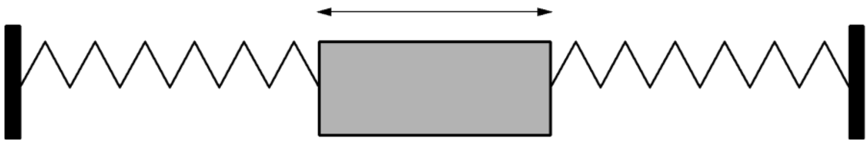
27 A mass *M* oscillates in simple harmonic motion between two fixed supports. Frictional effects can be ignored. The time period of the oscillation is T_1.



The mass is replaced with a mass of 4 M **and** the amplitude of the oscillation is doubled. The new time period is T_2.

Which is the correct statement?

A $T_2 = 4\ T_1$

B $T_2 = 2\ T_1$

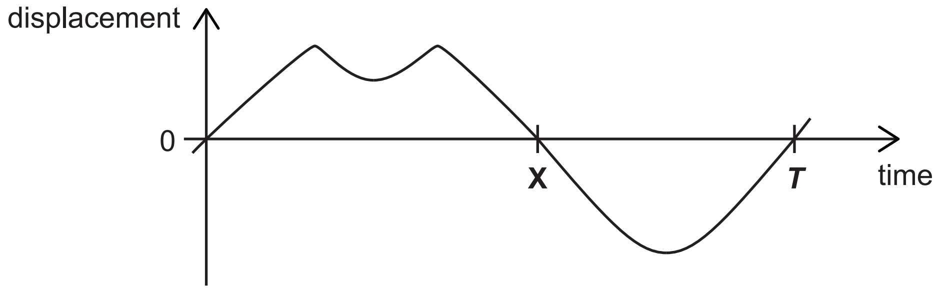
C $T_2 = T_1$

D $T_2 = ½\ T_1$

Your answer ☐

[1]

9 The graph shows the displacement of a body which is oscillating periodically with time period ***T***.



Which statement is correct?

A The acceleration is zero at time **X**.

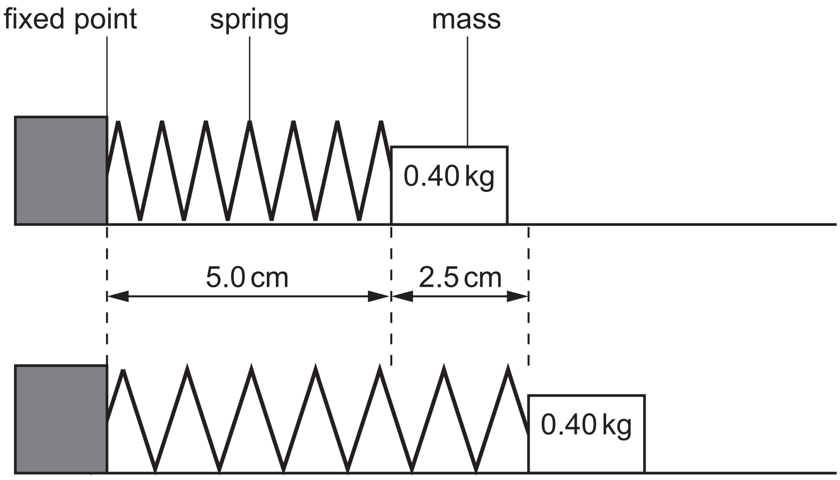
B The body is performing simple harmonic motion.

C In each cycle the velocity is zero three times.

D The body changes direction at **X**.

Your answer ☐ **[1]**

10 The spring in this diagram has a spring constant of $20\,\mathrm{N\,m^{-1}}$.
The mass is pulled away from the fixed point. The spring stretches by 2.5 cm.
The mass is then released.



What is the maximum speed reached by the mass?

A $0.18\,\mathrm{m\,s^{-1}}$

B $0.53\,\mathrm{m\,s^{-1}}$

C $1.25\,\mathrm{m\,s^{-1}}$

D $3.75\,\mathrm{m\,s^{-1}}$

Your answer **[1]**

11 An electron is travelling at a speed of $3.1 \times 10^5\,\mathrm{m\,s^{-1}}$.

What is its kinetic energy in electronvolts?

A $4.4 \times 10^{-20}\,\mathrm{eV}$

B $8.8 \times 10^{-7}\,\mathrm{eV}$

C 0.27 eV

D 500 eV

Your answer **[1]**

38 **Fig. 38.1** shows a displacement *s* against time *t* graph for the motion of a swing in simple harmonic motion.

