Kinematics worksheet 6

1. What will be the effect on horizontal range of a projectile when its initial velocity is doubled, keeping the angle of projection same? 1

Ans. $R = \dfrac{u^2 \sin 2\theta}{g}$

$u' = 2u$

$R' = \dfrac{(u')^2 \sin 2\theta}{g} = \dfrac{(2u)^2 \sin 2\theta}{g} = \dfrac{4u^2 \sin 2\theta}{g} = 4R$

2. What will be the effect on maximum height of a projectile when its angle of projection is changed from 30^o to 60^o, keeping the same initial velocity of projection? 1

Ans. $H = \dfrac{u^2 \sin^2 \theta}{2g}$

$For\ \theta = 30^0,\ H_1 = \dfrac{u^2 \sin^2 30^0}{2g} = \dfrac{u^2 (0.5)^2}{2g} = \dfrac{u^2}{8g}$

$\theta = 60^0,\ H_2 = \dfrac{u^2 \sin^2 60^0}{2g} = \dfrac{u^2 \left(\sqrt{3}/2\right)^2}{2g} = \dfrac{3u^2}{8g}$

$\dfrac{H_2}{H_1} = \dfrac{\frac{3u^2}{8g}}{\frac{u^2}{8g}}$

$H_2 = 3H_1$

3. What is the angular velocity of the hour hand of a clock? 1

Ans. $\omega = \dfrac{2\pi}{T} = \dfrac{2\pi}{12} = \dfrac{\pi}{6}\, rad.hr^{-1}$

4. A body is moving on a curved path with a constant speed. What is the nature of its acceleration? 2

Ans. Tangential to the direction of motion.

5. A stone tied at the end of string is whirled in a circle. If the string breaks, the stone flies away tangentially. Why? 2

Ans. When a stone is moving around a circular path, its velocity acts tangent to the circle.
When the string breaks, the centripetal force will not act. Due to inertia, the stone continues to move along the tangent to circular path, and flies off tangentially to the circular path.

6. What are the two angles of projection of a projectile projected with velocity 30m/s, so that the horizontal range is 45m? Take, g = 10m/s^2. 2

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

$45 = \frac{30^2 \sin 2\theta}{10}$

$\sin 2\theta = \frac{450}{900}$

$\sin 2\theta = \frac{1}{2}$

$2\theta = 30^0 or 150^0$

$\theta = 15^0 or 75^0$

7. The blades of an aero-plane propeller are rotating at the rate of 600 revolutions per minute. Calculate its angular velocity. 3

Ans. $\nu = 600rpm = \frac{600}{60} rps = 10rps$

$\omega = 2\pi\nu = 2 \times 3.14 \times 10 = 62.8rps$

8 What is a uniform circular motion? Explain the terms time period, frequency and angular velocity. Establish relation between them. 3

Ans. When an object moves in a circular path with constant speed then the motion is called uniform circular motion

Time period – The time taken by the object to complete one revolution

Frequency – The total number of revolutions in one second is called the frequency.

Angular velocity – It is defined as the time rate of change of angular displacement.

$\omega = \frac{2\pi}{T} = 2\pi\nu$

9 A body of mass m is thrown with velocity 'u ' at angle of 30^o to the horizontal and another body B of the same mass is thrown with velocity u at an angle of 60^o to the horizontal. Find the ratio of the horizontal range and maximum height of A and B?

Ans.

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

$$For\ \theta = 30^0,\ R_A = \frac{u^2 \sin 60^0}{g} = \frac{u^2\left(\sqrt{3}/2\right)}{g} = \frac{\sqrt{3}u^2}{2g}$$

$$\theta = 60^0,\ R_B = \frac{u^2 \sin 120^0}{g} = \frac{u^2\left(\sqrt{3}/2\right)}{g} = \frac{\sqrt{3}u^2}{2g}$$

$$\frac{R_A}{R_B} = \frac{\frac{\sqrt{3}u^2}{2g}}{\frac{\sqrt{3}u^2}{2g}}$$

$$R_A : R_B = 1:1$$

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

$$For\ \theta = 30^0,\ H_A = \frac{u^2 \sin^2 30^0}{2g} = \frac{u^2(0.5)^2}{2g} = \frac{u^2}{8g}$$

$$\theta = 60^0,\ H_B = \frac{u^2 \sin^2 60^0}{2g} = \frac{u^2\left(\sqrt{3}/2\right)^2}{2g} = \frac{3u^2}{8g}$$

$$\frac{H_A}{H_B} = \frac{\frac{u^2}{8g}}{\frac{3u^2}{8g}}$$

$$H_A : H_B = 1:3$$