Write your name, centre number and candidate number in the boxes below.

| Surname | Other names |
|---|---|
| | |

Centre number | | | | | |

Candidate number | | | | |

**STEM** | Exam Builder

# Electric circuits and electrical safety

Time allowed: 1 hour 15 minutes

**Subject code** **0625**

# Physics

## Questions from Paper 3 and Paper 4

**You must have:** a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

**/ 79**

### Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

### Information

- This paper has 10 questions worth 79 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

### Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

STEM | Exam Builder



Print at 100% (Actual size) so diagrams keep their real measurements.

**1** **(a)** Fig. 9.1 shows an electricity cable that has a fault.

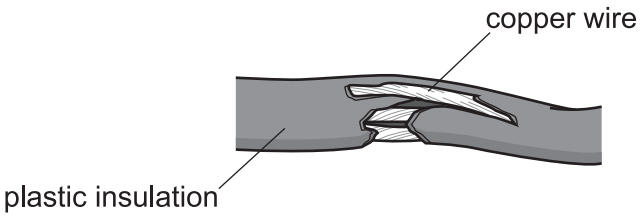



**Fig. 9.1**

The cable is used for supplying electricity at a high voltage.

State the fault and describe the hazard shown in Fig. 9.1.

fault .....

hazard .....

[2]

**(b)** Fig. 9.2 shows a piece of cable used in a mains circuit.

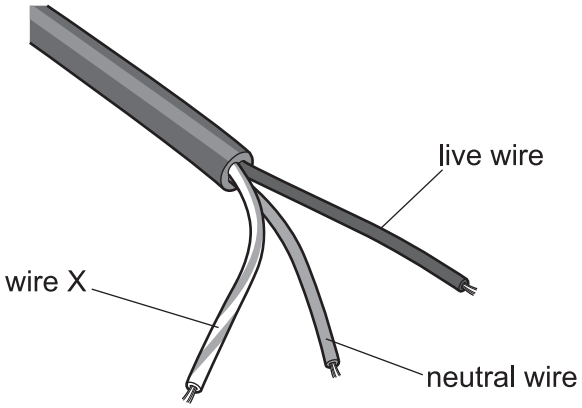



**Fig. 9.2**

**(i)** State the name of wire X in Fig. 9.2.

..... [1]

**(ii)** An electrical appliance is connected in the mains circuit. One of the wires in the cable is connected to the switch for the appliance.

State and explain which wire is connected to the switch.

.....

.....

..... [2]

[Total: 5]

Electrical safety Click for more variations

STEM | Exam Builder

| | | |
|---|---|---|
| 1(a) | fault: insulation damaged owtte | B1 |
| | hazard: electrocution **OR** electric shock | B1 |
| 1(b)(i) | earth (wire) | B1 |
| 1(b)(ii) | (switch is connected in) live (wire) | M1 |
| | (so appliance is) disconnected from main / supply **OR** disconnected from high voltage (when switch is open / off) | A1 |

**2** Fig. 8.1 shows two resistors forming part of a circuit.

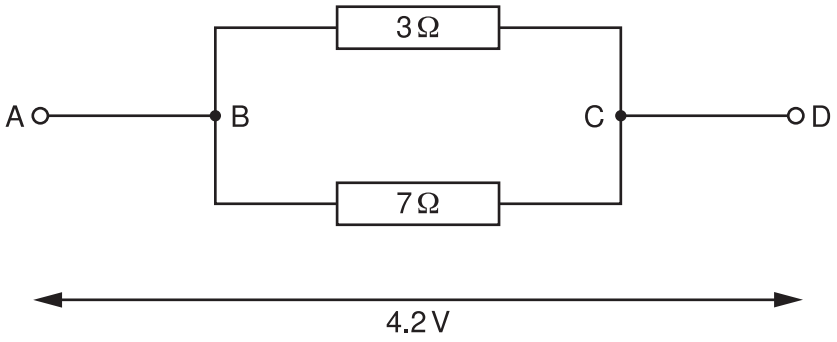



**Fig. 8.1**

**(a) (i)** Complete the following sentence about the two resistors connected between A and D.

The two resistors are connected in ..... . [1]

**(ii)** The potential difference between A and D is 4.2 V.

State the value of the potential difference between B and C.

