SAMPLE 1

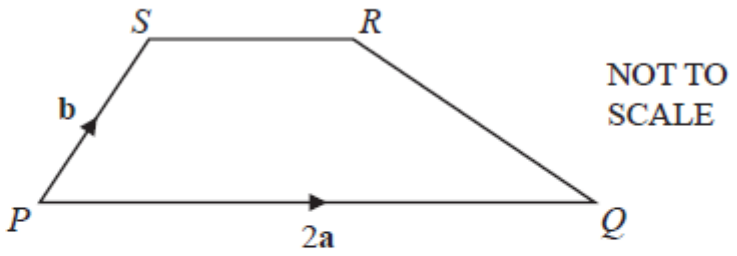
ENTRANCE EXAM IN MATHEMATICS, PHYSICS & INFORMATION TECHNOLOGY

III YEAR

Mathematics

1.

(a)

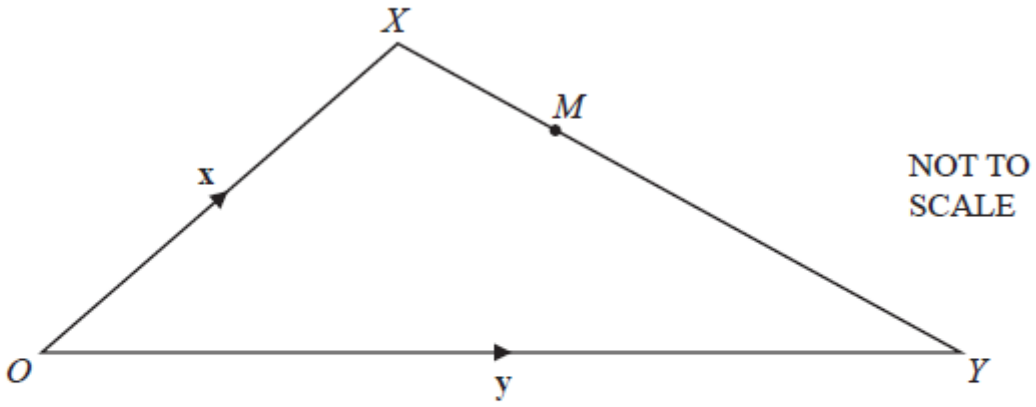


$PQRS$ is a trapezium with $PQ = 2SR$.
$\overrightarrow{PQ} = 2\mathbf{a}$ and $\overrightarrow{PS} = \mathbf{b}$.

Find $\overrightarrow{QR}$ in terms of **a** and **b** in its simplest form.

[2]

(b)



$\overrightarrow{OX} = \mathbf{x}$ and $\overrightarrow{OY} = \mathbf{y}$.
M is a point on XY such that $XM : MY = 3 : 5$.

Find $\overrightarrow{OM}$ in terms of **x** and **y** in its simplest form.

[2]

