2025

English Medium

AIIMS

B.Sc. Nursing (Hons.)

Solved Papers & Practice Book

Youth Competition Times

AIIMS

All India institute of medical science

B.Sc. NURSING

(Hons.)

Entrance Examination

PREVIOUS YEAR SOLVED PAPERS

SUBJECT	No. of Question	Marks	Duration
Chemistry	30	30	120 Minutes
Physics	30	30	
Biology	30	30	
General Knowledge	10	10	
Total Marks	100	100	

13 Sets

PRACTICE BOOK

Answers with Detail Explanation • Based on new exam pattern

CONTENT

Solved Paper

Practice Set

Scheme of Examination:

AIIMS Nursing Syllabus 2024: B.Sc. Nursing	
Subject	**Topics**
Physics	Communication Systems, Magnetic Effect of Current & Magnetism, Electronic Devices, Dual Nature of Matter, Alternating Current, Electromagnetic Induction, Electromagnetic Waves, Atoms and Nuclei, Optics, Current Electricity
Chemistry	Chemical Kinetics, Polymers, Biomolecules, General Principles & Processes of Isolation of Elements, P-Block Elements, D & F-Block Elements, Coordination Compounds, Organic Compounds containing Nitrogen, Electrochemistry, Solid State, Chemistry in Everyday, Solution, Surface Chemistry, Phenol & Esther, Ketones and Carboxylic Acids, Alcohols, etc.
Biology	The role of Plants in Human Welfare, Mineral Nutrition Essential, The Difference between Prokaryotic & Eukaryote, Structural Organization of Cell, Elements and their Function, Classification Binomial and Nominal Nomenclature, Five Kingdom Classification, Cell Theory, Mendel's Law of Inheritance, etc.
General Knowledge	History, Science, Geography, Culture, General Policy, Scientific research, Current affairs, etc.

All India Institute of Medical Science (AIIMS) 2024

B.Sc. (Hons) Nursing

(Solved Paper With Explanation)

Date-08/06/2024

1. If L = 15H, R = 20 Ω, V = 220 V and Q = 100 than find electric current :

(a) 0.11 A (b) 0.22 A

(c) 0.33 A (d) 0.44 A

Ans. (a) : Given the value,

Inductance (L) = 15 H

Resistance (R) = 20 Ω

Voltage (V) = 220 V

Q = 100

Electric current (I) = ?

As we know that,

$I = \frac{V}{Z},\ Z = \sqrt{(X_L)^2 + R^2}$ ..... (i)

$Q = \frac{wL}{R} \Rightarrow w = \frac{QR}{L}$

$X_L = w \times L$ ..... (ii)

Putting the value of w in equation (ii), we get

$X_L = \frac{QR}{L} \times L = QR$

$X_L = 100 \times 20 = 2000$

Putting the value of (X_L) and (R) in equation (i), we get

$Z = \sqrt{(2000)^2 + (20)^2} = \sqrt{4000000 + 400}$

$Z = \sqrt{4000400} = 2000.099 \square 2000$

$I = \frac{220}{2000} = 0.11A$

2. The wavelength of a wave in a medium is 0.5 meter. The phase difference between two points of this wave in this medium is π/5. The minimum distance between these two points is Kejil :

(a) 0.05 cm (b) 0.05 cm

(c) 0.06 cm (d) 0.06 cm

Ans. (b) : Given the value,

Wavelength (λ) = 0.5 m

Phase difference (ϕ) = π/5

Path difference (Δx) = ?

As we know that,

$\phi = \frac{2\pi}{\lambda}\Delta x$

$\Delta x = \frac{\phi \times \lambda}{2\pi} = \frac{\frac{\pi}{5} \times 0.5}{2 \times \pi} = \frac{\pi \times 0.5}{10 \times \pi}$

$\Delta x = 0.05\,m$

3. In a room where the temperature is 30^0C, an object cools from 61^0C to 59^0C in 4 minutes. The time taken (in minutes) for the object to cool from 51^0C to 49^0C will be :

(a) 2m (b) 4 m

(c) 6m (d) 8 m

Ans. (c) : Newton's law of cooling -

$$\frac{\Delta T}{\Delta t} = K(T_t - T_s)$$

Where,

T_t = average temperature, T_s = surrounding temperature

$T_t = \frac{T_1 + T_2}{2}$

$\frac{61-59}{4} = K\left(\frac{61+59}{2} - 30\right)$ ..... (i)

$\frac{51-49}{t} = K\left(\frac{51+49}{2} - 30\right)$ ..... (ii)

Divide equation (i) to (ii)

$\frac{\frac{61-59}{4}}{\frac{51-49}{t}} = \frac{K\left(\frac{61+59}{2} - 30\right)}{K\left(\frac{51+49}{2} - 30\right)}$

$\frac{t}{4} = \frac{60-30}{50-30}$

$t = 4 \times \frac{30}{20} = 6$ minutes

4. What is the elective potential of the earth?

(a) 0V (b) 1V

(c) 2V (d) ∞

Ans. (d) : If earthing is done correctly and the metallic part comes in contact with live wire, it will be discharged into the earth. In this condition due to zero potential of earth a large amount of current flows to the earth, if the current exceeds the limiting value of the fuse, it blows off or MCB trips and cuts off the application from supply.

5. SI unit of electric flux :

(a) $V \times m$ (b) $\frac{N}{C} \times m^2$

(c) (a) and (b) (d) None of these

Ans. (c) : Electric flux SI unit $\rightarrow V \times m = \frac{N}{C} \times m^2$

Dimensional formula of electric flux $\rightarrow [ML^3T^{-3}A^{-1}]$

6. 1 Tesla Gauss is equal to :

(a) 10^4 G (b) 10^3 G

(c) 10^2 G (d) 10 G

Ans. (a) : Gauss and Tesla the units of the magnetic field or magnetic flux density.

1 Tesla = 10^4 Gauss

1 Gauss = 10^{-4} Tesla

7. Dimension of magnetic field :

(a) $[M^0L^1T^{-1}A^{-2}]$ (b) $[M^1L^0T^{-2}A^{-1}]$

(c) $[M^2L^1T^0A^1]$ (d) $[M^1L^0T^{-1}A^{-2}]$

Ans. (b) : Magnetic filed (B) $= \frac{\text{Force}}{\text{Velocity} \times \text{Charge}}$

$$= \frac{\left[MLT^{-2}\right]}{\left[LT^{-1}\right](AT)} = \left[M^1L^0T^{-2}A^{-1}\right]$$

8. Value of ionization potential for hydrogen :

(a) 13.6 V (b) 12.6 V

(c) 18.6 V (d) 16.6 V

Ans. (a) : As we know that

$E = -\frac{13.6}{n^2} eV$

Ionization potential (V) =

$$\frac{w}{q} = \frac{13.6 \times 1.6 \times 10^{-19}}{1.6 \times 10^{-19}} = 13.6\,V$$

9. Match the item of column -I and column-II :

	Column -I		Column -II
P	Charles law	1	$P \propto \frac{1}{V}$
Q	Boyle's law	2	$P \propto T$
R	Gay-Lussac law	3	$V \propto n$
S	Avogadro law	4	$V \propto T$

(a) P-2, Q-1, R-4, S-3 (b) P-1, Q-2, R-3, S-4

(c) P-4, Q-3, R-2, S-1 (d) P-3, Q-4, R-1, S-2

Ans. (a) :

Charles law $\rightarrow$ $P \propto T$ (V = constant)

Boyle's law $\rightarrow$ $P \propto \frac{1}{V}$ (T = constant)

Gay-Lussac law $\rightarrow$ $V \propto T$ (P = constant)

Avogadro law $\rightarrow$ $V \propto n$

10. If $F = 3\hat{i} + C\hat{j} + 2\hat{k}$ and $x = -4\hat{i} + 2\hat{j} + 3\hat{k}$ then find the value of C. if work = 6J :

(a) 3 (b) 5

(c) 7 (d) 6

Ans. (d) : Given the value,

$F = 3\hat{i} + C\hat{j} + 2\hat{k}$

$X = -4\hat{i} + 2\hat{j} + 3\hat{k}$

W = 6 J

C = ?