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

**(iii)** Calculate the current in the 3 Ω resistor.

current = .....[4]

**(iv)** State how the current in AB compares with

**1.** the current in each of the two resistors,

.....

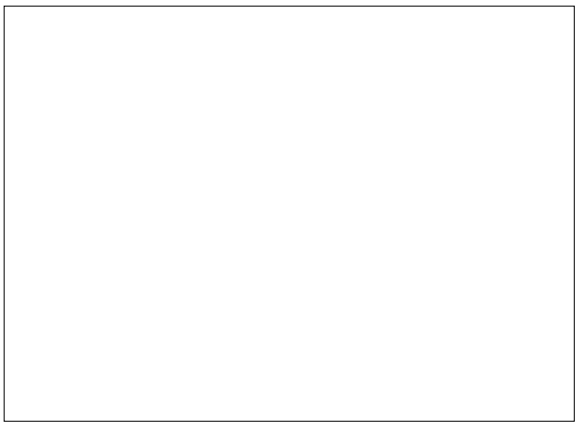
**2.** the current in CD.

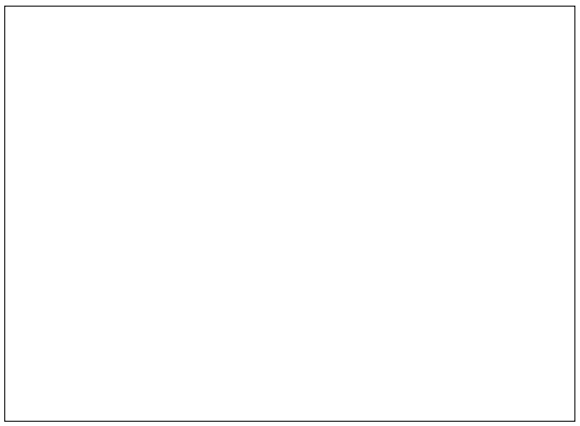
.....[2]

STEM | Exam Builder

**(b)** In the boxes below, draw two circuit diagrams, each containing a battery and three identical resistors. Arrange each circuit so that all the resistors in the circuit carry the same current.

Draw one circuit in each box.





[2]

[Total: 10]

Resistance Click for more variations

**2** **(a)** **(i)** parallel B1

**(ii)** 4.2 (V) B1

**(iii)** V=IR in any form OR V/R C1
4.2 / 3 e.c.f. **(ii)** C1
1.4 e.c.f. **(ii)** A1
A OR amp(s) OR ampere(s) B1

**(iv)** 1. bigger OR the sum of the two currents OR 2 (A) B1
2. same/equal B1

**(b)** clear series connection of all 3 across battery in one circuit B1
clear parallel connection of all 3 across battery in other circuit, and must not be shorted out B1
allow B1 max in (b) if correct series/parallel circuits both shown, but with more or less than 3 resistors in either/both

[10]

STEM | Exam Builder

**3** **(a)** Fig. 10.1 shows two resistors connected in series with a cell and three ammeters.

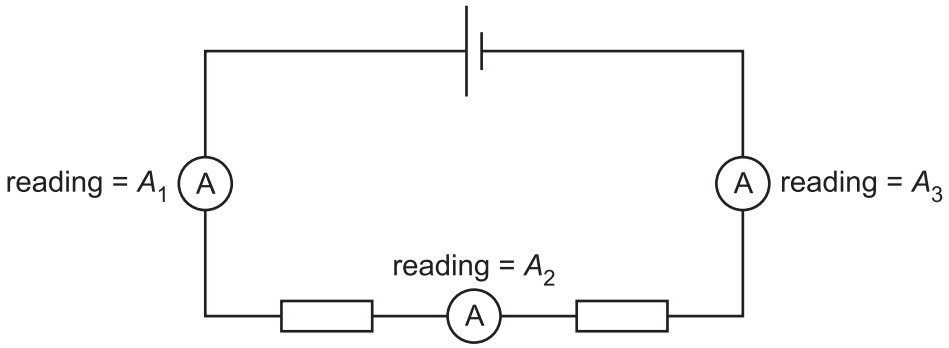



**Fig. 10.1**

**(i)** State the physical quantity that an ammeter measures.

..... [1]

