1 **(a)** Underline **all** the base quantities in the following list.

ampere charge current mass second temperature weight [2]

(b) The potential energy E_P stored in a stretched wire is given by

$$E_P = \tfrac{1}{2}C\sigma^2 V$$

where C is a constant,
σ is the strain,
V is the volume of the wire.

Determine the SI base units of C.

base units .....[3]

2 **(a)** Explain what is meant by a *scalar* quantity and by a *vector* quantity.

scalar: .....

.....

vector: .....

.....

[2]

(b) A ball leaves point P at the top of a cliff with a horizontal velocity of $15\,m\,s^{-1}$, as shown in Fig. 2.1.

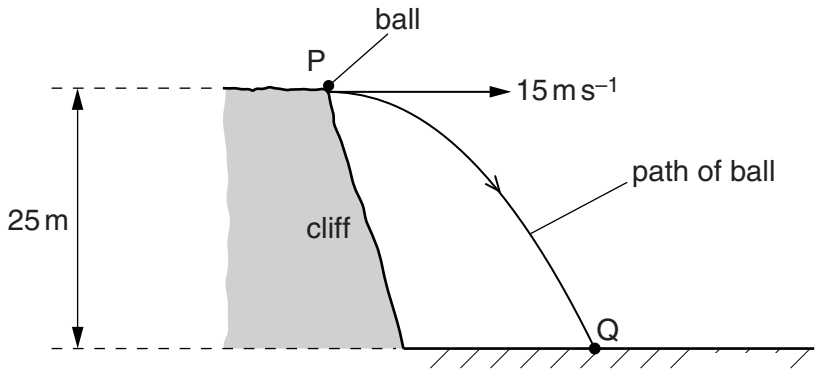

Fig. 2.1

The height of the cliff is 25 m. The ball hits the ground at point Q.
Air resistance is negligible.

(i) Calculate the vertical velocity of the ball just before it makes impact with the ground at Q.

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

(ii) Show that the time taken for the ball to fall to the ground is 2.3 s.

[1]

(iii) Calculate the magnitude of the displacement of the ball at point Q from point P.

displacement = ... m [4]

(iv) Explain why the distance travelled by the ball is different from the magnitude of the displacement of the ball.

.....

.....

.....[2]

3 **(a)** Explain what is meant by *work done*.

.....

.....[1]

(b) A boy on a board B slides down a slope, as shown in Fig. 3.1.

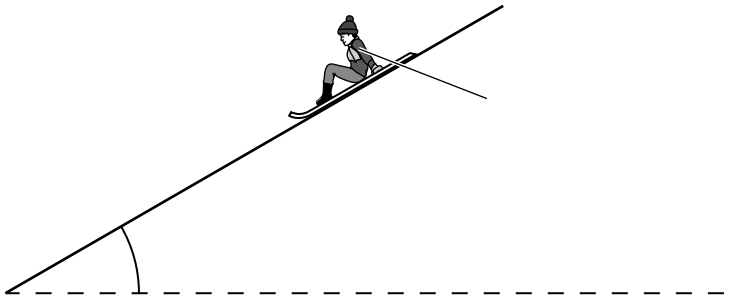

Fig. 3.1

The angle of the slope to the horizontal is 30°. The total resistive force F acting on B is constant.

(i) State a word equation that links the work done by the force F on B to the changes in potential and kinetic energy.

.....

.....[1]

(ii) The boy on the board B moves with velocity v down the slope. The variation with time t of v is shown in Fig. 3.2.

