Review Questions

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18 questions from the bank Edit

Speed MCQ - Easy

1. The distance traveled by a particle is proportional to the square of time then the particle travels with

- Uniform velocity
- angular velocity
- ✓ constant acceleration
- Decreasing acceleration

Explanation

let $s = kt^2$, where k is a constant

using $a = \frac{d^2 s}{dt^2}$

$a = 2k = constant$

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Free Fall MCQ - Medium

2. A ball is thrown up and attains a maximum height of 100 m. Its initial speed was.

- $9.8ms^{-1}$
- ✓ $44.2ms^{-1}$
- $19.6ms^{-1}$
- none of these

Explanation

Maximum height attained $H = 100\ m$

Preview Test

Free Fall

MCQ - Hard

3. A boy can throw a stone up to a maximum height of $10m$. The maximum horizontal distance up to which the boy can throw the same stone up to will be

- $20\sqrt{2}m$
- 10 m
- $10\sqrt{2}$
- ✓ 20 m

Explanation

Given,

$H = 10m$

The maximum height in the projectile motion is given by

$H = \frac{u^2}{2g}$.....(1)

The maximum horizontal distance,

$R = \frac{u^2}{g}$.....(2)

From equation (1) and equation (2), we get

$R = 2H$

$R = 2 \times 10$

$R = 20m$

The correct option is D.

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Problems on Position, Velocity and Acceleration

MCQ - Hard

4. A rifle bullets loses $\left(\frac{1}{20}\right) th$ of its velocity in passing through a plank. Assuming that the plank exerts a constant retarding force, the least number of such planks required just to stop the bullet is:

- ✓ 11
- 20
- 21

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Explanation

If the bullet looses 1/20th of its velocity then,

$v = u - \frac{1}{20}u$

$v = \frac{19u}{20}$

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

$\left(\frac{19u}{20}\right)^2 = u^2 - 2as$

$2as = u^2 - \frac{19u}{20}$.....(1)

Now initial velocity =0

$\therefore 0^2 = u^2 - 2as(n)$

$u^2 = 2as(n)$

Now putting value of 2as from (1)

$u^2 = n\left[u^2 - \left(\frac{19u}{20}\right)^2\right]$

$u^2 = nu^2\left[\frac{20^2-19^2}{20^2}\right]$

$n = \frac{20^2}{20^2-19^2}$

$n = \frac{400}{400-361}$

$n = \frac{400}{39}$

$n = 10.26 \approx 11 planks$

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Distance and Displacement

Multiple Select - Easy

5. In which of the following cases of motion,the distance moved and magnitude of displacement are equal?

- [x] The car is moving on straight road
- [ ] A planet is moving around the sun
- [ ] A car is moving on circular road
- [x] Freely falling body under the action of gravity

Explanation

The car is moving on straight road
Freely falling body under the action of gravity
Since under these cases the acceleration is constant(=gravitational acc.(g))

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6. A particle is moving in a circle with uniform speed. It has:

- [x] constant kinetic energy
- [x] constant acceleration
- [ ] constant velocity
- [ ] constant displacement

Explanation

As the speed(v) is constant so the $KE = \frac{1}{2}mv^2$ will also be $constant$
and the acceleration will also be $only\ centripetal$
which will also be $constant$ as $a = \frac{v^2}{r}$, r is radius of the circle.
velocity will $vary$ as the path is $not\ linear$ thus $displacement.$

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Basics of Projectile Motion

Multiple Select - Medium

7. 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,
$u = 10\ m/s$
$\theta = 30°$

$$T = 2 \times 10 \times Sin30$$

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$u = 10\sqrt{3}\ m/s$
$\theta = 60°$

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

$T = 3\ sec$

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

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

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

$$t = \frac{10\sqrt{3}}{10 \times Sin60}$$

$t = 2\ sec$

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

$$t = \frac{10}{10 \times Sin30}$$

$t = 2\ sec$

Since, $T = 1\ sec \leq t = 2\ sec$

$\therefore$ 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.