SAMPLE 1

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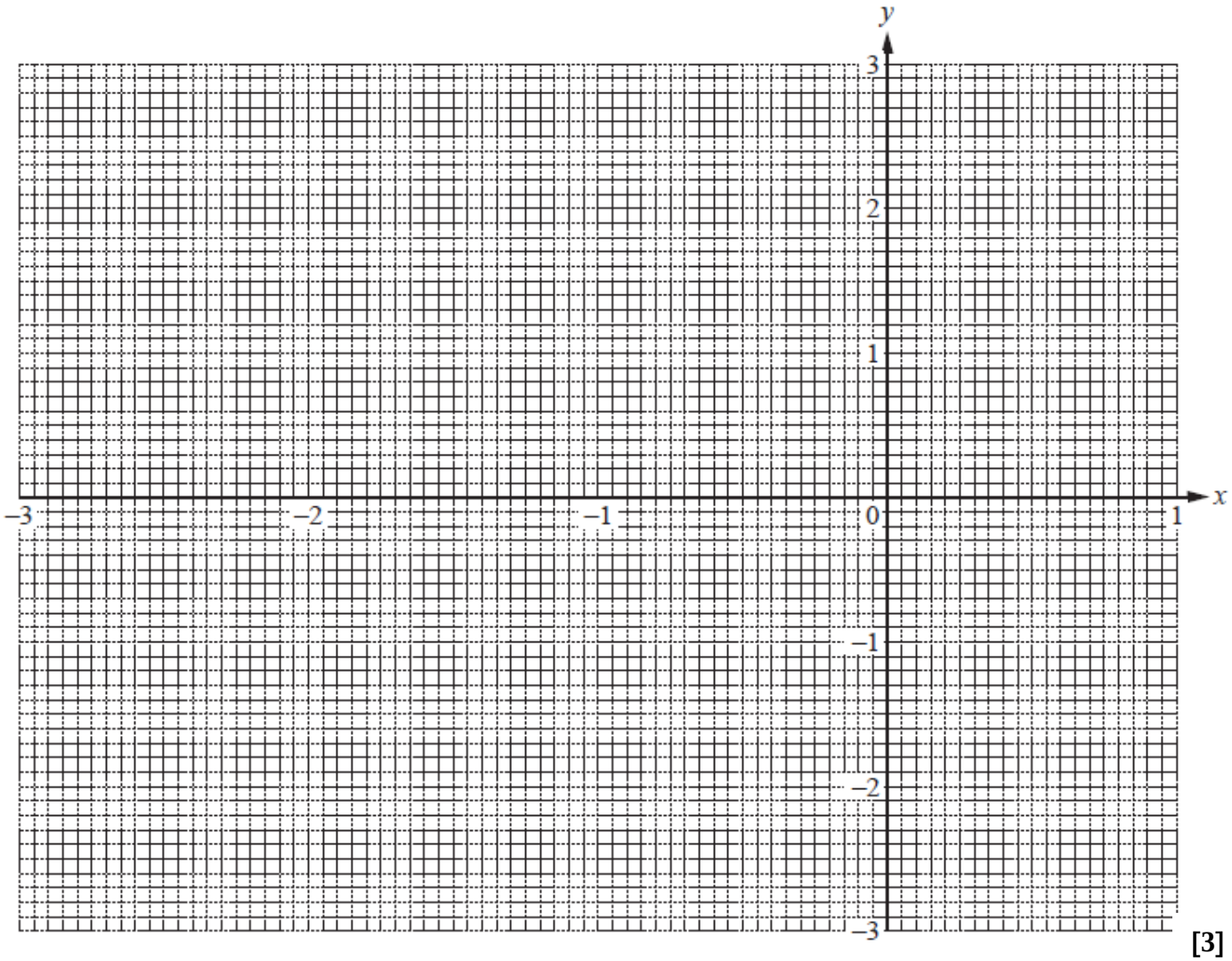
2.

The table shows some values of $y = x^3 + 3x^2 - 2$.

x	–3	–2.5	–2	–1.5	–1	–0.5	0	0.5	1
y	–2	1.13		1.38		–1.38		–1.13	

(a) Complete the table of values. **[2]**

(b) On the grid, draw the graph of $y = x^3 + 3x^2 - 2$ for $-3 \leqslant x \leqslant 1$.



[3]

SAMPLE 1

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(c) By drawing a suitable line, solve the equation $x^3 + 3x^2 - 2 = \frac{1}{2}(x + 1)$.

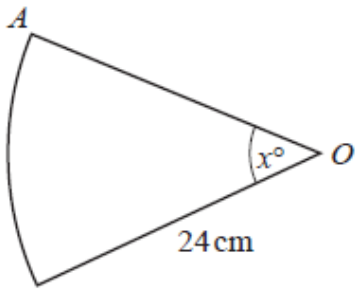
Answer(c) $x =$ ..... or $x =$ ..... or $x =$ ..... [3]

(d) By drawing a suitable tangent, find an estimate of the gradient of the curve at the point where $x = -1.75$.

[2]

3.

(a) The diagram shows a sector of a circle with centre O and radius 24 cm.