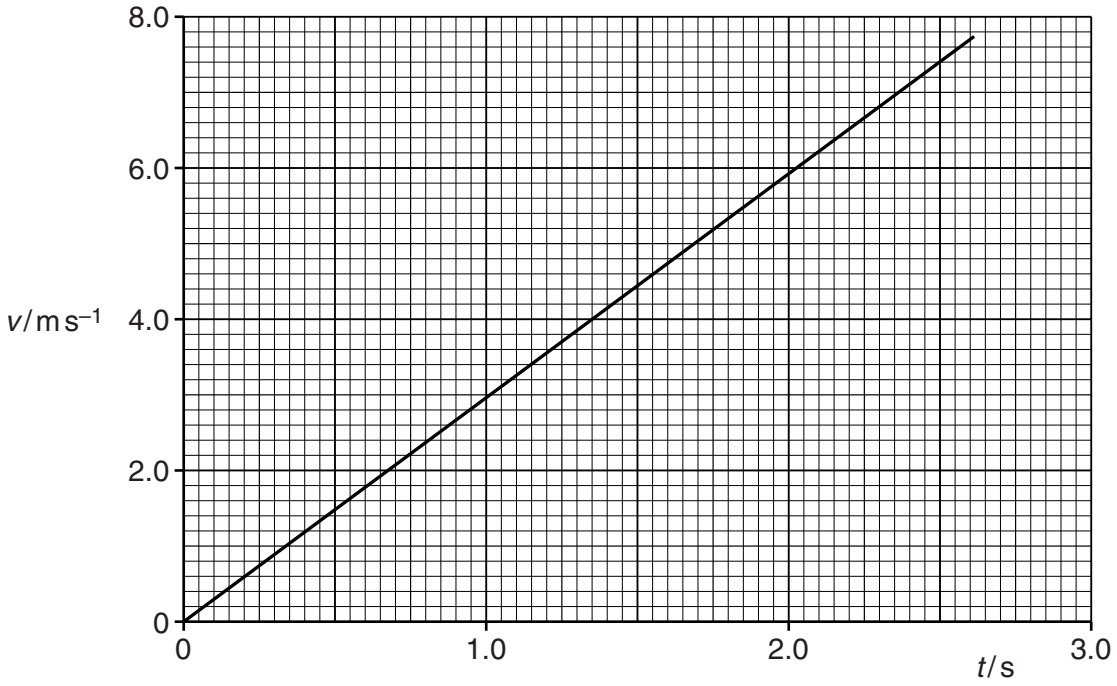

Fig. 3.2

The total mass of B is 75 kg.
B, from $t = 0$ to $t = 2.5$ s,

1. show that the distance moved down the slope is 9.3 m,

[2]

2. calculate the gain in kinetic energy,

gain in kinetic energy = ... J [3]

3. calculate the loss in potential energy,

loss in potential energy = ... J [3]

4. calculate the resistive force F.

F = ... N [3]

4 A spring hangs vertically from a point P, as shown in Fig. 4.1.

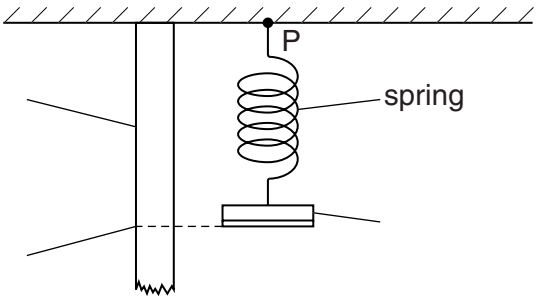

Fig. 4.1

A mass *M* is attached to the lower end of the spring. The reading *x* from the metre rule is taken, as shown in Fig. 4.1. Fig. 4.2 shows the relationship between *x* and *M*.

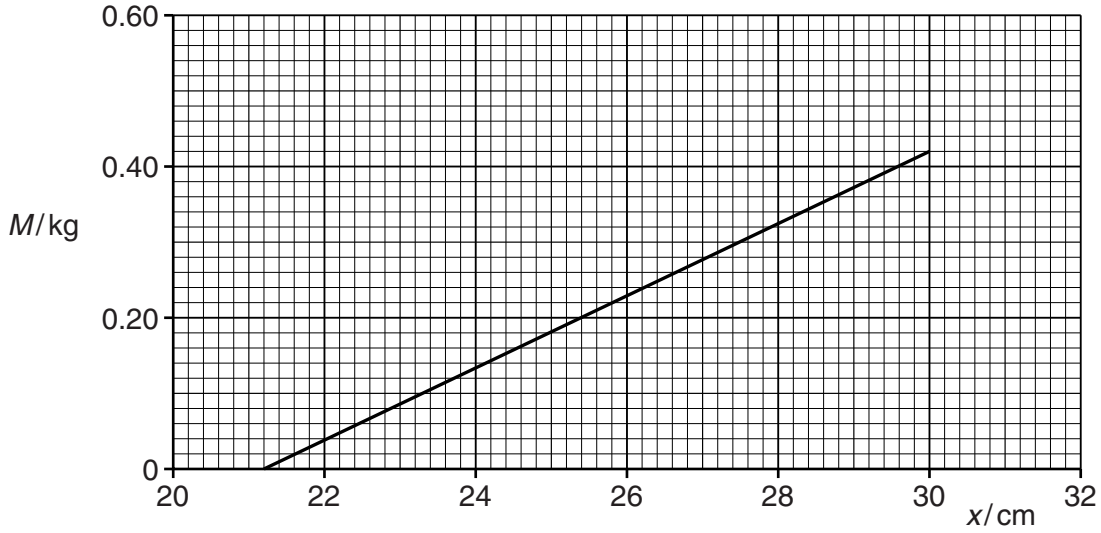

Fig. 4.2

(a) Explain how the apparatus in Fig. 4.1 may be used to determine the load on the spring at the elastic limit.

.....

