Relative Velocity

1. **A shower of rain appears to fall vertically down wards with a velocity12 kmph on a person walking West wards with a velocity of 5 kmph. The actual velocity and direction of the rain is**

   1. 8.5 kmph clock-wise to vertical
   2. 13kmph, anticlock-wise to vertical
   3. 13 kmph, clock-wise to vertical
   4. 8.5 kmph, vertically downwards

2. **A car starting from a point travels towards East with a velocity of 36 kmph. Another car starting from the same point travels towards North with a velocity of 24 kmph. The relative velocity of one with respect to another is**

   1) $12\sqrt{13}$ Kmph 2)30 kmph 3) 12 kmph 4) 20 kmph

3. **An aero plane starting from a point travels towards North-East with a velocity of 400 kmph. Another aero plane starting from the same point travels towards North West with a velocity of 300 kmph. The relative velocity of one aero plane w.r.t. other is**

   1) 350 kmph 2) 500 kmph 3)100kmph 4) 200 kmph

4. **A man is going due east with a velocity of 5 ms^{-1}. It is vertically raining downwards with a velocity of 4 ms^{-1}. At what angle should he hold the umbrella to the vertical so as to protect himself from the rain?**

   1) $\tan^{-1}\left(\frac{5}{4}\right)$ in anti-clockwise direction 2) $\tan^{-1}\left(\frac{5}{4}\right)$ in clock-wise direction

   3) $\tan^{-1}\left(\frac{4}{5}\right)$ North of East 4) $\tan^{-1}\left(\frac{4}{5}\right)$ East of North

5. **A man is going in a topless car with a velocity of 10.8 kmph. It is raining vertically downwards. He has to hold the umbrella at angle 53^0 to the vertical to protect him from rain. The actual velocity of the rain is** $\left(Cos\,53^0 = \frac{3}{5}\right)$

   1) 2.25 ms^{-1} 2) 3.75 ms^{-1} 3) 0.75 ms^{-1} 4) 2.75 ms^{-1}

6. **Wind is blowing from West to East along two parallel tracks. Two trains moving with the same speed in opposite directions have the stream track of one double that of the other. The speed of each train is**

1. Equal to that of wind
2. Double that of wind
3. Three times that of wind
4. Half of that of wind

7. **A ship moves at 40 kmph due North and suddenly moves towards East through 90^0 and continues to move with the same speed. Then the change in velocity is**

1) Zero 2) 40 kmph North East

3) 40 kmph South West 4) $40\sqrt{2}$ kmph South East

8. **Two particles having position vectors** $\vec{r}_1 = (3\vec{i} + 5\vec{j})m$ **and** $\vec{r}_2 = (-5\vec{i} + 3\vec{j})m$ **are moving with velocities** $\vec{V}_1 = (4\vec{i} + 3\vec{j})ms^{-1}$ **and. If they collide after 2 seconds, the value of 'a' is**

1) -2 2) -4 3) - 6 4) – 8

9. **A particle is moving eastwards with a velocity 5 ms^{-1}, changes its direction northwards in 10 seconds and moves with same magnitude of velocity. The average acceleration is**

1) Zero 2) $\frac{1}{\sqrt{2}} ms^{-2}$ towards N-E

3) $\frac{1}{\sqrt{2}} ms^{-2}$ towards S-E 4) $\frac{1}{\sqrt{2}} ms^{-2}$ towards N-W

10. **A particle is moving eastward with a velocity 5ms^{-1}. In 10 seconds the velocity changes to 5 ms^{-1} northwards. The average acceleration in this time is.**

1) $\frac{1}{\sqrt{2}} ms^{-2}\ north-west$ 2) $\frac{1}{2} ms^{-2}\ north-west$

3) $\frac{1}{\sqrt{2}} ms^{-2}\ north-east$ 4) $\frac{1}{2} ms^{-2}\ north-east$

11. **An aero plane is moving a circular path with a speed 250 km/hr. The change in velocity in half the revolution is**

1) 500 km/hr 2) 250 km/hr 3)125 km/hr 4) zero

12. **A man is walking due East at the rate of 2Kmph. The rain appears to him to come down vertically at the rate of 2kmph. The actual velocity and direction of rainfall with the vertical respectively are**

1) $2\sqrt{2}kmph, 45^0$ 2) $\frac{1}{\sqrt{2}}kmph, 30^0$ 3) 2 kmph, 0^0 4) 1kmph, 90^0

13. **When a man is standing, rain drops appear to him falling at 60^0 from the horizontal from his front side. When he is travelling at 5km per hour on a horizontal road they appear to him falling at 30^0, from the horizontal from his front side. The actual speed of the rain is (in km per hour):**

1) 3 2) 4 3) 5 4) 6

Key

1) 3 2) 1 3)2 4) 2 5) 1 6) 3 7)4 8) 4 9) 4

10) 1 11) 1 12) 1 13) 3

Hints

1. $\tan\theta = \frac{v_m}{v_r}$

2. $\Delta V = \sqrt{(36)^2 + (24)^2} = 12\sqrt{13}\ kmph$

3. $\Delta V = \sqrt{(400)^2 + (300)^2} = 500\, kmph$

4. $Tan\theta = \frac{5}{4}$ (Clockwise)

5. $Tan\theta = \frac{V_m}{V_r}$

6. $2(V - W) = (V + W)$

$\therefore V = 3W$

7. $\Delta V = \sqrt{(40)^2 + (40)^2} = 40\sqrt{2}\, kmph\ \ south\ \ east$

8. Final position vectors must be same

$$\vec{r} = \vec{r}_1 + \vec{v}_1 t = \vec{r}_2 + \vec{v}_2 t$$

9. $a = \frac{\Delta V}{t} = \frac{1}{\sqrt{2}} m^{-2}(N - W)$

10. $a = \frac{\Delta V}{t} = \frac{1}{\sqrt{2}} m^{-2}(N - W)$

11. $\vec{V} = \vec{V}_2 + \vec{V}_1 = 500 km/h$

12. $V_R = \sqrt{V^2 + V_m^2} = 2\sqrt{2}\ km/h$

$$Tan\theta = \frac{V_m}{V} \Rightarrow \theta = 45^0$$

13. $Tan\theta = \frac{V_m}{V_r}$