5.

Let three numbers be $2a$, $3a$ and $5a$.

According to the question,

$(2a)^2 + (3a)^2 + (5a)^2 = 1368$

$\Rightarrow 4a^2 + 9a^2 + 25a^2 = 1368$

$\Rightarrow 38a^2 = 1368$

$\Rightarrow a^2 = \frac{1368}{38} = 36$

$\Rightarrow a = 6$

The numbers are 2×6, 3×6 and 5×6 i.e., 12, 18 and 30.

Sum of the numbers

$= 12 + 18 + 30 = 60$

Hence, sum of the numbers is 60.

72. Consider the following inequalities

1. $\frac{a^2 - b^2}{a^2 + b^2} > \frac{a - b}{a + b}$ where $a > b > 0$

2. $\frac{a^3 + b^3}{a^2 + b^2} > \frac{a^2 + b^2}{a + b}$ only when $a > b > 0$

Which of the above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

(a) Given inequalities:

1. $\frac{a^2 - b^2}{a^2 + b^2} > \frac{a - b}{a + b}$ where $a > b > 0$

i.e., a and b are positive and $a > b$.

$\Rightarrow \frac{(a - b)(a + b)}{a^2 + b^2} > \frac{(a - b)}{(a + b)}$

$\Rightarrow \frac{a + b}{a^2 + b^2} > \frac{1}{a + b}$

[$\because (a - b)$ is a positive number]

$\Rightarrow (a + b)^2 > a^2 + b^2$

$\Rightarrow a^2 + b^2 + 2ab > a^2 + b^2$

$\Rightarrow 2ab > 0$

which is true. [$\because a > 0$ and $b > 0$]

2. $\frac{a^3 + b^3}{a^2 + b^2} > \frac{a^2 + b^2}{a + b}$ only when $a > b > 0$

Since, a and b are positive.

$\Rightarrow (a + b)(a^3 + b^3) > (a^2 + b^2)(a^2 + b^2)$

$\Rightarrow a^4 + ab^3 + ba^3 + b^4 > a^4 + b^4 + 2a^2b^2$

$\Rightarrow ab^3 + ba^3 > 2a^2b^2$

$\Rightarrow ab(b^2 + a^2) - 2a^2b^2 > 0$

$\Rightarrow ab[b^2 + a^2 - 2ab] > 0$

$\Rightarrow ab(a - b)^2 > 0$

$\therefore$ If a and b are positive then the given inequalities forms into $ab(a - b)^2 > 0$, which is true but here, it is not necessary that $a > b$.

The inequality is true for $b > a > 0$ also.

i.e., $a > b > 0$ is not the only condition.

Hence, option (a) is correct.

73. Let work done by $(3n-1)$ men in $(2n+1)$ days be x and work done by $(3n+1)$ men in $(4n-3)$ days be y. If $x : y = 6 : 11$, then what is the value n ?

(a) 6 (b) 7
(c) 8 (d) 9

(b) Let all the men do the same amount of work in one day and one day work of each men = 1 unit; we get

Amount of work done by $(3n-1)$ men in $(2n+1)$ days

$= x = (3n-1)(2n+1)$ units of work.

Similarly, amount of work done by $(3n+1)$ men in $(4n-3)$ days

$= y = (3n+1)(4n-3)$ units of work.

According to the question,

$$\frac{x}{y} = \frac{6}{11}$$

$$\Rightarrow \quad \frac{(3n-1)(2n+1)}{(3n+1)(4n-3)} = \frac{6}{11}$$

$$\Rightarrow \frac{6n^2+3n-2n-1}{12n^2-9n+4n-3} = \frac{6}{11}$$

$$\Rightarrow \quad \frac{6n^2+n-1}{12n^2-5n-3} = \frac{6}{11}$$

$$\Rightarrow$$

$$66n^2 + 11n - 11 = 72n^2 - 30n - 18$$

$$\Rightarrow \quad 0 = 6n^2 - 41n - 7$$

$$\Rightarrow \quad 6n^2 - 42n + n - 7 = 0$$

$$\Rightarrow 6n(n-7) + 1(n-7) = 0$$

$$\Rightarrow \quad (n-7)(6n+1) = 0$$

$$n = 7, \; n \neq -\frac{1}{6}$$

[∵number of men can't be negative]

Hence, the value of n is 7.

74. If $\frac{ay-bx}{c} = \frac{cx-az}{b} = \frac{bz-cy}{a}$, then which of the following is/are correct ?

1. $\frac{x}{a} = \frac{y}{b}$
2. $\frac{x+y+z}{a+b+c} = \frac{z}{c}$

Select the correct answer using the code given below:

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

(c) Let

$$\frac{ay-bx}{c} = \frac{cx-az}{b} = \frac{bz-cy}{a} = k \quad \ldots \text{(i)}$$

In the given condition we know that a, b and c can not be zero.

From Eq. (i), we get

$$ay - bx = ck \quad \ldots \text{(ii)}$$

$$cx - az = bk \quad \ldots \text{(iii)}$$

$$bz - cy = ak \quad \ldots \text{(iv)}$$

Multiplying Eq. (ii) by c, we get

$$acy - bcx = c^2k \quad \ldots \text{(v)}$$

Multiplying Eq. (iii) by b, we get

$$bcx - abz = b^2k \quad \ldots \text{(vi)}$$

Multiplying Eq. (iv) by a, we get

$$abz - acy = a^2k \quad \ldots \text{(vii)}$$

Adding Eq. (v), Eq. (vi) and Eq. (vii), we get

$$acy - bcx + bcx - abz + abz - acy = k(a^2 + b^2 + c^2)$$

$$\Rightarrow 0 = k(a^2 + b^2 + c^2)$$

Since, a, b and c are not zero.

$$\therefore \; k = 0$$

Put $k = 0$ into Eq. (ii), Eq (iii) and Eq. (iv), we get

$$*1)\; ay = bx \Rightarrow \frac{x}{a} = \frac{y}{b} \quad \ldots \text{(viii)}$$

$$*2)\; cx = az \Rightarrow \frac{x}{a} = \frac{z}{c} \quad \ldots \text{(ix)}$$

$$*3)\; bz = cy \Rightarrow \frac{z}{c} = \frac{y}{b} \quad \ldots \text{(x)}$$

Eq. (viii) says $\frac{x}{a} = \frac{y}{b}$ is correct.

Now,

From Eq. (ix), $x = \frac{z \cdot a}{c}$ and from Eq. (x), $y = \frac{z \cdot b}{c}$

Put into $\frac{x+y+z}{a+b+c}$, we get

$$\Rightarrow \quad \frac{\frac{z \cdot a}{c} + \frac{z \cdot b}{c} + z}{a+b+c} = \frac{\frac{z \cdot a + z \cdot b + z \cdot c}{c}}{a+b+c}$$

$$= \frac{z(a+b+c)}{c} \cdot \frac{1}{(a+b+c)} = \frac{z}{c}$$

Hence, both the Statements 1 and 2 are correct.

75. A person wishes to fence 375 m^2 rectangular garden. He has 65 m of barbed wire and is able to fence only three sides of the garden. What is the perimeter of the garden?

(a) 80 m
(b) 84 m
(c) 90 m
(d) 100 m

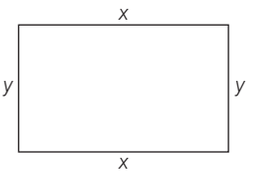
(a) Given,

Area of rectangular garden

$$= 375 m^2 \quad \ldots \text{(i)}$$

Sum of the lengths of three sides of garden = 65 m … (ii)

Let length and breadth of the garden be x and y m.



Then,

$$x \times y = 375 \; m^2 \quad \text{[from Eq. (i)]} \ldots \text{(iii)}$$

$$x + y + x = 65 \quad \text{[from Eq. (ii)]}$$

$$\Rightarrow 2x + y = 65$$

$$\Rightarrow \quad y = 65 - 2x \quad \ldots \text{(iv)}$$

From Eq. (iv), put $y = 65 - 2x$ into Eq. (iii), we get

$$x \cdot (65 - 2x) = 375$$

$$\Rightarrow \quad 65x - 2x^2 = 375$$

$$\Rightarrow \quad 2x^2 - 65x + 375 = 0$$

$$\Rightarrow 2x^2 - 50x - 15x + 375 = 0$$

$$\Rightarrow 2x(x-25) - 15(x-25) = 0$$

$$\Rightarrow \quad (x-25)(2x-15) = 0$$

$$\Rightarrow \quad x = 25 \text{ or } \frac{15}{2}$$

When $x = 25$

$\Rightarrow y = 65 - 2 \times 25$

[from Eq. (iv))]

$$\Rightarrow \quad y = 15$$

Perimeter $= 2(x + y) = 2(25 + 15)$
$= 2(40) = 80$ m

When, $x = \frac{15}{2}$

$$\Rightarrow y = 65 - 2 \times \frac{15}{2}$$

$$\Rightarrow y = 50$$

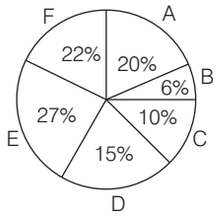
$$\text{Perimeter} = 2(x + y) = 2\left(\frac{15}{2} + 50\right)$$

$$= 15 + 100 = 115 m$$

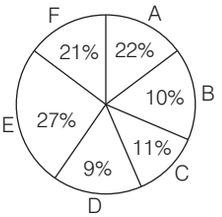
As per the given options, perimeter of the garden is 80 m.

Directions (Q.Nos. 76-79) *Consider the following for next four questions that follow.*

The following pie charts show the percentage of different categories (A, B, C, D, E and F) of employees in a company in the year 2019 and 2020. The total number of employees was 4000 in 2019 and 5000 in 2020.



2019



2020

76. There are two categories of employees in 2019 whose total strength remained the same in 2020. What are these two categories ?

(a) C and B (b) E and A (c) E and F (d) C and D

(d) Given pie chart,

In 2019, Strengths are :	In 2020, Strengths are
A : $\frac{20}{100} \times 4000 = 800$	A : $\frac{22}{100} \times 5000 = 1100$
B : $\frac{6}{100} \times 4000 = 240$	B : $\frac{10}{100} \times 5000 = 500$
C : $\frac{10}{100} \times 4000 = 400$	C : $\frac{11}{100} \times 5000 = 550$
D : $\frac{15}{100} \times 4000 = 600$	D : $\frac{9}{100} \times 5000 = 450$
E : $\frac{27}{100} \times 4000 = 1080$	E : $\frac{27}{100} \times 5000 = 1350$
F : $\frac{22}{100} \times 4000 = 880$	F : $\frac{21}{100} \times 5000 = 1050$

In 2019 $\Rightarrow$ Strength of C and D = 400 + 600 = 1000

In 2020 $\Rightarrow$ Strength of C and D = 550 + 450 = 1000

Hence, option (d) is correct.

77. In which one of the following categories of employees, the percentage change in number of employees in 2020 was maximum as compared to 2019?

(a) A (b) B (c) C (d) D

(b) Percentage change in number of employees

$$= \frac{\text{Final value} - \text{initial value}}{\text{Initial value}} \times 100$$

A : Percentage change $= \frac{1100 - 800}{800} \times 100 = 37.5\%$

B : Percentage change $= \frac{500 - 240}{240} \times 100 = 108.3\%$

C : Percentage change $= \frac{550 - 400}{400} \times 100 = 37.5\%$

D : Percentage change $= \frac{450 - 600}{600} \times 100 = -25\%$

E : Percentage change $= \frac{1350 - 1080}{1080} \times 100 = 25\%$

F : Percentage change $= \frac{1050 - 880}{880} \times 100 = 19.3\%$

Hence, the percentage change in number of employees is maximum for B.

78. What was the percentage increase of category-E employees in 2020 as compared to that in 2019?

(a) 20% (b) 25% (c) 30% (d) 40%

(b) It is already solved in Q. (77).

The percentage increase of category-E employees in 2020 as compared to that in 2019 is 25%.

Hence, option (b) is correct.

79. There are two categories of employees whose strength increased by same percentage in 2020. What are the two categories

(a) E and F (b) C and E (c) A and E (d) A and C

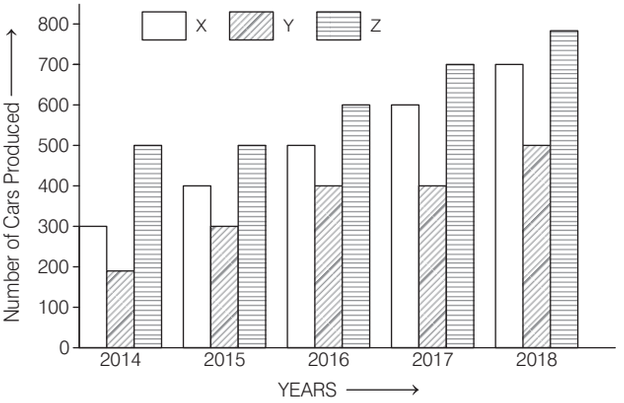
(d) It is already solved in Q. (77).

For category-A and category -C of employees strength increased by same percentage i.e., 37.5%.

Hence, option (d) is correct.

Directions (Q.Nos. 80-83) *Consider the following for the next four questions that follow .*

The following Bar chart gives the production of cars by three different companies X, Y and Z in different years



80. The percentage increase in the total production of cars from 2014 to 2018 was

(a) 50% (b) 100% (c) 150% (d) 200%

(b) Production of cars in 2014,

X : 300 cars

Y : 200 cars

Z : 500 cars

Total production of cars in 2014 = 300 + 200 + 500 = 1000

Production of cars in 2018,

X : 700

Y : 500

Z : 800

Total production of cars in 2018 = 700 + 500 + 800 = 2000

Percentage increase

$$= \frac{\text{Final value} - \text{initial value}}{\text{initial value}} \times 100$$

$$= \frac{2000 - 1000}{1000} \times 100 = \frac{1000}{1000} \times 100 = 100\%$$

Hence, option (b) is correct.

81. Consider the production of each company separately. In how many instances was the percentage increase in production of cars over the previous year's production greater than 20% ?

(a) 5 (b) 6 (c) 7 (d) 8

(a) Percentage increase in production of cars over the previous year's production

Company X :

Year	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018
Percentage increase	$\frac{400-300}{300}\times 100 = 33.3\%$	$\frac{500-400}{400}\times 100 = 25\%$	$\frac{600-500}{500}\times 100 = 20\%$	$\frac{700-600}{600}\times 100 = 16.7\%$

For company X, percentage increase in production is greater than 20% at two instances.

Company Y :

Year	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018
Percentage increase	$\frac{300-200}{200}\times 100 = 50\%$	$\frac{400-300}{300}\times 100 = 33.3\%$	$\frac{500-400}{400}\times 100 = 25\%$	$\frac{500-500}{500}\times 100 = 0\%$

For company Y, percentage increase in production is greater than 20% at three instances.

Company Z :

Year	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018
Percentage increase	$\frac{500-500}{500}\times 100 = 0\%$	$\frac{600-500}{500}\times 100 = 20\%$	$\frac{700-600}{600}\times 100 = 16.7\%$	$\frac{800-700}{700}\times 100 = 14.3\%$

For company Z, percentage increase in production is greater than 20% at zero instances.

Hence, in total 5 instances, the percentage increase in production of cars over the previous year's production greater than 20%.

82. In which year was the percentage increase in production of cars minimum as compared to its previous year?

(a) 2015 (b) 2016 (c) 2017 (d) 2018

(d) From the given Bar-chart, we have

Year	2014	2015	2016	2017	2018
Production of Cars	300 + 200 + 500 = 1000	400 + 300 + 500 = 1200	500 + 400 + 600 = 1500	600 + 500 + 700 = 1800	700 + 500 + 800 = 2000

Now, percentage increase in the production

Year	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018
Percentage increase	$\frac{1200-1000}{1000}\times 100 = 20\%$	$\frac{1500-1200}{1200} = 20\% = 25\%$	$\frac{1800-1500}{1500} = 20\% = 20\%$	$\frac{2000-1800}{1800} = 20\% = 11.1\%$

We can see that the percentage increase in production of cars is minimum in 2018 as compared to its previous year.

83. In one of the years the percentage increase in production of cars was minimum as compared to its previous year. What was the minimum percentage ?

(a) $11\frac{1}{9}\%$ (b) $11\frac{2}{9}\%$

(c) $13\frac{1}{3}\%$ (d) 20%

(a) It is already solved in Q. (82).

The minimum percentage increase in production of cars as compared to its previous year is 11.1% i.e., $11\frac{1}{9}\%$.

Hence, option (a) is correct.

Directions (Q.Nos. 84 and 85) *Consider the following for the next two questions that follow.*

Collect all the sequences of five consectutive integers such that their product is equal to one of these integers. Let X be the collection of all possible such sequences. Let P be the smallest integer and Q be the largest integer occuring in these sequences.

84. How many such sequences of five consecutive integers are possible ?

(a) One (b) Two

(c) Three (d) Five

(d) Let five consecutive integers be in the form $(x-2)$, $(x-1)$, x, $(x+1)$ and $(x+2)$.

Since, it is given that the product of these five consecutive integers is equal to one of these integers. This is only possible when one of the integer is zero.

Hence, all possible sequences are

(i) $-4, -3, -2, -1, 0$

(ii) $-3, -2, -1, 0, 1$

(iii) $-2, -1, 0, 1, 2$

(iv) $-1, 0, 1, 2, 3$

and (v) $0, 1, 2, 3, 4$

Hence, number of required sequences will be five.

85. What is the arithmetic mean of P and Q?

(a) 0

(b) 1

(c) 2

(d) Cannot be determined due to insufficient data

(d) Given,

P is the smallest integer.

Q is the largest integer.

Now, Arithmetic mean (AM),

$$AM = \frac{P+Q}{2}$$

(i) $-4, -3, -2, -1, 0$ [from previous solution]

$P = -4, Q = 0$

$$AM = \frac{-4+0}{2} = -2$$

(ii) $-3, -2, -1, 0, 1$

$P = -3, Q = 1$

$$AM = \frac{-3+1}{2} = \frac{-2}{2} = -1$$

(iii) $-2, -1, 0, 1, 2$

$P = -2, Q = 2$

$$AM = \frac{-2+2}{2} = \frac{0}{2} = 0$$

(iv) $-1, 0, 1, 2, 3$

$P = -1, Q = 3$

$$AM = \frac{-1+3}{2} = \frac{2}{2} = 1$$

(v) $0, 1, 2, 3, 4$

$P = 0, Q = 4$

$$AM = \frac{0+4}{2} = 2$$

Arithmetic mean of P and Q have five different values. As no particular condition is given.

Therefore, we cannot mark any of the mean with this insufficient information.

Hence, option (d) is correct.

86. If one of the roots of the equation $ax^2 - 4ax + 15 = 0$ is $\frac{3}{2}$, then what isthe sum of the squares of the roots?

(a) $\frac{15}{2}$ (b) $\frac{17}{2}$

(c) $\frac{19}{2}$ (d) $\frac{21}{2}$

(b) Given quadratic equation,

$ax^2 - 4ax + 15 = 0$ … (i)

One root of the equation is $\frac{3}{2}$.

