# Mixed Revision Questions – Pack 1

1.

**(a)** A plane has an air speed of 240 km $h^{-1}$ due north. A wind is blowing at 90 km $h^{-1}$ from east to west. Use a vector triangle to calculate the resultant velocity of the plane.

velocity = ..... m $s^{-1}$,

direction with respect to north = ..... °

[4]

**(b)** The plane flies under these conditions for 10 minutes. Calculate the component of the displacement

1. due north,

displacement =..... km

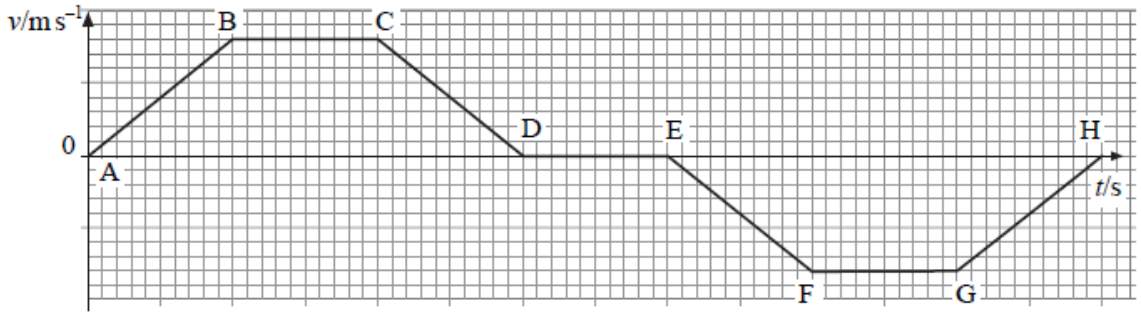
2. due west.

displacement = ..... km

[2]

2.

The graph below shows how the velocity of a toy train moving in a straight line varies over a period of time.




(a) Describe the motion of the train in the following regions of the graph.

AB .....

BC .....

CD .....

DE .....

EF .....

*(5 marks)*

(b) What feature of the graph represents the displacement of the train?

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*(1 mark)*

(c) Explain, with reference to the graph, why the distance travelled by the train is different from its displacement.

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*(2 marks)*

3.

(a) A car of mass $m$ is travelling in a straight line along a horizontal road at a speed $u$ when the driver applies the brakes. They exert a constant force $F$ on the car to bring the car to rest after a distance $d$.

(i) Write down expressions for the initial kinetic energy of the car and the work done by the brakes in bringing the car to rest.

Kinetic energy .....

Work done .....

**(1)**

(ii) Show that the base units for your expressions for kinetic energy and work done are the same.

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**(2)**

(b) A car is travelling at 13.4 m $s^{-1}$. The driver applies the brakes to decelerate the car at 6.5 m $s^{-2}$. Show that the car travels about 14 m before coming to rest.

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**(3)**

(c) On another occasion, the same car is travelling at twice the speed. The driver again applies the brakes and the car decelerates at 6.5 m $s^{-2}$. The car travels just over 55 m before coming to rest. Explain why the braking distance has more than doubled. You may be awarded a mark for the clarity of your answer.

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**(4)**

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4.

(a) (i) Define acceleration.

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(ii) State why acceleration is a vector quantity.

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*(2 marks)*

(b) State what feature of a velocity-time graph may be used to calculate

(i) acceleration,

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(ii) displacement.

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*(2 marks)*

(c) The graph in **Figure 1** shows how the displacement of a runner from a fixed point, along a straight track, varies with time.

