Projectiles – Inclined Plane

1. * A particle is projected up an inclined plane with initial velocity u m/s. The line of projection makes an angle $30°$ with the plane and the plane is inclined at $30°$ to the horizontal.Find, in terms of u, the range of the particle on the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.)

2. * A particle is projected down a slope which is inclined at $45°$ to the horizontal. The particle is projected from a point on the slope and has an initial velocity of $7\sqrt{2}$ m/s at an angle α to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.) Find the value of α if the time of flight is two seconds.

3. * A particle is projected up an inclined plane with initial velocity u m/s. The line of projection makes an angle α with the horizontal and the inclined plane makes an angle β with the horizontal. Find, in terms of u, g, α and β, the range of the particle up the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.)

4. * A plane is inclined at an angle β to the horizontal. A particle is projected up the plane with initial velocity u at an angle α to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.)

   (i) Find the range of the particle on the inclined plane in terms of u, α and β.

   (ii) Show that for a constant value of u the range is a maximum when $\alpha = 45° - \frac{\beta}{2}$.

5. * A ball is dropped from a height of h m onto a smooth inclined plane. The ball strikes the plane at p and rebounds. The plane is inclined at an angle of $30°$ to the horizontal and the coefficient of restitution between the ball and the plane is $\frac{1}{2}$. Find how far down the plane from p is the ball's next point of impact. Express your answer in terms of h. (The plane of projection is vertical and contains the line of greatest slope.)

6. * A particle is projected down an inclined plane with initial velocity 20 m/s. The line of projection makes an angle of $90°$ with the inclined plane and the plane is inclined at α to the horizontal. The particle strikes the plane at Q (the coefficient of restitution e is $\frac{1}{2}$). (The plane of projection is vertical and contains the line of greatest slope.) The range of the particle on the inclined plane is $\frac{1600\sqrt{3}}{g}$. Find

   (i) the value of α

   (ii) the rebound speed at Q.

7. * A particle is projected down an inclined plane with initial velocity u m/s. The line of projection makes an angle of $2\theta°$ with the inclined plane and the plane is inclined at $\theta°$ to the horizontal. The range of the particle on the inclined plane is $\frac{ku^2}{g}\sin\theta$. Find the value of k. (The plane of projection is vertical and contains the line of greatest slope.)

8. * A particle is projected from a point p with initial speed of 15 m/s, down a plane inclined at an angle of $30°$ to the horizontal. The direction of projection is at right angles to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.) Find

   (i) the vertical height above the plane at time t

   (ii) the greatest vertical height.

9. * A plane is inclined at an angle of 2β to the vertical. A particle is projected up the plane with initial velocity of $u\cos\beta$ at an angle β to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.) Find

   (i) the time of flight of the particle

   (ii) the range of the particle.

10. * A particle is projected up an inclined plane at an angle $\tan^{-1} 3$ to the plane which is inclined at an angle $9°$ to the horizontal. Find the value of $\frac{-v_y}{v_x}$ where v_x and v_y are the final velocities along the plane and perpendicular to it respectively.

Source(s):

- http://www. Maths Grinds .ie/
- http://www.examinations.ie/

Further Information:

- Questions marked with an asterisk * are past Leaving Cert Exam questions.

Answers:

1. $\frac{2u^2}{3g}$
2. $44.43°$
3. $\frac{u^2\left(\sin\left(2\alpha-\beta\right)-\sin\beta\right)}{g\cos^2\beta}$
4. (i) $23.4°$
   (ii) 52.9 m/s
5. $\frac{3h}{2}$
6. (i) $60°$
   (ii) 70 m/s
7. 4
8. (i) $10\sqrt{3}t-4.9t^2$
   (ii) $\frac{750}{49}$
9. (i) $\frac{u}{g}$
   (ii) $\frac{u^2}{2g}$
10. 0.16