

Projectiles - Questions

June 2015 Mathematics Advanced Paper 1: Mechanics 1

- 1.
2. A small stone is projected vertically upwards from a point O with a speed of 19.6 m s^{-1} . Modelling the stone as a particle moving freely under gravity,
- (a) find the greatest height above O reached by the stone, (2)
- (b) find the length of time for which the stone is more than 14.7 m above O . (5)

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- 2.
5. A particle P is projected vertically upwards from a point A with speed $u \text{ m s}^{-1}$. The point A is 17.5 m above horizontal ground. The particle P moves freely under gravity until it reaches the ground with speed 28 m s^{-1} .
- (a) Show that $u = 21$. (3)
- At time t seconds after projection, P is 19 m above A .
- (b) Find the possible values of t . (5)
- The ground is soft and, after P reaches the ground, P sinks vertically downwards into the ground before coming to rest. The mass of P is 4 kg and the ground is assumed to exert a constant resistive force of magnitude 5000 N on P .
- (c) Find the vertical distance that P sinks into the ground before coming to rest. (4)

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3.

5. A stone is projected vertically upwards from a point A with speed $u \text{ m s}^{-1}$. After projection the stone moves freely under gravity until it returns to A . The time between the instant that the stone is projected and the instant that it returns to A is $3\frac{4}{7}$ seconds.

Modelling the stone as a particle,

(a) show that $u = 17\frac{1}{2}$, (3)

(b) find the greatest height above A reached by the stone, (2)

(c) find the length of time for which the stone is at least $6\frac{3}{5}$ m above A . (6)

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4.

1. At time $t = 0$ a ball is projected vertically upwards from a point O and rises to a maximum height of 40 m above O . The ball is modelled as a particle moving freely under gravity.

(a) Show that the speed of projection is 28 m s^{-1} . (3)

(b) Find the times, in seconds, when the ball is 33.6 m above O . (5)

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5.

2. A ball is thrown vertically upwards with speed $u \text{ m s}^{-1}$ from a point P at height h metres above the ground. The ball hits the ground 0.75 s later. The speed of the ball immediately before it hits the ground is 6.45 m s^{-1} . The ball is modelled as a particle.

(a) Show that $u = 0.9$. (3)

(b) Find the height above P to which the ball rises before it starts to fall towards the ground again. (2)

(c) Find the value of h . (3)

6.

6. A ball is projected vertically upwards with a speed of 14.7 m s^{-1} from a point which is 49 m above horizontal ground. Modelling the ball as a particle moving freely under gravity, find

(a) the greatest height, above the ground, reached by the ball, (4)

(b) the speed with which the ball first strikes the ground, (3)

(c) the total time from when the ball is projected to when it first strikes the ground. (3)