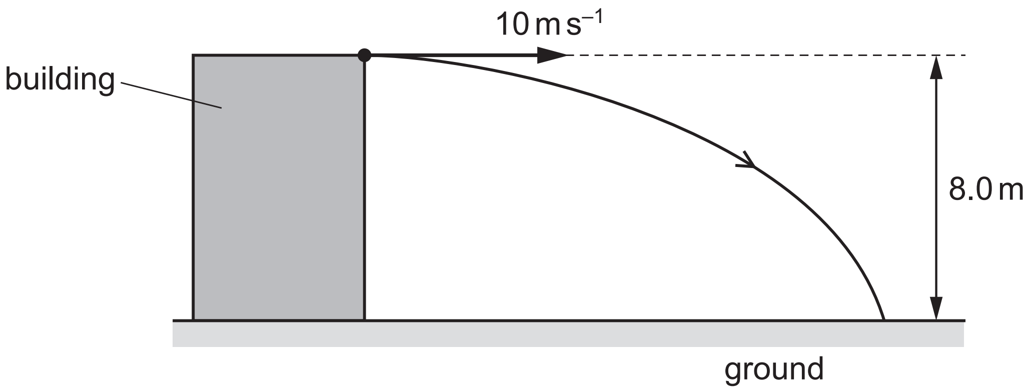
5 A projectile is launched at an angle of 25° to the horizontal with a horizontal component of velocity of $13\,\mathrm{m\,s^{-1}}$.

What is the vertical component of the velocity of the projectile when it is launched?

A $5.5\,\mathrm{m\,s^{-1}}$ **B** $6.1\,\mathrm{m\,s^{-1}}$ **C** $12\,\mathrm{m\,s^{-1}}$ **D** $14\,\mathrm{m\,s^{-1}}$

A-Level Physics: **w24 13**

4 A boy throws a stone with a horizontal velocity of $10\,\mathrm{m\,s^{-1}}$ from the top of a building. The height of the building is 8.0 m. The stone travels along a curved path until it hits the horizontal ground, as shown.



Air resistance is negligible.

How long does it take the stone to reach the ground?

A 0.61 s **B** 0.80 s **C** 1.3 s **D** 1.6 s

A-Level Physics: **s22 11**

6 A ball is thrown horizontally with a speed of $10.0\,\mathrm{m\,s^{-1}}$ above horizontal ground. The ball hits the ground after a time of 3.0 s.

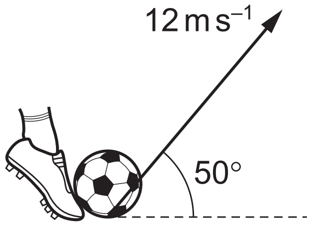
Air resistance is negligible.

What is the speed of the ball just before it hits the ground?

A $10\,\mathrm{m\,s^{-1}}$ **B** $29\,\mathrm{m\,s^{-1}}$ **C** $31\,\mathrm{m\,s^{-1}}$ **D** $39\,\mathrm{m\,s^{-1}}$

6 A ball is kicked so that it has an initial velocity of $12\,\mathrm{m\,s^{-1}}$ at an angle of 50° to horizontal ground.

Assume that air resistance is negligible.

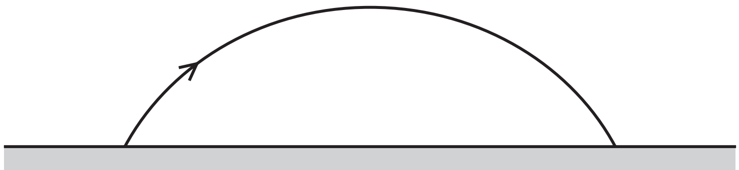


What is the maximum height above the ground that is reached by the ball?

A 0.47 m **B** 3.0 m **C** 4.3 m **D** 7.3 m

A-Level Physics: **s24 11**

7 The diagram shows the path of a golf ball.



Which row describes changes in the horizontal and vertical components of the golf ball's velocity when air resistance is ignored?

	horizontal	vertical
A	constant deceleration	constant acceleration downwards
B	constant deceleration	acceleration decreases upwards then increases downwards
C	constant velocity	constant acceleration downwards
D	constant velocity	acceleration decreases upwards then increases downwards

A-Level Physics: **w24 12**

6 A ball is thrown horizontally off a tall building. The ground is horizontal. Air resistance is negligible.

Which statement about the motion of the ball is correct?