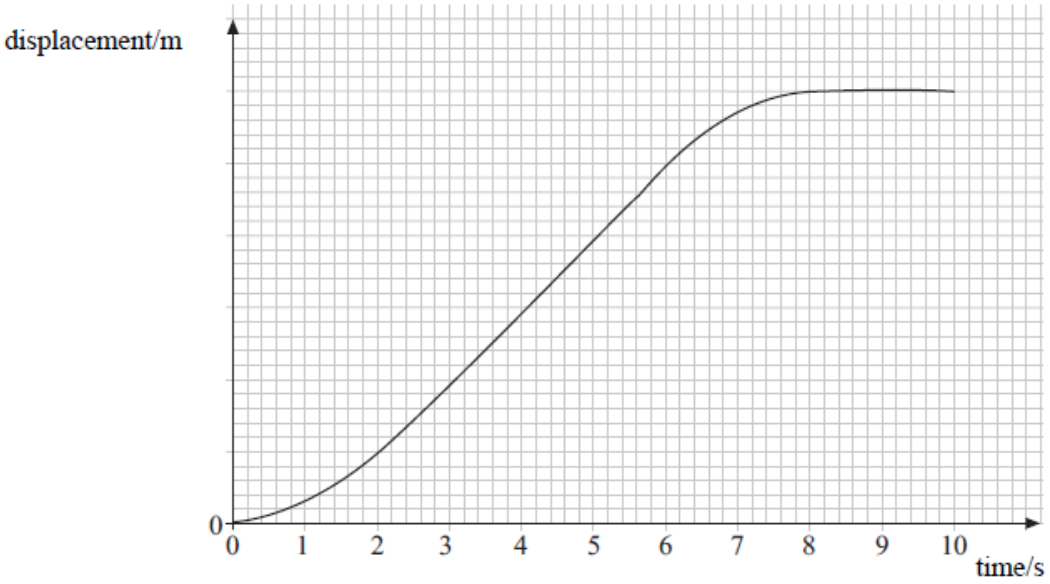



**Figure 1**

Without calculation, sketch on the grid in **Figure 2** a graph to show how the velocity of the same runner varies over the same period. The time scales are the same on both graphs.

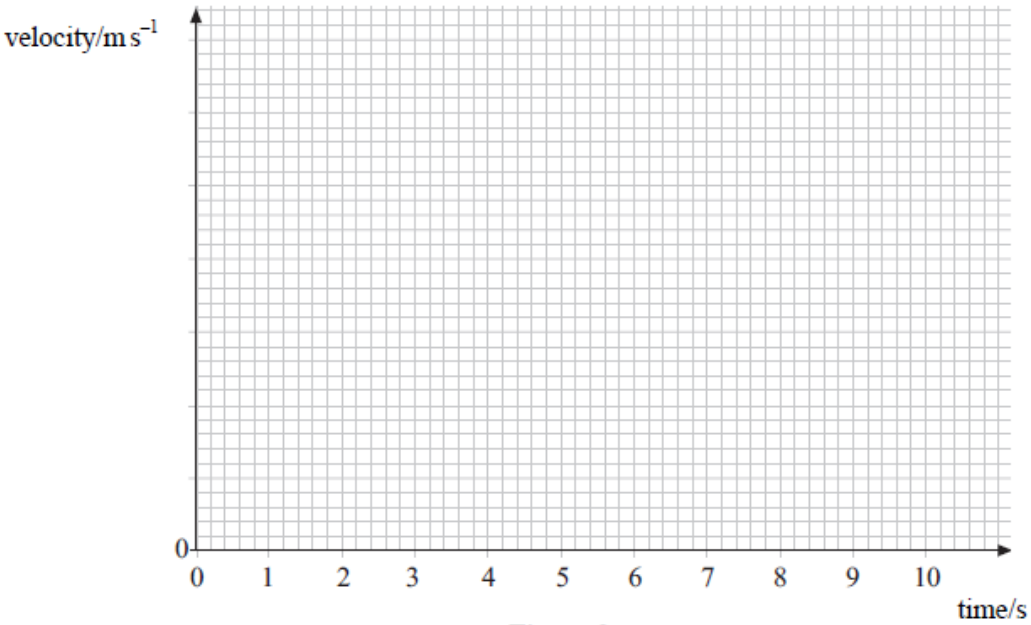
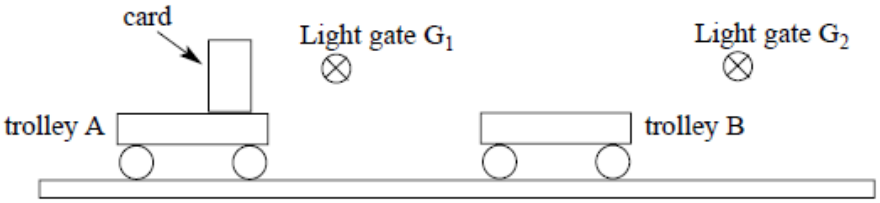



