Self Practice Paper (SPP)

1. Two objects moving along the same straight line are leaving point A with an acceleration a, 2 a & velocity 2 u, u respectively at time t = 0. The distance moved by the object with respect to point A when one object overtakes the other is :

(1) $\frac{6u^2}{a}$ (2) $\frac{2u^2}{a}$ (3) $\frac{4u^2}{a}$ (4) none of these

2. A particle is moving along x axis with constant acceleration. At t = 0 , the particle is at x = 3 m and $\frac{dx}{dt}$ = + 4 m/s. The maximum value of x co-ordinate of the particle is observed 2 seconds later. Starting from t = 0 sec after what time particle reaches its initial position again?

(1) 4 sec. (2) 6 sec. (3) 8 sec. (4) 12 sec.

3. The displacement 'x' and time of travel 't' for a particle moving on a straight line are related as t = $\sqrt{(x+1)(x-1)}$. Its acceleration at a time t is

(1) $\frac{1}{x} - \frac{1}{x^2}$ (2) $\frac{1}{x^3}$ (3) $\frac{-t^2}{x^3}$ (4) $\frac{-t}{x^2}$

4. A particle is projected from ground in vertical direction at t = 0. At t = 0.8 sec, it reaches h = 14m. It will again come to same height at t =------ [g = 10 m/s²]

(1) 2 sec. (2) $\frac{14}{5}$ sec. (3) 3 sec. (4) $\frac{7}{2}$ sec.

5. Three particles are projected upward with initial speeds 10m/s, 20m/s and 30 m/s. The displacements covered by them in their last second of motion are x_1,x_2 and x_3 then :

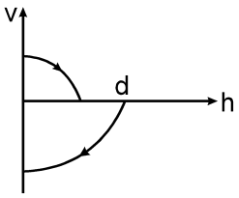
(1) $x_1 : x_2 : x_3 = 1 : 2 : 3$ (2) $x_1 : x_2 : x_3 = 1 : 4 : 9$

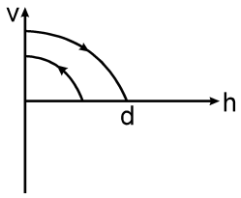
(3) $x_1 : x_2 : x_3 = 1 : 5 : 7$ (4) None of these

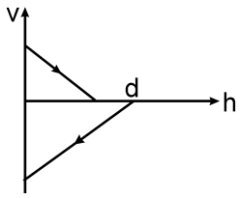
6. Two particles are projected vertically upwards with the same velocity on two different planets with acceleration due to gravities g_1 and g_2 respectively. If they fall back to their initial points of projection after lapse of time t_1 and t_2 respectively, then

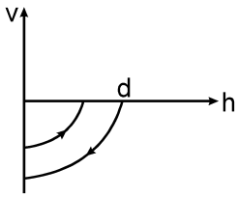
(1) $t_1 t_2 = g_1 g_2$ (2) $t_1 g_1 = t_2 g_2$ (3) $t_1 g_2 = t_2 g_1$ (4) $t_1 + t_2 = g_1 + g_2$

7. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height d/2. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as

(1) 

(2) 

(3) 

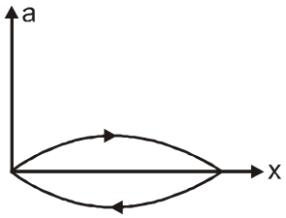
(4) 

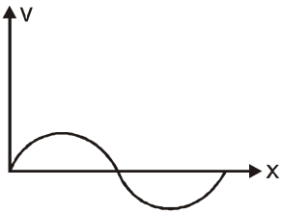
More than one choice type

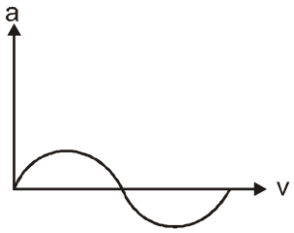
8*. A particle moves along the Y-axis and its y-coordinate(y) changes with time(t) as
$y = u(t - 2) + a(t - 2)^2$
(1) the initial velocity (at t = 0) of the particle is u (2) the acceleration of the particle is a
(3) the acceleration of the particle is 2a (4) at t =2s particle is at the origin

