PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 19

Total Marks : 25

Max. Time : 26 min.

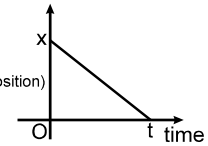
Topics : Rectilinear Motion, Projectile Motion

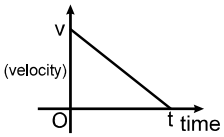
Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 3 min.)**	**[12, 12]**
Subjective Questions ('–1' negative marking) Q.5	**(4 marks, 5 min.)**	**[4, 5]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks, 3 min.)**	**[9, 9]**

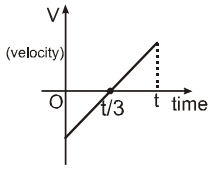
1. For a given acceleration - time graph , there exist _____ velocity - time graph.

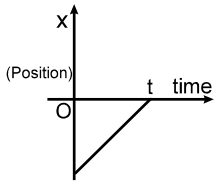
(A) 1 (B) 2 (C) 3 (D) many

2. For which of the following graphs the average velocity of a particle moving along a straight line for time interval (0, t) must be negative -

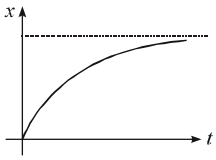
(A) 

(B) 

(C) 

(D) 

3. Variation of displacement x of a particle moving on a straight line with time t is shown in following figure. The figure indicates :



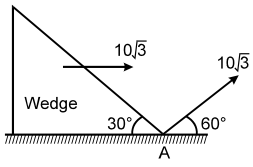
(A) the particle starts with a certain speed but the motion is retarded

(B) the velocity of particle is constant throughout motion

(C) the acceleration of the particle is constant throughout motion

(D) the particle starts with certain speed and moves with increasing speed .

4. A particle is projected at angle 60° with speed $10\sqrt{3}$ m/s from the point 'A' as shown in the figure. At the same time the wedge is made to move with speed $10\sqrt{3}$ m/s towards right. Then the time after which particle will strike with wedge is (g = 10 m/sec^2) :

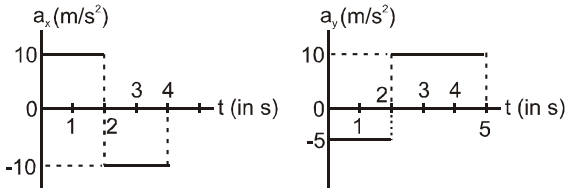


(A) 2 sec (B) $2\sqrt{3}$ sec (C) $\frac{4}{\sqrt{3}}$ sec (D) none of these

5. Two cars A and B are racing along straight line. Car A is leading, such that their relative velocity is directly proportional to the distance between the two cars. When the lead of car A is ℓ_1 = 10 m, its running 10 m/s faster than car B. Determine the time car A will take to increase its lead to ℓ_2 = 20 m from car B.

COMPREHENSION

A particle which is initially at rest at the origin, is subjected to an acceleration with *x*- and *y*-components as shown. After time *t* = 5 , the particle has no acceleration.



6. What is the magnitude of velocity of the particle at t = 2 seconds ?

(A) $10\sqrt{5}$ m/s (B) $5\sqrt{10}$ m/s (C) $5\sqrt{5}$ m/s (D) None of these

7. What is the magnitude of average velocity of the particle between t = 0 and t = 4 seconds?

(A) $\frac{5}{2}\sqrt{13}$ m/s (B) $\frac{5}{2}\sqrt{17}$ m/s (C) 30 m/s (D) None of these

8. When is the particle at its farthest distance from the y-axis?

(A) 3 sec. (B) 2 sec. (C) 4 sec. (D) 1 sec.

Answers Key

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1. (D) **2.** (A) **3.** (A) **4.** (A)
5. $t = (\log_e 2)$ sec **6.** (A) **7.** (B) **8.** (C)

Hint & Solutions

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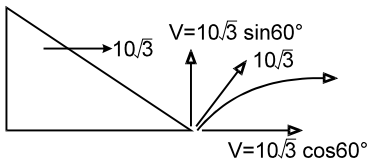
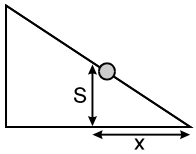
2. In (A) $x_f - x_i$
$0 - x = -x = -$ ve
So average velocity is – ve.

