Review Questions

Total questions: 18

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18 questions from the bank — Edit

Kinematics

18 questions

Distance and Displacement — MCQ - Medium

1. A boat takes two hours to travels 8 km and back in still water. If the velocity of water is 4 km/h, the time taken for going upstream 8 km and coming back is

- 2 hr
- ✓ 2 hr 40 min
- 1 hr 20 min
- 2 hr 30 min

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Coordinate System and Position Vectors — MCQ - Medium

2. On a long horizontally moving belt, a child runs to and fro with a speed 9 km h^{-1} (with respect to the belt) between his father and mother located 50 m apart on the moving belt. The belt moves with a speed of 4 km h^{-1}. For an observer on a stationary platform, the speed of the child running in the direction of motion of the belt is

- 4 km h–1
- 5 km h–1
- 9 km h–1
- ✓ 13 km h–1

Explanation

Preview Test

$V_{belt/g} = 4$

$V_{child/belt} = V_{child/go} - V_{belt/g}$

$9 = V_1 - 4$

$\Rightarrow \boxed{V_1 = 13km/hr}$ [both are in same direction].

Hide Explanation

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Basics of Projectile Motion

MCQ - Hard

3. A ball is thrown vertically upward. It has a speed of $10m/sec$ when it has reached one half of its maximum height. How high does the ball rise? Take $g = 10ms^{-2}$.

- $10m$
- $5m$
- $6m$
- $7m$

Explanation

Let consider H = Maximum height

$g = -10m/s^2$

$v = 0m/s$ final velocity at the maximum height

u = initial velocity,

3rd equation of motion,

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

$0^2 - u^2 = -2gH$

$u^2 = 2gH$.....(1)

Now, $h = \frac{H}{2}$ and $v = 10m/s$

3rd equation of motion,

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

$10^2 - 2gH = -\frac{2gH}{2}$

$100 = \frac{2gH}{2}$

$H = \frac{100 \times 2}{2g}$

$H = \frac{100 \times 2}{2 \times 10} = 10m$

The correct option is A.

Preview Test

Distance and Displacement

MCQ - Hard

4. The displacement of a particle moving in a straight line is described by the relation, $s = 6 + 12t - 2t^2$. Here $'s'$ is in metre and $'t'$ is in second. The distance covered by particle in first 5 sec is:

- 20 m
- 32 m
- 24 m
- 26 m

Explanation

$s = 6 + 12t - 2t^2$
differentiating with respect to t
$v = 12 - 4t$
direction is reversed v=0
At t=0,
The displacement is 6 meters
displacement in 3 secs is 6 + 12
$times 3 - 2$
$times 3^2 = 24$
displacement in 5 secs is 6 + 12
$times 5 - 2$
$times 5^2 = 16$
Distance travelled in forward direction in 3 sec is 24-6=18 m
Distance travelled in reverse direction in next 2 sec is 24-16=8 m
Thus total distance travelled in 5 sec= 18+8=26 m
'

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Speed

Multiple Select - Easy

5. A train covers equal displacements and distance in equal intervals of time then it moves with:

- Uniform acceleration.
- Uniform motion.
- Uniform speed

Preview Test

If a train covers equal displacements in equal intervals of time, this implies body moves with uniform velocity. If a body moves with uniform velocity, the motion and speed of the body are also uniform.

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Graphs in Relative Motion

Multiple Select - Easy

6. Two cars travel along a level straight highway. It is observed that the separation between the cars is increasing. Which one of following statement(s) concerning this situation is necessarily true?

- [ ] Velocity of both the cars is increasing.
- [x] The front car has greater acceleration.
- [ ] Both the cars may have same acceleration.
- [x] The rear car has smaller acceleration.

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Problems on Equation of Motion

Multiple Select - Medium

7. The ratio of time taken by two cars P, Q starting from rest moving along a straight road with equal accelerations is $\sqrt{2}$: 1, then the :

- [x] Final velocity of car P > final velocity of car Q.
- [ ] Final velocity of car P < final velocity of car Q.
- [ ] Ratio of V_P to V_Q is 2 : $\sqrt{2}$.
- [x] Ratio of distance travelled by car 'P' to car 'Q' is 2 : 1

Explanation

$t_P : t_Q = \sqrt{2} : 1$; $u_P = u_Q = 0$

$\frac{v_P}{v_Q} = \frac{t_P}{t_Q} = \frac{\sqrt{2}}{1} \Rightarrow v_P = \sqrt{2}V_Q$

$\therefore$ Final velocity of car P > final velocity of Q

$v_P : v_Q = 2 : \sqrt{2}$

$\frac{S_P}{S_Q} = \frac{t_P^2}{t_Q^2} = \frac{(\sqrt{2})^2}{(1)^2} = \frac{2}{1}$

Preview Test

8. A particle is projected at an angle θ from ground with speed $u(g = 10m/s^2)$, then which of the following is true?

- [x] If $u = 10m/s$ and $\theta = 30^o$, then time of flight will be 1 sec
- [x] If $u = 10\sqrt{3}m/s$ and $\theta = 60^o$, then time of flight will be 3 sec
- [x] If $u = 10\sqrt{3}m/s$ and $\theta = 60^o$, then after 2 sec velocity becomes perpendicular to initial velocity
- [x] If $u = 10m/s$ and $\theta = 30^o$, then velocity never becomes perpendicular to intial velocity during its flight

