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

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Series and parallel circuits

Time allowed: 1 hour 5 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

/ 66

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 66 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.

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

1 A student has devised the circuit in Fig. 7.1 to control the lighting of three lamps, A, B and C.

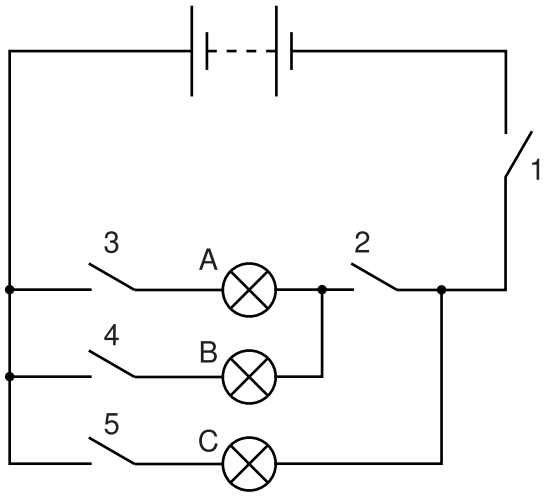


Fig. 7.1

More than one switch must be closed in order to light any lamp.

(a) In the table below, put ticks to indicate which switches **must** be closed in order to light the lamps. The first row has been completed for you.

lamp that is lit	switches closed				
	1	2	3	4	5
lamp A only	✓	✓	✓		
lamp B only					
lamp C only					

[3]

(b) **All** the switches are now closed.

Which of the lamps light up? ..... [1]

(c) Which one switch **must** be open to ensure that none of the lamps light up? ..... [1]

[Total: 5]

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1 **(a)**

lamp that is lit	switches closed				
	1	2	3	4	5
lamp A only	✓	✓	✓		
lamp B only	✓	✓		✓	
lamp C only	✓				✓

B1

B2

ignore any additions for lamp A
for C allow B1 only for ✓ ✓ ✓

(b) all of them OR A, B and C B1

(c) (switch) 1 B1

[Total: 5]

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2 **(a)** In a room in a house there are four electric lamps in parallel with each other, controlled by a single switch.

With all the lamps working, one of the lamp filaments suddenly breaks.

What, if anything happens to the remaining lamps? Explain your answer.

.....

.....

.....

.....[2]

(b) Fig. 10.1 shows the circuit diagram for the lamp in another room. X and Y are 2-way switches.

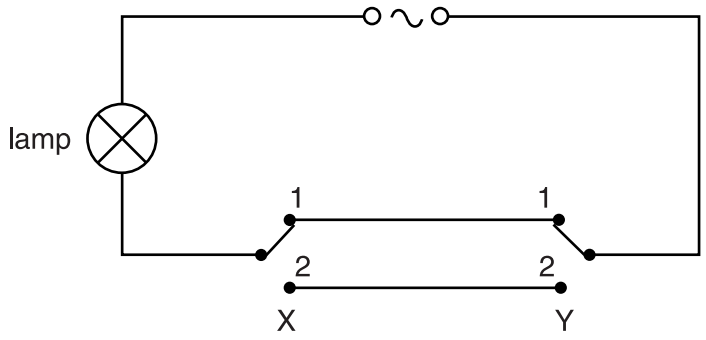


Fig. 10.1

(i) Complete the table, by indicating whether the lamp is on or off for each of the switch positions.

position of switch X	position of switch Y	state of lamp
1	1	
1	2	
2	1	
2	2	

[2]

(ii) Explain why this arrangement of switches is useful.

.....

.....[1]

[Total: 5]

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2 **(a)** (lamps) stay on / have same brightness as before / nothing happens B1
(lamps) still connected to supply / have same voltage as before / are connected in parallel B1

(b) **(i)** line 1: on line 2: off line 3: off line 4: on B2
deduct one mark for e.e.o.e.

(ii) when either switch is operated, the state of the lamp changes. B1

[Total: 5]

3 In the circuit of Fig. 9.1, a 12V car battery is connected to three identical lamps and two switches. The resistance of the battery is so small that it may be ignored.

