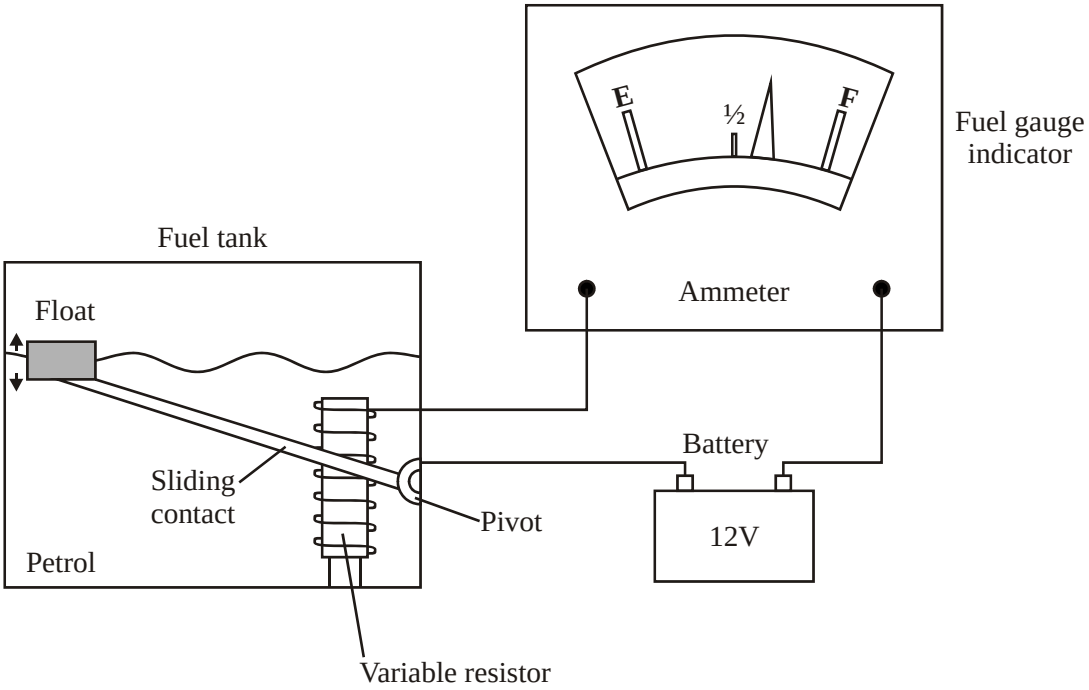
Currents in electric circuits

1. The diagram shows the fuel gauge assembly in a car.

- The sliding contact touches a coil of wire and moves over it.
- The sliding contact and the coil form a variable resistor.
- The sliding contact is connected to a float via a pivot.
- The fuel gauge indicator is an ammeter.
- When the petrol level changes, the resistance of the circuit changes.
- This causes the pointer in the fuel gauge indicator to move.



(a) Use standard symbols to draw a circuit diagram for the fuel gauge assembly.

(3)

(b) How will the current in the circuit change as the level of petrol in the tank falls?

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Explain the reason for your answer.

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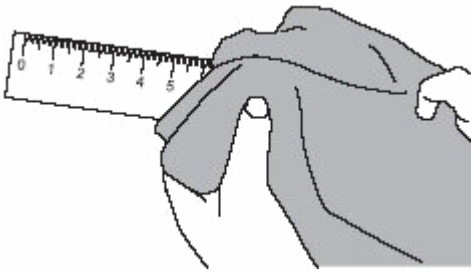
(2)
(Total 5 marks)

2. (a) A plastic ruler is rubbed with a cloth.



The ruler becomes negatively charged.

(i) Complete the following sentence by drawing a ring around the correct line in the box.

The ruler becomes negatively charged because it has

gained electrons
lost neutrons
lost protons

.

(1)

(ii) How could you show that the ruler is charged?

.....

