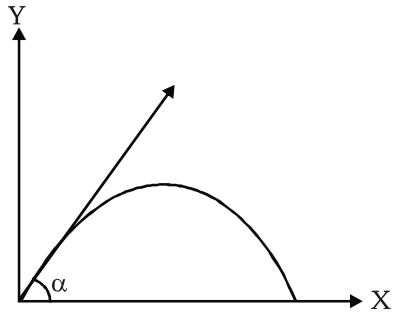
MAHESH TUTORIALS SCIENCE

00 – 00		Q. Booklet Serial No: 160815	
Test No : 1105	3 Hrs.		Q. Booklet Version :

Hints & Solutions

PART A - PHYSICS

1. **c)**



$V_y = u \sin \alpha - gt$

$V_x = a \cos a$

$V_y = v_x \Rightarrow u \sin \alpha - gt = u \cos \alpha$

$t = \dfrac{u(\sin \alpha - \cos \alpha)}{g}$

2. **a)**

Horizontal velocity of Bomb and helicopter is same, so it will always vertically below helicopter.

3. **b)**

As acceleration of particle w.r.t. each other is zero. So, path will be straight line along the direction of their relative velocity.

4. **c)**

$u \cos \theta = v \cos \phi$

$v \cos \phi = u \cos \theta$

$v = \dfrac{u \cos \theta}{\cos \phi}$

$= u \cos \theta \sec \phi$

5. **c)**

In oblique projection velocity and acceleration are perpendicular only at highest point.

6. **c)**

$t = \sqrt{\dfrac{2h}{g}}$ $\rightarrow$ Independent of velocity

7. **d)**

$R_A = \dfrac{u_A^2 \sin 30}{g} = \dfrac{u_A^2}{2g}$

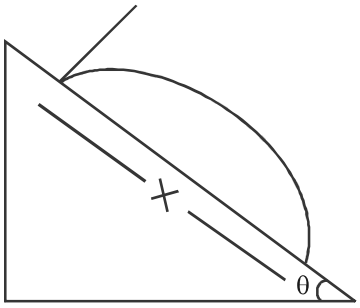
$R_B = \dfrac{u_B^2 \sin 90}{g} = \dfrac{u_B^2}{g}$

R_A and R_B Cannot be compared or u_A and u_B are not known

8. **a)**

For shortest time swimmer should swim across the river

9. **c)**



$X = \dfrac{1}{2} g \sin \theta t^2$

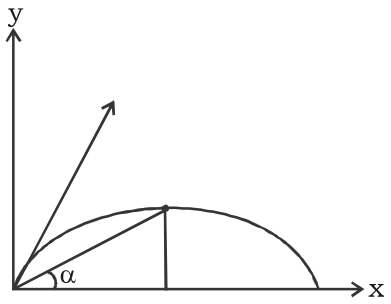
$ut - \dfrac{1}{2} g \cos \theta t^2 = 0$

$t = \dfrac{2u}{g \cos \theta}$

$$X = \frac{1}{2} g \sin . \frac{4u^2}{g^2 \cos^2 \theta}$$

$$X = \frac{2u^2 \tan\theta \sec\theta}{g}$$

10. **c)**



At maximum height instantaneous velocity makes an angle 0^0 with x-axis.

Let α is the angle which average velocity makes with x-axis.

$$\tan \alpha = \frac{H}{\frac{R}{2}}$$

$$\tan \alpha = \frac{\frac{u^2 \frac{\sin^2\theta}{2g}}{\frac{u^2 \sin 2\theta}{2g}}}{} = \frac{\sin\theta}{2\cos\theta} = \frac{\tan\theta}{2}$$

$$\alpha = \tan^{-1}\left(\frac{\tan\theta}{2}\right)$$

11. **c)**

$$y_1 + y_2 = \frac{u^2 \sin^2\theta_1}{2g} + \frac{u^2 \sin^2\theta_2}{2g}$$

$$= \frac{u^2}{2g}\left[\sin^2\theta_1 + \sin^2\left(\frac{\pi}{2} - \theta_1\right)\right]$$

$$= \frac{u^2}{2g}\left(\sin^2\theta_1 + \cos^2\theta_1\right)$$

$$= \frac{u^2}{2g}$$

12. **d)**

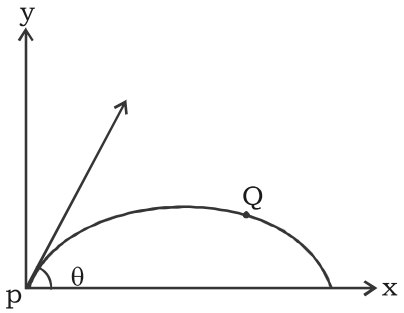
$$h = u \sin\theta t - \frac{1}{2} g t^2$$

$$\frac{1}{2} g t^2 - u \sin\theta t + h = 0$$

$$t_1 + t_2 = \frac{u\sin\theta}{\frac{1}{2}g} = \frac{2u\sin\theta}{g}$$

$$= T$$

13. **b)**



$$\left(v\cos\theta \hat{i} + v\sin\theta \hat{j}\right).\left(v\cos\hat{i} + \left(v\sin\theta - gt\right)\hat{j}\right) = 0$$