Put $x = \frac{3}{2}$ into Eq. (i), we get

$$a\left(\frac{3}{2}\right)^2 - 4a\left(\frac{3}{2}\right) + 15 = 0$$

$$\Rightarrow a \cdot \frac{9}{4} - 2 \cdot a \cdot 3 + 15 = 0$$

$$\Rightarrow \frac{9a}{4} - 6a + 15 = 0$$

$$\Rightarrow \frac{9a - 24a + 60}{4} = 0$$

$$\Rightarrow -15a + 60 = 0$$

$$\Rightarrow a = \frac{60}{15} = 4$$

The quadratic equation is

$4x^2 - 16x + 15 = 0$

$\Rightarrow 4x^2 - 10x - 6x + 15 = 0$

$\Rightarrow 2x(2x-5) - 3(2x-5) = 0$

$\Rightarrow (2x-5)(2x-3) = 0$

$x = \frac{5}{2}$ or $\frac{3}{2}$

Sum of the squares of the roots

$$= \left(\frac{5}{2}\right)^2 + \left(\frac{3}{2}\right)^2$$

$$= \frac{25}{4} + \frac{9}{4}$$

$$= \frac{34}{4} = \frac{17}{2}$$

Hence, sum of the squares of the roots is $\frac{17}{2}$.

87. A two-digit number is such that the product of the digits is 8. If 63 is added to this number, the digits interchange their places. What is the sum of the digits in the number ?

(a) 6 (b) 7

(c) 8 (d) 9

(d) Let the digits at units and tens place of the given number be x and y respectively.

Thus, the number is $10y + x$.

The product of the digits is 8.

$\therefore \quad xy = 8$ … (i)

After interchanging the digits, the number becomes $10x + y$.

If 63 is added to the number, the digits interchange their places.

Thus,

$(10y + x) + 63 = 10x + y$

$\Rightarrow 10x + y - 10y - x = 63$

$\Rightarrow 9x - 9y = 63$

$\Rightarrow x - y = 7$ … (ii)

From Eq. (ii), put $y = x - 7$ into Eq. (i), we get

$x(x-7) = 8$

$\Rightarrow x^2 - 7x - 8 = 0$

$\Rightarrow x^2 - 8x + x - 8 = 0$

$\Rightarrow x(x-8) + 1(x-8) = 0$

$\Rightarrow (x-8)(x+1) = 0 \Rightarrow x = 8$ or -1

From Eq. (ii),

when $x = 8$

$\Rightarrow y = 8 - 7 = 1$

When $x = -1$

$\Rightarrow y = -1 - 7 = -8$

We get $(x, y) = (8, 1)$ and $(x, y) = (-1, -8)$

Since, the digits of the number can't be negative.

So, we must remove second pair.

Therefore, the number is $10 \times 1 + 8 = 18$

Hence, sum of the digits in the number is $1 + 8 = 9$.

88. A motor boat has speed 30 km/h in still water. It goes 60 km down stream and comes back in $\frac{9}{2}$ h. What is the speed of the stream ?

(a) 5 km/h

(b) 8 km/h

(c) 10 km/h

(d) 12 km/h

(c) Let speed of stream be x km/h.

Speed of boat downstream $= (30 + x)$ km/h

Speed of boat upstream $= (30 - x)$ km/h

Distance travelled downstream $= 60$ km

Distance travelled upstream $= 60$ km

Time taken by boat in upstream

$$= \frac{\text{distance travelled upstream}}{\text{Speed upstream}}$$

$$= \frac{60}{(30-x)}$$

Time taken by boat in downstream

$$= \frac{\text{distance travelled downstream}}{\text{Speed downstream}}$$

$$= \frac{60}{30+x}$$

Total time taken $= \frac{9}{2}$ h

$$\frac{9}{2} = \frac{60}{30-x} + \frac{60}{30+x}$$

$$\Rightarrow \frac{9}{2} = \frac{60(30 + x) + 60(30 - x)}{900 - x^2}$$

$$\Rightarrow \frac{9}{2} = \frac{3600}{900 - x^2}$$

$$\Rightarrow \frac{1}{2} = \frac{400}{900 - x^2}$$

$$\Rightarrow 900 - x^2 = 800$$

$$\Rightarrow x^2 = 100$$

$$\Rightarrow x = 10 \text{ km/h}$$

Hence, the speed of the stream is 10 km/h.

89. The present age of a father is equal to sum of the ages of his 4 children. After ten years the sum of the ages of the children will be 1.6 times the age of their father. What is the present age of father?

(a) 36 yr
(b) 40 yr
(c) 42 yr
(d) 45 yr

(b) Let the age of father be x years and sum of the ages of his 4 children be y years.

$$\Rightarrow x = y \quad \ldots \text{(i)}$$

After 10 years, father's age = $x + 10$

and sum of ages of 4 children = $y + 40$

According to the question,

$$y + 40 = 1.6(x + 10)$$

$$\Rightarrow x + 40 = 1.6(x + 10) \text{ (from Eq. (i))}$$

$$\Rightarrow x + 40 = 1.6x + 16$$

$$\Rightarrow 40 - 16 = 1.6x - x$$

$$\Rightarrow 24 = 0.6x$$

$$\Rightarrow x = \frac{24}{0.6} = 40$$

Hence, the present age of the father is 40 yr.

90. The sum of nummerator and denominator of a fraction is 10. If the numerator is increased by 3 and denominator is decreased by 1, the fraction becomes 1. What is the difference between numberator and denominator of the fraction?

(a) 2 (b) 3
(c) 4 (d) 5

(c) Given,

Sum of numerator and denominator of fraction is 10.

Let the numerator be x.

Then, denominator = $10 - x$

According to the question,

$$\frac{x + 3}{(10 - x) - 1} = 1$$

$$\Rightarrow \frac{x + 3}{9 - x} = 1$$

$$\Rightarrow x + 3 = 9 - x$$

$$\Rightarrow 2x = 6$$

$$\Rightarrow x = 3$$

$\therefore$ Numerator = 3 and denominator = $10 - 3 = 7$

$\therefore$ Difference
= Denominator – Numerator
= $7 - 3 = 4$

Hence, the required difference is 4.

91. If the system of equations $7x + ky = 27$ and $kx + 7y = 19$ have unique solution, then which one of the following is correct

(a) $k \neq 7$ (b) $k \neq 13$
(c) $k = 7$ (d) $= 13$

(a) Given system of equations,

$$7x + ky = 27 \quad \ldots \text{(i)}$$

and $kx + 7y = 19 \quad \ldots \text{(ii)}$

We know two equation

$a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$ will have unique solution if

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{7}{k} \neq \frac{k}{7}$$

$$\Rightarrow 7 \times 7 \neq k \times k \Rightarrow k^2 \neq 7^2$$

$$\Rightarrow k \neq \pm 7$$

Hence, $k \neq 7$

92. A sum of money compounded annually doubles itself in 5 yr. In how many years will it become four times of itself?

(a) 10 years (b) 12 years
(c) 15 years (d) 20 years

(a) Let the sum be P and interest rate be r% per annum.

Time, $n = 5$ yr
(Compounded annually)

$A = 2P$

As we know the formula,

$$A = P\left(1 + \frac{r}{100}\right)^n$$

$$\Rightarrow 2P = P\left(1 + \frac{r}{100}\right)^5$$

$$\Rightarrow 2 = \left(1 + \frac{r}{100}\right)^5$$

$$\Rightarrow 2^{1/5} = 1 + \frac{r}{100} \quad \ldots \text{(i)}$$

Now, Sum = P

$A = 4P$

Time = n years

Again using, $A = P\left(1 + \frac{r}{100}\right)^n$

$$\Rightarrow 4P = P\left(1 + \frac{r}{100}\right)^n$$

$\Rightarrow 4 = (2^{1/5})^n$ [From Eq. (i)]

$\Rightarrow 2^2 = 2^{n/5}$

On comparing the powers with same base, we get

$$2 = \frac{n}{5} \Rightarrow n = 10$$

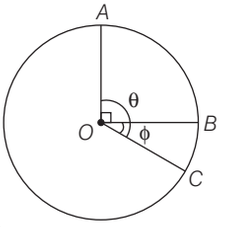
Hence, the sum will become four times in 10 yr.

93. Between 3 and 4 O'clock, both hour hand and minute hand will coincide past 3 O'clock between

(a) 15-16 min (b) 16-17 min
(c) 17-18 min
(d) 18-19 min

(b) In the clock

$\theta = 90 + \phi$



Where, $\theta \rightarrow$ angle travelled by minute hand

$\phi \rightarrow$ angle travelled by hour hand

We know that, 360° of minute hand = 30° of hour hand

$$\therefore \frac{\phi}{\theta} = \frac{30^\circ}{360^\circ}$$

$$\Rightarrow \phi = \frac{\theta}{12}$$

$$\Rightarrow \theta = 12\phi$$

$$\Rightarrow 90 + \phi = 12\phi \quad [\because \theta = 90 + \phi]$$

$$\Rightarrow 90 = 11\phi$$

$$\Rightarrow \phi = \frac{90}{11} \approx 8.2$$

$\therefore 12\phi = 12 \times 8.2 = 98.4$

360° angle means $\rightarrow$ 60 min.

96° angle means $\rightarrow$ 16 min

102° angle means $\rightarrow$ 17 min

$\therefore$ 98.4° will be meant between 16 to 17 min.

Hence, option (b) is correct.

94. Sheela can stitch a suit in 2 days, while Meena can stitch a suit in $1\frac{1}{2}$ days. How many days will both take in stitching 30 suits?

(a) 32 days
(b) 33 days
(c) 35 days
(d) 40 days

(*) Given,

Sheela stitches a suit in 2 days.

$\therefore$ Sheela's 1 day's work $= \frac{1}{2}$ suit

Meena stitches a suit in $\frac{3}{2}$ days.

$\therefore$ Meena's 1 day's work

$$= \frac{1}{3/2} = \frac{2}{3} \text{ suit.}$$

Sheela and Meena's 1 day's work

$$= \frac{1}{2} + \frac{2}{3}$$

$$= \frac{3+4}{6} = \frac{7}{6} \text{ suit}$$

Let number of days will both take in stitching 30 suits

$$= 30 \times \frac{6}{7} = \frac{180}{7}$$

Hence, the required number of days are 35 days.

95. If $2x - 3y - 7 = 0$

then what is the value of

$$8x^3 - 36x^2y + 54xy^2 - 27y^3 - 340?$$

(a) –1 (b) 0
(c) 1 (d) 3

(d) Given, $2x - 3y - 7 = 0$

$2x - 3y = 7$

On taking power 3 both the sides, we get

$(2x - 3y)^3 = 7^3$

$\Rightarrow (2x)^2 - (3y)^3 - 3(2x)^2(3y) + 3(2x)(3y)^2 = 343$

$[\because (a-b)^3 = a^3 - b^3 - 3a^2b - 3ab^2]$

$\Rightarrow 8x^3 - 27y^3 - 36x^2y + 54xy^2 - 343 = 0$

$\Rightarrow 8x^3 - 36x^2y + 54xy^2 - 27y^3 - 340 = 3$

Hence, the value of the given expression is 3.

96. If p varies directly as q and inversely as square of r, what is the percentage increase in p due to an increase in q by 20% and a decrease in r by 20% ?

(a) 87.5% (b) 85%
(c) 82.5% (d) 80%

(a) Given, p varies directly as q and inversely as square of r.

Hence, $p = \frac{q}{r^2}$, Assuming proportional constant as 1.

q is increased by 20% and r is decreased by 20%.

Hence, value of p becomes,

$$p = \frac{120q}{(8r)^2}$$

$$p = \frac{120q}{64r^2}$$

Change in value of

$$p = \frac{120q}{64r^2} - \frac{q}{r^2} = \frac{56}{64} \cdot \frac{q}{r^2}$$

Increase in P's percentage

$$= \frac{\left(\frac{56}{64} \cdot \frac{q}{r^2}\right)}{\left(\frac{q}{r^2}\right)} \times 100$$

$$= \frac{56}{64} \times 100$$

$$= \frac{7}{8} \times 100$$

$$= \frac{700}{8} = 87.5\%$$

Hence, percentage increase in p is 87.5%.

97. A person agrees to work for 30 days, on a condition that for every day's work he should receive ₹ 500, and that for every day's absence from work he should forfeit ₹ 100. At the end of the time he received ₹ 11,400. How many days did he work?

(a) 20 (b) 21
(c) 24 (d) 25

(c) Let the person work for x days.

$\therefore$ Number of days he does not work $= 30 - x$

Salary he gets for working x days = ₹ $x \times 500$ = ₹ $500x$

Fine for the day he does not work = ₹ $100(30 - x)$

Now, according to the question,

$500x - 100(30 - x) = 11400$

$\Rightarrow 500x - 3000 + 100x = 11400$

$\Rightarrow 600x = 11400 + 3000$

$\Rightarrow 600x = 14400$

$\Rightarrow x = \frac{14400}{600} = \frac{144}{6} = 24$

Hence, the person worked for 24 days.

98. A person bought a chair and a table for ₹ 750. He sold the chair at a gain of 5% and the table at a gain of 20%. he gained 16% on the whole. What is original cost of table?

(a) ₹ 400 (b) ₹ 450 (c) ₹ 550 (d) ₹ 600

(c) Let cost of chair be x and cost of table be y.

Then, $x + y = 750$ … (i)

By selling the chair at a gain of 5% and the table at a gain of 20%, there is a profit of 16% on the whole.

Then, (x + 5% of x)+ (y + 20% of y) = 750 + (16% of 750)

$$\Rightarrow \left(x + \frac{5}{100} \times x\right) + \left(y + \frac{20}{100} \times y\right) = 750 + \frac{16}{100} \times 750$$

$\Rightarrow 100x + 5x + 100y + 20y$

$= 75000 + 12000$

$\Rightarrow 105x + 120y = 87000$ … (ii)

From Eq. (i), put $y = 750 - x$ into Eq. (ii), we get

$\Rightarrow 105x + 120(750 - x) = 87000$

$\Rightarrow 105x + 90000 - 120x = 87000$

$\Rightarrow 90000 - 87000 = 120x - 105x$

$\Rightarrow 3000 = 15x$

$\Rightarrow x = 200$

$\therefore y = 750 - 200$ [from Eq. (i)]

$= 550$

Hence, the original cost of the table is ₹ 550.

99. A person rode one third of a journey at 60 km/hr, one third at 50 km/hr and the rest at 40 km/hr. Had the person ridden half of the journey at 60 km/hr and the rest at 40 km/hr, he would have taken 4 minutes longer to complete the journey. What distance did the person ride?

(a) 180 km (b) 210 km
(c) 240 km (d) 300 km

(c) Let the total distance be $3d$.

$\text{Time} = \frac{\text{Distance}}{\text{speed}}$

According to the question,

$t_1 = \frac{d}{60}$

$t_2 = \frac{d}{50}$

$t_3 = \frac{d}{40}$

$T_1 = t_1 + t_2 + t_3$

$= \frac{d}{60} + \frac{d}{50} + \frac{d}{40}$

$= \frac{d}{10}\left(\frac{1}{6} + \frac{1}{5} + \frac{1}{4}\right)$

$= \frac{d}{10}\left(\frac{10 + 12 + 15}{60}\right)$

$= \frac{37d}{600}$

$T_2 = \frac{1.5d}{60} + \frac{1.5d}{40}$

$= \frac{1.5d}{10}\left(\frac{1}{6} + \frac{1}{4}\right) = \frac{15d}{100}\left(\frac{2 + 3}{12}\right)$

$= \frac{25d}{400}$

$T_2 - T_1 = \frac{4}{60}$ h (given)

$\Rightarrow \frac{25d}{400} - \frac{37d}{600} = \frac{4}{60}$

$\Rightarrow \frac{75d - 74d}{1200} = \frac{4}{60}$

$\Rightarrow \frac{d}{20} = 4 \Rightarrow d = 80$

$\therefore 3d = 3 \times 80 = 240$ km

Hence, the required distance is 240 km.

100. A person saves ₹ 100 more than he did the previous year. If he saves ₹ 2000 in the first year, in how many years will he save ₹ 170000

(a) 16 yr

(b) 17 yr

(c) 18 yr

(d) 19 yr

(b) Given,

A person saves ₹ 1000 more than he did the previous year.

Savings in the first year is ₹ 2000.

The given problem forms the following AP,

AP : 2000, 3000, 4000, …

First term, $a = 2000$

Common difference,

$d = 3000 - 2000 = 1000$

Sum of n terms, $S_n = 170000$

We know, $S_n = \frac{n}{2}[2a + (n - 1)d]$

$\Rightarrow \frac{n}{2}[2a + (n - 1)d] = 170000$

$\Rightarrow \frac{n}{2}[2 \times 2000 + (n - 1)(1000)]$

$= 170000$

$\Rightarrow n[4000 + (n - 1)(1000)] = 340000$

$\Rightarrow n[4 + (n - 1)] = 340$

$\Rightarrow n(n + 3) = 340$

$\Rightarrow n^2 + 3n - 340 = 0$

$\Rightarrow n^2 + 20n - 17n - 340 = 0$

$\Rightarrow n(n + 20) - 17(n + 20) = 0$

$\Rightarrow (n + 20)(n - 17) = 0$

$n \neq -20, n = 17$

Hence, the person saves ₹ 170000 in 17 yr.

PAPER II English

Directions (Q. Nos. 1-10) *Given below are some idioms/phrases followed by four alternative meanings to each. Choose the most appropriate answer from among* (a), (b), (c) *or* (d).

1. Forty winks
(a) Winking forty times
(b) Sleep disorders
(c) Long sleeping hours
(d) A short sleep during the day

› ***(d)*** The idiom 'forty winks' means a short sleep or nap, especially during daytime.

2. Life in the raw
(a) Life in its natural, unembellished state
(b) Life at its easiest
(c) Life that is complex
(d) A daredevil's life

› ***(a)*** The idiom 'life in the raw' means life in its unnatural, unembellished state.

3. A paper tiger
(a) A person or thing that appears threatening but is ineffectual
(b) To threaten someone but do no harm
(c) Environmental protection paperwork
(d) To speak to people in a roaring voice

› ***(a)*** The idiom 'a paper tiger' refers to someone who seems powerful and dangerous at the first glance, but is actually powerless and harmless.

4. Penny-wise and pound-foolish
(a) Wise to spend each penny carefully
(b) Careful about small amounts but careless about large amounts
(c) People who don't understand the importance of each penny
(d) Careful about large amounts but careless about small amounts

› ***(b)*** The idiom 'penny-wise and pound-foolish' means to be careful about small amounts but not about large amounts.

5. Pin back your ears
(a) To listen carefully to something
(b) Person or organisation that pins important issues
(c) To keep yourself away from hearing bad stuff
(d) To clean your ears with a pin

› ***(a)*** The idiom 'pin back your ears' means to listen carefully to something.

6. Turncoat
(a) Expert at altering coats
(b) Someone who deserts one group to join another
(c) A truly dishonest person
(d) Going round and round in a court of law

› ***(b)*** 'Turncoat' refers to someone who switches to an opposite side. Hence, option (b) is the correct answer.

7. Say your piece
(a) Speak but don't listen
(b) Speak in a talkative manner
(c) Make your argument piece by piece
(d) Express your opinion

› ***(d)*** The idiom 'say your piece' means to state your opinions.

8. Top-notch
(a) The highest marking on a tree or a building
(b) Person or organisation that attracts only the top
(c) Of highest possible quality
(d) Person of integrity

› ***(c)*** 'Top-notch' means that something is of very high standard or quality.

9. Under the table
(a) Work under difficult circumstances
(b) Working undercover
(c) Working under furniture
(d) Making or receiving payments surreptitiously

› ***(d)*** The idiom 'under the table' means to do something secretly because it is illegal. Hence, option (d) is the correct anwer.

