1 **(a)** the definition of work done to show that the SI base units of energy are $kg\,m^2\,s^{-2}$.

[2]

(b) Define potential difference.

.....

..... [1]

(c) Determine the SI base units of resistance. Show your working.

units ..... [3]

2 A stone is thrown vertically upwards. The variation with time t of the displacement s of the stone is shown in Fig. 2.1.

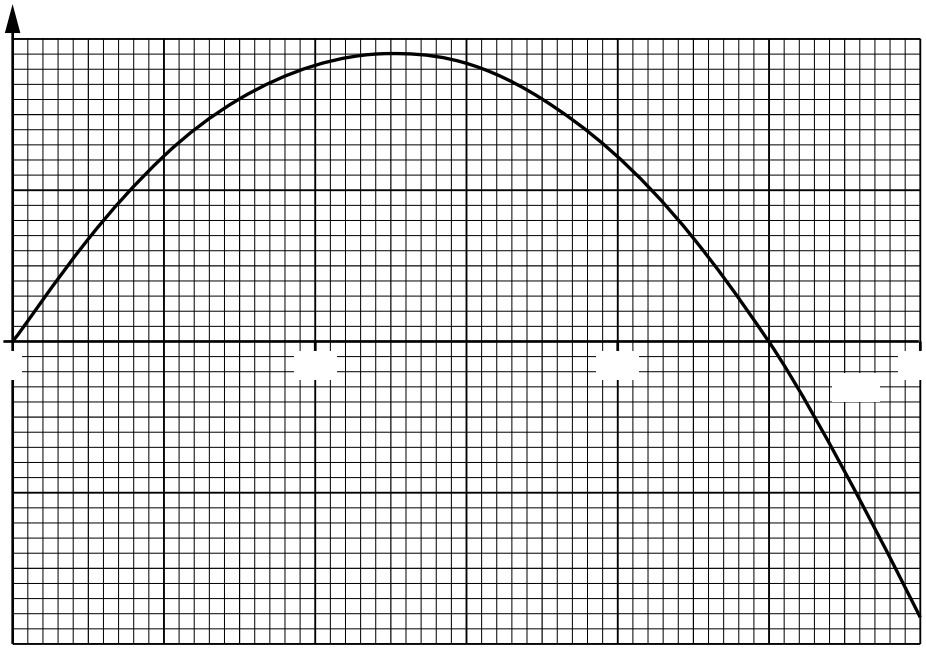

Fig. 2.1

(a) Fig. 2.1 to describe, without calculation, the speed of the stone from $t = 0$ to $t = 3.0\,s$.

.....

.....

..... [2]

(b) Assume air resistance is negligible and therefore the stone has constant acceleration.

Calculate, for the stone,

(i) the speed at 3.0 s,

speed = ... $m\,s^{-1}$ [3]

(ii) the distance travelled from $t = 0$ to $t = 3.0\,s$,

distance = ... m [3]

(iii) the displacement from $t = 0$ to $t = 3.0\,s$.

displacement = ... m

direction .....
[2]

(c) On Fig. 2.2, draw the variation with time t of the velocity v of the stone from $t = 0$ to $t = 3.0\,s$.

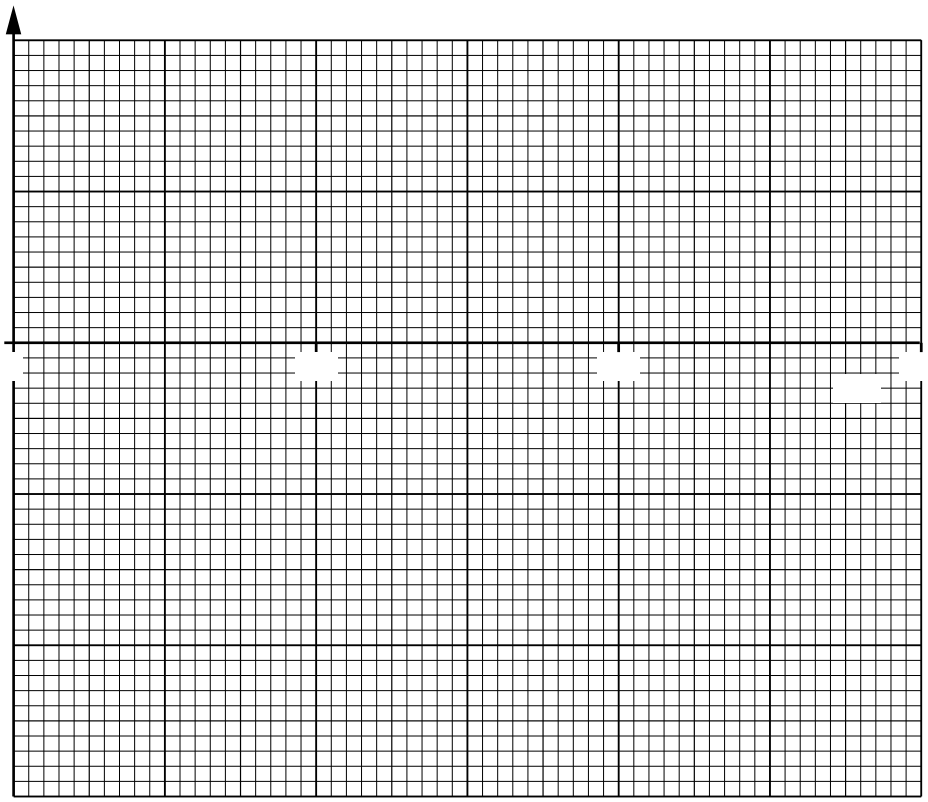

Fig. 2.2

[3]