**(ii)** Indicate the correct statement about the readings $A_1$, $A_2$ and $A_3$ on the ammeters in Fig. 10.1.

Tick **one** box.

| | |
|---|---|
| $A_2$ is greater than $A_1$ | |
| $A_2$ is less than $A_3$ | |
| $A_1$ is equal to $A_3$ | |
| $A_1$ is equal to $(A_2 + A_3)$ | |

[1]

**(b)** **(i)** Draw a circuit diagram for a battery connected to two resistors in parallel.

STEM | Exam Builder

[2]

**(ii)** State **one** advantage of connecting lamps in parallel.

..... [1]

**(c)** Fig. 10.2 shows another circuit.

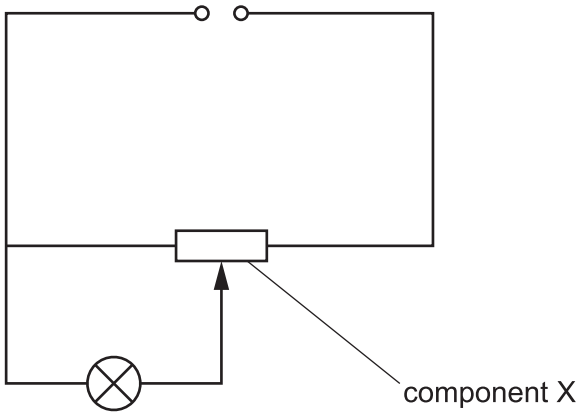



**Fig. 10.2**

The circuit consists of a power supply, a lamp and component X.

**(i)** Name component X in Fig. 10.2.

..... [1]

**(ii)** Suggest **one** use of the circuit.

..... [1]

**(iii)** Describe how to use component X and explain its effect on the circuit.

.....

.....

..... [2]

[Total: 9]

Potential dividers, thermistors, LDRs and diodes Click for more variations

Reduced to 78% to fit the page (wider than A4).

| | | |
|---|---|---|
| 3(a)(i) | (electric) current | **B1** |
| 3(a)(ii) | tick in third box $A_1$ is equal to $A_3$ | **B1** |
| 3(b)(i) | resistors in parallel | **B1** |
| | connected to battery AND correct circuit symbol for battery | **B1** |
| 3(b)(ii) | same brightness / if one fails the rest are still lit / lamps can be switched off independently / same p.d. across owtte | **B1** |
| 3(c)(i) | potential divider / potentiometer | **B1** |
| 3(c)(ii) | dimmer / change light output / intensity | **B1** |
| 3(c)(iii) | move the slider | **B1** |
| | varies p.d. (across lamp) | **B1** |

STEM | Exam Builder

**4** A student investigates how the resistance of a thermistor changes with temperature.
Fig. 9.1 shows part of the circuit the student uses.

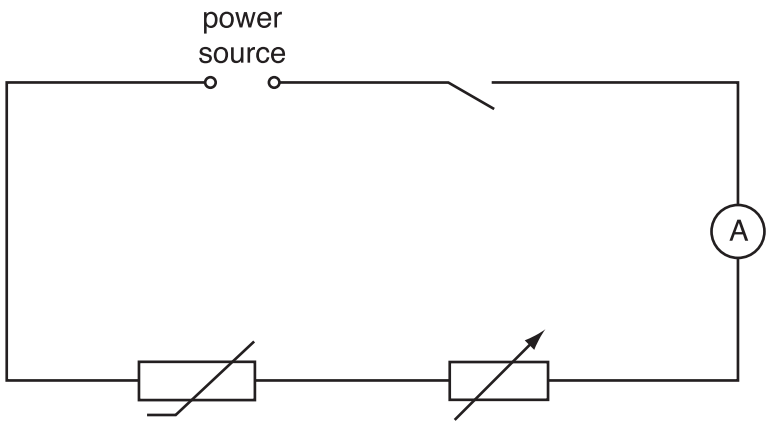



**Fig. 9.1**

**(a) (i)** On Fig. 9.1, label the thermistor. [1]

**(ii)** The student measures the potential difference (p.d.) across the thermistor.
On Fig. 9.1, draw a voltmeter symbol, correctly connected, to measure this potential difference. [2]

**(b)** The student varies the temperature of the thermistor and measures the current in it.
Some of the results are shown in the table.

| temperature of thermistor / °C | 20 | 40 | 60 | 80 |
|---|---|---|---|---|
| current in thermistor / A | 0.005 | 0.010 | 0.040 | |

**(i)** The potential difference across the thermistor is 6.0 V.

Calculate the resistance of the thermistor when its temperature is 40 °C.