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Introduction to Relative Motion

Multiple Select - Medium

8. Choose the INCORRECT options:-

- [ ] If relative velocity of one object with respect to other is towards the line joining them, then they must collide.
- [ ] If relative velocity of one object with respect to other is towards the line joining them, then they may collide.
- [x] A particle staring from rest under the action of constant acceleration must follow a straight line trajectory .
- [x] Motion under constant magnitude acceleration can never result in a closed path

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then they may collide $provided$
the relative $acceleration$ of one object with respect to other is towards the line joining them or if it is $retardation$
then it should not change the direction of motion $before$ striking the other object.

C is correct because it will have only one-dimensional motion along the acceleration.
D is $incorrect$ because an $uniform$ circular motion contradicts it.

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Free Fall

Multiple Select - Medium

9. A block slides down a smooth inclined plane when released from the top,while another falls freely from the same point

- [ ] Sliding block will reach the ground first
- [x] Freely falling block will reach the ground first
- [ ] Both the blocks will reach the ground with different speeds
- [x] Both the blocks will reach the ground with same speed

Explanation

Freely falling block will reach the ground first,because it has to travel less distance and with greater acceleration in comparison to the other block.
Both the blocks will reach the ground with the same speed,because the potential energies of both decrease by the same amount, which gets converted into KE.

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Graphs in Relative Motion

Multiple Select - Medium

10. Two particles move in the same straight line starting at the same moment from the same point in the same direction. The first moves with constant velocity u and the second starts from rest with constant acceleration f. Then

- [ ] They will be at the greatest distance at the end of time \dfrac {u}{2f} from the start
- [x] They will be at the greatest distance at the end of time \dfrac {u}{f} from the start
- [x] Their greatest distance is $\frac{u^2}{}$

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Explanation

Let S be the distance between the particles at time t

Particle 1 is $x_1 = u$

Particle 2 is $x_2 = \frac{1}{2}ft^2$

Then, $S = x_1 - x_2$

$= ut - \frac{1}{2}ft^2 \ldots\ldots (i)$

For S being maximum

$\frac{dS}{dt} = 0 \implies u - ft = 0$

$\implies t = \frac{u}{f}$

Substituting t in (i) we get

$S = u\frac{u}{f} - \frac{1}{2}f\left(\frac{u}{f}\right)^2$

$= \frac{u^2}{2f}$

Hence, they will be at the greatest distance and greatest distance is $\frac{u^2}{2f}$

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Introduction to Relative Motion

Multiple Select - Medium

11. Two cities A and B are connected by a regular bus services with buses plying in either direction every T seconds. The speed of each bus is uniform and equal to V_b. A cyclist cycles from A to B with a uniform speed of V_c. A bus goes past the cyclist in T_1 second in the direction A to B and every T_2 second in the direction B to A. Then

- [ ] $T_1 = \frac{V_bT}{V_b + V_c}$
- [ ] $T_2 = \frac{V_bT}{V_b - V_c}$
- [x] $T_1 = \frac{V_bT}{V_b - V_c}$
- [x] $T_2 = \frac{V_bT}{V_b + V_c}$

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Distance = Relative velocity × Time

$V_bT = (V_b - V_c)T_1 \Rightarrow T_1 = \frac{V_bT}{V_b - V_c}$

For B to A Direction :

$V_bT = (V_b + V_c)T_2 \Rightarrow T_2 = \frac{V_bT}{V_b + V_c}$

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Velocity

Multiple Select - Medium

12. If the displacement of a particle varies with time as $\sqrt{x} = t + 7$, which of the following statements is(are) true?

- [ ] Velocity of the particle is inversely proportional to t.
- [x] Velocity of the particle is proportional to t.
- [ ] Velocity of the particle is proportional to $\sqrt{t}$.
- [x] The particle moves with a constant acceleration.

Explanation

$\sqrt{x} = t + 7$

$\Rightarrow \quad x = (t + 7)^2$

$\Rightarrow \quad v = \frac{dx}{dt} = 2(t + 7)$

Thus, Velocity is proportional to time.

Also as $a = \frac{dv}{dt} = 2$

Thus particle moves with a constant acceleration.