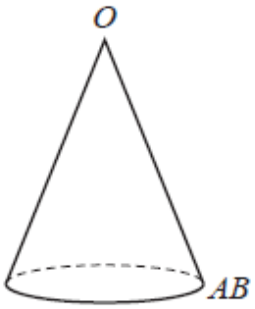


NOT TO SCALE

(i) The total perimeter of the sector is 68 cm. [2]

Calculate the value of x.

(ii) The points A and B of the sector are joined together to make a hollow cone.
The arc AB becomes the circumference of the base of the cone.



NOT TO SCALE

Calculate the volume of the cone.

[The volume, V, of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

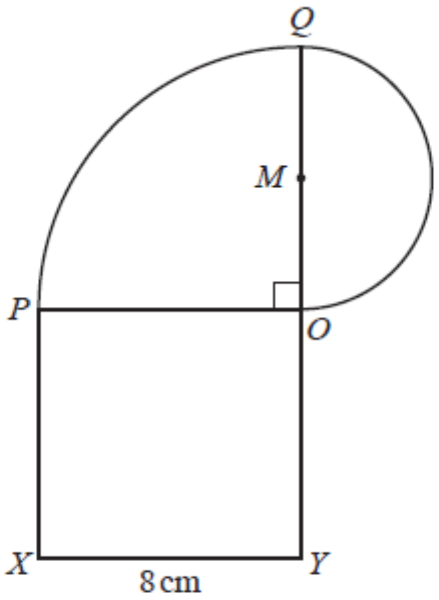
[4]

SAMPLE 1

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(b)



NOT TO SCALE

The diagram shows a shape made from a square, a quarter circle and a semi-circle.
OPXY is a square of side 8 cm.
OPQ is a quarter circle, centre *O*.
The line *OMQ* is the diameter of the semi-circle.

Calculate the area of the shape.

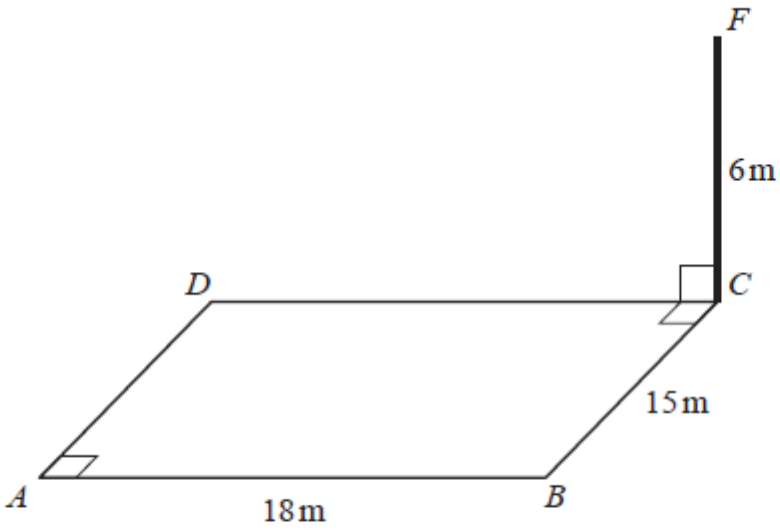
[3]

SAMPLE 1

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4.



The diagram shows a rectangular playground $ABCD$ on horizontal ground.
A vertical flagpole CF, 6 metres high, stands in corner C.
$AB = 18$ m and $BC = 15$ m.

Calculate the angle of elevation of F from A.

[3]

5.

Navpreet has 15 cards with a shape drawn on each card.
5 cards have a square, 6 cards have a triangle and 4 cards have a circle drawn on them.

(a) Navpreet selects a card at random.

Write down the probability that the card has a circle drawn on it.

[1]

(b) Navpreet selects a card at random and replaces it.
She does this 300 times.

Calculate the number of times she expects to select a card with a circle drawn on it.

[1]

(c) Navpreet selects a card at random, replaces it and then selects another card.

Calculate the probability that

(i) one card has a square drawn on it and the other has a circle drawn on it,

[2]

(ii) neither card has a circle drawn on it. [2]

(d) Navpreet selects two cards at random, without replacement.

