DSSSB/KVS/NVS/AEES/AWES
BIHAR TRE/EMRS

NCERT

SCIENCE

Physics, Chemistry & Biology
Chapter wise & Sub-topicwise
Solved Papers

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BIOLOGY

ANALYSIS OF QUESTION PAPERS

S.No.	Exam Name And Year	Total Exam Papers	No. Of Questions
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3.	DSSSB PGT Chemistry 2014-2021	5	940
4.	DSSSB PGT Biology 2014-2021	5	840
5.	KVS TGT Science 2014, 2023	2	180
6.	KVS TGT (LDCE) Science 2022	1	120
7.	KVS PGT Physics 2014, 2018, 2023	3	260
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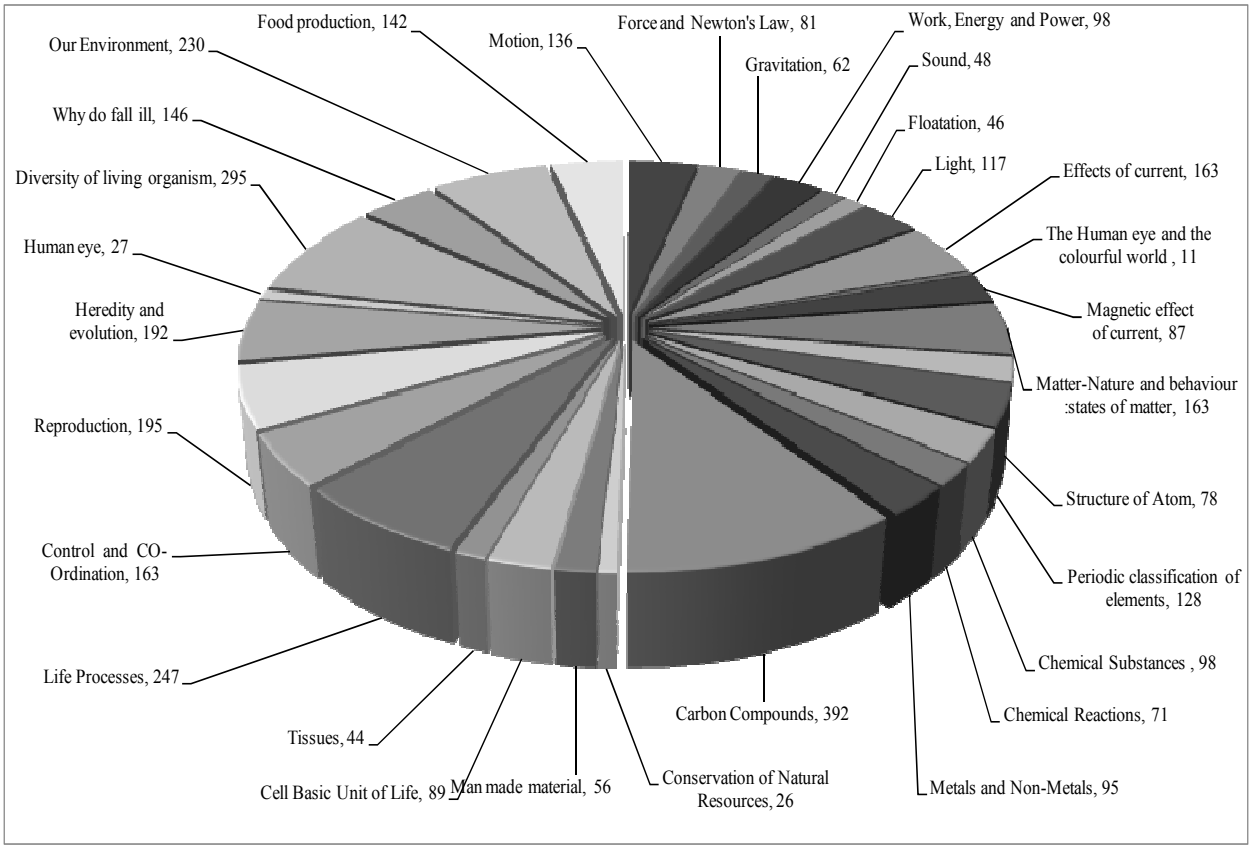
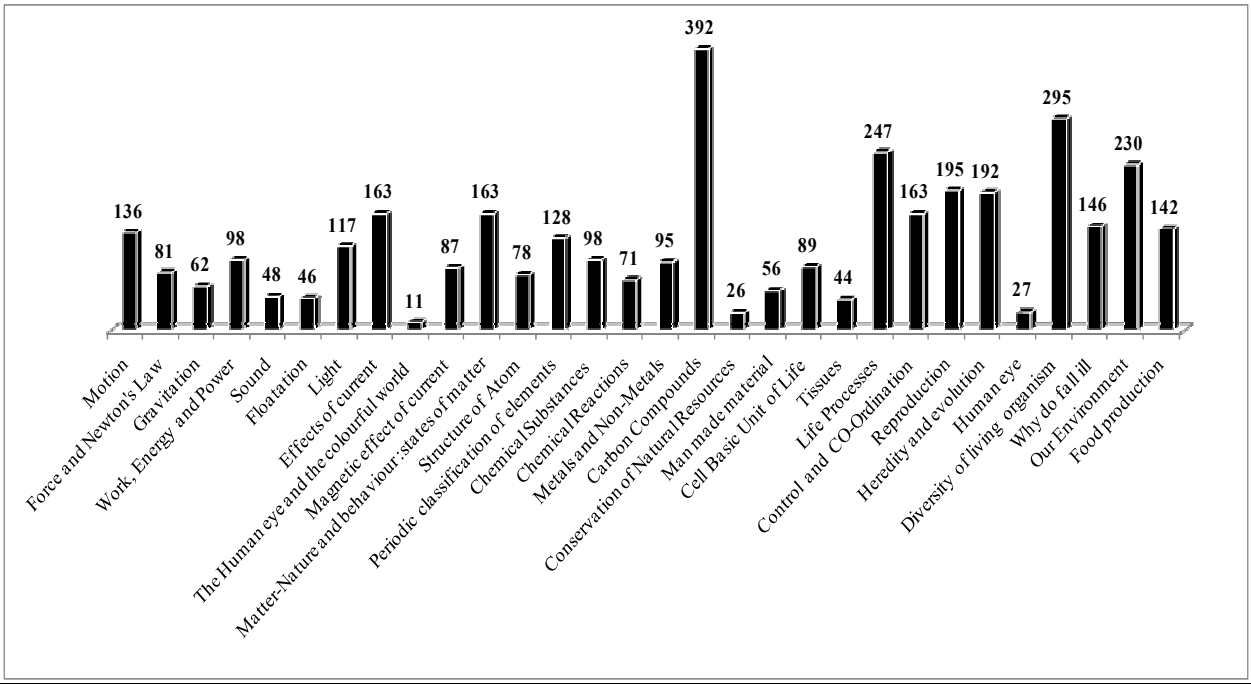
32.	EMRS PGT Biology 2023	1	80
	Total	78	8210

Note : After due analysis of the above question papers, **8210 questions** related to **Science** have been presented chapter wise. Questions of repetitive and similar nature have been included so that the technique of asking questions can benefit the competitors.

Trend Analysis of Science
Through Pie Chart and Bar Graph





01.

Motion

1. Distance and Displacement

1. Which is not an important point about the second law of motion?

(a) The second law is obviously consistent with the first law.
(b) The second law of motion is not a vector dependent law.
(c) The second law of motion is applicable to a single point particle.
(d) The second law of motion is a local relation, which means that force at a point in space at a certain instant of time is related to acceleration at that point at that instant.

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans.(b): The second law of motion is not a vector dependent law.
Second law of motion–Newton's second law of motion relates the net force acting on an object to its acceleration and mass as it states that the rate of change in momentum is equal to force i.e. $\frac{dp}{dt} = F$.
Mathematically, it can be expressed as
$F = ma$
Where,
F = net force,
m = mass of the object
and a = acceleration

2. Angular displacement is:

(a) Positive for counter-clockwise rotation
(b) Positive for clockwise rotation
(c) Negative for counter-clockwise rotation
(d) zero for clockwise rotation

DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans.(a): Angular displacement –Angular displacement is defined as the total angle made by the particle from its starting point to final point and it is represented in the form of radian or degrees.
For counter-clockwise rotaion, angular displacement is positive and for clockwise is negative.

3. On comparing pure translation with pure rotation, the term equivalent to mass is:

(a) Angular velocity
(b) Angular acceleration
(c) Rotational Inertia
(d) Energy

DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans.(c): Rotational inertia is a property of any object which can be rotated. It is a scalar value which tells us how difficult it is to change the rotational vleocity of an object around a rotational axis which is termed as moment of inertia.
On comparing pure translation with pure rotation, the term equivalent to mass is rotational inertia.

4. Light year is unit that is used to represent:

(a) Time (b) Length
(c) Angle (d) Mass

DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans.(b): A light year is a unit of distance, representing the distance light travles in one year, approximately 5.88 trillion miles or 9.46 trillion kilometers. It is commonly used in astronomy to measure huge interstellar distances.
A light-year is a distance travelled by light in a year so a light-year is a unit of length.

5. The displacement (x) vs. time (t) of a particle follows the condition:

$$x^2 = pt^2 + 2qt + r$$

Where p, q and r are constants. It is found that the acceleration of the particle varies at x^n, then n is equal to?

(a) –1 (b) –2
(c) –3 (d) –4

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(): Distance x varies with time t as,
$x^2 = pt^2 + 2qt + c$ .....(i)
Differentiating both side w.r.t. t

$$2x\frac{dx}{dt} = 2pt + 2q$$

$$x\frac{dx}{dt} = pt + q \quad \text{.....(ii)}$$

Again differentiating w.r.t. t -

$$x\frac{d^2x}{dt^2} + \left(\frac{dx}{dt}\right)^2 = p$$

$$\Rightarrow \quad \frac{d^2x}{dt^2} = \frac{p - \left(\frac{dx}{dt}\right)^2}{x}$$

Using eq^n. (ii), we get-

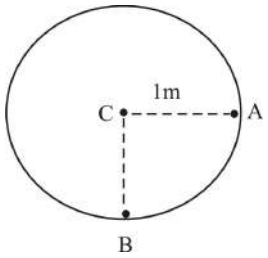
$$\frac{d^2x}{dt^2} = \frac{p - \left(\frac{pt+q}{x}\right)^2}{x}$$

$$\frac{d^2x}{dt^2} = a = \frac{px^2 - (pt+q)^2}{x^3}$$

$$a = \frac{p}{x} - \frac{(pt+q)^2}{x^3}$$

$a \propto x^{-3}$, here p, q and t are the constant and seeing the power of x in the denominator, value of n = – 3.

6. An object travels from point A to point B as shown in the figure. The distance and the magnitude of displacement for the motion are respectively

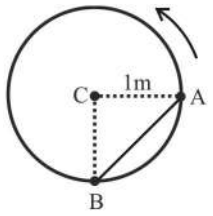


(a) $\sqrt{2}$m, $\sqrt{2}$m (b) 1·5πm, $\sqrt{2}$m

(c) 1·5π, 1·5πm (d) $\sqrt{2}$m, 1·5πm

NVS PGT 2022 (Science 28/11/2022)

Ans.(b):



Given,
radius of the circle, r = 1m
Using Pythagoras theorem,
$AB^2 = AC^2 + CB^2$

$$AB = \sqrt{(1)^2 + (1)^2} = \sqrt{2}\text{m}$$

$$AB = \sqrt{2}\text{m}$$

Note : The object can move either clockwise or anticlockwise sense in case of distance.

$$\text{Distance} = \frac{3}{4} \times 2\pi r$$

$$= \frac{3}{2}\pi r$$

$= 1.5\ \square$m (r = 1)

$= 1.5\ \square$m

7. A 150 m long train is travelling from east to west at a speed of 20 ms^{-1}. A bird is flying from west to east at a speed of 5 ms^{-1}. How long will the bird take to cross the train?

(a) 6 s (b) 8 s

(c) 10 s (d) 12 s

AEES PGT 2015 (Physics)

Ans.(a): Given,
Length of the train (l) = 150m
V_t = 20 m/s (East to West)
V_b = 5 m/s (West to East)
Speed of bird w.r.t. train = $V_b - V_t = 5 - (-20)$ m/s
= 25 m/s
Distance covered by the bird to cross the train = 150m
So,

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$= \frac{150\text{m}}{25\text{m/s}} = 6\,\text{sec}$$

8. A spaceship travelling in space at 300 km/s fires its engine for 15s, such that its final velocity is 600 km/s. The total distance travelled by the ship in one minute starting from the time of firing is :

(a) 6, 750 km (b) 27,000 km

(c) 33,750 km (d) 43,250 km

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans.(c):
Given, u = 300 km/s
v = 600 km/s
t = 15 s
Applying, v = u + at
$600 = 300 + a \times 15$
$\Rightarrow a = 20\ km/s^2$
Distance travelled in first 15 second is-

$$s = ut + \frac{1}{2}at^2 = 300 \times 15 + \frac{1}{2} \times 20 \times (15)^2$$

s = 6750 km
Now, the speed will be of 600 km/s, so the distance covered in 45 second (60 – 15 = 45s) is :
distance = speed × time = 600 × 45 = 27,000 km
Total distance = (6750 + 27000) km = 33, 750 km

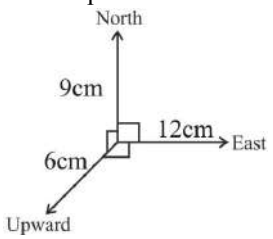
9. A particle has displacement 12 cm towards east and 9 cm towards north and then 6 cm vertically upwards. The magnitude of the displacement of the particle is :

(a) $\sqrt{261}$ cm (b) $\sqrt{131}$ cm

(c) $\sqrt{161}$ cm (d) $\sqrt{331}$ cm

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans. (a) : Given, displacement towards East = 12 cm
Displacement towards north = 9 cm
and upward displacement = 6 cm



So, these are mutually perpendicular in directions.
Therefore total displacement ,

$$d = \sqrt{(12)^2 + (9)^2 + (6)^2}$$

$$d = \sqrt{261}\,\text{cm}$$

2. Velocity and Speed

10. A bullet of mass 100g is fired from a gun of mass 20 kg with a velocity of 100m/s. The recoil velocity of the gun is:

(a) 0.1 ms^{-1} (b) 0.2 ms^{-1}

(c) 0.4 ms^{-1} (d) 0.5 ms^{-1}

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans. (d) : Given,

mass of bullet, $m_B = 100\ g = 0.1\ kg$

mass of gun, $m_G = 20\ kg$

velocity of bullet, $v_B = 100\ m/s$

Let the recoil velocity of gun be v_G.

Applying the conservation of linear momentum,

$$m_B v_B = m_G v_G$$

$$\Rightarrow v_G = \frac{m_B v_B}{m_G} = \frac{0.1 \times 100}{20}$$

$$v_G = 0.5\ m/s$$

11. A body is thrown with a velocity of projection 49ms^{-1} at an angle of projection 45°. Find the Range (g = 9.8 ms^{-2}).

(a) 240 m (b) 245 m

(c) 250 m (d) 278 m

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans.(b): Given,

$u = 49\ m/s$

$\theta = 45°$

$g = 9.8\ m/s^2$

Using formula,

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R = \frac{49^2 \times \sin(2 \times 45°)}{9.8}$$

$$R = 245m$$

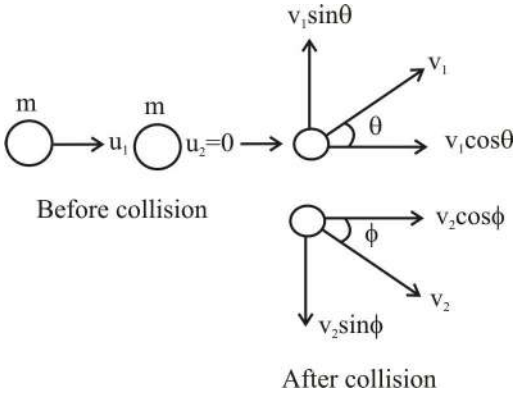
12. A ball moving on a smooth horizontal plane in a straight line with a velocity of 100 cms^{-1} hit an identical ball which is at rest. The collision is perfectly elastic and the two balls move along two straight paths after the collision. The velocity of the first ball gets reduced to 60cms^{-1}. Find the angle between the direction of the ball after the collision.

(a) 30° (b) 45°

(c) 60° (d) 90°

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(d): According to the question



In horizontal direction -

$$m_1u_1 + m_2u_2 = m_1v_1\cos\theta + m_2v_2\cos\theta$$

$$m_1u_1 + 0 = mv_1\cos\theta + mv_2\cos\phi$$

$$u_1 = v_1\cos\theta + v_2\cos\phi \quad \text{..... (i)}$$

In vertical direction -

$$0 = m_1v_1\sin\theta - m_2v_2\sin\phi$$

$$0 = v_1\sin\theta - v_2\sin\phi \quad \text{.....(ii)}$$

On squaring and adding equation (i) and (ii) both side we get -

$$u_1^2 = v_1^2 + v_2^2 + 2v_1v_2\cos(\theta + \phi) \quad \text{.....(iii)}$$

According to the question collision is perfectly elastic therefore K.E. is conserved -

$$u_1^2 = v_1^2 + v_2^2 \quad \text{.....(iv)}$$

From eq^n. (iii) and (iv) -

$$\cos(\theta + \phi) = 0$$

$$\boxed{\theta + \phi = 90°}$$

13. A bullet of mass 50g moving with a velocity 'v' strike a block of mass 2kg. The block is free to move in the direction of the bullet. In the process there is a loss of kinetic energy of 4100J. find u in metres per sec.

(a) 205 (b) 410

(c) $410\sqrt{2}$ (d) 820

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(b): Given,

$m_1 = 50g = 0.05\ kg$,

$m_2 = 2kg$

K.E. = 4100J

By the law of conservation of momentum,

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Here, initial velocity of bullet, $u_1 = v\ m/s$

Let, the final velocity under perfectly elastic collision between the bullet and block be u m/s.

$$0.05v + 0 = 2 \times u + 0.05\ u$$

$$v = \frac{2.05}{0.05}u$$

$$v = 41u$$

$$K.E. = \frac{1}{2}mv^2 - \frac{1}{2}(m_1 + m_2)u^2$$

$$4100 = \frac{1}{2} \times 0.5 \times (41u)^2 - \frac{1}{2} \times (2.05)\, u^2$$

$8200 = 0.05 \times 1618u^2 - 2.05\, u^2$

$8200 = 84.05u^2 - 2.05u^2$

$8200 = 82u^2$

$u^2 = 100$

$u = 10$ m/sec

$v = 41u = 41 \times 10 = 410$ m/sec.

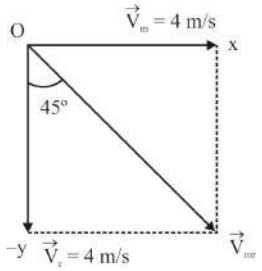
14. On a rainy day when a boy is running at a speed of 4 ms^{-1}, rain strikes him vertically at a speed of 4 ms^{-1}. For what speed of the boy will rain strike him at an angle of 45º?

(a) 2 m/s (b) 6 m/s

(c) 8 m/s (d) $8\sqrt{2}\,m/s$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(*):



$$\vec{V}_{mr} = \vec{V}_r - \vec{V}_m = -4\hat{j} - 4\hat{i}$$

$$\vec{V}_{mr} = \sqrt{(-4)^2 + (4)^2 - 2 \times (-4) \times 4 \times \cos 90^o}$$

$$\Rightarrow \quad \vec{V}_{mr} = 4\sqrt{2}\ m/s$$

Note :- Official answer given by commission is (c)

15. A train moving with a velocity 40 km/hr passes through a station at 9 AM. After 1.5 min a lightning bolt strikes the railway tracks 2 km from the station in the same direction as that of the motion of the train. Find the co-ordinates of the lightning flash as measured by an observer at the station.

(a) x = 2 km, t = 9 h 1m 30s

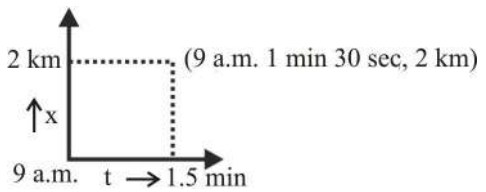
(b) x = 2 km, t = 9 h 30s

(c) x = 2 km, t = 9 h/m

(d) x = 1 km, t = 9 h

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(a):



From diagram correct answer will be (a).

16. A particle of mass 10 g moves with a velocity 10 m/s along a straight line and collides with another particle of mass 20 g which is moving with a velocity 5 m/s along the same line. If after collision, the first particle is brought to rest, the velocity of the other particle after impact is:

(a) 2.5 m/s (b) 4 m/s

(c) 5 m/s (d) 10 m/s

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(d): Given,

$m_1 = 10g$

$m_2 = 20g$

$u_1 = 10$ m/sec, $v_1 = 0$ m/s

We have,

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$10 \times 10 + 20 \times 5 = 0 + 20 \times v_2$

$100 + 100 = 20v_2$

$$v_2 = \frac{200}{20}$$

$v_2 = 10$ m/sec.

17. An open carriage is travelling at 20 m/s. A boy standing on the carriage throws a ball vertically upward with a velocity 10 m/s. The direction of motion of the carriage is along the x –axis, and the vertical dissection is along the y – axis. The frame of reference attached with a stationary observer is defined by (x, y, t) and that with the carriage is (x', y', t'). Where the symbols have their meanings. Wrote the displacement vs. time equations correcting (x, y) : (x', y') with (t, t'). Take g = 10 m/s^2

(a) $x = 0$, $y = 10t - 5t^2$,
$x' = 20t$, $y' = 10t' - 5t'^2$

(b) $x = 20t$, $y = 10t - 5t^2$,
$x' = 0$, $y' = 10t' - 5t'^2$

(c) $x' = 0$, $y' = 10t'$
$x = 20t$, $y = 10t$,

(d) $x' = 0$, $y' = 10t'$
$x = 0$, $y = 10t$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (b) : Displacement vs time equation (x, y) (x', y') with time (t, t')

Given, $v = 20$ m/s

$v_0 = 10$ m/s

$g = 10\ m/s^2$

- displacement in x' as a function of time,

$$x'(t') = v_{0x}t' = 0$$

- displacement in x as a function of time,

$x(t) = x'(t') + v_ct' = 0 + 20t$

$x(t) = 20t$

- displacement in y' as a function of time,

$$y'(t') = v_0t' - \frac{1}{2}gt'^2 = 10t' - \frac{1}{2} \times 10t'^2 = 10t' - 5t'^2$$

- displacement in y as a function of time,

$y(t) = y'(t') = 10t - 5t^2$

18. Two spherical drops of water of the same size attain terminal velocities of magnitude 0.1 ms^{-1}. In the process of falling they coalesce to form a single drop. What will be the new terminal velocity?