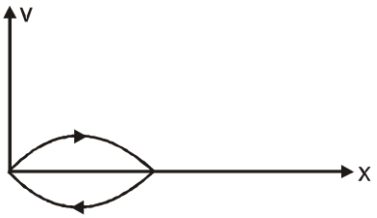
9*. The position of a body from a fixed reference point is given by, $\sqrt{x} = 2t - 3$, where ' x ' is in meters and t in seconds. This shows that the body:
(1) is at rest at t = 3/2 (2) is accelerated (3) is decelerated (4) is in uniform motion

10*. Which of the following graphs are wrong for a particle performing rectilinear motion, provided there is no collision any where :

(1) 

(2) 

(3) 

(4) 

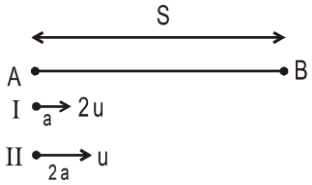
11*. The displacement of a moving particle is proportional to the square of the time. For this particle
(1) the velocity is constant (2) the velocity is variable
(3) the acceleration is constant (4) the acceleration is variable

SPP Answers

1.	(1)	**2.**	(1)	**3.**	(2)	**4.**	(4)	**5.**	(4)	**6.**	(2)	**7.**	(1)
8*.	(3,4)	**12*.**	(1,2)	**13*.**	(1,2,3)	**14*.**	(2,3)						

SPP Solutions

1.



Suppose at point B (displacement S) II particle overtakes particle I

For I particle $S = (2u)\,t + \frac{1}{2}\,a\,t^2$ ..... (1)

For II particle $S = u\,t + \frac{1}{2}\,(2a)\,t^2$ .....(2)

$\therefore 2ut + \frac{1}{2}\,a\,t^2 = ut + \frac{1}{2}\,(2a)\,t^2$

$ut = \frac{1}{2}\,a\,t^2$

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

Putting this value in equation (1) we get

$$S = 2u \times \frac{2u}{a} + \frac{1}{2} \times a \times \left(\frac{2u}{a}\right)^2 = \frac{4u^2}{a} + \frac{2u^2}{a} = \frac{6u^2}{a}$$

2. A constant acceleration is always towards –ve x direction so time to reach from A to B is same as time taken from B to A so total time $t_{A \to B \to A} = 4$ sec.

3. $t^2 = x^2 - 1$ $\quad x^2 = 1 + t^2$ $\quad x\frac{dx}{dt} = t$

$$\Rightarrow \left(\frac{dx}{dt}\right)^2 + x\frac{d^2x}{dt^2} = 1 \quad \Rightarrow \frac{x\,d^2x}{dt^2} = 1 - \left(\frac{dx}{dt}\right)^2 = 1 - \left(\frac{t}{x}\right)^2 = \frac{x^2 - t^2}{x^2} = \frac{1}{x^2} \Rightarrow \quad a = \frac{d^2x}{dt^2} = \frac{1}{x^3}$$

4. Taking upward direction as positive
initial velocity can be obtained by II equ. of motion i.e. $s = ut + 1/2\,at^2$
considering motion from C to A

$14 = u \times 0.8 - \frac{1}{2} \times 10 \times 0.8^2$ $\quad$ so, $u = \frac{43}{2}$ m/s