**Figure 2**

*(4 marks)*

5.

The simplified diagram shows an experimental arrangement to investigate the collision of two trolleys.




In the experiment, trolley A is travelling at speed $v$. It collides with and sticks to, the initially stationary trolley B.

(a) State the measurements you would need to take so that you could determine the speed of

(i) trolley A before the collision,

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(ii) trolleys A and B after the collision.

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*(3 marks)*

(b) Explain how you would verify that momentum was conserved in this collision, indicating what other measurements would be required.

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*(2 marks)*

(c) State and explain what you would do to minimise the effects of friction on the motion of the trolleys.

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*(2 marks)*

6.

Fig. 1.1 shows a vacuum cleaner of weight ***W*** being pushed with a force ***P***. The force ***P*** acts at 30° to the horizontal.

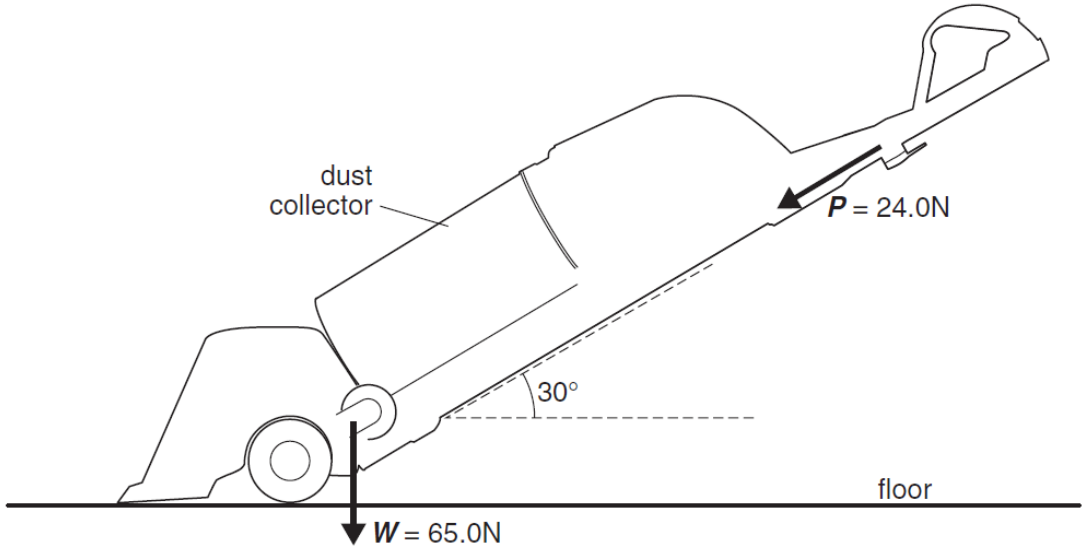


**Fig. 1.1**

The weight ***W*** is 65.0 N and the magnitude of force ***P*** is 24.0 N.

**(a) (i)** Calculate

**1** the horizontal component of the force ***P***

horizontal component = .....N

**2** the vertical component of the force ***P***.

vertical component = .....N [3]

**(ii)** Show that the total downward vertical force is 77.0 N.

[1]

**(iii)** Hence determine the magnitude of the resultant of the forces ***W*** and ***P***.

resultant force = .....N [2]

**(iv)** The vacuum cleaner is not switched on and is pushed in such a way that it travels at a constant velocity to the left. There are other forces acting on the vacuum cleaner. State and explain the magnitude of the resultant of these other forces.