(a) $\frac{1}{10}2^{1/3}\ ms^{-1}$ (b) $\frac{1}{10}2^{2/3}\ ms^{-1}$

(c) $\frac{1}{5}2^{2/3}\ ms^{-1}$ (d) $\frac{1}{20}2^{1/3}\ ms^{-1}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(b): If R is radius of new drop formed then,

$\frac{4}{3}\pi R^3 = 2\times\frac{4}{3}\pi r^3$

or $R = 2^{\frac{1}{3}}r$

If drop of radius r falling in a medium then it acquire a critical velocity

As $V \propto r^2$

$\frac{V_2}{V_1} = \frac{R^2}{r^2}$

$= \frac{(2^{1/3}r)^2}{r^2} = 2^{2/3}$

or $V_2 = V_1 \times 2^{2/3}$

$= 0.1\times(2)^{2/3}$

$= \frac{1}{10}\times(2)^{2/3}\ m/s$

19. A projectile of mass 40 kg is shot vertically upwards with a velocity 80 m/s. After 5sec it explodes into two equal parts and one of them travels vertically up with a velocity 100m/s. What is the velocity of the other fragment (in magnitude and direction) at this instant? (take g = 10 m/s^2)

(a) 40 m/s upward

(b) 40 m/s downward

(c) 20 m/s upward

(d) 20 m/s downward

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(b): Given,

mass = 40 kg

velocity = 80 m/s

time = 5 sec

After 5 sec velocity attained by them-

$v = u - gt$

$= 80 - 10\times 5$

$= 80 - 50$

$= 30$ m/s

Apply law of conservation of momentum for its fragment parts

$mv = m_1v_1 + m_2u_2$ .....(i)

The fragment mass equal because of identical in size then,

$m_1 = m_2 = 20$ kg and $v_1 = 100$ m/s

Now,

from equation. (i)

$mv = m_1v_1 + m_2u_2$

$40\times 30 = 20\times 100 + 20\times u_2$

$1200 = 2000 + 20u_2$

$20u_2 = -800$

$u_2 = -40$ m/s

20. In a mathematical treatment the expression of a function of velocity u, appears as e^{-bu^2}. The dimension of b is:

(a) L^2T^{-2} (b) ML^2T^{-2}

(c) $L^{-2}T^2$ (d) MLT^{-1}

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(c): $bu^2 = M^\circ L^\circ T^\circ = 1$

$bu^2 = 1$

$b = \frac{1}{u^2}$

$b = \frac{1}{[LT^{-1}]^2} = \frac{1}{L^2T^{-2}} = L^{-2}T^2$

21. What will be the angle of projection to find the maximum horizontal range by a projectile?

(a) 30° (b) 60°

(c) 45° (d) 90°

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(c): We know that,

Range $(R) = \frac{u^2\sin 2\theta}{g}$

For maximum range,

$\Rightarrow R_{max} = \frac{u^2}{g}$

$\sin 2\theta = 1$

$\sin 2\theta = 1$

$\theta = 45°$

So, angle of projection is 45º.

22. Find the magnitude of linear velocity of a particle whose angular velocity is $7\hat{i}+3\hat{j}-\hat{k}$ and the distance from the origin is $\hat{i}-\hat{j}+\hat{k}$.

(a) 15.75 ms^{-1} (b) 14.62 ms^{-1}

(c) 12.35 ms^{-1} (d) 13.75 ms^{-1}

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(c): Given,

angular velocity $(\vec{\omega}) = 7\hat{i}+3\hat{j}-\hat{k}$

distance $(\vec{r}) = \hat{i}-\hat{j}+k$

Liner velocity, $\vec{v} = \vec{\omega}\times\vec{r} = -(\vec{r}\times\vec{\omega})$

$$\vec{v} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 7 & 3 & -1 \end{vmatrix} = -2\hat{i}+8\hat{j}+10\hat{k} =$$

$= 2\hat{i}-8\hat{j}-10\hat{k}$

Its magnitude is–

$$v = \sqrt{(2)^2 + (8)^2 + (10)^2}$$

$$v = \sqrt{4 + 64 + 100}$$

$$v = \sqrt{168}$$

$$v = 12.96$$

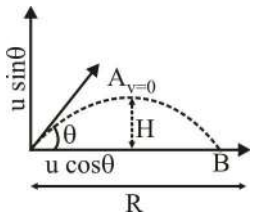
23. A boy throws a stone at a speed of 28 ms^{-1}. The stone makes 30^0 angle with the horizontal surface. Find the maximum height of the stone from the ground.

(a) 10.0 meter (b) 8.0 meter

(c) 12.0 meter (d) 6.0 meter

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(a):



We know that,

$$v^2 = u^2 - 2gh$$

$$0 = u^2 \sin^2\theta - 2gH$$

$$H = \frac{u^2 \sin^2\theta}{2g}$$

$$H = \frac{(28)^2 \times (\sin 30)^2}{2 \times 9.8}$$

$$H = 10m$$

24. A river is 1000 m wide and water flower at a speed of 50m/min. A man can swin at a speed of $66\frac{2}{3}$ m/min in still water. What is the time needed by the man to cross the river?

(a) 10 min (b) 15 min

(c) 20 min (d) 25 min

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(b): Using formula, Time = $\frac{\text{Distance}}{\text{Speed}}$

$$= \frac{1000}{66\frac{2}{3}} = \frac{1000 \times 3}{200} = 15\text{min}$$

25. Suppose that a projectile is launched with velocity V_0 that makes an angle θ_0 with the horizontal axis. What is the time of flight of the projectile?

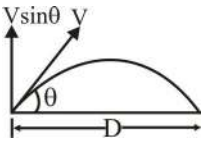
(a) $V_0 \sin\theta_0/g$ (b) $g_0 \sin\theta_0/g$

(c) $2V_0 \cos\theta_0/g$ (d) $2V_0 \sin\theta_0/g$

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(d): The time of flight of projectile motion is defined as the time from when the object is projected to the time it reaches the surface.

$$T = \frac{2u_y}{g}$$



i.e., $T = \frac{2v_0 \sin\theta_0}{g}$

26. Find the dimensional-formula of $X_0 + ut + \frac{1}{2}at^2$ -

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

(c) $M^{-1}L^1T^1$ (d) $M^1L^{-1}T^1$

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(b): The dimensional formula of displacement

$= M^0L^1T^0$

The SI unit of displacement is measured in meter (m).

So, the dimensional formula of $X_o + ut + \frac{1}{2}at^2 =$

$= M^0L^1T^0$

27. A balloon is filled with air. The mass of the air in the balloon is 10 gm. A small hole is made to the balloon and released. The balloon moves up with an average speed of 5 cm/s and shrinks completely in 5 seconds. Find the average force acting on the balloon.

(a) 10 dynes (b) 5 dynes

(c) 20 dynes (d) 15 dynes

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sce.

Ans.(a): Given,

m, mass of the air = 10 gram

u = 0 cm/s

v = 5 cm/s

Time to change the velocity = 5 sec

According to Newton's second law of motion,

$$F = \frac{mv - mu}{t} = m\left(\frac{v-u}{t}\right)$$

$$= 10\text{gm} \times \left(\frac{(5-0)\text{cm/s}}{5\text{sec}}\right)$$

$= 10\ \text{gmcms}^{-2}$

= 10 dynes.

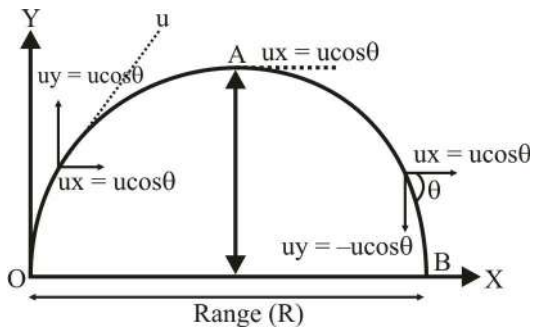
28. A body projected vertically upwards travels the same distance in the 5th and 6th seconds of its motion. Find the maximum height travelled by the body. $\left(g = 10m/s^2\right)$

(a) 250 m (b) 125 m

(c) 50 m (d) 100 m

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sce.

Ans.(a):



Given,

distance travelled by particle in 5^{th} and 6^{th} sec is equal in vertical motion of particle.

The distance travelled in 5^{th} sec-

$$h_5 = u - \frac{1}{2}g(2t-1)$$

$$\Rightarrow h_5 = u - \frac{9}{2}g$$

The distance travelled in 6^{th} sec-

$$h_6 = u - \frac{1}{2}g(2t-1)$$

$$h_6 = u - \frac{11}{2}g$$

So, $h_5 = -h_6$ (at t = 5 sec, particle will be at maximum heights)

$$\Rightarrow u - \frac{9}{2}g = -u + \frac{11}{2}g$$

$$\Rightarrow u = 5g$$

Maximum height attained,

$$H_{max} = \frac{u^2}{2g} = \frac{(5g)^2}{2g} = \frac{25g}{2} = \frac{25\times10}{2}$$

$$= 125$$

$$\boxed{H_{max} = 125m}$$

29. A man walks with a speed of 8km/hr for 2 km and 9 km/hr for 3 km. What is the average speed for 5 km?

(a) 8.75 km/hr (b) 9.75 km/hr

(c) 6.25 km/hr (d) 8 km/hr

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

Ans.(a): Given,

$v_1 = 8km/h$,

$v_2 = 9km/h$,

$d_1 = 2km$,

$d_2 = 3km$

We know that,

$$t_1 = \frac{d_1}{v_1} = \frac{2}{8}$$

$t_1 = 0.25$ hr,

$$t_2 = \frac{d_2}{v_2} = \frac{3}{9} = \frac{1}{3}$$

$t_2 = 0.33$ hr.

Total time (t) = $t_1 + t_2$

$= 0.25 + 0.33$

$= 0.58$hr

$$\text{Average speed} = \frac{\text{Total path length}}{\text{Total time taken}}$$

$$V = \frac{5}{0.58}$$

$V = 8.75$ km/h

30. If a particle travels a distance 's' in time t_1 to t_2, the average speed V_{av} is_____.

(a) $\frac{s}{t_2 - t_1}$ (b) $\frac{2s}{t_2 - t_1}$

(c) $\frac{s}{2(t_2 - t_1)}$ (d) $s(t_2 - t_1)$

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

Ans.(a): Given, the distance travelled is S and time interval, $t = t_2 - t_1$.

$$\text{Average speed} = \frac{\text{Total distance}}{\text{Total time}}$$

So, $\boxed{v_{av} = \frac{S}{t_2 - t_1}}$

31. Which of the following is not a vector quantity?

(a) Speed

(b) Displacement

(c) Velocity

(d) More than one of the above

(e) None of the above

Bihar Teacher 2013 (TRE-200) Science

Ans.(a): Vector quantity–The physical quantities which have both magnitude and direction and obey the laws of vector are called vector quantities or vectors.

Example–Displacement, velocity, force, weight momentum, acceleration etc.

Scalar quantity–The physical quantities which have only magnitude and not a fixed direction are called as scalar quantity or scalar.

Example– Mass, Speed, Volume, Distance, Time etc.

So, option (a) is correct.

32. A bullet of mass 25 g is fired horizontally with a velocity of 120 m/s from a pistol of 2·5 kg. The recoil velocity of the pistol is

(a) – 0·6 m/s (b) 0·6 m/s

(c) – 1·2 m/s (d) 1·2 m/s

NVS PGT 2022 (Science 28/11/2022)

Ans.(c): Given,
mass of the bullet, $m_1 = 25g = 25 \times 10^{-3}$ kg
velocity of the bullet, $v_1 = 120$ m/s
mass of the pistol, $m_2 = 2.5$ kg
From the conservation of the momentum,
$m_1v_1 + m_2v_2 = 0$

$$v_2 = \frac{-m_1v_1}{m_2}$$

$$= \frac{-25\times10^{-3}\times120}{2.5}$$

$$= -1.2 \text{ m/s}$$

So, recoil velocity is – 1.2 m/s.

33. A particle moves along a semicircular path of radius 20 m in 10 seconds. The average speeds of the particle is

(a) 2 m/s (b) 4 m/s
(c) 2π m/s (d) 4π m/s

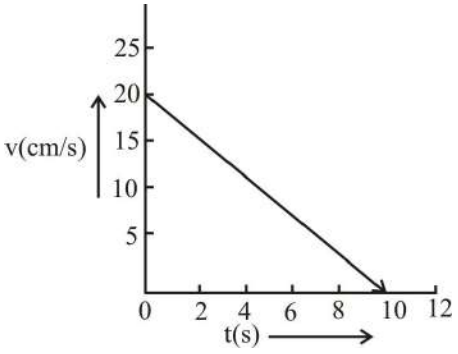
NVS PGT 2022 (Science 28/11/2022)

Ans.(c): Given,
The radius of the circle, r = 20 m
Time, t = 10 sec
The average speed of the particle is defined as the total distance travelled per unit time.

$$v_a = \frac{\pi r}{t}$$

$$= \frac{\pi\times20}{10} = 2\pi \text{m/sec}$$

34. The velocity (v)-time (t) graph of a ball of mass 50 g along a straight line on a horizontal surface is as shown. The magnitude of force exerted by the surface on the ball to bring it to rest is



(a) 1 N (b) 0.001 N
(c) 0.01 N (d) 0.1 N

NVS PGT 2022 (Science 29/11/2022)

Ans. (b) : Given, m = 50g
According to Newton's force law,

$$F = \frac{dp}{dt} = m\frac{dv}{dt} = \frac{50}{1000}\times\left(\frac{0-20}{0-10}\right)\times\frac{1}{100}$$

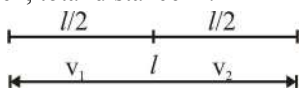
$$F = \frac{1000}{1000}\times\frac{1}{1000} = 10^{-3}\text{N} = 0.001\text{N}$$

35. A vehicle travels half the distance *l*. with speed V_1, and the other half with speed V_2, then the average speed of the vehicle is

(a) $\frac{v_1+v_2}{2}$ (b) $\frac{v_1v_2}{v_1+v_2}$
(c) $\frac{2v_1v_2}{v_1+v_2}$ (d) $\frac{v_1^2v_2^2}{v_1+v_2}$

NVS PGT 2022 (Science 29/11/2022)

Ans. (c) : Given, total distance = *l*



The time taken to cover the half distance, $t_1 = \frac{l/2}{v_1}$

Similarly, $t_2 = \frac{l/2}{v_2}$

So, total time $t = t_1 + t_2$

Therefore, average speed $(v) = \frac{\text{Total distance}}{\text{Total Time}}$

$$v = \frac{l}{\left(\frac{l}{2v_1}+\frac{l}{2v_2}\right)} = \frac{l}{\frac{l}{2}\left(\frac{v_2+v_1}{v_1v_2}\right)}$$

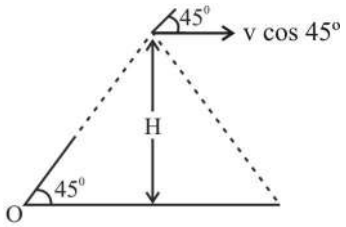
$$v = \frac{2v_1v_2}{(v_1+v_2)}$$

36. A ball whose kinetic energy is E, is thrown at an angle of 45^0 with the horizontal. The kinetic energy at the highest point of its flight will be :

(a) E (b) E/2
(c) E/3 (d) Zero

KVS PGT 2014 (Physics)

Ans. (b) :



The velocity at highest point of projectile path v' = v
$\cos\theta = v\cos45^0 \Rightarrow v' = \frac{v}{\sqrt{2}}$
At initially projected ball,

$$\text{kinetic energy} = \frac{1}{2}mv^2 = E$$

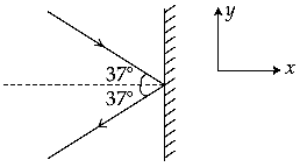
The kinetic energy at highest point

$$= \frac{1}{2}mv'^2 = \frac{1}{2}m\left(\frac{v}{\sqrt{2}}\right)^2 = \frac{1}{2}\times\frac{mv^2}{2}$$

$$= \left(\frac{1}{2}mv^2\right)\frac{1}{2} = \frac{E}{2}$$

37. A ball of mass 0.10 kg strikes a rigid wall with a speed of 5.0 m/s and is reflected with the same speed, as shown in the figure. The magnitude of impulse imparted to the ball by the wall is :

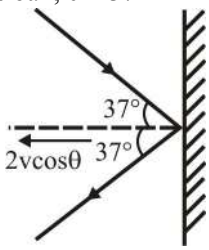
$\left(\tan 37° = \frac{3}{4}\right)$



(a) 0 (b) 0.50 N s
(c) 0.80 N s (d) 1.0 N s

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans. (c) : Given
Mass of ball (m) = 0.10 kg
Velocity of ball (v) = 5.0 m/s
Angle made by the ball, θ = 37°



We know that
Impulse (J) = Change in momentum = mvcosθ – (– mvcosθ).
Therefore,
J = 2 mvcos□□

$= 2 \times 0.10 \times 5 \times \cos 37° \quad \left[\therefore \tan 37° = \frac{3}{4} \cos 37° = \frac{4}{5}\right]$

$= 2 \times 0.10 \times 5 \times \frac{4}{5}$

$= 0.80 N$

38. The position x (in meter) of four objects A, B, C and D are given by following equations where time t is in second.

(A) $x=1.0+2.0t^2$
(B) $x=2.0t$
(C) $x=2.0t+3.0t^2$
(A) $x=1.0+2.0t+3.0t^2$

Which of them is moving with a uniform speed ?

(a) (A) (b) (B)
(c) (C) (d) (D)

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans.(b): Except the option (b), all others are non uniform because $\frac{dx}{dt} = f(t)$.
Now from the options,

(a) $x = 1.0 + 2.0t^2 \Rightarrow \frac{dx}{dt} = 4.0t$

(c) $x = 2.0t + 3.0t^2 \Rightarrow \frac{dx}{dx} = 2.0 + 6.0t$

(d) $x = 1.0 + 2.0t + 3.0t^2$

$\frac{dx}{dt} = 2.0 + 6.0t$

(b) $x = 2t \Rightarrow \frac{dx}{dt} = 2 = v$

which is a constant independent of t.
So, option (b) x = 2.0t is moving with a uniform speed.

39. The velocity *v* (in m/s) of a particle changes with time t (in second) as
$v=1.0+2.0t+1.0t^2$
The average acceleration of the particle for the duration t=0 s to t=2.0 s is :

(a) 1.0 m/s^2 (b) 3.0 m/s^2
(c) 4.0 m/s^2 (d) 5.0 m/s^2

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans. (c) : Given, velocity = $1.0 + 2.0t + 1.0t^2$
So, acceleration of particle at time t

$a_t = \frac{dv}{dt} = \frac{d}{dt}(1.0 + 2.0t + 1.0t^2)$

$a_t = 2.0 + 2.0t$
acceleration at t = 0,
$a_0 = 2.0 + 2.0 \times 0 = 2.0\ m/s^2$
acceleration at t = 2,
$a_0 = 2.0 + 2.0 \times 2 = 6.0\ m/s^2$
Average Acceleration,

$a = \frac{a_0 + a_2}{2} = \frac{2+6}{2} = 4.0\ m/s^2$

40. Match the List - I with List - II and select the correct answer :

List-I (Expression)	List-II (Physical Quantity)
(A) $\frac{R}{L}$	**(p) Time**
(B) RC	**(q) Frequency**
(C) $\frac{E}{B}$	**(r)Speed**
(D) $\sqrt{\mu_0 \varepsilon_0}$	**(s) $(Speed)^{-1}$**

(A) (B) (C) (D)
(a) (p) (q) (r) (s)
(b) (q) (p) (r) (s)
(c) (p) (q) (s) (r)
(d) (s) (r) (q) (p)

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans. (b) :

- $\frac{L}{R}$ = time constant [T]

  $\frac{R}{L} = \frac{1}{\text{time constant}}$ = frequecny
- RC = time constant [T]
- $\frac{E}{B} = C$ = speed
- $\frac{1}{\sqrt{\mu_0 \in_0}} = c$ = speed

  $\sqrt{\mu_0 \in_0} = \frac{1}{c} = (\text{speed})^{-1}$

So, option b is correct.

41. A 0.5 kg ball falls pass a window, whose top is 1.8 m in vertical extent from the ground. If the speed of the ball at the top of the window is 8 m/s, its speed at the ground will be: (Take g = 10 m/s^2)

(a) 10 m/s (b) 8 m/s
(c) 6 m/s (d) 5 m/s

KVS TGT 2023 (Science)

Ans.(a): Given,
m = 0.5kg
h = 1.8 m
v_1 = 8 m/s
We know that,

$$\frac{1}{2}mv_1^2 + mgh = \frac{1}{2}mv_2^2$$

$$\frac{1}{2}\times 0.5\times(8)^2 + 0.5\times 10\times 1.8 = \frac{1}{2}\times 0.5\times v_2^2$$

$$\frac{1}{2}\times 64 + 18 = \frac{1}{2}v_2^2$$

$$32 + 18 = \frac{1}{2}v_2^2$$

$$v_2^2 = 100$$

$$v_2 = 10 \text{ m/s}$$

42. The ratio of average velocity and average speed of a body is

(a) 1
(b) more than 1
(c) 1 or less than 1
(d) More than one of the above
(e) None of the above

BPSC School Teeacher 2023 Paper-IV Physics

Ans.(c): Displacement is the shortest distance between two points.
Displacement ≤ Distance

$$\frac{\text{Displacement}}{\text{Distance}} \le 1$$

$$= \frac{\text{Average velocity}}{\text{Average speed}} \le 1$$

So, option (c) is correct.

43. If a wave is having group velocity of 2 × 10^8 m/sec, then what is phase velocity?

(a) 4.5 × 10^8 m/sec
(b) 5.5 × 10^8 m/sec
(c) 9 × 10^8 m/sec
(d) More than one of the above
(e) None of the above

BPSC School Teeacher 2023 Paper-III Science

Ans.(a): Given,
Group velocity (v_g) = 2 × 10^8 m/s
Phase velocity, v_p = ?
c = 3 × 10^8 m/s
We know that,
$v_g \times v_p = (c)^2$

$$v_p = \frac{(c)^2}{V_g}$$

$$= \frac{(3\times 10^8)^2}{2\times 10^8}$$

= 4.5 × 108 m/s

44. A particle moves with different uniform speeds v, 2v,3v, ...,nv in equal intervals of time. The average speed of particle over complete journey is

(a) $\frac{nv}{2}$ (b) $\frac{(n-1)v}{2}$
(c) $\frac{(n+1)v}{2}$ (d) (n + 1)v

KVS PGT 2023 (17/02/2023) Physics

Ans.(c): $V_{avg} = \frac{\text{Total Distance}}{\text{Total Time}}$

$$V_{av} = \frac{(v\times t) + (2v\times t) + ...(nv\times t)}{t + t + t + ... + n \text{ times}}$$

$$= \frac{vt + 2vt + 3vt + ... + nvt}{nt}$$

$$= \frac{v}{n}[1 + 2 + 3.....n]$$

$$= \frac{v}{n}\frac{(n)(n+1)}{2} = \frac{(n+1)v}{2}$$

45. An object is moving with a constant velocity $\vec{V}$. Which one of the following statements is correct for the angular momentum of this object?