10. At the drop of a hat
(a) Clumsy person who drops hats everywhere
(b) Suddenly and without much thought
(c) Do something without much pressure
(d) A happy and easygoing man

› ***(b)*** The idiom 'at the drop of a hat' means immediately and without any thought. Hence, option (b) is the correct answer

Directions (Q. Nos. 11-20) *In this section, each question consists of six sentences of a passage. The first and sixth sentences are given in the beginning as S1 and S6. The middle four sentences in each have been jumbled up and labelled as P, Q, R and S. You are required to find the proper sequence of the four sentences.*

11. S1: An ideal citizen is one who establishes his standard in everything.

S6: He can be called a thorough gentleman.

P : Because he is a true patriot.

Q : Also, he can lay down his life for the honour of his country.

R: That he can make any sacrifice for his motherland.

S : He loves his country so much so

The correct sequence should be
(a) S R Q P (b) R P Q S
(c) P Q R S (d) Q R S P

› ***(a)*** S R Q P

12. S1: There are multiple legal avenues for patients to indict doctors, but rarely is it the other way round.

S6: It is clear that patients have multiple avenues to pursue, should they feel an injustice has been perpetrated against them.

P : An FIR can be lodged against them under the section 304A of the Indian Penal Code.

Q : A compensation case can be filed in a consumer forum.

R : For one occurrence, there are multiple forums where doctors have to defend themselves.

S : For instance, a complaint can be made to their employer.

The correct sequence should be
(a) P Q R S (b) P S R Q
(c) R S Q P (d) S R Q P

› ***(c)*** R S Q P

13. S1: Paragraphs are the building blocks of any write-up.

S6: Understanding of these makes one a good writer of paragraphs.

P : A paragraph need not be pages together in length.

Q : But actually a paragraph is a group of at least five sentences on the lower limit.

R : In reality, unity and coherence, not length, constitute a really good paragraph.

S : Many people define paragraphs in terms of their length.

The correct sequence should be

(a) Q P R S (b) R Q P S
(c) S Q P R (d) Q R S P

(c) S Q P R

14. S1: Then what is necessary with regard to taming science and technology is :

S6: Then why do we not tame atomic energy to peaceful purposes ?

P : We must have the basic knowledge of the two.

Q : It is said, ''Science is a useful servant but destructive master''.

R : By the misuse of science, mankind will meet its doom quite soon.

S : If we do not harness it for the welfare of mankind, I am afraid, a total annihilation is a must.

The correct sequence should be

(a) S R Q P (b) P Q S R
(c) R Q S P (d) Q R S P

(b) P Q S R

15. S1: Uttarakhand is vulnerable to disasters.

S6: The lack of ability to learn lessons from disasters, and the lack of any accountability, ensure the perpetuation of the situation.

P : The absence of necessary monitoring, early warning systems and the overall disaster management system add another layer of damages during the disasters.

Q : Major interventions act as force multipliers during such disasters.

R : The violation of legal and other prudent norms, further increases the damages.

S : Climate change is increasing these vulnerabilities.

The correct sequence should be

(a) S Q R P (b) P Q S R
(c) Q S R P (d) R P S Q

(a) S Q R P

16. S1: Now only fifteen minutes were left.

S6: Our performance was excellent.

P : Thank God, we rubbed the word defeat' writ large on our forehead.

Q : It was a game of life and death.

R : Each one had concluded that we were going to lose.

S : It was a matter of minutes.

The correct sequence should be

(a) P S Q R (b) P Q S R
(c) R P S Q (d) R S Q P

(d) R S Q P

17. S1: The river Ganga is very important for us culturally, spiritually, ecologically- as well as economically.

S6: Journey in the right direction is firmly making progress, gathering momentum and becoming a people's movement.

P : It is rich in cultural heritage, natural splendour and biodiversity.

Q : People have used its water since the beginning of civilisation for different purposes.

R : It has the most dense cultivation in its basin and is critical for ensuring food and water security.

S : We need to utilise its water for different purposes while ensuring that its natural ecology is protected, aquatic life thrives, and forests along the river remain rejuvenated.

The correct sequence should be

(a) Q R S P (b) Q S R P
(c) R S Q P (d) P R Q S

(d) P R Q S

18. S1: The Republic Day in India falls on 26th January.

S6: He attends the march past.

P : The President of India takes the salute.

Q : It is organised at the India Gate.

R : People from far and wide come to witness it

S : It is celebrated with great pomp and show.

The correct sequence should be

(a) P R S Q (b) P Q S R
(c) S R Q P (d) R S Q P

(c) S R Q P

19. S1: Different people have different hobbies.

S6: With hobbies, you spend time in a gainful way.

P : Thus, they say, as many people, so many hobbies.

Q : In due course, that becomes your hobby.

R : Whatever leisure time you get, you use that in creative activity.

S : Hobby is a leisure time activity.

The correct sequence should be

(a) P Q R S (b) P Q S R
(c) S R Q P (d) R S Q P

(c) S R Q P

20. S1: Life in a village is ideal.

S6: They can no longer be considered backward.

P : Our villages are no longer dirty.

Q : Moreover, they are disease-free.

R : Because, the village people are well-educated now.

S : Rather, they are highly clean and tidy.

The correct sequence should be

(a) S R Q P (b) P S Q R
(c) S R P Q (d) R S Q P

(b) P S Q R

Directions (Q. Nos.21-30) *Each question in this section consists of sentences with an underlined word followed by four words or group of words. Select the option that is opposite in meaning to the underlined word and mark your answer accordingly.*

21. I am very <u>particular</u> about it.

(a) quiet (b) vague
(c) precise (d) minute

(b) 'Particular' means specific or distinct. Hence, 'vague' is the most nearly opposite in meaning to particular.

22. He has become <u>paunchy</u>.

(a) stout (b) slim
(c) plump (d) fat

(b) 'Paunchy' means having a large or protruding belly. Hence, 'slim' is its correct antonym.

23. This river originates from the Ganges.
(a) inaugurates (b) culminates
(c) initiates (d) emanates

(b) 'Originates' means to have a specified beginning. Hence, 'culminate' meaning to reach a climax or close with is its correct antonym.

24. The film I saw was hilarious.
(a) tragic (b) serious
(c) uproarious (d) jovial

(*) (a) and (b) 'Hilarious' means extremely amusing. Hence, 'tragic' and 'serious' are its correct antonyms.

25. On that day, pandemonium reigned in the hall.
(a) hullaballoo (b) uproar
(c) peace (d) accolade

(c) 'Pandemonium' means wild and noisy disorder or confusion. Hence, 'peace' is its correct antonym.

26. The police detained me today amidst busy traffic.
(a) impeded (b) released
(c) confined (d) held

(b) 'Detained' means to officially seize and hold someone or something. Hence, 'released' is its correct antonym.

27. In my state of despair, I confessed everything.
(a) despondency (b) determination
(c) dependant (d) elation

(d) 'Despair' means the complete loss or absence of hope. Hence, 'elation' meaning joy and happiness is the most nearly opposite in meaning to despair.

28. He was accused by the entire community after he failed in the mission .
(a) vindicated (b) incriminated
(c) indicted (d) arraigned

(a) 'Accused' means charged with an offence or crime. Hence, 'vindicated' meaning cleared of suspicion is its correct antonym.

29. There was much to boast about the quality of his work.
(a) bluster (b) brag
(c) deprecate (d) flaunt

(c) 'Boast' means to talk with excessive self-pride Hence, 'deprecate' meaning to express disapproval of is its correct antonym.

30. He delivered an eccentric speech.
(a) An odd (b) A peculiar
(c) A normal (d) An idiosyncratic

(c) 'Eccentric' means unconventional or slight strange. Hence, 'normal' is its correct antonym.

Directions (Q. Nos. 31-40) *Each of the following sentences has a word or phrase underlined. Read the sentences carefully and find which part of speech the underlined word belongs to.*

31. They wandered around aimlessly
(a) Verb (b) Adjective
(c) Intensifier (d) Noun

(c) 'Around' is an intensifier.

32. We went away after they had left.
(a) Pronoun (b) Adjective
(c) Intensifie (d) Conjunction

(d) Conjunction is a word that connects two or more clauses or sentences to form new sentences. Hence, 'after' is a conjunction.

33. Public culture is associated with extremely new civil societies .
(a) Adverb (b) Intensifier
(c) Adjective (d) Noun clause

(b) Intensifiers are adverb or adjective words that are used to add force and to intensify another adjective, adverb or verb. Hence, 'extremely' is an intensifier.

34. You are paying less attention to your studies these days.
(a) Adverb (b) Adjective
(c) Intensifier (d) Noun

(b) 'Less' is an adjective.

35. Why, is it really Sujata on the phone?
(a) Interjection (b) Adjective
(c) Intensifier (d) Noun

(a) 'Why' is an interjection.

36. Sit down and rest a while.
(a) Adverb (b) Adjective
(c) Intensifier (d) Noun

(a) The given sentence uses 'while' as an adverb.

37. Rakesh is too old to run fast.
(a) Adverb (b) Conjunction
(c) Intensifier (d) Noun

(c) 'Too' is an intensifier.

38. For the next generation of interior architects and design graduates, work opportunities are immense.
(a) Adverb (b) Adjective
(c) Noun (d) Pronoun

(c) 'Opportunities' is a noun.

39. Life is a solo fight, and each person makes his or her own journey.
(a) Noun (b) Adjective
(c) Intensifier (d) Adverb

(b) 'Solo' is an adjective.

40. The cat loves comfort.
(a) Indefinite article (b) Definite article
(c) Intensifier (d) Subject

(b) The is a definite article.

Directions (Q. Nos. 41-50) *Each of the following sentences in this section has a blank space with four words or group of words given. Select whichever word or group of words you consider the most appropriate for the blank space and mark your answer.*

41. The polythene bags ..... non-biodegradable, i.e. they cannot
(a) are (b) become
(c) is (d) were

(a) are

42. be decomposed ..... micro-organisms into manure. They
(a) by (b) through
(c) into (d) in

(a) by

43. remain as ..... even after years. Animals that started
(a) they are (b) it is
(c) even (d) after

(a) they are

44. eating waste food ..... with these polythene bags, ultimately
(a) besides (b) beside
(c) thorough (d) along

(d) along

45. started dying ..... their internal system was getting blocked.
(a) of
(b) though
(c) because
(d) for

(c) because

46. The Government had no alternative ..... to ban these polythene
(a) yet (b) but
(c) so (d) because

(b) but

47. bags. It is ..... duty of the government to look into this matter.
(a) but also (b) still
(c) the (d) yet
(c) the

48. however, it is also the duty of each individual to .....
(a) get it (b) do it
(c) convene it (d) see to it
(d) see to it

49. that we ..... use polythene bags. By using these we will
(a) didn't (b) weren't
(c) don't (d) aren't
(c) don't

50. not only harm the environment but also ourselves. Thus, say 'No' to plastic bags and contribute ..... the society.
(a) by (b) to (c) into (d) in
(b) to

Directions (Q. Nos. 51-60) *Each of the following sentences in this section has a blank space with four options. Select whichever preposition or determiner you consider the most appropriate for the blank space and mark your answer.*

51. He succeeded ..... dint of preseverance and hard work.
(a) by (b) for (c) on (d) upon
(a) By dint of means by means of. 'Hence', 'by' is appropriate to fill the blank.

52. Due to his illness, he could not finish the work ..... time.
(a) by (b) for (c) on (d) upon
(c) on

53. There is no meaning ..... what you say.
(a) by (b) for (c) in (d) on
(c) in

54. These are good rules ..... live by.
(a) with (b) to (c) in (d) on
(b) to

55. He is the man I have been looking .....
(a) at (b) for
(c) in (d) on
(b) for

56. Don't loiter ..... the street.
(a) near (b) around (c) in (d) on
(d) on

57. Sit here ..... me.
(a) by (b) beside
(c) in (d) on
(b) beside

58. We mustn't shy ..... entry-level or freelance jobs as they help us gain an insight into the context in which a company operates.
(a) in (b) with
(c) away from (d) upon
(c) away from

59. Civil society and media have a major role in making the coalition work ..... the people.
(a) for (b) about
(c) with (d) over
(a) for

60. He travelled ..... Mr. Joshi's car.
(a) by (b) for
(c) into (d) on
(a) by

Directions (Q. Nos. 61-70) *Each of the following sentences in this section has a blank space and four words or group of words are given after the sentence. Select the most appropriate word or group of words for the blank space and mark your answer.*

61. Honesty is ..... on his face.
(a) wrote (b) written
(c) writing (d) writes
(b) written

62. He lives ..... his pen.
(a) by (b) with (c) on (d) off
(d) 'Live off' means to depend on something as a source of income. Hence, 'off' is appropriate to fill the blank.

63. Much water has run ..... the bridge since then.
(a) near (b) about
(c) under (d) in
(c) Under

64. The gun ..... with a loud noise.
(a) went on (b) went off
(c) went about (d) went around
(b) 'Went off' means to be fired or explode. Hence, it is appropriate to fill the blank.

65. They fought ..... the last man in the army.
(a) on (b) from (c) with (d) to
(d) to

66. Keep him ..... arm's length.
(a) at (b) by (c) for (d) off
(a) at

67. He succeeded .....
(a) on himself (b) by himself
(c) in the long run (d) on the long run
(c) 'In the long run' means ultimately or eventually. Hence, it is the correct phrase to fill the blank.

68. Have you ever tried ..... a coconut tree ?
(a) climbing (b) to climbing
(c) going on (d) going up
(a) Climbing

69. He is a man ..... means.
(a) for (b) in (c) of (d) above
(c) of

70. He dislikes ..... punish his friends.
(a) have to (b) having to
(c) for (d) regarding
(b) having to

Directions (Q. Nos. 71-80) *Each question in this section consists of a sentence with an underlined word followed by four words. Select the option that is nearest in meaning to the underlined word and mark answer.*

71. He <u>drowned</u> in the flood water last year.
(a) swarmed (b) swam
(c) submerged (d) floated
(c) 'Drowned' means to die through submersion in the water or to 'submerge'. Hence, option (c) is the correct answer.

72. Autumn is a rather <u>dry</u> season.
(a) arid (b) humid
(c) rainy (d) moist
(a) 'Arid' is the correct synonym for 'dry'.

73. Our <u>differences</u> are growing day by day.
(a) confabulations (b) interferences
(c) disagreements (d) discrepancies
(c) 'Differences' means disagreement, quarrel or dispute. Hence, option (c) is the correct answer.

74. The big tree hindered access of sunlight into the house.
(a) impeded (b) shaded
(c) facilitated (d) poured

(a) 'Hinder' means to make something difficult for someone to do. Hence, 'impede' meaning to delay or prevent someone is its correct synonym.

75. The complexity of the issue baffled everyone.
(a) conclusion (b) intricacy
(c) grievance (d) complacency

(b) 'Complexity' refers to the state or quality of being intricate or complicated. Hence, 'intricacy' is its correct synonym.

76. He drank excessive amount of liquor.
(a) inculpable (b) inordinate
(c) unreasonable (d) innocuous

(c) 'Excessive' means more than necessary or desirable. Hence, 'unreasonable' is its correct synonym.

77. He initiated the dialogue.
(a) ordered (b) interfered
(c) began (d) planned

(c) 'Initiated' means started. Hence, 'began' is its correct synonym.

78. She looked pale after recovering from Covid-19.
(a) sallow (b) ruddy
(c) glowing (d) radiant

(a) 'Pale' means (a face) having less colour than usual, typically due to shock or illness. Hence, 'sallow' is its correct synonym.

79. I overrule your proposal.
(a) wan (b) veto
(c) weaken (d) supersede

(b) 'Overrule' means to reject or disallow by exercising one's superior authority. Hence, 'veto' is its correct synonym.

80. His behaviour shocked me.
(a) entreated (b) pacified
(c) appalled (d) scintillated

(c) 'Appalled' means greatly dismayed or horrified. Hence, it is the correct synonym for shocked.

Directions (Q. Nos. 81-90) *Each question in this section has a sentence with three underlined parts labelled as (a), (b) and (c). Read each sentence to find out whether there is any error in any underlined part. If you find no error, your answer should be option (d).*

81. (a) Everything is going well;
(b) we didn't have
(c) any problem.
(d) No error

(d) The given sentence is error free.

82. (a) Lavanya hasn't gone
(b) to work
(c) yesterday.
(d) No error

(a) Part (a) contains the error. Replace 'hasn't gone' with 'didn't go' to make the sentence error free.

83. (a) Look ! The boy over there
(b) wears the same sweater
(c) as you
(d) No error

(b) Part (b) contains the error. Replace 'wears' 'with 'is wearing' to make the sentence errror free.

84. (a) It begins
(b) to turn dark.
(c) Shall I switch on the lights?
(d) No error

(a) Part (a) contains the error. Replace 'begins' with 'is beginning' to make the sentence error free.

85. (a) Raman and Mitali
(b) have been married
(c) for twenty years.
(d) No error

(d) The given sentence is grammatically correct.

86. (a) I have played
(b) basketball
(c) for the past three hours.
(d) No error

(a) Part (a) contains the error. Replace 'played' with 'been playing' to make the sentence grammatically correct.

87. (a) Jamila had a book
(b) in front of her
(c) but she didn't read it.
(d) No error

(d) The given sentence is error free and grammatically correct.

88. (a) When she heard the news
(b) she hasn't been
(c) very pleased.
(d) No error

(b) Part (b) contains the error. Replace 'hasn't been' with 'wasn't' to make the sentence grammaticaly correct.

89. (a) Where are you coming from?
(b) Are you
(c) an American?
(d) No error

(d) The given sentence is error free.

90. (a) I went to Canada
(b) a few years ago
(c) for a holiday.
(d) No error

(b) Part (b) contains the error. Replace 'a few' with 'few' to make the sentence grammatically correct.

Directions (Q. Nos. 91-100) *Each of the following question in this section consists of a sentence, parts of which have been jumbled. These parts have been labelled as P, Q, R and S. Given below each sentence are four sequences, namely (a), (b), (c) and (d). You are required to rearrange the jumbled parts of the sentence and mark your answer.*

91. P: from Europe to America
Q : in 1992
R : his first voyage
S : Columbus made
The correct sequence is
(a) S P R Q (b) S R P Q
(c) P R S Q (d) Q R S P

(b) S R P Q

92. P: Scientists have
Q : the effects of
R : warned us about
S : climate change
The correct sequence is
(a) R P S Q (b) R S P Q
(c) P R Q S (d) Q S P R

(c) P R Q S

93. P : speed is a potent cause
Q: Industrial growth at a terrific
R : in a big city
S : of pollution
The correct sequence is
(a) R S Q P (b) Q P R S
(c) P R S Q (d) Q P S R

(d) Q P S R

94. P : and garbage
Q : today our environment
R : filth and squalor
S : is in constant grip of
The correct sequence is
(a) R P S Q (b) R S P Q
(c) Q S P R (d) Q S R P

(d) Q S R P

95. P : of corruption everywhere
Q : to ease out
R : the monster
S : it is the duty of the government
The correct sequence is
(a) S Q R P (b) Q R S P
(c) P R S Q (d) Q R P S
› ***(a)*** S Q R P

96. P : made the movement
Q : the poor visibility
R : of the vehicles
S : quite difficult
The correct sequence is
(a) Q R P S (b) R S P Q
(c) Q R S P (d) P R S Q
› ***(a)*** Q R P S

97. P : Mohan clearly
Q : I couldn't see
R : only a few yards ahead
S : though he was
The correct sequence is
(a) R Q S P (b) R S P Q
(c) P R S Q (d) S R Q P
› ***(d)*** S R Q P

98. P : both winter and summer
Q : extreme
R : are truly
S : here in India
The correct sequence is
(a) R P S Q (b) S R Q P
(c) S P R Q (d) P S R Q
› ***(c)*** S P R Q

99. P : get crystallised
Q : the self and world view
R : and physical space where basic ideas of
S : public culture is a mental
The correct sequence is
(a) R Q P S (b) S R Q P
(c) S R P Q (d) Q R S P
› ***(b)*** S R Q P

100. P : that he ordered
Q : the post was
R : the first job he performed on reaching
S : my release from jail
The correct sequence is
(a) R P S Q (b) R S P Q
(c) P R S Q (d) R Q P S
› ***(d)*** R Q P S

Directions (Q. Nos. 101-110) *The following questions have one part of the sentence followed by four alternatives. Complete the sentences by choosing the correct alternative.*

101. I asked two people the way to the station
(a) but neither of them could help me
(b) however none of them could show me the way
(c) yet they had doubts about the station
(d) nevertheless they couldn't guide me
› ***(a)*** I asked two people the way to the station but neither of them could help me.