.....

.....

.....[2]

(b) State and explain whether Fig. 4.2 suggests that the spring obeys Hooke's law.

.....

.....

.....[2]

(c) Fig. 4.2 to determine the spring constant, in $N\,m^{-1}$, of the spring.

spring constant = ... $N\,m^{-1}$ [3]

5 **(a)** Explain why the terminal potential difference (p.d.) of a cell with internal resistance may be less than the electromotive force (e.m.f.) of the cell.

.....

.....

.....[2]

(b) A battery of e.m.f. 4.5 V and internal resistance r is connected in series with a resistor of resistance 6.0 Ω, as shown in Fig. 5.1.

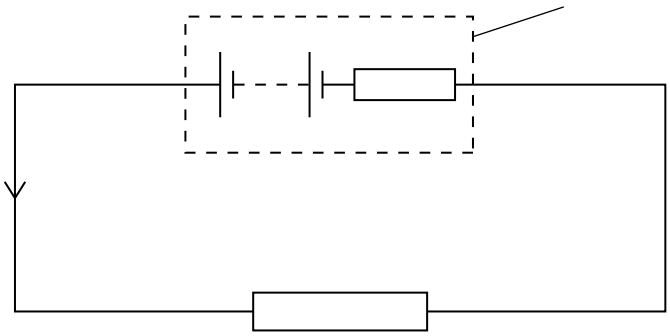

Fig. 5.1

The current I in the circuit is 0.65 A.

Determine

(i) the internal resistance r of the battery,

r = ... Ω [2]

(ii) the terminal p.d. of the battery,

p.d. = ... V [2]

(iii) the power dissipated in the resistor,

power = ... W [2]

(iv) the efficiency of the battery.

efficiency = ... [2]

(c) A second resistor of resistance 20 Ω is connected in parallel with the 6.0 Ω resistor in Fig. 5.1.

Describe and explain qualitatively the change in the heating effect within the battery.

.....

.....

.....

.....[3]

6 A hollow tube is used to investigate stationary waves. The tube is closed at one end and open at the other end. A loudspeaker connected to a signal generator is placed near the open end of the tube, as shown in Fig. 6.1.

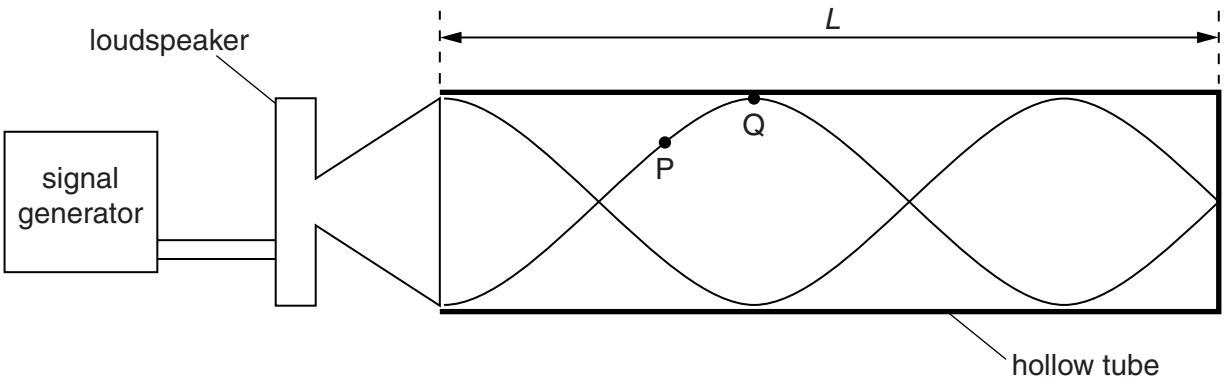

Fig. 6.1

The tube has length *L*. The frequency of the signal generator is adjusted so that the loudspeaker produces a progressive wave of frequency 440 Hz. A stationary wave is formed in the tube. A representation of this stationary wave is shown in Fig. 6.1.
Two points P and Q on the stationary wave are labelled.

(a) (i) Describe, in terms of energy transfer, the difference between a progressive wave and a stationary wave.

.....

.....[1]

(ii) Explain how the stationary wave is formed in the tube.

.....

.....

.....

.....[3]

(iii) State the direction of the oscillations of an air particle at point P.

.....

.....[1]

(b) On Fig. 6.1 label, with the letter N, the nodes of the stationary wave. [1]

(c) State the phase difference between points P and Q on the stationary wave.

phase difference = ... [1]

(d) The speed of sound in the tube is $330\,m\,s^{-1}$.

Calculate

(i) the wavelength of the sound wave,

wavelength = ... m [2]

(ii) the length *L* of the tube.

length = ... m [2]