(ii) Let velocity magnitude at point A = v $\quad$ so, $v = u - gt$

$v = \frac{43}{2} - 10 \times 0.8 = \frac{27}{2}$ m/s

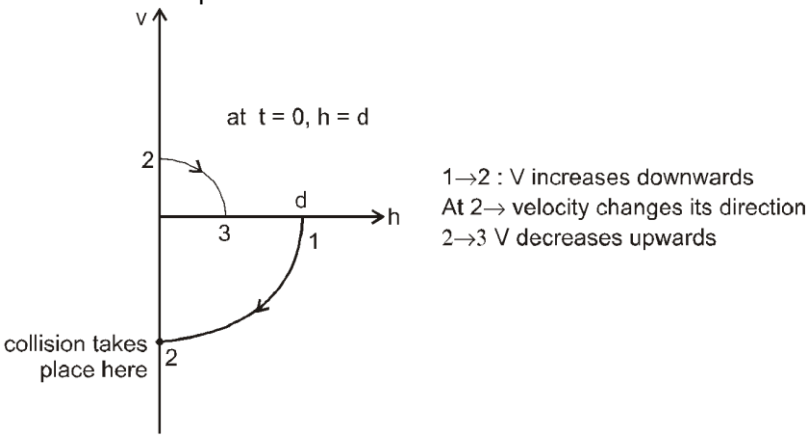
(iii) Hence time taken from A to B i.e. till same level = $\frac{2v}{g}$ = 2.7 s
Hence the time instant at which the particle comes to same level
= 0.8 + 2.7 = 3.5 s **Ans.**

5. Distance travelled by each particle in last second of motion i.e. downwards is equal to the distance travelled by it in first second of its motion i.e. upwards.

So, % $x_1 = 10 - ½ \times 10 \times 1^2 = 5$m
$x_2 = 20 - ½ \times 10 \times 1^2 = 15$m
$x_3 = 30 - ½ \times 10 \times 1^2 = 25$m so, $x_1 : x_2 : x_3 = 1 : 3 : 5$

6. $t_1 = \frac{2u}{g_1}$ and $t_2 = \frac{2u}{g_2}$
where, u is initial velocity of each ball and t_1, t_2 are total times of flight.
from here, $g_1 t_1 = g_2 t_2 = 2u$

7. (i) For uniformly accelerated/deaccelerated motion
$v_2 = u_2 \pm 2gh$
i.e. v-h graph will be a parabola (because equation is quadratic).
(ii) Initially velocity is downwards (-ve) and then after collision it reverses its direction with lesser magnitude. i.e. velocity is upwards (+ve). Graph (A) satisfies both these conditions.
Therefore, correct answer is (A)
Note that time t = 0 corresponds to the point on the graph where h = d
Next time collision takes place at 3.



8*. $y = u(t-2) + a(t-2)^2$

Velocity of particle at time t $\frac{dy}{dt} = u + 2a(t-2)$

Velocity at t = 0 $\frac{dy}{dt} = u - 4a$
acceleration of particle

$\frac{d^2y}{dt^2} = 2a$ $\qquad y_{t=2} = 0$
So correct answer is (3) and (4).

9*. $\sqrt{x} = 2t - 3 \qquad x = (2t-3)^2$

Velocity $v = \frac{dx}{dt} = 2(2t-3) \times 2 = 4(2t-3)$
if $v = 0 \quad \Rightarrow \quad t = 3/2$
acceleration

$a = \frac{dv}{dt} = 4 \times 2 = 8$ so correct answer is (1) and (2).

10*. The upper part of graph shows that acceleration is positive and becomes zero but just after this instant, the displacement cannot become negative suddenly. So, (1) is wrong.
(2) Displacement is not positive when velocity is negative. So, (2) is wrong.
(3) Velocity cannot increase if acceleration is negative. So, (3) is wrong.
(4) If velocity is negative then displacement will also be negative. So, (4) is correct.

11*. $s \propto t^2$
$\therefore s = ct^2$ where c = constant

(i) $v = \frac{ds}{dt} = 2ct \qquad \therefore \qquad v \propto t$

(ii) $a = \frac{dv}{dt} = 2c$ so, a = constant.