102. The room was very warm
(a) because the AC was set to moderate temperature
(b) though the AC was set to very cold
(c) since the AC was not very warm in its temperature setting
(d) since the AC was in a very low temperature setting
› ***(b)*** The room was very warm though the AC was set to very cold.

103. We could leave today or we could leave tomorrow
(a) preferring what you want
(b) as you prefer one of the two
(c) depending on what you prefer
(d) whichever you prefer
› ***(c)*** We could leave to day or we could leave tomorrow, depending on what you prefer.

104. Mohan and I couldn't get into the house because
(a) neither of us had the keys
(b) both of us do not have the keys
(c) either of us did not have the keys
(d) neither of us did have the keys
› ***(a)*** Mohan and I couldn't get into the house because neither of us had the keys.

105. There are many good hotels, you can choose to stay in
(a) many of them
(b) any one of them
(c) either of them
(d) All of them
› ***(b)*** There are many good hotels, you can choose to stay in any one of them.

106. The bus service is very good; there is a bus
(a) after ten minutes
(b) in ten minutes
(c) before ten minutes
(d) every ten minutes
› ***(d)*** The bus service is very good; there is a bus every ten minutes.

107. We live near a busy airport; the planes fly
(a) near our house
(b) by our house
(c) over our house
(d) around our house
› ***(c)*** We live near a busy airport, the planes fly over our house.

108. Dan was very quiet. He didn't say a word
(a) all the evening
(b) the entire evening
(c) all the entire evening
(d) entire evening
› ***(b)*** Dan was very quiet. He didn't say a word the entire evening.

109. I don't like stories
(a) which can have unhappy endings
(b) which had sad endings
(c) that have unhappy endings
(d) which are unhappy endings
› ***(c)*** I don't like stories that have unhappy endings.

110. Not everything
(a) that happened was my fault
(b) which happen was my fault
(c) what happened was my fault
(d) whatever happened was my fault
› ***(a)*** Not everything that happened was my fault.

Directions (Q. Nos. 111-120) *In this section, you have two short passages. After each passage, you will find some questions based on the passage. Read the passage and answer the questions based on it.*

Passage I

As to happiness, I am not so sure. Birds, it is true, die of hunger in large numbers during the winter, if they are not birds of passage. But during the summer they do not foresee this catastrophe or remember how nearly it befell them in the previous winter. With human beings the matter is otherwise. I doubt whether the percentage of birds that will have died of hunger during the present winter (1946-47) is as great as the percentage of human beings that will have died from this cause in India and central Europe during the same

period. But every human death by starvation is preceded by a long period of anxiety, and surrounded by the corresponding anxiety of neighbours. We suffer not only the evils that actually befall us, but all those that our intelligence tells us we have reason to fear. The curbing of impulses to which we are led by forethought averts physical disaster at the cost of worry, and general lack of joy. I do not think that the learned men of my acquaintance, even when they enjoy a secure income, are as happy as the mice that eat the crumbs from their tables while the erudite gentlemen snooze. In this respect, therefore, I am not convinced that there has been any progress at all.

111. The birds die of hunger in winter because
(a) they do not move to warmer places
(b) people do not feed them
(c) they do not get the food of their choice
(d) they are too young to get the food

(a) According to the passage, if the birds are not 'birds of passage' (migratory), they die in large numbers during winters.

112. The birds do not foresee the catastrophe because they
(a) cannot predict an accident
(b) overlook a difficult situation
(c) cannot expect a sudden disaster
(d) ignore the problems

(*) (b) and (c) according to the passage, birds don't expect this catastrophic situation of the winter and overlook the situation even with the prior experience of winter.

113. Human beings cannot be happy because they
(a) do not get time to enjoy
(b) worry too much about their work
(c) are not healthy
(d) worry too much about future

(d) The passage mentions that human beings worry too much about the future, giving uncecessary forethought, Hence, they cannot be happy.

114. Which one of the following is the antonym of the word 'erudite' in the passage?
(a) Qualified (b) Ill educated
(c) Logical (d) Learned

(b) 'Erudite' means learned and scholarly. Hence, 'ill-educated is its correct antonym.

115. Which one of the following is the central theme of the passage ?
(a) Life of the birds and the mice
(b) Starvation in India and central Europe
(c) Progress of mankind
(d) Disasters in 1946-47

(c) 'Progress of mankind' is the central theme of the given passage.

Passage II

More than eight months after the national lockdown was announced in late March, urban India is learning to live with the Covid-19 pandemic. In fact, indicating a positive outlook for the future, many survey respondents in a recent survey say they plan to return to pre-lockdown levels of shopping, personal grooming, going to cinemas and socialising as pandemic fears continues to recede.

The survey findings highlight that the suppression of consumer demand because of fears of job losses and salary cuts could be coming to an end. Increasingly, urban Indians are showing increased confidence about the future of the economy. This could be an indicator of the possible 'pent-up demand' that several economists have been talking about - a demand that could be unleashed once a vaccine is developed and distributed, or when there are signs of the pandemic's spread reducing to negligible levels or vanishing totally.

Around 65 per cent of respondents said they had settled into new routines, or that they saw signs of the situation improving, or they had come to terms with the pandemic and were moving on with their lives. And since the survey was conducted before the news of the successful trials of the Pfizer vaccine for the coronavirus was announced, it is likely that the consumers are now even more positive in their outlook about the future.

116. The general tone of the passage is that of
(a) Optimism (b) Pessimism
(c) Fatalism (d) Defeatism

(a) The general tone of the passage is optimistic .

117. The willingness of consumers to go back to normal lifestyle indicates their
(a) Casual attitude
(b) Change of moods
(c) Desire for future plans
(d) Sense of economic security

(d) The passage suggests that Indian consumers show increased confidence about the future of the economy and that consumers feel secure about the economy. Hence, option (d) is the correct answer.

118. Which statement in the passage/phrase indicates that 'Life must go on'?
(a) They "settled into their new routines"
(b) "Salary cuts could be coming to an end"
(c) People are "moving on with their lives"
(d) "Pent - up demand"

(c) By the line, people are 'moving on with their lives' the author aims to indicate that' 'life must go on'.

119. What does the author mean by 'pent-up demand' ?
(a) Desire (suppressed) to spend money once pandemic is controlled
(b) Economic normalcy of consumers
(c) Flamboyant shopping by consumers
(d) Criticism of the public on the pay-cuts

(a) By the phrase 'pent-up demand', the author means that the desire to spend money in shopping for a product will increase once the pandemic is brought under control.

120. What, according to the author, is the reason behind suppression of consumer demands ?
(a) The lack of vaccine till date
(b) Professional insecurity
(c) Motive to save up some money
(d) Careful and calculative attitude of the general public

(b) The reason behind the suppression of consumer demands is fear of job losses and salary cuts. Hence, option (b) is the correct answer.

PAPER III General Studies

1. Who among the following ancient Indian kings was praised in glowing terms in the Prayaga Prashasti?

(a) Ashoka
(b) Harshavardhana
(c) Samudragupta
(d) Bindusara

(c) Samudragupta was the Ancient Indian king who was praised in glowing terms in the Prayaga Prashasti.In Prayaga Prashasti the poet Harishena mentions the victories of Samudragupta. The inscription is a panegyric praising Samudragupta and lists the political and military achievements of his reign including his expeditions to the South.

2. The Self-Respect Movement was initiated by

(a) B.R. Ambedkar
(b) Jyotiba Phule
(c) E.V. Ramaswamy Naicker
(d) Jawaharlal Nehru

(c) The Self-Respect Movement was initiated by E.V. Ramaswamy Naicker in 1925 in Tamil Nadu. Self-Respect Movement was a dynamic social movement aimed at destroying the contemporary Hindu social order in its totality and creating a new, rational society without caste, religion and God.

3. The location of the ancient city of Taxila (Takshshila), mentioned in ancient Indian texts, was identified by

(a) Alexander Cunningham
(b) R.D. Banerji
(c) John Marshall
(d) Daya Ram Sahni

(a) Alexander Cunningham identified the location of the ancient city of Taxil as mentioned in the Ancient Indian Text. Alexander Cunningham was keen admirer of heritage, sculptures, antiquities and numismatics. He laid the foundation of Archaeological Survey of India (ASI) in 1861.He also became its first Director-General.

4. Who among the following was not a Jain Acharya?

(a) Bhadrabahu
(b) Khema
(c) Haribhadra
(d) Siddhasena Divakara

(b) Khema is not a jain Acharya.Khema was a Buddhist bhikkhuni or nun, who was one of the top female disciples of the Buddha. She is considered the first of the Buddha's two chief female disciples, along with Uppalavanna.

5. In India, the first major public appearance of Mahatma Gandhi was in

(a) Champaran (1917)
(b) Kheda (1918)
(c) Inauguration of Banaras Hindu University (1916)
(d) Rowlatt Satyagraha (1919)

(c) Gandhi's first major public appearance was during the inauguration of Banaras Hindu University in 1916.Banaras Hindu University is an internationally reputed temple of learning, situated in the holy city of Varanasi.

6. Consider the following statements about Patanjali's Mahabhashya

1. It makes a mention of Kautilya.
2. It is a book on grammar and refers to historical personalities only incidentally.

Which of the statements given above is/are correct?

(a) Only 1 (b) Only 2
(c) Both 1and 2 (d) Neither 1 nor 2

(b) Statement 2 is correct. The Mahabhasya, attributed to Patanjali, is a commentary on selected rules of Sanskrit grammar from Panini's treatise, the Astadhyayi, as well as Katyayana's Varttika-sutra, an elaboration of Panini's grammar. It is dated to the 2nd century BCE.

7. Which one of the following may lead to movement along the demand curve of a commodity ?

(a) Change in its price
(b) Change in price of the other commodities
(c) Change in income of the consumer
(d) Change in tastes and preferences of consumers

(a) The demand curve is a graphical representation of the relationship between the price of a good or service and the quantity demanded for a given period of time. Thus change in a price of commodity may lead to the movement along the demand curve of a commodity.

8. Which one of the following is the opportunity cost of a chosen activity ?

(a) Out of pocket cost
(b) Out of pocket cost plus cost incurred by the Government
(c) Value of all opportunities forgone
(d) Value of next best alternative that is given up

(d) In microeconomic theory, the opportunity cost of a particular activity option is the loss of value or benefit that would be incurred by engaging in that activity, relative to engaging in an alternative activity offering a higher return in value or benefit. Thus, opportunity cost of a chosen activity is the value of next best alternative that is given up. For example-Someone gives up going to see a movie to study for a test in order to get a good grade. The opportunity cost is the cost of the movie and the enjoyment of seeing it.

9. Which one of the following statements in the context of social sector spending in India during 2014 - 19 (both States and the Union Government together) is true?

(a) Expenditure on' education was 5% of GDP.
(b) Expenditure on health was 4% of the social services expenditure.
(c) There was a stagnation in the spending on education as a percent of GDP.
(d) Health sector spending amounted to 10% of the total expenditure.

(c) There was a stagnation in the spending on education as a percent of GDP in the context of special sector spending in India during 2014-19 as the education expenditure has grown only to 3.1% of GDP in 2019 from 2.8% in 2014.

10. According to UNDP's Human Development Report - 2020, in which of the HDI components has India improved in recent years?

1. Life expectancy at birth
2. Expected years of schooling
3. GNI per capita
4. Mean years of schooling

Select the correct using the codes given below:

(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1,2,3 and 4

> ***(d)*** All 1,2,3 and 4 are correct. According to UNDP's HDI Report, 2020,HDI value of India has increased to 0.645 from 0.429, registering an increase of over 50%. Life expectancy at birth in India rose by nearly 12 years. Mean years of schooling witnessed an increase of 3.5 years. The expected years of schooling also rose by 4.5 years. GNI per capita of India also increased, registering a rise of nearly 274%.

11. Which one of the following is true of a pure voluntary exchange between two parties A and B ?

(a) A can exploit B or vice-versa
(b) Both gain; it is a win-win situation
(c) If A makes profit, it must be at the cost of B
(d) Both can lose

> ***(b)*** In a pure voluntary exchange between two parties A and B, both gain which is a win-win situation. Voluntary exchange is the act of buyers and sellers freely and willingly engaging in market transactions. Voluntary exchange is a fundamental assumption made by neoclassical economics which forms the basis of contemporary mainstream economics.

12. The provision, ''the State shall take steps to separate the Judiciary from the Executive in the public services of the State'' is incorporated in which part of the Constitution of India ?

(a) Part-IV (b) Part-V
(c) Part-VI (d) Part-VII

> ***(a)*** Article 50 contained in Part IV of Constitution of India is a directive principle of state policy . It gives a direction to the State to keep Judiciary separated and independent of the Executive, particularly in judicial appointments.

13. Which of the following statements are correct?

1. Speaker may permit any Member to address the House in his/her mother tongue, if he/she cannot adequately express in either Hindi or English.
2. Business of the Parliamentary Committees is transacted either in Hindi or in English.
3. The minutes of the Parliamentary Committees are prepared invariably in Hindi or English.

Select the correct answer using the codes given below:

(a) 1,2 and 3 (b) 1 and 2,
(c) 2 and 3 (d) 1 and 3

> ***(a)*** Statements 1,2 and 3 are correct.Under Article 120 of the Constitution, the business of the House is to be transacted in Hindi or in English, but a member who cannot adequately express himself in either of the two languages can, with the permission of the Speaker, address the House in any of the languages mentioned in the Eighth Schedule of the Constitution or in his mother tongue. The minutes and reports of the Parliamentary Committees are invariably prepared and presented to the house both in Hindi and in English.

14. Which one of the following is the correct meaning of the term 'State', as defined in Article 12 of the Constitution of India ?

(a) It refers only to the Government of India.
(b) It refers only to the Government of India and the Parliament of India.
(c) It refers only to the Government of India, Parliament of India, and Governments and Legislatures of each State.
(d) It refers to the Government of India, Parliament of India, Governments and Legislatures of each State, and all local or other authorities within the Territory of India.

> ***(d)*** According to Article 12 of the Constitution of India, the term 'State' denotes the Union and State Governments, the Parliament and state legislatures, and all local or other authorities within the Territory of India or under the control of the Indian Government.

15. Which one among the following is the largest State in terms of seats in the Rajya Sabha?

(a) Andhra Pradesh
(b) Bihar
(c) Rajasthan
(d) Karnataka

> ***(b)*** Among the mentioned states, Bihar with 16 Rajya Sabha seats is the largest state in terms of seats in the Rajya Sabha. Andhra Pradesh, Rajasthan and Karnataka has 11,10 and 12 Rajya Sabha seats respectively.
> Uttar Pradesh with 31 seats is the largest states in terms of Rajya Sabha seats

16. Under which Article of the Constitution of India has provision been made for reservation of seats for women in Panchayats ?

(a) Article 243 B (b) Article 243 C
(c) Article 243 D (d) Article 243 E

> ***(c)*** Article 243D clause (3) after the 73rd constitutional amendment ensures participation of women in Panchayati Raj Institutions by mandating not less than one- third reservation for women out of total number of seats to be filled by direct election and number of offices of chairpersons of Panchayats.

17. The painted illustration of the moving of the Ashoka Pillar at Topra is found in

(a) Tarikh-i-Firuz Shahi
(b) Tarikh-i-Shahi
(c) Sirat-i-Firuz Shahi
(d) Akbar Nama

> ***(a)*** Tarikh-i Firuz Shahi is the finest specimen of Indo-Persian historiography produced during the Sultanate period in India. It contains the painted illustration of the moving of the Ashokan pillar at Topra. Situated in Pong valley of is the original home of Delhi-Topra Ashokan pillar, one of many pillars of Ashoka, that was moved from Topra to Feroz Shah Kotla in Delhi in 1356 CE by Firuz Shah Tughlaq (1309-1388 CE).

18. Which one among the following is a temple of the Vaishnavite tradition?

(a) Srirangam (b) Chidambaram
(c) Gangaikonda Cholapuram
(d) Thanjavur

> ***(a)*** Srirangam is a temple of Vaishanvite tradition.Srirangam is the foremost of the eight self-manifested shrines (Swayam Vyakta Kshetras) of Lord Vishnu .It is also considered the first and the most important of the 108 main Vishnu temples (Divyadesams). The Vaishnavite tradition is known for the loving devotion to an avatar of Vishnu (often Krishna), and as such has been key to the spread of the Bhakti movement in South Asia in the 2nd millennium CE. Chidambaram, Gangaikonda Cholapuram and Thanjavur temples are dedicated to lord shiva.

19. The biography of Shaikh Muinuddin Chishti, authored by Jahanara, is known as

(a) Munis al Arwah
(b) Fawaid ul Fuwad

(c) Sirat ul Auliya
(d) Muraqqa-e Dehli

(a) The biography of Shaikh Muinuddin Chishti, authored by Jahanara, is known as Munis al Arwah.Jahanara Begum was a Mughal princess and later became Padshah Begum of the Mughal Empire from 1631 to 1658 and again from 1668 until her death. She was the second and the eldest surviving child of Emperor Shah Jahan and Mumtaz Mahal.

20. Which one of the following is not a political method of the moderates in the National Movement?

(a) Overthrow of alien rule
(b) Constitutional agitation
(c) Slow, orderly political progress
(d) Mobilisation of public opinion

(a) The Early Nationalists, also known as the Moderates, were a group of political leaders in India active between 1885 and 1907. Their emergence marked the beginning of the organised national movement in India.Moderates believed in the policy of settlement of minor issues with the government by deliberations. The methods of the moderates were: (i) Sending petitions to the Government officials. (ii) Sending memorandums to the officers. (iii) Passing resolutions.

21. The town of Chisht, from which the Sufi Chishti Silsila derives its name, is located in

(a) Western Turkey
(b) Central Afghanistan
(c) Eastern Iran
(d) Eastern Iraq

(b) The town of Chisht, from which the Sufi Chishti Silsila derives its name, is located in central Afghanistan.The Chishti Order is a tariqa, an order or school within the mystic Sufi tradition of Sunni Islam. The Chishti Order is known for its emphasis on love, tolerance, and openness. It began in Chisht, a small town near Herat located in Central Afghanistan, about 930 AD.

22. The rules for congregational worship (Sangat) involving collective recitation were organised by

(a) Guru Nanak (b) Guru Angad
(c) Guru Arjan
(d) Guru Govind Singh

(a) Guru Nanak organised rules for congregational worship involving collective recitation. Sangat is a Sikh term with its origin in the Sanskrit word Sangh, which means company, fellowship and association.In Sikh vocabulary, the word has a special connotation. It stands for the body of men and women who meet religiously, especially in the presence of the Guru Granth Sahib.

23. Who amongst the following will be at more risk with respect to the earthquake hazard zone specified by the Geological Survey of India?

