PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 18

Total Marks : 32

Max. Time : 35 min.

Topics : Relative Motion, 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]**
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	**(4 marks, 4 min.)**	**[8, 8]**
Subjective Questions ('–1' negative marking) Q.7	**(4 marks, 5 min.)**	**[4, 5]**
Match the Following (no negative marking) (2 × 4) Q.8	**(8 marks, 10 min.)**	**[8, 10]**

1. Person A observes B moving in east direction with speed 10 m/s, B observes C moving in south direction with speed 20 m/s, C observes D moving in west direction with speed 30 m/s & D observes a tree moving with speed 40 m/s in north direction. Then the actual direction of motion of person 'A' (with respect to ground) will be -

(A) north - west (B) north - east (C) south - east (D) none of these

2. A boat has a velocity 4 m/s towards east with respect to river and river is flowing towards north with velocity 2 m/s. Wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is:

(A) north-west (B) south-east (C) $\tan^{-1}\frac{1}{2}$ with east (D) north

3. For a particle undergoing rectilinear motion with uniform acceleration, the magnitude of displacement is one third the distance covered in some time interval. The magnitude of final velocity is less than magnitude of initial velocity for this time interval. Then the ratio of initial speed to the final speed for this time interval is :

(A) $\sqrt{2}$ (B) 2 (C) $\sqrt{3}$ (D) 3

4. A man is sitting inside a moving train and observes the stationary objects outside of the train. Then choose the single correct choice from the following statements -

(A) all stationary objects outside the train will move with same velocity in opposite direction of the train with respect to the man.

(B) stationary objects near the train will move with greater velocity & object far from train will move with lesser velocity with respect to the man.

(C) large objects like moon or mountains will move with same velocity as that of the train.

(D) all of these.

5. A particle is projected in such a way that it follows a curved path with constant acceleration $\vec{a}$. For finite interval of motion. Which of the following option(s) may be correct :

$\vec{u}$ = initial velocity $\vec{a}$ = acceleration of particle $\vec{v}$ = velocity at t > 0

(A) $|\vec{a}\times\vec{u}|\neq 0$ (B) $|\vec{a}\times\vec{v}|= 0$ (C) $|\vec{u}\times\vec{v}|= 0$ (D) $\vec{u}.\vec{v}=0$

6. A particle is projected vertically upwards in vacuum with a speed u.

(A) When it rises to half its maximum height, its speed becomes u/2.

(B) When it rises to half its maximum height, its speed becomes $u/\sqrt{2}$.

(C) The time taken to rise to half its maximum height is half the time taken to reach its maximum height.

(D) The time taken to rise to three-fourth of its maximum height is half the time taken to reach its maximum height.

7. When two bodies move uniformly towards each other, the distance between them diminishes by 16 m in every 10 s. If bodies move with velocities of the same magnitude (as before)and in the same direction then distance between them will decrease 3 m every 5 s. Calculate the velocity of each body.

8. Two particles A and B moving in x-y plane are at origin at t = 0 sec. The initial velocity vectors of A and B are $\vec{u}_A = 8\hat{i}$ m/s and $\vec{u}_B = 8\hat{j}$ m/s. The acceleration of A and B are constant and are $\vec{a}_A = -2\hat{i}$ m/s^2 and $\vec{a}_B = -2\hat{j}$ m/s^2. Column I gives certain statements regarding particle A and B. Column I gives corresponding results. Match the statements in column I with corresponding results in Column II.

Column I	**Column II**
(A) The time (in seconds) at which velocity of A relative to B is zero	(p) $16\sqrt{2}$
(B) The distance (in metres) between A and B when their relative velocity is zero.	(q) $8\sqrt{2}$
(C) The time (in seconds) after t = 0 sec, at which A and B are at same position	(r) 8
(D) The magnitude of relative velocity of A and B	(s) 4

Answers Key

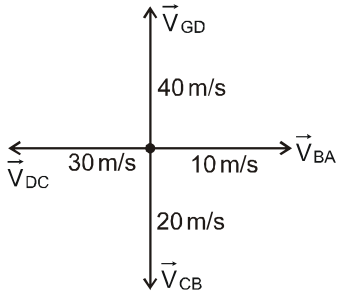
DPP NO. - 18

1. (C) **2.** (A) **3.** (A) **4.** (A)
5. (A),(D) **6.** (B), (D) **7.** 0.5 m/s.
8. (A) s (B) p (C) r (D) q

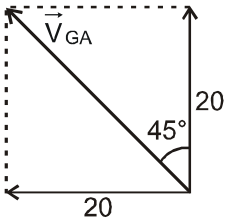
Hint & Solutions

DPP NO. - 18

1. All the velocities are marked in diagram where G represents ground



adding we get



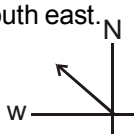
Then $\vec{V}_{GD} + \vec{V}_{DC} + \vec{V}_{CB} + \vec{V}_{BA} = \vec{V}_{GA} = -\vec{V}_{AG}$

Hence velocity of A is towards south east.