Calculate the probability that

only one card has a triangle drawn on it.

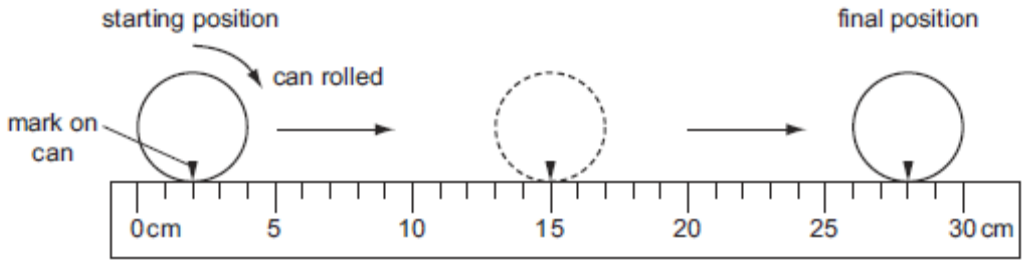
[2]

SAMPLE 1

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Physics

1 A cylindrical can is rolled along the ruler shown in the diagram.



The can rolls over twice.

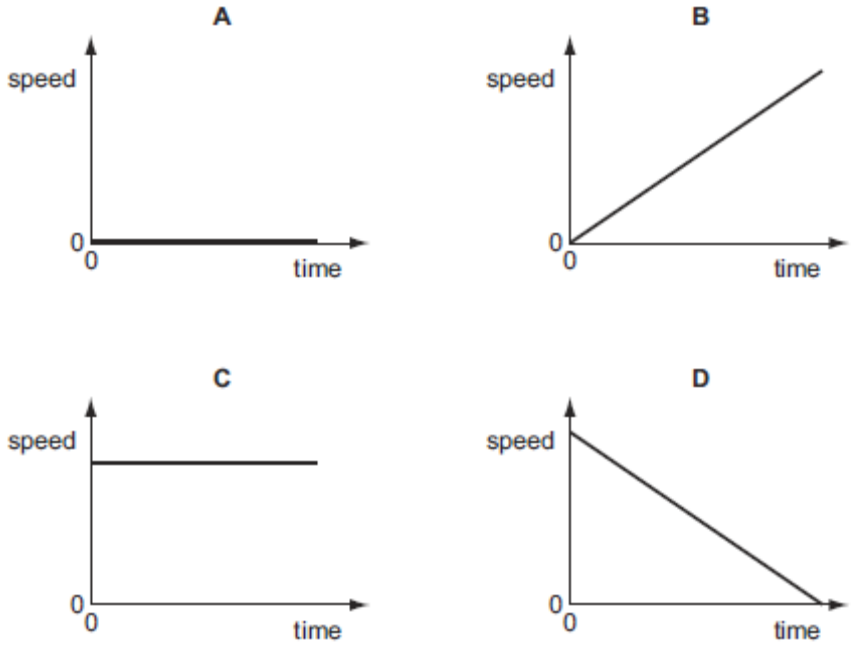
What is the circumference (distance all round) of the can?

A 13 cm **B** 14 cm **C** 26 cm **D** 28 cm

[1]

2 A car is moving downhill along a road at a constant speed.

Which graph is the speed / time graph for the car?



[1]

3 In a race, a car travels 60 times around a 3.6 km track. This takes 2.4 hours.

What is the average speed of the car?

A 1.5 km / h **B** 90 km / h **C** 144 km / h **D** 216 km / h

[1]

SAMPLE 1

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4 Which statement about mass and weight is correct?

A Mass and weight are both forces.

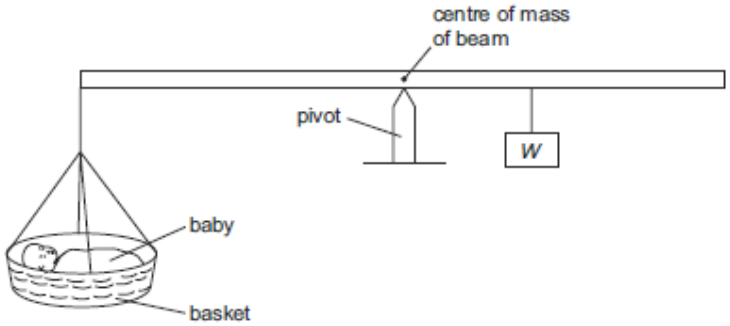
B Neither mass nor weight is a force. **[1]**

C Only mass is a force.