(a) Shahji at Secunderabad
(b) Ranbir at Indore
(c) Malti at Pithoragarh
(d) Maitri at Bhubaneswar

(c) Malti at Pithoragarh is at zone-V of seismic zone which is the highest seismic zone as given by Geological survey of India. A seismic hazard zone describes an area with a particular level of hazard due to earthquakes. Typically, a high seismic hazard zone is nearest a seismic zone where there are more earthquakes, and a lower seismic hazard zone is farther away from a seismic zone.

24. The Government wants to prepare a plan for drought prone areas of the country. Which one of the following regions will be predominantly focused?

(a) Coastal Andhra Pradesh
(b) Ganga plains
(c) North-eastern region
(d) Kutch region

(d) Kutch region is the dry land region which is prone to droughts as it is close to Thar desert and this government has to prepare a plan for such drought prone region. Other region mentioned gets adequate rainfall.

25. Four persons are travelling to different States of India. To whom will you advise to protect oneself from blizzards?

(a) The person travelling to Arunachal Pradesh
(b) The person travelling to Assam
(c) The person travelling to Tripura
(d) The person travelling to Odisha

(a) Person travelling to Arunachal pradesh should be advised to protect oneself from Blizzards. Blizzards commonly occur with temperatures around or below 20 degrees Fahrenheit.These low temperatures combined with strong winds create a low wind-chill factor, which is the amount of cooling someone feels from the combination of temperature and wind speed.

26. Which one of the following States is not prominent for plantation agriculture?

(a) Rajasthan (b) Assam
(c) Nagaland (d) Kerala

(a) Among the given options, the state of Rajasthan is not prominent for plantation agriculture. Rajasthan is a dry state where Wheat, Jau, Jwar, Bajra, Maize and Pulses are the major food crops. Some examples of plantation crops are Coffee, Cocoa, Cotton, Tea, Sugarcane, Sisal, Oil seeds, Rubber trees etc. which are found in states of Assam, Nagaland and Kerala.

27. The distance between which two cities has been reduced by the Atal Tunnel?

(a) Bagdogra to Gangtok
(b) Jammu to Srinagar
(c) Manali to Leh
(d) Itanagar to Tawang

(c) The distance between Manali to Leh has been reduced by the Atal Tunnel. Atal Tunnel in Himachal Pradesh's Rohtang, connects Solang Valley near Manali to Sissu in Lahaul and Spiti district. Atal tunnel is the first step towards all-year connectivity to Ladakh. The tunnel has the potential to link Ladakh to Manali and Chandigarh throughout the year, as it would bypass Rohtang Pass, which is snowed in through the winter months.

28. Which one of the following biosphere reserves comprises islands with estuaries, beaches, coral reefs, salt marshes and mangroves?

(a) Sunderban biosphere reserve
(b) Gulf of Mannar biosphere reserve
(c) Nilgiri biosphere reserve
(d) Nandadevi biosphere reserve

(b) Gulf of Mannar biosphere reserve comprises islands with estuaries, beaches, coral reefs, salt marshes and mangroves.The Gulf of Mannar, running down South from Rameswaram to Kanyakumari in Tamil Nadu. It is one of the biologically richest coastal regions in all of mainland of India. It is the first Marine Biosphere Reserve in the South and South-East Asia.

29. Which one of the following is not a correct statement with reference to the Constitution of India?

(a) The Constitution (Eighty-Fifth) Amendment Act has inserted the 'Right to Education under Article 21-A.

(b) Article 22 talks about preventive detention.
(c) Right to Constitutional Remedies is in Part-III of the Constitution.
(d) Writ jurisdiction of High Courts is wider than the Supreme Court of India.

› ***(a)*** 85th Amendement Act to the Constitution of Indian made an amendment In Article 16 of the Constitution, in clause (4A), The Constitution (Eighty-sixth Amendment) Act, 2002 inserted Article 21-A in the Constitution of India to provide free and compulsory education of all children in the age group of six to fourteen years as a Fundamental Right in such a manner as the State may, by law, determine.

30. Which one of the following statements about the Cripps Mission is not correct?
(a) It was sent to India by the British Government in March 1942.
(b) It proposed that the Constitution of India was to be framed by an elected Constituent Assembly of the Indian people.
(c) Any province which was not prepared to accept the Constitution would be free to retain its constitutional provisions existing at that time.
(d) The British Government could enter into a separate Constitutional arrangement with any of the acceding provinces.

› ***(b)*** Cripps Mission proposed that a Constituent Assembly would be formed to frame a new constitution for the country. This Assembly would have members elected by the provincial assemblies and also nominated by the princes.

31. Which of the following statements regarding constitutional amendment is/are correct?
1. The procedure for amendment to the Constitution is provided in Article 368.
2. A Bill to amend the Constitution can be introduced in either House of the Parliament.
3. The special procedure in Article 368 vests constituent powers upon the ordinary legislation.

Select the correct answer using the codes given below:
(a) Only 1
(b) 1, 2 and 3
(c) 2 and 3
(d) 1 and 2

› ***(b)*** All 1, 2 and 3 are correct. Article 368 (1) of the Constitution of India grants constituent power to make formal amendments and empowers Parliament to amend the Constitution by way of addition, variation or repeal of any provision according to the procedure laid down therein, which is different from the procedure for ordinary legislation.Article 368 of Part XX of Indian Constitution provides for two types of amendments. Viz, By a special majority of Parliament and By a special majority of the Parliament with the ratification by half of the total states.

32. Which one of the following is not a circumstance for proclamation of Emergency by the President of India under Article 352 of the Constitution of India ?
(a) War
(b) External aggression
(c) Internal disturbance
(d) Armed rebellion

› ***(c)*** Among the given options, internal disturbance is not a circumstance for proclamation of Emergency by the President of India. After 44th Amendment Act, 1978, National Emergency can only be declared on grounds of ''External aggression or war'', also called as External Emergency and on the ground of ''armed rebellion'', also called as Internal Emergency.

33. Akbar issued a Farman in 1598 permitting in the city of Cambay (Khambat), Gujarat, the construction of a
(a) Temple (b) Church
(c) Synagogue (d) Jain Upashraya

› ***(b)*** Akbar issue a Farman in 1598 permitting in the city of Cambay(Khambat), Gujarat, the construction of a Church. Akbar permits the Jesuit order to build a church in the city of Cambay, Gujarat. The date given in the farman is: ''written on the 25th day of the month of Farvardin, year 42 of the Ilahi era.''

34. Domingo Paes, the medieval traveller, has described the city of
(a) Madurai (b) Vijayanagara
(c) Arikamedu (d) Gingee

› ***(b)*** Domingo Paes was a Portuguese traveller who visited the Vijayanagara Empire, located in the Deccan in southern India, around 1520. He went there as part of a group of traders from the then colony of Goa.His visit took place during the rule of King Krishna Deva Raya and Paes recorded his impressions of Vijayanagara state in his Chronica dos reis de Bisnaga (''Chronicle of the Vijayanagar kings'').

35. The extent of damage caused by earthquake is not influenced by which one of the following ?
(a) Strength of earthquake
(b) Population density
(c) Type of building
(d) Climate of the area

› ***(d)*** The extent of damage caused by earthquake is not influenced climate of the area. When an earthquake strikes, the intensity of earthquake shaking determines the severity of damage. In turn, the main factors affecting earthquake shaking intensity are earthquake depth, proximity to the fault, population density, the underlying soil,and building characteristics particularly height.

36. An avalanche is a type of which one of the following disasters?
(a) Atmospheric (b) Terrestrial
(c) Aquatic (d) Biological

› ***(b)*** An Avalanche is a Terrestrial type of disaster. An avalanche (also called a snow slide) is a rapid flow of snow down a slope, such as a hill or mountain.Terrestrial disasters include earthquake, volcanic eruption, landslide, avalanches, subsidence, etc.

37. An infection constantly maintained at a baseline level in a geographic area without external input is known as
(a) Endemic (b) Pandemic
(c) Epidemic (d) Outbreak

› ***(a)*** Endemic (of a disease) persisting in a population or region, generally having settled to a relatively constant rate of occurrence. Thus, an infection constantly maintained at a baseline level in a geographic area without external input is called Endemic. Endemic describes a disease that is present permanently in a region or population.

38. Streams and rivers coming from the mountains deposit heavy materials of rocks and boulders in
(a) Khadar (b) Bhangar
(c) Bhabar (d) Terai

› ***(c)*** Streams and rivers coming from the mountains deposit heavy materials of rocks and boulders in Bhabar. Bhabar is a region located to south of the Lower Himalayas and the Sivalik Hills in Uttarakhand state of India. It is the alluvial apron of sediments washed down from the

Sivaliks along the northern edge of the Indo-Gangetic Plain. In Bhabar, streams and rivers comes from the mountains deposit heavy materials of rocks and boulders.

39. Which of the following statements regarding the electoral rolls is/are correct?

1. There is one general electoral roll for every territorial constituency.
2. No person is ineligible for inclusion in the electoral roll on grounds of religion, race, caste, sex or any of them.
3. A citizen of India, not less than 18 years of age, can cast his/her vote unless disqualified under a law of an appropriate legislature.

Select the correct answer using the codes given below:

(a) Only 1 (b) 1, 2 and 3
(c) 2 and 3 (d) 1 and 2

› ***(b)*** All statements 1,2 and 3 are correct.Right to equality provides that there cannot be any ineligibility for inclusion in the electoral roll on grounds if religion, race, caste, sex or any of them.
Requirements for registering to vote:-You can enroll as a Voter if you:

- are an Indian citizen.
- have attained the age of 18 years on the qualifying date i.e. 1st of January of the year of revision of electoral roll.
- are ordinarily resident of the part/polling area of the constituency where you want to be enrolled.
- are not disqualified to be enrolled as an elector.

40. Which one of the following statements is not correct about 'Totalitarianism'?

(a) It is not akin to autocracy and authoritarianism.
(b) It usurps political freedom of the individuals, but it doesn't usurp personal freedoms.
(c) It implies abolition of civil society.
(d) It is usually identified with a one-party state.

› ***(b)*** Totalitarianism is a form of government and a political system that prohibits all opposition parties, outlaws individual opposition to the State and its claims, and exercises an extremely high degree of control and regulation over public and private life. It usurps political freedom of the individuals as well as the personal freedoms.

41. Who among the following was chosen for the Kuvempu Award 2020 ?

(a) Dr. Rajendra Kishore Panda
(b) Amitav Ghosh
(c) Vikram Seth
(d) Chetan Bhagat '

› ***(a)*** Dr. Rajendra Kishore Panda was awarded Kuvempu Awar 2020. Rajendra Kishore Panda is an Indian poet and novelist from Odia language. He has published 16 poetry collections.The Kuvempu Rashtriya Puraskar, the national award was instituted in memory of late poet laureate Kuvempu. The prestigious award carries a cash award of Rs 5 lakh, a silver medal, and a citation.

42. Avani Lekhara became the first Indian woman to win two Paralympics medals at the Tokyo Paralympics 2020. Which one of the following was her discipline?

(a) Badminton (b) Shooting
(c) Table Tennis
(d) Archery

› ***(b)*** Avani Lekhara is an Indian Paralympian and rifle shooter. She won a gold medal in 10m air rifle standing and a bronze medal in 50m rifle 3 positions at Tokyo 2020 Paralympics.She became the first Indian women to win two paralympics medals at the Tokyo Paralympics 2020.

43. Bagram Air Base is located in

(a) Turkey (b) Pakistan
(c) Afghanistan (d) Israel

› ***(c)*** Bagram Air base is located in Afganistan.Bagram Airfield-BAF also known as Bagram Air Base is an Afghan military base, and formerly the largest U.S. military base in Afghanistan. It is located next to the ancient city of Bagram, 11 kilometres southeast of Charikar in the Parwan Province of Afghanistan.

44. The Panchmuli Lake is situated near

(a) Statue of Equality
(b) Thiruvalluvar Statue
(c) Dhyan Buddha Statue
(d) Statue of Unity

› ***(d)*** Panchmuli lake is situated near the Sardar Vallabhbhai Patel 'Statue of Unity' in Kevadia, Gujarat.The Statue of Unity is a colossal statue of Indian statesman and independence activist Vallabhbhai Patel, who was the first deputy prime minister and home minister of independent India

45. Pinaka, developed in India, is a

(a) battle tank
(b) multi-barrel rocket launcher
(c) anti-tank guided missile
(d) armoured utility vehicle

› ***(b)*** Pinaka is a Multi Barrel rocket launcher produced in India and developed by the Defence Research and Development Organisation for the Indian Army. The system has a maximum range of 40 km for Mark-I and 60 km for Mark-I enhanced version and can fire a salvo of 12 HE rockets in 44 seconds.

46. What is Itat e-dwiar ?

(a) An Urdu magazine published from Lucknow
(b) An e-filing portal of Income Tax Appellate Tribunal
(c) A religious monument
(d) Name of a UNESCO world heritage site

› ***(b)*** Itat e-dwar is an e-filling portal of the Income Tax Appellate Tribunal.It is an initiative to reduce the digital divide among the people. The launch of the e-Filing Portal 'itat e-dwar' aims to enhance the accessibility, accountability and transparency in the day-to-day working of the ITAT.It is a step towards the digitisation of ITAT.

47. What is the range capability of Agni-P Ballistic Missile?

(a) 1,000 - 2,000 km
(b) 2,000 - 3,000 km
(c) 3,000 - 4,000 km
(d) 4,000 - 5,000 km

› ***(a)*** Agni-P Ballistic Missile is a canisterised missile with a range capability between 1,000 and 2,000 km. Agni-P is a new generation advanced variant of the Agni class (under IGMDP - Integrated Guided Missile Development Program).

48. Which one of the following Indian states has recently declared itself as the first rabies-free state?

(a) Punjab
(b) Himachal Pradesh
(c) Tamil Nadu (d) Goa

› ***(d)*** Goa has recently declared itself as the first rabies-free state in India.Goa has not reported a single rabies case in the last three years since 2017.

49. Department of Public Enterprises is a part of

(a) Ministry of Finance
(b) Ministry of Heavy Industries
(c) PMO
(d) Ministry of Commerce and Industry

> ***(a)*** Department of Public Enterprises is a part of ministry of Finance. Department of Public Enterprises is the nodal department for all the Central Public Sector Enterprises (CPSEs) and formulates policy pertaining to CPSEs.

50. Chronologically arrange the following Indian-origin astronauts on the basis of their flying into space starting with the first.

1. Sunita Williams
2. Rakesh Sharma
3. Sirisha Bandla
4. Kalpana Chawla

Select the correct using the codes given below.

(a) 4-3-2-1 (b) 2-4-1-3
(c) 2-1-4-3 (d) 1-4-3-2

> ***(b)*** The correct order of Indian origin astronauts on the basis of their flying into space starting with the first is Rakesh Sharma (1984), Kalpana Chawla (1997), Sunita Williams(2006) and Sirisha Bandla (2021).

51. President Jovenel Moise, who was assassinated recently, was the President of which one of the following countries?

(a) Dominican Republic
(b) Haiti
(c) Guatemala (d) Cuba

> ***(b)***Jovenel Moïse was a Haitian entrepreneur and politician who served as the President of Haiti from 2017 until his assassination in 2021. He was sworn in as President in February 2017 after winning the November 2016 election. In 2019, political unrest and calls for his resignation became a crisis.

52. Recently, which one among the following Ministries was formed under the Government of India?

(a) Ministry of New and Renewable Energy
(b) Ministry of Development of North-Eastern Region
(c) Ministry of Cooperation
(d) Ministry of Jal Shakti

> ***(c)*** The Ministry of Co-operation is a ministry under the Government of India which was formed in July 2021. The ministry provides a separate administrative, legal and policy framework for strengthening the cooperative movement in the country.

53. Indian Naval Ship INS Tabar had recently participated in a two-day naval exercise with the Italian Navy. The exercise was conducted in

(a) Ionian sea
(b) Adriatic sea
(c) Tyrrhenian sea
(d) Mediterranean sea

> ***(d)*** Indian Naval Ship Tabar participated in two day Naval exercises with a frontline frigate of the Italian Navy after it entered the Port of Naples as part of a deployment to the Mediterranean Sea.

54. Which one of the following countries has recently been awarded a malaria-free certification by the WHO

(a) Pakistan (b) Bhutan
(c) China (d) Nepal

> ***(c)*** The World Health Organisation (WHO) has declared China as 'malaria-free'.The final decision on awarding a malaria-free certification rests with the WHO Director-General, based on a recommendation by the independent Malaria Elimination Certification Panel (MECP).

55. Who amongst the following was honoured with Gandhi Peace Prize for the year 2020 ?

(a) Qaboos bin Said Al Said
(b) Sheikh Mujibur Rahman
(c) Ekal Abhiyan Trust
(d) Sulabh International

> ***(b)*** Sheikh Mujibur Rahman was honoured with Gandhi Peace Prize 2020 for his outstanding contributions towards social, economic and political transformation through non-violent and other Gandhian methods break Gandhi Peace Prize is an annual award instituted by the Government of India since 1995, the 125th Birth Anniversary commemoration year of Mahatma Gandhi. The award is open to all persons regardless of nationality, race, language, caste, creed or sex.

56. Why was Dholavira in the news recently?

(a) Skeletons discovered at this site
(b) For its conservation effects
(c) For the discovery of gold and precious stones at this site
(d) It received the UNESCO World Heritage Tag

> ***(d)*** Dholavira is an archaeological site at Khadirbet in Bhachau Taluka of Kutch District, in the state of Gujarat. Dholavira, the archaeological site of a Harappan-era city, received the UNESCO world heritage site tag. Dholavira became the fourth site from Gujarat and 40th from India to make the list, it is the first site of the ancient Indus Valley Civilisation (IVC) in India to get the tag.

57. Which one of the following is the oldest football tournament of Asia?

(a) Federation Cup
(b) Santosh Trophy
(c) Durand Cup
(d) Rovers Cup

> ***(c)*** Durand Cup is the oldest football tournament in Asia. It was first held in 1888 in Annadale, Shimla. It is hosted by the Durand Football Tournament Society.

58. Who among the following is the first Indian woman to win a medal in the Olympics ?

(a) Karnam Malleswari
(b) Mirabai Chanu
(c) P.T. Vsha
(d) P. V. Sindhu

> ***(a)*** She is the first Indian woman to win a medal at the Sydney Olympics in 2000. She is a retired Indian weightlifter. She received the Arjuna Award and in 1999, she received the Rajiv Gandhi Khel Ratna award, India's highest sporting honour and the civilian Padma Shri award.

59. The Russian Federation participated in the Tokyo Olympics, 2020 under which of the following names?

(a) Russian Olympic Committee
(b) Russian Federal Committee
(c) Russian Sports Committee
(d) Russian Republican Committee

> ***(a)*** Russian Federation participated in the Tokyo Olympics 2020 under Russian Olympic Committee.Athletes didn't compete under the Russian flag because of a punishment handed down by the World Anti-Doping Agency (WADA). Originally, Russia had been suspended for four years of Olympic action, but in late 2020, that punishment was reduced to two years.

60. Which of the following States/Union Territory/Region are in special focus in the National Mission on Edible Oils - Oil Palm?

(a) Himachal Pradesh and Andaman and Nicobar Islands
(b) North-East Region and Andaman and Nicobar Islands
(c) North-East Region and Gujarat
(d) Uttar Pradesh and Gujarat

> ***(b)*** National Mission on Edible Oil-Oil Palm (NMEO-OP) is a new Centrally Sponsored Scheme. It is proposed to have an additional 6.5 lakh hectares for palm oil by 2025-26. It will involve raising the area under oil palm cultivation to 10 lakh hectares by 2025-26 and 16.7 lakh hectares by 2029-30.The special emphasis of the scheme will be in India's North-Eastern (NE) states and the Andaman and Nicobar Islands due to the conducive weather conditions in the regions.