(a) Its value is always zero
(b) Its value is always non-zero
(c) It value is zero only once during its journey
(d) Its value is zero only if the trajectory of the object passes through the origin

KVS PGT 2023 (17/02/2023) Physics

Ans.(d): Angular Momentum

$\vec{L} = \vec{r} \times \vec{p}$

$\vec{L} = \vec{r} \times (m\vec{v})$

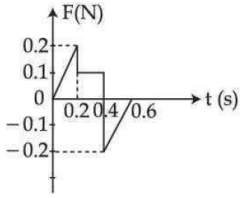
if $\vec{r} = 0$ (passing through origin)

$\vec{L} = 0 \times (m\vec{v})$

$\vec{L} = 0$

So, angular momentum is zero only if the trajectory of the object passes through the origin.

46. A ball of mass 200g is at rest at t = 0. An external force F varying with time as shown in Fig is applied on ball. The speeds of ball at (i) t = 0.2s, (ii) 0.4 s and (iii) 0.6 s are (i) V_1 (ii) V_2 and (iii) V3 respectively. $\frac{V_2}{V_1}$ and $\frac{V_3}{V_2}$ are :

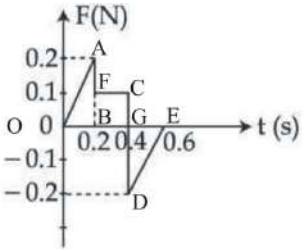


(a) $\frac{V_2}{V_1} = 1; \frac{V_3}{V_2} = 0.5$ (b) $\frac{V_2}{V_1} = 2; \frac{V_3}{V_2} = 0.5$

(c) $\frac{V_2}{V_1} = 2; \frac{V_3}{V_2} = 1$ (d) $\frac{V_2}{V_1} = 2; \frac{V_3}{V_2} = 2$

KVS PGT 2023 (17/02/2023) Physics

Ans.(b):



We know, $\Delta P = F \times \Delta t$

Area $\Delta OAB = \Delta P = \frac{1}{2} \times 0.2 \times 0.2$

$\Rightarrow \quad m\Delta V = 0.1 \times 0.2$

$\Rightarrow 0.2 \times (V_1 - V_0) = 0.1 \times 0.2 \quad [\because m = 200g = 02kg]$

$\Rightarrow 0.2(V_1 - V_0) = 0.1 \times 0.2$

$V_1 = 0.1 m/s$

Area of square (BGCF) $= 0.2 \times 0.1$

$\Rightarrow m(V_2 - V_1) = 0.2 \times 0.1$

$\Rightarrow m(V_2 - 0.1) = 0.2 \times 0.1$

$\Rightarrow 0.2(V_2 - 0.1) = 0.2 \times 0.1$

$\Rightarrow V_2 = 0.1 + 0.1$

$V_2 = 0.2 m/s$

Now, area $\Delta GDE = -\frac{1}{2} \times 0.2 \times 0.2$

$\Rightarrow \quad 0.2(V_3 - V_2) = -\frac{1}{2} \times 0.2 \times 0.2$

$\Rightarrow \quad V_3 - 0.2 = -0.1$

$V3 = 0.1 m/s$

$\therefore \quad \frac{V_2}{V_1} = \frac{0.2}{0.1} = 2$ and $\frac{V_3}{V_2} = \frac{0.1}{0.2} = 0.5$

47. Two objects each of 5 kg are moving on a straight line but in opposite directions. The velocity of each object is 20 m/s before they collide and stick together. What will be the velocity of the combined system?

(a) 20 m/s (b) 40 m/s

(c) zero (d) 10 m/s

KVS (LDCE) TGT 2022 (Science)

Ans.(c): Given,

$m_1 = 5kg$

$m_2 = 5kg$

$v_1 = 20 m/s$

$v_2 = -20 m/s$

Now,

From the law of conservation of momentum,

Momentum before collision = Momentum after collision

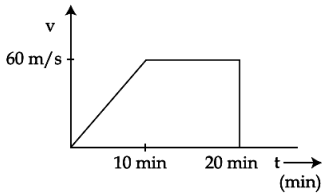
$m_1v_1 + m_2v_2 = (m_1 + m_2)v$

$(5 \times 20) + (5 \times -20) = (5 + 5) v$

$100 - 100 = 10v$

$\boxed{v = 0}$

48. The change in the velocity of a bus is depicted in the following graph. Find the total distance travelled by the bus.



(a) 900 m (b) 54 m

(c) 9 m (d) 540 m

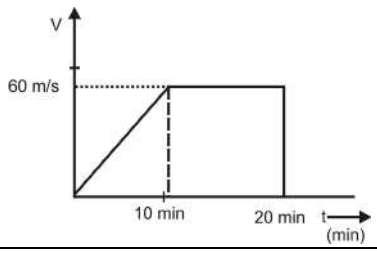
KVS (LDCE) TGT 2022 (Science)

Ans.(a): Total distance traveled by bus area under the curve below.

S = Area under curve

$S = \frac{1}{2} \times 10 \times 60 + 60 \times 10$

$S = 900 m$



49. Ravi is travelling from Delhi to Agra in a car. He covers one - third of distance at a speed of 30 km/h and rest of the distacne at a speed of 50 km/h
The average speed is approximately:
(a) 41 km/h (b) 45 km/h
(c) 35 km/h (d) 48 km/h
KVS (LDCE) TGT 2022 (Science)

Ans.(a): Given,

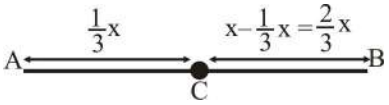
$D_1 = \frac{x}{3}$ km, $D_2 = \frac{2x}{3}$ km,

$v_1 = 30$ km/hr, $v_2 = 50$ km/hr

$$t_1 = \frac{D_1}{v_1} = \frac{x/3}{30} = \frac{x}{3\times 30}$$

$$t_2 = \frac{\frac{2}{3}x}{50} = \frac{2x}{3\times 50}$$

Total time = $t_1 + t_2$



$$t_1 + t_2 = \frac{x}{3\times 30} + \frac{2x}{3\times 50}$$

$$t_1 + t_2 = \frac{x}{3\times 10}\left[\frac{1}{3}+\frac{2}{5}\right]$$

$$t_1 + t_2 = \frac{x}{30}\left[\frac{5+6}{15}\right]$$

$$t_1 + t_2 = \frac{11x}{30\times 15}$$

Now,

$$V_{av} = \frac{\text{Total Distance}}{\text{Total Time Taken}} = \frac{x}{t_1 + t_2}$$

$$V_{av} = \frac{x}{\frac{x\times 11}{30\times 15}} = \frac{30\times 15}{11} = \frac{450}{11}$$

$= 40.909$
$= 41$ km/h.

50. The length of minute hand in a clock is 4.5 cm. What is the average velocity of the tip of the minute hand between 6.00 am and 6.30 am.
(a) 0.3 m/s (b) 0.5×10^{-4} m/s
(c) 5×10^{-3} cm/s (d) 0.5 cm/s
KVS (LDCE) TGT 2022 (Science)

Ans.(c): Between 6:00 Am to 6:30 Am
 Displacement = 2 × (length of minute hand)
$= 2 \times 4.5$
$= 9$ cm
and time taken (t) = 30 min = 30×60
$= 1800$ sec
 average velocity $= \frac{s}{t} = \frac{9}{1800} = 5\times 10^{-3}$ cm/sec

51. Which of the following statement is/are correct?
S1 - Average speed of an object over a finite intervel of time is greater than or equal to the magnitude of average velocity.
S2 - Instantaneous speed at any instant is equal to the magnitude of instantaneous velocity.
(a) S1 is correct and S2 in incorrect
(b) S1 is incorrect and S2 is correct
(c) Both S1 and S2 and correct
(d) Neither S1 nor S2 is correct
KVS (LDCE) TGT 2022 (Science)

Ans.(c): Average speed of an object over a finite interval of time is greater than or equal to the magnitude of average velocity because the two are equal only if the path length is equal to the magnitude of displacement.

52. The dimension of speed is-
(a) LT^{-1} (b) LT^{-3}
(c) LT (d) LT^{-2}
DSSSB TGT 2021(male,08/09/2021)Shift-II N.Sci.

Ans.(a): $\text{speed} = \frac{\text{distance}}{\text{time}}$
distance = [L]
time (t) = [T]
$V = \left[\frac{L}{T}\right]$
$= M^{0}LT^{-1}$.

53. If an object moves 40 m towards north in 10 s and then 30 m east ward in next 10s, The average velocity of the object is-
(a) 2 ms^{-1} (b) 2.5 ms^{-1}
(c) 3 ms^{-1} (d) 1.5 ms^{-1}
DSSSB TGT 2022 (Female, 26/09/2022) Shift-I N.Sci.

Ans.(b): Since, object moves 40 m north and 30 m east.
Then, the resultant displacement of object
$= \sqrt{(40)^2 + (30)^2} = 50$m
Total time (t) = 10 + 10 = 20 second
Average velocity $= \frac{50}{20} = 2.5$m/s

54. A man running with a uniform velocity u on a straight road sees a bus just starting when it is at a distance x from him. If the acceleration of the bus is f, then what is the maximum possible value of x that would enable the man to catch the bus?
(a) There is no upper limit (b) $\frac{u^2}{4f}$
(c) $\frac{u^2}{f}$ (d) $\frac{u^2}{2f}$
NVS PGT 2019 (Physics)

Ans.(d): Given,

velocity of man = u

Acceleration of bus = f

Distance travelled by the bus, $= S_1 = 0 + \frac{1}{2}ft^2 = \frac{1}{2}ft^2$

Distance travelled by the man, $S_2 = ut$

When man catches the Bus,

$x + S_1 = S_2$

$\Rightarrow x = S_2 - S_1 = ut - \frac{1}{2}ft^2$

$\Rightarrow \frac{1}{2}ft^2 - ut + x = 0$

$\Rightarrow t = \frac{4 \pm \sqrt{u^2 - 4 \times \frac{f}{2} \times x}}{2 \times f/2}$

For real time t, $u^2 \geq 2fx$

$\Rightarrow \frac{u^2}{2f} \geq x$

i.e. the maximum possible value of x that would enable the man to catch the bus is $x = \frac{u^2}{2f}$

55. Abhiram leaves his house at 8.30 am for his school. The school is 2 km away and classes start at 9.00 am. If he walks at a speed of 3 km/hr for the first kilometer, at what speed should he walk the second kilometer to reach just in time?

(a) 6 km/hr (b) 5.5 km/hr

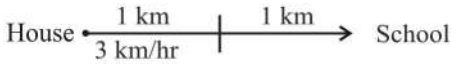
(c) 4.5 km/hr (d) 3 km/hr

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans.(a): Given,

Total distance, d = 2 km

Total time taken by Abhiram, t = 30 Minute $= \frac{1}{2}$hr



Time taken by abhiram in first 1 km = 1/3 hr

Suppose time taken in next 1 km = t_2

$\therefore t_1 + t_2 = t$

$\Rightarrow \frac{1}{3} + t_2 = \frac{1}{2}$

$\Rightarrow t_2 = \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$hr

Thus, the speed through which he walks the second kilometer is $v_2 = \frac{1}{(1/6)} = 6$ km/hr.

56. A body freely falling from rest has acquired a velocity 'v' after it falls through a distance 'h'. The distance it has to fall down further for its velocity to become doubled is :

(a) h (b) 2h

(c) 3h (d) 4h

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans.(c): At h height,

$\frac{1}{2}mv^2 = mgh$

$\Rightarrow v^2 = 2gh$

$\Rightarrow v^2 \propto h$

Here, $v_1 = v$, $v_2 = 2v$, $h_1 = h$, $h_2 = ?$

$\left(\frac{v_1}{v_2}\right)^2 = \frac{h_1}{h_2}$

$\Rightarrow \left(\frac{v}{2v}\right)^2 = \frac{h}{h_2} \Rightarrow h_2 = 4h$

Since, body already fall at height h. So, from height h, it only fall 4h – h = 3h height to gain its double velocity.

57. A mass of 4 kg moving at 3m/s collides with a mass of 6 kg moving at 2m/s in the opposite direction and they stick together. The combined mass has velocity of:

(a) zero (b) 2.4 m/s

(c) 4.8 m/s (d) 5.6 m/s

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans.(a): Given, $m_1 = 4$ kg, $v_1 = 3$m/s

$m_2 = 6$ kg, $v_2 = -2$ m/s

As per question, using the conservation of linear momentum,

$(m_1 + m_2)\, v = m_1v_1 + m_2v_2$

$10v = 4 \times 3 - 6 \times 2$

$\Rightarrow v = 0$

Thus the combined mass is at rest.

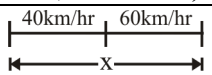
58. A car covers the first half of the distance between two places at a speed of 40 km/hr and the second half at 60 km/hr. What is the average speed of the car?

(a) 50 km/hr (b) 48 km/hr

(c) 100 km/hr (d) 60 km/hr

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans. (b) :



$\text{Avg.speed} = \frac{\text{Total distance covered}}{\text{Total time taken}} = \frac{x}{t}$

Time $t_1 = \frac{x}{2} \times \frac{1}{40} = \frac{x}{80}$

$t_2 = \frac{x}{120}$

Total time $t = t_1 + t_2$

$t = \frac{x}{80} + \frac{x}{120} \Rightarrow t = \frac{x}{40}\left[\frac{1}{2} + \frac{1}{3}\right]$

Average speed $\frac{x}{t} = 40 \times \frac{6}{5} = 48$ km/h

59. A sphere of mass 2 kg strikes another sphere of mass 3 kg at rest with a velocity of 5m/s. If they move together after collision, what is their common velocity?

(a) 5 m/s (b) 6 m/ s

(c) 1 m/s (d) 2 m/s

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans. (d) : $m_1 = 2$ kg

$v_1 = 5$ m/s

$m_2 = 3$ kg.

$v_2 = 0$

$m_1v_1 + m_2v_2 = (m_1 + m_2)\, v_f$

$2\times5+3\times0=(2+3)\times v_f$

$5v_f = 10$

$v_f = 10/5 = 2m/s$

60. The dimensions of $\in_0 \mu$ are the same as those of

(a) $(\text{velocity})^{-2}$ (b) $(\text{velocity})^2$

(c) velocity (d) $(\text{velocity})^{-1/2}$

DSSSB TGT 2014 (28/12/2014) N.SCI.

Ans. (a) : $\because\ c = \dfrac{1}{\sqrt{\mu_0 \in_0}}$, where c = speed of light

$\therefore\ \mu_0 \in_0 = \dfrac{1}{c^2}$

So, dimensions of $\mu_0 \in_0$ will be same as of $(\text{velocity})^{-2}$

Hence, option (a) is correct.

61. Two balls of equal mass are moving in the same direction along the same straight line with velocities of magnitude in the ratio 2:1. They collide and in the process lose x% of their kinetic energy. If the coefficient of restitution is $\frac{2}{3}$, find x:

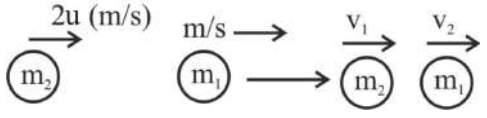
(a) $5\frac{1}{4}$ (b) $5\frac{2}{9}$

(c) $5\frac{5}{9}$ (d) $6\frac{1}{4}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Let the initial velocities of the given balls be 2u and u and final velocity after collision be V_1 and V_2.

Applying, Law of conservation of momentum here,



here, $m_1 = m_2 = m$

$\Rightarrow m(2u) + mu = mv_1 + mv_2$

$\Rightarrow 3mu = mv_1 + mv_2$

$\Rightarrow v_1 + v_2 = 3u$ ... (i)

and after collision,

Net Initial kinetic energy =

$$\frac{1}{2}m(2u)^2 + \frac{1}{2}m(u)^2$$

and net final kinetic energy =

$$\frac{1}{2}m\left(v_1^2 + v_2^2\right)$$

ATQ,

$$\Rightarrow \frac{1}{2}m\left(4u^2 + u^2\right) = \frac{1}{2}m\left(v_1^2 + v_2^2\right) + \frac{mx}{100}\left(\frac{5u^2}{2}\right) \quad \text{.... (ii)}$$

Coefficient of restitution

$$e, = -\left(\frac{v_2 - v_1}{u_2 - u_1}\right)$$

$$e = -\frac{v_2 - v_1}{2u - u}$$

$$\Rightarrow \frac{2}{3} = -\frac{(v_2 - v_1)}{u}$$

$\Rightarrow 3(v_1 - v_2) = 2u$

$\Rightarrow v_1 - v_2 = \dfrac{2}{3}u$ ... (iii)

Adding (i) and (iii), equation, we get

$$2v_1 = 3u + \frac{2}{3}u = \frac{11}{3}u$$

$$\Rightarrow v_1 = \frac{11}{6}u$$

So, $v_2 = 3u - v_1$ [From (i)]

$$= 3u - \frac{11}{6}u$$

$$= \frac{7}{6}u$$

From (ii), we get

$$\frac{1}{2}m(5u^2) - \frac{1}{2}\left[\left(\frac{11}{6}\right)^2 + \left(\frac{7}{6}\right)^2\right]u^2 = \frac{x}{100}\times\frac{5u^2}{2}\times m$$

$$\Rightarrow 5u^2 - \frac{170}{36}u^2 = \frac{x}{20}\times mu^2$$

$$\Rightarrow \frac{10}{36}u^2 = \frac{x}{20}mu^2$$

$$\Rightarrow x = \frac{20\times10}{36} = \frac{50}{9}$$

$$\therefore x = 5\frac{5}{9}$$

62. A particle is moving along a straight line. It starts from rest and moves with a uniform acceleration 'a', till it attains a velocity 'V' and then travels with uniform retardation 'b' till it again comes to rest. The total time of travel is 't'. then,

(a) $\dfrac{1}{a}+\dfrac{1}{b}=\dfrac{2t}{V}$ (b) $\dfrac{1}{a}+\dfrac{1}{b}=\dfrac{t}{V}$

(c) $\dfrac{1}{a}+\dfrac{1}{b}=\dfrac{V}{2t}$ (d) $\dfrac{1}{a}-\dfrac{1}{b}=\dfrac{t}{V}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans.(b): We have,
Equation of motion,
(i) For the acceleration phase

$V = 0 + at_1$

$t_1 = \frac{V}{a}$ .....(i)]

(ii) For the retardation phase

$0 = V - bt_2$

$t_2 = \frac{V}{b}$ .....(ii)

Now find (t_2) we know that the total time of travel (t) is the sum of the times taken in each point.

$\boxed{t = t_1 + t_2}$

Putting the values of t_1 and t_2 from eq^n. (i) and (ii) we get–

$t = \frac{V}{a} + \frac{V}{b}$ .....(iii)

$\boxed{\frac{1}{a} + \frac{1}{b} = \frac{t}{V}}$

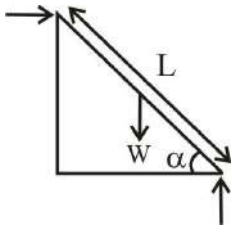
63. A heavy uniform rod is in equilibrium and resting against a smooth vertical wall, and the other against a smooth plane inclined to the wall at 45º. If 'α' is the inclination of the rod to the horizontal, then tan α is equal to:

(a) $\frac{1}{3}$ (b) $\frac{1}{4}$

(c) $\frac{1}{2}$ (d) $\frac{1}{6}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) :



Given, θ = 45º
In the equilibrium condition of rod-
Torque due to weight = Torque due to normal force on inclination

$W \cdot \frac{L}{2} \cdot \sin\alpha = W.L.\cos\alpha$

$\frac{\sin\alpha}{\cos\alpha} = \frac{1}{2}$

$\tan\alpha = \frac{1}{2}$

64. A particle moving in a straight line follows the equation:
$v^2 = 4x - x^2$
What is the range of motion?

(a) $0 < x < 4$ (b) $x \le 0$

(c) $x \ge 4$ (d) $0 \le x \le 4$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (d) : Given,

$v^2 = 4x - x^2$

$v = \sqrt{4x - x^2}$

$\Rightarrow$ $4x - x^2 \ge 0$

$\Rightarrow$ $x^2 - 4x \le 0$

$\Rightarrow$ $x(x-4) \le 0$

$\Rightarrow$ $x \in (0, 4)$

Hence, $0 \le x \le 4$

65. A body is projected at an angle 30º to the horizontal, so as just to clear walls of equal height 5m at a distance 10m from each other. The total range of the body in meters is?

(a) 20 (b) $10\sqrt{3}$

(c) 10 cot15º (d) 20 cot15º

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Given,
Angle, $\alpha = 30º$
Height of wall, a = 5m

From formula, $h = 2a\cot\left(\frac{1}{2}\right)\alpha$

Where, h = total range of the body.

$h = 2 \times 5\cot\left(\frac{1}{2}\right) \times 30º$

$h = 10\cot\frac{30º}{2}$

$h = 10\cot15º$

66. A ball is thrown up at a speed of 2m/s. If g = 10m/s^2, then find the maximum height the ball will reach?

(a) 0.80 m (b) 0.40 m

(c) 0.20 m (d) 0.10 m

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

Ans. (c) : Given

$v = 2m/s,\ g = 10m/s^2$

Initial K.E. = final P.E.

$\frac{1}{2}mv^2 = mgh$

$v^2 = 2gh$

$\Rightarrow$ $h = \frac{v^2}{2g} = \frac{4}{2 \times 10} = \frac{2}{10} = 0.2m$

67. A particle moves in a straight line such that its displacement at any time t is given by s= $t^3 - 6t^2 + 3t + 7$ meters. The velocity of the particle when the acceleration is zero is :

(a) 42 m/s (b) –9 m/s

(c) 3 m/s (d) –12 m/s

KVS PGT 2014 (Physics)

Ans. (b) : Given, $s = t^3 - 6t^2 + 3t + 7$

$$v = \frac{ds}{dt} = 3t^2 - 12t + 3$$

$$a = \frac{dv}{dt} = \frac{d^2s}{dt^2} = 6t - 12$$

since acceleration is zero,

$a = 0 \Rightarrow 6t - 12 = 0 \Rightarrow t = 2$ second

Therefore, velocity of particle at t = 2s,

$v = 3(2)^2 - 12 \times 2 + 3 = -9$ m/s

68. Ramesh travels on a straight path with uniform velocity v_1 for some time and with uniform Velocity v_2 for the next equal time.
The average velocity v of Ramesh is

(a) $v = \sqrt{v_1 v_2}$ (b) $\frac{1}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

(c) $v = \frac{v_1 + v_2}{2}$ (d) $\frac{2}{v} = \frac{1}{v_1} + \frac{1}{v_2}$

KVS (LDCE) TGT 2022 (Science)

Ans.(c): Displacement during the velocity v_1 will be,

$x_1 = v_1 t$

Displacement during the velocity v_2 will be,

$x_2 = v_2 t$

$$\text{Average velocity} = \frac{\text{Displacement}}{\text{Time}}$$

$$= \frac{x_1 + x_2}{t + t}$$

$$= \frac{v_1 t + v_2 t}{2t}$$

$$= \frac{v_1 + v_2}{2}$$

69. For an object moving along a straight line without changing its direction the-

(a) distance is not zero but displacement is zero
(b) distance travelled > displacement
(c) distance travelled = displacement
(d) distance travelled < displacement

DSSSB TGT 2021(male,08/09/2021)Shift-II N.Sci.

