M2 Projectiles

1) A particle is projected horizontally from a point A which is $h\ m$ above horizontal ground. The projectile strikes the ground at a point b which is at a horizontal distance of $x\ m$ from A.

a) Find an expression for the speed of projection of the particle in terms of h and x.

b) Find the speed of the projectile if h = 25 and x = 200

2) A stone is thrown with speed $u\ ms^{-1}$ from a window which is $h\ m$ above horizontal ground.
The stone hits the ground $3.5\ s$ later and the horizontal distance from the window to the ground is $x\ m$.

a) Find an expression for $tan\ \alpha$, where α is the angle of projection.
Write your answer in the form $\frac{p-h}{x}$, where p is a rational number.

b) Given that the horizontal distance from the window to the ground is $97\ m$ and the window is $20\ m$ above horizontal ground, find

i) the angle of projection

ii) the initial speed

3) A ball is thrown from a point O on horizontal ground with speed $16\ ms^{-1}$ at an angle of elevation θ. The ball strikes a vertical wall which is $20\ m$ from O at a point which is $3\ m$ above the ground. Find the two possible values of θ.

Socrative

1) A particle is projected from a point with speed $21\ ms^{-1}$ at an angle of elevation α and moves freely under gravity. When the particle has moved a horizontal distance $x\ m$, its height above the point of projection is $y\ m$.

a) Find an expression for y in terms of $x\ and\ \alpha$

b) Given that y = 8.1 when x = 36, find the value of $\tan\alpha$

2) A projectile is launched from a point on a horizontal plane with initial speed $u\ ms^{-1}$ at an angle of elevation α. The particle moves freely under gravity until it strikes the plane. The range of the projectile (the horizontal distance travelled) is $R\ m$.

a) Find an expression for the time of flight of the particle in terms of $u, g\ and\ \alpha$.

b) Find an expression for R in terms of $u, g\ and\ \alpha$

c) Given that u is fixed, find the value of α which gives the greatest possible range.

d) Given that $R = \frac{2u^2}{5g}$, find the two possible values of the angle of elevation at which the projectile could have been launched.

Multichoice answers

1a)

A $y = x\tan\alpha - \frac{x^2}{90\cos^2\alpha}$

B $y = x\tan\alpha + \frac{x^2}{90\cos^2\alpha}$

C $y = x\tan\alpha - \frac{x^2}{90\sin^2\alpha}$

D $y = x\tan\alpha + \frac{x^2}{90\sin^2\alpha}$

E None of these

1b) A $\frac{4}{5}$ B $\frac{5}{4}$ C $\frac{3}{5}$ D $\frac{4}{5}$ E $\frac{3}{4}$ F $\frac{4}{3}$ G None of these

2a) A $\frac{2u\ sin\ \alpha}{g}$ B $\frac{u\ sin\ \alpha}{g}$ C $\frac{2u\ cos\ \alpha}{g}$ D $\frac{u\ cos\ \alpha}{2g}$ E None of these

2b) A $\frac{u^2\sin\alpha}{g}$ B $\frac{u^2\sin 2\alpha}{2g}$ C $\frac{u\sin 2\alpha}{g}$ D $\frac{u^2\sin 2\alpha}{g}$ E None of these

2c) A $90°$ B $60°$ C $45°$ D $30°$

2d) A $18°\ and\ 72°$ B $12°\ and\ 78°$

C $30°\ and\ 60°$ D $0°\ and\ 90°$