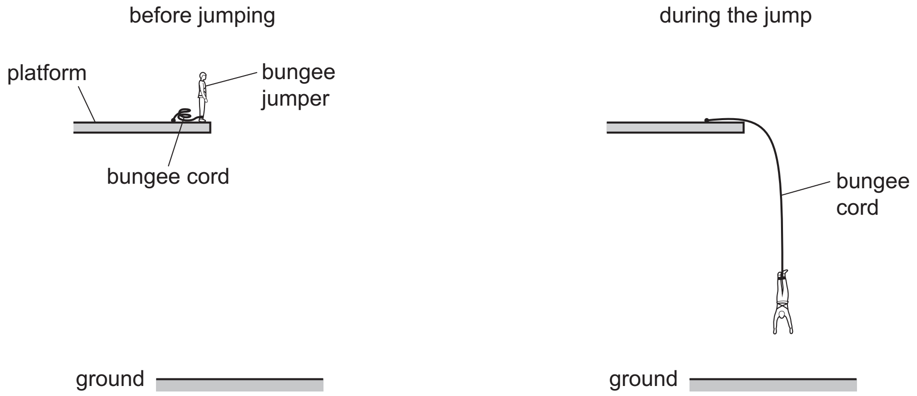
17 An object with a mass of 100 g falls a vertical distance of 10 m.

What is the change in the gravitational potential energy of the object?

A 1 J **B** 10 J **C** 100 J **D** 10 000 J

18 A bungee jumper jumps from a platform and is decelerated by an elastic bungee cord, as shown.



NOT TO SCALE

When the jumper makes the jump, his initial gravitational potential energy relative to the ground is converted into his kinetic energy and into elastic potential energy in the cord.

At which part of the jump are all three types of energy non-zero?

A on the platform before the jump

B on the way down before the cord has started to extend

C on the way down as he decelerates

D at the bottom of the jump when he is stationary

A-Level Physics: **w25 12**

17 A student attempts to derive the formula for kinetic energy E_K. She begins by considering an object of mass m that is initially at rest. A constant force F applied to the object causes it to accelerate to final velocity v in displacement s. The kinetic energy gained by the object is equal to the work done on the object by the force F.

Which equation does the student **not** need in order to derive the formula for E_K?

A $F = ma$ **B** $W = Fs$ **C** $E = \frac{1}{2}Fs$ **D** $v^2 = u^2 + 2as$

A-Level Physics: **w25 12**

18 A ball falls towards the ground from point X. Point X is 2.4 m above the ground.

The ball rebounds from the ground and rises to point Y. Point Y is 1.8 m above the ground.

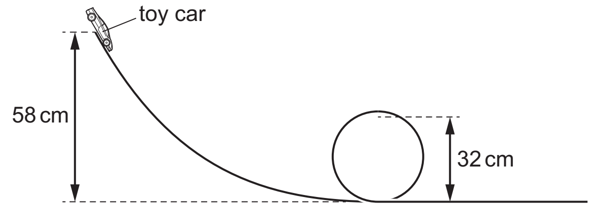
A single value of the change in height Δh is used to calculate the change in gravitational potential energy of the ball from X to Y.

What is the magnitude of Δh?

A 0.6 m **B** 1.8 m **C** 2.4 m **D** 4.2 m

A-Level Physics: **w25 14**

17 A toy car travels around a vertical loop track.



The toy car is released from rest at a height of 58 cm above the bottom of the vertical loop.

The car is at a height of 32 cm when it is at the top of the vertical loop.

Assume that no resistive forces act on the car.

What is the speed of the car at the top of the vertical loop?

A $0.87\,\text{m s}^{-1}$ **B** $2.3\,\text{m s}^{-1}$ **C** $2.5\,\text{m s}^{-1}$ **D** $3.4\,\text{m s}^{-1}$

19 An object travels between two points. The change in gravitational potential energy ΔE_p of the object is given by

$$\Delta E_p = mg\Delta h$$

where m is the mass of the object, Δh is its change in height and g is the acceleration of free fall.

What is a necessary condition in order for the above equation to be valid?

A The object must have a constant acceleration of $9.81\,\text{m s}^{-2}$.

B The object must be travelling in a uniform gravitational field.

C The object must be travelling only in a vertical direction.

D The resultant force on the object must be equal to its weight.

17 An object is falling in a uniform gravitational field.

Which two quantities are sufficient to calculate the change in gravitational potential energy?

A mass and acceleration of free fall

B mass and change in vertical displacement

C weight and acceleration of free fall

D weight and change in vertical displacement

A-Level Physics: **s25 12**

18 A ball of mass 1.2 kg travels horizontally at a speed of $3.0\,\mathrm{m\,s^{-1}}$.

The ball hits a cushion and comes to rest over a horizontal distance of 0.020 m.