Ans.(c): Distance travelled by an object means the amount of total movement of an object from the reference point. While the displacement is the shortest distance measured from the initial to the final position of object. i.e., the direction of moving object plays great role in displacement.

Therefore, for an object moving along a straight line without changing its direction, then the distance travelled by object is equal to displacement of object.

70. If the net external force is zero, a body at rest continues to remain at rest and a body in motion continues to move with a uniform velocity. This property of the body is called___.

(a) Mobility (b) Inertia
(c) Resistance (d) Acceleration

DSSSB TGT 2021 (Female, 25/09/2021) Shift-I N.Sci.

Ans. (b) : If the net external force is zero, a body at rest continuous to remain at rest and a body in motion continuous to move with a uniform velocity. This property of the body, is called inertia. The concept of inertia given by Galileo. This statement is the Newton's first law of motion.

71. A car takes 20 s to stop after the application of the brakes. The distance it travels during this interval if brakes produce a retardation of 0.6 m/s^2 is :

(a) 240 m (b) 120 m
(c) 60 m (d) 360 m

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans. (b) : Given,

t = 20 sec

$a = -0.6$ m^2/s

s = ?

v = 0 m/s

from $v = u + at$

$0 = u - 0.6 \times 20$

$u = 12$ m/s

Also, $S = ut + \frac{1}{2}at^2$

$$S = 12 \times 20 + \frac{1}{2}(-0.6)(20)^2$$

$S = 240 - 120$

$S = 120$ m

3. Acceleration

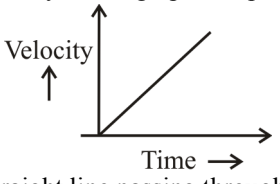
72. Given below are four statements related to uniformly accelerated motion.

(p) The velocity vs. time graph is always a straight line passing through the origin
(q) The square of the velocity has a linear relations with the displacement.
(r) The velocity has a linear relation with the square of the displacement.
(s) The displacement during a period of time is the arithmetic mean between the initial and final velocities.
Which among the above statement (s) is /are true?

(a) (p) and (q) (b) (r) and (s)
(c) (q) and (s) (d) only (r)

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (a) : A velocity - time graph is represented by



It is always a straight line passing through the origin.
Also represented by -

$v = u + at$

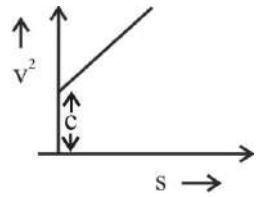
$y = mx$

The square of the velocity has a linear relation with the displacement.

$v^2 = u^2 + 2as$

$y = mx + c$

$y = v^2 \quad m = 2a \quad x = s \quad c = u^2$



Hence, the statement p and q are correct and option (a) is correct.

73. An electric motor starts from rest and on application of a torque on the shaft, that is about the axis rotation of the motor, it acquires and angular acceleration, $\propto = 2t - t^2$ during the first 2 seconds of its start, after which it becomes zero. What will be the total angular displacement (in terms of number of revolution) of the shaft in 5 sec?

(a) $\frac{8}{3\pi}$ (b) $\frac{16}{3\pi}$

(c) $\frac{4}{3\pi}$ (d) $\frac{4}{\pi}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (*) : Angular acceleration, $\alpha = 2t - t^2$

We know that

$$\alpha = \frac{d\omega}{dt}$$

$$\alpha dt = d\omega$$

$$(2t - t^2)dt = d\omega$$

On integrating both sides we get -

$$\omega = t^2 - \frac{t^3}{3}$$

at $t = 2$, $\omega = 4 - \frac{8}{3}$

$$\omega = \frac{4}{3}\text{rad/sec}$$

We know that, $\omega = \frac{d\theta}{dt}$

$$d\theta_1 = \omega dt$$

On integrating both sides we get -

$$\theta_1 = \frac{4}{3}[t]_0^2$$

$$\theta_1 = \frac{4}{3} \times 2$$

$$\theta_1 = \frac{8}{3}\text{rad}$$

$$d\theta_2 = \omega dt$$

$$\theta_2 = \frac{4}{3}[t]_2^5$$

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

$$\theta_2 = 4 \text{ rad}$$

Now,

$$\Delta\theta = 2\pi n$$

$$(\theta_2 - \theta_1) = 2\pi n$$

$$4 - \frac{8}{3} = 2\pi n$$

$$n = \frac{4}{3 \times 2\pi}$$

$$n = \frac{2}{3\pi}$$

Note : Official answer given by commission is option (a).

74. In the case of an one-dimensional motion, the relation between to velocity (v) and position (x) is given by.

$$v = 2\sqrt{a(x\cos x - \sin x)},$$

Where 'a' is a constant. Find its acceleration

(a) $2a\sin x$ (b) $2a\cos x$

(c) $-2a\sin x$ (d) $-2a\cos x$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Given,

$$v = 2\sqrt{a(x\cos x - \sin x)}$$

where, a = constant

$$\frac{v^2}{4} = a(x\cos x - \sin x)$$

Now, differentiating both side with respect to 't', we get-

$$2v\frac{dv}{dt} \cdot \frac{1}{4} = a\left(-x\sin x\frac{dx}{dt} + \cos x\frac{dx}{dt} - \cos x\frac{dx}{dt}\right)$$

$$\left[\because \frac{dx}{dt} = v\right]$$

$$\Rightarrow \quad \frac{1}{2}\frac{dv}{dt} = a(-x\sin x)$$

$$\Rightarrow \quad \frac{dv}{dt} = 2a(-x\sin x)$$

$$a = \frac{dv}{dt} = -2ax\sin x$$

75. A flexible heavy chain of length 10 m, is moving over a smooth fixed pulley. The two unequal portions of the chain are hanging vertically. The instant when the middle point of the chain is at a distance 3 m below the pulley. The acceleration with which it is moving is: ($g = 10\ m/s^2$)

(a) $6\ m/s^2$ (b) $3\ m/s^2$

(c) $2\ m/s^2$ (d) $4\ m/s^2$

DSSSB PGT 2018 (04 July 2018 Female) Physics

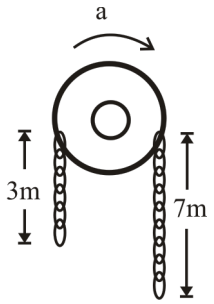
Ans.(d): Let the mass of 10m length be m kg.

$10 \rightarrow m$

$1 \rightarrow \frac{m}{10}$

$3 \rightarrow \frac{3m}{10}$

$7 \rightarrow \frac{7m}{10}$



When the mid point of the chain is at 3 m below the pulley-

$$\left(\frac{7m}{10}-\frac{3m}{10}\right)g = ma$$

$$\frac{4mg}{10} = ma$$

$$a = \frac{4}{10}\times 10 = 4\ m/s^2$$

76. A glass plate can just support a weight of 54 kg. The plate with a body on it is raised with gradually increasing acceleration. It is found that the plate breaks when the acceleration is 8 ms^{-2}. Find the mass of the body in kg (take g = 10 ms^{-2})

(a) 120 (b) 90

(c) 60 (d) 30

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (d) : Let, mass of the body is 'm' kg.

A glass plate can support 54 kg mass.

So, force it can suffer = m×a'

Considering, g = 10 m/s^2

The force it can bear = 54×10 = 540 N

It is found that the plate break when the acceleration is 8 ms^{-2}.

$\therefore$ a = 8 ms^{-2}

Acceleration added with gravity = a' = g+a

a' = 10+8

= 18 ms^{-2}

Now,

$540 = m\times a'$

$540 = m\times 18$

$$\therefore \quad m = \frac{540}{18} = 30\,kg$$

So, the mass of the body is 30 kg.

77. Projectile motion is an example of motion in a plane with _____ acceleration.

(a) Increasing (b) Decreasing

(c) Zero (d) Constant

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

Ans.(d): Projectile motion is an example of zero accleration in horizontal plane and constant accleration in vertical plane.

In projectile motion our consideration is vertical plane so correct answer is option (d).

78. In which of the following situations, the velocity of an object may be zero at some instant but its acceleration is not zero at that instant ?

A. An object released from a certain height

B. A ball thrown up

C. An object moving in a uniform circular motion

(a) A and B

(b) B and C

(c) A and C

(d) A only

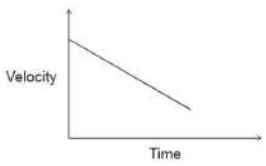
NVS PGT 2022 (Science 28/11/2022)

Ans.(a): Statement A–An object released from a certain height then its initial velocity is zero.

Also, it is falling freely, then it has acceleration due to gravity.

Statement B–A ball is thrown up, then its velocity becomes zero when it reaches to a maximum height but it has constant acceleration g.

79. Which of the following situations is depicted by the given graph ?



(a) The object is moving with non-uniform acceleration

(b) The object is moving with non-uniform retardation

(c) The object is moving with uniform acceleration

(d) The object is moving with uniform retardation

NVS PGT 2022 (Science 28/11/2022)

Ans.(d): The object is moving with uniform retardation.

80. An object is covering distance in direct proportion to the square of time elapsed. The acceleration of the object is

(a) constant (b) increasing

(c) decreasing (d) zero

NVS PGT 2022 (Science 29/11/2022)

Ans.(a): Given, distance proportional to square of time

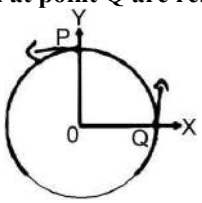
$\Rightarrow x \propto t^2 \Rightarrow x = kt^2$

So, velocity $v = \frac{dx}{dt} = 2kt$

and, acceleration $a = \frac{d^2x}{dt^2} = 2k$

Thus, The acceleration of object is independent of time. So, it is constant.

81. A particle is moving with a constant speed along a circular path, as shown in the figure. When the particle is at point P(0, 1.5 m), its velocity is □(3.0 m/s)$\hat{i}$. Its velocity and acceleration at point Q are respectively:



(a) $(3.0\text{m/s})\hat{j}, -(6.0\text{m/s}^2)\hat{i}$

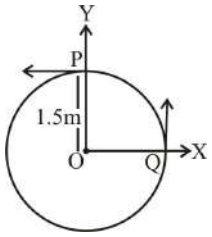
(b) $-(3.0\text{m/s})\hat{j}, -(6.0\text{m/s}^2)\hat{i}$

(c) $-(3.0\text{m/s})\hat{j}, (6.0\text{m/s}^2)\hat{i}$

(d) $(3.0\text{m/s})\hat{j}, (6.0\text{m/s}^2)\hat{i}$

KVS PGT 2018 (Physics)

Ans. (a) :



Point P (0, 1.5)

Velocity at $P = -3\text{m/s}\hat{i}$

Since, on circular path, there is only change in direction.

So, Velocity at Q = 3m/s $\hat{j}$

Acceleration at $Q = \frac{v^2}{r} = \frac{9}{1.5} = 6\text{m/s}^2$

Particle posses only centripetal acceleration which is directed towards centre.

Hence, Acceleration at point Q is $(-6\text{m/s}^2)\hat{i}$

82. A flywheel is rotating at a uniform angular speed of 6 revolution per second. It is subjected to a retarding force to bring it to rest within 10 s. What is the angular acceleration in rad/s^2 of the wheel during its retarding motion?

(a) 3□ (b) –6□

(c) $+\frac{6\pi}{5}$ (d) $-\frac{6\pi}{5}$

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans.(d): Given, revolution per second = n= 6 rev/sec

angular velocity = □ = 2□n = 2□ × 6 = 12□

To find the angular acceleration (□) we can use first equation of motion.

$\omega_f = \omega_i + \alpha t$

$0 = 12\pi + 10\alpha$

$\alpha = \frac{-12\pi}{10}\text{rad/s} = \frac{-6\pi}{5}\text{rad/s}^2$

83. The position x of a particle varies with time t as $x = at^2 - bt^3$. For what value of t acceleration is zero?

(a) 2a/3b (b) a/b

(c) a/3b (d) zero

AEES TGT 2015 (Math, Physics)

Ans.(c): Given,

$x = at^2 - bt^3$

$\text{Velocity} = \frac{dx}{dt} = 2at - 3bt^2$

$\text{Acceleration} = \frac{d^2x}{dt^2} = \frac{d}{dt}(2at - 3bt^2) = 2a - 6bt$

or $0 = 2a - 6bt$ (For $a = 0$)

$\Rightarrow 2a = 6bt$

$t = \frac{2a}{6b} = \frac{a}{3b}$

84. A bus is accelerating uniformly as it passes two checkpoints that are 60 m apart. The time taken between the checkpoint is 6 s and the speed of the bus at the second checkpoint is 16 ms^{-1}. The speed of the bus at the first checkpoint is :

(a) 4 ms^{-1} (b) 8 ms^{-1}

(c) 12 ms^{-1} (d) 16 ms^{-1}

KVS TGT 2023 (Science)

Ans.(c): Given, S = 60m, t = 6 sec

v = 16 m/s u = ?

Acceleration of bus

$a = \frac{16 - u}{6}$

Now, using the second eq^n. of motion.

$s = ut + \frac{1}{2}at^2$

$60 = u.6 + \frac{1}{2}\left(\frac{16-u}{6}\right)(6)^2$

$60 = 6u + 48 - 3u$

$60 = 3u + 48$

$3u = 12$

$u = \frac{12}{3} = 4\text{m/s}$

85. Which of the following is the maximum acceleration of the bus in which a box lying on its floor will remain stationary, given that the co-efficient of static friction between the box and the bus's floor is 0.14 and g = 10 ms^{-2}?

(a) 2.8 ms^{-2} (b) 1.4 ms^{-2}
(c) 14 ms^{-2} (d) 4.2 ms^{-2}

DSSSB TGT 2021(male,08/09/2021)Shift-II N.Sci.

Ans.(b):

$\mu_s = 0.14$
$g = 10\ m/s^2$
Let, mass of box = m
for the above case-
$f_s = \mu_s mg = ma$
$\Rightarrow ma = 0.14 \times m \times 10$
$\Rightarrow a = 1.4\ m/s^2$

86. The dimension of acceleration is -

(a) LT^{-2} (b) LT
(c) LT^{-1} (d) LT^{-3}

DSSSB TGT 2021 (Female, 25/09/2021) Shift-II N.Sci.

Ans.(a): Acceleration $= \frac{\text{Velocity}}{\text{time}}$
dimension of velocity (V) = $[LT^{-1}]$
t = [T]
So, dimensional formula of acceleration $= \frac{[LT^{-1}]}{[T]}$
$= [M^0L^1T^{-2}]$ or LT^{-2}

87. The velocity of a particle changing with position X as $v = (2x^2 + x)$ m/s. Find its acceleration at X = 0.1 m

(a) 0.168 m/s^2 (b) 0.3 m/s^2
(c) zero (d) 1.67 m/s^2

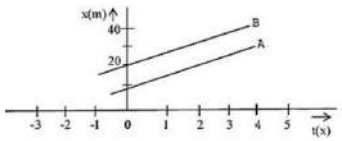
DSSSB TGT 2018 (Female, 27/09/2018) Shift-I N.Sci.

Ans.(a): Given, velocity $v = (2x^2 + x)$

$\Rightarrow \frac{dv}{dx} = 4x + 1$

Acceleration, $a = \frac{vdv}{dx}$
$a = (2x^2 + x)(4x+1)$
$= 8x^3 + 2x^2 + 4x^2 + x$
$a = 8x^3 + 6x^2 + x$
a at x = 0.1 m,
$a = 8(0.1)^3 + 6(0.1)^2 + 0.1$
$a = 0.168\ m/s^2$

88. What does the following graph indicate?

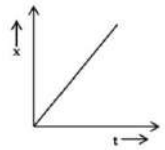


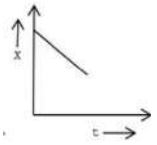
(a) Position-time graphs of two objects with equal velocities.
(b) Position time graphs of two objects with parallel velocities.
(c) Position time graphs of one objects in different positions.
(d) Position-time graphs of one objects with two different velocities.

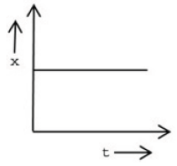
DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

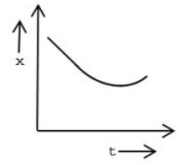
Ans. (a) : The graph shown above represents two objects having equal slope on position time graph that means the objects have equal velocities on given graph and have zero relative velocity.

89. The position - time graph for an object moving with negative velocity is-

(a) 

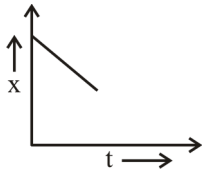
(b) 

(c) 

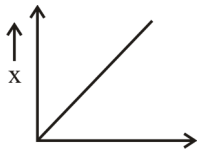
(d) 

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

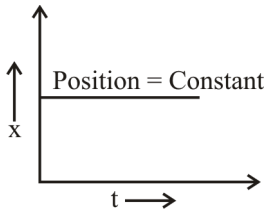
Ans. (b) : The position-time graph for an object moving with negative velocity is option (b).



Negative velocity
$y = -mx + c$
$x = -mt + c$
Slope $= \frac{-dx}{dt}$

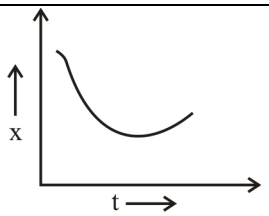
(a) 

Uniform motion
x= mt

(c) 

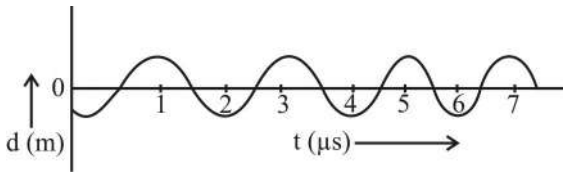
Position = Constant

(d)



Position time graph follows linear function and is a quadratic function hence it is not a position time graph.

90. The given displacement-time (d-t) graph represents a disturbance travelling with a speed of 1200 m/s. The wavelength of the disturbance is



(a) 1.2×10^{-4} m (b) 2.4×10^{-4} m
(c) 1.2×10^{-3} m (d) 2.4×10^{-3} m

NVS PGT 2022 (Science 29/11/2022)

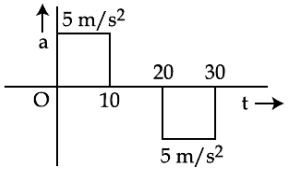
Ans.(d): Given, speed v = 1200 m/s
Let's see figure, The time period for complete one cycle
$T = 2\mu s = 2 \times 10^{-6}$ s

Since, $v = \frac{\lambda}{T}$

$\Rightarrow \lambda = v \times T = 1200 \times 2 \times 10^{-6}$

$\lambda = 24 \times 10^{-4} m = 2.4 \times 10^{-3} m$

91. Find the distance travelled in 30 s by an object starting from rest from the information given in the following graph:



(a) 500 m (b) 1000 m
(c) 250 m (d) 2000 m

KVS (LDCE) TGT 2022 (Science)

Ans.(b): Given, $a = 5\ m/S^2$
$t = 10$

$S = ut + \frac{1}{2}at^2$

$S_{10} = 0 \times t + \frac{1}{2} \times 5 \times 100$

$S_{10} = 250m$
$V_{10} = u + at$
$V_{10} = u + 5 \times 10$
$V_{10} = 50$ m/s
$S_{10-20} = 50 \times 10$
$= 500m$

$S_{20-30} = 50 \times 10 + \frac{1}{2} \times (-5) \times (10)^2$
$= 500 - 250$
$= 250$
Total distance = 250 + 500 + 250
= 1000m

92. The position x (in meter) of four objects A, B, C and D are given by following equations where time t is in second:
A : $x = 3.0 + 4.0\ t + 5.0\ t^2$
B : $x = -4.0 + 5.0\ t$
C : $x = 5.0\ t + 6.0\ t^2$
D : $x = 6.0\ t^3$
Which of them is moving with a uniform speed?
(a) A (b) B
(c) C (d) D

NVS PGT 2022 (16/12/2022) Shift -I Physics

Ans.(b): Given
B: $x = -4.0 + 5.0t$

$\frac{dx}{dt} = 5.0$ [Uniform speed]

other are non-uniform because

$\frac{dx}{dt} \neq$ constant

$\frac{dx}{dt} = f(t)$

A: $x = 3.0 + 4.0t + 5.0\ t^2$

$\frac{dx}{dt} = 4.0 + 10.0t = f(t)$

C: $x = 5.0t + 6.0t^2$

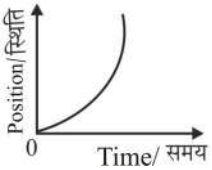
$\frac{dx}{dt} = 5.0 + 12.0t = f(t)$

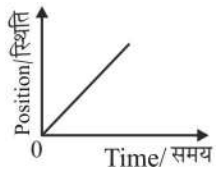
D: $x = 6.0\ t^3$

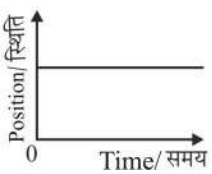
$\frac{dx}{dt} = 18.0t^2 = f(t)$

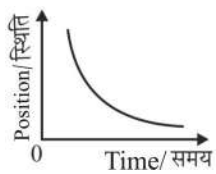
So, option b: (B) is moving with uniform speed.

93. Which of the following position - time graph represents non-uniform motion, where the rate of change of position is decreasing ?

(a) 

(b) 

(c) 

(d) 

DSSSB TGT 2021 (Male, 07/09/2021)Shift-III N.Sci.

Ans.(d): Only the graph (d) shows position-time graph of non-uniform motion where the rate of change of position is decreasing.

94. The acceleration 'a' (m/s^2) of a body starting from rest varies with time t (in s) following the equation a = 3t + 4 . The velocity of the body at time t = 2s will be.

(a) 10 m/s (b) 18 m/s
(c) 14 m/s (d) 26 m/s

DSSSB TGT 2018 (Female, 27/09/2018) Shift-I N.Sci.