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Basics of Projectile Motion

Multiple Select - Hard

13. At a height of $15\ m$ from ground velocity of a projectile $\vec{v} = \left(10\hat{i} + 10\hat{j}\right)$ and ($g = 10\ ms^{-2}$)

- [ ] particle was projected at an angle of $45°$ with horizontal
- [x] time of flight of projectile is $4\ s$

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Explanation

Using kinematics IIIrd equation

$v^2 - u^2 = 2gS$

$10^2 - u_y^2 = -2g \times 15$

$100 + 300 = u_y^2$

$u_y = 20\ m/s$
$u_x = 10\ m/s$
From above values of u_x and u_y it is clear that the angle of projection is not 45^o

$T = \frac{2u_y}{g} = 4\ s$
$Range = u_x \times T = 10 \times 4 = 40m$

maximum height of projectile $h_{max} = \frac{u_y^2}{2g} = \frac{20^2}{2 \times 10} = 20\ m$

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Velocity

Multiple Select - Hard

14. If acceleration is constant and initial velocity of the body is 0, then choose the correct statement. Symbols have their usual meaning.

- [ ] $v \propto \sqrt{t}$
- [x] $v \propto \sqrt{x}$
- [x] $v \propto t$
- [ ] $v \propto x^2$

Explanation

$(B), (C)$
$a = k$ (constant)
$a = \frac{dV}{dt}$
$\therefore \quad V = \int a dt$
$V = kt + C$
at $t = 0, V = 0$
$\therefore \quad V = kt + C \Rightarrow O = O + C \quad \Rightarrow C = 0$

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assume that x = 0 at t = 0

$\Rightarrow C_1$ = 0

$$\therefore \quad x = \frac{kt^2}{2} \Rightarrow x\alpha t^2$$

$\Rightarrow t\alpha\sqrt{x} \quad \rightarrow (2)$

(2) in (1) $\Rightarrow V\alpha\sqrt{x}$

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Speed

Subjective - Medium

15. The speed of a bus is 72 km/h, whereas the speed of a car is 125 m/s. Which vehicle moves faster?

Explanation

Speed of bus v_b = 72 km/h

$$\therefore v_b = 72\ km/h \times \frac{1000\ m}{km} \times \frac{1\ h}{3600\ s}$$

$\Longrightarrow \quad v_b$ = 20 m/s

Speed of car v_c = 125 m/s

Thus car moves faster than bus.

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Basics of Projectile Motion

Subjective - Medium

16. A snowball is thrown from ground level (by someone in a hole) with initial speed v_o at an angle of 45 relative to the (level) ground, on which the snowball later lands. If the launch angle is increased, do (a) the range and (b) the flight time increase, decrease,or stay the same?

Explanation

(B)If the launch angle increases , $sin\theta$ increases that means $T = \frac{2usin\theta}{g}$ increases.

(A)on the other hand as velocity is constant so, if angle is increasing vertical velocity is

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Problems on Equation of Motion

Subjective - Hard

17. A stone is thrown vertically upward with a speed of 28 m/s.
a) Find the maximum height reached by the stone.
b) Find its velocity one second before it reaches the maximum height.
c) Does the answer of part
d) change if the initial speed is more than 28 m/s such as 40 m/s or 80 m/s?

Explanation

Initial speed=u = $28m/s$

Final velocity at maximum height= v = $0m/s$

a = g = $10m/s^2$

A) maximum height attained by stone= $u^2/2g$ = 28 × 28/2 × 10 = $39.2m$

B) time=t = u/g = 28/10 = $2.8sec$

$t1$ = 2.85 – 1 = 1.85

V = u + at

= 28 – (10)(1.85) = 28 – 18.13 = $9.87m/s$

Hence the velocity is 0.87 m/s

c) No it will not change .

Because after 1-sec final velocity becomes zero for any initial velocity...

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Acceleration - Time Graph

Subjective - Hard

18. A car starting from rest on a straight road first acceleration with 6 m/s then suddenly decelerates with $3m/s$ till it stops if total time of journey is 10 seconds, Then the maximum speed and distance acquired by the car is:

Explanation

If car is starting from rest then its initial velocity is 0

so u = 0

a = 2

v = $20m/s$

Kinematics

18 questions

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$(20)^2 - 0 = 2 \times 2 \times s$

$s = 400/4$

$s = 100m$

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