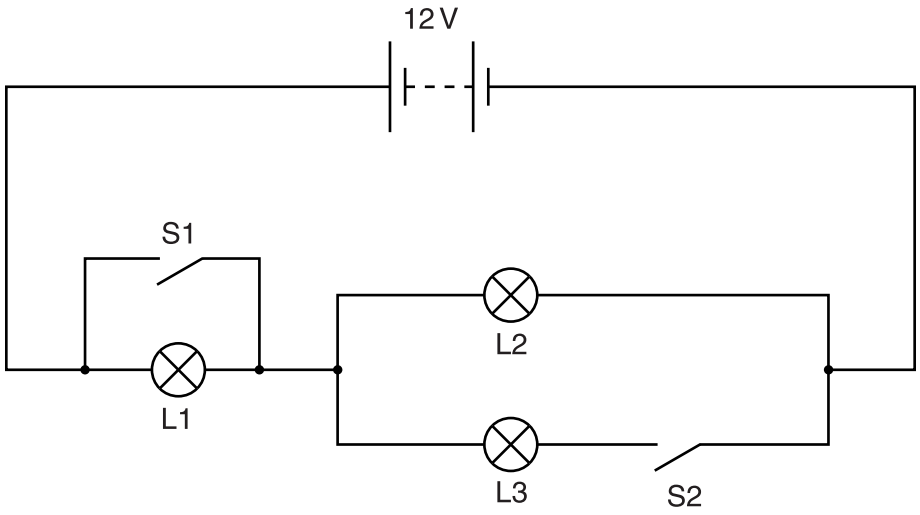


Fig. 9.1

(a) **(i)** When switches S1 and S2 are both open, which two lamps are in series?

..... and .....

(ii) When switches S1 and S2 are both closed, which two lamps are in parallel?

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

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(b) Each of the three lamps glows with full brightness when there is a p.d. of 12V across the lamp.

With a smaller p.d., a lamp will glow with partial brightness.

With no p.d. across it, it will be off.

Complete the tables below, to show how the lamps glow with different switch combinations. Tick one box in each row.

	switch combination: **S1 closed** and **S2 open**		
	full brightness	partial brightness	off
L1			
L2			
L3			

[2]

	switch combination: **S1 open** and **S2 closed**		
	full brightness	partial brightness	off
L1			
L2			
L3			

[2]

[Total: 6]

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3 **(a)** **(i)** L1 and L2 B1

(ii) L2 and L3 B1

(b) L1 off
L2 full
L3 off
} – 1 e.e.o.o. B2

L1 partial
L2 partial
L3 partial
} – 1 e.e.o.o. B2

[6]

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4 Fig. 11.1 shows lamps in series. Fig. 11.2 shows lamps in parallel.

The lamps are all identical 6.0 V lamps. In each circuit there are three ammeters A_1, A_2 and A_3.

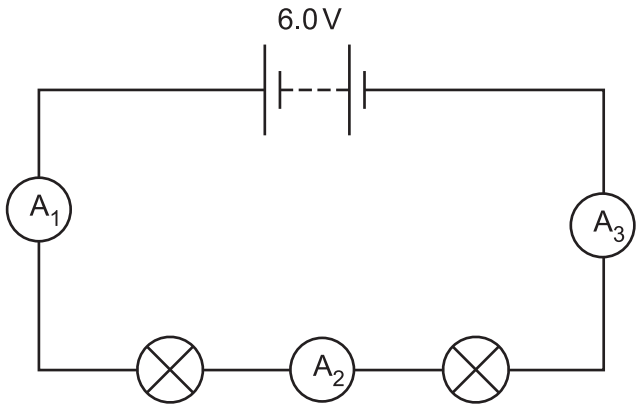


Fig. 11.1

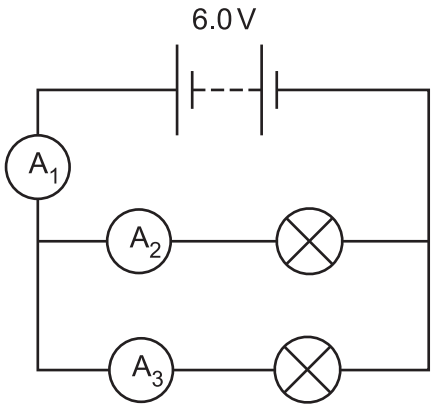


Fig. 11.2

(a) (i) Compare the readings on ammeters A_1, A_2 and A_3 in Fig. 11.1.

..... [1]

(ii) Compare the readings on ammeters A_1, A_2 and A_3 in Fig. 11.2.

..... [1]

(iii) State **two** advantages of connecting the 6.0 V lamps in parallel with the 6.0 V battery, compared with connecting the lamps in series with the battery.

1. .....

.....

2. .....

.....

[2]

(b) Each lamp has a resistance of 12 Ω.

(i) Determine the combined resistance of the two lamps connected in **series**.

resistance = ... Ω [1]

(ii) Compare the resistance of one lamp with the combined resistance of the two lamps in **parallel**.

.....