D Only weight is a force.

5 The diagram shows a balance being used to find the weight of a baby. The weight of the basket can be ignored.

At equilibrium, the pivot is nearer to the weight *W* than to the baby.



What is the weight of the baby?

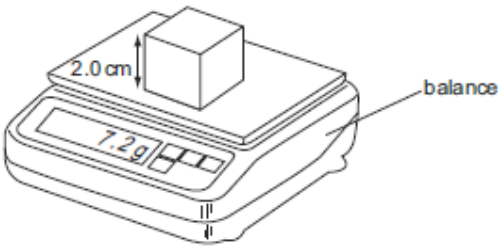
A less than *W*

B more than *W*

C *W* **[1]**

D impossible to tell

6 A cube of side 2.0 cm is placed on a balance.



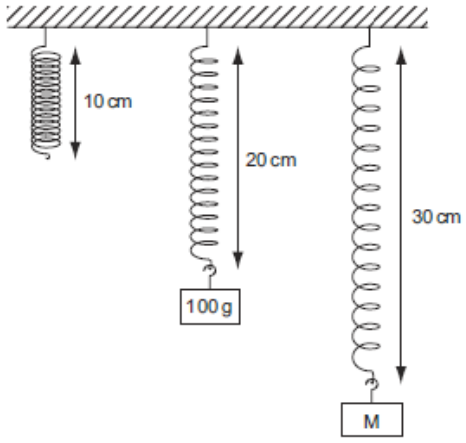
What is the density of the cube?

A 0.90 g/cm^3 **B** 1.2 g/cm^3 **C** 1.8 g/cm^3 **D** 3.6 g/cm^3 **[1]**

SAMPLE 1

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7 Objects with different masses are hung on a spring. The diagram shows how much the spring stretches.

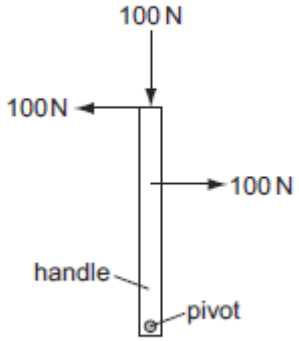


The extension of the spring is directly proportional to the mass hung on it. **[1]**

What is the mass of object M?

A 110 g **B** 150 g **C** 200 g **D** 300 g

8 The diagram shows a handle with three forces, each 100 N, applied to it. The handle is free to move.



What is the effect of the forces on the handle?

A The handle will move downwards.

B The handle will not move.

C The handle will turn anticlockwise (to the left).

D The handle will turn clockwise (to the right). **[1]**

9 In which pair of energy sources are both sources renewable?

A oil and coal

B oil and tidal

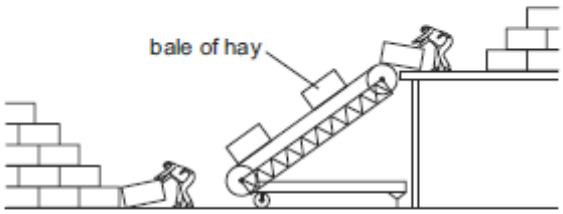
C tidal and geothermal

D tidal and nuclear fission **[1]**

SAMPLE 1

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10 Two farmers use an electrically powered elevator to lift bales of hay. All the bales of hay have the same mass.



As sunset approaches, they increase the speed of the motor so that more bales are lifted up in a given time.

How does this affect the work done in lifting each bale and the useful output power of the motor?

	work done in lifting each bale	useful output power of the motor
A	increases	decreases
B	increases	increases
C	no change	decreases
D	no change	increases

[1]

11 A man lifts 20 bricks, each of weight 6 N.

What other information is needed to calculate the useful work done in lifting the bricks?