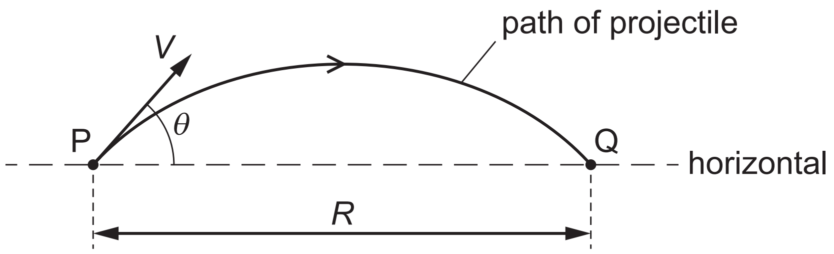
A The acceleration of the ball is always at right angles to the path of the ball.

B The ball follows a circular path until it hits the ground.

C The ball has constant acceleration.

D The ball's time in the air is proportional to the velocity at which the ball is thrown.

6 A projectile is fired from point P with velocity V at an angle θ to the horizontal. It lands at point Q, a horizontal distance R from P, after time T.



The acceleration of free fall is g. Air resistance is negligible.

Which equation is correct?

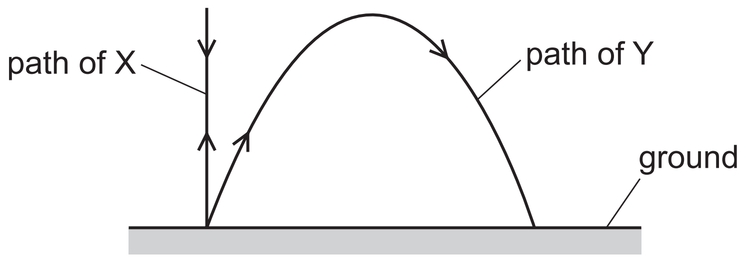
A $R = VT\cos\theta$

B $R = VT\sin\theta$

C $R = VT\cos\theta - \frac{1}{2}gT^2$

D $R = VT\sin\theta - \frac{1}{2}gT^2$

6 Two projectiles, X and Y, are fired into the air from the same place on level ground and reach the same maximum height, as shown.



Projectile X is fired vertically upwards and projectile Y is fired at an angle to the horizontal.

Air resistance is negligible.

Which statement is correct?

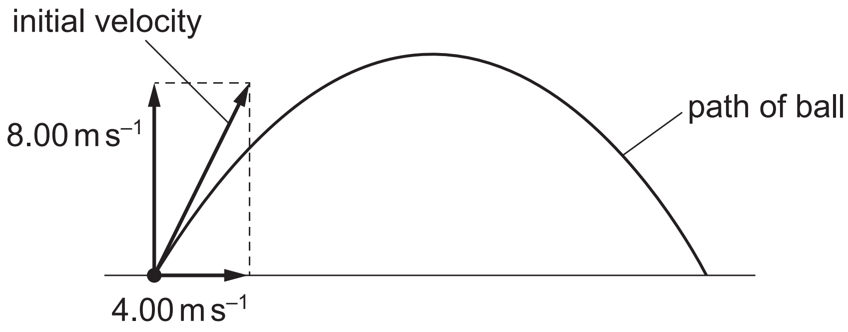
A X and Y are at rest at their maximum heights.

B X and Y are fired with the same speed.

C X and Y take the same time to return to the ground.

D X and Y travel the same distance.

6 An astronaut on the Moon, where there is no air resistance, throws a ball. The ball's initial velocity has a vertical component of $8.00\,\text{m}\,\text{s}^{-1}$ and a horizontal component of $4.00\,\text{m}\,\text{s}^{-1}$, as shown.

