PHYSICS PAPER I - SOLUTIONS

MORE THAN ONE CORRECT

Q.1 **[C,D]**

Q.2 **[A,D]**

Q.3 **[B,C,D]**

Sol. Equation of straight line

$v^2 = 15x + 25$

$2v \dfrac{dv}{dx} = 15$

$v \dfrac{dv}{dx} = \dfrac{15}{2}$ m/s^2 = acceleration

$a = 7.5\ m/s^2$

$v = u + at = 5 + 7.5 \times 1$

$= 12.5$ m/s

Q.4 **[A.B,C,D]**

Sol. Area under a-t curve :

Δv = Area 1 = $2 \times 4 = 8$

$v - u = 8$

$v = u + 8 = 0 + 8 = 8$ m/s

$v' - v$ = Area 2 = $-\left(\dfrac{1}{2}\times 8 \times 2\right) = -8$ m/s

$v' = v - 8 = 8 - 8 = 0$

final velocity is zero at t = 10 sec

Displacement: Can be directly calculated from a–t cure without using v–t curve.

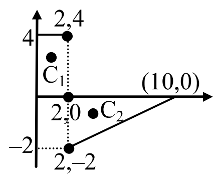
$\Delta S = u_0 t_0$ + (area under a–t curve) $(t_0 - t_c)$

Where ΔS = displacement

u_0 = initial velocity

t_0 = total time

t_c = Abscissa of centroid of corresponding area



Centroid of area 1: $C_1 = (1,2)$

Centroid of area 2 : $C_2 = \left(\dfrac{14}{3}, \dfrac{-2}{3}\right)$

$\Delta S = 0 + 8\,[10 - 1] + \left[(-8)\left(10 - \dfrac{14}{3}\right)\right]$

$= 8 \times 9 + \left[-8 \times \dfrac{16}{3}\right]$

$= 8\left[9-\frac{16}{3}\right]$

$= 8 \times \left[\frac{11}{3}\right]$

$= 8 \times 3.666$

$= 8 \times 3.67$

$\Delta S = 29.36$ m

Q.5 **[C,D]**

Of $\vec{v}$ and $\vec{a}$ are in same direction, speed increase and vice-versa

Q.6 **[A,D]**

Q.7 **Sol. [A,B,C]**

$v_{max} = \frac{\alpha\beta}{\alpha+\beta}\ t,\ \ s = \frac{1}{2}\left(\frac{\alpha\beta}{\alpha+\beta}\right) t^2$ and

$v_{av} = \frac{1}{2}\left(\frac{\alpha\beta}{\alpha+\beta}\right) t$

Q.8 **[A,C,D]**

Q.9 **[A,C,D]**

Sol. $\tan\alpha = \frac{Q\sin\theta}{P+Q\cos\theta}$ and $\tan\beta = \frac{P\sin\theta}{Q+P\cos\theta}$

Q.10 **[A,B,C,D]**

Sol. If body is always moving towards origin then,

$\vec{v}$ is antiparallel to $\vec{r}$.

MATRIX MATCH

Q.1 **Sol. (A) → R ; (B) → P ; (C) → R ; (D) → S**

$v_i = +10$ m/s and $v_f = 0$

$\Delta v = v_f - v_f = -10$ m/s

$a_{av} = \frac{\Delta v}{\Delta t} = \frac{-10}{6} = \frac{-5}{3}$ m/s^2

Total displacement = area under v-t graph (with sign) and acceleration = slope of v-t graph.

Q.2 **Sol. (A)** → S **; (B)** → R **; (C)** → P **; (D)** → Q

INTEGER TYPE

1. 8

v = = $2t + 6t^2$

at t = 1 sec ; v = 8 m/s

2. 3

$a = -\alpha v^{1/2}$

$\frac{dv}{dt} = -\alpha v^{1/2}$

$\int v^{-1/2}\, dv = \int -\alpha\, dt$

$\frac{v^{1/2}}{v_2} = -\alpha t + c$

$2\sqrt{v} = -\alpha t + c$

at $t = 0$; $v = v_0$

$\therefore \quad c = 2\sqrt{v_0}$

$2\sqrt{v} = -\alpha t + 2\sqrt{v_0}$

Simderly, by write

$a = v\frac{dv}{dx}$

we get, $x = \frac{2}{3}\frac{v_0^{3/2}}{\alpha}$ when it stops

$t = \frac{2\sqrt{v_0}}{\alpha}$

$$\text{Avg speed} = \frac{x}{t} = \frac{\cancel{2}}{3}\frac{v_0^{3/2}\ \cancel{\alpha}}{\cancel{\alpha}\ \cancel{2}\sqrt{v_0}} = \frac{v_0}{3}$$