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.....[2]

**(b) (i)** The total area of the vacuum cleaner in contact with the floor is $4.2 \times 10^{-3}$ $m^2$. Calculate the pressure exerted on the floor by the total downward vertical force.

pressure = .....Pa [2]

**(ii)** State and explain what happens to this pressure if the handle is lifted so that its angle with the horizontal direction is more than 30°. The force ***P*** and the total area in contact with the floor remain constant.

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.....[1]

7.

**(a)** State the principle of conservation of energy.

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..... **[1]**

**(b)** Describe one example where elastic potential energy is stored.

..... **[1]**

**(c)** Fig. 5.1 shows a simple pendulum with a metal ball attached to the end of a string.

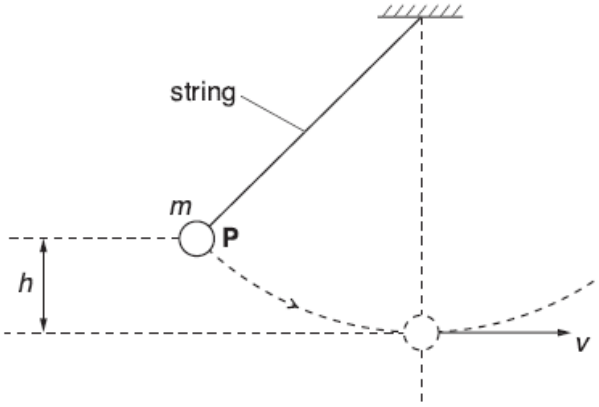


**Fig. 5.1**

When the ball is released from **P**, it describes a circular path. The ball has a maximum speed *v* at the bottom of its swing. The vertical distance between **P** and bottom of the swing is *h*. The mass of the ball is *m*.

**(i)** Write the equations for the change in gravitational potential energy, $E_p$, of the ball as it drops through the height *h* and for the kinetic energy, $E_k$, of the ball at the bottom of its swing when travelling at speed *v*.

$E_p =$

$E_k =$ **[1]**

**(ii)** Use the principle of conservation of energy to derive an equation for the speed *v*. Assume that there are no energy losses due to air resistance.

**[2]**

**(d)** Some countries in the world have frequent thunderstorms. A group of scientists plan to use the energy from the falling rain to generate electricity. A typical thunderstorm deposits rain to a depth of $1.2 \times 10^{-2}$ m over a surface area of $2.0 \times 10^{7}$ m$^2$ during a time of 900 s. The rain falls from an average height of $2.5 \times 10^{3}$ m. The density of rainwater is $1.0 \times 10^{3}$ kg m$^{-3}$. About 30% of the gravitational potential energy of the rain can be converted into electrical energy at the ground.

**(i)** Show that the total mass of water deposited in 900 s is $2.4 \times 10^{8}$ kg.

**[2]**

**(ii)** Hence show that the average electrical power available from this thunderstorm is about 2 GW.

**[3]**

**(iii)** Suggest one problem with this scheme of energy production.

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..... **[1]**

8.

**(a)** Fig. 5.1 shows a wooden block motionless on an inclined ramp.

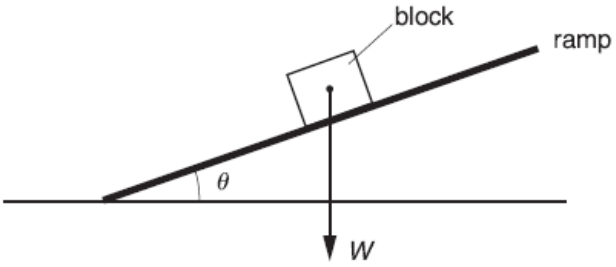


**Fig. 5.1**

The angle between the ramp and the horizontal is $\theta$.