61. Swami Dayanand Saraswati took inspiration from

(a) Puranas (b) Vedas
(c) Medieval saints (d) Sufism

> ***(b)*** Swami Vivekananda took inspiration from Vedas. He was of the view that All that is called knowledge is in the Vedas. Every word is sacred and eternal, eternal as the soul, without beginning and without end.According to him, the three essentials of Hinduism are belief in God, in the Vedas as revelation, in the doctrine of Karma and transmigration.

62. The call for 'renunciation of (all) voluntary associations with the (British) Government' was given during

(a) Non-Cooperation Movement
(b) Civil Disobedience Movement
(c) Quit India Movement
(d) Protest against partition of Bengal

> ***(a)*** Non-Cooperation Movement gave a call for renunciation of all voluntary associations with the British Government.The Non-Cooperation Movement was a political campaign launched on 4th September, 1920. by Mahatma Gandhi to have Indians revoke their cooperation from the British Government, with the aim of inducing the British to grant self-governance and full independence (Purna Swaraj) to India.

63. Which of the following statements is/are correct with respect to Time Zone in India?

1. There is one standard time for the whole country.
2. Andaman and Nicobar Islands and Lakshadweep Islands have different Time Zones.
3. Indian Standard Time (lST) is five and half hours behind GMT.

Select the correct answer using the codes given below.

(a) Only 1 (b) Only 2
(c) 1 and 2 (d) 1 and 3

> ***(a)*** Statement 1 is correct. India uses only one time zone (even though it spans across two geographical time zones) across the whole nation and all its territories, called Indian Standard Time (IST), which equates to GMT+05:30, five and half hours ahead of Greenwhich mean time.

64. D had recently visited Khardung La, Nubra Valley and several Buddhist monasteries. Which one of the following States / UT had she visited?

(a) Himachal Pradesh(b) Uttarakhand
(c) Sikkim (d) Ladakh

> ***(d)*** Khardung La, Nubra Valley and several Buddhist monasteries are situated in Ladakh. Ladakh is most famous for breathtaking landscapes, the crystal clear skies, the highest mountain passes, thrilling adventure activities, Buddhist monasteries and festivals.

65. Which one of the following states receives rainfall from both the Arabian Sea branch and the Bay of Bengal branch of Monsoon ?

(a) Punjab (b) Maharashtra
(c) Meghalaya (d) Tamil Nadu

> ***(d)*** Tamil Nadu experiences two major periods of rainfall: The South-West Monsoon (Arabian sea branch) in Tamil Nadu starts in June and lasts till September.
> The North-East Monsoon (Bay of Bengal Branch) in Tamil Nadu begins in October and goes on till December.

66. Inceptisols, Entisols, Vertisols and Mollisols are orders of which one of the following?

(a) Sugarcane (b) Soil
(c) Coal (d) Copper

> ***(b)*** Inceptisols, Entisols, Vertisols and Mollisols are orders of Soil. Soil Taxonomy places soils into one of 12 categories known as 'orders.' Each of these orders represents a grouping of soils with distinct characteristics and ecological significance.The 12 soil orders are Entisols, Inceptisols, Andisols, Mollisols, Alfisols, Spodosols, Ultisols, Oxisols, Gelisols, Histosols, Aridisols and Vertisols.

67. S had witnessed contour bunding and contour ploughing while visiting one of the states in India. Identify the state from the options given below.

(a) Punjab (b) Haryana
(c) Himachal Pradesh
(d) Rajasthan

> ***(c)*** Contour bunding or contour farming or Contour ploughing is the farming practice of plowing and/or planting across a slope following its elevation contour lines.Such type of farming practice is prevalent in hIlly regions. Out of four options, Himachal Pradesh is the states S witnessed such farming practice.

68. Which one of the following target groups is the beneficiary of 'Garib Kalyan Rojgar Abhiyan' scheme?

(a) All rural women
(b) All returning migrants
(c) All below poverty line households
(d) All new migrants to town

> ***(b)***The Government of India launched the Garib Kalyan Rojgar Abhiyaan initiative to tackle the impact of COVID-19 on shramik workers (All returning migrants) in India. It is a rural public works scheme which was launched on 20th June, 2020 with an initial funding of ₹ 50,000 crore.

69. Match List I with List II and select the correct using the codes given below the lists.

	List I (curve)		List II (Indication)
A.	Lorenz curve	1.	Inflation and employment
B.	Phillips curve	2.	Tax rates and tax revenue
C.	Engel curve	3.	Inequality in distribution of income or wealth
D.	Laffer curve	4.	Income and proportion of expenditure on food

Codes

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	2	1	4	3
(c)	3	1	4	2	(d)	2	4	1	3

> ***(c)*** The correct matching is A-3,B-1,C-4,D-2.
> The Lorenz Curve (the actual distribution of income curve), a graphical distribution of wealth developed by Max Lorenz in 1906, shows the proportion of income earned by any given percentage of the population.
> The Phillips curve is an economic concept developed by A. W. Phillips. He stated that inflation and unemployment have a stable and inverse relationship.
> Engel curves relate the quantity of good consumed to income. If the good is a normal good, the Engel curve is upward sloping. If the good is an inferior good, the Engel curve is downward sloping.
> The Laffer curve illustrates a theoretical relationship between rates of taxation and the resulting levels of the government's tax revenue.

70. Which one of the following is a typical example of monopolistic competition?
(a) Retail vegetable markets
(b) Market for soaps
(c) Indian Railways
(d) Labour market for software engineers

(b) Market for soaps is a typical example of monopolistic competition Monopolistic competition is a type of imperfect competition such that there are many producers competing against each other, but selling products that are differentiated from one another and hence are not perfect substitutes.

71. Following the Constitution (One Hundred Arid First Amendment) Act, 2016, the Parliament of India enacted quite a few GST Acts in the year 2017. Which one of the following does not fall in this category?
(a) The Central Goods and Services Tax Act
(b) The Integrated Goods and Services Tax Act
(c) The Goods and Services Tax (Compensation to States) Acts
(d) The State Goods and Services Tax Act

(c) The Constitution (One Hundred and First Amendment) Act, 2016, amendment introduced a national Goods and Services Tax (GST) in India from 1st July, 2017. It replaces all Indirect taxes levied on goods and services by the Indian Central and State Governments.

Goods and Service Tax (GST) is levied on the supply of goods and services. Goods and Services Tax Law in India is a comprehensive, multi-stage, destination-based tax that is levied on every value addition. GST is a single domestic indirect tax law for the entire country.

72. Which one of the following is not correct in respect of Directorate of Enforcement ?
(a) It is a specialised financial investigation agency under the Department of Revenue, Ministry of Finance.
(b) It enforces the Foreign Exchange Management Act, 1999.
(c) It enforces the Prevention of Money Laundering Act, 2002.
(d) It enforces the Prohibition of Benami Property Transaction Act, 1988.

(d) The Directorate of Enforcement is a law enforcement agency and economic intelligence agency responsible for enforcing economic laws and fighting economic crime in India. It is part of the Department of Revenue, Ministry of Finance, Government Of India.The prime objective of the Enforcement Directorate is the enforcement of two key Acts of the Government of India namely, the Foreign Exchange Management Act, 1999 (FEMA) and the Prevention of Money Laundering Act, 2002 (PMLA).

73. Which one of the following is not correct?
(a) Taxes on agricultural income is a subject under the State List.
(b) Price control is a subject under the Concurrent List.
(c) Insurance does not come under the Union List.
(d) 'Forests' is a subject under the Concurrent List.

(b) Price controls are restrictions set in place and enforced by governments, on the prices that can be charged for goods and services in a market.In India, the government first enacted price control in 2013 for the Drug Price Control order.This order gave local regulatory body and the Pharmaceutical Pricing Authority the power to set ceiling prices on the National List of Essential medicines. It comes under the Union List.

74. Which one of the following statements is not correct about the nature of India's federal system?
(a) There is no equality of representation of states in the Council of States.
(b) Sikkim was not initially included in the Union as a full-fledged state.
(c) Special provisions have been laid down in the Constitution of India for Andhra Pradesh under Article 371 D.
(d) The Constitution of India enables the federal government to acquire the strength of a unitary system during emergencies.

(d)A national emergency modifies the federal system of government to a unitary one by granting Parliament the power to make laws on the 66 subjects of the State List (which contains subjects on which the state governments can make laws). Also, all state money bills are referred to the Parliament for its approval.

75. The Constitution of India guarantees freedom of speech and expression. But the freedom is subject to certain reasonable restrictions imposed by the state. These restrictions may relate to which of the following?
1. Defamation
2. Decency or morality
3. Incitement to an offence

Select the correct answer using the codes given below.
(a) Only 1 (b) 2 and 3
(c) 1 and 3
(d) 1, 2 and 3

(d) All statements 1,2 and 3 are correct.The right to freedom of speech and expression is not absolute and has been reasonably restricted by the Constitution of India under Article 19(2). The grounds for imposing these restrictions are:Sovereignty and Integrity of India, Security of the State, to maintain friendly relations with foreign states, decency and morality, defamation and contempt of court.

76. Which one of the following amendments in the Constitution of India made a Proclamation of Emergency immune from judicial review?
(a) 39th Amendment
(b) 40th Amendment
(c) 42nd Amendment
(d) 44th Amendment

(*) The Thirty-eighth (38th) Amendment of the Constitution of India, officially known as The Constitution Act, 1975, made the declaration of ''The Emergency'' final and conclusive. In particular it codified and enlarged the State's power to remove fundamental rights from its citizens during states of emergency.

77. Which one of the following British officials was elevated to the position of Governor General after the Regulating Act of 1773 ?
(a) Warren Hastings
(b) Lord North
(c) Mountstuart Elphinstone
(d) Philip Francis

(a) Among the given options, Governor General Warren Hastings was elevated to the aforementioned position after the Regulating Act of 1773. It limited his power by making

the Governor-General one member of a five-man Supreme Council. He was the first Governor of the Presidency of Fort William (Bengal), the head of the Supreme Council of Bengal and so the first de facto Governor-General of Bengal in 1772–1785.

78. Which of the following ideas was preached by the Kherwar or Sapha Har Movement of the 1870s?

(a) Acceptance of. the Hindu pantheonic order
(b) Monotheism and internal social reform
(c) Philosophy of Yoga and Mimansa
(d) Polytheism

(b) Monotheism and internal social reform was preached by Sapha Har movement. Kherwar Movement was started apparently in 1868. It is also known as Sapha Har Movement. This movement had popularised the concept of One God as well as aimed at social reform.This movement initially taught Monotheism and Internal social reform and but before its suppression it took the form of campaign against revenue endowment.

79. In which one of the following years was the Poona Sarvajanik Sabha established

(a) 1884 (b) 1876 (c) 1869 (d) 1870

(d) Poona Sarvajanik Sabha, was established in 1870 at Pune by MG Ranade in 1870.Poona Sarvajanik Sabha, was a sociopolitical organisation in British India which started with the aim of working as a mediating body between the government and people of India and to popularise the peasants' legal rights.

80. Which one of the following was an important Pandya port, celebrated for its pearls in Sangam Poems and Greek Accounts?

(a) Muchiri
(b) Korkai
(c) Puhar
(d) Arikamedu

(b) Korkai was popularly known for its pearl fishery and has a long history to cherish finding its name in Tamil sangam literatures and also noted as 'Colchis' in Periplus of the Erythrean Sea which is a maritime traders' guide belong to the mid-first century and 'Kolkhoi' by Ptolemy who visited the Southern peninsula in the second century.

81. Refraction of light, as it enters from one transparent medium to another, is due to

(a) change in temperature of the media
(b) change in the amplitude of light
(c) change in speed of light
(d) internal property of light

(c) Light refracts whenever it travels at an angle into a substance with a different refractive index (optical density). This change of direction is caused by a change in speed.When light travels from air into water, it slows down, causing it to change direction slightly. This change of direction is called refraction.

82. A bus starting from a bus-stand and moving with uniform acceleration attains a speed of 20 km/h in 10 minutes. What is its acceleration ?

(a) 200 km/h^2 (b) 120 km/h^2
(c) 100 km/h^2 (d) 240 km/h^2

(b) Acceleration is the rate of change of the velocity of an object with respect to time. Accelerations are vector quantities.
Change in velocity = (final velocity – initial velocity) $v - v_0 = 20 - 0 = 20$km/h
Time (t) = 10min = 10/60 h
Now, Acceleration

$$= \frac{\text{Change in velocity}}{\text{time}}$$

$$= \frac{20}{\frac{10}{60}} = 120\ \text{km/h}^2$$

83. Which one of the following is the correct reactivity order of metals reacting with dilute HCl?

(a) Mg >Al > Zn > Fe
(b) Mg< Al < Zn < Fe
(c) Mg > Zn > Fe > Al
(d) Fe> Mg> Al> Zn

(a) Those metals which are above in the reactivity series displace hydrogen from dilute acids as nitrogen monoxide,dinitrogen monoxide. The arrangement of metals in decreasing order of their reactivities is called reactivity series or activity series of metals. This is a decreasing order of chemical reactivity.Thus, correct sequence is Mg>Al>Zn>Fe.

84. Which one of the following acids is secreted by leaves of Nettle that causes painful stings ?

(a) Methanoic acid (b) Citric acid
(c) Tartaric acid (d) Acetic acid

(a) Leaves of the nettle plant secrete methanoic acid which causes a painful sting on touching.Nettle stings contain formic acid, histamine and other chemicals. Formic acid is also known as methanoic acid (HCOOH).

85. Which of the following statements is/are correct ?

1. All the bases are alkali.
2. All alkalis dissolve in water.
3. Alkalis are soapy-to-touch, bitter in taste and corrosive in nature .

Select the correct using the codes given below.

(a) Only 1
(b) 1 and 3
(c) 2 and 3
(d) Only 3

(c) Statement 2 and 3 are correct. Alkali is a base.It is a base that dissolves in water which is very important to remember.Not all bases are alkali but all alkali is base.Bases that dissolve in water are alkali.Alkalis are soapy to touch as they react with oils of our skin to form soaps.Compounds that have an alkaline pH, such as baking soda, often have a bitter flavor.Alkalis are very corrosive in nature and penetrate deeply.

86. Which one of the following materials is present in a guard tube (drying tube) that is used for preparation of HCl gas?

(a) Calcium chloride
(b) Calcium bromide
(c) Calcium iodide
(d) Calcium fluoride

(a) During the preparation of hydrogen chloride gas on a humid day, the gas is usually passed through the guard tube containing anhydrous calcium chloride. The role of anhydrous calcium chloride taken in the guard tube is to absorb moisture from the gas,moisten the gas and absorb moisture the gas.

87. Fertilizers are used to obtain higher yields of crops. However, all nutrients are usually not available in fertilizers. Which one of the following nutrients is usually not available in fertilizers?

(a) Iron
(b) Potassium
(c) Nitrogen
(d) Phosphorus

> ***(a)*** Most fertilizers that are commonly used in agriculture contain the three basic plant nutrients: nitrogen, phosphorus and potassium.Iron is a micronutrient for plant growth which is not available in fertilizers. Iron helps the plant move oxygen throughout the roots, leaves and other parts of the plant, producing the green colour that lets you know your plant is healthy. Many plants also rely on iron to complete the enzyme functions that keep the plant thriving.

88. Rupa and Sachin observed an animal in their school garden. Rupa called it an insect while Sachin identified it as an earthworm. Which one of the following characteristics confirms that it is an insect?

(a) The animal had jointed legs.
(b) Body of the animal had very little segmentation.
(c) Body of the animal was cylindrical.
(d) Body of the animal was bilaterally symmetrical,

> ***(a)*** Insects have segmented bodies, which are divided into head, thotax and abdomen, three pairs of jointed legs and external skeletons (exoskeletons) made up of chitin.The word 'arthropod' refers to all invertebrates with jointed legs. Arthropods also have a hard exoskeleton, like you might see on a crab or on a beetle.

89. Animals which are marine, bilaterally symmetrical, have a coelom and a notochord, but never form a vertebral column are placed under which one of the following groups?

(a) Chordata (b) Protochordata
(c) Vertebrata (d) Mammalia

> ***(a)*** Animals in the phylum Chordata share five key chacteristics that appear at some stage during their development: a notochord, a dorsal hollow (tubular) nerve cord, pharyngeal gill arches or slits, a post-anal tail and an endostyle/thyroid gland.

90. What is the location of intercalary meristem in plants?

(a) Base of the leaves or internodes
(b) Stems or roots
(c) Tips of stems and leaves
(d) Base of flower pedicel

> ***(a)*** Intercalary Meristems are located at the internodes or the base of the leaves. The intercalary meristems help in increasing the length of the internode of stem. This is usually seen in monocotyledonous plants.

91. The federation of which one of the following states has been described as' an indestructible union of indestructible states'?

(a) India (b) U.S.A.
(c) Canada (d) Australia

> ***(b)*** The US Constitution, in all its provisions, looks to an 'indestructible union composed of indestructible states' while on the other hand India is a 'indestructible union of destructible state'. In USA,States cannot be altered in terms of its size,name unlike in India where states are destructible provided in the Article 3 of the Indian Constitution.

92. Who among the following is the author of the famous essay, 'The End of History and the Last Man'?

(a) Francis Fukuyama (b) Daniel Bell
(c) Abraham Lincoln
(d) Anthony Giddens

> ***(a)*** The End of History and the Last Man is a 1992 book of political philosophy by American political scientist Francis Fukuyama which argues that with the ascendancy of Western liberal democracy after the end of cold war and after the fall of Soviet Union in 1991, mankind has reached the end of history.

93. Which one of the following statements is not correct ?

(a) Allahabad High Court has a Bench at Lucknow.
(b) Madhya Pradesh High Court has a Bench at Gwalior.
(c) Rajasthan High Court is located at Jodhpur.
(d) Guwahati High Court has no Bench.

> ***(d)*** Guwahati High Court has the largest number of Benches. The principal seat of the Guwahati High Court is at Guwahati in Assam.Apart from the Principal Seat, the High Court has 3 (three) outlying Benches, viz, Kohima Bench for the State of Nagaland (1972), Aizawl Bench for the State of Mizoram (1990) and Itanagar Bench for the State of Arunachal Pradesh (2000).

94. Which among the following is not a condition for the disqualification of a Member of Parliament?

(a) Voluntary acquisition of citizenship of a foreign country
(b) Holding the office of the Chairperson of the National Commission for Women
(c) The member abstains from voting in the House without prior permission
(d) The Member holds the office of the Chairman of the Board of Directors of the National Coal Development Corporation Ltd

> ***(c)*** Following are the disqualification grounds of a Member of Parliament. The Constitution of India has provided (in Article 102) that a member of Parliament will be disqualified for membership if:
> - He holds any office of profit under the Union or State Government (except that of a minister or any other office exempted by Parliament).
> - He is of unsound mind and stands so declared by a court.
> - He is an undischarged insolvent.
> - He has ceased to be a citizen of India.
> - He is disqualified under any other law by parliament.

95. Who among the following considered the Directive Principles of State Policy as aiming at 'furthering the goals of social inclusion' ?

(a) B.N. Rau (b) Granville Austin
(c) K.C. Wheare
(d) Rajni Kothari

> ***(b)*** Granville Austin considered Directive principles of state policy as aiming at furthering the goals of social inclusion. He was of the view that core of the commitment to the social revolution lies in Part III and IV, in the Fundamental Rights and in the Directive Principles of State Policy. These are conscience of the Constitution.