$W = \vec{F}.\vec{x}$

$$w = \left(3\hat{i} + C\hat{j} + 2\hat{k}\right).\left(-4\hat{i} + 2\hat{j} + 3\hat{k}\right) \quad \therefore \begin{bmatrix} \hat{i}.\hat{i} = 1 \\ \hat{j}.\hat{j} = 1 \\ \hat{k}.\hat{k} = 1 \end{bmatrix}$$

$6 = -12 + 2C + 6$

$6 = -6 + 2C$

$2C = 12$

$C = \frac{12}{2} = 6$

11. Determine the magnetic field produced by the solenoid of length 80 cm when the number of turns of the coil is 360 and the current passing through is 15A :

(a) 8.5×10^{-4} N/Am (b) 18.5×10^{-4} N/Am

(c) 80.3×10^{-4} N/Am (d) 1.7×10^{-5} N/Am

Ans. (a) : Given the value,

length (l) = 80 cm = 0.8 m

Turns of the coil (N) = 360

Current (I) = 1.5 A

$(n) = \frac{N}{\ell} = 450$

As we know that,

Magnetic field (B) = $\mu_0 nI$

$B = 4\pi \times 10^{-7} \times 450 \times 15$

$B = 8.5 \times 10^{-4}$ N/Am

12. Relation between critical angle and wave length and light :

(a) $i_c \propto \lambda$ (b) $i_c \propto \frac{1}{\lambda}$

(c) $i_c \propto \lambda^2$ (d) $i_c \propto \frac{1}{\lambda^2}$

Ans. (a) : In optics, the angle of incidence to which the angle of refraction is 90^0 is called the critical angle. Wavelength (λ) is directly proportional to the critical angle (i_c)

$$i_c \propto \lambda$$

This means as wavelength increases, critical angle also increases.

13. Dimensional formula of angular momentum :

(a) $[M^1L^2T^{-1}]$ (b) $[M^2L^1T^2]$

(c) $[M^1L^{-2}T^{-1}]$ (d) $[M^0L^2T^{-1}]$

Ans. (a) : Angular momentum (L) = Moment of inertia (I) × Angular momentum (ω)

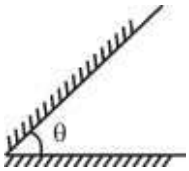
$$= r \times m \times v$$

Angular momentum of dimensional formula

$$= [L] \times [M] \times [LT^{-1}]$$

$$= [ML^2T^{-1}]$$

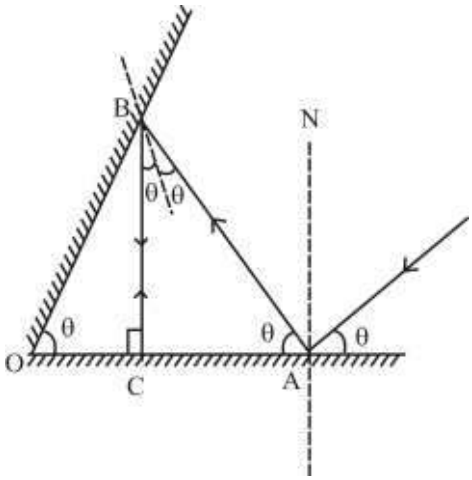
14. Two mirrors are inclined at an angle θ as shown in the figure. Light ray is incident parallel to one of the mirror, light will start retracing its path after third reflection if :



(a) $\theta = 45^0$ (b) $\theta = 30^0$

(c) $\theta = 60^0$ (d) All three

Ans. (b) : It is clear that for third reflection the ray must hit the mirror normaly.



In ΔOBC, $\angle OBC = 90^0 - \theta$

$\therefore \angle CBN = \theta$

Now in $\Delta ABC \Rightarrow \theta + \theta + \theta + 90^0 = 180^0$

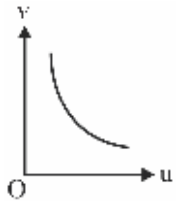
$$3\theta + 90^0 = 180^0$$

$$3\theta + 90^0$$

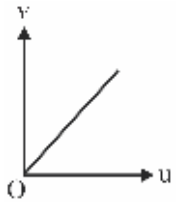
$$\theta = 30^0$$

15. Select a graph between 'V' and 'u' for a concave mirror :

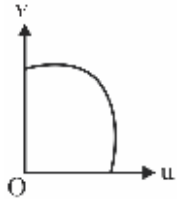
(a)



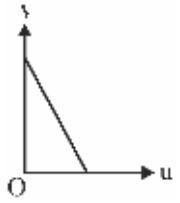
(b)



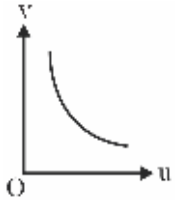
(c)



(d)



Ans. (a) : Concave mirror for virtual objects the object distance is +ve and the corresponding image formed will be real (image distance will be –ve)



$$\boxed{\frac{1}{f} = \frac{1}{v} + \frac{1}{u}}$$

16. The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to :

(a) accommodation (b) presbyopia

(c) far-sightedness (d) near-sightedness

Ans. (a) : The ability of the eye lens to adjust its focal length is called accommodation to accommodate literally means to adjust or adopt to some one or something, the eye also adjust or accommodates its lens to see objects at different distance clearly.

17. The least distance of distinct vision for a young adult with normal vision is about :

(a) 25 m (b) 2.5 cm

(c) 25 cm (d) 2.5 m

Ans. (c) : The minimum distance, at which objects can be seen most distinctly without strain, is called the least distance of distinct vision, the least distance of district, vision for a young adult with normal vision is about 25 cm.

18. The Lenz's law is the consequence of the conservation of :

(a) Charge

(b) Momentum

(c) Energy

(d) Charge and energy both

Ans. (c) : The lenz law induces the concept of conservation of energy in faraday law. According to the faraday law, the change in magnetic flux causes electric current. Lenz law states that the induced current always tends to oppose the cause which produce it.

19. Dimensional formula of linear charge density is-

(a) $[M^0L^{-1}T^1A^1]$ (b) $[M^1T^0L^{-1}]$

(c) $[M^1T^2L^{-1}]$ (d) $[T^1A^2L^2]$

Ans. (b) : Dimensional formula of linear charge density is $[M^1L^{-1}T^0]$.

Linear charge density (λ) is the quantity of charge per unit length measured in coulombs per meter c/m, at any point on a line charge distribution.

20. If L = 15 H, R = 20 Ω, V = 220 V and Q = 100 then find electronic current.

(a) 1.11 A (b) 2.11 A

(c) 0.11 A (d) 0.51 A

Ans. (c) : Given, L = 15 H, V = 220 V,

$R = 20\ \Omega,\ Q = 100$

The quality factor Q is defined as :

$$Q = \frac{wL}{R}$$

$$w = \frac{QR}{L}$$

$$= \frac{100 \times 20}{15}$$

$$= \frac{2000}{15}$$

$$w = \frac{400}{3}\text{rad/sec}$$

Now, $Z = \sqrt{R^2 + (wL)^2}$

$$= \sqrt{20^2 + 2000^2}$$

$$= \sqrt{400 + 4000000}$$

$$= \sqrt{4000400}$$

$$\approx 2000\,\Omega$$

Now, $I = \frac{V}{Z}$

$$= \frac{220}{2000}$$

$$\boxed{I = 0.11\,A}$$

21. The wavelength of a wave in a medium is 0.5 meter. The phase difference between two points of this wall in this medium is $\frac{\pi}{5}$. The minimum distance between these two points is-

(a) 5 m (b) 0.05 m

(c) 50 m (d) 550 m

Ans. (b) : Given, $\lambda = 0.5$ m

$$\phi = \frac{\pi}{5}$$

Relation between phase difference and path difference is –

$$\Delta\phi = \frac{2\pi}{\lambda}\Delta x$$

$$\Delta x = \frac{\pi}{5} \times \frac{0.5}{2\pi}$$

$$\Delta x = \frac{0.1}{2}$$

$$\boxed{\Delta x = 0.05\,m}$$

22. Arrange the following increasing order of acidic strength ?

(a) O-methyl phenol < ethanol < phenol < o-nitrophenol

(b) ethanol < 0-methylphenol < 0-nitrophenol< bhenol

(c) ethanol < 0-methyl phenol < phenol < 0-nitrophenol

(d) phenol < ethanol <0-methyl phenol < 0-nitrophenol

Ans. (c) : Then increasing order of acidic strength are ethanol < 0 - methylphenol < phenol < 0-nitrophenol

Acidic strength is the measure of the ability of the acid to lose its H^+ ion.

23. Number of atoms in FCC unit cell?

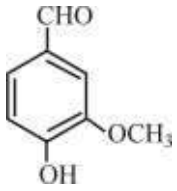
(a) 2 (b) 1

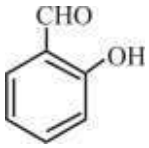
(c) 4 (d) 6

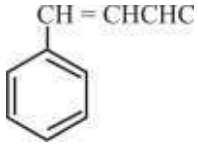
Ans. (c) : Number of atom in FCC (Face centered cubic unit cell has 4 atoms.

In FCC unit cell, these are B atoms at the corners and 6 atoms at face centres

24. Structure of valine are-

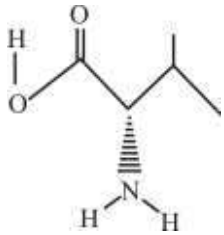
(a) 

(b) 

(c) 

(d) 

Ans. (d) : The structure of valine are-



Valine is a branched-chain essential amino acid. It is found in mainly in protein food sources such as meats, dairy, soy and fish.

