

**WEEKLY TEST TYM-02 TEST - 6 RAJPUR ROAD**  
**SOLUTION Date 08-09-2019**

**[PHYSICS]**

1. Because there is no acceleration or retardation along horizontal direction, hence horizontal component of velocity remains same.

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

Since,  $H = R$

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

or  $\tan \theta = 4$  or  $\theta = \tan^{-1}(4)$

3. At the highest point,  $v = u \cos 45^\circ = \frac{u}{\sqrt{2}}$

Hence,  $K$  (at the top)  $= \frac{1}{2} m \left( \frac{u}{\sqrt{2}} \right)^2$

$$= \frac{1}{2} \left[ \frac{1}{2} m u^2 \right] = \frac{E}{2}$$

4. For the person to be able to catch the ball, the horizontal component of velocity of the ball should be same as the speed of the person, i.e.,

$$v_0 \cos \theta = \frac{v_0}{2}$$

or  $\cos \theta = \frac{1}{2}$  or  $\theta = 60^\circ$

5. The bullets are fired at the same initial speed. Hence,

$$\frac{h}{h'} = \frac{u^2 \sin^2 60^\circ}{2g} \times \frac{2g}{u^2 \sin^2 30^\circ} = \frac{\sin^2 60^\circ}{\sin^2 30^\circ} = \frac{3}{1}$$

6.  $h = \text{maximum height} = \frac{u^2 \sin^2 \theta}{2g}$

Linear momentum  $= mu \cos \theta$  at the highest point. Angular momentum of the projectile at the highest point  $= \text{linear momentum} \times \text{perpendicular distance}$

$$= mu \cos \theta \times h = m u \cos \theta \times \frac{u^2 \sin^2 \theta}{2g}$$

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

7. If  $h$  be the maximum height attained by the projectile, then

$$h = \frac{u^2 \sin^2 \theta}{2g} \quad \text{and} \quad R = \frac{u^2 \sin 2\theta}{g}$$

$$\frac{R}{h} = \frac{2 \sin \theta \cos \theta}{(\sin^2 \theta) / 2} = 4 \cot \theta$$

$$\text{Therefore, } \frac{\Delta R}{R} = \frac{\Delta h}{h}$$

$\therefore$  Percentage increase in  $R$  = percentage in  $y_m$  = 5%

8. From above question;  $\frac{h}{T^2} = \frac{g}{8}$

If  $T$  is doubled,  $h$  becomes four times.

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

$$\text{When } 2\theta = 90^\circ, R = R_{\max.} = \frac{u^2}{g}$$

$$\text{Given: } R_{\max.} = h, \text{ hence } \frac{u^2}{g} = h$$

$$\text{Height } H \text{ is given by: } H = \frac{u^2 \sin^2 \theta}{2g}$$

$$\text{When } \theta = 90^\circ, H = H_{\max.} = \frac{u^2}{2g} = \frac{h}{2}$$

10. Given that:  $R_1 = 50 \text{ m}$

$$u_1 = u \text{ (say)}$$

$$\text{and } u_2 = 2u$$

We know that range of the projectile is given by:

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

$$\text{i.e., } R \propto u^2$$

$$\therefore \frac{R_2}{R_1} = \left( \frac{u_2}{u_1} \right)^2 = 4$$

$$\text{i.e., } R_2 = 4R_1 = 4 \times 50 = 200 \text{ m.}$$

11.  $t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 90}{9.8}} = 10$

$$\therefore R = 150 \times 10 = 1500 \text{ m}$$

12. Vertical component of velocity is maximum ( $= u \sin \theta$ ) when  $\theta = 90^\circ$  [Because maximum height is covered in minimum time when vertical component of velocity is maximum].

As  $\theta = 90^\circ$  is the angle w.r.t. horizontal, hence angle w.r.t. vertical direction is  $0^\circ$ .

13. The horizontal range is the same for the angles of projection  $\theta$  and  $(90^\circ - \theta)$

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

$$t_2 = \frac{2u \sin(90^\circ - \theta)}{g} = \frac{2u \cos \theta}{g}$$

$$\therefore t_1 t_2 = \frac{2u \sin \theta}{g} \times \frac{2u \cos \theta}{g}$$



$$= \frac{2}{g} \left[ \frac{u^2 \sin 2\theta}{g} \right] = \frac{2}{g} R$$

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

Hence,  $t_1 t_2 \propto R$ . (as  $g$  is constant)

$$14. \quad R_1 = \frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin 2 \times 75^\circ}{g}$$

$$= \frac{u^2}{g} \sin 150^\circ = \frac{u^2}{g} \sin(180^\circ - 30^\circ)$$

$$\frac{u^2}{g} \sin 30^\circ = \frac{u^2}{2g}$$

$$R_2 = \frac{u^2}{g} \sin 90^\circ = \frac{u^2}{g}$$

$$\therefore R_2 = 2R_1 = 0.5 \times 2 = 1.0 \text{ km.}$$

15. Range is same for angles of projection  $\theta$  and  $(90^\circ - \theta)$

$$\therefore R = \frac{u^2 \sin 2\theta}{g}; \quad h_1 = \frac{u^2 \sin^2 \theta}{2g}$$

$$\text{and } h_2 = \frac{u^2 \cos^2 \theta}{2g}$$

$$\text{Hence, } \sqrt{h_1 h_2} = \frac{u^2 \sin \theta \cos \theta}{2g}$$

$$= \frac{1}{4} \left[ \frac{u^2 \sin 2\theta}{g} \right] = \frac{R}{4}$$