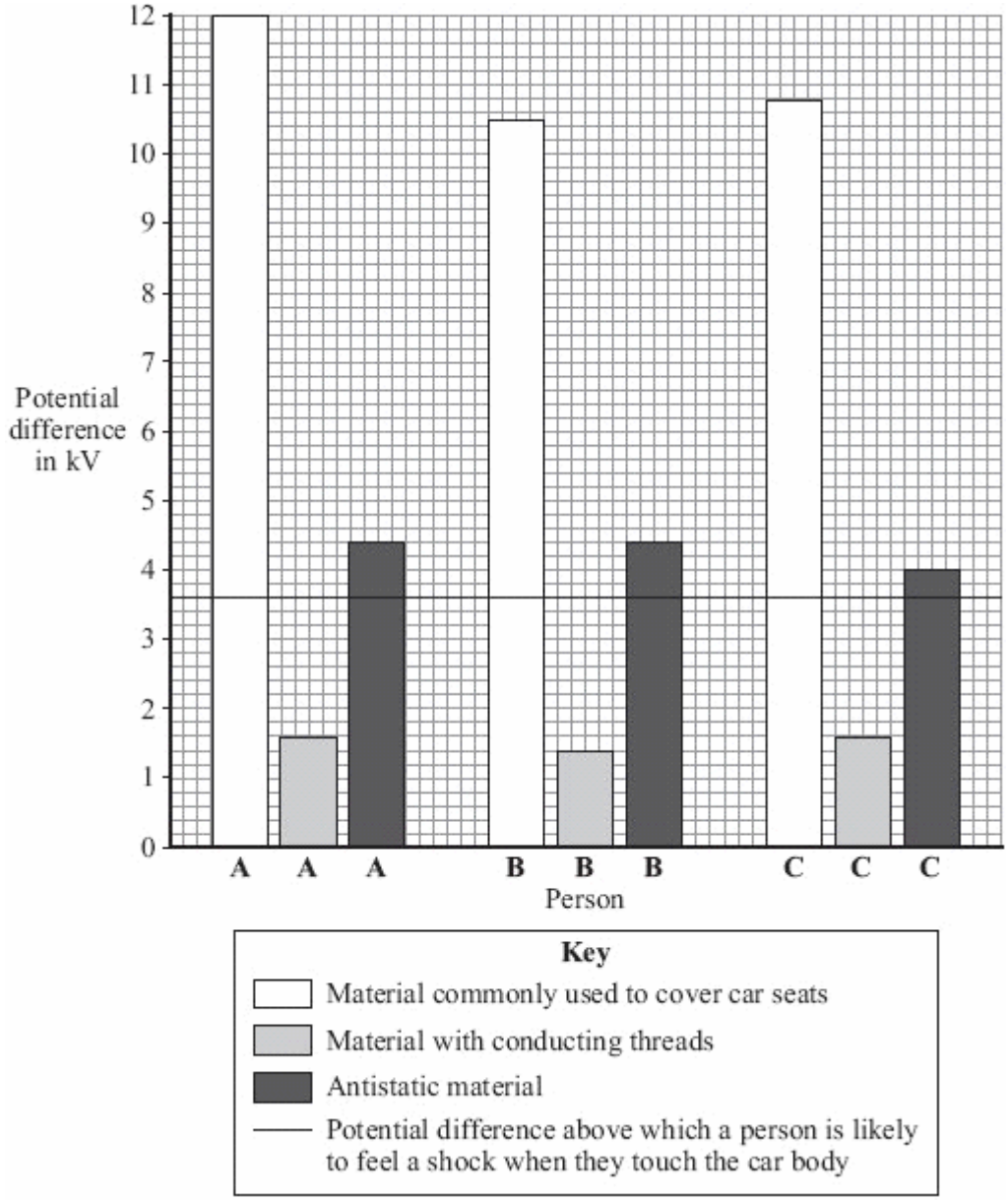
.....

(1)

(b) People often become electrostatically charged as they get out of a car.
This happens because their clothing rubs against the car seat.