Ans.(b): Given, $a = 3t + 4$

$$\frac{dv}{dt} = 3t + 4, \qquad \left(\because a = \frac{v}{t}\right)$$

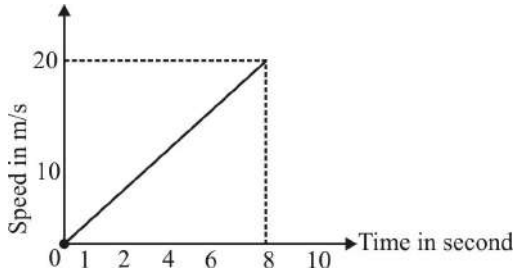
$$\therefore \int_0^v dv = \int_0^t (3t+4)dt$$

$$v = \frac{3}{2}t^2 + 4t$$

at t = 2s,

$$v = \frac{3}{2}(2)^2 + 4(2) = 14 \text{ m/s}$$

95. The speed of a car as a function of time is shown in figure :
The distance travelled by the car in 8s



(a) 20 m (b) 40 m
(c) 60 m (d) 80 m

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans.(d): The graph of velocity and time gives the acceleration of moving object.

From the v-t graph, slope = Acceleration,

$$a = \frac{\Delta V}{\Delta t} = \frac{20}{8} = \frac{5}{2} m/s^2$$

The distance travelled by car in 8s,

$$S = ut + \frac{1}{2}at^2$$

$$S = 0 + \frac{1}{2} \times \frac{5}{2} \times 8 \times 8 \qquad \{\because u = 0\}$$

S = 80 m

96. A truck running at 54 km/hr is brought to rest in 10s. The distance travelled by the truck in 10^{th} second is:

(a) 0.25 m (b) 0.50 m
(c) 0.75 m (d) 0.90 m

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans.(c): Given,

$$u = 54 \text{ km/hr} = 54 \times \frac{1000}{3600} = 15 m/s$$

v = 0, t = 10 s

Since, $v = u + at \Rightarrow 0 = 15 + a \times 10$

$$\Rightarrow a = -1.5 \text{ m/s}^2$$

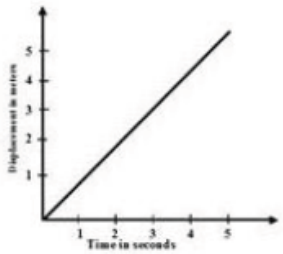
Also, the distance travelled in n^{th} second,

$$S_n = u + a\left(n - \frac{1}{2}\right)$$

$$S_{10^{th}} = 15 - 1.5\left(10 - \frac{1}{2}\right)$$

$$S_{10^{th}} = 15 - 14.25 = 0.75 m$$

97. Displacement time graph of a moving body is shown in figure. How much force is acting on the body?



(a) 12.5 N (b) Zero
(c) 25N (d) 5 N

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans.(b): The displacement time graph is a straight line, so its slope is constant. Hence, the object is moving with a constant velocity.
Since, velocity is constant, so there is no acceleration.
Hence, in this graph, the force is zero.

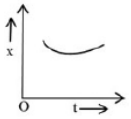
98. In terms of acceleration, the state of rest and the state of uniform linear motion are-

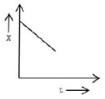
(a) Opposite (b) Contradictory
(c) Similar (d) Equivalent

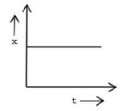
DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans.(d): The state of rest position and the state of uniform linear position are equivalent.
No net force is acting in both cases.
Therefore,
There is no need to apply an external force to keep a body in uniform motion.

99. Which of the following shows Zero acceleration?

(a) 

(b) 

(c) 

(d) 

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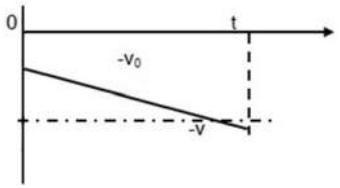
Ans. (*) :
The given graph is about the displacement and time. Since, change in velocity with respect to time gives acceleration and change in displacement with respect to change in time gives velocity.
Thus, if there is a constant velocity so the change in acceleration is zero and if the displacement is uniform for a time period then the velocity will be zero.
Note : For this question, discrepancy is found in question/answer.
So, this question is ignored for all candidates.

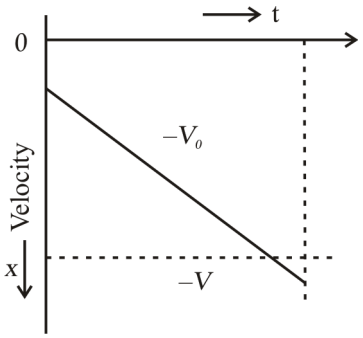
100. What does the following graph indicate?



(a) Motion in positive direction with positive acceleration.
(b) Motion in negative direction with negative acceleration.
(c) Motion in Positive direction with negative acceleration.
(d) Motion of an object with negative acceleration that changes direction at anytime.

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (b) :



In the given graph slope is negative -

$$m = \frac{-dv}{dt} = \text{negative acceleration}$$

Therefore, motion in negative direction with negative acceleration.

101. The advantage of the method of calculus for deriving the equations of motion for constant acceleration is that-

(a) It can be used for motion with non-uniform acceleration also.
(b) It can be used for motion with instant acceleration also.
(c) It can be used for motion with linear acceleration also.
(d) It can be used for motion with effective acceleration also.

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

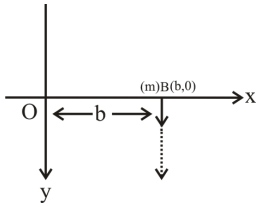
Ans. (a) : The advantage of the method of calculus for deriving equations of motion for constant acceleration is that it can be used for motion with non-uniform acceleration as well.

102. A particle of mass m is at the point (b, o) say B. The y-axis is chosen vertically downward and the particle is let fall from B parallel to the y-axis, find the angular momentum of the particle about the origin 2 sec after the ball.

(a) $2\,mg\,b\,\hat{k}$ (b) $-2\,mg\,b\,\hat{k}$
(c) $\frac{1}{2}mg\,b\,\hat{k}$ (d) $-\frac{1}{2}mg\,b\,\hat{k}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (b) : After t = 2 sec, particle's velocity will be given by-



$v = u+at$
$\Rightarrow \quad v = 0+g\times 2$
$\Rightarrow \quad v = 2g$

Now, angular momentum, $\vec{L} = m(\vec{v}\times\vec{r}) = mvr\sin\theta$
So, $L = m2g.b \qquad [\theta = 90^\circ]$
$= 2mgb$, along the direction perpendicular to $\vec{v}$ and $\vec{r}$ i.e. in the direction of Z'.
$\therefore L = -2mgb\,\hat{k}$
Note : Official answer given by commission is option (a).

103. A particle starts from rest and accelerates, where its acceleration vs. time equation is:
$f = p - qt$,
where p and q are positive constants. Find the distance travelled by the particle till the time it reaches its maximum velocity.

(a) $\frac{P^3}{q^2}$ (b) $\frac{p^3}{3q^2}$
(c) $\frac{p^3}{2q^2}$ (d) $\frac{3p^3}{2q^2}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Given equation,

$f = p-qt$
$\frac{dv}{dt} = p-qt \qquad \ldots (i)$
$p-qt = 0$
$t = \frac{p}{q}$

Equation (i) integrating, we get

$$\int dv = \int (p - qt)dt$$

$$v = pt - \frac{qt^2}{2} \quad \text{... (ii)}$$

Putting value of t equation (ii) we have

$$V = p \times \frac{p}{q} - \frac{q\left(\frac{p}{q}\right)^2}{2} = \frac{p^2}{q} - \frac{p^2}{2q}$$

$$V = \frac{p^2}{2q}$$

Now,

$$s = V \times t$$

$$= \frac{p^2}{2q} \times p/q = \frac{p^3}{2q^2}$$

104. Find the maximum value of acceleration of the bus if a mass of 3 kg lying on the floor of the bus will remain stationary (Given the co efficient ofstatic friction is 0.15)?

(a) 0.5 ms^{-2} (b) 2.0 ms^{-2}

(c) 1.5 ms^{-2} (d) 2.5 ms^{-2}

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(c): Given

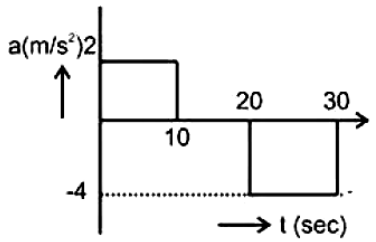
Coefficient of static friction (μ) = 0.15

friction force (f) = μmg

 ma = mg (where a is the maximum acceleration of bus)

$$a = \mu g = 0.15 \times 10 = 1.5 \text{ m/s}^2$$

105. The acceleration - time graph for a body starts from rest is as shown. Find the distance travelled by the body till the velocity of the body becomes zero first time.



(a) 200 m (b) 100 m

(c) 350 m (d) 300 m

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sci.

Ans.(c): Distance for first 10sec

$$S_{10} = ut + \frac{1}{2}at^2$$

$$= 0 + \frac{1}{2} \times 2 \times 10 \times 10$$

$$S_{10} = 100 \text{ m}$$

$$V_{20} = u + at \Rightarrow V_{20} = 0 + 2 \times 10$$

$$V_{20} = 20 \text{m/s}$$

Distance for 10 to 20 sec.

$$S_{10\text{-}20} = 20 \times 10 = 200 \text{ m}$$

For 20 -30 sec time at which velocity is zero

$$V_0 = V_{20} + at$$

$$0 = 20 + (-4) \times t$$

$$t = 5\text{sec}$$

Distance for t = 5 sec

$$S_{20\text{-}30} = 20 \times 5 + \frac{1}{2} \times (-4) \times 25 = 100 - 50 = 50\text{m}$$

Total distance = 100+200+50 = 350m.

106. A body starts from rest and moved with uniform acceleration. The distance travelled in the first 2 seconds and in the next 2 seconds are S_1 and S_2. Find $\frac{S_1}{S_2}$

(a) $\frac{1}{2}$ (b) $\frac{2}{3}$

(c) $\frac{1}{3}$ (d) $\frac{1}{4}$

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sci.

Ans.(d): t= 2 sec

$$S_1 = ut + \frac{1}{2}at^2 = \frac{1}{2} \times a \times (2)^2$$

$$= +\frac{1}{2}a \times 4$$

$$S_1 = 2$$

In next 2 Sec

So t = 4

$$S_2 = ut + \frac{1}{2}at^2$$

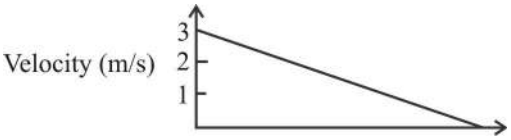
$$= \frac{1}{2} \times a \times (4)^2 = \frac{1}{2}a \times 16$$

$$S_2 = 8a$$

So, $\frac{S_1}{S_2} = \frac{2a}{8a} = \frac{1}{4}$

107. The velocity-time graph of a ball of mass 50 g moving along a straight line on a table is depicted in the following figure.

Calculate the force exerted on the ball by the table to bring it to rest.



(a) 15 N

(b) 0·015 N

(c) Zero

(d) 1·5 N

NVS PGT 2022 (Science 28/11/2022)

Ans.(b): Given, m = 50g

From graph,

Initial velocity, u = 3 m/s

Final velocity, v = 0m/s

t = 10s

From the first eq^{n}. of motion,

$v = u + at$

$$a = \frac{v-u}{t} = \frac{0-3}{10} = -0.3\,m/s^2$$

Thus, force exerted on the table,

$F = ma$

$= 50 \times 10^{-3} \times (-0.3) = 15 \times 10^{-3}$

$= -0.015N$

108. The velocity time graph of an object is a straight line. Which of the following conclusions can be definetly drawn from this information?

(A) If is a uniform motion

(B) It is a uniformly accelerated motion

(C) It is a non uniform motion

(D) The object is at rest

(a) (A) or (D) (b) (A) or (B)

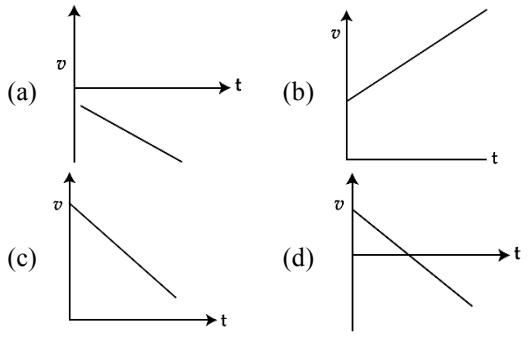
(c) (B) or (C) (d) (B) or (D)

KVS (LDCE) TGT 2022 (Science)

Ans.(b): The velocity at all the points in the graph is the same that is the velocity is remaining constant with the time.

If a body is moving with constant velocity. It is said to be in a uniform motion and it is in an uniformly accelerated motion.

109. Which of the following velocity -time graphs represent motion of an object in positive direction with negative accelaration?



KVS (LDCE) TGT 2022 (Science)

Ans.(c):

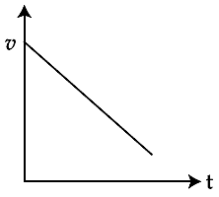


Fig negative acceleration since, velocity is decreasing linearly, its negative acceleration.

When motion is in positive direction but acceleration is negative.

110. The velocity v (in m/s) of an object changes with time t (in second) as :

$v = 2.0+1.0\,t^2$.

The average acceleration of the object for the duration t=1.0 s to t=3.0 s is :

(a) 4.0 m/s^2 (b) 7.0 m/s^2

(c) 9.0 m/s^2 (d) 11.0 m/s^2

NVS PGT 2022 (16/12/2022) Shift -I Physics

Ans.(a): Given the velocity function, $v = 2 + t^2$

at t = 1,

$V_1 = 2 + (1)^2 = 3$ m/s

At t = 3,

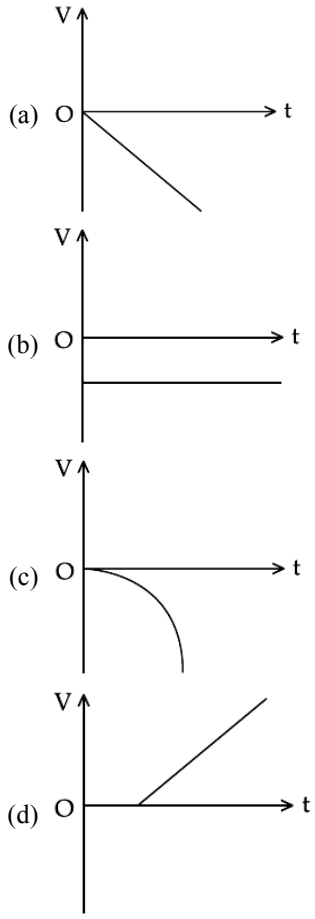
$V_2 = 2 + (3)^2$

$= 11$ m/s

Now, the average acceleration from (t) = 0 to t = 3 sec

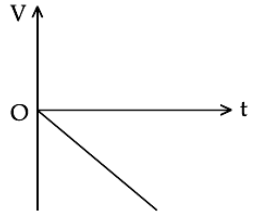
$$a_{aver} = \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{t_2 - t_1} = \frac{11-3}{3-1} = \frac{8}{2} = 4\,m/sec^2$$

111. Which of the following options represents the velocity – time graph of an object under free fall, when vertical upward direction is taken as positive direction.

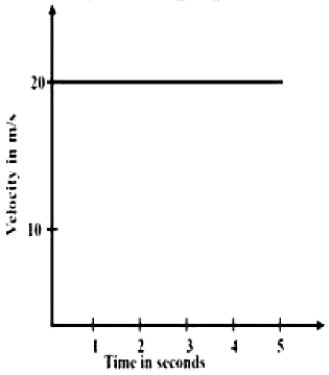


KVS PGT (LDCE) 2022 Physics

Ans.(a):



112. Velocity-time graph of a moving particle is shown in figure.



How much net force acts on the body?

(a) Zero (b) 10N

(c) 20N (d) 40N

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans.(a): The slope of velocity and time is acceleration.

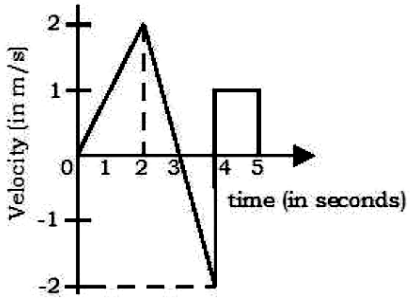
Let's see graph, there is no variation in velocity with time.

So, acceleration, $a = 0\ m/s^2$

Therefore, net force acts on the body, $F = ma$

$$F = m \times 0 = 0\ N$$

113. The velocity - time graph of a body in motion is as follows :



The dislacement of the body in 5s.

(a) 1 m (b) 2 m

(c) 3 m (d) 5 m

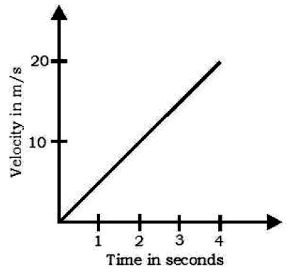
DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans. (c) : The displacement of the body in 5s = Area of curve in graph

$$d = \frac{1}{2}\times 2\times 3 + \frac{1}{2}\times 1\times(-2) + 1\times 1$$

$$d = 3 - 1 + 1 = 3m$$

114. The velocity - time graph of a ball moving on the surface of floor is shown in figure :



The force acting on the ball, if mass of the ball is 100 gm.

(a) 0.1 N (b) 0.2 N

(c) 0.4 N (d) 0.5 N

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

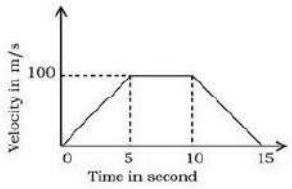
Ans.(d): The slope of velocity and time graph gives the acceleration.

$$\text{So, acceleration, } a = \frac{20}{4} = 5 m/s^2$$

$$\text{Force acting on the ball } F = ma = \frac{100}{1000}\times 5$$

$$F = 0.5\ N$$

115. The velocity time graph for a car moving in a straight line is shown below, the total distance covered by the body is :



(a) 1000 m (b) 10 m

(c) 100 m (d) Zero

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans.(a): Distance covered = Area of the paralellogram.

$$= \text{Area of I} + \text{Area of II} + \text{Area of III}$$

$$= \frac{1}{2}\times 5\times 100 + 5\times 100 + \frac{1}{2}\times 5\times 100$$

$$= 250 + 500 + 250$$

$$= 1000\ m$$

4. Uniform Circular Motion

116. A car moving at 5m/s on a road, takes in a circular road of radius 4m without decreasing the speed. The coefficient of static friction between the wheel and the road is 0.2 What will happen while taking the turn?

(a) The car will slip

(b) The car will not slip

(c) The car moves steadily

(d) The car will roll

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (a) :

Frictional force, $f = \mu mg$

Centripetal force, $F_c = \frac{mv^2}{r}$

for no slip condition,

$F_c = f$

$\mu mg = \frac{mv^2}{r}$

$\Rightarrow \mu g = \frac{v^2}{r}$

but $0.2 \times 9.81 = \frac{(5)^2}{4}$

$\boxed{1.962 \neq 6.25}$

Hence, the car will slip.

117. A point moves uniformly along a straight line. Its angular velocity about any point at a distance 'r' from it varies as:

(a) $\frac{1}{r}$ (b) $\frac{1}{r^2}$

(c) r (d) r^2

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (b) : Whan a particle is moving in a straight line it has zero angular momentum.

So, $L = mvr = 0$

$\Rightarrow L = m \times r \times \omega \times r = mr^2\omega$

$\Rightarrow \omega = \frac{L}{mr^2}$

$\Rightarrow \omega \propto \frac{1}{r^2}$

118. A particle is executing uniform angular motion with an angular velocity $\vec{w} = \left(2\hat{i} - \hat{j} + 5\hat{k}\right)$ radians sec^{-1}. (–1, 2, 3) is a position of the particle in its path (co-ordinates are in metres). Find the linear velocity of the particle in ms^{-1}.

(a) $12\hat{i} + 10\hat{j} + 3\hat{k}$ (b) $-13\hat{i} + 11\hat{j} + 3\hat{k}$

(c) $-11\hat{i} + 13\hat{j} - 4\hat{k}$ (d) $-12\hat{i} + 4\hat{j} - 9\hat{k}$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (b) : Angular velocity, $\vec{\omega} = \left(2\hat{i} - \hat{j} + 5\hat{k}\right)$ rad/sec

$\vec{r} = (-1, 2, 3) = -\hat{i} + 2\hat{j} + 3\hat{k}$

Linear velocity, $\vec{v} = \vec{w} \times \vec{r}$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 5 \\ -1 & 2 & 3 \end{vmatrix}$$

$= \hat{i}(-3-10) - \hat{j}(6+5) + \hat{k}(4-1)$

$= -13\hat{i} - 11\hat{j} + 3\hat{k}$

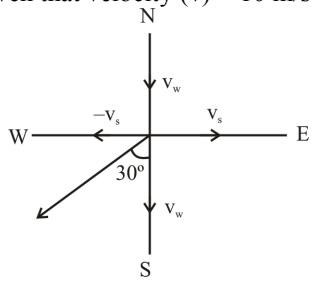
119. A steamer is going due East with a velocity 10 ms^{-1}, and wind is blowing from North. The smoke the chimney points 30° West of south. Find the magnitude of the velocity of wind.

(a) $10\sqrt{3}$ ms^{-1} (b) 30 ms^{-1}

(c) $30\sqrt{3}$ ms^{-1} (d) $\frac{10\sqrt{3}}{3}$ ms^{-1}

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (a) : Given that velocity (v) = 10 m/s



$\tan\theta = \frac{v_s}{v_w}$

$\tan 30^\circ = \frac{10}{V_w}$

$\frac{1}{\sqrt{3}} = \frac{10}{V_w}$

$V_w = 10\sqrt{3}$ m/s

120. A ball is projected vertically upwards from a point A to reach its greatest height B. It again returns to the point B. In course of the above journey is passes through two points P and Q twice (Q is above P). Now, which among the following options is true?

(a) Time of rise from P to Q is greater than Time of fall from Q to P.

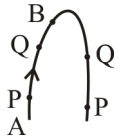
(b) Time of rise from P to Q is equal to the Time of fall from Q to P.

(c) Time of rise from P to Q is less than Time of fall from Q to P.

(d) (Time of rise from P to Q) plus (Time of fall from Q to P) is equal to Half of the total time of flight.

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (a) : Time of rise from P to Q is greater than time of fall from Q to P because when it goes in the upward direction it is in opposite direction to the gravity due to earth or we can say that when a body releases from height it goes under the effect of gravity (i.e. attained acceleration) so it takes lesser time than going upward for the same PQ.



121. Find the total energy of a circularly orbiting satellite?

(a) Zero (b) Postive
(c) Negative (d) Infinite

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(c): The kinetic energy of the satellite of mass (m) in a circular orbit is.

$$KE = \frac{1}{2}m\left(\frac{GM}{R+h}\right)$$

The potential energy at distance (R + h) from the center of the earth is given by

$$PE = -\frac{GmM}{R+h}$$

Total energy = KE + PE

$$\text{Total energy} = \frac{1}{2}m\left(\frac{GM}{R+h}\right) - \frac{GmM}{R+h}$$

$$\text{Total energy} = -\frac{GmM}{2(R+h)}$$

The total energy of a circularly orbiting satellite is negative.