What is the work done by the cushion on the ball to bring the ball to rest?

A 0.24 J **B** 1.8 J **C** 5.4 J **D** 11 J

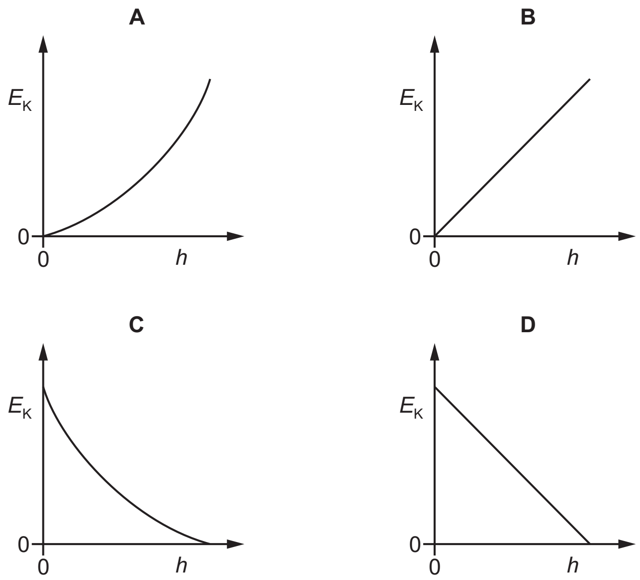
A-Level Physics: **s25 13**

18 A ball is released from rest and falls vertically to the ground.

The kinetic energy E_K of the ball varies as the height h of the ball above the ground changes.

Air resistance is negligible.

Which graph shows the variation of E_K with h?



A-Level Physics: **s25 13**

19 An object travelling with a speed of $10\,\mathrm{m\,s^{-1}}$ has kinetic energy of 1500 J.

The speed of the object is increased to $40\,\mathrm{m\,s^{-1}}$.

What is the new kinetic energy of the object?

A 4500 J **B** 6000 J **C** 24 000 J **D** 1 350 000 J

3 The lower end of a vertical spring is fixed to a horizontal surface, as shown in Fig. 3.1.

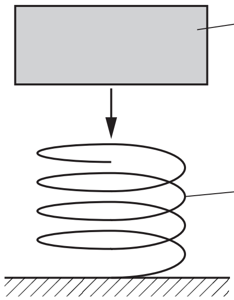


Fig. 3.1

The mass of the spring is negligible. A block of mass 5.5 kg drops vertically onto the spring and is brought to rest as the spring is compressed.

(a) The block has kinetic energy 110 J as it makes contact with the spring.

Calculate the speed of the block as it makes contact with the spring.

speed = ... $m\,s^{-1}$ [2]

(b) The gravitational potential energy of the block decreases by 20 J as the spring is compressed to its maximum compression x_0.

Show that x_0 is 0.37 m.

[2]

(c) Assume that, as the spring compresses, all of the energy lost by the block is converted into the elastic potential energy of the spring.

Use the data from **(a)** and **(b)** to determine the maximum elastic potential energy of the spring.

Show your working.

maximum elastic potential energy = ... J [1]

(d) The variation of the force F acting on the spring with the compression x of the spring is shown in Fig. 3.2.

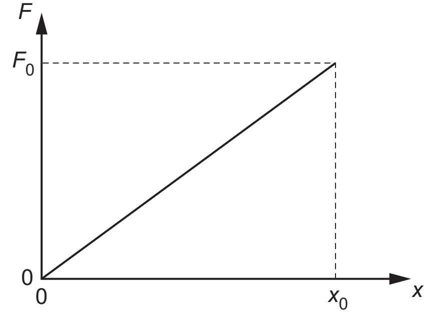


Fig. 3.2

Use the information in **(b)** and your answer in **(c)** to show that the maximum force F_0 exerted on the spring by the block is 700 N.

[2]

(e) Use the information in **(d)** to determine, for the instant that the block is first brought to rest by the spring, the magnitude of:

(i) the resultant force acting on the block

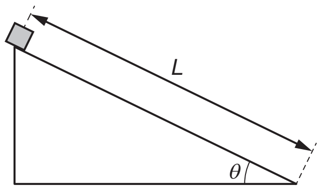
resultant force = ... N [2]

(ii) the acceleration of the block.

acceleration = ... $m\,s^{-2}$ [2]

[Total: 11]

15 A block is released from rest at the top of a slope inclined at an angle to the horizontal. The slope has length L as shown in the diagram.



There are no resistive forces acting on the block.

What is the speed of the block at the bottom of the slope?

A $4.43\sqrt{L\cos\theta}$ **B** $4.43\sqrt{L\sin\theta}$ **C** $19.6L\cos\theta$ **D** $19.6L\sin\theta$