Kinematics worksheet 4

1. What is "Trajectory of a projectile? 1

Ans. path followed by a projectile

2. A projectile is fired at an angle of 30^o with the horizontal with velocity 10m/s. At what angle with the vertical should it be fired to get maximum range? 1

Ans. 45^o

3. What is the value of angular speed for 1 revolution 1

Ans. $\omega = \frac{2\pi}{T}$

4. What is the angle between two forces of 2N and 3N having resultant as 4N? 2

Ans. $R^2 = A^2 + B^2 + 2AB\cos\theta$

$4^2 = 2^2 + 3^2 + 2\times 2\times 3\times\cos\theta$

$16 = 13 + 12\cos\theta$

$\cos\theta = \frac{1}{4}$

$\theta = \cos^{-1}\left(\frac{1}{4}\right)$

5. What is the angle of projection at which horizontal range and maximum height are equal? 2

Ans. $R = H$

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

$\tan\theta = 4$

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

6. Prove that for elevations which exceed or fall short of 45^o by equal amounts the ranges are equal? 2

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

Case I : $\theta = 45 - \alpha$

$$R_1 = \frac{u^2\sin 2(45-\alpha)}{g} = \frac{u^2\sin(90-2\alpha)}{g} = \frac{u^2\cos 2\alpha}{g}$$

Case II : $\theta = 45 + \alpha$

$$R_2 = \frac{u^2\sin 2(45+\alpha)}{g} = \frac{u^2\sin(90+2\alpha)}{g} = \frac{u^2\cos 2\alpha}{g}$$

$R_1 = R_2$

7. Derive expressions for velocity and acceleration for uniform circular motion. 3

Ans. Derive $a = \frac{v^2}{r}$

8. Derive an equation for the path of a projectile fired parallel to horizontal. 2

Ans. Derive $y = \frac{gx^2}{2u^2}$

9. (a) Define time of flight and horizontal range? 2

(b) From a certain height above the ground a stone A is dropped gently. Simultaneously another stone B is fired horizontally. Which of the two stones will arrive on the ground earlier?

Ans. (a) **Time of flight** – The time taken by the projectile to complete its trajectory.

Horizontal Range – The maximum horizontal distance covered by the projectile form the foot of the tower to the point where projectile hits the ground.

(b) Both the stones will reach the ground simultaneously because the initial vertical velocity in both cases is zero and both are falling with same acceleration equal to acceleration due to gravity.