122. In pure translational motion at any instant of time all particles of the body have _____.

(a) Different velocity
(b) Different momentum
(c) Same velocity
(d) Same momentum

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans.(c): In pure translational motion at any instant of time all particles of the body have the same velocity. A rigid body fixed at one point or along a line can have only rotational motion. A rigid body not fixed in same way can have either pure translation or a combination of translation and rotation.

123. A particle moving along a circular path with uniform speed has a

(a) radial velocity and radial acceleration
(b) radial velocity and transverse acceleration
(c) transverse velocity and radial acceleration
(d) transverse velocity and transverse acceleration

AEES PGT 2015 (Physics)

Ans.(c): A particle moving along a circular path with uniform speed has a transverse velocity and radial acceleration.

124. Two satellites of masses 3M and M orbit the earth in the circular orbits of radil r and 3r respectively. The ratio of their orbital velocities is

(a) 1 : 1 (b) $\sqrt{3}$: 1
(c) 3 : 1 (d) 9 : 1

AEES PGT 2015 (Physics)

Ans.(b): $v_1 \propto \frac{1}{\sqrt{r_1}}$ and $v_2 \propto \frac{1}{\sqrt{r_2}}$

$$\frac{v_1}{v_2} = \sqrt{\frac{r_2}{r_1}} = \sqrt{\frac{3r}{r}} = \sqrt{3}$$

125. If v_e be the orbital velocity of a satellite in a circular orbital close to earth's surface and v_e is the escape velocity for the earth, the relation between the two is-

(a) $v_e = \sqrt{2}v_e$ (b) $v_e = \sqrt{3}\ v_e$
(c) $v_o = v_e$ (d) $v_e = 2v_o$

AEES PGT 2015 (Physics)

Ans.(d): Escape velocity, $(V_e) = \sqrt{\frac{2GM}{r}}$ .....(i)

The orbital velocity of satellite close to the earth surface.

$$V_o = \sqrt{\frac{GM}{R}} \quad .....(i)$$

From eq^n. (i) and (ii)

$$\boxed{V_e = \sqrt{2}v_o}$$

126. The motion of planets in the solar system is an example of conservation of:

(a) Mass
(b) Linear momentum
(c) Angular momentum
(d) Kinetic energy

AEES PGT 2015 (Physics)

Ans.(c): The motion of planets in the solar system is based on the conservation of angular momentum.

127. A person having mass 60 kg, is moving in uniform circular motion on horizontal surface which is frictionless. The radius of circle is 5m. The centripetal force applied is 50 N. What is the amount of work done by the force when the person moves through one-half of a rotation

(a) 0 Nm (b) 250 Nm
(c) 500 Nm (d) 250 πNm

KVS PGT 2023 (17/02/2023) Physics

Ans.(d): Given,

m = 60 kg

r = 5m

Centripetal force (F) = 50N

□ = 180°

Using formula,

Work = Force × Distance × cos □

W = 50 × (πr) × cos 180

W = 50 × □ × 5 × (– 1)

W = – 250□ Nm

128. A point object is moving with uniform speed v in a circle of radius R. Let n be the frequency of its motion. The acceleration of the object is :

(a) π^2n^2R (b) $2\pi^2n^2R$
(c) $4\pi^2n^2R$ (d) $\left(\frac{\pi v}{n}\right)^2 R$

KVS PGT 2023 (17/02/2023) Physics

Ans.(c): We have,

$$a = \frac{v^2}{R} \quad .....(i)$$

Where (a) = centripetal acceleration
(v) = speed of object
(R) = radius of circle

The frequency of the motion, (n) is related to speed and the circumference of the circle

$$n = \frac{V}{2\pi R}$$

$$\boxed{V = 2\pi nR}$$

Putting the value of 'v' in eq^n. (i)

$$a = \frac{(2\pi nR)^2}{R}$$

$$a = 4\pi^2 Rn^2$$

129. A ball is made to uniformly move on a horizontal circular path. The work done by the agency providing necessary force for one complete revolution of the ball is zero because:

(a) the average force for each revolution is zero.
(b) there is no friction.
(c) the force is perpendicular to the velocity of ball throughout the motion.
(d) there is no gravitational force acting on the ball.

NVS PGT 2022 (16/12/2022) Shift -I Physics

Ans.(c): The force is perpendicular to the velocity of ball throughout the motion. It means the force is acting as a centripetal force, keeping the ball moving in a curved path. This sould occur, for example, in uniform circular motion where the velocity is constantly changing direction but the speed remains constant.

130. A small ball is moving with uniform speed v in a circle of radius R. If T is the time period of its motion, its acceleration is given by :

(a) $\left(\frac{2\pi}{T}\right)^2 R$ (b) $\left(\frac{\pi}{T}\right)^2 R$

(c) $\left(\frac{2\pi}{T}\right)^2 R^2$ (d) $\left(\frac{\pi}{T}\right)^2 R^2$

NVS PGT 2022 (16/12/2022) Shift -I Physics

Ans.(a): The acceleration of an object moving in a circle with uniform sped is given by the formula.

$$a = \frac{v^2}{R}$$

$$a = \frac{\left(\frac{2\pi R}{T}\right)^2}{R}$$

$$= \left(\frac{2\pi}{T}\right)^2 R$$

131. The angular speed of a motor wheel is increased from 1800 rpm to 3240 rpm in 12 seconds. Its angular acceleration, assuming the acceleration to be uniform will be:

(a) 2π rad/s^2 (b) 3π rad/s^2
(c) 4π rad/s^2 (d) 5π rad/s^2

KVS PGT (LDCE) 2022 Physics

Ans.(c): The relation between (α) and changing (π) is given by–

$$\boxed{\omega_1 = \omega_o + \alpha t}$$

Where π_1 = final angular velocity
π_o = initial angular velocity
α = angular acceleration

Given,

f_o = 1800 rpm
f_1 = 3240 rpm
t = 12 sec

We have,

Angular velocity $\omega = \frac{2\pi f}{60}$

$$\omega_o = \frac{2\pi f_o}{60} = \frac{2\pi \times 1800}{60} = 60\pi$$

$$\omega_1 = \frac{2\pi f_1}{60} = \frac{2\pi \times 3240}{60} = 108\pi$$

From eq^n. (i)

$$\pi_1 = \pi_o + \alpha t$$

$$108\pi = 60\pi + \alpha \times 12$$

$$108\pi - 60\pi = 12\alpha$$

$$\alpha = \frac{48\pi}{12} = 4\pi \text{ rad/sec}^2$$

132. A toy train engine steadily moves in a circular track of radius 14 cm and completes 6 rounds in 80 s. Its angular speed and magnitude of acceleration respectively are:

(a) 0.4713 rad/s and 3.10 cm s^{-2}
(b) 0.4713 rad/s and 31.02 cm s^{-2}
(c) 0.7413 rad/s and 3.10 cm s^{-1}
(d) 0.7413 rad/s and 31.02 cm s^{-1}

KVS PGT (LDCE) 2022 Physics

Ans.(a): The angular speed is given by–

$$\omega = \frac{2\pi \times \text{Number of revolutions}}{\text{Time taken}}$$

$$\omega = \frac{2\pi \times 6}{80}$$

$\omega = \frac{12\pi}{80} = \frac{3\pi}{20} = 0.4713\,\text{rad/s}$

Now, $a = \square^2 \times \text{radius}$

$= (0.4713)^2 \times 14$

$= 0.2222 \times 14$

$= 3.11\ \text{cm/s}^2$

133. The angle of 1" is equal to :
[360° = 2□ radian, 1° = 60 minutes (60') and 1' = 60 arc second (60")]

(a) 1.745×10^{-4} radian (b) 4.85×10^{-6} radian

(c) 4.85×10^{-4} radian (d) 1.745×10^{-2} radian

KVS PGT (LDCE) 2022 Physics

Ans.(d): Since, $360° = 2\pi$ rad

$$1° = \frac{\pi}{180}\text{ rad}$$

$$= 1.745 \times 10^{-2}\text{ rad}$$

134. A vehicle travels in a circular motion. Which of the following statements are true ?

(a) The distance traveled by the vehicle is always be equal to the displacement of the vehicle

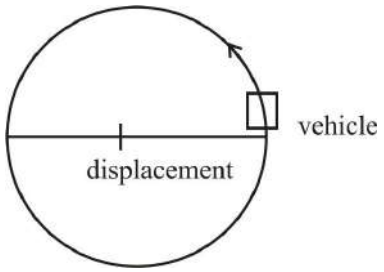
(b) The distance covered by the vehicle will always be less than the displacement of the vehicle

(c) When the displacement is zero, the distance covered by the vehicle will be zero

(d) The distance covered by the vehicle will always be greater than the displacement of the vehicle

DSSSB TGT 2021 (Male, 07/09/2021)Shift-III N.Sci.

Ans. (d) :



When the vehicle complete the round, the distance covered will be $2\pi r$ but the displacement will be zero.

135. Which of the following statements is/are true?

1. Motion is a combined property of the object under study and the observer.

2. There is absolute rest or absolute motion.

Choose the correct code :

(a) Only 2 (b) Neither 1 nor 2

(c) Only 1 (d) Both 1 and 2

DSSSB TGT 2021 (Female, 25/09/2021) Shift-II N.Sci.

Ans.(c):

* When an object change its position with respect to time then we called the object is in the motion otherwise in the rest.
* Motion is a combined property of the object under study and the observer. There is no meaning of rest or motion without observer or viewer.
* Absolute rest and absolute motion is not possible because there is no point in the universe which is at rest and can be taken as point of reference. The planet Earth is in continuous motion.

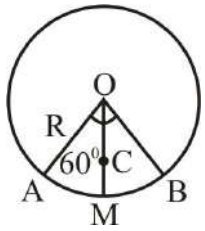
136. AB is the arc of a circle of radius R whose centre is at O, where it subtends an angle 60°. M is the midpoint of the arc AB. The centre of mass of the arc lies at a point C on OM such that OC is equal to:

(a) $\frac{3R}{2\pi}$ (b) $\frac{3R}{\pi}$

(c) $\frac{2R}{3\pi}$ (d) $\frac{2R}{\pi}$

NVS PGT 2019 (Physics)

Ans. (b) :



For arc, the centre of Mass,

$$OC = \frac{r\sin\alpha}{\alpha}$$

Here, Whole angle = 60°

$$\alpha = \frac{60°}{2} = 30° = \frac{\pi}{6}$$

$$= \frac{R\sin\left(\frac{\pi}{6}\right)}{\left(\frac{\pi}{6}\right)} = \frac{R\left(\frac{1}{2}\right)}{\frac{\pi}{6}}$$

$$\boxed{OC = \frac{3R}{\pi}}$$

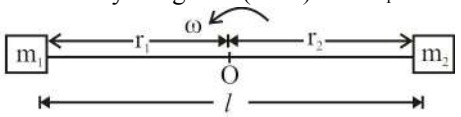
02.

Force and Newton's Law

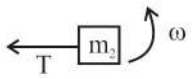
1. Force and Motion

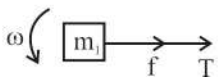
1. Two blocks of mass as m_1 and m_2 are connected to each other by a massless inextensible string length *l* and these are placed along a diameter of a turn table. There is no friction between m_2 and the surface of the table whereas the friction between m_1 and the surface of the table is μ. The table is rotating with an angular velocity ω about a vertical axis passing through the centre of the turn table. The masses m_1 and m_2 are lying at distances r_1 and r_2 respectively from the centre of the turn-table. If the masses are observed to be at rest with respect to an observer on the turn table.
Calculate the friction force on m_1–
(a) $m_1(r_1 - r_2)\omega^2$ (b) $m_2(r_1 - r_2)\omega^2$
(c) $(m_1r_1 - m_2r_2)\omega^2$ (d) $(m_1r_1 + m_2r_2)\omega^2$
DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Given,
Mass of first block = m_1
Mass of second block = m_2
Angular velocity of turn table = ω
The coefficient of friction between m_1 and the surface of the table = μ
Tension T and friction force f will be directed towards centre of circular path to provide necessary centripetal force.
From the free body diagram (FBD) of m_1 and m_2,



FBD:-





:
All the vertical forces are balanced due to equilibrium in vertical direction.
Along the radial direction -
For the block having mass m_2 :
$T = m_2\omega^2r_2$ ... (i)
For block m_1 :
$F+T = m_1\omega^2r_1$ ... (ii)
Subtracting equation (i) from equation (ii),
$F = m_1r_1\omega^2 - m_2r_2\omega^2$
$F = (m_1r_1 - m_2r_2)\omega^2$

2. Hooke's law gives relation between:
(a) Stress and strain
(b) Mass and velocity
(c) Force and acceleration
(d) Potential energy and height
DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans. (a) : Hooke's law states that the strain of the material is proportional to the applied stress within the elastic limit of that material. It is expressed as -
stress ∝ strain
$\sigma = E\varepsilon$
So, Hooke's law gives relation between stress and strain.

3. Which is the example of centrifugal force?
(a) A body tied to one end of a string is being rotated in a circle; the force is supplied by the tension of the string.
(b) The moon revolving around the earth, the force is the gravitational pull of the earth on the moon.
(c) A person riding a cycle along a circular path, the necessary force is supplied by a sidewise pressure exerted by the road on the tyres.
(d) A stone tied to one end of a string is being rotated in a circle, the stone itself exerts an equal and opposite force on the hand holding the string.
DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (d) : Centrifugal force, a fictitious force, peculiar to a particle moving on a circular path, that has the same magnitude and dimensions as the force that keeps the particles on its circular path but acts in the outward direction.
Example of centrifugal force,-
A stone tied to one end of a string is being rotated in a circle, the stone itself exerts an equal and opposite force on the hand holding the string.

4. Who first gave the view that if a body is moving, something external is required to keep it moving?
(a) Aristotle (b) Democritus
(c) Kanada (d) Copernicus
DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (a): The Greek thinker, Aristotle (384 B.C-322 B.C), held the view that if a body is moving, something external is required to keep it moving.
• Aristotle made observation from practical experiences and came to the conclusion that an external source is required to keep a body in uniform motion.

5. What does "Centripetal" mean?
(a) Central (b) Center seeking
(c) Around the center (d) Away from center
DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (b) : Centripetal: Something acting in a direction towards the center or center seeking objects round a circular path is called as centripetal.

6. The dimensional formula of force is -

(a) $[M^oL\ T^{-2}]$ (b) $[M\ L^o\ T^{-2}]$

(c) $[M\ L\ T^o]$ (d) $[M\ L\ T^{-2}]$

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (d): Force is a vector quantity. It is defined as the mass of the object or a body multiplied by the acceleration i.e., F = ma.

The dimensional formula for the force is $[M\ L\ T^{-2}]$.

7. Mark the correct relation with respect to the strength of the forces, out of the following-

(a) Electromagnetic force > Gravitational force

(b) Electromagnetic force < Gravitational force

(c) Electromagnetic force = Gravitational force

(d) Can't be determined

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (a): Electromagnetic force:- The electromagnetic force is a type of physical interaction of charged particles.

Gravitational Force:- The gravitational force is a force that attracts any two objects with mass under the effect of gravity.

Electromagnetic force > Gravitational Force

8. What is the relative strength of strong nuclear force?

(a) 1

(b) 10

(c) 100

(d) 1000

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (a) :

Force	Relative Strength
(1) Strong nuclear force	**1**
(2) Electromagnetic force	$\mathbf{10^{-2}}$
(3) Weak nuclear force	$\mathbf{10^{-13}}$
(4) Gravitational force	$\mathbf{10^{-39}}$

So, the relative strength of strong nuclear force is 1

9. Which among the following is/are the characteristics of a conservative force field?

(p) The force can be derived from a potential by taking its negative space gradient.

(q) The work done by the force round a closed path is zero.

(r) The total mechanical energy is a constant of time.

(s) For the motion of a particle in the field, the gain in kinetic energy is equal to the loss in potential energy.

(a) Only (p)

(b) Only (p) and (q)

(c) Only (p), (q) and (r)

(d) (p), (q), (r) and (s)

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (c) : Conservative force:- A conservative force is a force with the property that the total work done in a moving particle between two points is independent of the path taken.

Characteristics of Conservative force field-

- When the force depends only on the initial and final position irrespective of the path taken.
- In any closed path, the work done by a conservative force is zero.
- The work done by a Conservative is reversible.
- Another property of a Conservative force is that it can be derived from a potential energy function. Thus for any Conservative force, there exists a scalar function V (x,y,z) such that the force is equal to-grad V, or - ΔV.
- The Conservative law for total mechanical energy, states sum of kinetic and potential energy is constant.

10. A body of mass 'm' has been falling from rest under the action of gravity for t seconds. Find the vertical force required to be applied in order to bring it to rest within another distance 'a'. ('m' is in kg and 'a' is in metres)

(a) $mg^2\frac{t^2}{2a}$ (b) $mg^2\frac{t^2}{4a}$

(c) $Mg\left(1+\frac{gt^2}{4a}\right)$ (d) $Mg\left(1+\frac{gt^2}{2a}\right)$

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (d) : Mass = m, Distance = a

time = t, deceleration = a'

from the 3rd equation of motion,

$v^2 = u^2 + 2aS$

$0 = u^2 - 2aa'$ [acceleration = –a' and S = a]

$u^2 = 2aa'$ ———— (i)

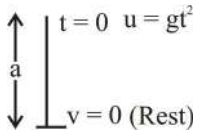
from $v = u + at$

$v = u - gt$

$u = gt$ [v = 0] ———— (ii)

$\Rightarrow (gt)^2 = 2a.a'$

$a' = \frac{g^2t^2}{2a}$



Force = weight + Deceleration force

$F = mg + ma'$

$F = mg + m\frac{g^2t^2}{2a}$

$F = mg\left(1+\frac{gt^2}{2a}\right)$

Thus the vertical force required is $mg\left(1+\frac{gt^2}{2a}\right)$.

11. A 50 g bullet is fired through a stack of fibre board sheets 10 cm thick. The velocity of the bullet at the point of approaching the stack is 500 ms^{-1}. What will be its velocity in ms^{-1} at the exit point from the stack if the average resistance offered by the stack to the bullet 4 × 10^4N.

(a) 200 (b) 300

(c) 400 (d) 500

DSSSB PGT 2018 (04 July 2018 Female) Physics

Ans. (b) : Given, $F = 4\times10^4$ N

Mass of bullet, $m = 50g = 50\times10^{-3}$ kg

Velocity of bullet, u = 500m/sec

S = Thickness of the fiber sheet = 10cm = 0.1m

Let a be the average retardation offered by sheet then average resistance offered,

$$F = ma$$

$$4\times10^4 N = 50\times10^{-3} kg\times a$$

$$a = \frac{4\times10^4\ N}{50\times10^{-3}\ kg}$$

$$a = -8\times10^5\ m/sec^2$$

(–) Sign indicate the retardation of the bullet.

Then from the equation of motion-

$$v^2 = u^2+2aS$$

$$= (500)^2+2\times(-8\times10^5)\times0.1$$

$$= 25\times10^4 - 1{\cdot}6\times10^5$$

$$= 25\times10^4 - 1{\cdot}6\times10^4$$

$$v^2 = 9\times10^4$$

$$v = 300\ m/sec$$

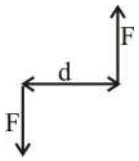
12. A pair of forces of equal magnitude but acting in opposite direction with different lines of action is known as?

(a) Moment
(b) Couple
(c) Precession
(d) Centre of mass

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans. (b): A pair of forces of equal magnitudes, opposite in direction and different lines of action called as "Couple".

- A Couple produces rotation without translation



13. Impulsive force is?

(a) Small force acts in a short time
(b) Large force acts in a longtime
(c) Small force acts in a long time
(d) Large force acts in a short time

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans. (d): A large force acting for a short time to produce a finite change in momentum is called an Impulsive force.

- Impulsive force is defined as a force that acts on a body for a short period of time.

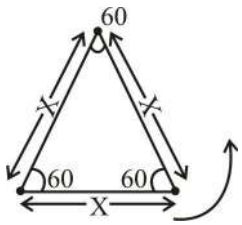
14. Three point masses each of mass m are placed at the three corners of an equilateral triangle of side x. Find the resultant force acting on any one particle at the corner.

(a) $\frac{Gm^2}{x^2}$ (b) $\frac{3Gm^2}{x^2}$

(c) $\frac{\sqrt{3}Gm^2}{x^2}$ (d) Zero

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sce.

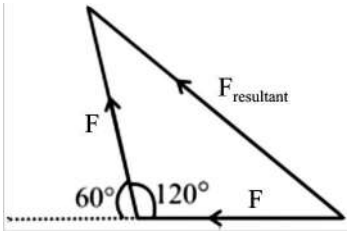
Ans. (c) :



We know that each angle of the equilateral triangle be 60°.

$$F = G\frac{m\times m}{x^2} = G\frac{m^2}{x^2}$$

Now, apply vector addition of these two forces.



$$F_{resultant} = \sqrt{F^2+(-F)^2+2F\cdot(-F)Cos120°}$$

$$= \sqrt{2F^2-2F^2\left(-\frac{1}{2}\right)}$$

$$= \sqrt{3F^2}$$

$$= F\sqrt{3}$$

$$F_{res} = \sqrt{3}\times\frac{Gm^2}{x^2}$$

15. A uniform rope is suspended from the roof of a building. The rope breaks if the tension in the rope is greater than 700 N. A man of mass 50 kg climbs up the rope. Find the maximum acceleration with which he can climb up the rope $\left(g = 10 m/s^2\right)$.

(a) 2 m/s^2 (b) 4 m/s^2

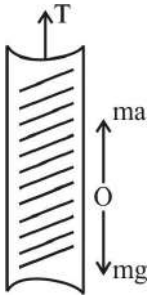
(c) 7 m/s^2 (d) $\frac{7}{2}$ m/s^2

DSSSB TGT 2018 (27/09/2018 Shift-II) N.Sce.

Ans. (b) : Given, T = 700N

M = 50kg

Mass of man = 50×10 = 500N



If T is the tension in the string and a is the upward acceleration, then according to Newton's Second law of motion, the net downward force acting in the string is given by –

$ma = mg - T$
$50 \times a = 50 \times 10 - 700N$
$50a = 500 - 700$
$50a = 200N$
$a = \frac{200}{50} = 4m/s^2$

16. Which of the following is/are type/s of forces in nature?
1. Gravitational
2. Electromagnetic
3. Nuclear
4. Weak
Choose the correct one.
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4 only,

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

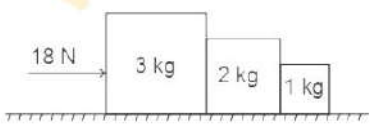
Ans. (d): Gravitational Force:- The gravitational force is a force that acts between any two masses.
• The law of Gravitation was given by Sir Isaac Newton. The force between two objects of mass m_1 and m_2 separated by a distance r is given by –
$F = \frac{Gm_1m_2}{r^2}$, where G is a universal Gravitational constant = $6.67 \times 10^{-11} Nm^2kg^{-2}$.
Electromagnetic Force:- The electromagnetic force is a type of physical interaction that occurs between electrically charged particles. It acts between charged particles and is the combination of all the magnetic and electrical forces.
Strong Nuclear Force:- The strong nuclear force binds protons and neutrons in a nucleus. The strong nuclear force acts when the distance between nucleons is less than 10^{-15}m or 1 fermimeter.
Weak Nuclear force:- The weak nuclear forces appears only in certain nuclear processes such as the β decay of a nucleus.