25. Diamagnetic configuration are-

(a) $[Co(C_2O_4)]^{3-}$

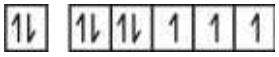
(b) $[Mn(CN)_6]^{3-}$

(c) $[Cr(CN)_6]^{3-}$

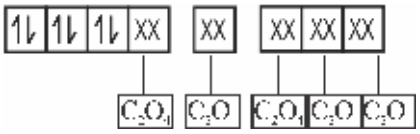
(d) All of the above

Ans. (a) : $[Co(C_2O_4)]^{3-}$

$_{27}Co \rightarrow |Ar| 4s^2\ 3d^7$



$Co^{+3} \rightarrow |Ar| 3d^6$

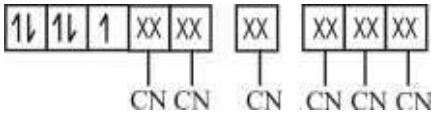


C_2O_4 is act as SFL so it has pairing So it has all paired electron since it is diamagnetic.

$[Mn(CN)_6]^{4-}$

$_{25}Mn = |Ar| 4s^2.3d^5$

$Mn^{+2} = |Ar| 4s.3d^4$



In Mn one unpaired electron are present so it is paramagnetic.

$[Cr(CN)_6]^{3-}$

$_{24}Cr = |Ar| 4s^1.3d^5$

$|Cr^{+3}| = d^3$

It has one unpaired electron so it is paramagnetic.

26. Select the correct Geometry (shape)

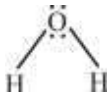
(a) $H_2O \longrightarrow$ Linear

(b) $SO_2 \longrightarrow$ Square planer

(c) $CH_4 \longrightarrow$ Octahedral

(d) $NH_4^+ \longrightarrow$ Tetrahedral

Ans. (d) : $H_2O \rightarrow sp^3$ hybridization it has tetrahedral geometry and bent shape.



$SO_2 \rightarrow sp^2$ hybridization occur, it has trigonal geometry and bent shape.

$CH_4 \rightarrow sp^3$ hybridization occurs it has tetrahedral geometer and shape is also tetrahedral.

$NH_4^+ \rightarrow sp^3$ hybridization occurs it is tetrahedral geometry.

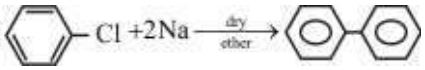
27. Which is conjugate acid?

(a) NH_4^+ (b) NH_2^-

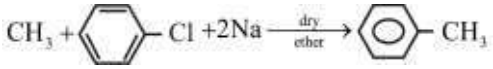
(c) OH^- (d) None of these

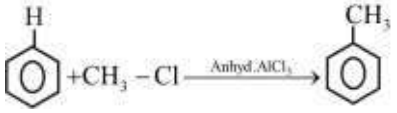
Ans. (c) : In acid-base chemistry, the hydroxide ion (OH^-) acts as a base. Its conjugate acid, formed when it accepts a proton (H^+), is water (H_2O).

28. Fitting reaction are -

(a) 

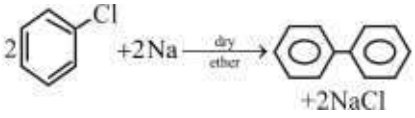
(b)



(c) 

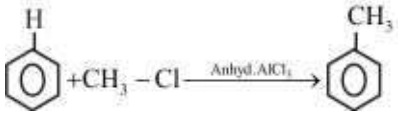
(d) b and c both

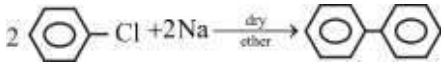
Ans. (a) : Fitting reaction are -

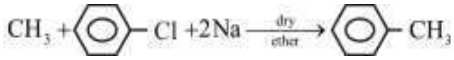


In fitting reaction, two aryl halides are coupled in presence of sodium metal in dry ether or tetra-hydrofurosis to furnish signals compounds. It is named after the German Chemist Wilhelm Rudolph fitting who discovered it in 1860.

29. Friedel craft reaction are shown by-

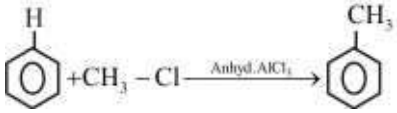
(a) 

(b) 

(c) 

(d) All of the above

Ans. (a) : Fridel Crafts reaction are shown by-



A Fridel crafts reaction is an organic coupling reaction involving an electrophilic aromatic substitution that is used for substituents to aromatic rings.

30. 15 g ethanal mix with 95g acetone find the molality?

(a) 5.6 (b) 3.4

(c) 4.8 (d) 6.9

Ans. (b) : Ethanol mix with 95 g acetone the molality will be 3.43.

$$\text{Molality (M)} = \frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$$

$$= \frac{15/46}{95/1000}$$

$$\frac{15\times1000}{46\times95} = 3.43 \text{ w/kg}$$

31. Which is covalent solid?

(a) CCl_4 (b) SiO_2

(c) MgO (d) NaCl

Ans. (b) : SiO_2 is a covalent solid. Covalent solids is also called network solids, are solids that are held together by covalent bonds. SiO_2 is an oxide of silicon with a chemical name silicon dioxide which is widely found in nature as quartz.

32. Ore of zinc is-

(a) Calamine (b) Malachite

(c) Chalcopyrite (d) Calaverite

Ans. (a) : Ore of zinc is calamine. Zinc ore is most commonly found as zinc carbonate ($ZnCO_3$), known as calamine or smithsonate.

It is a form of zinc sulfide is the most heavily mined zinc-containing ore because its concentrate contains 60-62% zinc.

33. In which compounds are not semiconductor?

(a) Cds (b) GaAs

(c) CdSl (d) H_2S

Ans. (c) : In CdSl compounds are not semi-conductor.

Semiconductors are materials which have a conductivity between conductors (generally metals) and non-conductions or insulators.

34. Mn electronic configuration is-

(a) $Mn_{25} = [Ar]_{18}\ 3d^5\ 4S^2$

(b) $Mn_{25} = [Ar]_{18}\ 3d^4\ 4S^2$

(c) $Mn_{25} = [Ar]_{18}\ 3d^2\ 4S^2$

(d) None of the above

Ans. (a) : Mn electronic configuration is

Mn 25 = $[Ar]_{18}\ 3d^5 4S^2$

The electron configuration of an element describes how electrons are distributed in its atomic orbital's.

Every neutral atom consists of a fixed number of electrons which is equal to the number of protons and is called the atomic number.

35. Zero dipole moment are -

(a) Bf_3 (b) H_2O

(c) NH_3 (d) All of the above

Ans. (d) : Zero dipole moment are Bf_3, H_2O, NH_3 and CO_2.

Zero dipole moment is the dipole moment between two atoms being zero. It depends on the polarities of individual bonds and the geometry of the atoms. The dipole bonds are equal in magnitude but opposition in nature.

36. $H_2O_2 + KMnO_4 \xrightarrow[\text{Medium}]{\text{Alkaline}}$?

(a) $KMnO_2 + O_2$

(b) $MnO_2 + KOH$

(c) $MnO_2 + KOH + 2O_2$

(d) $MnO_2 + KOH + O_2$

Ans. (b) : $H_2O_2 + KMnO_4 \xrightarrow[\text{Medium}]{\text{Alkaline}} MnO_2 + KOH$

When hydrogen peroxide reacts with potassium permagnate in alkaline medium then, the potassium moves from potassium permagnate and combines with hydroxide and manganese oxide is left.

37. Petroleum obtained from crude oil in which process are-

(a) Fractional distillation
(b) Osmosis
(c) chromatography
(d) all of the above

Ans. (a) : Fractional distillation is the process by which petroleum obtained from crude oil.

So, obtaining petrol, kerosene and diesel from crude oil.

38. Plants show different types of leaf shapes and sizes due to the influence of the environment-

(a) Plasticity (b) Degeneration
(c) Redifferention (d) Defferention

Ans. (a) : Plasticity refers to plant's ability to adjust their leaf shapes and sizes in response to environmental factors like light and water availability, optimizing their growth and adaptation.

39. Which factor is not responsible for biodiversity loss?

(a) Invasion of Alien species
(b) Over exploitation
(c) Habitats loss and fragmentation
(d) Biodiversity reserve deforestation

Ans. (d) : "Biodiversity reserve deforestation" is not a factor responsible for biodiversity loss; instead, it describes the consequence of habitat destruction within protected areas intended to safe guard biodiversity.

40. Which of the following factor affect the activity of enzyme?

(a) Moisture (b) Temperature
(c) pH (d) pH and temperature

Ans. (d) : The activity of enzymes are influenced by pH and temperature. pH affects the enzyme's active site structure, while temperature impacts molecular motion and can cause denaturation, affecting enzyme activity and function.