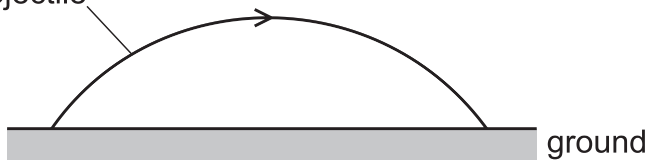


The acceleration of free fall on the Moon is $1.62\,\text{m}\,\text{s}^{-2}$.

What is the speed of the ball 9.00 s after being thrown?

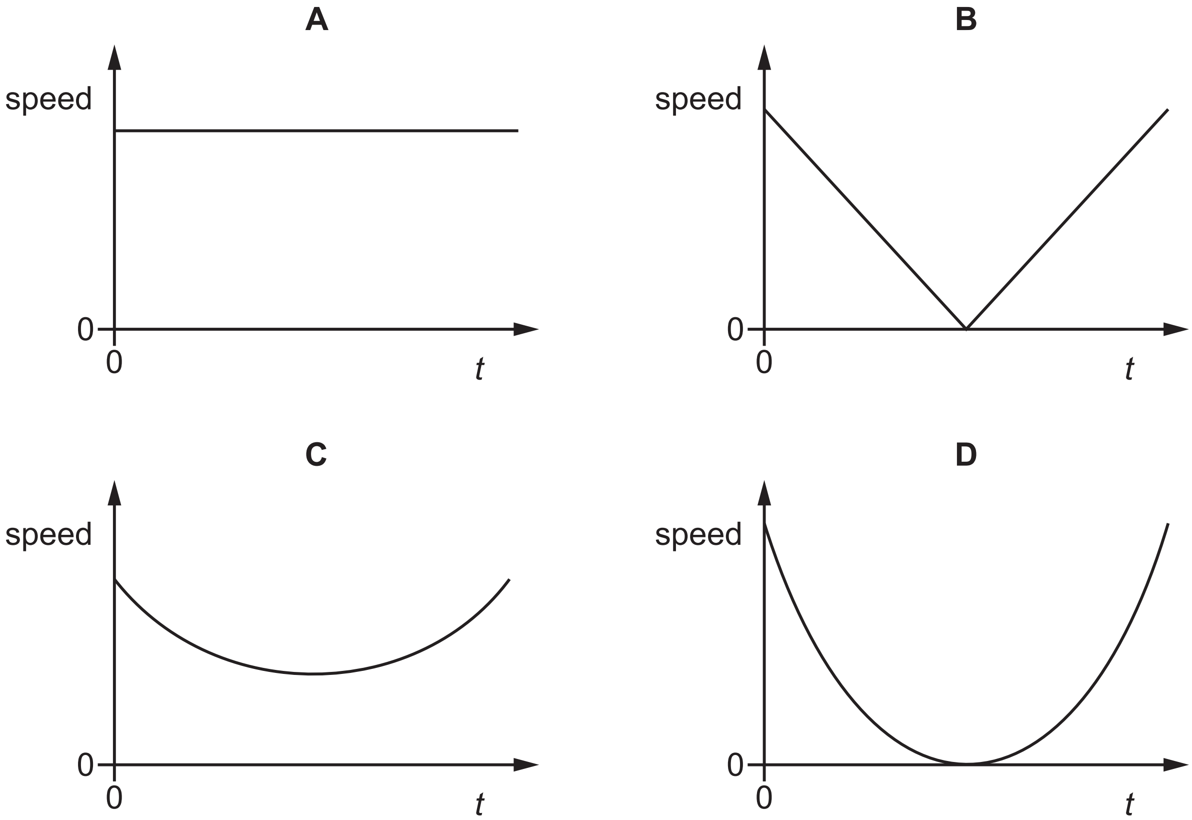
A $6.58\,\text{m}\,\text{s}^{-1}$ **B** $7.70\,\text{m}\,\text{s}^{-1}$ **C** $10.6\,\text{m}\,\text{s}^{-1}$ **D** $14.6\,\text{m}\,\text{s}^{-1}$

6 A projectile is launched at an angle to the horizontal at time $t = 0$. It travels over horizontal ground, as shown.



Air resistance is negligible.

Which graph best shows the variation with t of the speed of the projectile from when it is launched to when it lands on the ground?