17. Kepler's second law is based on–
(a) Newton's first law
(b) Newton's second law
(c) Conservation of angular momentum
(d) More than one of the above
(e) None of the above

Bihar Teacher 2013 (TRE-200) Science

Ans. (c): Kepler's 2nd law states that the areal velocity of a planet is constant which implies that the angular momentum of planet remains constant.
So the Kepler's law is based on conservation of angular momentum.

18. Three blocks of mass 3 kg, 2 kg, and 1 kg respectively are placed in contact with each other on a smooth horizontal surface as shown in the figure. A horizontal force of 18 N is applied on the 3 kg block. Find the net force on the 2 kg block.



(a) 18 N
(b) 6 N
(c) 9 N
(d) 0 N

NVS PGT 2022 (Science 28/11/2022)

Ans. (b) : Given,
Masses = 3kg, 2kg, 1kg
force (f) = 18N
Since, 18N is applied on the total mass = 3+2+1 = 6kg
$F = ma$
$a = \frac{F}{m} = \frac{18}{6} = 3m/s^2$
Thus the net force on 2kg block,
$F_{net} = m \times a$
$= 2 \times 3$
$= 6N$

19. Two spheres of mass m_1 and m_2 have gravitational force F acting between them, when placed in air at a distance d. On placing the same spheres at the same distance in a liquid medium of relative density 4, the gravitational force between them will be –
(a) become 4 F
(b) become $\frac{F}{4}$
(c) be F
(d) become zero

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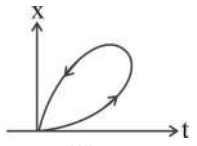
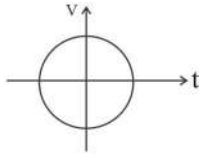
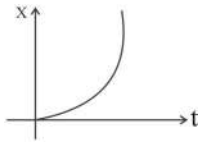
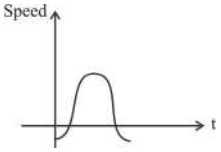
Ans. (c): The gravitational force (F) between two spheres will be F because F is independent of the medium in which the two bodies are placed.

20. Which of the following graphs can possibly represent one-dimensional motion of a particle ?

(a) 

(b) 

(c) 

(d) 

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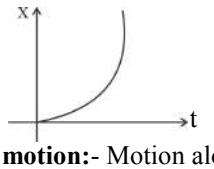
Ans. (c) :



One-dimensional motion:- Motion along a straight line or motion in one particular direction.
In one dimensional motion there is some unique value of y for each value of x. Clearly except (c), all the graphs have more than one value of y. So the option (c) is the correct one.

21. An object is thrown vertically upwards with a speed of 20 m/s. If the air resistance is negligible, the greatest height to which this object would rise is (g=10 m/s^2)
(a) 10 m (b) 20 m
(c) 40 m (d) 200 m

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Ans. (b) : Given, initial velocity (u) = 20 m/s
At highest point, final velocity (v) = 0
So,
$v^2 = u^2 - 2gh$ (thrown upward, a = –g)
$0 = (20)^2 - 2gh$
$\Rightarrow h = \frac{20 \times 20}{2 \times 10} = 20m$

22. SI units of Universal Gravitational Constant (G) and acceleration due to gravity (g) are respectively
(a) N kg^2/m^2 ; m/s^2 (b) N m^2/kg^2 ; m/s^2
(c) N m^2/kg^2 ; m/s (d) N m^2/s^2 ; m/s^2

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Ans. (b) : Newton's gravitational force is given by -

$$F = \frac{GMm}{r^2}$$

$$G = \frac{Fr^2}{Mm}$$

The unit of G (Universal Gravitational Constant)
$= \frac{\text{Newton} - m^2}{kg - kg} = N - m^2/kg^2$
Since,
$F = mg \Rightarrow g = \frac{F}{m} = \frac{ma}{m} = a$
$[g] = m/s^2$

23. An engine of mass 10000 kg pulls a train of 5 wagons each of 2000 kg, along a horizontal trak. If the engine exerts of force of 45000 N and the track offers a friction force of 5000 N, the acceleration of the train is
(a) 2.0 m/s^2 (b) 2.25 m/s^2
(c) 4.0 m/s^2 (d) 4.5 m/s^2

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Ans. (a) : Given, Mass of engine, M = 10000 kg
Number of wagons, N = 5
Total mass of wagons, m = 5 × 2000 = 10,000 kg
and Friction force, f_s = 5000 N
Net force, $F_a = F - f_s$ = (45000 – 5000)N = 40000 N
The acceleration of train,

$$a = \frac{F_a}{\text{Total Mass}} = \frac{40000}{20000} = 2m/s^2$$

24. A block of mass 2 kg is sliding on a smooth horizontal surface with a constant speed of 0.5 m/s. The force required to keep the block sliding with the same speed is
(a) 400 N (b) 200N
(c) 100 N (d) Zero

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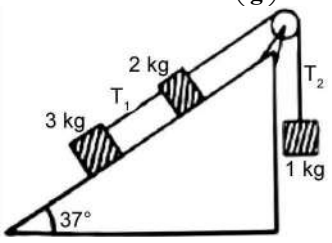
Ans. (d) : Since, block is sliding with constant speed.
So, there is no friction. Therefore, there is no force required to keep the block sliding with the same speed.

25. Consider a system of three blocks connected by cords, as shown in the figure. The pulley is massless and frictionless. The inclined plane is also frictionless. Let *a* be the acceleration of the blocks when the system is released and *g* is the acceleration due to gravity at the place.
Given: sin 37° = 0.6. Then $\left(\frac{a}{g}\right)$ is:



(a) $\frac{1}{3}$ (b) $\frac{1}{4}$
(c) $\frac{1}{5}$ (d) $\frac{1}{6}$

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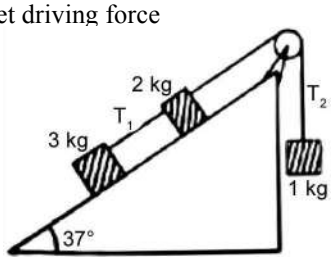
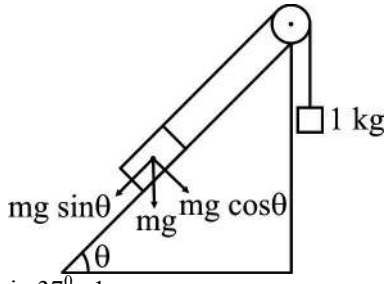
Ans. (a) : Net driving force



FBD –



$F_{net} = 5\,g \sin 37^0 - 1g$
Total mass = 2 + 3 + 1 = 6 kg
We know that,

$$\frac{(F_{net})_{driving}}{\text{Total mass}} = \text{acceleration}(a)$$

$$\frac{5g \sin 37^0 - g}{6} = a$$

$$\frac{5g(0.6)-g}{6}=a \quad (\because \sin 37^0 = 0.6 \text{ (given)})$$

$$\frac{2g}{6}=a$$

$$\Rightarrow \boxed{\frac{a}{g}=\frac{1}{3}}$$

26. A batsman deflects a ball of mass 0.15 kg by an angle of 30° without changing its initial speed which is equal to 72 km/h. What is the impulse imparted to the ball?

(a) 2.4 kg m/s (b) 3.7 kg m/s
(c) 5.8 kg m/s (d) 7.2 kg m/s

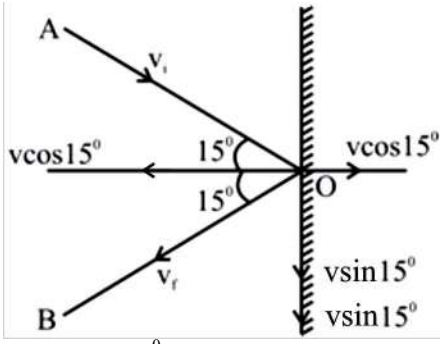
KVS PGT 2018 (Physics)

Ans. (c) : Given that

m = 0.15 kg

$$v = 72 \text{ km/hr} = 72\times\frac{5}{18} = 20 \text{ m/s}$$

As we know that the horizontal components of velocity are to be considered for imparting impulse as the vertical components are in the same direction, thus the net impulse in the vertical direction is zero.



$v_i = -v\cos15^0$

$v_f = v\cos15^0$

Impulse imparted to ball = change in momentum

$P_i = mv_i = -mv\cos 15^0$

$P_f = mv_f = mv\cos15^0$

Impulse = $P_f - P_i = mv\cos 15 - (-mV\cos15^0)$

$= 2mv\cos15^0$

$= 2 \times 0.15 \times 20 \times \cos 15^0$

$= 2 \times 0.15 \times 20 \times 0.96$ [$\because \cos 15^o = 0.96$]

$= 5.76$

$= 5.8$ kg m/sec

27. The extension of a wire by the application of load is 3 mm. The extension in other wire of the same material and same length but half the radius by the same load is :

(a) 12 mm (b) 0.75 mm
(c) 15 mm (d) 6 mm

KVS PGT 2014 (Physics)

Ans. (a) : Given, $\Delta l_1 = 3$mm

wire made up of same material i.e., $Y_1 = Y_2$

and $L_1 = L_2$, load $F_1 = F_2$

Young Modulus , $Y = \dfrac{FL}{(\pi r^2)\Delta l}$

$$\Rightarrow \Delta l \propto \frac{1}{r^2}$$

$$\Rightarrow \frac{\Delta l_1}{\Delta l_2} = \frac{r_2^2}{r_1^2}$$

$$\Rightarrow \frac{\Delta l_1}{\Delta l_2} = \left(\frac{r/2}{r}\right)^2 = \frac{1}{4}$$

$$\Rightarrow \Delta l_2 = 4(\Delta l_1) = 4\times 3 = 12\text{mm}$$

28. A circular disc X of radius r is made from an iron plate of thickness t and another circular disc Y of radius 4r is made from an iron plate of thickness t/4. The relation between the moments of inertia I_x and I_y is :

(a) $I_X > I_Y$
(b) $I_X = I_Y$
(c) $I_X < I_Y$
(d) Depends on actual values of r and t

KVS PGT 2014 (Physics)

Ans. (c) : Moment of inertia $I = \dfrac{1}{2}MR^2$

Since Mass $M \propto t \propto R^2$

For circular disc X, the moment of inertia

$$I_x = \frac{1}{2}\left[\rho\times\pi r^2 t\right]r^2$$

Similarly, for circular disc Y,

The moment of inertia, $I_y = \dfrac{1}{2}\left[\rho\pi(4r)^2\, t/4\right](4r)^2$

Thus,

$$\frac{I_x}{I_y} = \frac{\frac{1}{2}\left[\rho\times\pi r^2 t\right]r^2}{\frac{1}{2}\left[\rho\pi(4r)^2\, t/4\right](4r)^2} = 1/64$$

$$\Rightarrow I_x = \frac{I_y}{64} \Rightarrow I_y = 64I_x$$

i.e. $I_y > I_x$

Hence the moment of inertia of Y is 64 times that of X.

29. A wheel having moment of inertia 2 kg m^2 about its axis rotates at 50 rpm about its axis. The torque that can stop the wheel in one minute is :

(a) π N m (b) π/3 N m
(c) 2π/9 N m (d) π/18 N m

KVS PGT 2014 (Physics)

Ans. (d) : Given, Moment of Inertia (I) = 2 kg – m^2

and $\omega_0 = 50\text{rpm} = 50\times\dfrac{2\pi}{60}\text{red/s} = \dfrac{5\pi}{3}\text{red/s}$

t = 1 minute = 60 s

Also, $\omega = \omega_0 - \alpha t$

$$0 = \frac{5\pi}{3} - \alpha.60$$

$$\alpha = \frac{5\pi}{3\times 60} = \frac{\pi}{36}$$

since, $\tau = I.\alpha$

$$\tau = 2\times\frac{\pi}{36}$$

$$\tau = \frac{\pi}{18}\text{Nm}$$

30. Two bodies X and Y have masses M and m respectively, where M > m, and they are at a distance d apart. Equal force is applied to them so that they approach each other. The position where they hit each other is :

(a) near to Y
(b) nearer to X
(c) at equal distance from X and Y
(d) can not be decided

KVS PGT 2014 (Physics)

Ans. (b) : Since, the forces are equal and directed to each other i.e., applied in opposite directions. Therefore, the net external force is zero. Thus, the centre of mass will remain at rest and they meet at the centre of mass and the centre of mass lies closer to big massive bodies. So, the position where they hit each other is nearer to X.

31. The moment of inertia of a thin rod of mass M and length L about an axis passing through its end and perpendicular to the length is :

(a) $ML^2/3$ (b) $ML^2/12$
(c) $ML^2/2$ (d) ML^2

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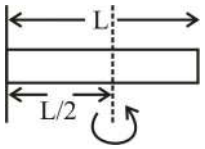
Ans. (a) : For a uniform rod with negligible thickness, the moment of inertia about its centre of mass is :

$$I_{cm} = \frac{1}{12}ML^2$$

The distance between the centre of mass and one end of rod x = L/2



So, using parallel axis theorem,

$$I = I_{cm} + Mx^2$$

$$I = \frac{1}{12}ML^2 + \frac{ML^2}{4} = \left(\frac{1}{12} + \frac{1}{4}\right)ML^2 = \frac{1}{3}ML^2$$

Thus, the moment of inertia of a rod about its one end is, $I = \frac{ML^2}{3}$

32. Two springs X and Y ($k_x = 2k_y$) are stretched by applying forces of equal magnitudes at the four ends. If the energy stored in X is E, then the energy stored in Y is :

(a) E/2 (b) 2E
(c) E (d) E/4

KVS PGT 2014 (Physics)

Ans. (b) : Given, $F_A = F_B$

In case of spring, restoring force, F = – kX

Since the force applied was equal,

$$\Rightarrow k_x X_x = k_y X_y \Rightarrow X_y = \left(\frac{k_x}{k_y}\right)X_x = 2X_x$$

The energy stored in spring $X = \frac{1}{2}k_x X_x^2 = E$

Then, the energy stored in spring $Y = \frac{1}{2}k_y X_y^2$

$$U_y = \frac{1}{2}\left(\frac{k_x}{2}\right)(2X_x)^2 = \frac{1}{2}k_x X_x^2 \times 2$$

$$U_y = 2E$$

33. A 2 kg stone at the end of a string 1 m long is whirled in a vertical circle at a constant speed of 4 m/s. The tension in the string will be 52 N when the stone is :

(a) at the top of the circle
(b) halfway down
(c) at the bottom of the circle
(d) anywhere on the circle

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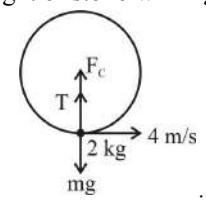
Ans. (c) : The weight of stone w = mg = 2 × 10 = 20 N.



The centrifugal force,

$$F_C = \frac{mv^2}{r}$$

$$F_C = \frac{2 \times 4 \times 4}{1} = 32N$$

When the stone is at the bottom most position, the three forces will act on it. Tension of string is in the upward direction and weight and centrifugal force is in the downward direction.

Therefore,

$$T_{Bottom} = mg + F_e = mg + \frac{mv^2}{r}$$

$$= 2 \times 10 + \frac{2 \times 4^2}{1} = 52N$$

34. The linear momentum of a particle is given by $p = a + bt^2$, where t is time and a & b are constants. The force acting on the body varies directly as :

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

KVS PGT 2014 (Physics)

Ans. (b) : Given, linear Momentum $p = a + bt^2$

$$\Rightarrow \frac{dp}{dt} = 0 + 2bt = 2bt$$

According to Newton's law of force,

$$F \propto m \Rightarrow F = \frac{dp}{dt}$$

i.e. The applying force on the body is equal to the time of change of linear momentum of body.

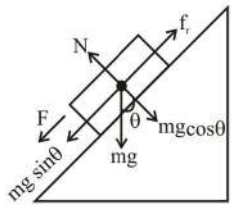
So, force $F = 2bt \Rightarrow F \propto t$

35. A body starts sliding down at an angle θ to horizontal. Then coefficient of friction is equal to :

(a) sin θ (b) cos θ
(c) tan θ (d) cot θ

KVS PGT 2014 (Physics)

Ans. (c) :



From the free body diagram,

In equilibrium,

$N = mg\cos\theta$ ..... (1)

and

$f_r = mg\sin\theta$ =.....(2)

from eq^n (1) and (2)

$\frac{f_r}{N} = \tan\theta$

$\Rightarrow \mu = \tan\theta$

36. Two cylindrical metallic wires A and B of same material having radii r and 2r and length L and 2L respectively are stretched within the proportional elastic limits by the same force F. If the wire A is stretched by 1 cm, the stretch in wire B would be :

(a) 0.25 cm (b) 0.50 cm

(c) 1.00 cm (d) 2.00 cm

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans. (b) : According to Hook's law,

Stress $\propto$ Strain

$\Rightarrow \quad \sigma = P/A \propto \frac{\Delta L}{L}$

$\Rightarrow \quad \frac{P}{A} \propto \frac{e}{L} \Rightarrow e \propto \frac{PL}{A}$

$\Rightarrow \quad e \propto \frac{L}{A}$

$\Rightarrow \quad \frac{e_1}{e_2} = \frac{L_1}{L_2} \times \frac{A_2}{A_1}$

$\frac{e_1}{e_2} = \frac{L_1}{r_2} \times \frac{4r^2}{2L_1}$

$\frac{e_1}{e_2} = \frac{2}{1}$ Given ($e_1 = 1$cm)

$\frac{1}{e_2} = \frac{2}{1}$

$e_2 = \frac{1}{2} = 0.50\,\text{cm}$

37. Two rotating circular discs A and B have equal angular momentum. The two disc have equal mass and thickness but made from different materials. The disc B has higher moment of inertia than that of disc A. Which one of the following statements is true in this context ?

(a) The kinetic energy of disc A is more than that of the disc B.

(b) The kinetic energy of disc A is less than that of the disc B.

(c) The kinetic energies of the two discs are equal.

(d) The angular speeds of two discs are equal.

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Ans. (a) : Given,

Angular momentum, $L_A = L_B$

Moment of Inertia, $I_B > I_A$

Then, kinetic Energy of disc,

$KE = \frac{1}{2}\frac{L^2}{I}$

Ratio of KE of A to the KE of B,

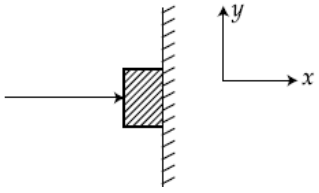
$\frac{KE_A}{KE_B} = \left(\frac{L_A}{L_B}\right)^2 \left(\frac{I_B}{I_A}\right)$

$\Rightarrow \quad \frac{KE_A}{KE_B} = \left(\frac{I_B}{I_A}\right) (\because L_A = L_B)$

$\Rightarrow \quad KE_B < KE_A \ (\because I_B > I_A)$

So, Kinetic Energy of disc A is more than that of the disc B.

38. A box of mass 0.60 kg is pressed against a wall by a force of 12 N, as shown in figure. The coefficient of static friction between the box and the wall is 0.6. The magnitude of net force exerted by the wall on the box is close to: (take g=10 m/s^2)



(a) 6.0 N

(b) 12.0 N

(c) 13.4 N

(d) 18.0 N

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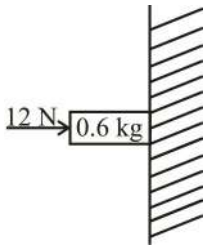
KVS PGT 2023 (17/02/2023) Physics

Ans. (c) : Given,

$\mu = 0.6$

$m = 0.6$ kg

$F = 12$ N



We know that,

Limiting friction = $\mu \times F$

$= 0.6 \times 12$

$= 7.2$ N

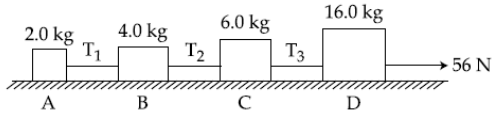
Weight acting downwards = $mg = 0.6 \times 10$

$= 6.0$ N

Thus force of friction, $f = 6$N

So, the net contact force = $\sqrt{6^2 + 12^2} = \sqrt{180} = 13.4$ N

39. Four boxes A(2.0 kg), B(4.0 kg), C(6.0 kg) and D(16.0 kg) are lying on a horizontal smooth surface and are connected by a light strings, as shown in the figure. A force of 56 N is applied horizontally to the box D. T1, T2 and T3 are tensions in strings, as shown. The ratio $\left(\frac{T_2}{T_3}\right)$ is:



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

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

(c) 1

(d) 2

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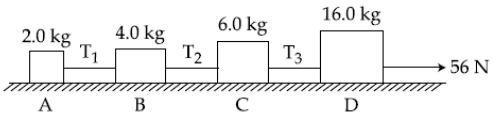
Ans. (a) : Given,



From figure,

$56 - T_3 = 16a$ .....(i)

$T_3 - T_2 = 6a$ .....(ii)

$T_2 - T_1 = 4a$ .....(iii)

$T_1 = 2a$ .....(iv)

Now from eq^n (iv) & (iii), we get –

$T_2 - 2a = 4a$

$T_2 = 6a$

Putting the value of T_2 in eq^n (ii),

$T_3 - T_2 = 6a$

$T_3 - 6a = 6a$

$T_3 = 12a$

Ratio of $\frac{T_2}{T_3} = \frac{6a}{12a} = \frac{1}{2}$

40. Two forces $\vec{F_1}$ and $\vec{F_2}$, given by $\vec{F_1} = (16N)\hat{i}$ and $\vec{F_2}(12N)\vec{j}$ act simultaneously on an object of mass 5.0 kg. Here $\hat{i}$ and $\hat{j}$ are unit vectors along x-axis and y - axis respectively. The acceleration of the object has a magnitude _____ and it makes an angle of _____ with the x-axis.