A scientist was asked to find out whether the amount of charge on a person depended on the type of material which covered the car seat.
Three people, **A**, **B** and **C**, were used to test three different types of seat covering.

In each test, the person got out of the car and stood on a thick sheet of plastic.
The scientist then measured the potential difference between the person and the car body.
The results of the investigation are displayed in the bar chart.



(i) Explain why the measurement was made with the person standing on a thick sheet of plastic.

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(2)

(ii) To make this a fair test, the three people, **A**, **B** and **C**, each wore the same type of clothing.

Suggest a reason why this was important.

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(1)

(iii) The smallest scale division on the voltmeter was 0.1 kV.
Suggest why, from the data, it was **not** necessary to increase the precision of the potential difference measurements.

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.....

(1)

(iv) Explain why this investigation may cause a manufacturer to change the material used to cover car seats.

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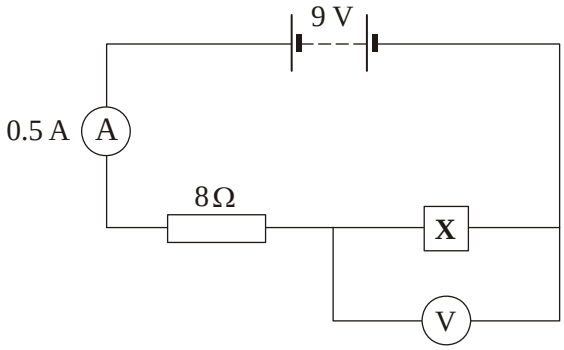
(2)
(Total 8 marks)

3. (a) The circuit diagram drawn below includes a component labelled **X**.



(i) Use the equation in the box to calculate the potential difference across the 8 ohm resistor.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

Potential difference = ... volts

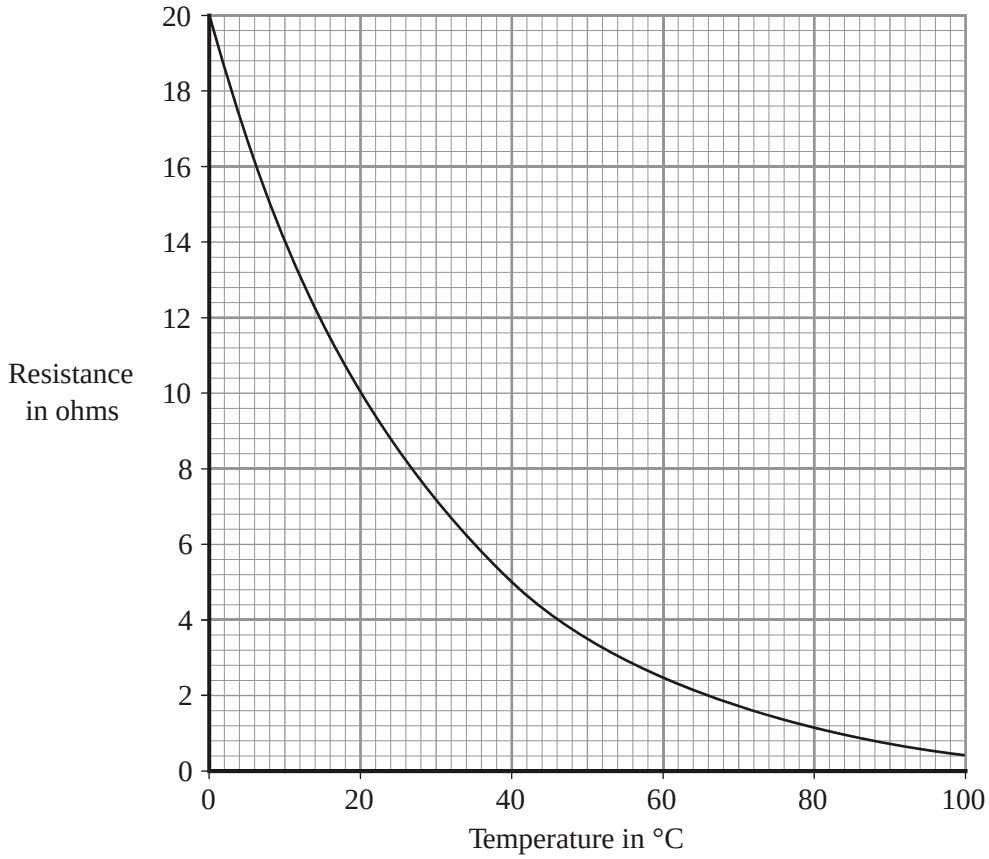
(2)