41. Sliding theory states that-

(a) actin and myosin filaments shorten and slide past each other.
(b) when myofilaments slide past each other, shortening of actin filaments occurs.
(c) when myofilaments slide past each other, shortening of myosin filaments occur
(d) actin and myosin filaments do not shorten, they only slide past each other

Ans. (d) : Sliding theory states that actin and myosin filaments do not shorter they only slide past each other. Sliding theory is basically based on the 'I band', which is rich in thinner filaments made of actin, changed its length along with the sarcomere. The sliding filament theory of muscle contraction was given by A.F. Huxley and other scientists in 1954.

42. Hibernation is related to sleep same as marathan is related to -

(a) Sleep (b) Race
(c) Read (d) Walk

Ans. (b) : Just as hibernation is related to sleep, marathan is related to race.

Hence, option (b) is correct.

43. Space between two germ layer ?
(Three germ layer and mesoderm line space)

(a) Coelom (b) pseudocoelom
(c) acoelom (d) Non of three

Ans. (a) : Space between two germ layer (Three germ layer and mesodown line space) is called coelom.

44. Taxonomy is-

(a) Identification (b) Nomenclature
(c) Classification (d) All of above

Ans. (d) : Taxonomy is the science of naming and classifying organisms and includes all plants, animals and microorganisms. It include characterization, identification, classification and nomenclature.

45. Amniocentesis is-

(a) chromosomal abnormlity
(b) Juandice
(c) Haemophilia
(d) a and b both

Ans. (a) : Amniocentesis diagnoses chromosomal abnormalities like down syndrome. It involves extracting amniotic fluid for genetic analysis. It does not diagnose jaundice or hemophillia.

46. Enzyme that helps in clot dissolution :

(a) Cyclosporine (b) Pectinase
(c) Streptokinase (d) Protease

Ans. (c) : Streptokinase, a bacterial enzyme, dissolves blood clots by converting plasminogen, which breaks down fibrin, the main component of clots, aiding in the treatment of clot-related conditions.

47. Balanoglossus is a member of which phylum?

(a) Arthropoda (b) Mollusca
(c) Coelenterata (d) Hemichordata

Ans. (d) : Balanoglossus belongs to the Phylum Hemichordata, characterized by marine acorn worms. They exhibit a tripartite body plan with a proboscis, collar and trunk, showing affinities with both chordates and echinoderms.

48. Which relationship does Lichen show?

(a) Commensalism (b) Parasitism

(c) Mutualism (d) Amensalism

Ans. (c) : Lichen demonstrates a mutualistic symbiotic relationship where a fungus provides structure and protection, while an alga or cyanobacterium conducts photosynthesis, yielding nutrients beneficial to both partners.

49. What has the least similarly?

(a) Species (b) Phylum

(c) Family (d) Genus

Ans. (b) : Among species, genus, family and phylum, the phylum has the least similarly because it represents a higher taxonomic level encompassing broader groups of organisms, whereas the others are progressively more specific categories.

50. In 100 ml deoxygenated blood carries ____ ml of CO_2 to the alveoli.

(a) 4 ml (b) 5 ml

(c) 15 ml (d) 20 ml

Ans. (a) : In deoxygenated blood, approximately 4 ml of CO_2 is carried to the alveoli per 100 ml of blood. This CO_2 is transported in dissolved form, contributing to respiratory gas exchange.

51. Which component of blood is not related to blood coagulation?

(a) Plasma (b) Serum

(c) Fibrinogen (d) Thrombocyte

Ans. (b) : Serum, unlike plasma, lacks clotting factors like fibrinogen. It is blood plasma without proteins involved in coagulation, formed after clotting factors are utilized during blood clot formation.

52. Bt-toxin is activated in :

(a) Alkaline pH of Gut

(b) Acidic pH of Gut

(c) Neutral pH of Gut

(d) None of the above

Ans. (a) : Bt-toxin, produced by *Bacillus thuringiensis*, is activated in the alkaline pH of the gut. This triggers its toxicity specifically against insects that ingest it.

53. Which hormone maintains the endometrium?

(a) Estrogen (b) Progesterone

(c) Relaxin (d) Androgen

Ans. (b) : Progesterone maintains the endometrium by promoting its thickening and preparing it for implantation of a fertilized egg. The estrogen supports this process, while relaxin and androgen have different physiological functions.

54. Female heterogamety is -

(a) XX-XY (b) ZW-ZZ

(c) XX-XO (d) None of the above

Ans. (b) : Female heterogamety, exemplified by ZW-ZZ, involves females having two different sex chromosomes (ZW). This differs from the XX-XY system found in male heterogamety, where males have different sex chromosomes (XY).

55. Which of the following does not cause degradation of the cell wall?

(a) Lipase (b) Cellulase

(c) Lysozyme (d) Chitinase

Ans. (a) : Lipase is an enzyme that breaksdown lipids, not cell walls composed mainly of carbohydrates and proteins. Cell wall degradation involves enzymes like cellulases, lysozymes and proteases instead.

56. Which neuron have one dendrite and one axon?

(a) Multipolar (b) Unipolar

(c) Bipolar (d) Apolar

Ans. (c) : Bipolar neurons have one dendrite and one axon emerging from opposite ends of the cell body. This structure is characteristic of sensory neurons like those in the retina and olfactory epithelium.

57. Adenine derivative of-

(a) ABA (b) Auxin

(c) Cytokinin / kinetin (d) GA

Ans. (c) : Kinetin, a type of cytokinin plant hormone, is a derivative of adenine. This adenine-derived molecule plays a role in cell division and growth regulations in plants.

58. Which type of antibody are present in colostrum?

(a) IgG (b) IgM

(c) IgA (d) IgE

Ans. (c) : Colostrum contains IgA antibodies, which are crucial for immune defense at mucosal surfaces. These antibodies provide passive immunity to newborns, protecting them from infections early in life.

59. Which is not a product of light reaction?

(a) NADPH (b) H_2O

(c) O_2 (d) ATP

Ans. (b) : Water (H_2O) is consumed during the light reactions of photosynthesis to produce oxygen (O_2), ATP and NADPH.

Thus H_2O is not a product of light reactions.

60. The end product of Glycolysis is-

(a) PGA (b) Pyruvic acid

(c) Acetyl CoA (d) Citric acid

Ans. (b) : The end product of glycolysis is pyruvate. During glycolysis, one molecule of glucose is broken down into two molecues of pyruvate, along with the production of ATP and NADPH.

61. Heart Dub sound originated from ?

(a) Closer of tricuspid valve

(b) Closer of bicuspid valve

(c) Closer of semilunar valves

(d) Opening of semilunar valves

Ans. (c) : The 'dub' sound is indeed caused by the closing of the semilunar valves, which include the aortic and pulmonary valves.

This occurs at the end of ventricular systole, marking the beginning of diastole.

62. Sleep wake cycle is :

(a) Thymus

(b) Thyroid

(c) Adrenal

(d) Melatonin

Ans. (d) : Melatonin is a hormone primarily produced by the pineal gland in response to darkness. It helps regulate the sleep-wake cycle (circardian rhythm) by promoting sleepiness and maintaining the body's internal clock.

63. Match the following (Column-I with Column-II)

	Column-I (Microbes)		**Column-II (Organic acid)**
(A)	**Aspergillus niger**	**(I)**	**Butyric acid**
(B)	**Clostridium butalicum**	**(II)**	**Citric acid**
(C)	**Acetobacter aceti**	**(III)**	**Lactic acid**
(D)	**Lactobacillus**	**(IV)**	**Acetic acid**

(a) A-II, B-IV, C-III, D-I

(b) A-I, B-II, C-III, D-IV

(c) A-II, B-I, C-IV, D-III

(d) A-IV, B-III, C-II, D-I

Ans. (c) :

	Column-I (Microbes)		**Column-II (Organic acid)**
A.	Aspergillus niger	II.	Citric acid
B.	Clostridium butalicum	I.	Butyric acid
C.	Acetobacter aceti	IV.	Acetic acid
D.	Lactobacillus	III.	Lactic acid

64. Match the names of the scientists with their contributions and choose the correct answer.

	Column-I (Name of Scientist)		**Column-II (Contribution)**
A.	**Hershey and Chase**	**I.**	**PCR**
B.	**Karry Mullis**	**II.**	**DNA finger printing**
C.	**Messelson & Stahl**	**III.**	**DNA, genetic material**
D.	**Alec Jeffreys**	**IV.**	**Semi-conservative replication**

(a) A-III, B-I, C-IV, D-II

(b) A-I, B-III, C-II, D-IV

(c) A-IV, B-II, C-III, D-I

(d) A-I, B-II, C-III, D-IV

Ans. (a) :

	Column-I (Name of scientist)		**Column-II (Contribution)**
A.	Hershey and Chase	III.	Semi-conservative replication
B.	Karry Mullis	I.	DNA finger printing
C.	Messelson & Stahl	IV.	DNA genetic material
D.	Alec Jeffreys	II.	PCR

65. Tidal volume is-

(a) 2500-3000 ml (b) 500 ml

(c) 1100-1200 ml (d) 1000-1100 ml

Ans. (b) : Tidal volume (TV) is typically around 500 milliliters (ml) in healthy adults. This means that during normal breathing, a person inhales approximately 500 ml of air with each breath.