$v^2 \cos^2\theta + v \sin\theta (v \sin\theta - gt) = 0$

$v^2 - v \sin\theta gt = 0$

$$t = \frac{v}{g\sin\theta}$$

$$\vec{V_Q} = v\cos\theta \hat{i} + \left(v\sin\theta - g.\frac{v}{g\sin\theta}\right)\hat{j}$$

$$= v\cos\theta \hat{i} + \frac{v\left(\sin^2\theta - 1\right)}{\sin\theta}\hat{j}$$

$$\vec{V_Q} = v\cos\theta \hat{i} - \frac{v\cos^2\theta}{\sin\theta}\hat{j}$$

$$\left|\vec{V_Q}\right| = v\cos\theta\sqrt{1^2 + \left(\frac{\cos\theta}{\sin\theta}\right)^2}$$

$= v \cos\theta . \operatorname{cosec}\theta$

$= v \cot\theta$

14. **d)**

$$h = ut - \frac{1}{2} g t^2$$

$$H = uT - \frac{1}{2} g T^2$$

$H - h = u(T - t) - \frac{1}{2}g(T^2 - t^2)$

$u = gT$

$H - h = gT(T - t) - \frac{1}{2}g(T^2 - t^2)$

$H - h = \frac{1}{2}gT^2 + \frac{1}{2}gT^2 - gTt$

$H - h = \frac{1}{2}g\,(T - t)^2$

$h = H - \frac{1}{2}g\,(T - t)^2$

15. **c)**

First part of the problem

$\vec{V}_{M_E} = 3\hat{i}$

$\vec{V}_{R_M} = x\left(-\hat{j}\right)$

$\vec{V}_{R_M} = \vec{V}_{R_E} - \vec{V}_{M_E}$

$\vec{V}_{R_E} = x\left(-\hat{j}\right) + 3\hat{i}$

$= 3\hat{i} - x\hat{j}$

Second part

$\vec{V}_{M_E} = 6\hat{i}$

$\vec{V}_{R_E} = 3\hat{i} - x\hat{j}$

$\vec{V}_{R_M} = 3\hat{i} - x\hat{j} - 6\hat{i}$

$= -3\hat{i} - x\hat{j}$

$\frac{3}{x} = \tan 45^0$

$\frac{3}{x} = 1$

$x = 3$

$\vec{V}_{R_E} = -3\hat{i} - 3\hat{j}$

$\left|\vec{V}_{R_E}\right| = 3\sqrt{2}$

16. **b)**

Velocity at Maximum height is $u\cos\theta$

17. **c)**

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

$= R \propto u^2$

If R is doubled, velocity become $\sqrt{2}$ times.

$t = \frac{2u\sin\theta}{g}$

$t \propto u$

So, time of flight also become $\sqrt{2}$ times.

18. **b)**

$v \sin 30^0 = 80$

$v = 160$ m/s

$\vec{V}_t = \left(v\cos\theta\,\hat{i}\right) + \left(v\sin\theta - gt\right)\hat{j}$

$= 160\cos 30\,\hat{i} + 0\,\hat{j}$

$= 160.\frac{\sqrt{3}}{2}$

$= 80\sqrt{3}$

19. **c)**

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

$R_{max} = \frac{u^2}{g}$

$100 = \frac{u^2}{g}$

$u^2 = 100\,g$

$u = \sqrt{1000}$

$u = 32$ m/s

20. **a)**

$\frac{H}{T^2} = \frac{\frac{u^2 \sin^2\theta}{2g}}{\frac{4u^2\sin^2\theta}{g^2}} = \frac{g}{8} = \frac{10}{8}$

$= \frac{5}{4}$

21. **b)**

22. **b)**

$t_1 t_2 = \frac{2u\sin\theta_1}{g} . \frac{2u\sin\theta_2}{g}$

$= \frac{4u^2 \sin\theta_1 \cos\theta_1}{g^2}$

$t_1 t_2 = \frac{2R}{g}$

$t_1 t_2 \propto R$

23. **a)**

Complementary angle

24. **b)**

$R = u\cos\theta . t$

$= u\cos\theta . \frac{2u\sin\theta}{g}$

$= u_x . \frac{2.u_y}{g}$

$= \frac{6.2.8}{10} = 9.6$ m

25. **a)**

$u\cos\theta = \frac{1}{\sqrt{2}}u$

$\theta = 45^0$

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

26. **c)**

$R \propto u^2$

27. **a)**

$R_{max} = \frac{u^2}{g}$

$\theta = 45^0$

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

$= \frac{u^2}{4g} = \frac{400}{4}$

$= 100$

28. **a)**

$\frac{2u\cos\theta}{g} = 10$

$u\cos\theta = 5g$

$\frac{u^2 \sin^2\theta}{g} = 500$

$\frac{2.u\sin\theta.u\cos\theta}{g} = 500$

$\frac{2.u\sin\theta.5g}{g} = 500$

$u\sin\theta = 50$

$H = \frac{u^2 \sin^2\theta}{g} = \frac{50\times50}{2\times10}$

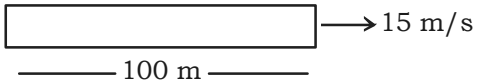
$= 125$ m

29. **c)**

$t = \frac{2}{5} + \frac{2}{1}$

$t = \frac{12}{5} = 2.4$ hrs.

30. **b)**



$10 = \frac{100}{15 - v} \Rightarrow v = 5$

$t = \frac{100}{20}$ 5 sec