**(i)** The weight $W$ of the block is already shown on Fig. 5.1. Complete the diagram by showing the normal contact (reaction) force $N$ and the frictional force $F$ acting on the block. **[2]**

**(ii)** Write an equation to show how $F$ is related to $W$ and $\theta$.

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..... **[1]**

**(b)** Fig. 5.2 shows a kitchen cupboard securely mounted to a vertical wall. The cupboard rests on a support at **A**.

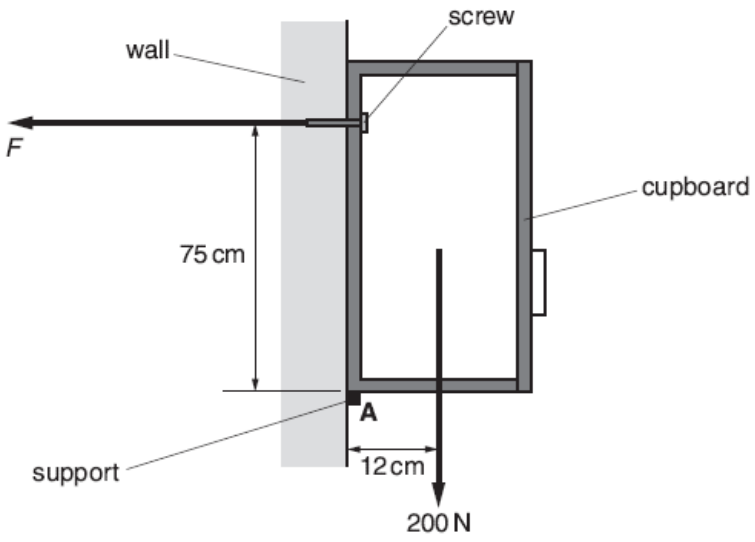



**Fig. 5.2**

The total weight of the cupboard and its contents is 200 N. The line of action of its weight is at a distance of 12 cm from **A**. The screw securing the cupboard to the wall is at a vertical distance of 75 cm from **A**.

**(i)** State the principle of moments.

*In your answer, you should use appropriate technical terms, spelled correctly.*

.....

.....

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

**(ii)** The direction of the force *F* provided by the screw on the cupboard is horizontal as shown in Fig. 5.2. Take moments about **A**. Determine the value of *F*.

*F* = .....N **[2]**

**(iii)** The cross-sectional area under the head of the screw in contact with the cupboard is $6.0 \times 10^{-5}\,m^2$. Calculate the pressure on the cupboard under the screw head.

pressure = ..... Pa **[2]**

**(iv)** State and explain how your answer to **(iii)** would change, if at all, if the same screw was secured much closer to **A**.

.....