3 A rod PQ is attached at P to a vertical wall, as shown in Fig. 3.1.

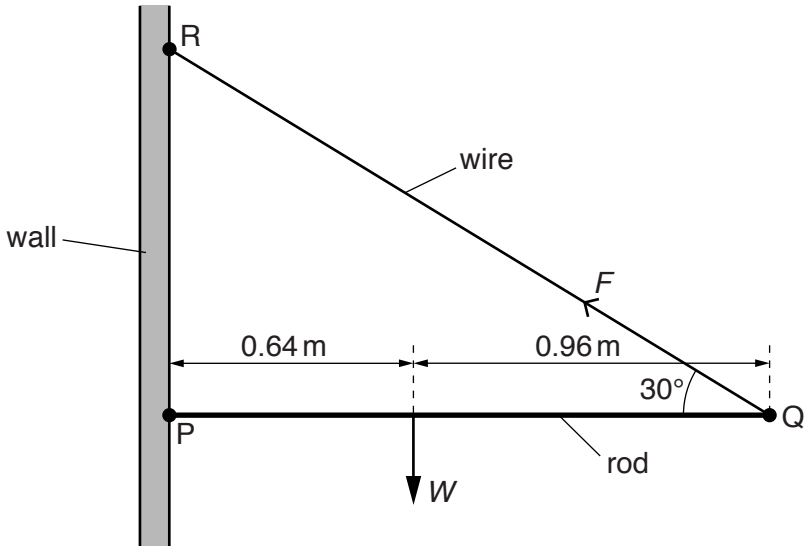

Fig. 3.1

The length of the rod is 1.60 m. The weight W of the rod acts 0.64 m from P. The rod is kept horizontal and in equilibrium by a wire attached to Q and to the wall at R. The wire provides a force F on the rod of 44 N at 30° to the horizontal.

(a) Determine

(i) the vertical component of F,

vertical component = ... N [1]

(ii) the horizontal component of F.

horizontal component = ... N [1]

(b) By taking moments about P, determine the weight W of the rod.

W = ... N [2]

(c) Explain why the wall must exert a force on the rod at P.

.....

.....

..... [1]

(d) On Fig. 3.1, draw an arrow to represent the force acting on the rod at P. Label your arrow with the letter S. [1]

4 **(a)** A gas molecule has a mass of 6.64×10^{-27} kg and a speed of $1250\,m\,s^{-1}$. The molecule collides normally with a flat surface and rebounds with the same speed, as shown in Fig. 4.1.

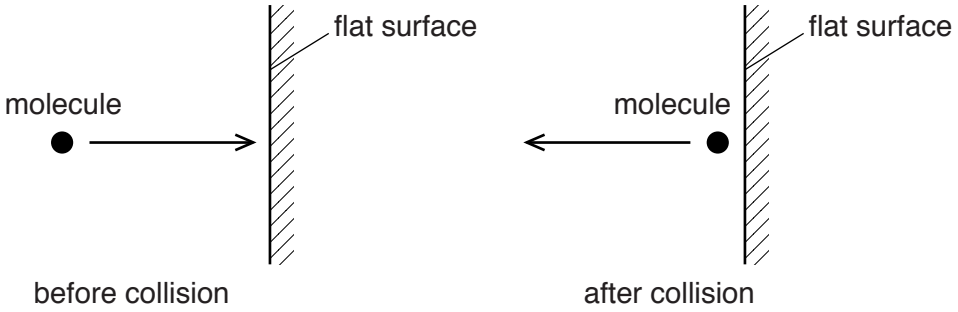

Fig. 4.1

Calculate the change in momentum of the molecule.

change in momentum = ... N s [2]

(b) **(i)** the kinetic model to explain the pressure exerted by gases.

.....

.....

.....

.....

.....

..... [3]

(ii) Explain the effect of an increase in density, at constant temperature, on the pressure of a gas.

.....

..... [1]

5 **(a)** On Fig. 5.1, sketch the temperature characteristic of a thermistor.