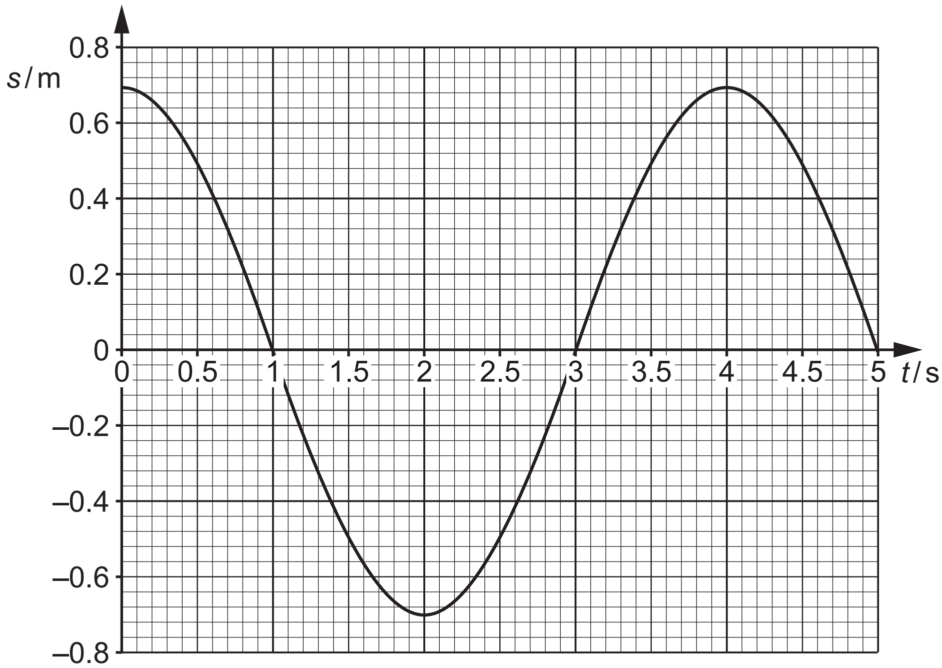


Fig. 38.1

(a) Use **Fig. 38.1** to find the magnitude of the maximum velocity of the swing. Make your method clear.

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

(b) On **Fig. 38.2** scale the *y*-axis suitably and draw the velocity *v* against time *t* graph for this motion.

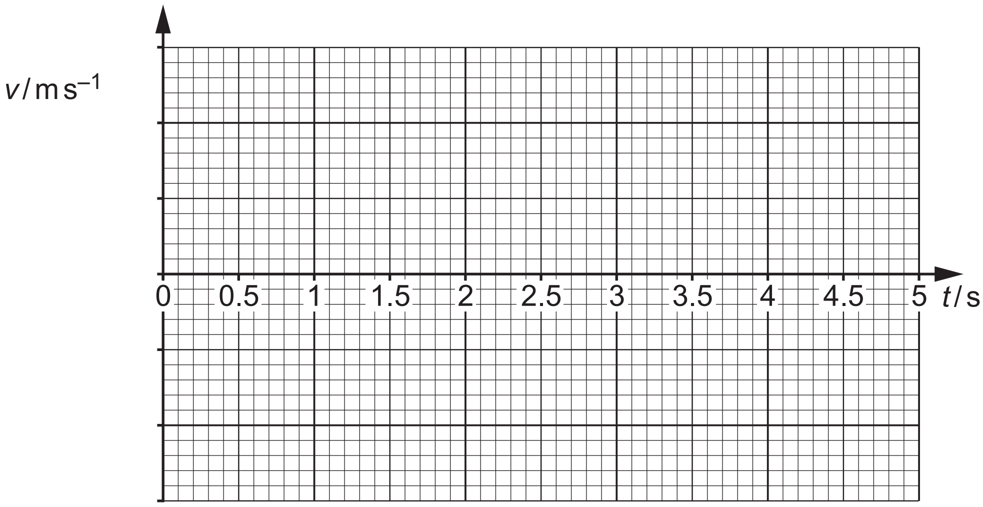


Fig. 38.2

[2]

(c) Show that the length of the simple pendulum having the same time period as the swing in **Fig. 38.1** is less than 4.0 m.

[2]

2 This question is about the behaviour of a mass on a spring.

(a) The table below shows how the extension *x* of a spring varies as the mass *m* suspended vertically from it alters.

***m* / g**	***x* / cm**
100	2.5
200	5.1
300	7.5
400	9.9
500	12.5
600	15.0

Fig. 2.1

(i) Apply a test to the data to see if the extension of the spring is proportional to the applied force. Explain your method and state your conclusion.