66. Albuminous seed -

(a) Barley (b) Maize

(c) Wheat (d) Groundnut

Ans. (d) : Groundnuts or peanuts are albuminous seeds rich in proteins and oils. They provide essential nutrients for germination and growth, making them valuable as a source of food and oil production.

67. Parallel venation is found in-

(a) Monocot (b) Dicot

(c) Both (d) None of the above

Ans. (a) : Parallel venation is found in monocots, in their leaves, where veins run parallel to each other from the base to the tip. Examples include grasses, lilies and orchids.

68. Example of Deuteromycetes are-

(a) Agaricus, Ustilago, Alternaria

(b) Aspergillus, Neurospara, Trichoderma

(c) Trichoderma, Alternaria, Colletotrichum

(d) Rhizopus, Albugo, Mucor

Ans. (c) : Deuteromycetes is a fungi, also known as *Fungi imperfecti*, include *Trichoderma, Alternaria and Colletotrichum*.

These fungi are characterized by their a sexual reproduction and the absence of a known sexual stage in their life cycle.

69. What is incorrect about trichome ?

(a) Unicellular

(b) Multicellular

(c) Present in stem

(d) Epidermal tissue system

Ans. (a) : In shoot system, trichomes are usually multicellular. They may be soft or stiff, branched or unbranched. It is present in epidermal tissue system.

70. What is not correct about rupturing of Graffin follicle hormone?

(a) Increase LH level

(b) Formation of corpus luteum

(c) Formation of secondary oocyte

(d) Formation of primary oocyte

Ans. (d) : The incorrect option about the rupture of Graffian follicle is the formation of primary oocyte. The primary oocyte develops earlier in the follicle's maturation process, whereas the rupture of the Graffin follide leads to the formation of a secondary oocyte.

71. Incorrect statement about metaphase stage :

(a) Spindle fibres are attached to small disc shaped structure at the surface of centromeres called kinetochores

(b) The plane of alignment of the homologous pair of chromosomes at metaphase is referred to as metaphasic plate

(c) Chromosomes appears to be made up of two sister chromotids

(d) The shape of chromosomes cannot be studied in this phase.

Ans. (d) : The incorrect statement about metaphase stage is (d) the shape of chromosome cannot be studied in this phase. Metaphase is when chromosomes are aligned at the metaphase plate and their shape, consisting of two sister chromatids, can indeed be observed clearly under a microscope.

72. Which types of bond are present in DNA?

(a) Carbon bond

(b) Phosphodiester bond

(c) Peptide bond

(d) None of the above

Ans. (b) : DNA contains phosphodiester bonds, which link the sugar of one nucleotide to the phosphate group of the next, forming the sugar-phosphate backbone. Peptide bonds are found in proteins, not DNA.

73. Sliding theory states that :

(a) Actin and myosin filaments shorten and slide past each other.

(b) When myofilaments slide past each other, shortening of actin filaments occur

(c) When myofilaments slide past each other, shortening of myosin filaments occur

(d) Actin and myosin filaments do not shorten, they only slide past each other

Ans. (d) : The sliding filament theory explains muscle contraction, where actin and myosin filaments slide past each other without shortening, causing the sarcomere to shorten and thus contracting the muscle.

74. Colourless plastid is-

(a) Chloroplast (b) Chromoplast

(c) Leucoplast (d) None of the above

Ans. (c) : Leucoplast are colorless plastids found in plant cells. They are responsible for storing starch, oils or proteins.

75. When did the Jallianwala Bagh Massacre take place?

(a) 12 April 1919 (b) 13 April 1919

(c) 12 April 1918 (d) 13 April 1918

Ans. (b) : The Jallianwala Bagh Massacre, also known as the massacre of Amritsar, was an incident that took place on April 13, 1919, that clay, British troops fired on a large crowd of unarmed Indians in an open space called the Jallianwala Bagh in Amritsar, in the Punjab region of India.

76. Which plane is known as giant planet?

(a) Venus (b) Mars

(c) Earth (d) Jupiter

Ans. (d) : Jupiter planet is known as giant planet a gas giant is a large planet mostly composed of helium and/or hydrogen, these planets, like Jupiter and Saturn in our solar system, don't have hard surface and instead have swirling gases above a solid core.

77. Tulip festival is celebrated in which state?

(a) Assam

(b) Jammu and Kashmir

(c) Bihar

(d) Punjab

Ans. (d) : Tulip festival is celebrated in which Jammu and Kashmir. Tulip festival is an annual celebration that aims to showcase the magic of tulips in the world famous tulip garden as part of tourism efforts by the government of Jammu and Kashmir. It is organized during the onset of spring session in Kashmir valley.

78. Who was the first Nobel Prize winner in India?

(a) Mahtma Gandhi ji

(b) Rabindra Nath Tagore

(c) C.V. Raman

(d) Kailash Satyarthi

Ans. (b) : The first Noble Prize winner in India was Rabindranath Tagore. He won the Nobel Prize in Literature in 1913 for his book of poems titled 'Gitanjali'.

79. Which is the largest lake in the world?

(a) Victoria lake (b) Caspian sea

(c) Dal lake (d) Chilka lake

Ans. (b) : The largest lake in the world by surface area is the Caspian sea. Its actually a saltwater lake, bordered by several countries including Russia, Iran and Kazakhstan.

80. A is mother of B and B is sister of Z, Z is father of D. What is relation between A and Z?

(a) A is mother Z

(b) Z is brother A

(c) A is father Z

(d) A is sister Z

Ans. (a) : A is mother of Z. This is inferred from the relationships given : A is mother of B, B is sister of Z, and Z is father of D, indicating A's maternal connection to Z.

81. The sequence 6, 12, 24, 48, 96, 288, 576, which one is wrong in sequence?

(a) 96 (b) 288

(c) 48 (d) 576

Ans. (b) : Given sequence,
6,12,24,48,96,288,576
Here,
$6 \times 2 \rightarrow 12$
$12 \times 2 \rightarrow 24$
$24 \times 2 \rightarrow 48$
$48 \times 2 \rightarrow 96$
$96 \times 2 \rightarrow 192$
$\therefore$ 288 is wrong in sequence.

82. Ravi bought a dozen books for 125 rupees and got a discount of 20% on it. So how many books will he buy for 75 rupees?

(a) 8 (b) 9

(c) 6 (d) 4

Ans. (b) : 12 books $\rightarrow$ 125 Rs,

$1 \text{ book} \rightarrow \frac{125}{12}$ Rs,

After a discount of 20%

$1 \text{ book} \rightarrow \frac{125}{120} \times 0.8 = \frac{25}{3}$ Rs.

$\frac{25}{3}$ Rs. $\rightarrow$ 1 Book

$1 \text{ Rs} \rightarrow \frac{1 \times 3}{25}$ Book

$75 \text{ Rs} \rightarrow \frac{1 \times 3}{25} \times 75 = 9$ Books

83. Aman bought 6000 grams of rice for 960 rupees. There was discount of 20% on that rice, what will be the price of rice per kg?

(a) 100 (b) 200

(c) 250 (d) 400

Ans. (b) : Let initial price of rice = x rupees
After 20% discount we have

$$x \times \frac{20}{100} = \frac{x}{5}$$

$$\Rightarrow \quad x - \frac{x}{5} = 960$$

$$\Rightarrow \quad \frac{4x}{5} = 960$$

$$\Rightarrow \quad x = 1200 \text{ rupees.}$$

$\because$ 6 kg $\rightarrow$ 1200 rupees.

$\therefore$ 1 kg $\rightarrow$ 200 rupees.