STEM | Exam Builder

resistance = ..... Ω [3]

**(ii)** Describe and explain what happens to the current in the thermistor as the temperature of the thermistor rises.

.....

.....

..... [2]

**(iii)** Suggest a value for the current in the thermistor at 80 °C.

.....A [1]

**(c)** At a different temperature, the resistance of the thermistor is 300 Ω and the resistance of the variable resistor is 400 Ω.

Calculate the value of their combined resistance.

combined resistance = ..... Ω [1]

[Total: 10]

Resistance Click for more variations

Reduced to 75% to fit the page (wider than A4).

| | | |
|---|---|---|
| **4**(a)(i) | Thermistor correctly identified | **B1** |
| **4**(a)(ii) | correct symbol for voltmeter | **B1** |
| | Voltmeter in parallel with thermistor | **B1** |
| **4**(b)(i) | V= IR | **C1** |
| | (R) = 6.0 ÷ 0.010 | **C1** |
| | 600 (ohms or Ω) | **A1** |
| **4**(b)(ii) | Resistance is decreasing | **B1** |
| | So current will increase | **B1** |
| **4**(b)(iii) | Current greater than 0.04 (A) | **B1** |
| **4**(c) | 700 (ohms or Ω) | **B1** |

STEM | Exam Builder

5 **(a)** Fig. 9.1 shows a hazardous scenario of using electricity in a kitchen.

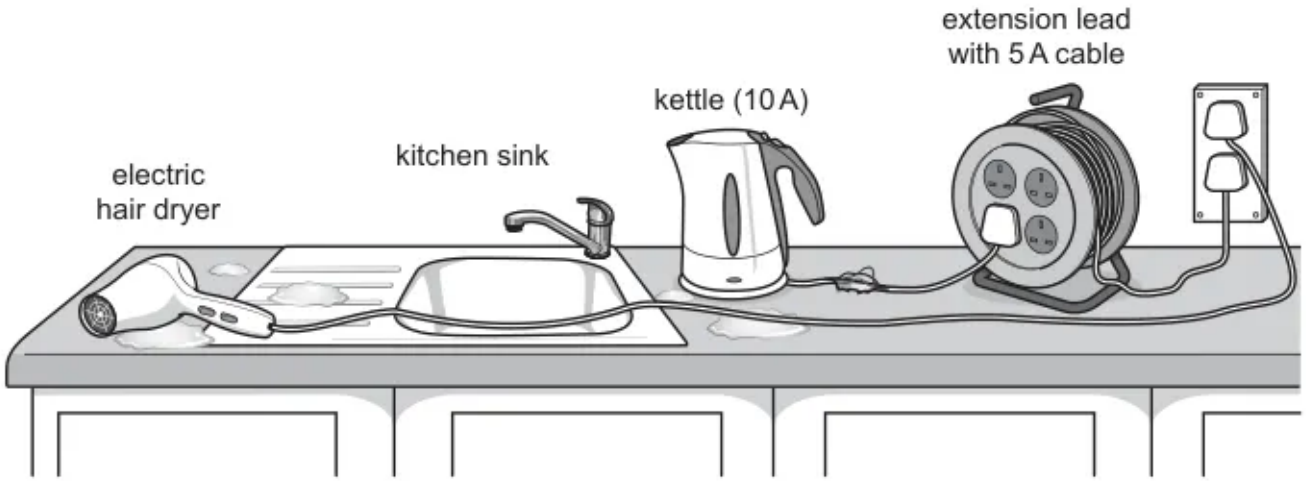



**Fig. 9.1**

**(i)** Identify **three** electrical hazards in Fig. 9.1.

1. .....

2. .....

3. .....

[3]

**(ii)** Give **two** possible consequences of the electrical hazards in Fig. 9.1.

1. .....

.....

2. .....

.....