(ii) What is the potential difference across component **X**?

.....

(1)

(b) The graph shows how the resistance of component **X** changes with temperature.



(i) What is component **X**?

.....

(1)

(ii) Over which range of temperatures does the resistance of component **X** change the most?

Put a tick (✓) next to your choice.

0 °C to 20 °C ☐

20 °C to 40 °C ☐

40 °C to 60 °C ☐

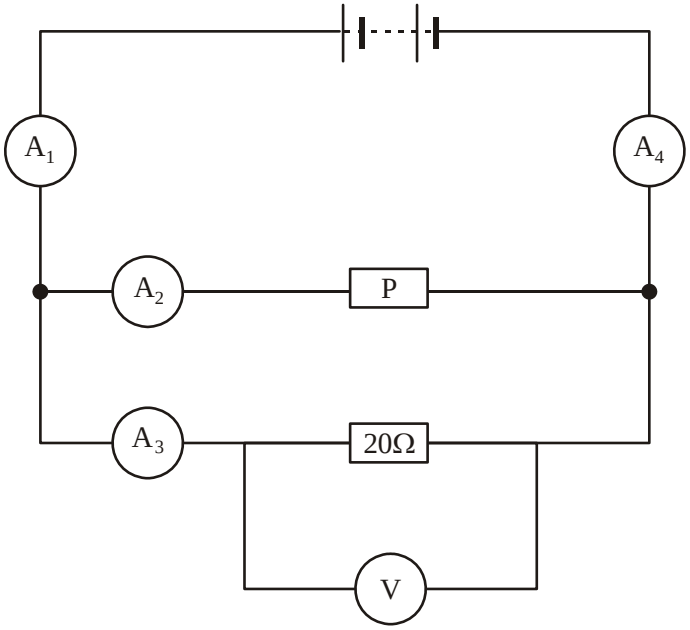
60 °C to 80 °C ☐

80 °C to 100 °C ☐

(1)

(Total 5 marks)

4. The circuit shown has four identical ammeters.



(a) The table gives the current through two of the ammeters.

(i) Complete the table to show the current through the other two ammeters.

Ammeter	Reading on ammeter in amps
A_1	
A_2	0.2
A_3	0.3
A_4	

(2)

(ii) Which **one** of the following statements is correct. Tick (✓) the box next to your choice.

The resistance of **P** is more than 20 Ω. ☐

The resistance of **P** is equal to 20 Ω. ☐

The resistance of **P** is less than 20 Ω. ☐

Give a reason for your choice.

.....

.....

(2)

(b) (i) Write down the equation that links current, potential difference and resistance.

.....

(1)

(ii) Calculate the reading on the voltmeter. Show clearly how you work out your answer.

.....

.....

Voltmeter reading = …… volts.

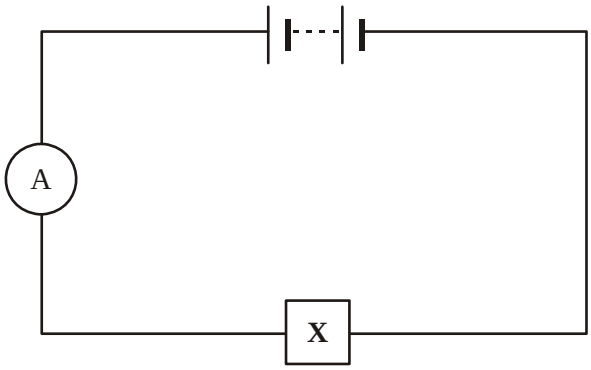
(2)

(iii) State the potential difference of the power supply.

