DPP - 2

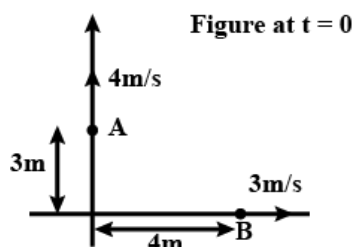**RELATIVE MOTION**

Q.1 Particles A and B are moving as shown in the figure at t = 0. Find their velocity of separation

(a) at t = 0

(b) at t = 1 s

Figure at t = 0
4m/s
A
3m
3m/s
4m → B

Q.2 The distance between two moving particles P and Q at any time is a. If v_r be their relative velocity and if u and v be the components of v_r along and perpendicular to PQ, then show that their closest distance is $\frac{av}{v_r}$ and that the time that elapses before they amric. at their nearest distance is $\frac{au}{v_r^2}$.

Q.3 A swimmer can swim at the rate of 5kmh^{-1} in still water. A1 km wide river flows at the rate of 3kmh^{-1}. The swimmer wishes to swim across the river directly opposite to the starting point.

(a) Along what direction must the swimmer swim?

(b) What should be his resultant velocity?

(c) How much time will he take to cross the river?

Q.4 Find the time an Aeroplan having velocity v, takes to fly around a square with side l if the wind is blowing at a velocity u along one side of the square.

Q.5 A girl standing on road holds her umbrella at 45° with the vertical to keep the rain away. If she starts running without umbrella with a speed of $15\sqrt{2} \text{ km h}^{-1}$, the rain drops hit her head vertically. The speed of rain drops with respect to the moving girl is

(A) 30 km h^{-1} (B) $\frac{25}{\sqrt{2}} \text{ km h}^{-1}$ (C) $\frac{30}{\sqrt{2}} \text{ km h}^{-1}$ (D) 25 km h^{-1}

Q.6 2Car B overtakes another car A at a relative speed of 40 m s^{-1}. How fast will the image of car B appear to move in the mirror of focal length 10 cm fitted in car A, when the car B is 1.9 m away from the car A ?

(A) 0.1 m s^{-1} (B) 0.2 m s^{-1} (C) 40 m s^{-1} (D) 4 m s^{-1}

Q.7 Train A and train B are running on parallel tracks in the opposite directions with speeds of 36 km/ hour and 72 km/ hour, respectively. A person is walking in train A in the direction opposite to its motion with a speed of 1.8 km/ hour. Speed (in m/s s $^{-1}$) of this person as observed from train B will be close to (take the distance between the tracks as negligible)

(A) 29.5 m s^{-1} (B) 28.5 m s^{-1} (C) 31.5 m s^{-1} (D) 30.5 m s^{-1}

Q.8 When a car is at rest, its driver sees rain drops falling on it vertically. When driving the car with speed v, he sees that rain drops are coming at an angle 60° from the horizontal. On further increasing the speed of the car to $(1 + \beta)$v, this angle changes to 45°. The value of β is close to

(A) 0.50   (B) 0.41

(C) 0.37   (D) 0.73

Q.9 A passenger train of length 60 m travels at a speed of 80 km/hr. Another freight train of length 120 m travels at a speed of 30 km/hr. The ratio of times taken by the passenger train to completely cross the freight train when: (i) they are moving in the same direction, and (ii) in the opposite direction is

(A) $\frac{25}{11}$ (B) $\frac{3}{2}$ (C) $\frac{5}{2}$ (D) $\frac{11}{5}$

Q.10 A swimmer wants to cross a river from point A to point B. Line AB makes an angle of 30° with the flow of river. Magnitude of velocity of the swimmer is same as that of the river. The angle θ with the line AB should be ∴, so that the swimmer reaches point B.
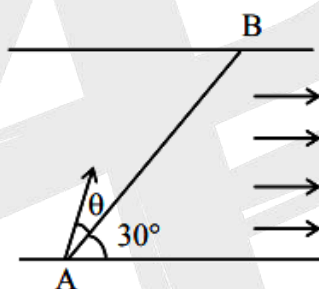
Q.11 A swimmer can swim with velocity of 12 km/h in still water. Water flowing in a river has velocity 6 km/h. The direction with respect to the direction of flow of river water he should swim in order to reach the point on the other bank just opposite to his starting point is _. (Round off to the nearest integer) (Find the angle in degrees)

Q.12 A person is swimming with a speed of 10 m/s at an angle of 120° with the flow and reaches to a point directly opposite on the other side of the river. The speed of the flow is ' x ' m/s. The value of ' x ' to the nearest integer is.

Q.13 A particle is moving along the x-axis with its coordinate with time t given by $x(t) = 10 + 8t - 3t^2$. Another particle is moving along the y-axis with its coordinate as a function of time given by $y(t) = 5 - 8t^3$. At t = 1 s, the speed of the second Particle measured in the frame of the first particle is given as $\sqrt{v}$. Then v(in m/s) is

ANSWER KEY

1. (a) $v_{sep} = 3\left(\frac{4}{5}\right) + 4\left(\frac{3}{5}\right) = \frac{24}{5} = 4.8 \text{ ms}^{-1}$ (b) $v_{sep} = 3\left(\frac{1}{\sqrt{2}}\right) + 4\left(\frac{1}{\sqrt{2}}\right) = \frac{7}{\sqrt{2}} \text{ ms}^{-1}$

2. (i) $S_{min} = \frac{av}{v_r}$ (ii) $t = \frac{QR}{v_r} = \frac{(PQ)\sin\alpha}{v_r} = \frac{(a)\left(\frac{u}{v_r}\right)}{v_r} = \frac{aut}{v_r^2}$

3. (a) $\theta = 127°$ (b) 4kmh^{-1} (c) 15 min

4. $t = \frac{2a}{v^2 - u^2}\left(v + \sqrt{v^2 - u^2}\right)$

5. (C)   **6.**   (A)   **7.**   (A)   **8.**   (D)   **9.**   (D)   **10.**   30   **11.**   120

12. 5   **13.**   580