Self Practice Paper (SPP)

1. A stone is dropped from a running bus. It will hit the ground in a-
(1) Straight path (2) Circular path (3) Parabolic path (4) None of these

2. A bucket is placed in the open where the rain is falling vertically. If a wind begins to blow at double the velocity of the rain, how will be rate of filling of the bucket change?
(1) Remain unchanged (2) Doubled (3) Halved (4) Become four times

3. A man can swim with velocity v relative to water. He has to cross a river of width d flowing with a velocity u (u > v). The distance through which he is carried down stream by the river is x. Which of the following statement is correct -

(1) If he crosses the river in minimum time x = $\frac{du}{v}$

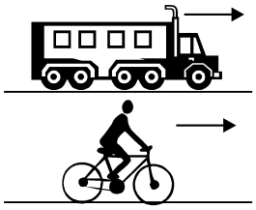
(2) x can not be less than $\frac{du}{v}$

(3) For x to be minimum he has to swim in a direction making an angle of $\frac{\pi}{2} - \sin^{-1}\left(\frac{v}{u}\right)$ with the direction of the flow of water

(4) x will be max. if he swims in a direction making an angle of $\frac{\pi}{2} + \sin^{-1}\frac{v}{u}$ with direction of the flow of water

4. Two observers A and B are moving opposite to each other on a parallel track, separated by a distance d, with same speed. When they are at the shortest distance, a particle is thrown horizontally from some height from ground by A towards B with respect to itself. The path of the particle observed by B is –
(1) Horizontal straight line.
(2) Vertical straight line.
(3) Straight line at some angle with the horizontal.
(4) Parabolic.

5. A cyclist observes a passenger in a bus. He finds that the passenger closed his glass window displacing 20 cm in forward direction with constant speed in 1 sec. Bus overtakes the cyclist in 3 sec. Initially he was at the middle of the bus as shown in the figure. Length of the bus is 18 m. Both cyclist and bus are moving with constant speed in the same direction. Then velocity of the glass window with respect to cyclist was:



(1) 0.2 m/s (2) 2.8 m/s (3) 3.2 m/s (4) 3 m/s

6. A boat is moving towards east with velocity 4 m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the 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:

(1) north-west (2) south-east (3) $\tan^{-1}\frac{1}{2}$ with east (4) north

7. Man A is sitting in a car moving with a speed of 54 km/hr observes a man B in front of the car crossing perpendicularly a road of width 15 m in three seconds. Then the velocity of man B (in m/s) will be:

(1) $5\sqrt{10}$ towards the car at some angle (2) $5\sqrt{10}$ away from the car at some angle

(3) 5 perpendicular to the road (4) 15 along the road

8. A river is flowing with a velocity of 1 m/sec toward east direction. When the boat runs with a velocity of 3 m/s relative to the river in the direction of the river flow, the flag on the boat flutter in north direction. If the boat runs with the same speed but in north direction relative the river, the flag flutters towards north-east direction. The actual velocity of the wind (relative to the ground) should be : ($\hat{i}$ = east direction and $\hat{j}$ = north direction)

(1) $4\hat{i}+6\hat{j}$ (2) $6\hat{i}+4\hat{j}$ (3) $4\hat{i}-6\hat{j}$ (4) $6\hat{i}-4\hat{j}$

9. Hail stones falling vertically with a speed of $12\sqrt{3}$ m/s hits the wind screen which makes an angle 30º with the horizontal. If car is running at velocity v(in m/s) so that the driver find the hailstones striking perpendicular to the wind screen. Find the value of $\frac{v}{2}$?

(1) 2 m/s (2) 4 m/s (3) 6 m/s (4) 8 m/s

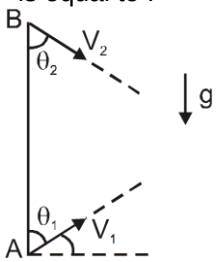
10. A man is on ship which is moving in east direction with speed 60 km/hr. Waves of ocean is taking ship towards west with speed 20 km/hr. Man start running on ship with flag in his hand in north direction with speed 30 km/hr and wind is blowing with 50 km/hr, 37º towards south of west then find the direction of flutter the flag as seen by man on ground.