[2]

STEM | Exam Builder

**(b)** Fig. 9.2 shows the circuit for a hair dryer.

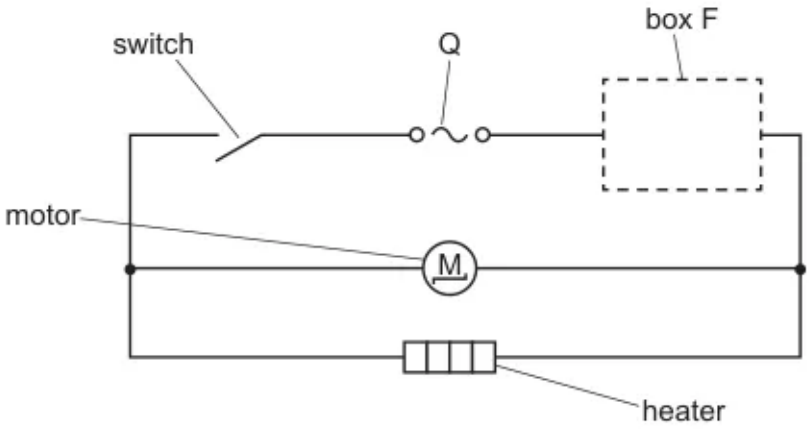



**Fig. 9.2**

**(i)** State the name of the component labelled Q in Fig. 9.2. ..... [1]

**(ii)** On Fig. 9.2, in the dashed box F, draw the circuit symbol for a fuse. [1]

**(iii)** State the purpose of a fuse.

..... [1]

**(iv)** State an advantage of using a circuit breaker instead of a fuse.

..... [1]

**(c)** A different hair dryer has a fuse and two heat settings.

When the hair dryer is used on the low heat setting, the current in the hair dryer is 5.2 A.
When the hair dryer is used on the high heat setting, the current in the hair dryer is 8.9 A.

Circle **one** correct fuse rating for this hair dryer.

**5A** **10A** **13A** **15A** **30A** [1]

[Total: 10]

Electrical safety Click for more variations

Reduced to 77% to fit the page (wider than A4).

| | | |
|---|---|---|
| 5(a)(i) | **any three** from:<br>damaged insulation owtte<br>coiled cables<br>damp / wet conditions<br>5 A / thin cable connected to (10 A) kettle owtte | **B3** |
| 5(a)(ii) | overheating / fire | **B1** |
| | electric shock | **B1** |
| 5(b)(i) | a. c. (power) supply | **B1** |
| 5(b)(ii) |  | **B1** |
| 5(b)(iii) | to protect a circuit / prevents excess currents owtte | **B1** |
| 5(b)(iv) | easy to reset / quick to reset OR reusable | **B1** |
| 5(c) | 13 A | **B1** |

**6** **(a)** State and explain why electrical sockets and plugs used outside in a garden need to be different from those that can be used safely in a room inside a house.

.....

.....

.....

..... [2]

**(b)** State and explain why fuses and circuit breakers are installed in electrical circuits connected to the mains supply.

.....

.....

.....

..... [2]

[Total: 4]

Electrical safety Click for more variations

Reduced to 78% to fit the page (wider than A4).

| | | |
|---|---|---|
| **6**(a) | conditions (outdoors) may be damp / wet | **C1** |
| | water conducts (electricity) OR clear statement of need for waterproof / outdoor specification (components) | **A1** |
| **6**(b) | protects components / appliances / circuit / wires / user / mains supply<br>prevents electrical supply overheating / fires / electrocution / shocks | **B1** |
| | excess current / power in circuit / wires OR fuse melts / blows OR circuit breaker opens | **B1** |

STEM | Exam Builder

7 Fig. 9.1 shows a circuit containing an LED and two resistors in parallel, each of resistance *R*.

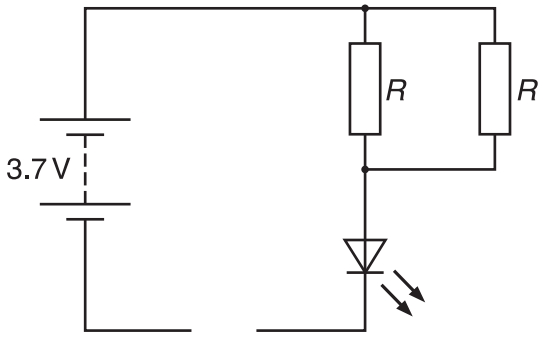



**Fig. 9.1**

The normal operating voltage of the LED is 2.1 V and the normal current is 0.19 A.