..... [1]

[Total: 6]

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4(a)(i)	the ammeters all have the same reading	B1
4(a)(ii)	the reading on A_1 is the biggest	B1
4(a)(iii)	lamps have normal brightness (in parallel) or brighter (than lamps in series)	B1
	If one lamp fails the other lamp is still lit	B1
4(b)(i)	24 (Ω)	B1
4(b)(ii)	(resistance of one lamp / 12 (Ω)) is more (than the combined resistance (of lamps in parallel))	B1

5 Fig. 8.1 shows a circuit.

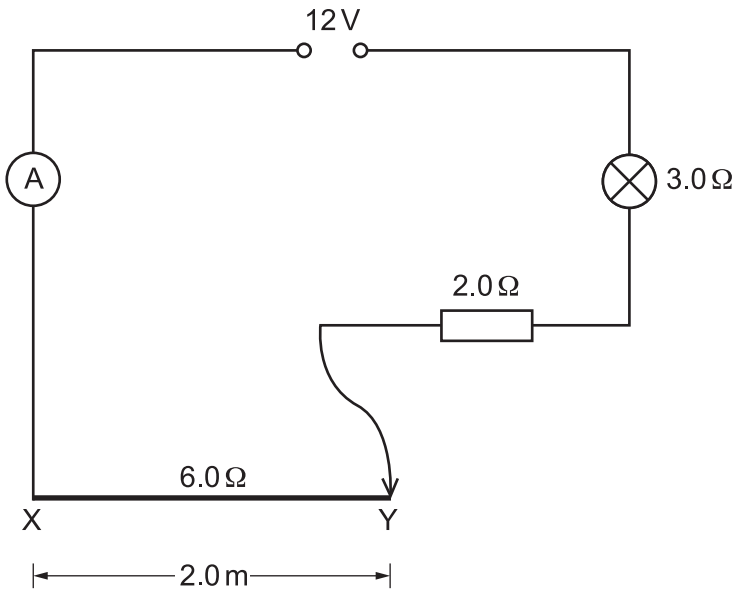


Fig. 8.1

The lamp has a resistance of 3.0 Ω. Line XY represents a uniform resistance wire of resistance 6.0 Ω.

(a) Calculate the reading on the ammeter.

ammeter reading = ... [2]

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(b) Fig. 8.2 shows the circuit with a different connection to the resistance wire and an added resistor. The length XY of the whole resistance wire is 2.0 m. The contact is made at Q where the distance XQ is 0.60 m.

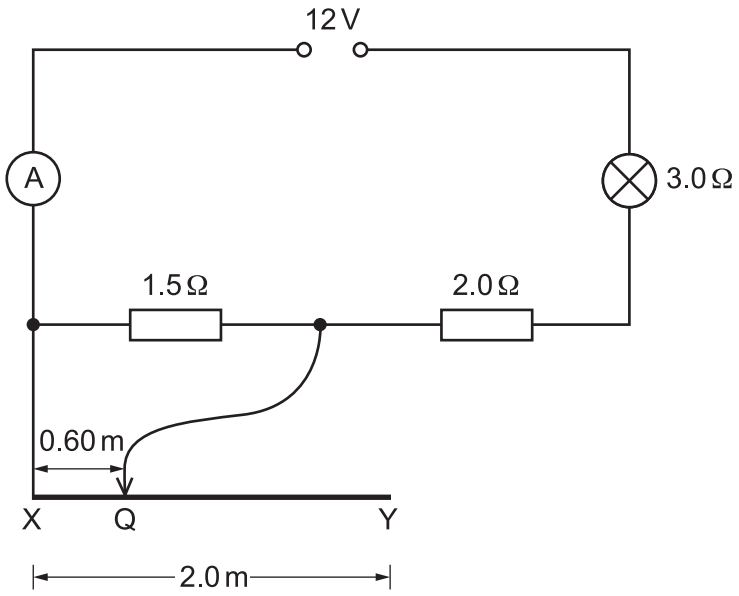


Fig. 8.2

Calculate the resistance of the circuit.

resistance = ... [4]

[Total: 6]

Series and parallel circuits Click for more variations

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5(a)	{$R_s = R_1 + R_2 + R_3$ in any form OR (R_s)= $R_1 + R_2 + R_3$ OR (R_s) = 3 + 2 + 6 (Ω) OR (R_s) = 11 (Ω)} AND {V= IR in any form OR (I=)V / R OR (I=) 12 / 11 (A)}	**C1**
	(I=) 1.1 A	**A1**
5(b)	uses resistance of wire proportional to length OR (resistance XQ =) 6 Ω 0.6 / 2.0 (Ω) OR 1.8 (Ω)	**B1**
	$1 / R_p = 1 / R_1 + 1 / R_2$ OR (R_p=) $R_1R_2 / (R_1 + R_2)$	**C1**
	$1 / R_p = 1 / 1.5 + 1 / (6 \times 0.6 / 2)$ OR (R_p=) $1.5 \times (6 \times 0.6 / 2) / (1.5 + 6 \times 0.6 / 2)$ OR (R_p= $1.5 \times 1.8 / \{1.5 + 1.8\}$) = 0.82 (Ω)	**C1**
	(R = 3 + 2 + 0.82 =) 5.8 Ω	**A1**

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6 Fig. 10.1 shows an incomplete circuit diagram for two identical lamps arranged in parallel. The circuit contains an ammeter and a voltmeter.