Explanation

Using the formula,

$$T = \frac{2uSin\theta}{g}$$

For OPTION A, we have,
$u = 10\ m/s$
$\theta = 30°$

$$T = \frac{2 \times 10 \times Sin30}{10}$$
$$T = 1\ sec$$

For OPTION B, we have,
$u = 10\sqrt{3}\ m/s$
$\theta = 60°$

$$T = \frac{2 \times 10\sqrt{3} \times Sin60}{10}$$
$$T = 3\ sec$$

Time taken by velocity to become perpendicular to the initial velocity is given by:

$$t = \frac{u}{gSin\theta}$$

For OPTION C, we have,
$u = 10\sqrt{3}\ m/s$
$\theta = 60°$
$t =$ $10\sqrt{3}$

Preview Test

$u = 10\ m/s$
$\theta = 30°$
$t = \dfrac{10}{10 \times Sin30}$
$t = 2\ sec$

Since, $T = 1\ sec \leq t = 2\ sec$
∴. The velocity never becomes perpendicular to the initial velocity during its flight as time of flight is less than time when velocity becomes perpendicular to the initial velocity.

Hence, OPTIONS A, B, C, D are correct.

Hide Explanation

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Advanced Projectile Motion

Multiple Select - Medium

9. Mark correct statements .

- [x] Two particles are thrown with the same speed from the same point at the same instant but at a different angle cannot collide in mid-air
- [ ] A body projected in uniform gravitational field follows a parabolic path
- [ ] In projectile motion velocity is never perpendicular to the acceleration .
- [x] A particle dropped from rest and blown over by horizontal wind with constant velocity traces a parabolic path

Explanation

A) If two stones are to collide in mid-air then they mus travel equal horizontal distance in time t
Suppose one projectile is launched at angle θ_1 and the other at θ_2 both will same velocity then after time t the will cover a horizontal distance=
$v \cos\theta_1 \times t = v \cos\theta_2 \times t$
$\theta_1 = \theta_2$
So projectiles thrown at different angles will never collide in mid-air.
option A correct

B) It is not always true that under uniform gravity the path will be parabolic.
If the velocity of projection is more than the escape velocity then the path will be circular.
If more energy is provided then the path is an ellipse.

C) At the highest point of the projectile, the velocity is perpendicular to the acceleration.

D)The horizontal wind provides a force in the horizontal direction in addition to the downward gravitational force. The resultant force gives rise to a parabolic path.
option D is correct

Preview Test

Acceleration

Multiple Select - Medium

10. The displacement (x) of a particle depends on time (t) as $x = \alpha t^2 - 2\beta t^3$.

- [x] The particle will return to its starting point after time $\frac{\alpha}{2\beta}$.
- [x] The particle will come to rest after time $\frac{\alpha}{3\beta}$.
- [x] The initial velocity of the particle was zero but its initial acceleration was 2α.
- [x] No net force will act on the particle at $t = \frac{\alpha}{6\beta}$.

Explanation

It is given that

$x = \alpha t^2 - 2\beta t^3$

$\Rightarrow v = \frac{dx}{dt} = 2\alpha t - 6\beta t^2$

$\Rightarrow a = \frac{dv}{dt} = 2\alpha - 12\beta t$

Put $x = 0$

$\Rightarrow t^2(\alpha - 2\beta t) = 0$

$\Rightarrow t = \frac{\alpha}{2\beta}$

Put $v = 0$

$v = 2\alpha t - 6\beta t^2 = 0$

$\Rightarrow t = \frac{\alpha}{3\beta}$

initial velocity at time $t = 0 \Rightarrow v_{initial} = 0$

Put $a = 0$ for force to be zero because $F = ma$

$a = 2\alpha - 12\beta = 0$

$\Rightarrow t = \frac{\alpha}{6\beta}$

initial acceleration at time $t = 0 \Rightarrow a_{initial} = 2\alpha$

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Speed

Multiple Select - Medium

11. Which of the following is/are correct regarding uniform and non-uniform motion?

- [x] If a body travels equal distances in unequal time intervals of time then the body is said to be in a state of non-uniform motion

Preview Test

If a body travels equal distances in equal time intervals of time then the body is said to be in a state of non-uniform motion

All of the above

Explanation

If a body travels equal distance in unequal time intervals or If a body travels unequal distance in equal time intervals then the body is said to be in a state of non uniform motion.

Hide Explanation

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Speed

Multiple Select - Medium

12. A particle initially starts from rest, travels a distance Y in the first two seconds and a distance of X in next two seconds then,

$X = 2Y$

$X + Y = 4X$

$X + Y = 4Y$

$X = 3Y$

Explanation

$u = 0$

$t = 2s\ y = \frac{4}{2}a = 2a$

$t = 4s(X + Y) = \frac{16a}{2} = 8a$

$X + Y = 4Y\ (or)\ X = 3Y$

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Graphs in Relative Motion

Multiple Select - Hard

13. Ship A is located $4\ km$ north and $3\ km$ east of ship B. Ship A has a velocity of $20\ kmh^{-1}$ towards the south and ship B is moving at $40\ kmh^{-1}$ in a direction 37^o north of east. X and Y axes are along east and north directions, respectively.

