Review Questions

Total questions: 20

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Speed MCQ - Easy

1. Speed is a scalar quantity with dimensions

- ✓ $distance$
- $\frac{time}{distance}$
- $\frac{length}{time^2}$
- $\frac{time^2}{distance}$

Explanation

Rate of motion is speed. Speed tells about the rate change of position. It is measured as distance moved (d) per unit of time (t). Speed is a scalar quantity with dimensions d/t, i.e., distance/time.

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Problems on Equation of Motion MCQ - Easy

2. If a ball is thrown vertically upwards with 40 m/s its velocity after two second will be:-

- 10 m/s
- ✓ 20 m/s
- 30 m/s
- 40 m/s

Explanation

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Basics of Projectile Motion

MCQ - Easy

3. An object is projected at an angle α with the level ground. At an instant time t, the angle made by its position vector (from the point of projection) is β. Initial velocity of the projectile is:

- $\frac{gt\cos(\beta)}{2\sin(\alpha-\beta)}$
- $\frac{gt\sin(\alpha-\beta)}{2\cot(\beta)}$
- $\frac{gt\cos(\beta)}{2\sin(\alpha+\beta)}$
- ✓ $u = \frac{gtcos\beta}{sin(\alpha-\beta)}$

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Free Fall

MCQ - Easy

4. A stone dropped from the roof of a building takes 4 s to reach the ground. The height of the building is.

- 9.8m
- 19.6m
- 39.2m
- ✓ 78.4m

Explanation

The formula for time of flight is $t = \sqrt{\frac{2h}{g}}$

where h is the height from which ball is dropped.

since, $t = 4s$

Putting the value in above formula,

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Speed

MCQ - Medium

5. In a ballistic demonstration, a police officer fires a bullet of mass 50 g with speed of $200ms^{-1}$ on soft plywood of thickness 2 cm. The bullet emerges with only 10 % of its initial kinetic energy. What is the emergent speed of the bullet?

- 30 m/s
- $30\sqrt{2}$ m/s
- $63.24m/s$
- $30\sqrt{10}$ m/s

Explanation

Mass of bullet m = $50g$ = $0.05kg$
initial velocity of bullet = u = $200m/s$
initial energy of the bullet, $\frac{1}{2}mu^2$\frac{1}{2}\left({0.05} \right)\left({200\,square} \right) = 1000JThe bullet emerges with only 10\% $ofits$K.E. let the final velocity with which it emerges to be vSo,$final$K.Eis\dfrac{1}{2}m{v^2}10\% of\frac{1}{2}m{u^2}\dfrac{1}{2}m{v^2}\left({\dfrac{{10}}{{100}}} \right) \times 1000={v^2} = 100 \times \dfrac{2}{{0.05}} = v = 63.24m/s
Hence,
option (C)$ is correct answer.

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Basics of Projectile Motion

MCQ - Medium

6. The maximum range of a gun on horizontal surface is $16km$. If g = 10 ms^2, the muzzle velocity of the shell must be :

- 1600 ms^{-1}
- 400 ms^{-1}
- $200\sqrt{2}$ ms^{-1}
- $160\sqrt{10}$ ms^{-1}

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$$R = \frac{u}{g}$$

$$u = \sqrt{Rg} = \sqrt{16 \times 10^3 \times 10} = 400\ m/s$$

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Problems on Equation of Motion

MCQ - Medium

7. A car travelling at 2 ms^{-1} undergoes an acceleration of 1 ms^{-2}. How long will it take to double its velocity?

- 1s
- 2s
- 3s
- 4s

Explanation

$u = 2\ ms^{-1}$
$a = 1\ ms^{-2}$
$v = 2u = 4\ ms^{-1}$
$\therefore t = \frac{v - u}{a} = \frac{4 - 2}{1} s = 2\ s$

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Graphs in Relative Motion

MCQ - Medium

8. A taxi leaves the station X for station Y every 10 minutes. Simultaneously, a taxi leaves the station Y also for station X every 10 minutes. The taxis move at the same constant speed and go from X to Y or vice-versa in 2 hours. How many taxis coming from the other side will each taxi meet en route from Y to X?

- 10
- 12

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Basics of Projectile Motion

MCQ - Medium

9. Which of the following quantities remain constant during projectile motion?

- Average velocity between two points
- Average speed between two points
- ✓ $\frac{d\vec{v}}{dt}$
- $\frac{d\vec{y}}{dt}$ where y is vertical displacement.

Explanation

For a projectile, acceleration is constant, which is depicted by C option.

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Problems on Equation of Motion

MCQ - Medium

10. A particle is moving in a straight line with constant acceleration 'a' and initial velocity v_0. Average velocity during first t second is ____

- ✓ $v_0 + \frac{1}{2}at$
- $v_0 + at$
- $\frac{v_0 + at}{2}$
- $\frac{v_0}{2}$

Explanation

Initial velocity = v_0

Acceleration = a

Time = t

Distance moved = $v_0 t + \frac{1}{2}at^2$

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$$= \frac{v_0 t + \frac{1}{2} a t^2}{t}$$

$$= v_0 + \frac{1}{2} a t$$

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Velocity

MCQ - Medium

11. Joseph jogs from one end A to the other end B of the straight 300 m road in 2 minutes 50 seconds and then turns around and jogs 100 m back to point C in another 1 minutes. Joseph's average speeds and velocities in jogging, between points A and B, respectively, will be

- ✓ 1.76 ms^{-1}, 1.76 ms^{-1}
- 0.869 ms^{-1}, 0.869 ms^{-1}
- 1.76 ms^{-1}, 0.869 ms^{-1}
- 0.869 ms^{-1}, 1.76 ms^{-1}

Explanation

Between points A and B,
T =2 minute 50 second=170 sec.