3. **0**

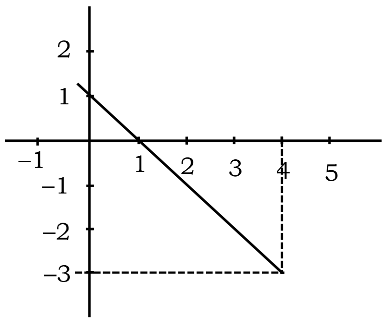
$v = u + at$

$v = 10 - 8(5)$

$v = -30$

which means the car has stopped long before 5 s. so speed = zero

4. **4**



$a = -t + 1$

$\frac{dv}{dt} = -t + 1$

$\int dv = \int (-t + 1)\, dt$

$$v = \frac{-t^2}{2} + t$$

$$0 = \frac{-t^2}{2} + t$$

$$\cancel{t} = \frac{t^{\cancel{2}}}{2}$$

at t = 2 sec.

$v = 0$

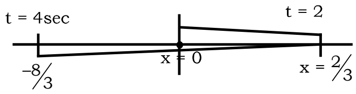
$$\frac{dx}{dt} = \frac{-t^2}{2} + t$$

$$\int dx = \int\left(\frac{-t^2}{2} + t\right)dt$$

$$x = \frac{-t^3}{6} + \frac{t^2}{2}$$

$t = 4$

$$x = \frac{-4^3}{6} + \frac{4^2}{2}$$



$$\text{Distance} = \frac{2}{3} + \frac{2}{3} + \frac{8}{3} = \frac{12}{3}$$

$= 4$

$$= \frac{-64 + 48}{6} = \frac{-16}{6}$$

$t = 2$

$$x = \frac{-23}{6} + \frac{2^2}{2}$$

$$\frac{-8 + 12}{6} = \frac{4}{6}$$

5. 8

$x = t^2 + t - 3$

at t = 2, $x = 2^2 + 2 - 3$

$= 3$

t = 5sec. $x = 5^2 + 5 - 3$

$= 27$

$$v_{avg} = \frac{27 - 3}{3} = \frac{24}{3} = 8$$

6. 2

at t = 5 sec.

$v = 10(5) = 50$ m/s

$$s = \frac{1}{2}10(5)^2 = 125\text{m}$$

at t = 10 sec

$v = 10(10) = 100$m/s

$$s = \frac{1}{2}10(10)^2 = 500m$$

$$-125 = 50\ t_1 - 5_1^2$$

$$t_1^2 - 10\ t_1 - 25 = 0$$

$$t_1 = \frac{10 \pm \sqrt{100+100}}{2}$$

$$-500 = 100\ t_2 - 5\ t_2^2$$

$$t_2^2 - 20\ t_2 - 100 = 0$$

$$t_2 = \frac{20 \pm \sqrt{400+400}}{2}$$

$$\frac{t_1}{t_2} = \frac{10 \pm \sqrt{200}}{20 \pm \sqrt{800}} = \frac{(10 \pm \sqrt{200})}{2(10 \pm \sqrt{200})} = \frac{1}{2}$$

$\therefore$ $t_2 : t_1 = 2 : 1$

7. 2

$$\left(\frac{u}{2}\right)^2 = u^2 + 2a(x)$$

$$a = \frac{-3u^2}{4(2x)}$$

$$0 = u^2 + 2\left(\frac{-3u^2}{4(2\cancel{x})}\right)n\cancel{x}$$

$$\frac{3}{4}\cancel{u^2}n = \cancel{u^2}$$

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

$\therefore$ minimum no : f plank = 2

8. **6**

$$T = \frac{2v_{x1}}{g} = \frac{2 \times 30}{10} = 6 \text{ secs.}$$