A the distance he lifts the bricks

B the mass of the bricks

C the time taken to lift the bricks

D the volume of the bricks

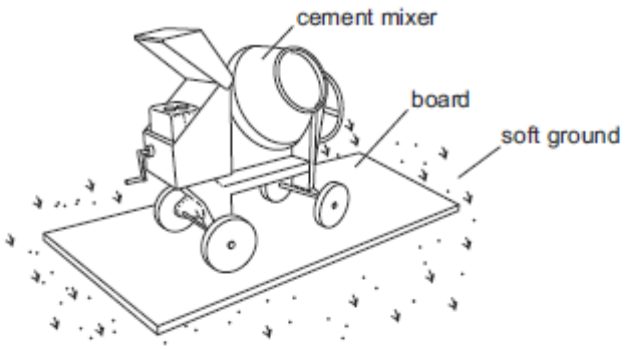
[1]

SAMPLE 1

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12 To prevent a cement mixer sinking into soft ground, the mixer is placed on a large flat board.



Why does this prevent the mixer sinking?

A The large area decreases the pressure on the ground.

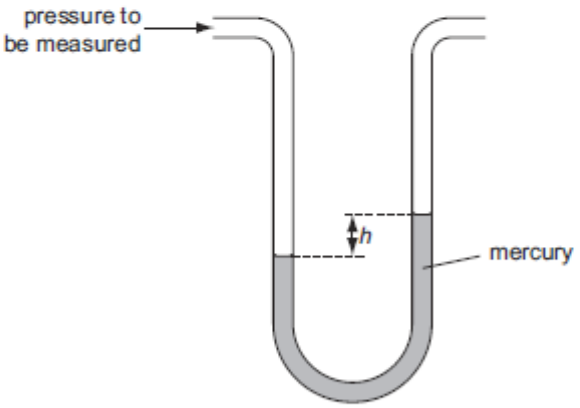
B The large area increases the pressure on the ground.

C The large area decreases the weight on the ground.

D The large area increases the weight on the ground.

[1]

13 The pressure of a gas is measured using a manometer as shown in the diagram.



The mercury in the manometer is replaced with a liquid which is less dense.

How does the value of *h* change?

A It becomes zero.

B It decreases, but not to zero.

C It stays the same.

D It increases.

[1]

SAMPLE 1

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14. The circuit of Fig. 4.1 is set up to run a small immersion heater from a 6.0V battery.

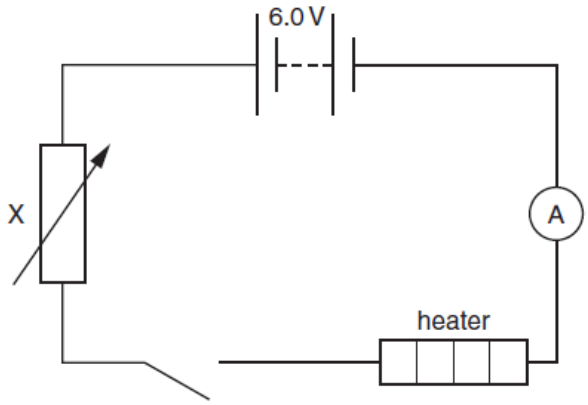


Fig. 4.1

(a) State the name and purpose of component X.

name .....

purpose .....[1]

(b) The heater is designed to work from a 3.6V supply. It has a power rating of 4.5W at this voltage.

(i) Calculate the current in the heater when it has the correct potential difference across it.

current = ...[2]

(ii) Calculate the resistance of component X if there is to be the correct potential difference across the heater. The battery and the ammeter both have zero resistance.

resistance = ... **[2]**

(c) Some time after the heater is switched on, the ammeter reading is seen to have decreased.

Suggest why this happens.

.....

.....[1]

SAMPLE 1

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(d) As an alternative to running the heater from a battery, it is decided to construct a circuit to enable it to be operated from the a.c. mains supply.