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

$$\text{Average speed} = \frac{300}{170} = 1.76\ ms^{-1}$$

$$\text{Average velocity} = \frac{\text{total displacement}}{\text{time}}$$

$$\text{Average velocity} = \frac{300}{170} = 1.76\ ms^{-1}$$

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Uniformly Accelerated Motion

MCQ - Medium

12. The motor of an electric train can give it an acceleration of 1 ms^{-2} and brakes can give a negative acceleration of 3 ms^{-2} . The shortest time in which the train

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56.9s

60s

55s

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Uniformly Accelerated Motion

MCQ - Medium

13. Ben Rushin is waiting at a stoplight. When it finally turns green, Ben accelerated from rest at a rate of a $6.00 m/s^2$ for a time of 4.10 seconds. Determine the displacement of Ben's car during this time period.

- $50.4m$
- $50m$
- $40.4m$
- $80.4m$

Explanation

Here, acceleration of Ben's car is $a = 6m/s^2$
Time taken $t = 4.10s$ and initial velocity is $u = 0m/s$
Let S be the required displacement.
Using formula $S = ut + at^2/2$
$\therefore S = 0(4.10) + 0.5(6)(4.10)^2 = 50.4m$

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Acceleration

MCQ - Medium

14. A person drops a stone from a building of height $20m$. At the same instant the front end of a truck passes below the building moving with constant acceleration of $1m/s^2$ and velocity of $2m/s$ at the instant. Length of the truck if the stone just misses to hits its rear part is:-

- $6\ m$

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2 m

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Uniformly Accelerated Motion

MCQ - Medium

15. A 7 kg object is subjected two forces (in Newton) $\vec{F}_1 = 20\hat{i} + 30\hat{j}$ and $\vec{F}_2 = 8\hat{i} - 5\hat{j}$. The magnitude of resulting acceleration in ms^{-2} will be.

5

4

3

2

Explanation

Given,
$m = 7kg$
$\vec{F}_1 = 20\hat{i} + 30\hat{k}$
$\vec{F}_2 = 8\hat{i} - 5\hat{j}$
The net force is equal to the sum of two force,
$\vec{F} = \vec{F}_1 + \vec{F}_2$
$\vec{F} = 20\hat{i} + 30\hat{j} + 8\hat{i} - 5\hat{j} = 28\hat{i} + 25\hat{j}$
Magnitude, $|\vec{F}| = \sqrt{(28)^2 + (25)^2} = 35N$
Force, $F = ma$
$a = \frac{F}{m}$
acceleration, $a = \frac{37.5}{7} = 5m/s^2$.
The acceleration is $5m/s^2$.
The correct option is A.

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Acceleration - Time Graph

MCQ - Medium

16. The acceleration - time graph of a particle, which starts from rest and moves in a straight line, is given as shown in figure. The distance covered by particle in first

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- $\frac{16}{5}\ m$
- ✓ $8\ m$
- $\frac{16}{3}\ m$

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Coordinate System and Position Vectors

MCQ - Hard

17. An elevator is going up with an upward acceleration of $1\ m/s^2$. At the instant when its velocity is $2m/s$, a stone is projected upward from its floor with a speed of $2m/s$ relative to the elevator, at an elevation of $30°$. If the elevator was moving with a downward acceleration equal to g, how would the motion be altered?

- ✓ A straight line with respect to elevator and projectile with respect to ground
- Projectile with respect to elevator and straight line with respect to ground
- Projectile wrt both elevator and ground
- Straight wrt both elevator and ground

Explanation

Since the lift is going down with an acceleration of g, both the stone and the elevator are in free fall and their relative acceleration is $zero$, thus, the stone would move in a straight line with respect to the elevator but its path will be a parabola with respect to the ground.

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Velocity

MCQ - Easy

18. Two objects of mass ratio 1 : 4 are dropped from the same height. The ratio between their velocities when they strike the ground is:

- ✓ Both objects will have the same velocity.
- The velocity of the first object is twice that of the second one.
- The velocity of the 2^{nd} object is one fourth of that of the 1^{st} object.

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Let the masses of the two objects be m_1, m_2,
Let u_1, u_2, be their initial velocities respectively. Let h be the height from where the objects are dropped.
Let v_1, v_2 be the final velocities respectively.

Let t_1, t_2 be the time taken to strike the ground
$u_1 = u_2 = 0, h_1 = h_2 = h$
$h = \frac{1}{2}gt_1^2 .....(a)$
$h = \frac{1}{2}gt_2^2 .....(b)$
$\therefore t_1 - t_2 = t = \sqrt{\frac{2h}{g}} .....(c)$
Now, $v_1 = gt_1, v_2 = gt_2$
From equation (c)
$v_1 = v_2 = gt$
$\therefore \frac{v_1}{v_2} = \frac{1}{1}$

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Introduction to Relative Motion

MCQ - Hard

19. Two swimmers A and B start swimming from exactly opposite points on the separate banks of a river of width 8 km, flowing with a speed of 3 km/h. If speed of both the swimmers w.r.t to ground is 5 km/hr then what is the distance travelled by $'A'$ till they meet?
(Assume that their velocities w.r.t. to river are perpendicular to river flow).

- 4 km
- 6 km
- 20 km
- 5 km

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Introduction to Relative Motion

MCQ - Hard

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acceleration due to gravity $= g$

- $\frac{u - gt}{t}$
- $\frac{2u - gt}{t}$
- $\frac{u + gt}{t}$
- $\frac{2u + gt}{t}$

Explanation

velocity of lift $v_{rel} = u$

acceleration due to gravity $a_g = -g$

relative acceleration $a_{rel} = -g - a$

$t_{rel} = \frac{2u}{g + a}$

$a = \frac{2u - gt}{t}$

hence,option A is correct.

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