**(a) (i)** The potential difference (p.d.) across the LED is measured with a voltmeter.

On Fig. 9.1, draw the symbol for this voltmeter connected to the circuit. [1]

**(ii)** The current in the LED is measured with an ammeter.

On Fig. 9.1, draw the symbol for this ammeter connected to the circuit. [1]

**(b)** Calculate the value of *R* when the LED is operating normally.

*R* = ..... [5]

[Total: 7]

Series and parallel circuits Click for more variations

Reduced to 78% to fit the page (wider than A4).

| | | | |
|---|---|---|---|
| 7(a)(i) | voltmeter shown connected across LED | | **B1** |
| 7(a)(ii) | ammeter shown connected in series with LED | | **B1** |
| 7(b) | p.d. across two resistors in parallel = (3.7 – 2.1 =) 1.6 V | resistance of circuit = (3.7 / 0.19) = 19.5 Ω<br>AND resistance of LED (= 2.1 / 0.19) = 11.1 Ω | **B1** |
| | combined resistances of two resistors in parallel = R / 2<br>OR<br>$1 / R = 1 / R_1 + 1 / R_2$<br>OR<br>$R = R_1 R_2 / R_1 + R_2$<br>OR<br>current in either R = I / 2 | resistance across parallel combination of resistors<br>= (19.5 – 11.1) = 8.4 Ω | **B1** |
| | $R = V / I$ in any form | $R = V / I$ in any form | **C1** |
| | $R / 2 = 1.6 / 0.19$ | $R / 2$ = 8.4 Ω | **C1** |
| | 17 Ω | 17 Ω | **A1** |

STEM Exam Builder

**8** Fig. 9.1 shows a circuit with a 3-position switch.

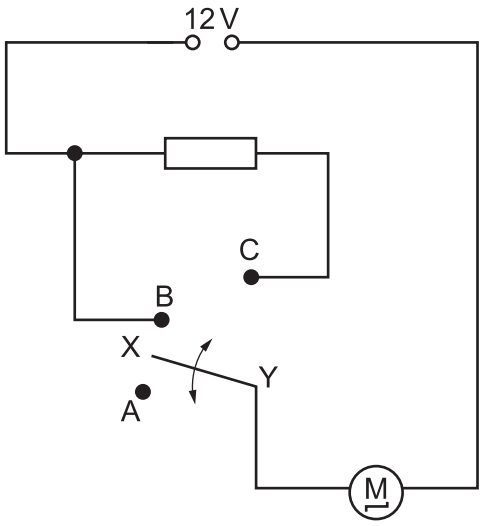



**Fig. 9.1**

The moving part of the switch is always connected to point Y around which it pivots. The other end of the moving part, labelled X, can be connected to one of the points A, B or C.

**(a)** The resistance of the motor is 2.0 Ω and the resistance of the resistor is 3.0 Ω.

Determine the current in the motor when the switch is connected to:

**(i)** point A

current = ..... [1]

**(ii)** point B

current = ..... [2]

**(iii)** point C.

current = ..... [2]

**(b)** Two resistors of resistance 2.0 Ω and 3.0 Ω are connected in parallel.

Calculate the combined resistance of the resistors in this arrangement.

STEM | Exam Builder

resistance = ..... [3]

[Total: 8]

Series and parallel circuits Click for more variations

| | | |
|---|---|---|
| **8**(a)(i) | 0 (A) | **B**1 |
| **8**(a)(ii) | ($I$ = 12 / 2 =) 6.0 A | **A2** |
| | ($I$ =) $V$ / $R$ in any form | C1 |
| **8**(a)(iii) | ($I$ = 12 / 5 =) 2.4 A | **A2** |
| | ($R_s = R_1 + R_2$ = 2 + 3 =) 5 (Ω) | C1 |
| **8**(b) | ($R_p$ = 6 / 5 =) 1.2 Ω | **A3** |
| | $1/R_p = 1/R_1 + 1/R_2$ OR ($R_p$ =) $R_1 R_2 / (R_1 + R_2)$ | C1 |
| | $1/R_p = 1/2 + 1/3$ OR ($R_p$ =) $2 \times 3 / (2 + 3)$ | C1 |