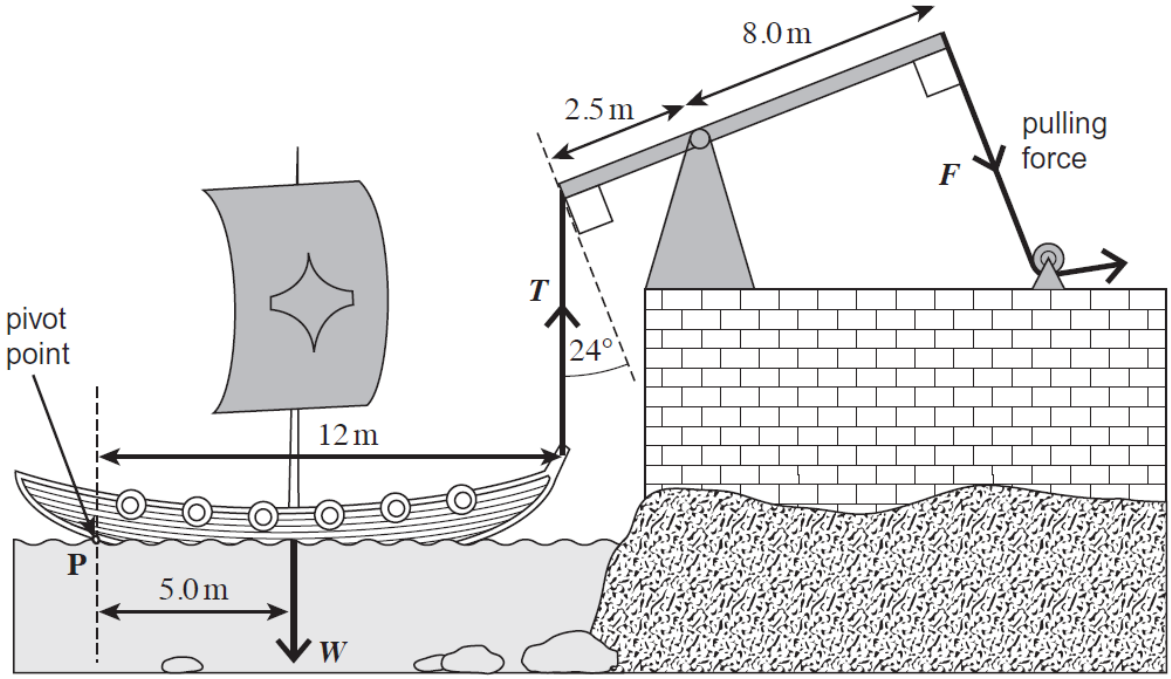
.....

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

9.

It is said that Archimedes used huge levers to sink Roman ships invading the city of Syracuse. A possible system is shown in **Figure 3** where a rope is hooked on to the front of the ship and the lever is pulled by several men.

**Figure 3**




**(a) (i)** Calculate the mass of the ship if its weight was $3.4 \times 10^4$ N.

**[1 mark]**

mass ..... kg

**(a) (ii)** Calculate the moment of the ship's weight about point **P**. State an appropriate unit for your answer.

**[2 marks]**

moment ..... unit .....

**(a) (iii)** Calculate the minimum vertical force, $T$, required to start to raise the front of the ship. Assume the ship pivots about point **P**.

**[2 marks]**

minimum vertical force ..... N

**(a) (iv)** Calculate the minimum force, $F$, that must be exerted to start to raise the front of the ship.

**[3 marks]**

force ..... N

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10.

**(a)** State the difference between a vector and a scalar quantity.

.....

..... **[1]**

**(b)** In the following list underline **all** the scalar quantities.

displacement kinetic energy mass power velocity weight **[1]**

**(c)** Fig. 1.1 shows a climber on a vertical rock face supported by a rope. The climber is in equilibrium.

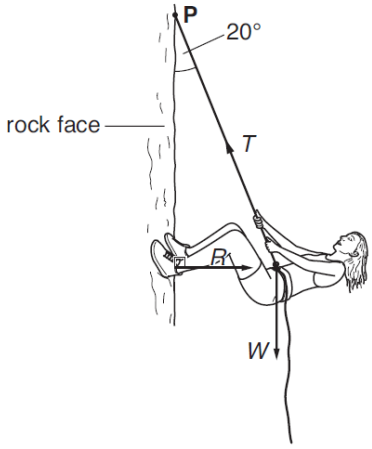


Fig. 1.1

The weight of the climber and her equipment is 650 N. The rope is attached to the climber and fixed to a point **P** where it makes an angle of 20° to the vertical. The contact force $R$ acts on the climber at right angles to the rock face.

**(i)** Use a vector triangle or resolve forces to calculate

**1** the tension $T$ in the rope

$T =$ ..... N

**2** the contact force $R$.

$R =$ ..... N

**[3]**

**(ii)** The climber moves down the rock face and the angle the rope makes with the vertical decreases. Explain why the magnitude of the tension decreases.

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..... **[1]**

11.

**(a)** A battery delivers a constant current through a circuit when a switch is closed at time $t = 0$.

**(i)** On Fig. 5.1, sketch a graph to show how the total charge that has been supplied by the battery varies with time $t$.