(a) 2.0 m/s2, $\tan^{-1}\left(\frac{3}{4}\right)$

(b) 2.0 m/s^2 $\tan^{-1}\left(\frac{3}{4}\right)$

(c) 4.0 m/s^2, $\tan^{-1}\left(\frac{3}{4}\right)$

(d) 4.0 m/s^2, $\tan^{-1}\left(\frac{3}{4}\right)$

NVS PGT 2022 (15/12/2022) Shift -I Physics

Ans. (c) : Given,

$F_1 = (16N)\hat{i}$

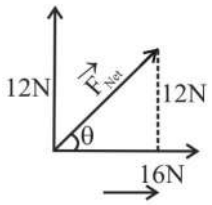
$F_2 = (12N)\hat{j}$

$m = 5.0$ kg

$$\vec{a} = \frac{\sum\vec{F}}{m} = \frac{\vec{F_1} + \vec{F_2}}{m} = \frac{(16i + 12j)}{5.0}$$

$$a = \frac{\left((16)^2 + (12)^2\right)}{5.0} = \frac{\sqrt{400}}{5}$$

$$a = \frac{20}{5} = 4\,m/s^2$$



$$\tan\theta = \frac{12}{16} = \frac{3}{4}$$

$$\theta = \tan^{-1}\left(\frac{3}{4}\right)$$

41. Mohan is cycling on a level circular road of radius 8.0 m. The coefficient of static friction between the tyres and the road is 0.2. The maximum speed with which he can cycle without slipping is : (take g=10 m/s^2)

(a) 1.0 m/s

(b) 2.0 m/s

(c) 3.0 m/s

(d) 4.0 m/s

NVS PGT 2022 (15/12/2022) Shift -I Physics
KVS PGT 2023 (17/02/2023) Physics

Ans. (d) : Given,

Radius (r) = 8.0 m

$\mu = 0.2$

$g = 10$ m/s^2

Maximum speed, $V = \sqrt{\mu rg}$

$= \sqrt{0.2 \times 8.0 \times 10}$

$= \sqrt{16}$

$= 4$ m/s

42. The amplitude of the bob of an oscillation simple pendulum decreases with time. The force F responsible for depends on the velocity v of the bob as

(a) $F \propto v$

(b) $F \propto v^2$

(c) $F \propto \frac{1}{v}$

(d) $F \propto \frac{1}{v^2}$

AEES PGT 2015 (Physics)

Ans. (a) : We know that-

$F = ma$

$a = v/t$

So, $F = m\frac{v}{t}$

$F \propto v$

In damped oscillations, damping force is directly proportional to speed of the simple pendulum.

43. One spacing has force constant $200Nm^{-1}$, another has force constant $500Nm^{-1}$. If they are joined in series, the force constant will be nearest to-

(a) $700Nm^{-1}$
(b) $300Nm^{-1}$
(c) $143Nm^{-1}$
(d) $100Nm^{-1}$

AEES PGT 2015 (Physics)

Ans. (c) : Given,

Force constant (k_1) of one spring = 200 Nm^{-1}

Force constant (k_2) of another spring = 500 Nm^{-1}

Since, they are connected in series.

$$\Rightarrow \quad \frac{1}{K_{eq}} = \frac{1}{k_1} + \frac{1}{k_2}$$

$$\frac{1}{K_{eq}} = \frac{1}{200} + \frac{1}{500}$$

$$K_{eq} = \frac{1000}{7} = 142 \cdot 8\,Nm^{-1}$$

Thus, force constant will be nearest to 143 Nm^{-1}.

44. A 4 kg object is moving at a speed of 5 m/s. The constant force needed to stop the object in 5×10^{-4} s will be :

(a) $+4 \times 10^{+4}$ N in the direction of motion.
(b) + 20 N in the direction of motion.
(c) + 100 N in the opposite direction of motion.
(d) $+ 4 \times 10^4$ N in the opposite direction of motion.

KVS TGT 2023 (Science)

Ans. (d) : Given,

$m = 4$ kg

$v = 5$ m/s

$t = 5 \times 10^{-4}$ sec

from the equation of motion, $v = u + at$

$0 = 5 + a(5 \times 10^{-4})$

$a = -10^4$ m/s^2

So, $F = ma = 4 \times -10^4 = -4 \times 10^4$ N acting in the opposite direction of motion.

45. A rocket, set for vertical firing, weighs 50 kg and contains 450 kg of fuel. It can have a maximum exhaust velocity of 5 km/sec. What should be its minimum rate of fuel consumption to just lift it off the launching pad?

(a) 0·98 kg/sec
(b) 0·098 kg/sec
(c) 9·8 kg/sec
(d) More than one of the above
(e) None of the above

BPSC School Teacher 2023 Paper-III Science

Ans. (a): According to question,

Weight of rocket and fuel (mg) = (450 + 50) × 9.8

$V_r = 5$ km/sec $= 5 \times 10^3$ m/sec

Minimum rate of fuel consumption $\left(\frac{dm}{dt} = \frac{mg}{V_r}\right)$

$$= \frac{(450 + 50) \times 9 \cdot 8}{5 \times 10^3}$$

Minimum fuel consumption rate $\left(\frac{dm}{dt}\right)$

$$= \frac{500 \times 9 \cdot 8}{5000} = \frac{4900}{5000}$$

Minimum fuel consumption rate $\left(\frac{dm}{dt}\right) = 0.98$kg/sec.

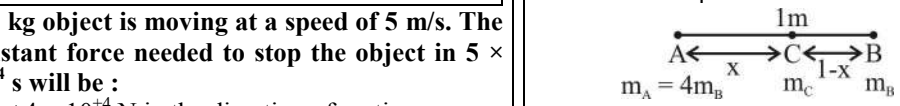
46. Two objects A and B are separated by 1m. A is 4 times heavier than B. When another mass C is placed between A & B (along the line), the force between A and C is $\frac{1^{th}}{4}$ the force between B & C. At what distance C is placed from A?

(a) 0.5 m (b) 0.2 m
(c) 0.8 m (d) 0.6 m

KVS (LDCE) TGT 2022 (Science)

Ans. (c) : Given,

$$F_{AC} = \frac{1}{4} F_{BC}$$



$$F_{AC} = \frac{1}{4} F_{BC}$$

$$\frac{Gm_a m_c}{x^2} = \frac{1}{4}\frac{Gm_b m_c}{(1-x)^2}$$

$$\frac{m_a}{x^2} = \frac{m_b}{4(1-x)^2}$$

$$\frac{4m_b}{x^2} = \frac{m_b}{4(1-x)^2}$$

$$\left(\frac{x}{1-x}\right)^2 = 16$$

$$\frac{x}{1-x} = 4$$

$x = 4 - 4x$

$5x = 4$

$$x = \frac{4}{5} = 0.8\text{m}$$

Thus the distance of point C from A is 0.8 m.

47. Which of the following statement is/are correct regarding momentum?

(A) It has direction, same as that of velocity.
(B) Rate of change of momentum is opposite to the direction of force.

(C) Change in momentum does not depend on duration of force applied.

(D) Change in momentum takes place on application of unbalance force only.

(a) (A) & (B) (b) (B) & (C)

(c) (C) & (D) (d) (A) & (D)

KVS (LDCE) TGT 2022 (Science)

Ans. (d): The rate of change in linear momentum of a body is directly proportional to the external force applied on the body, and this change takes place in the direction of the applied force.

- Momentum and velocity always have the same direction as $\vec{p} = m\vec{v}$
- Newton's Second law of motion states that the rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of the force

So, option (A) & (D) are correct.

48. Which of the following statements is/are true?

1. If a body does not change its position it is at rest.

2. There is no meaning of rest or motion without the viewer.

Choose the correct code.

(a) Neither 1 nor 2 (b) Both 1 and 2

(c) Only 1 (d) Only 2

DSSSB TGT 2021(male,08/09/2021)Shift-II N.Sci.

Ans. (b) : The concept of rest and motion can be explained by an example, consider Ram is moving in train. He is in motion with respect to a person standing outside train. As the train moves his position is changing with respect to the man outside.

* Here the point of reference is the man sitting outside.

* Ram is at rest with respect to the train because their relative position is not changing.

An object at rest remains at rest, or if in motion remains in motion at a constant velocity unless and until an external force is applied on it.

49. Find the maximum height a ball will reach if it is thrown vertically up at a speed of 4 m/s? (Given g = 10m/s^2)

(a) 1.6 m (b) 0.4 m

(c) 0.6 m (d) 0.8 m

DSSSB TGT 2021 (Female,25/09/2021)N.Sci.

DSSSB TGT 2022 (Female, 26/09/2022) Shift-I N.Sci.

Ans. (d) : (For vertical motion 'S' is replaced by h)

$v^2 - u^2 = 2aS$

$(0)^2 - (4)^2 = 2\times(-10)\times h$ (a = –g)

h = 0.8m

50. The force of attraction (F) between two particles having masses m_1 and m_2 is given by -------. (If r is the distance between them and G is a universal constant)

(a) $G\frac{m_1m_2}{r}$ (b) $G\frac{m_1m_2}{r^3}$

(c) $G\frac{m_1m_2}{r^2}$ (d) $G.m_1.m_2.r^2$

DSSSB TGT 2021 (Female, 25/09/2021) Shift-II N.Sci.

Ans. (c) : According to the law of gravitation, The force F between two bodies of masses m_1 and m_2 placed at a distance of 'r' from each other, is given as,

Where G is universal constant, G= 6.67 × 10^{-4} N–m^2/kg^2

$$F = G\frac{m_1m_2}{r^2}$$

51. Which of the following equations is the correct representation of momentum?

[mass m and velocity v and momentum is denoted by p of the body]

(a) p = v/m (b) p = mv

(c) p = m-v (d) p = m/v

DSSSB TGT 2021 (Female, 25/09/2021) Shift-I N.Sci.

Ans. (b) : It is the capacity to make an objects moving in the direction of their motion.

Linear momentum is given by –

$$\vec{P} = m\cdot\vec{v}$$

m = Mass of object

v = velocity of object

- Linear momentum is the product of mass and velocity.
- Mass is scalar quantity and velocity is a vector quantity.

So, momentum is a vector quantity.

52. A bullet of mass 0.08 kg moving with a speed of 50 ms^{-1} enters a heavy wooden block and is stopped after a distance of 40 cm. What is the average resistive force exerted by the block on the bullet?

(a) 220 N (b) 350 N

(c) 250 N (d) 300 N

DSSSB TGT 2021 (Female, 25/09/2021) Shift-I N.Sci.

Ans. (c) : Given,

m = 0.08 kg,

u = 50 m/s,

v = 0,

and s = 40 cm

3rd equation of motion is-

$2as = v^2 - u^2$

$$a = -\frac{u^2}{2s}$$

$$a = \frac{50\times50}{2\times40\times10^{-2}}\left(\text{Retardation}\right)$$

The resistive force, F = m.a

$$F = 0.08 \times \frac{50\times50}{2\times40\times10^{-2}}$$

F = 250 N

53. Which of the following is not an example of conservative force?

(a) Force of friction (b) Force of gravity

(c) Force of spring (d) Coulomb force

DSSSB TGT 2022 (Female, 26/09/2022) Shift-I N.Sci.

Ans. (a) : The frictional force is a non-conservative force.

- A non-conservative force is one for which work depends on the path taken.

- Work done against friction depends on the length of the path between the starting and ending point because of this dependence on the path there is no potential energy associated with non- conservative force.

54. The term impending motion means:

(a) Motion that would not take place (but does actually take place) under the applied force, if friction were absent.

(b) Motion that would take place (but does not actually take place) under the applied force, if friction were present.

(c) Motion that would take place (but does not actually take place) under no applied force, if friction were absent.

(d) Motion that would take place (but does not actually take place) under the applied force, if friction were absent.

DSSSB TGT 2022 (Female, 26/09/2022) Shift-I N.Sci.

Ans. (d) : Static friction does not exist by itself. When there is no applied force there is no static friction.
It comes to play as soon as the external force is applied.
The component of contact force normal to the surface is called normal reaction and the component parallel to the surface is called friction.
Static friction opposes the impending motion impending motion means the motion that would take place (but does not actually takes place) under applied force if friction were absent.

55. A body is projected vertically upwards with a velocity u. Find its speed when it is at half of the maximum height.

(a) $\frac{u}{2}$ (b) $\frac{u}{4}$

(c) $\frac{u}{\sqrt{2}}$ (d) $\frac{u}{2\sqrt{2}}$

DSSSB TGT 2018 (Female, 27/09/2018) Shift-I N.Sci.

Ans. (c) : For a body projected upward from horizontal, $\theta = 90°$

Hence, $H_{max} = \frac{u^2 \sin^2\theta}{2g}$

$= \frac{u^2}{2g}$ $(\sin 90° = 1)$

by equation,

$v^2 = u^2 - 2gh \quad \left(\text{from equation } h = \frac{H_{max}}{2}\right)$

$= u^2 - 2g\frac{u^2}{4g}$

$= u^2 - \frac{u^2}{2}$

$v^2 = \frac{u^2}{2}$

$v = \frac{u}{\sqrt{2}}$

56. A particle starts from rest and moving with uniform acceleration and attains velocity 20 m/s after travelling some distance. Find its velocity at mid-point of the journey distance.

(a) 10 m/s (b) $10\sqrt{2}$ m/s

(c) 5 m/s (d) 20 m/s

DSSSB TGT 2018 (Female, 27/09/2018) Shift-I N.Sci.

Ans. (b) : Given,
initial velocity, u = 0
Final velocity , v = 20 m/s
Since, $v^2 = u^2 + 2aS$
$\Rightarrow (20)^2 = 0 + 2aS$
$2aS = 400$ ..... (i)
At mid-point of journey, $= \frac{S}{2}$

$v_m^2 = 2a \times \frac{S}{2}$

$v_m^2 = (2aS) \times \frac{1}{2} = 400 \times \frac{1}{2}$ [from (i)]

$v_m = \sqrt{200} = 10\sqrt{2}\,m/s$

57. A body is dropped freely from a height 'X' m. If it takes Y seconds to reach the ground. The time it takes to reach half of the height of the tower is (Take g = 10m/s^2)

(a) $\frac{Y}{2}$s (b) $\frac{Y}{\sqrt{2}}$s

(c) $\frac{Y}{4}$s (d) $\frac{Y}{\sqrt{10}}$s

DSSSB TGT 2018 (Female, 27/09/2018) Shift-III N.Sci.

Ans. (b) : Given, a body is dropped freely from a height X (= s) and reach the ground in Y seconds (= t')

$\therefore\ s = ut + \frac{1}{2}gt'^2$

$s = 0 + \frac{1}{2}gt'^2 \ \Rightarrow\ X = \frac{1}{2}g\,Y^2$

As per question,

$\frac{s}{2} = ut + \frac{1}{2}gt^2$

$\Rightarrow \frac{X}{2} = 0 + \frac{1}{2}gt^2$

$X = gt^2$

$\Rightarrow \frac{g}{2}Y^2 = gt^2$

$\Rightarrow t = \frac{Y}{\sqrt{2}}$ second

58. The velocity of a body of mass 100 g is increased from 5 m/s to 36 km/hr in 5s. The force acting on the body is :

(a) 0.1 N (b) 0.2 N

(c) 0.5 N (d) 0.8 N

DSSSB TGT 2018 (Male, 29/09/2018)Shift-I N.Sci.

Ans. (a) : Given, $m = 100g = \frac{100}{1000}kg$

$v_1 = 5$ m/s, $v_2 = 36$ km/hr $= 36 \times \frac{5}{18} = 10 m/s$

Acceleration, $a = \frac{v_2 - v_1}{t} = \frac{10-5}{5} = 1 m/s^2$

Force, F = mass × acceleration

$F = \frac{100}{1000} \times 1 = 0.1N$

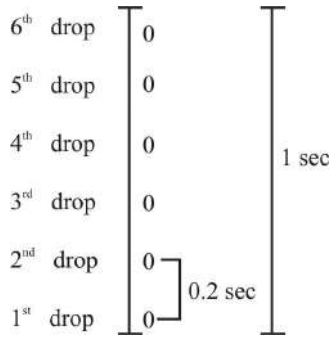
59. Water drops fall from the nozzle of a shower 5 m high on to the floor. The drops are released at regular intervals of time such that the first drop reaches the ground when sixth drop is released from the nozzle. Taking g = 10m/s^2. What is the height of the fourth drop from the ground?

(a) 1.8 m (b) 4.2 m
(c) 2.6 m (d) 3.4 m

DSSSB TGT 2018 (Male, 29/09/2018)Shift-II N.Sci.

Ans. (b) : Given,

The height of the shower is 5m, at regular interval the drop reaches the ground. According to the question when 1st drop reaches the ground, 6th drop released at the nozzle.



1st drop to reach ground

$s = ut + 1/2\ at^2$

$s = 0 + 1/2 \times 10 \times t^2$

$5 = 1/2 \times 10 \times t^2$

$t = 1$ sec

Since, five drops gap at regular interval so each drop come after 1/5 = 0.2 sec

fourth drop's height from the ground,

h = 5m – 4th drop distance covered in

(0.2 + 0.2 = 0.4) sec

$h = 5m - \left(ut + \frac{1}{2}at^2 \right)$

$h = 5 - \frac{1}{2} \times 10 \times 0.4 \times 0.4$

h = 5m – 0.8 m = 4.2 m

2. Newton's Law of Motion

60. What will be the change in momentum if a 10 Newton force applied on a 20 kg mass object for a 10 second?

(a) 5 kg m/sec (b) 100 kg m/sec
(c) 200 kg m/sec (d) 1000 kg m/sec

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (b) : Given, F = 10N

u = 0
v = ?
m = 20 kg
t = 10 sec.

We have, $a = \frac{F}{m} = \frac{10}{20} = \frac{1}{2} m/sec^2$

v = u + at

$v = 0 + \frac{1}{2} \times 10$

v = 5 m/sec.

Now,

Change in momentum, $\Delta P = m(v - u)$
$= 20 \times (5 - 0)$
$= 100$ kg m/sec

61. Which of the following is obtained if we calculate the area under the force-displacement graph?

(a) Impulse (b) Momentum
(c) Work done (d) Torque

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (c) : Work done is equal to area under the force-displacement graph.

$W = \vec{F}.\vec{d} = Fd\cos\theta$

62. What is the dimensional formula for impulse?

(a) M L T (b) $M^{-1} L^{-1} T^{-1}$
(c) $ML^{-1}T^{-1}$ (d) MLT^{-1}

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics

Ans. (d) : Since, impulse I = F × t.
So, dimensionally represented as
$[M^1L^1T^{-1}]$

63. _____ is defined by Newton's first law of motion.

(a) Energy (b) Work
(c) Inertia (d) Moment of Inertia

DSSSB PGT 2021 (23/07/2021 Shift-I) Physics
DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans. (c) : Inertia is defined by Newton's first law of motion.

Inertia:- Inertia is the tendency of objects at rest to stay at rest, unless a force causes its speed or direction to change. It is one of the fundamental principles in classical physics, and described by Newton's first law of motion.

64. When a rocket is fired from the Earth:

(a) The law of conservation of energy is used
(b) The law of conservation of linear momentum is used
(c) The law of conservation of charge is used
(d) The Ohm's law is followed

DSSSB PGT 2018 (03 July 2018, Male) Phy.

Ans. (b) : Law of conservation of linear momentum is used

- The law of conservation of momentum states that when two objects collide in an isolated system, the total momentum before and after the collision remains equal.
- The principle of conservation of momentum is a direct consequence of Newton's third law of motion. So when a rocket is fired from the earth, the law of conservation of linear momentum is used.

65. Which is the frame of reference in which Newton's first law holds true?

(a) Internal frame
(b) Uniform frame
(c) Intersticial frame
(d) Inertial frame

DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans. (d) : Inertial frame- Newton's first law

$\Rightarrow$ An Inertial frame of reference is a frame where Newton's first law hold. It means if no external force is acting on a body it will stay at rest or remain in uniform motion.

66. Which of the following statement is correct about action and reaction?

(a) Both act on the same object
(b) Both may or may not have equal magnitude
(c) Both Have same direction
(d) Both act along the line joining the bodies

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.
DSSSB PGT 2021 (Female 29/06/2021 Shift-I) Phy.

Ans. (d) : Action and reaction both act along the line joining the bodies.

- It explain the Newton's Third law which states that every action has an equal and opposite reaction.

67. Which of the following statements is/are true?

1. If a body changes its position with time it is said to be moving

2. Nothing is in absolute rest or in absolute motion

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

DSSSB TGT 2021 (07/09/2021 Shift-II Male) Natural Sci.

Ans. (c) :Moving Body:- When a body changes its position with its time, it is said to in motion or a moving body.

- Nothing is in absolute rest or in absolute motion as the frame of reference matters .

So, Both 1 and 2 statement are true.

68. The angular momentum (L) of a wheel changes from 2.45L to 4.45L in 2 seconds. The magnitude of the torque acting on it will be :

(a) L/3 (b) L/5
(c) L (d) L/2

KVS PGT 2014 (Physics)

Ans. (c) : Given, Change in angular momentum

$\Delta L = (4.45 - 2.45)L = 2L$

Time interval $\Delta t = 2$ seconds

According to Newton's law of force,

$$F = \frac{dp}{dt}$$

where F is the force while p is linear momentum

$$\Rightarrow \bar{r} \times \bar{F} = \frac{d(\bar{r} \times \bar{p})}{dt}$$

{$\because$ Torque $\tau = r \times F$, Angular Momentum $L = r \times p$}

$$\Rightarrow \tau = \frac{dL}{dt} = \frac{2L}{2} = L \text{ N} - \text{m}$$

69. A body is thrown vertically upward with velocity u. What is the greatest height H to which it will rise?

(a) u/g
(b) $u^2/2g$
(c) u^2/g
(d) u/2g

AEES TGT 2015 (Math, Physics)

Ans. (d) : Given,

Initial Velocity = u m/s
Final Velocity = v = 0
Acceleration = $-$ g m/s^2

Let 'h' be the maximum height, thus by the equation of motion, we get-

$v^2 - u^2 = 2ah$
$0 - u^2 = 2 \times (-g) \times h$
$u^2 = 2gh$

$$h = \frac{u^2}{2g}$$

70. Apparent weight of a body in a lift will be double of its real weight when

(a) Lift comes down with accelerating g
(b) Lift goes up with velocity 9.8m/sec
(c) Lift goes up with acceleration g
(d) Lift goes down with velocity 9.8m/sec

AEES TGT 2015 (Math, Physics)

Ans. (c) : Lift goes up with acceleration g.

When the lift is moving up with acceleration g then we have.

$R = m(g + a)$
$= m(g + g)$
$= 2mg$

$\Rightarrow$ It is more compared to actual weight when the lift is going up.

71. A projectile projected at 30º with the horizontal achieves a horizontal range R. It can achieve the same horizontal range R if projected (with the same initial velocity) at the following angle with the vertical.

(a) 15º
(b) 22.5º
(c) 30º
(d) It cannot achieve the same horizontal range for any angle $\alpha < 60^\circ$ with the vertical.

AEES PGT 2015 (Physics)

Ans. (d) : For the first projectile motion, the angle from horizontal is given as,

$\theta_1 = 30°$

For second projectile motion, the angle from horizontal for same range is,

$\theta_2 = 90° - 30$
$\theta_2 = 60°$