PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 13

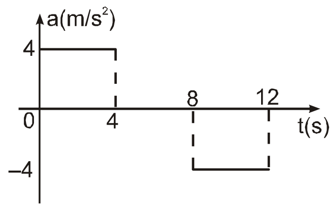
Total Marks : 24

Max. Time : 24 min.

Topic : Rectilinear Motion

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. A lift starts from rest. Its acceleration is plotted against time in the following graph. When it comes to rest its height above its starting point is:



(A) 20 m (B) 64 m (C) 32 m (D) 128 m

2. A particle moves through the origin of an xy-cordinate system at t = 0 with initial velocity u = 4i - 5j m/s. The particle moves in the xy plane with an acceleration a = 2i m/s^2. Speed of the particle at t = 4 second is :

(A) 12 m/s (B) $8\sqrt{2}$ m/s (C) 5 m/s (D) 13 m/s

3. The instantaneous velocity of a particle is equal to time derivative of its position vector and the instantaneous acceleration is equal to time derivative of its velocity vector. Therefore:
(A) the instantaneous velocity depends on the instantaneous position vector
(B) instantaneous acceleration is independent of instantaneous position vector and instantaneous velocity
(C) instantaneous acceleration is independent of instantaneous position vector but depends on the instantaneous velocity
(D) instantaneous acceleration depends both on the instantaneous position vector and the instantaneous velocity.

4. The velocity of a car moving on a straight road increases linearly according to equation, v = a + bx, where a & b are positive constants. The acceleration in the course of such motion: (x is the displacement)
(A) increases (B) decreases (C) stay constant (D) becomes zero

5. A point moves in a straight line under the retardation a v^2 , where 'a' is a positive constant and v is speed. If the initial velocity is u , the distance covered in 't' seconds is :

(A) a u t (B) $\frac{1}{a}$ ln (a u t) (C) $\frac{1}{a}$ ln (1 + a u t) (D) a ln (a u t)

COMPREHENSION

The velocity 'v' of a particle moving along straight line is given in terms of time t as v = 3(t^2 – t) where t is in seconds and v is in m/s.

6. The distance travelled by particle from t = 0 to t = 2 seconds is :
(A) 2 m (B) 3 m (C) 4 m (D) 6 m

7. The displacement of particle from t = 0 to t = 2 seconds is
(A) 1 m (B) 2 m (C) 3 m (D) 4 m

8. The speed is minimum after t = 0 second at instant of time
(A) 0.5 sec (B) 1 sec. (C) 2 sec. (D) None of these

Answers Key

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1. (D)	**2.** (D)	**3.** (B)	**4.** (A)	**5.** (C)
6. (B)	**7.** (B)	**8.** (B)		

Hint & Solutions

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1. At t = 4 sec, V = 0 + (4) (4) = 16 m/sec.

At t = 8 sec, V = 16 m/sec.

At t = 12 sec, V = 16 – 4 (12 – 8) = 0

For 0 to 4 sec ; $s_1 = \frac{1}{2} at^2 = \frac{1}{2} (4) (4)^2 = 32$ m

For 4 to 8 sec ; $s_2 = 16 (8 - 4) = 64$ m

For 8 to 12 sec ; $s_3 = 16 (4) - \frac{1}{2} (4) (4)^2 = 32$ m

So $s_1 + s_2 + s_3 = 32 + 64 + 32 = 128$ m

Alter : Draw v-t graph

Area of v-t graph = displacement.

2. Using $v_x = u_x + a_x t$

= 4 i + (2i) 4

= 12 i

As $a_y = 0$, velocity component in y-direction remains unchanged. Final velocity = 12 i - 5j

speed at t = 4 sec. = $\sqrt{12^2 + (-5)^2}$ = 13 m/s.

$v_x = u_x + a_x t$

= 4 i + (2i) 4

= 12 i

4. V = a + bx

(V increases as x increases)

$\frac{dV}{dx} = b$; $\frac{dx}{dt} = V$

so, acceleration = $V \frac{dV}{dx} = V.b$

hence acceleration increases as V increases with x.

5. The retardation is given by

$$\frac{dv}{dt} = -av^2$$

integrating between proper limits

$$\Rightarrow -\int_u^v \frac{dv}{v^2} = \int_0^t a\,dt$$

$$\text{or} \quad \frac{1}{v} = at + \frac{1}{u}$$

$$\Rightarrow \frac{dt}{dx} = at + \frac{1}{u}$$

$$\Rightarrow dx = \frac{u\ dt}{1+aut}$$

integrating between proper limits

$$\Rightarrow \int_0^s dx = \int_0^t \frac{u\,dt}{1+aut}$$

$$\Rightarrow S = \frac{1}{a}\ell n\,(1 + aut)$$

Sol. 6 to 8

The velocity of particle changes sign at t = 1 sec.

∴ Distance from t = 0 to t = 2 sec. is

$$= \int_1^0 v\,dt + \int_2^1 v\,dt$$

$$= \left[(t^3 - \frac{3}{2}t^2)\right]_1^0 + \left[(t^3 - \frac{3}{2}t^2)\right]_2^1 = 3\text{ m}$$

Displacement from t = 0 to t = 2 sec. is $\int_0^2 v\,dt$

$$= \left[(t^3 - \frac{3}{2}t^2)\right]_0^2 = 2\text{ m.}$$