**[1]**

**Fig. 5.1**

**(ii)** The battery delivers a constant current of 5.2 A for a time of 3.5 hours. Calculate the total charge supplied by the battery after a time of 3.5 hours.

charge = ..... unit ..... **[3]**

**(b)** Fig. 5.2 shows an electrical circuit.

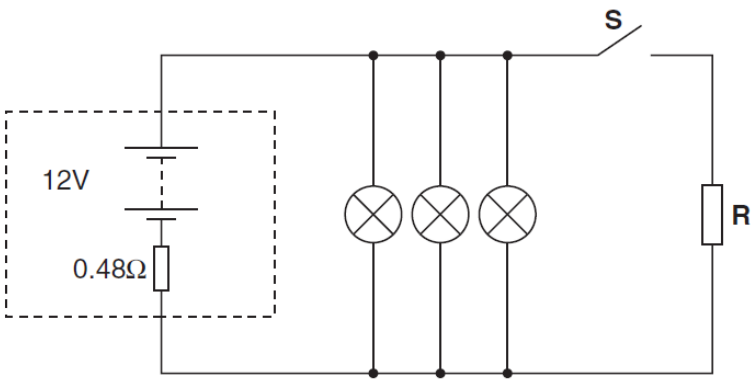


**Fig. 5.2**

The switch **S** is open. The battery has e.m.f. 12V and an internal resistance 0.48 Ω. The three lamps are identical, each of resistance 3.6 Ω. The filament of each lamp is a coiled wire of cross-sectional area of $2.0 \times 10^{-8}\,m^2$. The material of the filament has resistivity $7.9 \times 10^{-7}\,\Omega m$.

**(i)** Calculate the length of the filament wire in each lamp.

length = ..... m **[3]**

**(ii)** With the switch **S open**, determine

**1** the total resistance of the circuit

total resistance = ..... Ω **[2]**

**2** the current from the battery.

current = ..... A **[1]**

**(iii)** With the switch **S closed**, the current in the resistor **R** is 20 A. Explain why the lamps dim when the switch is closed.

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

12.

**(a)** The $I/V$ characteristic of a particular component is shown in Fig. 1.1.

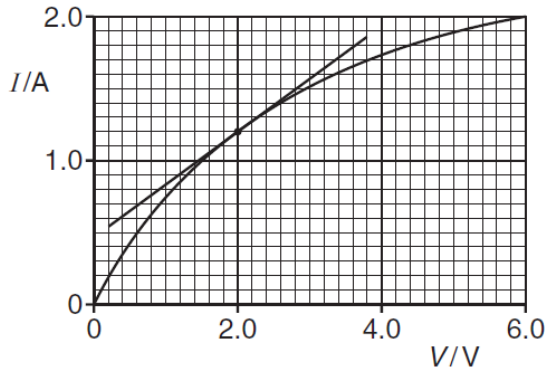



**Fig. 1.1**

**(i)** Name the component.

..... **[1]**

**(ii)** According to one student, the *'gradient of the graph at 2.0V can be used to determine the resistance of the component at 2.0V'*.
Explain why the student is wrong.

.....

..... **[1]**

**(iii)** Determine the resistance of the component at 2.0V.

resistance = ..... Ω **[2]**

**(b)** Fig. 1.2 shows a sketch graph of the variation of resistance $R$ of a different component with potential difference (voltage) $V$.

