WEEKLY TEST TYJ-02 TEST - 7 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, $v = u\cos 45^o = \frac{u}{\sqrt{2}}$

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

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

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 $\theta = 60^o$

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

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

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

Linear momentum = mu cosθ at the highest point. Angular momentum of the projectile at the highest point = linear momentum × perpendicular distance

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

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

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

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

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

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

∴ 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. $R = \frac{u^2\sin 2\theta}{g}$

When 2θ = 90º, $R = R_{max.} = \frac{u^2}{g}$

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

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

When θ = 90º, $H = H_{max.} = \frac{u^2}{2g} = \frac{h}{2}$

10. Given that: R_1 = 50 m
u_1 = u(say)
and u_2 = 2u
We know that range of the projectile is given by:

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

i.e., $R \propto u^2$

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

i.e., $R_2 = 4R_1$ = 4 × 50 = 200 m.

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

∴ R = 150 × 10 = 1500 m

12. Vertical component of velocity is maximum (= u sinθ) when θ = 90º [Because maximum height is covered in minimum time when vertical component of velocity it maximum].
As θ = 90º is the angle w.r.t. horizontal, hence angle w.r.t. vertical direction = 0º.

13. The horizontal range is the same for the angles of projection θ and (90º – θ)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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