(1) 37º south of west (2) 53º south of west
(3) 37º west of north (4) flag will not flutter

11. Three particles A,B and C are initially at points $\left(-\frac{3}{2},\ 3,\ 0\right)$, $\left(\frac{3}{2},\ 3,\ 0\right)$ and $\left(0, 3, \frac{3\sqrt{3}}{2}\right)$ respectively. They start their motion at t = 0 with same constant speed 2 m/s. Particle A always heads towards particle B, particle B heads towards particle C and particle C heads towards particle A. At what time will the particles meet each other :

(1) 1 sec. (2) 2 sec. (3) $\frac{3}{2}$ sec. (4) $\frac{1}{2}$ sec.

12. Two balls are projected from points A and B in a vertical plane as shown in figure. AB is a straight vertical line. The balls will collide in mid–air if $\frac{V_1}{V_2}$ is equal to :



(1) $\frac{\sin\theta_2}{\sin\theta_1}$ (2) $\frac{\sin\theta_1}{\sin\theta_2}$ (3) $\frac{\cos\theta_2}{\cos\theta_1}$ (4) $\frac{\cos\theta_1}{\cos\theta_2}$

13. A man crosses the river perpendicular to river flow in time t seconds and travels an equal distance down the stream in T seconds. The ratio of man's speed in still water to the speed of river water will be :

(1) $\frac{t^2-T^2}{t^2+T^2}$ (2) $\frac{T^2-t^2}{T^2+t^2}$ (3) $\frac{t^2+T^2}{t^2-T^2}$ (4) $\frac{T^2+t^2}{T^2-t^2}$

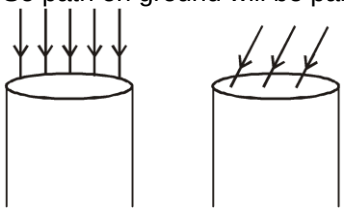
SPP Answers

1.	(3)	**2.**	(1)	**3.**	(1)	**4.**	(4)	**5.**	(1)	**6.**	(1)	**7.**	(2)
8.	(1)	**9.**	(3)	**10.**	(1)	**11.**	(1)	**12.**	(1)	**13.**	(3)		

SPP Solutions

1. In this condition velocity and acceleration both are perpendicular w.r.t. ground.
So path on ground will be parabolic.

2.



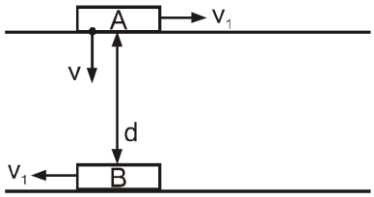
In both cases

$\frac{dQ}{dt}$ = AV = constant

$\frac{dQ}{dt}$ = rate of flow; A = Area; V = velocity downward

3. Time of crossing the river = $\frac{d}{v}$

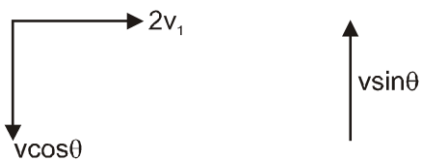
drift along the river = ut = u $\frac{d}{v}$



4. velocity of particle w.r.t. B

Let particle is projected at angle θ with horizontal

In horizontal In vertical



So, path observed by B is parabolic (projectile motion).

5. Relative displacement of glass window w.r.t. cyclist is 20 cm time taken = 1 sec.

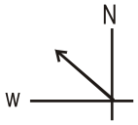
So, relative velocity of glass window w.r.t. cyclist = $\frac{20}{1}$ cm/sec. = 0.2 m/sec.

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

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

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

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

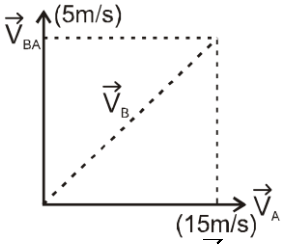


so flag blown in north west.

7. Velocity of A and velocity of B relative to A are as shown.

$\therefore \vec{V}_B = \vec{V}_{BA} + \vec{V}_A$

$\Rightarrow V_0 = \sqrt{5^2 + 15^2} = 5\sqrt{12}$



and direction of $\vec{V}_B$ is away from $\vec{V}_A$.

