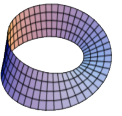
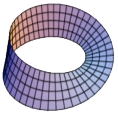


## Projectiles – Inclined Plane

- \* A particle is projected up an inclined plane with initial velocity  $u$  m/s. The line of projection makes an angle  $30^\circ$  with the plane and the plane is inclined at  $30^\circ$  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.)
- \* A particle is projected down a slope which is inclined at  $45^\circ$  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  $\alpha$  to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.) Find the value of  $\alpha$  if the time of flight is two seconds.
- \* A particle is projected up an inclined plane with initial velocity  $u$  m/s. The line of projection makes an angle  $\alpha$  with the horizontal and the inclined plane makes an angle  $\beta$  with the horizontal. Find, in terms of  $u$ ,  $g$ ,  $\alpha$  and  $\beta$ , the range of the particle up the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.)
- \* A plane is inclined at an angle  $\beta$  to the horizontal. A particle is projected up the plane with initial velocity  $u$  at an angle  $\alpha$  to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.)
  - Find the range of the particle on the inclined plane in terms of  $u$ ,  $\alpha$  and  $\beta$ .
  - Show that for a constant value of  $u$  the range is a maximum when  $\alpha = 45^\circ - \frac{\beta}{2}$ .
- \* 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  $30^\circ$  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.)
- \* A particle is projected down an inclined plane with initial velocity 20 m/s. The line of projection makes an angle of  $90^\circ$  with the inclined plane and the plane is inclined at  $\alpha$  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
  - the value of  $\alpha$
  - the rebound speed at Q.
- \* A particle is projected down an inclined plane with initial velocity  $u$  m/s. The line of projection makes an angle of  $2\theta^\circ$  with the inclined plane and the plane is inclined at  $\theta^\circ$  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.)
- \* A particle is projected from a point p with initial speed of 15 m/s, down a plane inclined at an angle of  $30^\circ$  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
  - the vertical height above the plane at time  $t$
  - the greatest vertical height.
- \* A plane is inclined at an angle of  $2\beta$  to the vertical. A particle is projected up the plane with initial velocity of  $u \cos \beta$  at an angle  $\beta$  to the inclined plane. (The plane of projection is vertical and contains the line of greatest slope.) Find
  - the time of flight of the particle
  - the range of the particle.
- \* A particle is projected up an inclined plane at an angle  $\tan^{-1} 3$  to the plane which is inclined at an angle  $9^\circ$  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.MathsGrinds.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.  $44.43^\circ$

3.  $\frac{u^2 (\sin(2\alpha - \beta) - \sin \beta)}{g \cos^2 \beta}$

4. (i)  $23.4^\circ$   
(ii)  $52.9 \text{ m/s}$

5.  $\frac{3h}{2}$

6. (i)  $60^\circ$

(ii)  $70 \text{ m/s}$

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.  $0.16$