[3]

(ii) Calculate the spring constant *k* of this spring.
$g = 9.8\,N\,kg^{-1}$

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

(b) In order to investigate the behaviour of an oscillating mass and spring system, the spring is suspended vertically below a vibration generator. A mass is added to the bottom of the spring. The arrangement is suspended above an ultrasound distance sensor as shown in Fig. 2.2.

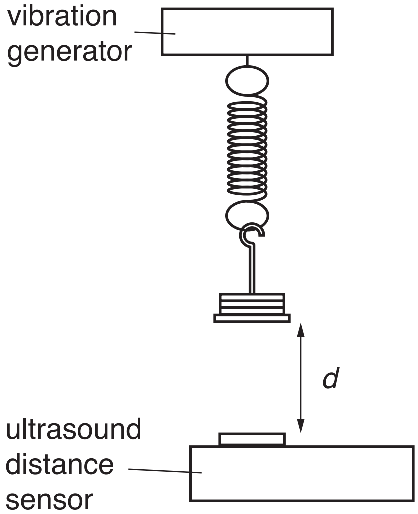


Fig. 2.2

With the vibration generator switched off, the mass is given a small vertical displacement then released. A few oscillations later the ultrasound distance sensor is started and the trace shown in Fig. 2.3 is displayed on a computer.

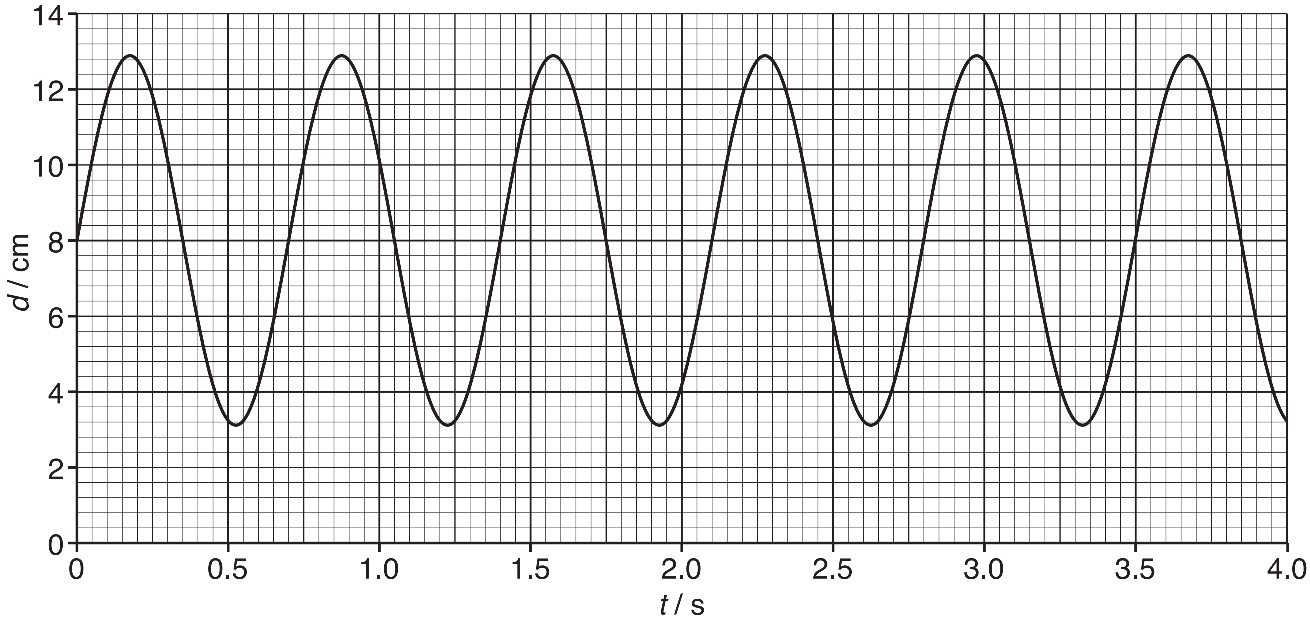


Fig. 2.3

(i) Mark **two** points on the curve shown in Fig. 2.3, to indicate where the speed of the oscillating mass is at its maximum. Label each point with a letter **V**. **[1]**

(ii) Use data from the trace shown in Fig. 2.3 to calculate the natural frequency *f* of the mass and spring system.

f = ... Hz **[2]**

(iii) Show that the mass *m* supported by the spring is about 500 g.

[2]

(c)* By connecting the vibration generator to a signal generator it is possible to use this apparatus to investigate forced oscillations of the mass and spring system. Describe in as much detail as possible how you would carry out the investigation, the data that you would record and what you would expect the results to show.

.... **[6]**