Name the electrical component needed to

(i) reduce the potential difference from that of the mains supply down to a potential difference suitable for the heater,

.....[1]

(ii) change the current from a.c. to a current which has only one direction.

.....[1]

15. Fig. 6.1 shows a glass flask full of water at 10 °C and sealed with a bung. A long glass tube passes through the bung into the water. The water level in the tube is at X.

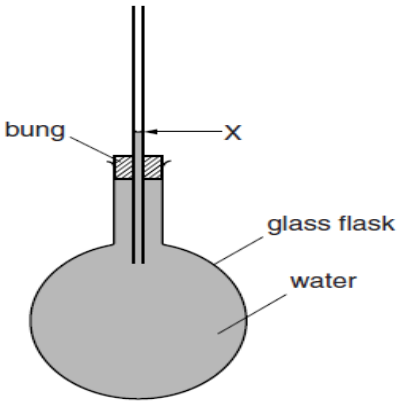


Fig. 6.1

When the flask is placed in hot water, the water level initially falls a little below X, and then rises some way above X.

(a) Suggest why

(i) the water level initially falls,

.....

..... [2]

(ii) the water level then rises,

.....

..... [2]

(iii) the rise is greater than the fall.

.....

..... [1]

(b) Suggest a change to the apparatus that would make the fall and rise of the water level greater.

.....

..... [1]

SAMPLE 1

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16. The circuit shown in Fig. 10.1 uses a 12V battery.

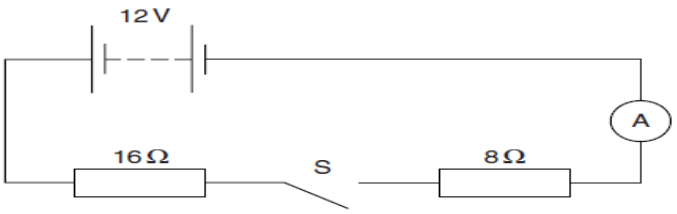


Fig. 10.1

(a) Switch S is open, as shown in Fig. 10.1.

State the value of

(i) the reading on the ammeter,

reading = ... [1]

(ii) the potential difference (p.d.) across S.

p.d. = ... [1]

(b) Switch S is now closed.

(i) Calculate the current in the ammeter.

current = ... [2]

(ii) Calculate the p.d. across the 8Ω resistor.

p.d. = ... [2]

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Information Technology

1. There are a number of different internal hardware devices. Write down the most appropriate type of internal hardware that fits the following descriptions:

(a) A volatile device that is used to store data.
.....[1]
(b) This is the main printed circuit board found in computer systems.
.....[1]
(c) A non-volatile chip that stores the start-up commands.
.....[1]
(d) This electronic device provides a computer with the ability to produce sounds.
.....[1]



(e) Give the type of interface shown above.
.....[1]

(f) One of the features of this type of interface is an icon. Describe what is meant by the term icon.
.....
.....[2]

g) Identify **one** way you would select an icon using this type of interface.
.....[1]

4 John is working on a school History project and saves his work. He is told by one of his teachers that the school network has been infected by a computer virus.

(a) Explain what is meant by a computer virus and give examples of how a computer virus can affect a computer.
.....
.....
.....
.....
.....

.....
.....
.....[4]

5. Name **three** health problems associated with the prolonged use of IT equipment, and for eachone, suggest a possible method to prevent the problem. The methods should be different in each case.
Problem 1 .....
Method 1 .....
.....
Problem 2 .....
Method 2 .....
.....
Problem 3 .....
Method 3 .....
.....[6]

6. Users of a weather station launch a weather balloon into the upper atmosphere.

(a) An example of a sensor attached to the weather balloon would be a pressure sensor.
Name **one** other sensor that should be attached to the balloon.

.....[2]
(b) The weather station continuously monitors the sensors on the weather balloon.
Describe the monitoring process.
.....
.....
.....
.....
.....
.....
.....
.....[5]

7. Students in a class are undertaking research for a school project. Much of the research is beingcarried out using the internet. Other than e-safety issues, discuss the benefits and drawbacks of students using the internet to carry out the research.
.....
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.....[8]