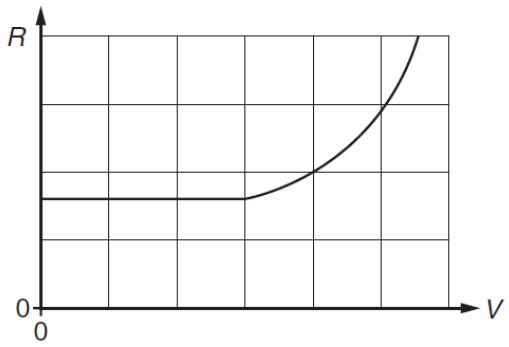



**Fig. 1.2**

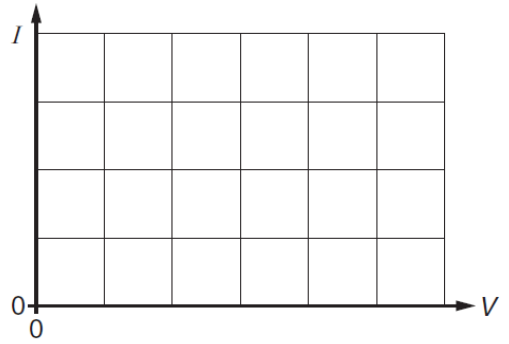



**Fig. 1.3**

Complete Fig. 1.3 by drawing a sketch graph to show the $I/V$ characteristic of the component. **[2]**

**(c)** Fig. 1.4 shows an electrical circuit containing a semiconductor diode.

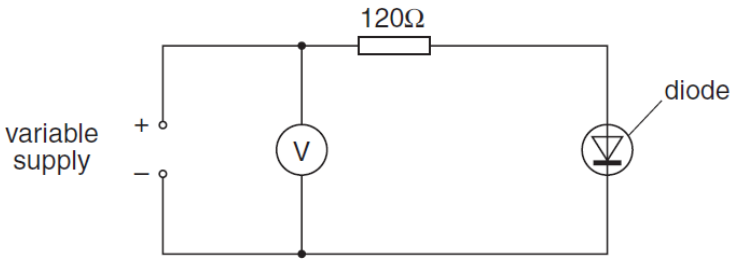



**Fig. 1.4**

This diode has a very low resistance when it conducts. It has an infinite resistance when the potential difference across it is less than 0.6V. The variable supply is adjusted to give a reading of 0.4V on the voltmeter.

**(i)** State the current in the 120Ω resistor.

current = ..... A **[1]**

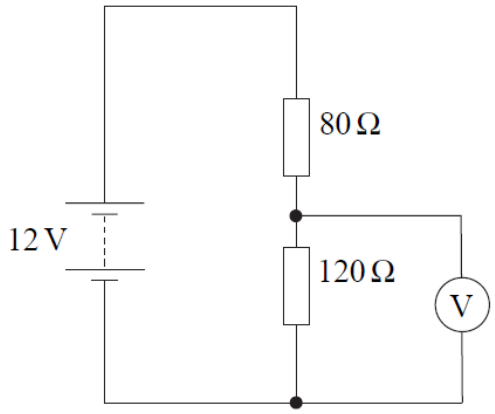
**(ii)** State the potential difference across the diode.

potential difference = ..... V **[1]**

13.

(a) In the potential divider circuit shown in **Figure 2**, the battery has negligible internal resistance.

**Figure 2**




Calculate the reading on the voltmeter, stating the assumption made.

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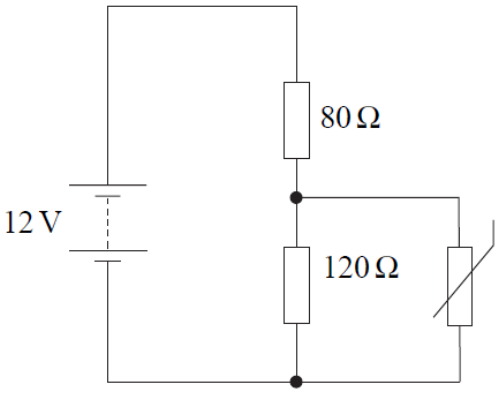
*(3 marks)*

(b) The voltmeter in **Figure 2** is replaced by a thermistor, giving the circuit shown in **Figure 3**.

**Figure 3**



The resistance of the thermistor at 0 °C is 120 Ω. As the temperature increases, its resistance decreases. Explain, without calculation, whether the current through the battery increases or decreases as the temperature of the thermistor is increased from 0 °C.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

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*(3 marks)*