1 **(a)** The kilogram, metre and second are SI base units.

State two other base units.

1. .....

2. .....
[2]

(b) Determine the SI base units of

(i) stress,

SI base units .....[2]

(ii) the Young modulus.

SI base units .....[1]

2 A microphone detects a musical note of frequency *f*. The microphone is connected to a cathode-ray oscilloscope (c.r.o.). The signal from the microphone is observed on the c.r.o. as illustrated in Fig. 2.1.

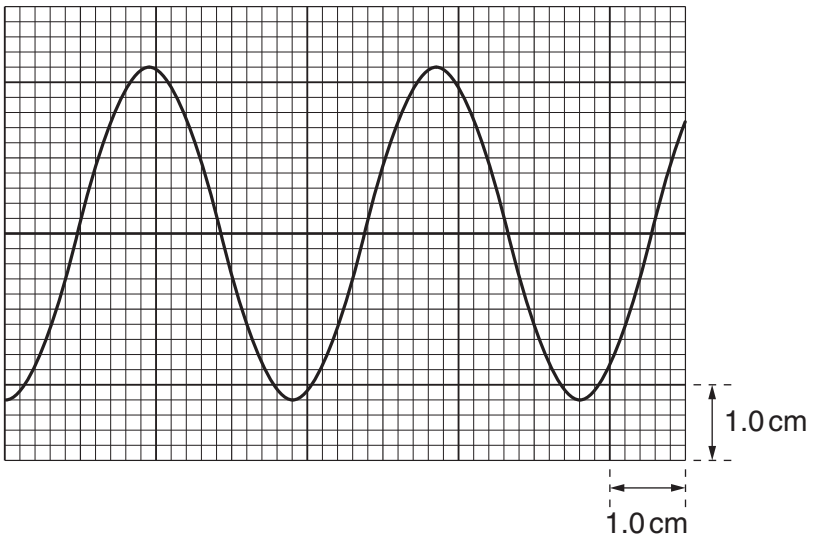

Fig. 2.1

The time-base setting of the c.r.o. is 0.50 ms cm^{-1}. The Y-plate setting is 2.5 mV cm^{-1}.

(a) Fig. 2.1 to determine

(i) the amplitude of the signal,

amplitude = ... mV [2]

(ii) the frequency *f*,

f = ... Hz [3]

(iii) the actual uncertainty in *f* caused by reading the scale on the c.r.o.

actual uncertainty = ... Hz [2]

(b) State *f* with its actual uncertainty.

f = ... ± ..... Hz [1]

3 **(a)** ce is a vector quantity. State three other vector quantities.

1. .....

2. .....

3. .....

[2]

(b) Three coplanar forces *X*, *Y* and *Z* act on an object, as shown in Fig. 3.1.

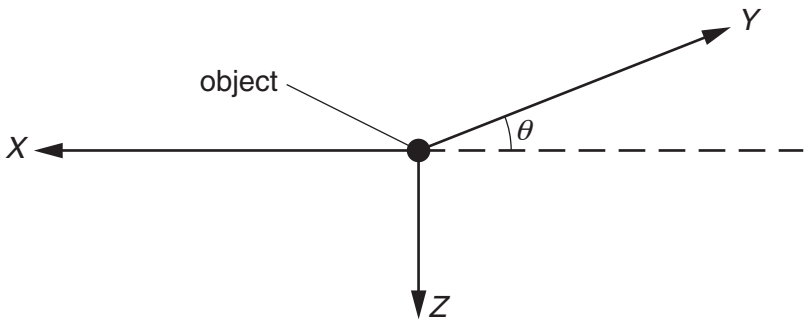

Fig. 3.1

The force *Z* is vertical and *X* is horizontal. The force *Y* is at an angle θ to the horizontal. The force *Z* is kept constant at 70 N.

In an experiment, the magnitude of force *X* is varied. The magnitude and direction of force *Y* are adjusted so that the object remains in equilibrium.

Fig. 3.2 shows the variation of the magnitude of force *Y* with the magnitude of force *X*.