.....

(1)

(c) A second circuit contains an unknown component labelled **X**.



As component **X** is heated, the reading on the ammeter goes up.

What is component **X**?

.....

Give a reason for your answer.

.....

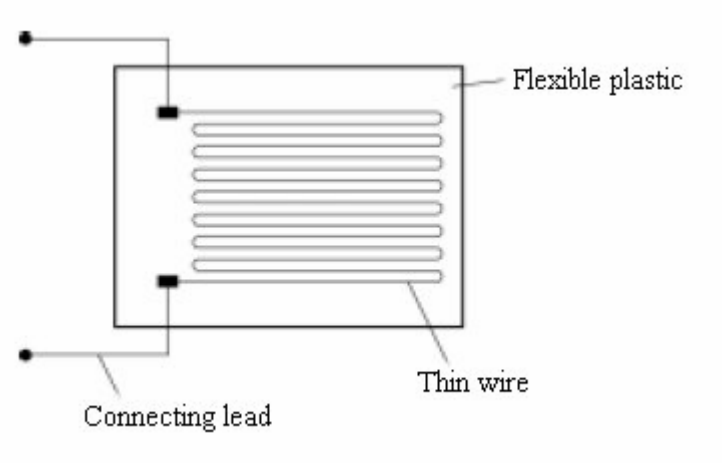
.....

(2)

(Total 10 marks)

5. A strain gauge is a device used to detect a force. It is made from a thin piece of wire set into a flexible piece of plastic. When the plastic bends, the wire stretches. This causes the electrical resistance of the gauge to change.

(a) Using the correct symbols, complete the diagram to show how a battery, an ammeter and a voltmeter can be used to measure the resistance of the gauge.



(1)

(b) Before being stretched, a gauge correctly connected to a 3 V battery has a current of 0.025 A flowing through it.

(i) Write down the equation that links current, potential difference and resistance.

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(1)

(ii) Calculate the resistance of the unstretched gauge. Show clearly how you get your answer.

.....

.....

resistance = ... Ω

(2)

(iii) When a gauge is stretched, the current flowing through it changes to 0.022 A.

State how the resistance of the gauge has changed. (You do not need to do any further calculation.)

.....

(1)

(c) John has been asked to measure the strain that heavy lorries cause when they go over a road bridge. John decides to do this by linking a strain gauge to a data logger and computer.

Give **one** practical reason why John decided to link the strain gauge to the data logger and computer.

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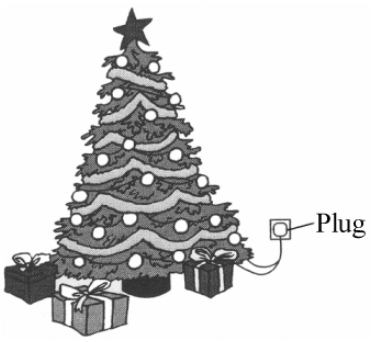
(1)

(Total 6 marks)

6. A set of Christmas tree lights is made from twenty identical lamps connected in series.



(a) Each lamp is designed to take a current of 0.25 A. The set plugs directly into the 230 V mains electricity supply.

(i) Write down the equation that links current, potential difference and resistance.

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(1)

(ii) Calculate the resistance of **one** of the lamps. Show clearly how you work out your final answer and give the unit.

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.....

Resistance = ...

(4)

(iii) What is the total resistance of the set of lights?

.....

.....

Total resistance = ...

(1)

(b) How does the resistance of a filament lamp change as the temperature of the filament changes?

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(1)

(Total 7 marks)