2. Vboat , river = $4\hat{i}$

Vriver , ground = $2\hat{i}$

Vwind , ground = $6\hat{j}$

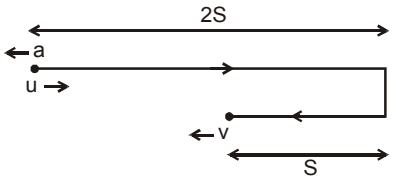


$\vec{V}$ wind, boat = $\vec{V}_{wg} + \vec{V}gr + \vec{V}_{rb}$ = $6\hat{j} - 2\hat{j} - 4\hat{i}$

= $-4\hat{i} + 4\hat{j}$

so flag blown in north west.

3. Let u and v denote initial and find velocity, then then nature of motion is indicated in diagram



Hence initial and final speed are given by equation

$0^2 = u^2 - 2a \times 2S$ and $v^2 = 0^2 + 2as$

$\therefore \quad v = \frac{u}{\sqrt{2}}$ or $\frac{u}{v} = \sqrt{2}$ **Ans.**

4. $\vec{V}_{O,M} = \vec{V}_O - \vec{V}_M$ $\vec{V}_{O,M} = \vec{V}_O - \vec{V}_{Train}$

$V_{O,M}$ = velocity of object with respect to man

V_O = velocity of object

V_M = velocity of man

Here velocity of object is zero.

So, $\vec{V}_{O,M} = -\vec{V}_M$

5. If $|\vec{a} \times \vec{u}| = 0$ particle will not follow curved path.

Above described motion is a projectile motion with parabolic path

6. At maximum height, velocity = 0

$H = \frac{u^2}{2g}$ &

At height h = H/2 $V^2 = u^2 - 2gh$

$V^2 = u^2 - 2g.\frac{u^2}{4g}$ $V^2 = \frac{u^2}{2}$ $\Rightarrow$ $V = \frac{u}{\sqrt{2}}$

Time taken to rise to maximum height $T = \frac{u}{g}$

for height $h = \frac{H}{2}$ $t = \frac{(u - u/\sqrt{2})}{g} = \frac{(\sqrt{2}-1)u}{\sqrt{2}g}$

Time taken to rise to $\frac{3}{4}$ H = T – time taken to fall down by $\frac{H}{4}$

$= T - \frac{T}{2} = \frac{T}{2}$

7. Let velocity of bodies be v_1 and v_2.

in first case

$u_1 = v_1 + v_2$ .... (i)

in second case

$u_2 = v_1 - v_2$ .... (i)

$\therefore\ v_1 = \dfrac{u_1 + u_2}{2}$ and $v_2 = \dfrac{u_1 - u_2}{2}$

Here $u_1 = \dfrac{16}{10}$ m/s and $u_2 = \dfrac{3}{5}$ m/s

After solving we have

$v_1 = 1.1$ m/s and $v_2 = 0.5$ m/s.

8. The initial velocity of A relative to B is $\vec{u}_{AB} = \vec{u}_A - \vec{u}_B$

$= (8\hat{i} - 8\hat{j})$ m/s

$\therefore\ u_{AB} = 8\sqrt{2}$ m/s

Acceleration of A relative to B is -

$\vec{a}_{AB} = \vec{a}_A - \vec{a}_B = (-2\hat{i} + 2\hat{j})$ m/s^2

$\therefore\ a_{AB} = 2\sqrt{2}$ m/s^2

since B observes initial velocity and constant acceleration of A in opposite directions, Hence B observes A moving along a straight line.

From frame of B

Hence time when $v_{AB} = 0$ is $t = \dfrac{u_{AB}}{a_{AB}} = 4$ sec.

The distance between A & B when $v_{AB} = 0$ is $S = \dfrac{u_{AB}^2}{2a_{AB}} = 16\sqrt{2}$ m

The time when both are at same position is -

$T = \dfrac{2u_{AB}}{a_{AB}} = 8$ sec.

Magnitude of relative velocity when they are at same position in $u_{AB} = 8\sqrt{2}$ m/s.