3. From the graph ; we observe that slope is non–zero positive at t = 0 & slope is continuously decreasing with time and finally becomes zero. Hence we can say that the particle starts with a certain velocity, but the motion is retarded (decreasing velocity)

4. Suppose particle strikes wedge at height 'S' after time t. $S = 15t - \frac{1}{2}10\ t^2 = 15t - 5\ t^2$. During this time distance travelled by particle in horizontal direction $= 5\sqrt{3}$ t. Also wedge has travelled travelled extra distance





$$x = \frac{S}{\tan 30^\circ} = \frac{15t - 5t^2}{1/\sqrt{3}}$$

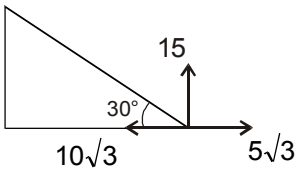
Total distance travelled by wedge in time
$t = 10\sqrt{3}$ t. $= 5\sqrt{3}\ t + \sqrt{3}\ (15 - 5t^2)$
$\Rightarrow$ t = 2 sec.

$t = 10\sqrt{3}\ t. \ = 5\sqrt{3}\ t + \sqrt{3}\ (15 - 5t^2)$

$\Rightarrow$ t = 2 sec.

Alternate Sol.

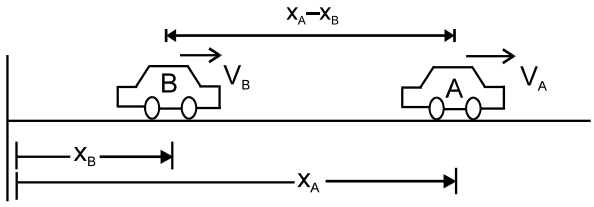
(by Relative Motion)



$$T = \frac{2u\sin 30^\circ}{g\cos 30^\circ} = \frac{2x10\sqrt{3}}{10} \times \frac{1}{\sqrt{3}} = 2 \text{ sec.}$$

$\Rightarrow$ t = 2 sec.

5.



As given

$(V_A - V_B) \propto x_A - x_B$

$(V_A - V_B) = K(x_A - x_B)$

when $x_A - x_B = 10$ We have $V_A - V_B = 10$

We get

$10 = K10 \Rightarrow K = 1$

$\Rightarrow V_A - V_B = (x_A - x_B)$.....(1)

Now Let

$x_A - x_B = y$ .....(2)

On differentiating with respect to 't' on both side.

$$\Rightarrow \frac{dx_A}{dt} - \frac{dx_B}{dt} = \frac{dy}{dt} \Rightarrow V_A - V_B = \frac{dy}{dt} \text{ ..... (3)}$$

$\Rightarrow$ Using (1) , (2), (3)

We get $\frac{dy}{dt} = y$

Here y represents sepration between two cars

$$\Rightarrow \int_{10}^{20} \frac{dy}{y} = \int_0^t dt \quad \Rightarrow \quad [\log_e y]_{10}^{20} = t$$

$t = (\log_e 2)$ sec ***Required Answer.***

Alter. (Assume to be at rest)

$V \propto s$

$V = ks$

$V = 10, s = 10, k = 1$

$$\frac{ds}{dt} = s \qquad \int_{10}^{20} \frac{ds}{s} = \int_{0}^{t} dt$$

6 to 8. At t = 2 sec (t = 2 sec पर)

$v_x = u_x + a_x t = 0 + 10 \times 2 = 20$ m/s

$v_y = u_y + a_y t = 0 - 5 \times 2 = -10$ m/s

$$v = \sqrt{v_x^2 + v_y^2} = \sqrt{(20)^2 + (-10)^2} = 10\sqrt{5} \text{ m/s}$$

From t = 0 to से t = 4 sec

$$x = \left[\frac{1}{2}(10)(2)^2\right]_{(0\to 2)} + \left[(10\times 2)2 - \frac{1}{2}(10)(2)^2\right]_{(2\to 4)}$$

x = 40 m

$$y = \left[-\frac{1}{2}5(2)^2\right]_{(0\to 2)} - \left[(10(2) - \frac{1}{2}(10)(2)^2\right]_{(2\to 4)}$$

y = – 10 m

Hence, average velocity of particle between t = 0 to t = 4 sec is

$$v_{av} = \frac{\Delta x}{\Delta t} = \frac{\sqrt{(40)^2 + (-10)^2}}{4}$$

$$v_{av} = \frac{5}{2}\sqrt{17} \text{ m/s}$$

At t = 2 sec u = 10 × 2 = 20 m/s

After t = 2sec

v = u + at

0 = 20 – 10 t

t = 2 sec.

Hence, at t = 4 sec. the particle is at its farthest distance from the y-axis.

The particle is at farthest distance from y-axis at t $\geq$ 4. Hence the available correct choice is t = 4.