2 Water leaves the end of a hose pipe at point P with a horizontal velocity of $6.6\,m\,s^{-1}$, as shown in Fig. 2.1.

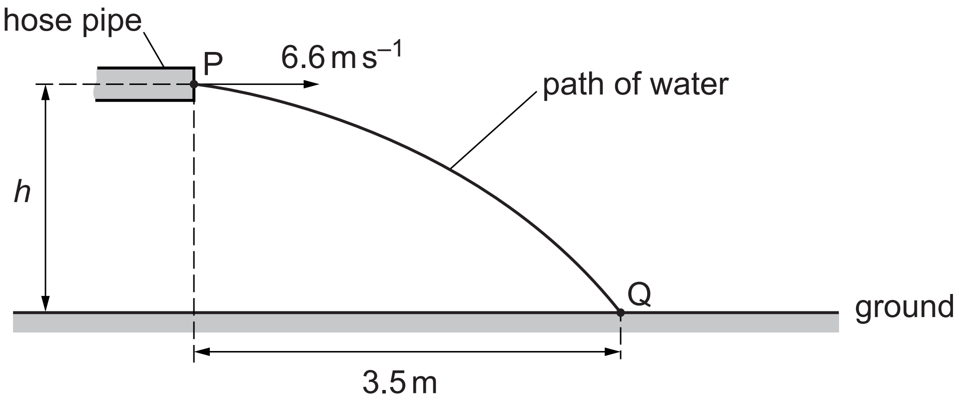


Fig. 2.1 (not to scale)

Point P is at height h above the ground. The water hits the ground at point Q. The horizontal distance from P to Q is 3.5 m.

Air resistance is negligible. Assume that the water between P and Q consists of non-interacting droplets of water and that the only force acting on each droplet is its weight.

(a) Explain, briefly, why the horizontal component of the velocity of a droplet of water remains constant as it moves from P to Q.

....

.... [1]

(b) Show that the time taken for a droplet of water to move from P to Q is 0.53 s.

[1]

(c) Calculate height h.

h = ... m [2]

(d) For the movement of a droplet of water from P to Q, state and explain whether the displacement of the droplet is less than, more than or the same as the distance along its path.

....

....

.... [1]

(e) Calculate the magnitude of the displacement of a droplet of water that moves from P to Q.

displacement = ... m [2]

[Total: 7]

2 A steel ball is projected horizontally from the top of a table, as shown in Fig. 2.1.

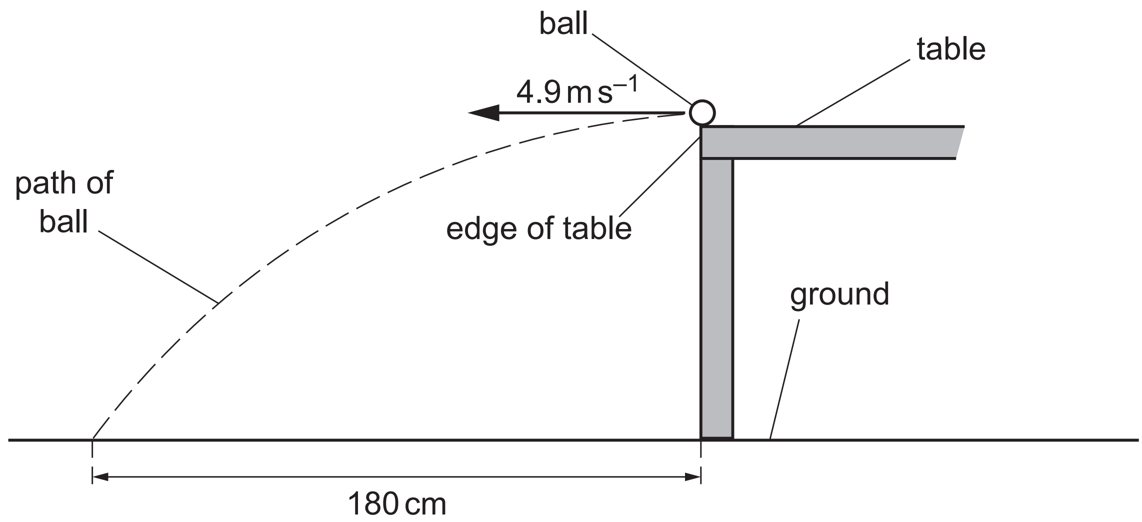


Fig. 2.1 (not to scale)

The ball is projected horizontally at a speed of 4.9 m s^{-1}. The ball lands on the ground a horizontal distance of 180 cm from the edge of the table.