96. D performs her train journey by the shortest route from Bengaluru to New Delhi. Which one of the following rivers will she not cross while performing the journey?

(a) Narmada (b) Yamuna
(c) Godavari (d) Krishna

> ***(a)*** While traveiling from Bengaluru to New Delhi, D will not cross Narmada River. The Narmada, the largest West flowing river of the Peninsula, rises near Amarkantak range of mountains in Madhya Pradesh. Yamuna , Godavari and Krishna River will be encountered while travelling through states of Karnataka (krishna),Maharashtra (Godavari), Gujarat, Rajasthan,Uttar Pradesh(Yamuna) and New Delhi.

97. Identify the State on the basis of the following characteristics.

1. Tropic of Cancer passes through the state.
2. The state has more North-South extension.
3. The state has international border with Bangladesh and Myanmar.

Select the correct using the codes given below:

(a) Tripura
(b) Mizoram
(c) Nagaland
(d) Manipur

› ***(b)*** Mizoram is a state in North-Eastern India, with Aizawl as its seat of government and capital city.Aizawl-Lunglei road, is now identified as the exact location where the Tropic of Cancer passes in Mizoram. The length of the state from North to South is 277 km. At the broadest from East to West, it is 121 km.Thus, Mizoram has more North-South extension.Mizoram shares a 722-kilometre border with the neighbouring countries of Bangladesh and Myanmar.

98. M wants to visit a place in a Union Territory, which is located at 34° N and 77° E. Which one of the following Union Territories must he have planned to visit?

(a) Andaman and Nicobar Islands
(b) Lakshadweep
(c) Puducherry
(d) Ladakh

› ***(b)*** M must have planned to visit Lakshadweep. The latitude of Ladakh, Jammu and Kashmir, India is 34.209515 degree N and the longitude is 77.615112 degree E.

99. Consider the following statements with respect to the adolescent population (age group of 10 to 19 years) of India, according to the 2011 Census.

1. Adolescent population comprises half the population of the country.
2. The group is regarded as youthful population with high potential.
3. In this group there are greater number of females than males.

Which of the statements given above is/are correct?

(a) Only 1
(b) Only 2
(c) 1 and 2
(d) 2 and 3

› ***(b)*** Statement 2 is correct. India has the largest population of adolescents in the world being home to 243 million individuals aged 10-19 years and is regarded as a youthful population with high potential.Since 1971 the proportion of adolescent population has remained around 21 per cent proportion of youth population increased steadily from 16.5 per cent in 1971 to 19.2 per cent in 2011.

100. In a discussion, M from Arunachal Pradesh, J from Assam, N from Meghalaya and S from Nagaland are claiming that as per Census 2011, their state has the maximum density of population. Identify the person making the correct claim.

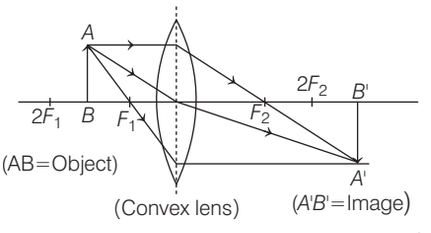
(a) M (b) J
(c) N (d) S

› ***(b)*** Assam ranks first among all the states of North-East India in terms of density of population in the region with 397 person per sq. km followed by Tripura (350 person per sq. km), Meghalaya(132 person per sq. km), Manipur (122 person per sq. km), Nagaland (119 person per sq. km), Mizoram (51 person per sq. km) and Arunachal Pradesh (16 person per sq. Km) according to census year 2011.

101. Where should an object be placed in front of a convex lens to get a real and enlarged image of the object?

(a) At twice the focal length
(b) At infinity
(c) Between the principal focus and twice the focal length
(d) Beyond twice the focal length

› ***(c)*** To form an inverted and enlarged image by a convex lens, the object should be placed between F and 2F in front of the lens i.e. Between the principal focus and twice the focal length.



102. The magnetic field lines inside a current carrying long solenoid are in the form of

(a) ellipse
(b) parabola
(c) hyperbola
(d) parallel straight lines

› ***(d)*** One end of the solenoid behaves as a magnetic North pole, while the other behaves as the South pole. The field lines inside the solenoid are in the form of parallel straight lines. This indicates that the magnetic field is the same at all points inside the solenoid. That is, the field is uniform inside the solenoid.

103. A ray of light travelling from a rarer medium to a denser medium

(a) slows down and bends away from, the normal.
(b) slows down and bends towards the normal.
(c) speeds up and bends away from the normal.
(d) speeds up and bends towards the normal.

› ***(b)*** When a ray of light enters from a rarer to denser medium,light bends towards the normal and slows down. Since the speed of light changes as it enters from a rarer to denser medium the frequency of light does not change but its wavelength changes.

104. An electric circuit is consisting of a cell, an ammeter and a nichrome wire of length l. If the length of the wire is reduced to half (l/2), then the ammeter reading

(a) decreases to one half
(b) gets doubled
(c) decreases to one-third
(d) remains unchanged

› ***(b)*** According to the Ohm's Law $V = IR$.

but $R = \rho\frac{l}{A} \Rightarrow R \propto l \Rightarrow R \propto \frac{l}{A}$

Hence, the resistance of the wire is directly proportional to the length of the wire.

In the first cast, $R_1 = KL_1$

In second case $R_2 = \frac{KL_1}{2}$

$\therefore \quad R_2 = \frac{R_1}{2}$

105. What is the effect of pressure of a human body on sand?

(a) Larger while standing than while lying.
(b) Smaller while standing than while lying.
(c) Same while standing or lying.
(d) Larger while standing during the daytime and smaller during the night time while lying.

› ***(a)*** The effect of pressure of a human body on sand is larger while standing than while lying because the pressure exerted on a surface by an object increases as the weight of the object

increases or the surface area of contact decreases. Alternatively the pressure exerted decreases as the weight of the object decreases or the surface area of contact increases.

106. An athlete completes one round of a circular track of diameter 100 m in 20 s. What will be the displacements after 1 minute and 10 s, respectively?

(a) 0 m, 50 m (b) 300 m, 100 m
(c) 300 m , 50 m (d) 0 m, 100 m

› ***(a)*** Displacement = Final position – initial position = change in position. After 1 minutes i.e. 60 sec, Displacement will be 0 m as change in position will be 0 m because athlete will be at the Initial position.
After 10 s , Displacement will be 50 m (50 - 0) is the change on position of the athlete.

107. Which of the following statements about universal indicator is/are true?

1. It is a mixture of several indicators.
2. It shows different colours at different concentrations of hydrogen ions in solution.
3. It helps to determine the strength of given acid and base in titration.

Select the correct using the codes given below.

(a) Only 1 (b) 1 and 2
(c) 2 and 3 (d) 1,2 and 3

› ***(d)*** Statements 1,2 and 3 are correct. A universal indicator is a pH indicator made of a solution of several compounds that exhibits several smooth colour changes over a wide range pH values to indicate the acidity or alkalinity of solutions.The main components of a universal indicator, in the form of a solution, are thymol blue, methyl red, bromothymol blue and phenolphthalein. This mixture is important because each component loses or gains protons depending upon the acidity or alkalinity of the solution being tested.

108. Which of the following carbon allotropes is/are good conductor(s) of electricity?

1. Diamond
2. Graphite
3. Fullerene

Select the correct using the codes given below.

(a) Only 1 (b) 1 and 2
(c) Only 2 (d) 1 and 3

› ***(c)*** Graphite is a good conductor of electricity because in a graphite molecule, one valence electron of each carbon atom remains free. Due to the free electrons in its framework, graphite can perform electricity. Therefore, graphite is said to be a good conductor of electricity.

109. What is the approximate percentage of carbon in the Earth's crust?

(a) 0·045% (b) 0'025%
(c) 0·015% (d) 0·005%

› ***(b)*** Although widely distributed in nature, carbon is not particularly plentiful as it makes up only about 0.025 per cent of Earth's crust yet it forms more compounds than all the other elements combined.Carbon is a chemical element with the symbol C and atomic number is 6. It is non-metallic and tetravalent element. It is having 4 electrons available for covalent chemical bonds. It belongs to group 14 of the periodic table.

110. When copper reacts with moist carbon dioxide (CO_2) in air, it forms a green coating of which one of the following compounds?

(a) Cupric carbonate
(b) Cuprous oxide
(c) Cupric oxide
(d) Copper sulphate

› ***(a)*** Cupric carbonate, $Cu_2(OH)_2CO_3$, is formed when copper(Cu) reacts with moist carbon dioxide (CO_2) in air.Cupric Carbonate is used as a pigment in products, paints and varnishes.Copper carbonate is used in artist paints to obtain desired colours for which it is also known with different names such as verditer and mountain green.Copper carbonate is highly demanded in fireworks and pottery glazes as pigment and colorant.

111. What is the name of the process that converts sulphide ores into oxides by heating strongly in the presence of excess air?

(a) Calcination
(b) Roasting·
(c) Smelting
(d) Incineration

› ***(b)*** Roasting is a process of heating a sulfide ore to a high temperature in the presence of air. It is a step in the processing of certain deres.This process is generally applied to sulfide minerals. During roasting, the sulfide is converted to an oxide and sulfur is released as sulfur dioxide, a gas.

112. What are the constituents of alloy solder?

(a) Pb and Zn
(b) Pb and Sn
(c) Pb and Si
(d) Pb and Co

› ***(b)*** The composition of solder alloy is 50 per cent lead (Pb) and 50 per cent tin (Sn).It has a very low melting point that is quite less than its constituting metals (Pb and Sn). Thus, solder is widely used in soldering and welding of electrical wires.

113. Which of the following limits the number of trophic levels in a food chain ?

(a) Deficient food supply
(b) Polluted air
(c) Decrease in the available energy at higher trophic levels
(d) Parasitic organisms

› ***(c)*** Energy in the form of food decreases as it moves up trophic levels in food chain because 90% energy is lost as metabolic heat on each trophic level as organisms from one trophic level are consumed by organisms from the next level. Trophic Level Transfer Efficiency (TLTE) measures the amount of energy that is transferred between trophic levels.Thus, decrease in the available energy at higher trophic levels limits the number of trophic levels in a food chain available.

114. In pea, a pure tall plant (TT) is crossed with a short plant (tt). What will be the ratio of pure tall plants to short plants in the F_2 generation?

(a) 1:1 (b) 1:3
(c) 3:1 (d) 2:1

› ***(a)*** The ratio of pure tall plants to pure short plants in F_2 generation will be 1:1 because according to the mechanism of inheritance, when a pure homozygous tall plant and short plant crossed together, the resulting offsprings of F_1 generation are all tall.In the F_2 generation, the tall and dwarf plants will be produced in 3 : 1 ratio. Out of the three tall plants, one tall plant will be homozygous tall (TT) and two tall plants will be heterozygous tall (Tt).

115. Which one of the following statements about variations is not true?

(a) Variation is minimum in asexual reproduction.
(b) All variations in a species have equal chances of survival.

(c) Changes in genetic constitution result in variation.
(d) Variants can be selected by environmental factors.

(b) All variations in a species will not have equal chance of survival as according to 'Survival of the fittest', only the species with adaptable variation which can adapt themselves to the environment can survive. Selection of the variants occurs by the different environmental factors harmful. Variations that are not suitable or advantageous to the organism in the prevailing environmental conditions are not maintained.

116. While studying vegetation of an area, terms like 'population' and 'community' are often used. Which one of the following statements best describes a population ?

(a) A group of organisms of one species, living in the same area at the same time.
(b) A group of organisms of one species living in different areas during different seasons.
(c) A unit consisting of biotic and abiotic components.
(d) A group of organisms of more than one species, living in the same area at the same time.

(d)A population refers to a group of organisms of a species that interbreed and live in the same place at the same time. It is a group of one particular species in a particular place. with interacts of species level. Community is a group of all organism or species found in a particular area which interact with one-another through interspecific interactions. Community are named after local dominant vegetation type e.g. grassland community, forest community etc.

117. In the human body, blood flows through a process of double circulation. Which one of the following statements is true in this regard?

(a) Oxygenated blood reaches the left side of the heart from the lungs.
(b) Blood in the left side of the heart is poor in oxygen and is brought to the right side of the heart.
(c) Deoxygenated blood from the left side of the heart is brought to the lungs for oxygenation.
(d) Oxygenated blood from the right side of the heart is sent around the body.

(a) Double circulation is a process by which blood passes twice through the heart during one complete cycle.It is oxygenated in the lungs and comes back to the heart. From left side of heart oxygenated blood is distributed to all parts of the body. Hearts's right side collect deoxygenated blood and send it to lungs for oxygenation.

118. In which of the following groups of organisms, is food material broken down outside the body and absorbed ? .

(a) Yeast, mushroom, bread mould
(b) Mushroom, *Amoeba*, green plants
(c) *Caserta*, tapeworm, lice
(d) *Paramecium*, *Amoeba*, *Caserta*

(a) Organism like Mushroom, Yeast and Bread mould are saprophytic fungi They break down dead organic compounds outside the body and absorb the simpler digested nutrients particles. This is known as extracellular digestion.

119. A sound wave has a frequencuy of 4 kHz and wavelength 30 cm. How long will it take to travel 2.4 km?

(a) 2.0 s (b) 0.6 s
(c) 1.0 s (d) 8.0 s

(a) Velocity (v) = frequency (v) × wavelength (w)

$= 4000 \times 0.3$ m
$= 1200$ m/s
Distance given = 2400 m
Thus, Time (t) = $\frac{\text{Distance (d)}}{\text{Speed (v)}}$

= 2400 m/ 1200 s
= 2.0 seconds.

120. An electric bulb is connected to a 110 V generator. The current is 0.2 A. What is the power of the bulb?

(a) 0.22 W
(b) 2.2 W
(c) 22 W
(d) 220 W

C. Power = Voltage × Current
Voltage= 110 V
Current = 0.2 A
Thus, power = 110 × 0.2
= 22 watt

CDS

Combined Defence Service

SOLVED PAPER 2021 (I)

PAPER I Elementary Mathematics

1. If the number 413283P759387 is divisible by 13, then what is the value of P?

(a) 3 (b) 6
(c) 7 (d) 8

(d) Given, dividend
$= 413283P759387$
and divisor = 13
Let $N = n_1n_2n_3n_4n_5n_6n_7n_8n_9n_{10}n_{11}n_{12}n_{13}$
$\Rightarrow (n_{11}n_{12}n_{13}) - (n_8n_9n_{11}) + (n_5n_6n_7) - (n_2n_3n_4) + (n_1) = T$
If T is divisible by 13 then the whole number N will be divisible by 13.
$N = 4132\ 83P759\ 387$
Here, $T = 387 - 759 + 83P - 132 + 4$
$= 83P - 500$
At $P = 3$
$\Rightarrow T = 833 - 500 = 333$
333 is not divisible by 13.
At $P = 6$
$\Rightarrow T = 836 - 500 = 336$
336 is not divisible by 13.
At $P = 7 \Rightarrow T = 837 - 500 = 337$
337 is not divisible by 13.
At $P = 8$
$\Rightarrow T = 838 - 500 = 338$
$338 \div 13 = 26$.
Hence, the given number will be divisible by 13 when $P = 8$.

2. What is the remainder when $2^{1000000}$ is divided by 7?

(a) 1 (b) 2
(c) 4 (d) 6

(b) Given,
$2^{1000000}$ is divided by 7.
$2^{1000000} = 2^1 \times 2^{999999} = 2(2^3)^{333333}$
$= 2(8)^{333333}$ ...(i)
All the 8's will be divided by 7 which will give remainder as 1 for each $8 \div 7$. Then all the remainders will be multiplied and the result will be again divided by 7.
$\therefore 2^{1000000} = 2(8)^{333333}$
$2(8)^{333333}$ is divided by $7 = 2(1)^{333333}$ is divided by 7
$= 2 \times 1 \div 7$
$= 2 \div 7$
Hence, the remainder will be 2 when $2^{1000000}$ is divided by 7.

3. How many pairs of (x, y) can be chosen from the set $\{2, 3, 6, 8, 9\}$ such that $\frac{x}{y} + \frac{y}{x} = 2$, where $x \neq y$?

(a) Zero (b) One
(c) Two (d) Three

(a) Given set,
$(x, y) \in \{2, 3, 6, 8, 9\}$
$\frac{x}{y} + \frac{y}{x} = 2$, where $x \neq y$
$\Rightarrow \frac{x^2 + y^2}{y \cdot x} = 2$
$\Rightarrow x^2 + y^2 = 2xy$
$\Rightarrow x^2 + y^2 - 2xy = 0$
$\Rightarrow (x - y)^2 = 0$
$\Rightarrow x - y = 0$
$\Rightarrow x = y$
But it is given that $x \neq y$.
Hence, the required number of pairs will be zero.

4. Consider the pairs of prime numbers (m, n) between 50 and 100 such that $m - n = 6$. How many such pairs are there?

(a) 2 (b) 3 (c) 4 (d) 5

(d) Given,
(m, n) is a pair of prime numbers between 50 and 100 such that
$m - n = 6$.
Prime numbers between 50 and 100 are the following :
53, 59, 61, 67, 71, 73, 79, 83, 89, 97.
Since, $m - n = 6$
$\therefore$ Pairs will be (59, 53), (67, 61), (73, 67), (79, 73), (89, 83).
Hence, the required number of pairs are 5.

5. How many terms are there in the following product?

$(a_1 + a_2 + a_3)(b_1 + b_2 + b_3 + b_4)(c_1 + c_2 + c_3 + c_4 + c_5)$

(a) 15 (b) 30 (c) 45 (d) 60

(d) Given product,
$(a_1 + a_2 + a_3) \cdot (b_1 + b_2 + b_3 + b_4) \cdot (c_1 + c_2 + c_3 + c_4 + c_5)$
Number of terms in $(a_1 + a_2 + a_3) = 3$
Number of terms in
$(b_1 + b_2 + b_3 + b_4) = 4$
Number of terms in
$(c_1 + c_2 + c_3 + c_4 + c_5) = 5$
Since, all the terms are distinct.
Therefore, the total number of terms in the expansion
= Product of number of terms in each component.
$= 3 \times 4 \times 5 = 60$
Hence, option (d) is correct.

6. What is the remainder when $27^{27} - 15^{27}$ is divided by 6?

(a) 0 (b) 1 (c) 3 (d) 4

(a) Let $N = 27^{27} - 15^{27}$

$27^{27} = (21 + 6)^{27}$

$= {}^{27}C_0(21)^{27} + {}^{27}C_1(21)^{27}(6)^1 + \ldots + {}^{27}C_{27}(21)^0(6)^{27}$ ...(i)

$15^{27} = (21 - 6)^{27} = {}^{27}C_0(21)^{27} - {}^{27}C_1(21)^{26}(6)^1 + \ldots - {}^{27}C_{27}(21)^0(6)^{27}$ ...(ii)

Subtracting Eq. (i) from Eq. (ii), we get

$27^{27} - 15^{27}$

$= 2[{}^{27}C_1(21)^{26}(6)^1 + {}^{27}C_3(21)^{24}(6)^3 + \ldots + {}^{27}C_{27}(21)^0(6)^{27}]$ ...(iii)

In Eq. (iii), we can see that all the terms contains 6.

Therefore, when Eq. (iii) is divided by 6 i.e., $27^{27} - 15^{27}$ is divided by 6, the remainder will be zero.

Hence, the remainder is zero.

7. If $a + b + c = 0$, then which of the following are correct?

1. $a^3 + b^3 + c^3 = 3abc$
2. $a^2 + b^2 + c^2 = -2(ab + bc + ca)$
3. $a^3 + b^3 + c^3 = -3ab(a + b)$

Select the correct answer using the code given below.

