

- 1 The volume V of liquid flowing in time t through a pipe of radius r is given by the equation

$$\frac{V}{t} = \frac{\pi P r^4}{8 C l}$$

where P is the pressure difference between the ends of the pipe of length l , and C depends on the frictional effects of the liquid.

An experiment is performed to determine C . The measurements made are shown in Fig. 1.1.

$\frac{V}{t} / 10^{-6} \text{ m}^3 \text{ s}^{-1}$	$P / 10^3 \text{ N m}^{-2}$	r / mm	l / m
1.20 ± 0.01	2.50 ± 0.05	0.75 ± 0.01	0.250 ± 0.001

Fig. 1.1

- (a) Calculate the value of C .

$$C = \dots\dots\dots \text{ N s m}^{-2} \text{ [2]}$$

- (b) Calculate the uncertainty in C .

$$\text{uncertainty} = \dots\dots\dots \text{ N s m}^{-2} \text{ [3]}$$

- (c) State the value of C and its uncertainty to the appropriate number of significant figures.

$$C = \dots\dots\dots \pm \dots\dots\dots \text{ N s m}^{-2} \text{ [1]}$$

- 2 (a) A ball is thrown vertically down towards the ground and rebounds as illustrated in Fig. 2.1.

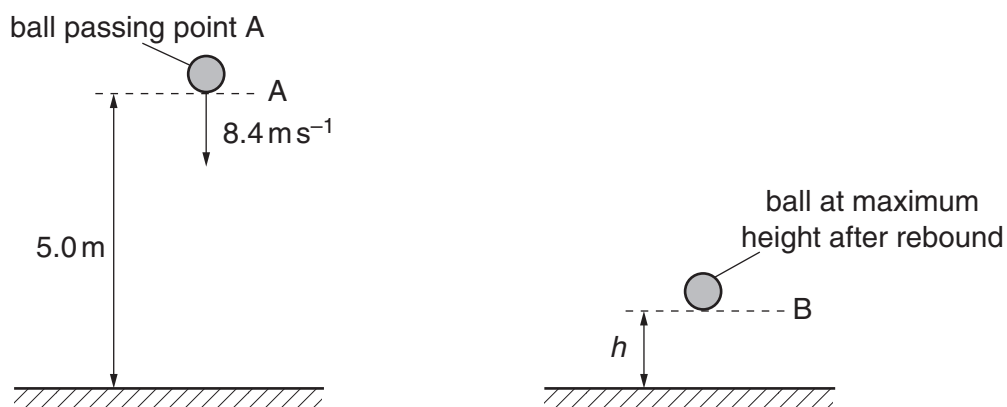


Fig. 2.1

As the ball passes A, it has a speed of 8.4 m s^{-1} . The height of A is 5.0 m above the ground. The ball hits the ground and rebounds to B. Assume that air resistance is negligible.

- (i) Calculate the speed of the ball as it hits the ground.

speed = m s^{-1} [2]

- (ii) Show that the time taken for the ball to reach the ground is 0.47 s.

- (b) The ball rebounds vertically with a speed of 4.2 m s^{-1} as it leaves the ground. The time the ball is in contact with the ground is 20 ms . The ball rebounds to a maximum height h .

The ball passes A at time $t = 0$. On Fig. 2.2, plot a graph to show the variation with time t of the velocity v of the ball. Continue the graph until the ball has rebounded from the ground and reaches B.

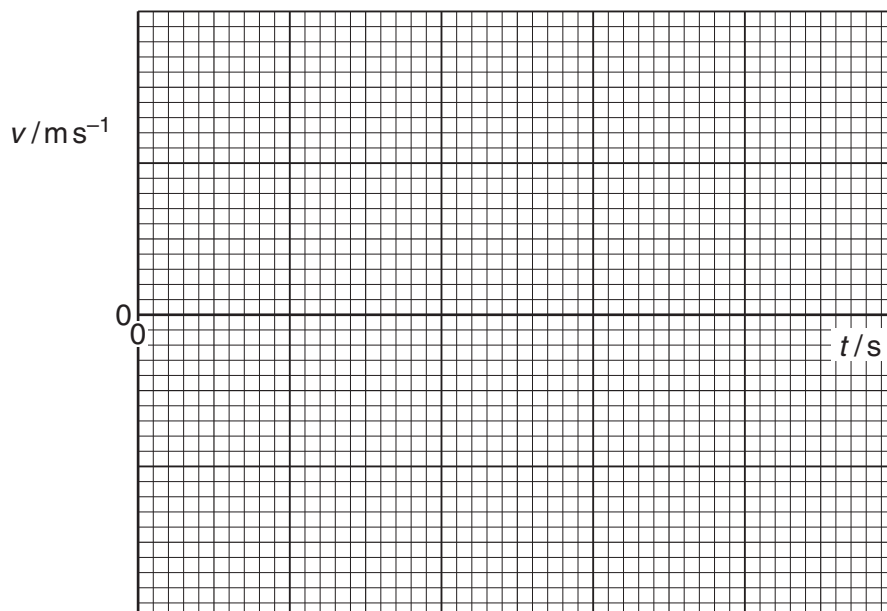


Fig. 2.2

[3]

- (c) The ball has a mass of 0.050 kg . It moves from A and reaches B after rebounding.

- (i) this motion, calculate the change in

1. kinetic energy,

change in kinetic energy = J [2]

2. gravitational potential energy.

change in potential energy = J [3]

(ii) State and explain the total change in energy of the ball for this motion.

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.....[2]

- 3 (a) State Newton's first law.

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..... [1]

- (b) A log of mass 450 kg is pulled up a slope by a wire attached to a motor, as shown in Fig. 3.1.