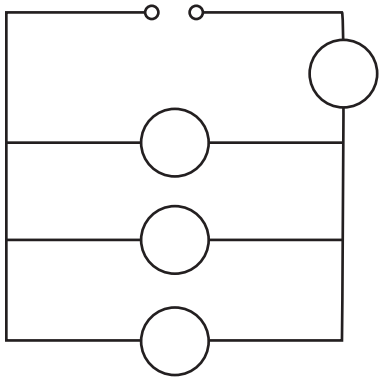


Fig. 10.1

(a) On Fig. 10.1, complete the symbols for two lamps, an ammeter and a voltmeter positioned correctly. [5]

(b) One of the lamps breaks.

State the effect, if any, this has on the brightness of the other lamp. Explain your answer.

effect .....

explanation .....

.....

[2]

[Total: 7]

Series and parallel circuits Click for more variations

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6(a)	ammeter symbol	**B1**
	ammeter in series (with power supply)	**B1**
	voltmeter symbol	**B1**
	voltmeter in parallel (with lamps/power supply)	**B1**
	two lamps in parallel	**B1**
6(b)	(brightness) stays the same	**B1**
	current (in working lamp) stays the same	**B1**

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

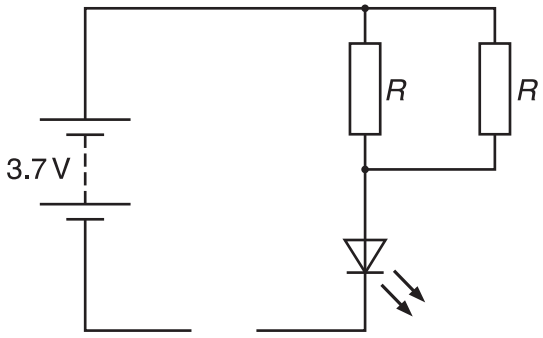


Fig. 9.1

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

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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 AND resistance of LED (= 2.1 / 0.19) = 11.1 Ω	**B1**
	combined resistances of two resistors in parallel = R / 2 OR $1 / R = 1 / R_1 + 1 / R_2$ OR $R = R_1 R_2 / R_1 + R_2$ OR current in either R = I / 2	resistance across parallel combination of resistors = (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**

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

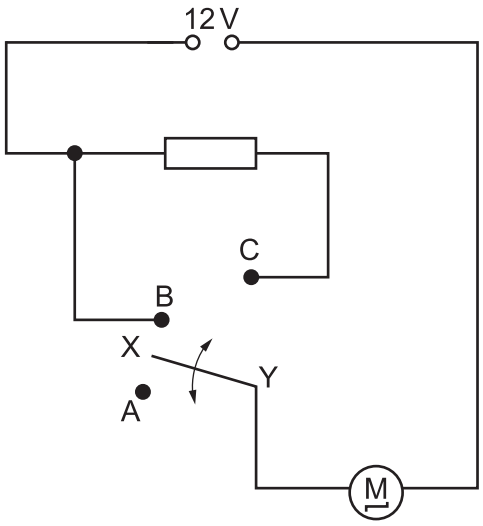


Fig. 9.1

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.

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resistance = ... [3]

[Total: 8]

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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