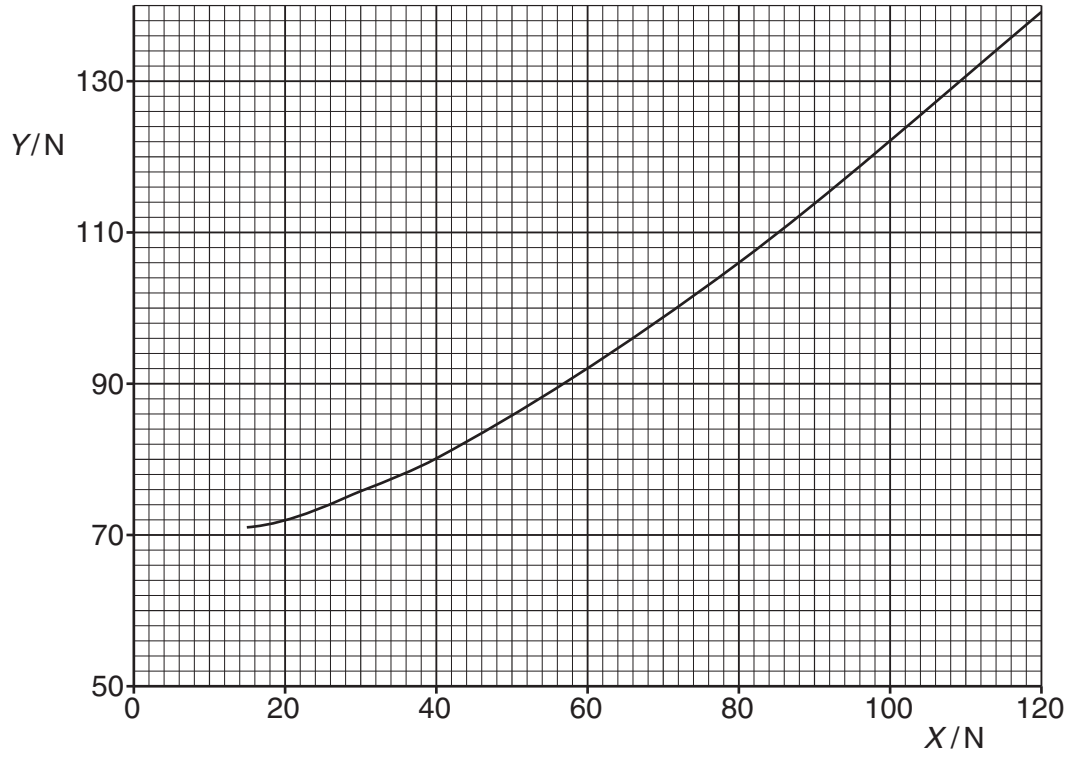

Fig. 3.2

(i) Fig. 3.2 to estimate the magnitude of Y for $X = 0$.

$Y =$ ..... N [1]

(ii) State and explain the value of θ for $X = 0$.

.....

.....

.....[2]

(iii) The magnitude of X is increased to 160 N. resolution of forces to calculate the value of

1. angle θ,

$\theta =$ ..... ° [2]

2. the magnitude of force Y.

$Y =$ ..... N [2]

(c) The angle θ decreases as X increases. Explain why the object cannot be in equilibrium for $\theta = 0$.

.....

.....

.....[1]

4 **(a)** State the principle of conservation of momentum.

.....

.....

.....[2]

(b) A ball X and a ball Y are travelling along the same straight line in the same direction, as shown in Fig. 4.1.

Fig. 4.1

Ball X has mass 400 g and horizontal velocity 0.65 m s^{-1}.
Ball Y has mass 600 g and horizontal velocity 0.45 m s^{-1}.

Ball X catches up and collides with ball Y. After the collision, X has horizontal velocity 0.41 m s^{-1} and Y has horizontal velocity v, as shown in Fig. 4.2.

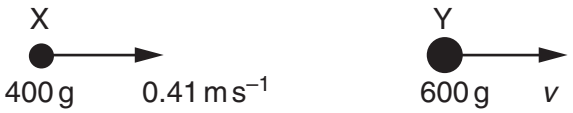

Fig. 4.2

Calculate

(i) the total initial momentum of the two balls,

momentum = ... N s [3]

(ii) the velocity v,

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

(iii) the total initial kinetic energy of the two balls.

kinetic energy = ... J [3]

(c) Explain how you would check whether the collision is elastic.

.....

.....[1]

(d) Newton's third law to explain why, during the collision, the change in momentum of X is equal and opposite to the change in momentum of Y.

.....

.....

.....

.....[2]

5 Distinguish between *evaporation* and *boiling*.

evaporation: .....

.....

.....

boiling: .....

.....

.....