Assume that air resistance is negligible.

(a) **(i)** Calculate the time taken for the ball to reach the ground.

time = ... s [1]

(ii) Calculate the vertical component of the velocity of the ball as it hits the ground.

velocity = ... m s^{-1} [2]

(iii) Determine the magnitude and the angle to the horizontal of the velocity of the ball as it hits the ground.

magnitude of velocity = ... $m\,s^{-1}$

angle to the horizontal = ... °

[3]

The variation with compression x of the applied force F for the spring is shown in Fig. 2.4.

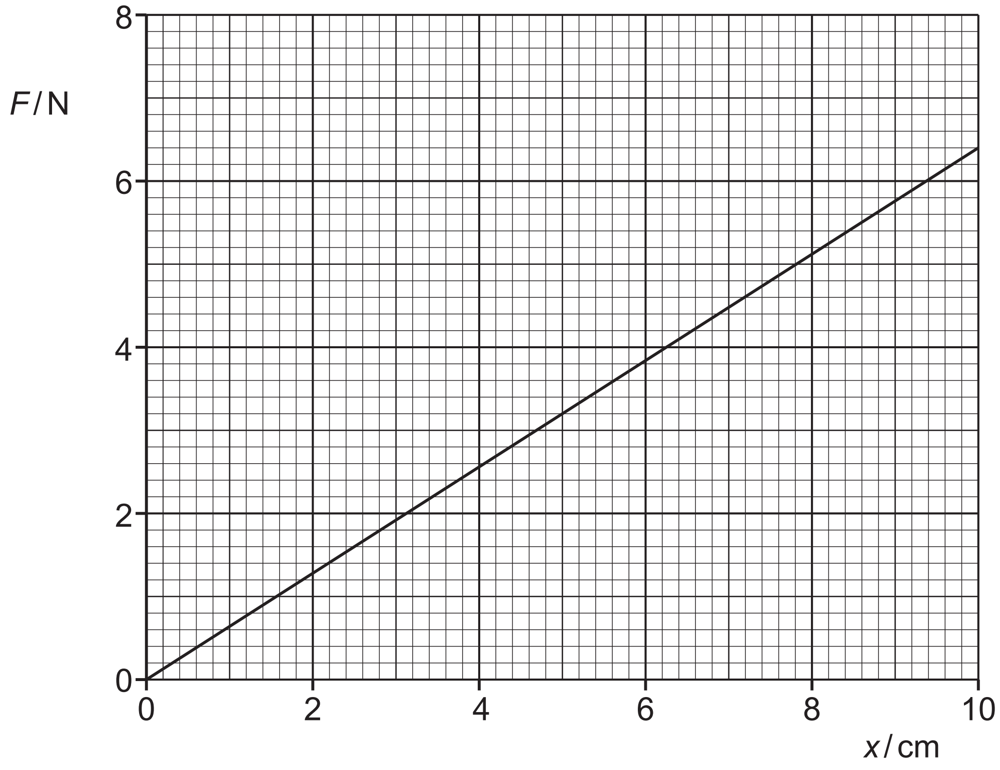


Fig. 2.4

The ball is a uniform sphere of steel of diameter 0.016 m and mass 0.017 kg.

(i) Calculate the density of the steel.

density = ... $kg\,m^{-3}$ [3]

(ii) All of the elastic potential energy in the spring is converted into kinetic energy of the ball. The speed of the ball as it leaves the spring is $4.9\,m\,s^{-1}$.

Show that the maximum elastic potential energy of the spring is 0.20 J.

[2]

(iii) Use Fig. 2.4 to determine the spring constant *k* of the spring.

k = ... $\mathrm{N\,m^{-1}}$ [2]

(iv) Use your answer in **(b)(iii)** and the value of energy given in **(b)(ii)** to determine the compression x_0 of the spring.

x_0 = ... m [2]