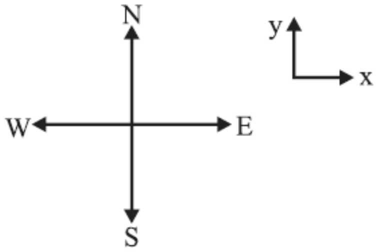
S1. Ans. (d)

Initial velocity = $-v\hat{j}$

Final velocity = $v\hat{i}$



Change in velocity = $v\hat{i} - (-v\hat{j})$

$= v(\hat{i} + \hat{j})$

Momentum gain is along $\hat{i} + \hat{j}$

$\Rightarrow$ Force experienced is along $\hat{i} + \hat{j}$

$\Rightarrow$ Force experienced is in North-East direction.

S2. Ans. (d)

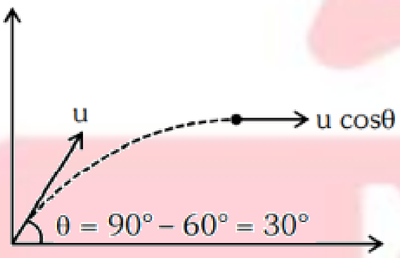
$$h_{max} = \frac{u^2 \sin^2\theta}{2g} = \frac{280 \times 280}{2 \times 9.8} \times \frac{1}{4}$$

$$= 1000\ m$$

S3. Ans. (a)

At highest point only horizontal component of velocity remains

$\Rightarrow u_x = u\cos\theta$



$u_x = u\cos\theta = 10\cos 30°$

$= 5\sqrt{3}\ ms^{-1}$

S4. Ans. (c)

Hint: $T = \frac{2\pi R}{V}$

$u = \frac{2\pi R}{T}$

$H = \frac{u^2 \sin^2\theta}{2g}$

$4R = \frac{4\pi^2 R^2 \sin^2\theta}{T^2 2g}$

$\sin^2\theta = \frac{8RT^2 g}{4\pi^2 R^2}$

$\sin\theta = \sqrt{\frac{2T^2 g}{\pi^2 R}}$

$\theta = \sin^{-1}\left(\frac{2T^2 g}{\pi^2 R}\right)^{\frac{1}{2}}$

S5. Ans. (c)

Hint: u = 0

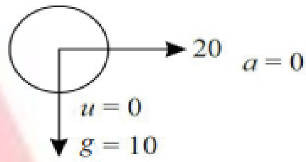
a = 5 m/s^2

t = 4 sec

V = u + at

V = 0 +5 ×4

V = 20 m/s



$V_x = 20$ m/sec

$V_y = u + at$ [∵ t = 6 – 4 = 2 sec]

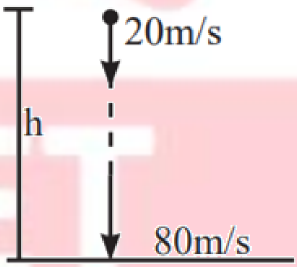
$= 10 \times 2$ m/s

$V_y = 20$ m/sec

$V = 20\sqrt{2}$

and $a = 10$ m/sec^2

S6. Ans. (c)



$v^2 = u^2 + 2gh$

$80^2 + 20^2 + 2 \times 10h$

h = 300 m

S7. Ans. (a)

Hint: From equation of motion

$S = ut + \frac{1}{2}at^2$

Here S = 1.5 m t = 0.1 s

$1.5 = u(0.1) + \frac{1}{2}(10)(0.1)(0.1)$

$\Rightarrow u = 14.5$ m/s

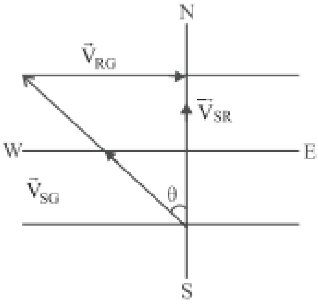
S8. Ans. (a)

$V_{SG} = 20\ m/s$

$V_{RG} = 10\ m/s$

For shortest path

$\vec{V}_{SG} + \vec{V}_{RG} = \vec{V}_{SR}$



From vector triangle:-

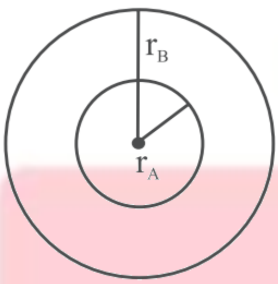
$\sin\theta = \left|\frac{\vec{V}_{RG}}{\vec{V}_{SG}}\right|$

$\text{Sin}\theta = \frac{10}{20}$

$\text{Sin}\ \theta = \frac{1}{2} = \theta = 30°$ west

S9. Ans. (d)

Hint:



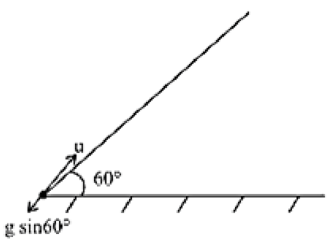
$T_A = T_B = T$

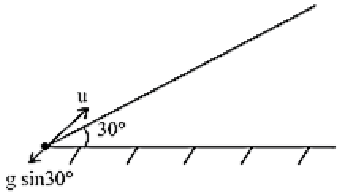
$\omega_A = \frac{2\pi}{T_A}$

$\omega_B = \frac{2\pi}{T_B}$

$\frac{\omega_A}{\omega_B} = \frac{T_B}{T_A} = \frac{T}{T} = 1$

S10. Ans. (c)





(Stopping distance) $x_1 = \frac{u^2}{2g\sin 60°}$

(Stopping distance) $x_2 = \frac{u^2}{2g\sin 30°}$

$\Rightarrow \frac{x_1}{x_2} = \frac{\sin 30°}{\sin 60°} = \frac{1\times 2}{2\times\sqrt{3}} = 1:\sqrt{3}$

S11. Ans. (b)

$\vec{A} - \vec{B}$ will give us a new vector whose direction will be in the plane of A and B.

$\vec{A} \times \vec{B}$ will give us a new vector whose direction will be perpendicular to A and B.

Then the angle between $\vec{A} - \vec{B}$ and $\vec{A} \times \vec{B}$ will be 90º

S12. Ans. (c)

Hint: $T_1 = T_2$

V_y = same for both cases

$H = \frac{V_y^2}{2g}$

$H_1 = H_2$ since all are same for both cases

S13. Ans. (b)

Hint: $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$

$\vec{A} + \vec{B} + 2AB\cos\theta = A^2 + B^2 - 2AB\cos\theta$

$4AB\cos\theta = 0$

$\cos\theta = 0$

$\theta = 90°$

S14. Ans. (c)

Hint:

$\vec{r} = \cos\omega t\hat{x} + \sin\omega t\hat{y}$

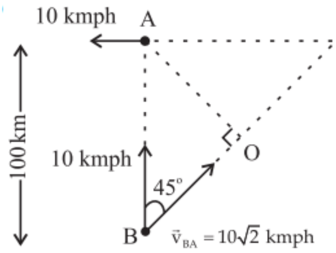
$\hat{v} = -\omega\sin\omega t\hat{x} + \omega\cos\omega t\hat{y}$

$\vec{a} = -\omega^2\cos\omega t\hat{x} + \omega^2(-\sin\omega t)\hat{y}$

$= -\omega^2\vec{r}$

$\vec{r}.\vec{v} = 0$ hence $\vec{r} \perp \vec{v}$

S15. Ans. (a)



$|\vec{v}_{BA}| = \sqrt{10^2 + 10^2} = 10\sqrt{2}$ kmph

Distance OB = $100 \cos 45° = 50\sqrt{2}$ km

Time taken to reach the shortest distance between

A& B = $\frac{50\sqrt{2}}{\vec{v}_{BA}} = \frac{50\sqrt{2}}{10\sqrt{2}} = 5$ h

S16. Ans. (d)

$\vec{R} = 4\sin(2\pi t)\hat{i} + 4\cos(2\pi t)\hat{j}$

$\vec{v} = \frac{d\vec{R}}{dt} = 8\pi\cos 2\pi t\hat{i} - 8\pi \sin 2\pi t\hat{j}$

$|\vec{v}| = \sqrt{[8\pi\cos(2\pi t)^2] + [-8\pi\sin(2\pi t)^2]}$

$= \sqrt{64\pi^2}$

$= 8\pi$ m/s

∴ statement in option (d) is wrong

S17. Ans. (d)

Hint: $= \vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \frac{(13-2)\hat{i}+(14-3)\hat{j}}{5-0} = \frac{11}{5}(\hat{i}+\hat{j})$

S18. Ans. (a)

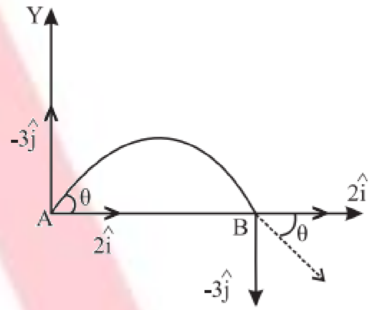
Hint: As Range $= \frac{u^2\sin^2\theta}{g}$ so, $g \propto u^2$

Therefore $g_{planet} = \left(\frac{3}{5}\right)^2 (9.8\ ms^{-2})$

$= 3.5\ ms^{-2}$

S19. Ans. (d)

Hint: In a projectile vertical component of velocity keeps on changing with time. While horizontal velocity component remains constant



∴ Velocity is $2\hat{i} - 3\hat{j}$