8. Let actual velocity of wind is $v_x\hat{i} + v_y\hat{j}$

In I-case

$\vec{v}_{w/b} = \vec{v}_w - \vec{v}_b = (v_x\hat{i} + v_y\hat{j}) - (4\hat{i})$

$\vec{v}_{w/b} = (v_x - 4)\hat{i} + v_y\hat{j}$, since $\vec{v}_{w/b}$ is towards north so $v_x - 4 = 0 \Rightarrow v_x = 4$

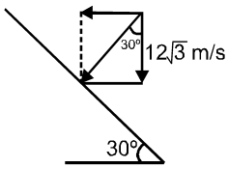
In IInd case

$\vec{v}_{w/b} = \vec{v}_w - \vec{v}_b = (4\hat{i} + v_y\hat{j}) - (1\hat{i} - 3\hat{j})$

$\vec{v}_{w/b} = 3\hat{i} + (v_y - 3)\hat{j}$, since $\vec{v}_{w/b}$ is towards N–F

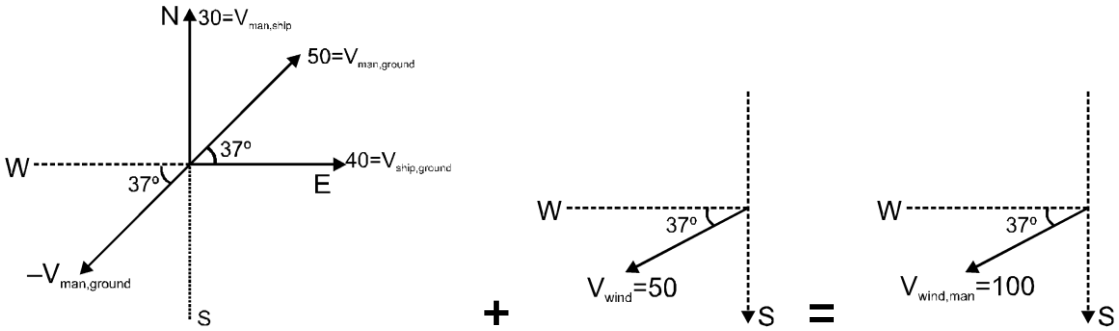
So $v_y - 3 = 3 \Rightarrow v_y = 6$

9. $\tan 30^\circ = \dfrac{v}{12\sqrt{3}}$



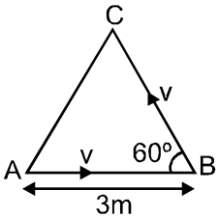
$\Rightarrow$ v = 12 m/s $\Rightarrow \dfrac{v}{2}$ = 6 m/s **Ans.**

10. Flag will flutter in the direction of wind and opposite to the direction of velocity of man i.e. in the direction of V_{wm}



11. AB = BC = CA = 3m

$\Rightarrow$ A,B,C are vertex of an equilaternal



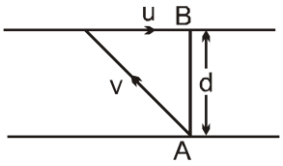
Approach velocity = $v + v\cos 60^\circ$ Now, time = $\frac{3}{v + v\cos 60^\circ}$ = 1 sec.

12. $V_2\sin\theta_2 = V_1\sin\theta_1$ (horizontal component should be same)

$\Rightarrow \quad \frac{V_1}{V_2} = \frac{\sin\theta_2}{\sin\theta_1}$.

13. Let v = man's speed in still mater and
u = speed of river water

$t = \frac{d}{\sqrt{v^2 - u^2}}$

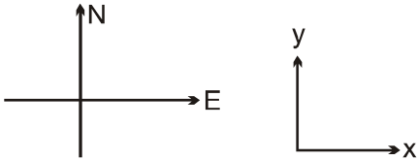


$\Rightarrow \quad v_2 - u_2 = \frac{d^2}{t^2}$

$T = \frac{d}{v+u}$

$\Rightarrow \quad (v+u)_2 = \frac{d^2}{T^2} \Rightarrow \frac{(v+u)^2}{v^2-u^2} = \frac{t^2}{T^2}$

$\Rightarrow \quad \frac{v+u}{v-u} = \frac{t^2}{T^2}$



$\Rightarrow \quad \frac{(v+u)+(v-u)}{(v+u)-(v-u)} = \frac{t^2+T^2}{t^2-T^2}$

$\Rightarrow \quad \frac{v}{u} = \frac{t^2+T^2}{t^2-T^2}$