Velocity of A relative to B is $-32\hat{i} - 44\hat{j}$

Preview Test

- [ ] Position of A relative to B as a function of time is given by $(32t\hat{i} - 44t\hat{j})$

Explanation

Assuming B is at origin $\vec{r}_B = 0$ at $t = 0$,then,
position vector A is given as : $\vec{r}_A = 3\hat{i} + 4\hat{j}$
at $t = 0$
From given data:
$\vec{V}_A = (-20\hat{j})$
$\vec{V}_B = (40cos37^o)\hat{i} + (40sin37^o)\hat{j}$
$= (32\hat{i} + 24\hat{j})$
Relative velocity of A w.r.t. B is given as:
$\vec{V}_{AB} = (-32\hat{i} - 44\hat{j})km/h$
Option A is correct.
Position vector of A w.r.t. B is given as:
At time $t = 0$
$\vec{r}_{AB} = \vec{r}_A - \vec{r}_B = (3\hat{i} + 4\hat{j})$
Option B is correct.
$\therefore$ At time $t = t$,
$\vec{r}_{AB} = (\vec{r}_{AB\ at\ t=0}) + \vec{V}_{AB}t$
$= (3 - 32t)\hat{i} + (4 - 44t)\hat{j}$

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Velocity

Multiple Select - Hard

14. A racing car starts from rest at $t = 0$ and reaches a final speed v at time t. If the acceleration of the car is constant during this time, which of the following statements are true?

- [ ] The car travels a distance vt
- [x] The average speed of the car is $v/2$.
- [x] The magnitude of the acceleration of the car is v/t.
- [ ] The velocity of the car remains constant
- [ ] None of statements (a) through (d) is true.

Explanation

The initial velocity of the car is $v_0 = 0$ and the velocity at time t is v. The constant acceleration is therefore given by
$a = \frac{\Delta v}{} = \frac{v - v_0}{} = \frac{v - 0}{} = \frac{v}{}$

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hence $v = v_0 = 0$), we see that statements (a), (b), (c), and (d) are all correct. However, in the general case ($a = 0$, and hence $v = 0$) only statements (b) and (c) are true. Statement (e) is not true in either case

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Coordinate System and Position Vectors

Subjective - Easy

15. Is it possible that the train in which you are sitting appears to move while it is at rest?

Explanation

Yes it is possible because the train may be in motion for the person who is outside the train but for passengers inside the train may be at rest as motion and rest are relative terms.

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Graphs in Relative Motion

Subjective - Medium

16. A person walks up a stationary escalation in t_1 second. If he remains stationary on the escalator, then it can take him up in t_2 second. If the length of the escalator is L, then
a. Determine the speed of man with respect to the escalator.
b. Determine the speed of the escalator.
c. How much time would it take him to walk up the moving escalator?

Explanation

a. As the escalator is stationary, so the distance covered in t_1 seconds is L which is the length of the escalator.

Speed of man w.r.t. the escalator, $v_{me} = \frac{L}{t_1}$

b.When the man is stationary, by taking man as a reference point the distance covered by escalator is L in time t_2.

Speed of escalator, $v_c = \frac{L}{t_2}$

c. Speed of man w.r.t. the ground, $v_m = v_{me} + v_c$

$$\Rightarrow v_m = \frac{L}{t_1} + \frac{L}{t_2} = L\left[\frac{1}{t_1} + \frac{1}{t_1}\right] = L\left[\frac{t_1 + t_2}{t_1 t_2}\right]$$

$$L \quad \left[\ t_1 t_2\ \right]$$

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Introduction to Relative Motion

Subjective - Easy

17. Two trains A and B, 100m and 60m long,are moving in opposite directions on parallel tracks.The velocity of the shorter trains is 3 times that of the longer one.If the trains take 4s to cross each other, the velocities of the trains are

Explanation

let us assume that the longer train is stopped.then the velocity of shorter train w.r.t longer train is 4V

$\therefore t = \frac{160}{4V}$

$V = \frac{160}{4t} = \frac{160}{4 \times 4} = 10\ m/s$

now $3V = 3 \times 10 = 30 \frac{m}{s}$

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Uniformly Accelerated Motion

Subjective - Hard

18. Check the correctness of the relation $S_{nth} = u + \frac{a}{2}(2n - 1)$, where u is initial velocity, a is acceleration and $S_{nth}$is the distance travelled by the body in nth second.

Explanation

$s_{nth} = \mu + \frac{a}{2}(2n - 1)$

The real formula is ;

$\mu(1) + \frac{a}{2}(1)$ (2n - 1)

where 1 represent 1 sec as times

LHS = [L]

[L] = $\mu(1) = [LT^{-1}][T]$

= [L]

$\frac{a}{a}(1)[2n - 1] = LT^{-2}$ [T] [T]

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hence the formula is correct

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