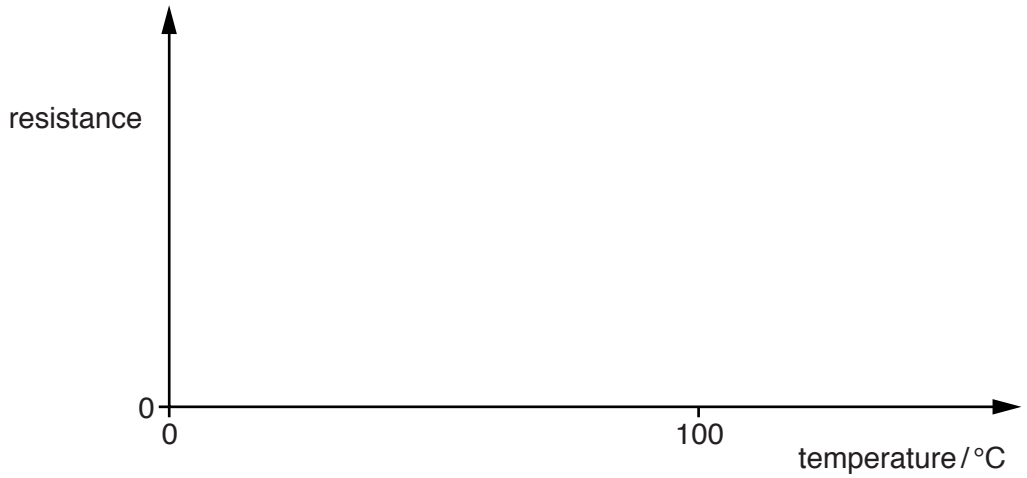

Fig. 5.1

[2]

(b) A potential divider circuit is shown in Fig. 5.2.

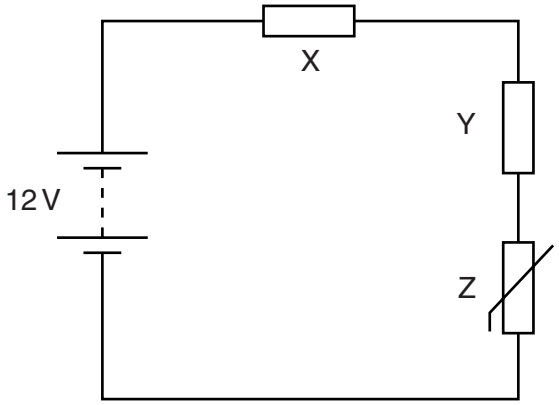

Fig. 5.2

The battery of electromotive force (e.m.f.) 12 V and negligible internal resistance is connected in series with resistors X and Y and thermistor Z. The resistance of Y is 15 kΩ and the resistance of Z at a particular temperature is 3.0 kΩ. The potential difference (p.d.) across Y is 8.0 V.

(i) Explain why the power transformed in the battery equals the total power transformed in X, Y and Z.

..... [1]

(ii) Calculate the current in the circuit.

current = ... A [2]

(iii) Calculate the resistance of X.

resistance = ... Ω [3]

(iv) The temperature of Z is increased.

State and explain the effect on the potential difference across Z.

.....

.....

.....

..... [2]

6 **(a)** State two differences between progressive waves and stationary waves.

1. .....

.....

2. .....

..... [2]

(b) A source S of microwaves is placed in front of a metal reflector R, as shown in Fig. 6.1.

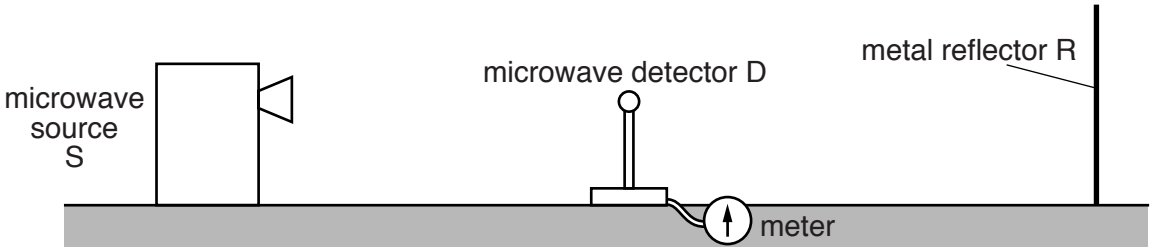

Fig. 6.1

A microwave detector D is placed between R and S.

Describe

(i) how stationary waves are formed between R and S,

.....

.....

.....

..... [3]

(ii) how D is used to show that stationary waves are formed between R and S,

.....

.....

..... [2]

(iii) how the wavelength of the microwaves may be determined using the apparatus in Fig. 6.1.

.....

.....

..... [2]

7 A uranium-235 nucleus absorbs a neutron and then splits into two nuclei. A possible nuclear reaction is given by

$$^{235}_{92}\mathrm{U} + {}^{a}_{b}\mathrm{n} \rightarrow {}^{93}_{37}\mathrm{Rb} + {}^{c}_{d}\mathrm{X} + 2{}^{a}_{b}\mathrm{n} + \text{energy}.$$

(a) State the constituent particles of the uranium-235 nucleus.

..... [1]

(b) Complete Fig. 7.1 for this reaction.

	value
a	
b	
c	
d	

[3]

Fig. 7.1

(c) Suggest a possible form of energy released in this reaction.

..... [1]

(d) Explain, using the law of mass-energy conservation, how energy is released in this reaction.

.....

.....

..... [2]