STEM | Exam Builder

**9** Fig. 9.1 shows current–potential difference (p.d.) graphs for a resistor, a thermistor and a filament lamp.

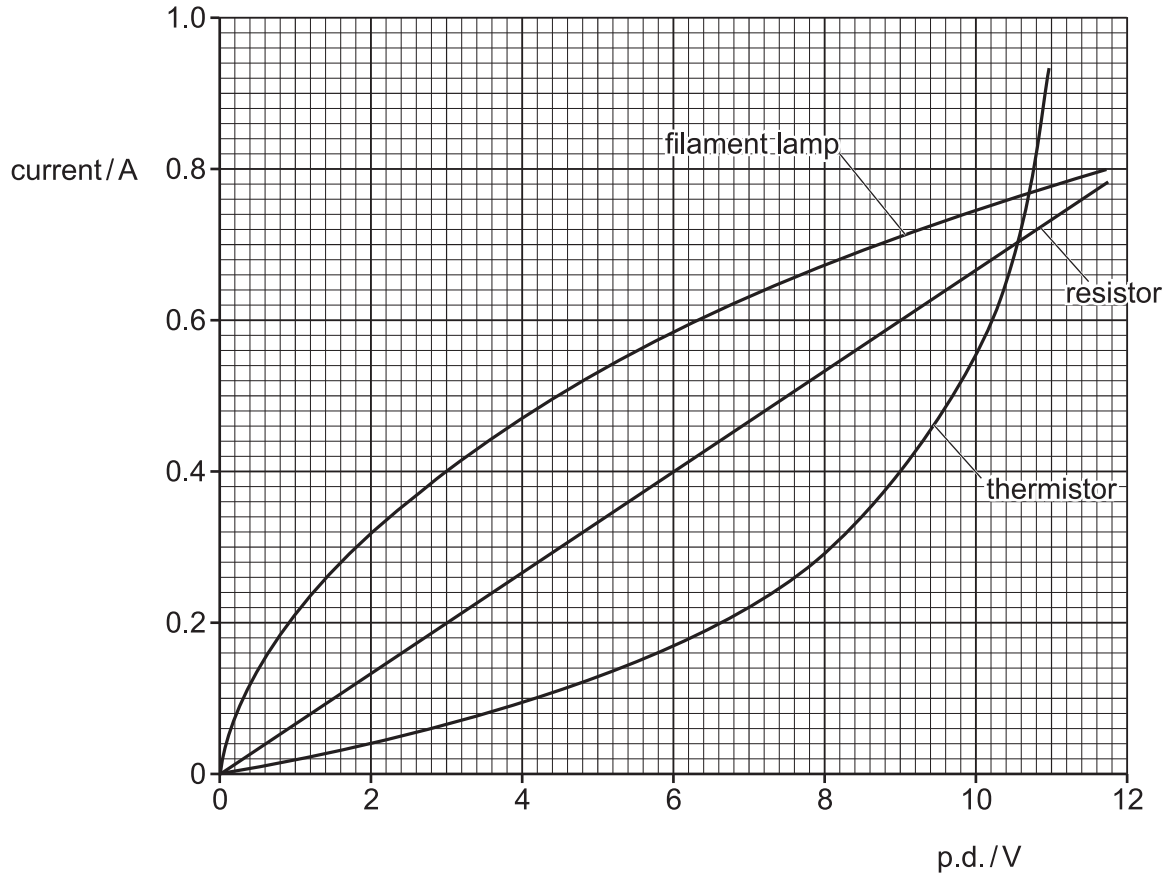



**Fig. 9.1**

The resistor, the thermistor and the filament lamp are connected in series with a power supply.

**(a) (i)** Draw a circuit diagram for this circuit.

[2]

STEM | Exam Builder

**(ii)** Add a voltmeter to your circuit diagram in **(a)(i)** in a correct position to measure the p.d. across the resistor. [1]

**(iii)** Using the graph in Fig. 9.1, determine the p.d. across the terminals of the power supply when the p.d. across the resistor is 6.0 V.

p.d. across terminals of power supply = ..... [4]

**(b)** Describe a practical use for a thermistor.

.....