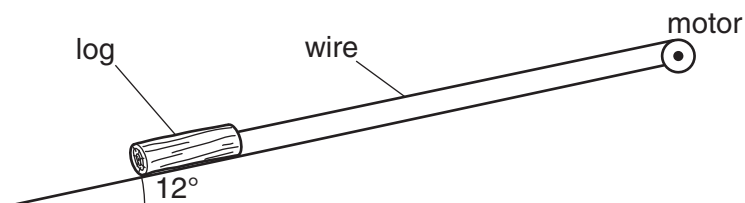


Fig. 3.1

The angle that the slope makes with the horizontal is 12° . The frictional force acting on the log is 650 N. The log travels with constant velocity.

- (i) With reference to the motion of the log, discuss whether the log is in equilibrium.

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.....
..... [2]

- (ii) Calculate the tension in the wire.

tension = N [3]

- (iii) State and explain whether the gain in the potential energy per unit time of the log is equal to the output power of the motor.

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..... [2]

- 4 A battery of electromotive force 12V and negligible internal resistance is connected to two resistors and a light-dependent resistor (LDR), as shown in Fig. 4.1.

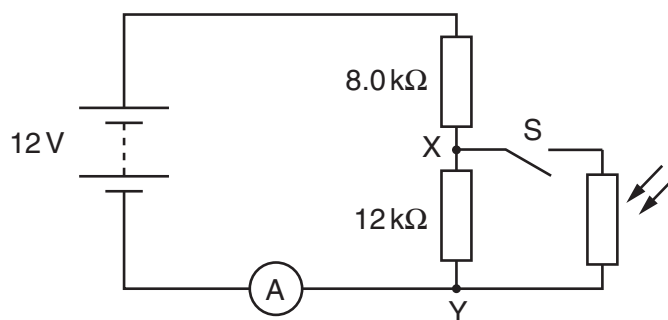


Fig. 4.1

An ammeter is connected in series with the battery. The LDR and switch S are connected across the points XY.

- (a) The switch S is open. Calculate the potential difference (p.d.) across XY.

p. d. = V [3]

- (b) The switch S is closed. The resistance of the LDR is $4.0\text{ k}\Omega$. Calculate the current in the ammeter.

current = A [3]

(c) The switch S remains closed. The intensity of the light on the LDR is increased. State and explain the change to

(i) the ammeter reading,

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.....
.....[2]

(ii) the p.d. across XY.

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.....
.....[2]

5 (a) Define the *Young modulus*.

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..... [1]

(b) A load F is suspended from a fixed point by a steel wire. The variation with extension x of F for the wire is shown in Fig. 5.1.

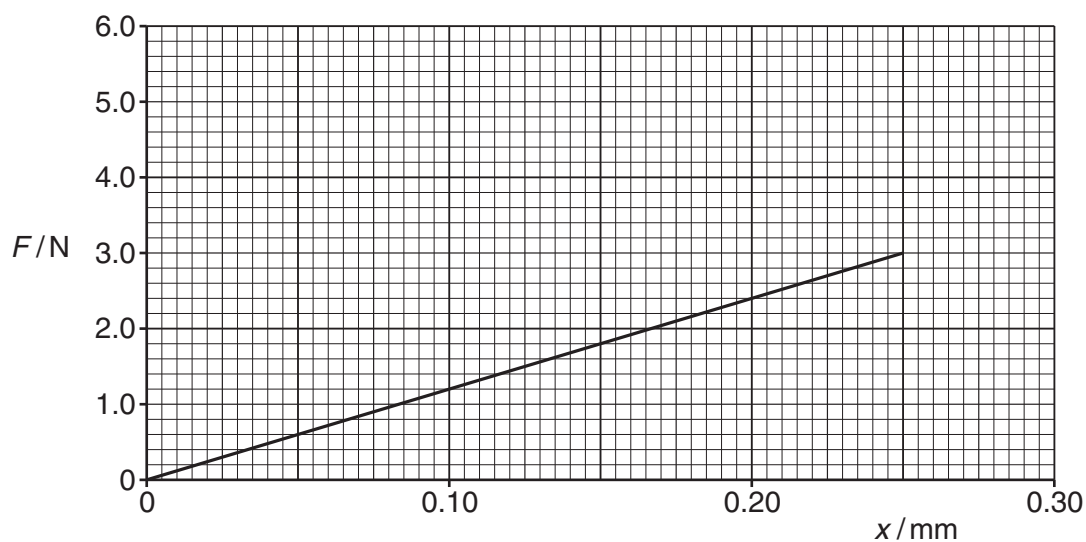


Fig. 5.1

(i) State two quantities, other than the gradient of the graph in Fig. 5.1, that are required in order to determine the Young modulus of steel.

1.
2.

[1]

(ii) Describe how the quantities you listed in (i) may be measured.

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..... [2]

- (iii) A load of 3.0 N is applied to the wire. Fig. 5.1 to calculate the energy stored in the wire.

energy = J [2]

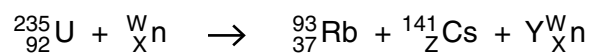
- (c) A copper wire has the same original dimensions as the steel wire. The Young modulus for steel is $2.2 \times 10^{11} \text{ Nm}^{-2}$ and for copper is $1.1 \times 10^{11} \text{ Nm}^{-2}$.

On Fig. 5.1, sketch the variation with x of F for the copper wire for extensions up to 0.25 mm. The copper wire is not extended beyond its limit of proportionality. [2]

.....[3]

[3]

- 7 (a) A nuclear reaction occurs when a uranium-235 nucleus absorbs a neutron. The reaction may be represented by the equation:



State the number represented by the letter

W

X

Y

Z

[3]

- (b) The sum of the masses on the left-hand side of the equation in (a) is not the same as the sum of the masses on the right-hand side.

Explain why mass seems not to be conserved.

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.....[2]