[4]

6 **(a)** A wire has length 100 cm and diameter 0.38 mm. The metal of the wire has resistivity $4.5 \times 10^{-7}\,\Omega\,\text{m}$.

Show that the resistance of the wire is $4.0\,\Omega$.

[3]

(b) The ends B and D of the wire in **(a)** are connected to a cell X, as shown in Fig. 6.1.

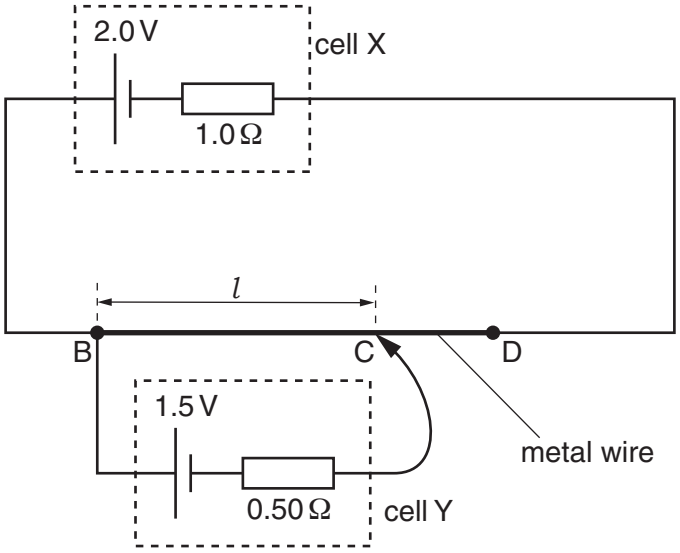

Fig. 6.1

The cell X has electromotive force (e.m.f.) 2.0 V and internal resistance $1.0\,\Omega$.

A cell Y of e.m.f. 1.5 V and internal resistance $0.50\,\Omega$ is connected to the wire at points B and C, as shown in Fig. 6.1.

The point C is distance l from point B. The current in cell Y is zero.

Calculate

(i) the current in cell X,

current = ... A [2]

(ii) the potential difference (p.d.) across the wire BD,

p.d. = ... V [1]

(iii) the distance l.

l = ... cm [2]

(c) The connection at C is moved so that l is increased. Explain why the e.m.f. of cell Y is less than its terminal p.d.

.....

.....

.....[2]

7 **(a)** **(i)** Explain what is meant by a *progressive transverse* wave.

progressive: .....

.....

transverse: .....

.....
[2]

(ii) Define frequency.

.....

.....[1]

(b) The variation with distance x of displacement y for a transverse wave is shown in Fig. 7.1.

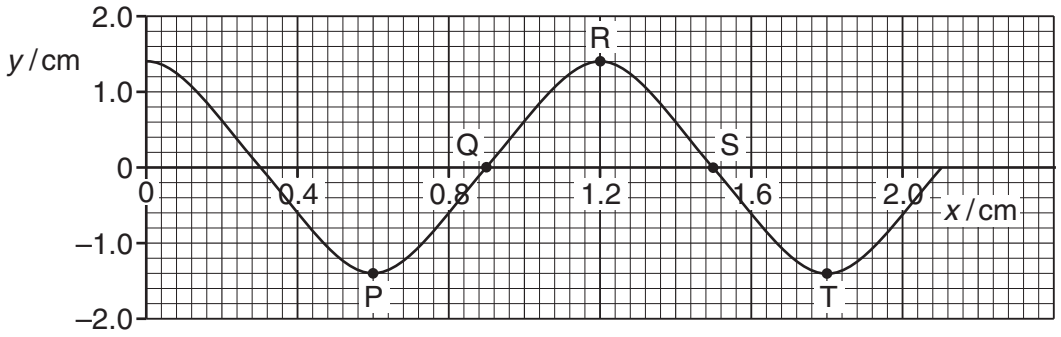

Fig. 7.1

On Fig. 7.1, five points are labelled.

Fig. 7.1 to state any two points having a phase difference of

(i) zero,

.....[1]

(ii) 270°.

.....[1]

(c) The frequency of the wave in **(b)** is 15 Hz.

Calculate the speed of the wave in **(b)**.

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

(d) Two waves of the same frequency have amplitudes 1.4 cm and 2.1 cm.

Calculate the ratio

$$\frac{\text{intensity of wave of amplitude 1.4 cm}}{\text{intensity of wave of amplitude 2.1 cm}}.$$

ratio = ... [2]