All India Institute of Medical Science (AIIMS) 2023

B.Sc. (Hons) Nursing

(Solved Paper With Explanation)

Date-12/06/2023

1. A body starts to fall freely under gravity. The distances covered by it in first, second and third second are in ration

(a) 1: 3: 5 (b) 1 : 2: 3

(c) 1: 4: 9 (d) 1: 5: 6

Ans. (a) : We know that,

Distance covered in n^{th} second,

$$s_{n^{th}} = u + \frac{1}{2}g(2n-1)$$

Where,

u = initial velocity of body

g = acceleration due to gravity

Distance covered in 1^{st} second,

$$s_1 = 0 + \frac{1}{2}g(2\times1-1) \qquad [\because u = 0]$$

$$s_1 = \frac{g}{2}$$

Distance covered in 2^{nd} second,

$$s_2 = 0 + \frac{1}{2}g(2\times2-1) \qquad [\because u = 0]$$

$$s_2 = \frac{3g}{2}$$

Distance covered in 3^{rd} second,

$$s_3 = 0 + \frac{1}{2}g(2\times3-1) \qquad [\because u = 0]$$

$$s_3 = \frac{5g}{2}$$

Now,

$$S_1 : S_2 : S_3 = \frac{g}{2} : \frac{3g}{2} : \frac{5g}{2}$$

$$= 1 : 3 : 5$$

Hence, the ratio of distance traveled by a body falling freely under gravity from rest in the first, second and third seconds of its fall is 1 : 3 : 5.

2. Two cars of mass m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that they make complete circles in the same time t. The ration of their centripetal acceleration is:

(a) $m_1r_1 : m_2r_2$ (b) $m_1 : m_2$

(c) $r_1 : r_2$ (d) 1 : 1

Ans. (c) : Let the velocities of the two care are v_1 and v_2 and the time taken to complete one circle is t for both cars.

Let centripetal acceleration of first car = a_1

Let centripetal acceleration of second car = a_2

Two cars of mass m_1 and m_2 are moving in circles of radii r_1 and r_2 respectively.

Distance traveled by first car = $2\pi r_1$

$$\therefore \text{Velocity of first car, } v_1 = \frac{2\pi r_1}{t}$$

Distance traveled by second car = $2\pi r_2$

$$\therefore \text{Velocity of second car, } v_2 = \frac{2\pi r_2}{t}$$

Now,

$$\text{Centripetal acceleration of first car, } a_1 = \frac{v_1^2}{r_1}$$

$$a_1 = \frac{\left(\frac{2\pi r_1}{t}\right)^2}{r_1}$$

$$a_1 = \frac{4\pi^2 r_1^2}{t^2 \times r_1}$$

$$a_1 = \frac{4\pi^2 r_1}{t^2}$$

$$\text{Centripetal acceleration of second car, } a_2 = \frac{v_2^2}{r_2}$$

$$a_2 = \frac{\left(\frac{2\pi r_2}{t}\right)^2}{r_2}$$

$$a_2 = \frac{4\pi^2 r_2^2}{t^2 \times r_2}$$

$$a_2 = \frac{4\pi^2 r_2}{t^2}$$

$$\therefore \text{ Ratio of their centripetal acceleration } = \frac{a_1}{a_2}$$

$$= \frac{\frac{4\pi^2 r_1}{t^2}}{\frac{4\pi^2 r_2}{t^2}}$$

$$= \frac{4\pi^2 r_1}{t^2} \times \frac{t^2}{4\pi^2 r_2} = \frac{r_1}{r_2} \text{ or } r_1 : r_2$$

3. A projectile is projected at 30° from horizontal with initial velocity 40 ms^{-1}. The velocity of the projectile at t = 2s from the start will be: (Given g = 10 m/s^2)

(a) $20\sqrt{3}\ ms^{-1}$

(b) $40\sqrt{3}\ ms^{-1}$

(c) $20\ ms^{-1}$

(d) zero

Ans. (a) : Given, Initial velocity of projection, u = 40 m/s^2

angle, $\theta = 30°$

Time of fight, $T = \frac{2u\sin\theta}{g} = \frac{2\times 40\times 1}{10\times 2} = 4s$ ($\because$ g = 10 m/s^2)

It means projectile is at maximum height at t = 2s. At maximum height vertical component of velocity is zero.

Velocity at t = 2s,

$v_x = u\cos\theta = 40\cos 30° = 20\sqrt{3} ms^{-1}$

4. A block A of mass 4 kg is placed on another block B of mass 5 kg, and the block B rests on a smooth horizontal table. If the minimum force that can be applied on A so that both the blocks move together is 12 N, the maximum force that can be applied to B for the blocks to move together will be

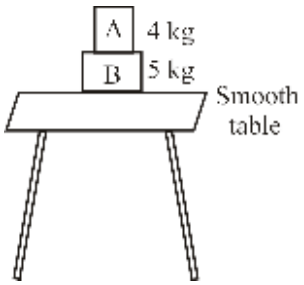
(a) 30 N (b) 25 N

(c) 27 N (d) 48 N

Ans. (c) : Minimum force on block A = frictional force between the surfaces = 12 N

Therefore maximum acceleration,

$a_{max} = \frac{12N}{4kg} = 3m/s^2$



Total mass = 4 + 5 = 9 kg

Hence maximum force, F_{max} = total mass × a_{max}

$F_{max} = 9\times 3 = 27$ N

5. A bullet of mass 'a' and velocity 'b' is fired into a large block of wood of mass 'c'. the bullet gets embedded into the block of wood. The final velocity of the system is

(a) $\frac{b}{a+b}\times c$ (b) $\frac{a+b}{c}\times a$

(c) $\frac{a}{a+c}\times b$ (d) $\frac{a+c}{a}\times b$

Ans. (c) : Given-

Mass of bullet = a

Mass of wood = c

Velocity of bullet = b

Initial momentum of the bullet = a×b = ab

Initial momentum of the wood = c×0 = 0

(Because the wood was at rest)

Final mass of the system (wood + bullet) = a + c

(Because bullet gets embedded into the block of wood)

Let the velocity of the system (wood + bullet) = v

We know that,

Initial momentum = Final momentum

Initial momentum of bullet + Initial momentum of the wood = Final momentum of the system (wood + bullet)

ab + 0 = (a + c) × v

ab = (a + c) × v

$\therefore\ v = \frac{ab}{a+c}$ or $\frac{a}{a+c}\times b$

6. The moment of inertia of a thin uniform rod of mass M and length L about an axis passing through its midpoint and perpendicular to its length is I_0. Its moment of inertia about an axis passing through one of its ends and perpendicular to its length is

(a) $I_0+ML^2/2$ (b) $I_0+ML^2/4$

(c) I_0+2ML^2 (d) I_0+ML^2

Ans. (b) : By theorem of parallel axes.

$I_{end} = I_{cm} + Md^2$

$I_{end} = I_0 + M(L/2)^2 = I_0 + ML^2/4$

7. A solid sphere is in rolling motion. In rolling motion a body possesses translational kinetic energy (K_t) as well as rotational kinetic energy (K_r) simultaneously. The ratio $K_t : (K_t + K_r)$ for the sphere is

(a) 7 : 10 (b) 5 : 7

(c) 2 : 5 (d) 10 : 7

Ans. (b) : Let r be the radius of the sphere.

In rolling motion,

The translational kinetic energy, $K_t = \frac{1}{2}mv^2$

The rotational kinetic energy, $K_r = \frac{1}{2}I\omega^2$

So, $K_t + K_r = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$

$= \frac{1}{2}mv^2 + \frac{1}{2}\left(\frac{2}{5}mr^2\right)\left(\frac{v}{r}\right)^2$

$\left[\because \text{ For sphere, } I = \frac{2}{5}mr^2,\ \omega = \frac{v}{r}\right]$

$= \frac{1}{2}mv^2 + \frac{1}{5}mv^2$

$= \frac{7}{10}mv^2$

$\therefore \frac{K_t}{K_t + K_r} = \frac{\frac{1}{2}mv^2}{\frac{7}{10}mv^2}$

$\frac{K_t}{K_t + K_r} = \frac{5}{7}$

or $K_t : (K_t + K_r) = 5 : 7$

8. A satellite is launched into circular orbit of radius R around the earth. A second satellite is launched into an orbit of radius 1.01 R. The period of second satellite is larger than the first one by approximately

(a) 0.5% (b) 1.0%

(c) 1.5% (d) 3.0%

Ans. (c) : The orbit radius for the first satellite, $R_1 = R$

The orbit radius for the second satellite, $R_2 = 1.01R$

Let the time period for the first and the second satellites as T_1 and T_2 respectively, then

From the Kepler's third law we get,

$T \propto R^{3/2}$

or $\frac{T_1}{T_2} = \frac{R_1^{3/2}}{R_2^{3/2}}$

$\frac{T_1}{T_2} = \frac{(R)^{3/2}}{(1.01R)^{3/2}}$

$\frac{T_1}{T_2} = \frac{R^{3/2}}{(1.01)^{3/2} \times R^{3/2}}$

$\frac{T_1}{T_2} = \frac{1}{(1.01)^{3/2}}$

$\frac{T_1}{T_2} = \frac{1}{1.015}$

$\therefore\ T_2 = 1.015T_1$

Now, the percentage increase $= \frac{T_2 - T_1}{T_1} \times 100$

$= \frac{1.015T_1 - T_1}{T_1} \times 100$

$= 1.5\%$

9. Geo-stationary satellite is one which

(a) remains stationary at a fixed height from the earth's surface

(b) revolves like other satellites but in the opposite direction of earth's rotation

(c) revolves around the earth at a suitable height with same angular velocity and in the same direction as earth does about its own axis

(d) None of these

Ans. (c) : Geo-stationary satellite is a satellite that revolves around the earth at a suitable height with same angular velocity and in the same direction as earth does about its own axis. Geo-stationary satellites are also called geo-synchronous satellites. They always remain about the same path on equator. i.e., it has a period of exactly one day (86400 sec)

So orbit radius $\left(T = 2\pi\sqrt{\frac{r^3}{GM}}\right)$ comes out to be 42400 km, which is nearly equal to the circumference of earth. So height of geostationary satellite from the earth surface is 42,400–6400 = 36,000 km.

10. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be

(a) 10 cm (b) 8 cm

(c) 20 cm (d) 4 cm

Ans. (c) : The height of rise of water in the capillary is given by–

$h = \frac{2T\cos\theta}{\rho g r}$

Where, T = Surface tension of water

θ = Angle of contact between water and glass tube

ρ = Density of water

g = Acceleration due to gravity

r = Radius of capillary tube

$h \propto \frac{1}{g}$

In the free-falling elevator, the relative acceleration due to gravity becomes zero (i.e. g = 0) and the height of the water inside the capillary becomes infinity (∞).

So, the water will fill the entire tube of length 20 cm.

11. Work done in increasing the size of a soap bubble from a radius of 3 cm to 5 cm is nearly (surface tension of soap solution = 0.03 Nm^{-1})

(a) 0.2 πmJ (b) 2πmJ

(c) 0.4πmJ (d) 4πmJ

Ans. (c) : Given-

Surface tension, $T = 0.03\ Nm^{-1}$

Initial radius of the soap bubble, $r_1 = 3cm = 3\times10^{-2}\ m$

Final radius of the soap bubble, $r_2 = 5cm = 5\times10^{-2}\ m$

Since bubble has two surfaces,

Initial surface area of the soap bubble $= 2\times4\pi r_1^2$

$= 2\times4\pi\times(3\times10^{-2})^2$

$= 72\pi\times10^{-4}\ m^2$

Final surface area of the soap bubble $= 2\times4\pi r_2^2$

$= 2\times4\pi\times(5\times10^{-2})^2$

$= 200\pi\times10^{-4}\ m^2$

Work done in increasing the size of soap bubble = surface tension × increase in area of both the free surface of the soap bubble

$W = T\times\Delta A$

$W = 0.03\times[200\pi\times10^{-4}-72\pi\times10^{-4}]$

$W = 0.03\times128\pi\times10^{-4}$

$W = 3.84\pi\times10^{-4}\ J$

$W \approx 4\pi\times10^{-4}\ J$

$W \approx 0.4\pi\ mJ$

12. If one mole of monoatomic gas $\left(\gamma=\frac{5}{3}\right)$, is mixed with one mole of diatomic gas $\left(\gamma=\frac{7}{5}\right)$, The value of γ for the mixture is

(a) 1.40 (b) 1.50

(c) 1.53 (d) 3.07

Ans. (b) : For mixture of gases -

$$\frac{n_1+n_2}{\gamma_m-1}=\frac{n_1}{\gamma_1-1}+\frac{n_2}{\gamma_2-1}$$

$$\text{or } \frac{1+1}{\gamma_m-1}=\frac{1}{\frac{5}{3}-1}+\frac{1}{\frac{7}{5}-1}$$

$$\frac{2}{\gamma_m-1}=4$$

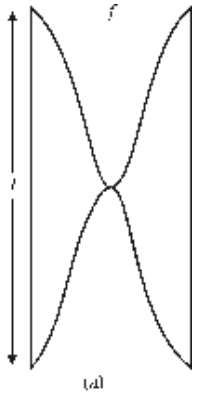
$$\therefore \gamma_m=\frac{3}{2}=1.5.$$

13. A pipe open at both ends has a fundamental frequency f in air. The pipe is dipped vertically in water so that half of it is in water. The fundamental frequency of the air column is now:

(a) 2f (b) f

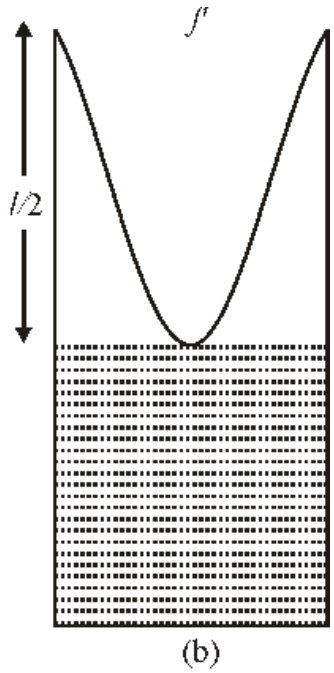
(c) $\frac{f}{2}$ (d) $\frac{3f}{4}$ j

Ans. (b) : For open end pipe in air, fundamental frequency, $f=\frac{v}{2l}$



(a)

For the pipe closed at one end (dipped in water), fundamental frequency, $f'=\frac{v}{4l'}$



(b)

$$l'=\frac{l}{2}$$

$$f'=\frac{v}{4\times\frac{l}{2}}$$

$$f'=\frac{v}{2l}$$

$f' = f$

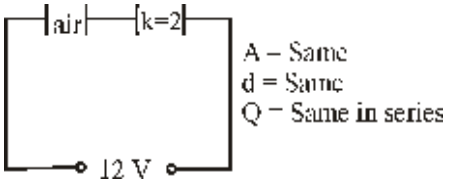
Thus, the fundamental frequency of the air column is now $f = f'$.

14. Two parallel plate capacitors X and Y, have the same area of plates and same separation between plates. X has air and Y with dielectric of constant 2 between its plates. They are connected in series to a battery of 12 V. The ration of electrostatic energy stored in X and Y is

(a) 4 : 1 (b) 1 : 4

(c) 2 : 1 (d) 1 : 2

Ans. (c) :



$C_x = \frac{\varepsilon_0 A}{d}$, $C_y = \frac{2\varepsilon_0 A}{d} = 2C_x$

$U_x = \frac{Q^2}{2C_x}$, $U_y = \frac{Q^2}{2C_y}$

$\therefore \frac{U_x}{U_y} = \frac{C_y}{C_x} = \frac{2C_x}{C_x} = \frac{2}{1}$

15. A hollow metal sphere of radius 5 cm is charged such that the potential on its surface is 10 V. The potential at a distance of 2 cm from the centre of the sphere is

(a) zero (b) 10 V

(c) 4 V (d) 10/3 V

Ans. (b) : In the case of a hollow metal sphere (spherical shell), the electric field inside the shell is zero (0). This means that the potential inside the shell is constant.

So, the potential at any point inside the sphere = potential at the surface of the sphere

Hence, the potential at a distance of 2 cm from the centre of the sphere = 10 V.

16. Suppose the charge of a proton and an electron differ slightly. One of them is –e, the other is (e+Δe). If the net of electrostatic force and gravitational force between two hydrogen atoms placed at a distance d (much greater than atomic size) apart is zero, then Δe is of the order of [given mass of hydrogen $m_h = 1.67\times10^{-27}$ kg]

(a) 10^{-23} C (b) 10^{-37} C

(c) 10^{-47} C (d) 10^{-20} C

Ans. (b) : According to question,

the net electrostatic force (F_E) = gravitational force (F_G)

$F_E = F_G$ or $\frac{1}{4\pi\varepsilon_0}\frac{(\Delta e)^2}{d^2} = \frac{Gm_h^2}{d^2}$

$(\Delta e)^2 = 4\pi\varepsilon_0 Gm_h^2$

$(\Delta e)^2 = Gm_h^2 \times 4\pi\varepsilon_0$

$(\Delta e)^2 = 6.67\times10^{-11}\times(1.67\times10^{-27})^2 \times\left(\frac{1}{9\times10^9}\right)$

$\left(\because \frac{1}{4\pi\varepsilon_0} = k = 9\times10^9\ N-m^2/C^2\right)$

$(\Delta e)^2 = \frac{6.67\times10^{-11}\times(1.67\times10^{-27})^2}{9\times10^9}$

$\Delta e = \sqrt{\frac{6.67\times10^{-11}\times(1.67\times10^{-27})^2}{9\times10^9}}$

$\Delta e = 1.437\times10^{-37}$ C

Hence option (b) is the correct answer.

17. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. Calculate the capacitance if the distance between the plates is reduced by half and the space between them filled with a substance of dielectric constant. (ε_r = 6)

(a) 72 pF (b) 81 pF

(c) 84 pF (d) 96 pF

Ans. (d) : Capacitance of parallel plate capacitor

$C = \frac{\varepsilon_r\varepsilon_0 A}{d}$ (For air $\varepsilon_r = 1$)

So, $\frac{\varepsilon_0 A}{d} = 8\times10^{-12}$

If $d \to \frac{d}{2}$ and $\varepsilon_r \to 6$ then new capacitance,

$C' = \frac{6\times\varepsilon_0\times A}{\frac{d}{2}}$

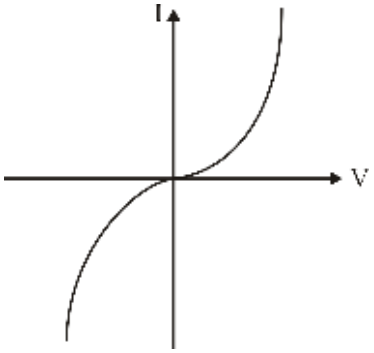
$C' = 12\frac{\varepsilon_0 A}{d}$

$C' = 12\times8\times10^{-12}$ $\left(\because \frac{\varepsilon_0 A}{d} = 8\times10^{-12}\ F\right)$

$C' = 96\times10^{-12}$ F

C' = 96 pF

18. The I-V characteristics shown in figure represents



(a) ohmic conductor
(b) non-ohmic conductors
(c) insulators
(d) super conductors

Ans. (b) : The figure is showing I-V characteristics of non ohmic or non linear conductors.

19. Resistance of conductor is doubled keeping the potential difference across in constant. The rate of generation of heat will

(a) becomes one fourth (b) be halved
(c) be doubled (d) become four times

Ans. (b) : Potential difference, V = constant
Let initial resistance of conductor, $R_1 = R$
$\therefore$ Final resistance of conductor, $R_2 = 2R$
We know that,

Rate of generation of heat $= \frac{H}{t} = \frac{V^2}{R}$

$\therefore$ Rate of generation of heat $(H/t) \propto \frac{1}{R}$ (V = constant)

$$\frac{(H/t)_1}{(H/t)_2} = \frac{R_2}{R_1}$$

$$\frac{(H/t)_1}{(H/t)_2} = \frac{2R}{R}$$

$$(H/t)_2 = \frac{1}{2} \times (H/t)_1$$

or Final rate of generation of heat = $\frac{1}{2} \times$ Initial rate of generation of heat

Hence, option (b) is the correct answer.

20. A primary cell has an e.m.f of 1.5 volt. When short-circuited it gives a current of 3 ampere. the internal resistance of the cell is

(a) 4.5 ohm
(b) 2 ohm
(c) 0.5 ohm
(d) (1/45) ohm

Ans. (c) : e.m.f of a primary cell, E = 1.5 volt
When short - circuited it gives a current of 3 ampere.
i.e $I_{sc} = 3$ ampere

Internal resistance of the cell, $r = \frac{E}{I_{sc}}$

$$= \frac{1.5}{3}$$

$$= 0.5 \text{ ohm}$$

21. A beam of electrons is moving with constant velocity in a region having simultaneous perpendicular electric and magnetic fields of strength 20 Vm^{-1} and 0.5 T respectively at right angles to the motion of the electrons. Then the velocity of electrons must be

(a) 8 m/s
(b) 20 m/s
(c) 40 m/s
(d) $\frac{1}{40}$ m/s

Ans. (c) : Electric field, E = 20 v/m
magnetic field, B = 0.5T
The force on electron in a magnetic field, $F_M = qvB$
The force on electron in an electric field, $F_E = qE$
As electron move with constant velocity without deflection. Hence, force due to magnetic field is equal and opposite of force due to electric field.

$\therefore F_M = F_E$
$qvB = qE$

$$v = \frac{E}{B} = \frac{20}{0.5} = 40 \text{ m/s}$$

22. A solenoid of length 1.5 m and 4 cm diameter possesses 10 turns per cm. A current of 5A is flowing through it, the magnetic induction at axis inside the solenoid is
($\mu_0 = 4\pi \times 10^{-7}$ weber amp^{-1} m^{-1})

(a) $4\pi \times 10^{-5}$ gauss (b) $2\pi \times 10^{-5}$ gauss
(c) $4\pi \times 10^{-5}$ tesla (d) $2\pi \times 10^{-5}$ tesla

Ans. (*) : Length of solenoid, l = 1.5 m
Diameter of solenoid, d = 4 cm = 0.04 m
n = 10 turns per cm = 1000 turns per meter
Current, I = 5 amp.
Permeability of vacuum, $\mu_0 = 4\pi \times 10^{-7}$ weber amp^{-1} m^{-1}
Magnetic induction inside the solenoid,

$B = \mu_0 nI$ ($\because l >> d$)

$B = 4\pi \times 10^{-7} \times 1000 \times 5$
$B = 2\pi \times 10^{-3}$ T or $2\pi \times 10^{-3}$ tesla

3. A galvanometer of resistance 5 ohms gives a full scale deflection for a potential difference of 10 mV. To convert the galvanometer into a voltmeter giving a full scale deflection for a potential difference of 1V, the size of the resistance that must be attached to the voltmeter is

(a) 0.495 ohm (b) 49.5 ohm
(c) 495 ohm (d) 4950 ohm

Ans. (c) : Resistance of galvanometer, $R_g = 5$ ohm
Potential difference for full scale deflection of the galvanometer, $V_g = 10$ mV

$$V_g = 10\times10^{-3}\,V$$
$$V_g = 10^{-2}\,V$$

$\therefore$ Current for full - scale deflection of the galvanometer, $I_g = \dfrac{10^{-2}}{5} = 2\times10^{-3}\,A$

Potential difference for full scale deflection of the voltmeter, V = 1 volt
A galvanometer is converted into a voltmeter by connecting a shunt in series of the galvanometer.
$\therefore$ The resistance of shunt connected in series,

$$R = \frac{V}{I_g} - R_g$$
$$= \frac{1}{2\times10^{-3}} - 5$$
$$= 500 - 5$$
$$= 495\ \Omega \text{ or } 495 \text{ ohm}$$

24. When the current in a coil changes from 2 amp. to 4 amp. in 0.05 sec., an e.m.f. of 8 volt is induced in the coil. the coefficient of self inductance of the coil is

(a) 0.1 henry (b) 0.2 henry
(c) 0.4 henry (d) 0.8 henry

Ans. (b) : Given–
$I_1 = 2$ amp., $I_2 = 4$ amp. dt = 0.05 sec
Induced emf, in the coil, $\varepsilon = 8$ volt
Coefficient of self inductance, L = ?
We know that,

$$\varepsilon = -L\frac{dI}{dt}$$
$$8 = -L\frac{(2-4)}{0.05}$$
$$8 = -L\times\frac{(-2)}{0.05}$$
$$8 = L \times 40$$
$$\therefore\ L = \frac{8}{40}$$
$$L = \frac{1}{5} = 0.2\,H \text{ or } 0.2 \text{ henary}$$

25. A conducting circular loop is placed in a uniform magnetic field, B = 0.025 T with its plane perpendicular to the loop. The radius of the loop is made to shrink at a constant rate of 1 mms^{-1}. The induced e.m.f. when the radius is 2 cm, is

(a) $2\pi\mu V$ (b) $\pi\mu V$
(c) $\frac{\pi}{2}\mu V$ (d) $2\mu V$

Ans. (b) : Given–
Magnetic field, B = 0.025T
The radius of the loop, $r = 2\ cm = 2\times10^{-2}\,m$
The constant rate at which the loop shrinks,

$$\frac{dr}{dt} = 1\,mms^{-1}$$
$$= 1\times10^{-3}\,ms^{-1}$$

Magnetic flux linked with the loop, $\phi = BA\cos\theta = B\pi r^2\cos0° = B\pi r^2$ [$\because \cos0° = 1$]

Induced emf, $|\varepsilon| = \dfrac{d\phi}{dt}$

$$= \frac{d}{dt}\left(B\pi r^2\right)$$
$$= B\pi\times2r\frac{dr}{dt}$$
$$= 0.025\times\pi\times2\times2\times10^{-2}\times1\times10^{-3}$$
$$= 0.1\pi\times10^{-5}$$
$$= \pi\times10^{-6} \text{ volt or } \pi\mu V$$

26. The transformation ratio in the step-up transformer is

(a) one
(b) greater than one
(c) less than one
(d) the ratio greater or less than one depends on the other factor

Ans. (b) : We know that,
The transformation ratio (K) of transformer is given by following-

$$\boxed{K = \frac{N_S}{N_P} = \frac{E_S}{E_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}}$$

N_P = Number of turns in primary coil
N_S = Number of turns in secondary coil
E_P , V_P = Primary side emf or voltage
E_S , V_S = Secondary side emf or voltage
I_P = Primary side current
I_S = Secondary side current
For a step-up transformer,
$N_S > N_P$ or $E_S > E_P$
$\therefore$ K > 1
Hence, the transformation ration in the step-up transformer is greater then one.