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

(d) Given, $a + b + c = 0$ ...(i)

1. $a^3 + b^3 + c^3 = 3abc$

We know that,

$a^3 + b^3 + c^3 - 3abc$

$= (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$

$\Rightarrow a^3 + b^3 + c^3 - 3abc = 0$ [from Eq. (i)]

$\Rightarrow a^3 + b^3 + c^3 = 3abc$ ...(ii)

2. $a^2 + b^2 + c^2 = -2(ab + bc + ca)$

We know that,

$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

$\Rightarrow 0 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$ [from Eq. (i)]

$\Rightarrow a^2 + b^2 + c^2 = -2(ab + bc + ca)$

3. $a + b + c = 0$

$\Rightarrow a + b + = -c$

$\Rightarrow a^3 + b^3 + 3ab(a + b) = -c^3$

$\Rightarrow a^3 + b^3 + c^3 = -3ab(a + b)$

Hence, 1, 2 and 3 are correct.

8. If $p = \dfrac{\sqrt{3q+2} + \sqrt{3q-2}}{\sqrt{3q+2} - \sqrt{3q-2}}$, then what is the value of $p^2 - 3pq + 2$?

(a) 0 (b) 1 (c) 2 (d) 3

(b) Given,

$p = \dfrac{\sqrt{3q+2} + \sqrt{3q-2}}{\sqrt{3q+2} - \sqrt{3q-2}}$

$\Rightarrow p = \dfrac{(\sqrt{3q+2} + \sqrt{3q-2})}{(\sqrt{3q+2} - \sqrt{3q-2})} \times \dfrac{(\sqrt{3q+2} + \sqrt{3q-2})}{(\sqrt{3q+2} + \sqrt{3q-2})}$

$\Rightarrow p = \dfrac{(\sqrt{3q+2} + \sqrt{3q-2})^2}{(\sqrt{3q+2})^2 - (\sqrt{3q-2})^2}$

$[\because (a - b)(a + b) = a^2 - b^2]$

$\Rightarrow p = \dfrac{3q + 2 + 3q - 2 + 2\sqrt{3q+2}\sqrt{3q-2}}{3q + 2 - (3q - 2)}$

$[\because (a + b)^2 = a^2 + b^2 + 2ab]$

$\Rightarrow p = \dfrac{6q + 2\sqrt{(3q)^2 - (2)^2}}{3q + 2 - 3q + 2}$

$\Rightarrow p = \dfrac{6q + 2\sqrt{9q^2 - 4}}{4}$

$\Rightarrow p = \dfrac{3q + \sqrt{9q^2 - 4}}{2}$

$\Rightarrow 2p - 3q = \sqrt{9q^2 - 4}$

$\Rightarrow 4p^2 + 9q^2 - 12pq = 9q^2 - 4$

$\Rightarrow 4p^2 - 12pq = -4$

$\Rightarrow p^2 - 3pq = -1$

$\Rightarrow p^2 - 3pq + 2 = -1 + 2 = 1$

Hence, $p^2 - 3pq + 2 = 1$

9. What is the unit digit in the expansion of 67^{32}?

(a) 1 (b) 3 (c) 7 (d) 9

(a) Given term is 67^{32}.

Unit digit of $(67)^{32}$ = Unit digit of $(7)^{32}$ = unit digit of $(7^4)^8$

Now, $7^1 = 7$, $7^2 = 49$

$7^3 = 343$, $7^4 = 2401$

Unit digit of 7^4 is 1.

So, the unit digit of $(7^4)^8$ is 1.

Hence, the unit digit in the expansion of $(67)^{32}$ is 1.

10. What is the value of x, if $\dfrac{b + \sqrt{b^2 - 2bx}}{b - \sqrt{b^2 - 2bx}} = a$?

(a) $\dfrac{ab}{(a+b)}$ (b) $\dfrac{2ab}{(a+1)}$
(c) $\dfrac{2ab}{(a+1)^2}$ (d) $\dfrac{ab}{(a+b)^2}$

(c) Given,

$\dfrac{b + \sqrt{b^2 - 2bx}}{b - \sqrt{b^2 - 2bx}} = a$

$\Rightarrow \dfrac{b + \sqrt{b^2 - 2bx}}{b - \sqrt{b^2 - 2bx}} = \dfrac{a}{1}$

Using componendo-dividendo rule,

$\Rightarrow \dfrac{(b + \sqrt{b^2 - 2bx}) + (b - \sqrt{b^2 - 2bx})}{(b + \sqrt{b^2 - 2bx}) - (b - \sqrt{b^2 - 2bx})} = \dfrac{a+1}{a-1}$

$\Rightarrow \dfrac{2b}{2\sqrt{b^2 - 2bx}} = \dfrac{a+1}{a-1}$

$\Rightarrow 2b(a - 1) = (a + 1) \cdot 2\sqrt{b^2 - 2bx}$

$\Rightarrow b(a - 1) = (a + 1)\sqrt{b^2 - 2bx}$

$\Rightarrow \dfrac{b(a-1)}{(a+1)} = \sqrt{b^2 - 2bx}$

$\Rightarrow \dfrac{b^2(a-1)^2}{(a+1)^2} = b^2 - 2bx$

$\Rightarrow \dfrac{b(a-1)^2}{(a+1)^2} = b - 2x$

$\Rightarrow 2x = b - \dfrac{b(a-1)^2}{(a+1)^2}$

$\Rightarrow 2x = \dfrac{b(a+1)^2 - b(a-1)^2}{(a+1)^2}$

$\Rightarrow 2x = \dfrac{b[a^2 + 1 + 2a - (a^2 + 1 - 2a)]}{(a+1)^2}$

$\Rightarrow 2x = \dfrac{b[4a]}{(a+1)^2}$

$\Rightarrow x = \dfrac{2ab}{(a+1)^2}$

11. The expression $\dfrac{(x^3 - 1)(x^2 - 9x + 14)}{(x^2 + x + 1)(x^2 - 8x + 7)}$ simplifies to

(a) $(x - 1)$ (b) $(x - 2)$
(c) $(x - 7)$ (d) $(x + 2)$

(b) Given expression,

$\dfrac{(x^3 - 1)(x^2 - 9x + 14)}{(x^2 + x + 1)(x^2 - 8x + 7)}$

We know,

$a^3 - b^3 = (a - b)(a^2 + b^2 + ab)$

$$= \frac{(x-1)(x^2 + 1^2 + x \cdot 1)}{(x^2 + x + 1)(x^2 - 7x - x + 7)}$$

$$= \frac{(x-1)(x^2 + x + 1)}{(x^2 + x + 1)} \frac{\{x(x-7) - 2(x-7)\}}{\{x(x-7) - 1(x-7)\}}$$

$$= \frac{(x-1)(x-7)(x-2)}{(x-7)(x-1)} = (x-2)$$

Hence, the given expression results is $(x - 2)$.

12. What should be added to $\frac{1}{(x-2)(x-4)}$ to get $\frac{2x-5}{(x^2-5x+6)(x-4)}$?

(a) $\frac{1}{(x^2 - 7x + 12)}$ (b) $\frac{1}{(x^2 + 7x + 12)}$

(c) $\frac{1}{(x^2 - 7x - 12)}$ (d) $\frac{1}{(x^2 + 7x - 12)}$

(a) Let a should be added to $\frac{1}{(x-2)(x-4)}$ to get

$$\frac{2x-5}{(x^2 - 5x + 6)(x-4)}$$

Therefore, $\frac{1}{(x-2)(x-4)} + a$

$$= \frac{2x-5}{(x^2 - 5x + 6)(x-4)}$$

$$\Rightarrow a = \frac{(2x-5)}{(x^2 - 5x + 6)(x-4)} - \frac{1}{(x-2)(x-4)}$$

$$\Rightarrow a = \frac{(2x-5)}{(x^2 - 3x - 2x + 6)(x-4)} - \frac{1}{(x-2)(x-4)}$$

$$\Rightarrow a = \frac{(2x-5)}{(x-3)(x-2)(x-4)} - \frac{1}{(x-2)(x-4)}$$

$$\Rightarrow a = \frac{(2x-5) - (x-3)}{(x-3)(x-2)(x-4)}$$

$$\Rightarrow a = \frac{2x - 5 - x + 3}{(x-3)(x-2)(x-4)}$$

$$= \frac{(x-2)}{(x-3)(x-2)(x-4)}$$

$$= \frac{1}{(x-3)(x-4)}$$

$$\Rightarrow a = \frac{1}{x^2 - 4x - 3x + 12}$$

$$= \frac{1}{x^2 - 7x + 12}$$

Hence, option (a) is correct.

13. If $\frac{x}{a} + \frac{y}{b} = a + b$ and $\frac{x}{a^2} + \frac{y}{b^2} = 2$, then what is $\frac{x}{a^2} - \frac{y}{b^2}$ equal to?

(a) – 2 (b) – 1

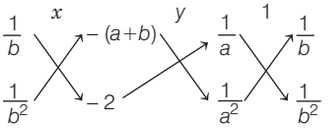
(c) 0 (d) 1

(c) The given equations are

$$\frac{1}{a}x + \frac{1}{b}y - (a + b) = 0$$

and $$\frac{1}{a^2}x + \frac{1}{b^2}y - 2 = 0$$

Using cross multiplication method, we get



$$\frac{x}{-\frac{2}{b} + \frac{(a+b)}{b^2}} = \frac{y}{-\frac{(a+b)}{a^2} + \frac{2}{a}} = \frac{1}{\frac{1}{ab^2} - \frac{1}{a^2 b}}$$

$$\Rightarrow \frac{x}{\frac{-2b + a + b}{b^2}} = \frac{y}{\frac{-a - b + 2a}{a^2}} = \frac{1}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow \frac{x}{\frac{a-b}{b^2}} = \frac{y}{\frac{a-b}{a^2}} = \frac{1}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow \frac{x}{\frac{a-b}{b^2}} = \frac{1}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow x = \frac{\frac{a-b}{b^2}}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow x = a^2$$

$$\Rightarrow \frac{y}{\frac{a-b}{a^2}} = \frac{1}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow y = \frac{\frac{a-b}{a^2}}{\frac{a-b}{a^2 b^2}}$$

$$\Rightarrow y = b^2$$

Now, $\frac{x}{a^2} - \frac{y}{b^2}$

$$= \frac{a^2}{a^2} - \frac{b^2}{b^2} = 1 - 1 = 0$$

14. If $(x - k)$ is the HCF of $x^2 + ax + b$ and $x^2 + cx + d$, then what is the value of k?

(a) $\frac{d-b}{c-a}$ (b) $\frac{d-b}{a-c}$

(c) $\frac{d+b}{c+a}$ (d) $\frac{d-b}{c+a}$

(b) Given, $(x - k)$ is HCF of $x^2 + ax + b$ and $x^2 + cx + d$.

Since, $(x - k)$ is the HCF.

Therefore, $(x - k)$ is a factor of $x^2 + ax + b$ and $x^2 + cx + d$.

Factor theorem states that $(x - p)$ is a factor of $f(x)$ only if $f(p) = 0$.

Using the fact that $x^2 + ax + b$ and $x^2 + cx + d$ have common factor $(x - k)$, we have

$k^2 + ak + b = 0$ …(i)

and $k^2 + ck + d = 0$ …(ii)

Using Eq. (i) – Eq. (ii), we get

$(a - c)k + (b - d) = 0$

$$\Rightarrow k = \frac{(d-b)}{(a-c)}$$

Hence, option (b) is correct.

15. Consider the following statements.

1. If x is directly proportional to z and y is directly proportional to z, then $(x^2 - y^2)$ is directly proportional to z^2.
2. If x is inversely proportional to z and y is inversely proportional to z, then (xy) is inversely proportional to z^2.

Which of the above statement(s) is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

(c) Given, statements :

1. $x \propto z$ and $y \propto z$

$\therefore x = k_1 z \Rightarrow x^2 = k_1^2 z^2$ …(i)

and $y = k_2 z \Rightarrow y^2 = k_2^2 z^2$ …(ii)

Here, k_1, k_2 are proportional constants.

Now, Eq. (i) – Eq. (ii), gives that,

$x^2 - y^2 = z^2(k_1^2 - k_2^2)$

$x^2 - y^2 = k_3 z^2$ [Let $k_3 = k_1^2 - k_2^2$]

$\therefore x^2 - y^2 \propto z^2$

2. $x \propto \frac{1}{z}$ and $y \propto \frac{1}{z}$

$\therefore \quad x = \frac{k_4}{z}$ …(iii)

and $y = \frac{k_5}{z}$ …(iv)

On multiplying Eq. (iii) and Eq. (iv), we get

$$x \cdot y = \frac{k_4}{z} \cdot \frac{k_5}{z}$$

$\Rightarrow x \cdot y = \frac{k_6}{z^2}$ [Let $k_6 = k_4 \cdot k_5$]

$\Rightarrow x \cdot y \propto \frac{1}{z^2}$

Hence, both the statements are correct.

16. What is the HCF of $x^3 - 19x + 30$ and $x^2 - 5x + 6$?

(a) $(x + 2)(x - 3)$ (b) $(x - 2)(x + 3)$
(c) $(x + 2)(x - 1)$ (d) $(x - 3)(x - 2)$

(d) Given function,

$f(x) = x^3 - 19x + 30$

and $g(x) = x^2 - 5x + 6$

$f(x) = x^3 - 19x + 30$

When, $x = 2$

$\Rightarrow \quad f(2) = 8 - 38 + 30 = 0$

Therefore, $(x - 2)$ is a factor of $f(x)$.

Using long division method,

$$\begin{array}{l} x-2\,)\,x^3 - 19x + 30\,(x^2 + 2x - 15 \\ \quad x^3 - 2x^2 \\ \quad - \quad + \\ \hline \quad\quad 2x^2 - 19x + 30 \\ \quad\quad 2x^2 - 4x \\ \quad\quad - \quad + \\ \hline \quad\quad\quad - 15x + 30 \\ \quad\quad\quad - 15x + 30 \\ \hline \quad\quad\quad\quad 0 \end{array}$$

$\therefore f(x) = (x - 2)(x^2 + 2x - 15)$

$f(x) = (x - 2)(x^2 + 5x - 3x - 15)$

$f(x) = (x - 2)(x + 5)(x - 3)$ …(i)

Now, $g(x) = x^2 - 5x + 6$

$g(x) = x^2 - 3x - 2x + 6$

$g(x) = (x - 3)(x - 2)$ …(ii)

From Eqs. (i) and (ii), we get

HCF of $f(x)$ and $g(x)$

$= (x - 3)(x - 2)$

Hence, option (d) is correct.

17. What is $\frac{8x}{1 - x^4} - \frac{4x}{x^2 + 1} + \frac{x + 1}{x - 1} - \frac{x - 1}{x + 1}$ equal to?

(a) 0 (b) 1 (c) 2 (d) 4

(a) Given expression,

$$\frac{8x}{1 - x^4} - \frac{4x}{x^2 + 1} + \frac{x + 1}{x - 1} - \frac{x - 1}{x + 1}$$

$$= \frac{8x}{1 - x^4} - \frac{4x}{x^2 + 1} + \frac{(x + 1)^2 - (x - 1)^2}{x^2 - 1}$$

$$= \frac{8x}{1 - x^4} - \frac{4x}{x^2 + 1} + \frac{4x}{x^2 - 1}$$

$[\because (a + b)^2 - (a - b)^2 = 4ab]$

$$= \frac{8x}{1 - x^4} - \frac{4x(x^2 - 1 - x^2 - 1)}{x^4 - 1}$$

$$= \frac{8x}{1 - x^4} + \frac{8x}{x^4 - 1}$$

$$= \frac{8x}{1 - x^4} - \frac{8x}{1 - x^4} = 0$$

Hence, option (a) is correct.

18. For what integral value of x is $\cfrac{12}{7 - \cfrac{6}{7 - \cfrac{3}{5 - x}}} = x$?

(a) 4 (b) 3 (c) 2 (d) 1

(c) Given,

$$\cfrac{12}{7 - \cfrac{6}{7 - \cfrac{3}{5 - x}}} = x$$

$$\Rightarrow \quad \cfrac{12}{7 - \cfrac{6}{\cfrac{7(5 - x) - 3}{(5 - x)}}} = x$$

$$\Rightarrow \quad \cfrac{12}{7 - \cfrac{6}{\cfrac{35 - 7x - 3}{(5 - x)}}} = x$$

$$\Rightarrow \quad \cfrac{12}{7 - \cfrac{6(5 - x)}{32 - 7x}} = x$$

$$\Rightarrow \quad \frac{12(32 - 7x)}{7(32 - 7x) - 6(5 - x)} = x$$

$$\Rightarrow \quad \frac{12(32 - 7x)}{224 - 49x - 30 + 6x} = x$$

$$\Rightarrow \quad \frac{384 - 84x}{194 - 43x} = x$$

$\Rightarrow \quad 384 - 84x = 194x - 43x^2$

$\Rightarrow \quad 43x^2 - 278x + 384 = 0$

$\Rightarrow 43x^2 - 86x - 192x + 384 = 0$

$\Rightarrow \quad 43x(x - 2) - 192(x - 2) = 0$

$\Rightarrow \quad (x - 2)(43x - 192) = 0$

$\because \quad x = 2 \quad \left[\because x \neq \frac{192}{43}\right]$

Hence, the value of x is 2.

19. If $x(x - 1)(x - 2)(x - 3) + 1 = k^2$, then which one of the following is a possible expression for k ?

(a) $x^2 - 3x + 1$
(b) $x^2 - 3x - 1$
(c) $x^2 + 3x - 1$
(d) $x^2 - 2x - 1$

(a) Given,

$x(x - 1)(x - 2)(x - 3) + 1 = k^2$ ...(i)

$\Rightarrow \quad x(x - 1)(x - 2)(x - 3) + 1 = k^2$

$\Rightarrow \quad (x^2 - x)(x^2 - 5x + 6) + 1 = k^2$

$\Rightarrow \quad x^4 - 5x^3 + 6x^2 - x^3 + 5x^2 - 6x + 1 = k^2$

$\Rightarrow \quad x^4 - 6x^3 + 11x^2 - 6x + 1 = k^2$

$\Rightarrow x^4 + 9x^2 + 1 - 6x^3 - 6x + 2x^2 = k^2$

$\Rightarrow \quad (x^2 - 3x + 1)^2 = k^2$

$[\because (a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca]$

$\therefore \quad k = x^2 - 3x + 1$

20. What is $\frac{1}{bc(a - b)(a - c)} + \frac{1}{ca(b - c)(b - a)} + \frac{1}{ab(c - a)(c - b)}$ equal to ?

(a) $a + b + c$ (b) 3
(c) $ab + bc + ca$ (d) 0

(d) Given expression,

$$\frac{1}{bc(a - b)(a - c)} + \frac{1}{ca(b - c)(b - a)} + \frac{1}{ab(c - a)(c - b)}$$

$$= \frac{1}{bc(a - b)(a - c)} - \frac{1}{ca(b - c)(a - b)} + \frac{1}{ab(a - c)(b - c)}$$

$$= \frac{a(b - c) - b(a - c) + c(a - b)}{abc(a - b)(b - c)(a - c)}$$

$$= \frac{ab - ac - ba + bc + ca - cb}{abc\,(a - b)(b - c)(a - c)}$$

$$= \frac{0}{abc(a - b)(b - c)(a - c)}$$

$= 0$

Hence, the given expression is equal to zero.

21. For how many real values of k is $6kx^2 + 12kx - 24x + 16$ a perfect square for every integer x ?

(a) Zero (b) One (c) Two (d) Four