Applied Maths Induction Workshop 3 – Projectiles – Exercises

2005 – Ordinary Level – Question 3(a)

A particle is projected from a point o on level horizontal ground with an initial speed of $50\sqrt{3}\,\text{m/s}$ at an angle β to the horizontal.

It strikes the level ground at p after 15 seconds.

(i)   Find the angle β

(ii)   Find $|op|$, the distance from o to p. Give your answer to the nearest metre.

2010 – Ordinary Level – Question 3

A particle is projected with initial velocity $72\vec{i}+30\,\vec{j}\,\text{m/s}$ from the top of a straight vertical cliff of height 35 m.

It strikes the horizontal ground at P.

Find

(i)   the time taken to reach the maximum height

(ii)   the maximum height of the particle above ground level

(iii)   the time of flight

(iv) $|OP|$, the distance from O to P

(v)   the speed of the particle as it strikes the ground.
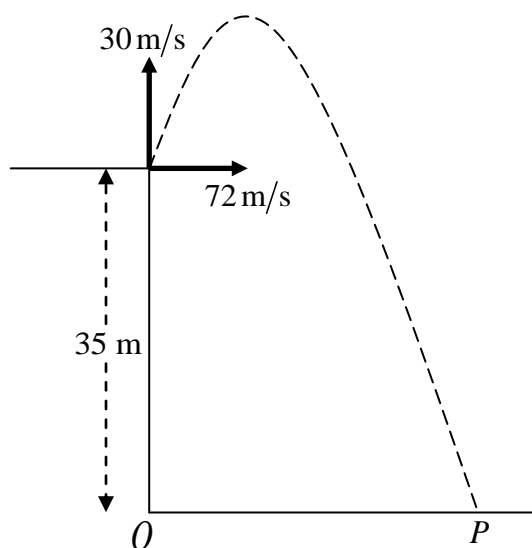
2007 – Higher Level – Question 3(a)

A particle is projected with a speed of $7\sqrt{5}\,\text{m/s}$ at an angle α to the horizontal.

Find the two values of α that will give a range of $12\cdot5\,\text{m}$.
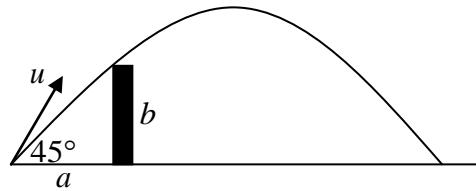
2003 – Higher Level – Question 3(a)

A particle is projected from a point on level horizontal ground at an angle θ to the horizontal ground.
Find θ, if the horizontal range of the particle is five times the maximum height reached by the particle.

2008 – Higher Level – Question 3(a)

A ball is projected from a point on the ground at a distance of a from the foot of a vertical wall of height b, the velocity of projection being u at an angle $45°$ to the horizontal.

If the ball just clears the wall prove that the greatest height reached is

$$\frac{a^2}{4(a-b)}.$$

2006 – Higher Level – Question 3(b)

A particle is projected up an inclined plane with initial velocity $u\,\text{m/s}$.

The line of projection makes an angle $30°$ with the plane and the plane is inclined at $30°$ to the horizontal.

The plane of projection is vertical and contains the line of greatest slope.

Find, in terms of u, the range of the particle on the inclined plane.

2008 – Higher Level – Question 3(b)

A particle is projected down an inclined plane with initial velocity $u\,\text{m/s}$.

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 plane of projection is vertical and contains the line of greatest slope.

The range of the particle on the inclined plane is $\dfrac{ku^2}{g}\sin\theta$.

Find the value of k.

Problem Involving Max. Height – "Applied Mathematics" – Dominick Donnelly.

A plane is inclined at an angle α to the horizontal. A particle is projected up this plane with a speed u at an angle θ to the plane.

The plane of projection is vertical and contains the line of greatest slope.

Find, in terms of u, α and θ, the maximum perpendicular height of the particle above the plane. Hence, or otherwise, show that the maximum vertical height of the particle above the plane is given by $\dfrac{u^2\sin^2\theta}{2g\cos^2\alpha}$.

1997 – Higher Level – Question 3(b)

A particle is projected from a point p with initial speed $15\,\text{m/s}$, 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 perpendicular height of the particle above the plane after t seconds and hence, or otherwise, shoe that the vertical height h of the particle above the plane after t seconds is $10\sqrt{3}\,t - 4\!\cdot\!9t^2$.

(ii) the greatest perpendicular height it attains above the plane (i.e. the maximum value of h) correct to two decimal places.
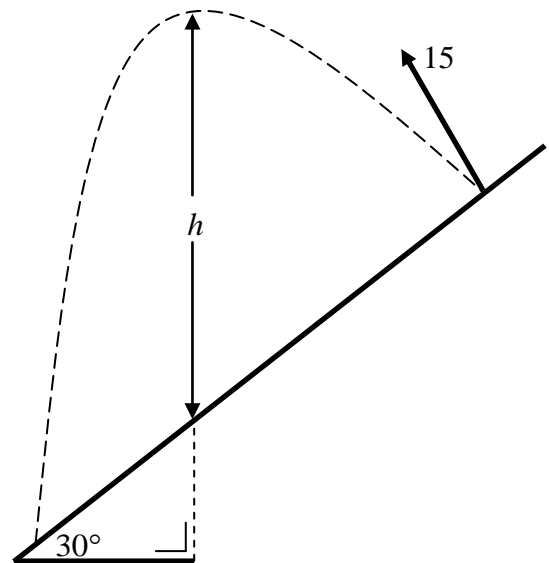
2010 – Higher Level – Question 3(b)

A particle is projected up an inclined plane with initial speed $80 \, \text{m/s}$.

The line of projection makes an angle of $30°$ with the inclined plane and the plane is inclined at an angle θ to the horizontal.

The plane of projection is vertical and contains the line of greatest slope.

The particle strikes the plane at an angle of $\tan^{-1} \dfrac{2}{\sqrt{3}}$.

Find   (i)   the value of θ

       (ii)   the speed with which the particle strikes the plane.

2007 – Higher Level – Question 3(b)

A plane is inclined at an angle $45°$ to the horizontal. A particle is projected up the plane with initial speed u at an angle θ to the horizontal.

The plane of projection is vertical and contains the line of greatest slope.

The particle is moving horizontally when it strikes the inclined plane.

Show that $\tan \theta = 2$.