PHYSICS

Motion in a Plane

31. (1)

Distance covered in one circular loop = $2\pi r$

$= 2 \times 3.14 \times 100 = 628$ m.

Average speed $= \frac{628}{62.8} = 10\ ms^{-1}$

Displacement in one circular loop = 0

Average velocity $= \frac{0}{\text{time}} = 0$

32. (4)

According to the given condition,

Let both y and meet at c in time t then,

AC = vt and BC = $v_1 t$

From Pythagoras theorem.

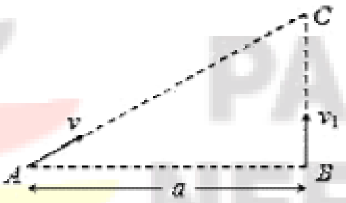
$AC^2 = AB^2 + BC^2$

$v^2 t^2 = a^2 + v_1^2 t^2$

$t^2(v^2 - v_1^2) = a^2$

$t^2 = \frac{a^2}{(v^2 - v_1^2)}$

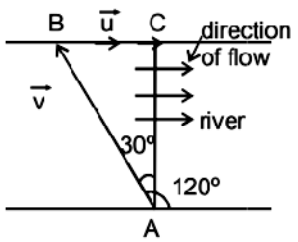
$t = \sqrt{\frac{a}{(v^2 - v_1^2)}}$



33. (1)

In circular motion of a particle with constant speed, particle repeats its motion after a regular interval of time but does not oscillate about a fixed point. So, motion of particle is periodic but not simple harmonic.

34. (3)



Velocity of person, $\vec{v}_m = 0.5\ ms^{-1}$

$\sin 30° = \frac{v_w}{v_m} \Rightarrow v_w = v_m \sin 30°$

$\Rightarrow v_w = \frac{v_m}{2} = \frac{0.5}{2} = 0.25\ ms^{-1}$

35. (2)

Radius of circular path $= 20\ cm = \frac{2}{10}\ m$

Angular speed of body = 10 rad s^{-1}

Linear velocity = radius × angular speed

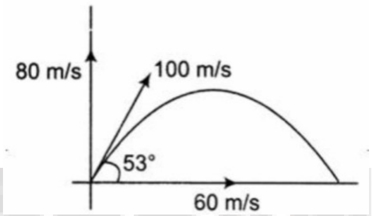
$= \frac{2}{10} \times 10 = 2\ m\ s^{-1}$

36. (2)

$v_r = \sqrt{v_R^2 - v_B^2} = \sqrt{10^2 - 8^2} = 6\ km\ h^{-1}$

37. (1)

Component 60 ms^{-1} will remain unchanged.



Velocity will make 45 with horizontal when vertical component also becomes $\pm 60\ ms^{-1}$

Using v = u + at (in vertical direction)

$+60 = 80 + (-10)t_1$

$\therefore t_1 = 2$ s

$-60 = 80 + (-10)t_2 \quad \therefore t_2 = 14$ s

38. (4)

H′ = H (as vertical component of acceleration has not changed)

$R' = u_x T + \frac{1}{2} a_x T^2$

$= R \frac{u^2 \sin^2\theta}{2g} = (R + H)$

$= R + \frac{1}{2} \times \frac{g}{4} \times \frac{4u^2 \sin^2\theta}{g^2}$

39. (3)

If $\alpha_1 = \alpha$, then $\alpha_2 = 90 - \alpha$

$\therefore R = \frac{u^2 \sin 2\alpha}{g}$

$$\Rightarrow \sin 2\alpha = \frac{10\times 5\sqrt{3}}{10^2} = \frac{\sqrt{3}}{2} \Rightarrow \alpha = 30°$$

$$\because T_1 = \frac{2u\sin\alpha_1}{g} = \frac{2\times 10\sin 30°}{10} = 1\ s$$

and

$$T_2 = \frac{2u\sin(90° - 30°)}{g} = \frac{2\times 0\times\sqrt{3}}{2\times 10} = \sqrt{3}\ s$$

$\therefore$ Difference in time of flights $\left(\sqrt{3}-1\right)$ s

40. (1)

Here, $2.5 = \frac{u^2\sin^2\alpha}{20}$

or $u\sin\alpha = \sqrt{50}$ and $u\cos\alpha = 5\sqrt{2}$

$$\therefore R = \frac{2u\sin\alpha u\cos\alpha}{g}$$

$$= \frac{2\times\sqrt{50}\times 5\sqrt{2}}{10} = 10\ m$$