..... [1]

[Total: 8]

Series and parallel circuits Click for more variations

Reduced to 78% to fit the page (wider than A4).

| | | |
|---|---|---|
| 9(a)(i) | | **B2** |
| | four components joined in series | B1 |
| | all circuit symbols correct for resistor, thermistor, a filament lamp and a power supply | B1 |
| 9(a)(ii) | voltmeter connected in parallel to the resistor | **B1** |
| 9(a)(iii) | (p.d. across terminals of power supply) = 18 V | **A4** |
| | (current through resistor when p.d. across it is 6.0 V =) 0.4 A | C1 |
| | current same through all components in series circuit<br>OR horizontal line through 0.4 A on graph through all three curves<br>OR p.d. across filament lamp = 3.0 V<br>OR p.d. across thermistor = 9.0 V | C1 |
| | p.d. across filament lamp = 3.0 V AND p.d, across thermistor = 9.0 V | C1 |
| 9(b) | any sensible use requiring temperature control or depending on temperature, e.g. fire alarms, to keep computers cool (by operating fan), in incubators, electronic thermometer, electronic thermostat in kettle / car engine | **B1** |

STEM | Exam Builder

**10** Fig. 7.1 shows a circuit that contains a battery, a switch, a voltmeter and three 40 Ω resistors, $R_1$, $R_2$ and $R_3$.

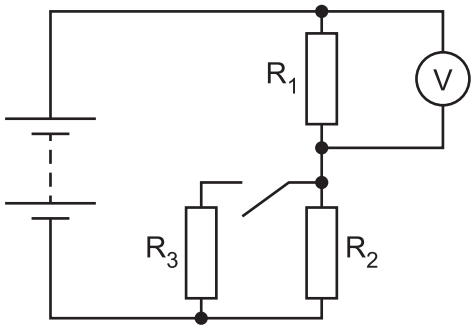



**Fig. 7.1**

The switch is open and resistors $R_1$ and $R_2$ form a potential divider.

**(a)** Describe what is meant by a potential divider.

.....

.....

..... [2]

**(b)** The reading on the voltmeter is 7.5 V.

**(i)** Calculate the electromotive force (e.m.f.) of the battery.

e.m.f. = ..... [1]

**(ii)** The switch is closed.

Calculate the resistance of the complete circuit.

resistance = ..... [3]

**(c)** Calculate the reading on the voltmeter when the switch is closed.

reading = ..... [2]

[Total: 8]

Potential dividers, thermistors, LDRs and diodes Click for more variations

STEM | Exam Builder

| | | |
|---|---|---|
| **10**(a) | any **two** from:<br>• (potential divider) splits / shares / divides the e.m.f. / voltage / potential difference / p.d. (of a power source / in a circuit)<br>• (e.m.f. is) split between (two) resistors / components (connected in series to power source)<br>• (potential divider shares e.m.f.) in proportion to the resistances (of the resistors / components) | **B2** |
| **10**(b)(i) | (e.m.f. =) 15 V | **B1** |
| **10**(b)(ii) | (resistance =) 60 Ω | **A3** |
| | ($R_{II}$ =) $R_2R_3$ / ($R_2$ + $R_3$) **OR** ($R_{II}$ =) 40 × 40 / (40 + 40) **OR** ($R_{II}$ =) 1600 / 80<br>**OR** 1 / $R_{II}$ = 1 / $R_2$ + 1 / $R_3$ **OR** 1 / $R_{II}$ = 1 / 40 + 1 / 40 **OR** ($R_{II}$ =) (1 / 40 + 1 / 40)$^{-1}$ **OR** ($R_{II}$ =) 20 (Ω) | C1 |
| | (resistance =) 40 + (candidate's value for combined resistance of $R_2$ and $R_3$) | C1 |

| | | |
|---|---|---|
| **10**(c) | (reading =) 10 V | **A2** |
| | emf shared in same proportion as resistance<br>**OR** e.g. $R_1$ / $R_{II}$ = $V_1$ / $V_{II}$<br>**OR** (reading =) 15 × 40 / 60 **OR** (reading =) 0.25 × 40 | C1 |

STEM | Exam Builder