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

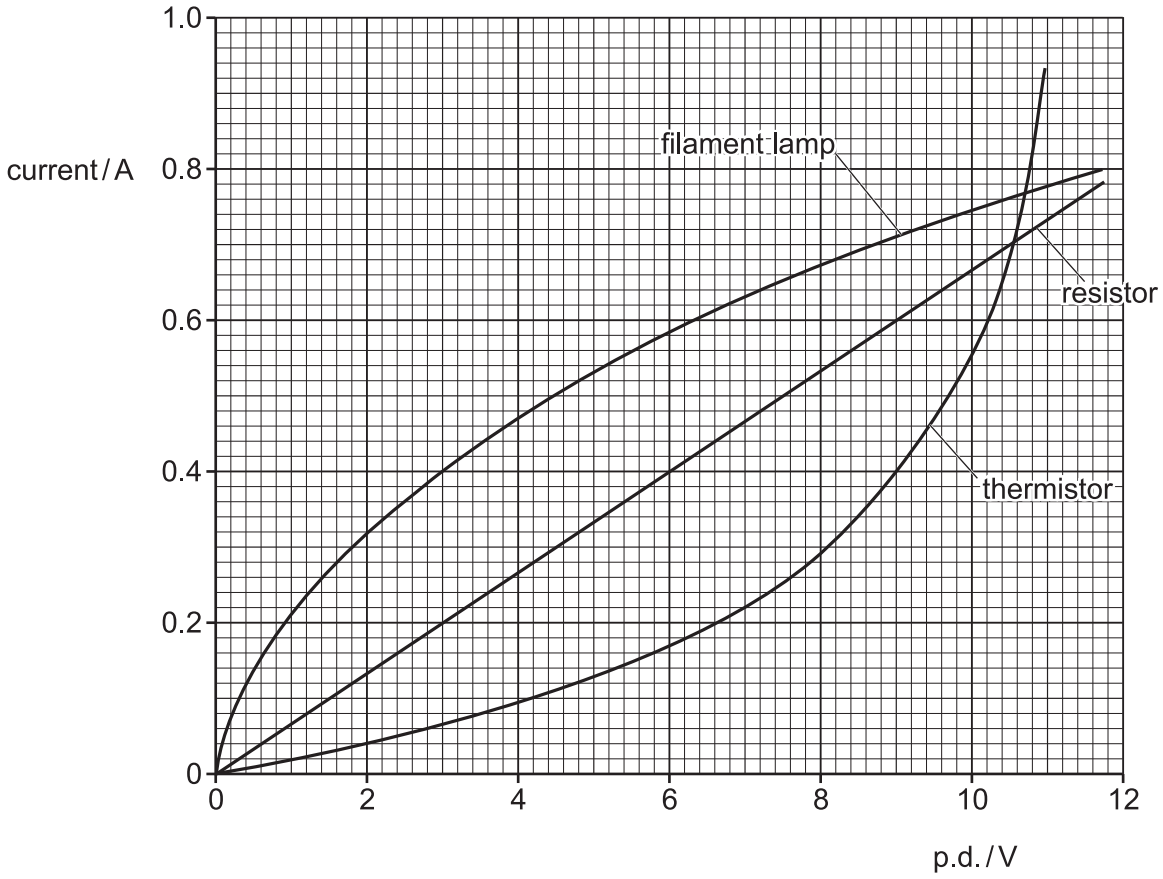


Fig. 9.1

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]

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(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

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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 OR horizontal line through 0.4 A on graph through all three curves OR p.d. across filament lamp = 3.0 V 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**

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10 Fig. 9.1 is a circuit diagram.

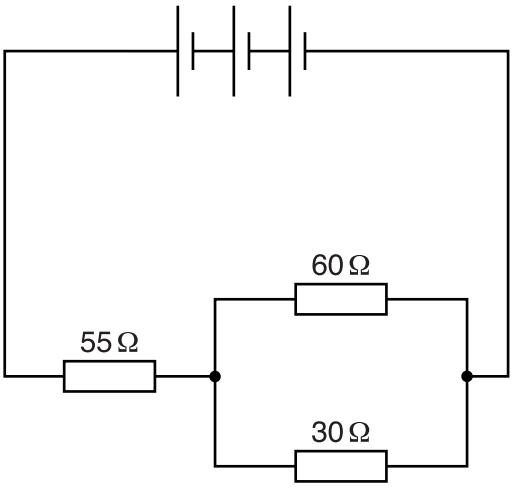


Fig. 9.1

The circuit consists of three resistors and three identical 1.5 V cells.

(a) State the total electromotive force (e.m.f.) of the three 1.5 V cells in series.

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

(b) Calculate

(i) the combined resistance of the resistors in parallel,

resistance = ... [2]

(ii) the total resistance of the circuit,

resistance = ... [1]

(iii) the current in the 55 Ω resistor.

current = ... [2]

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(c) The currents in the 30 Ω, the 55 Ω and the 60 Ω resistors are all different.

State the resistance of the resistor in which the current is

(i) the largest,

resistance = ... [1]

(ii) the smallest.

resistance = ... [1]

[Total: 8]

Series and parallel circuits Click for more variations

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10(a)	4.5 V	**B1**
10(b)(i)	$1/R = 1/R_1 + 1/R_2$ **OR** $R_1R_2/(R_1+R_2)$	**C1**
	(R =) 20 Ω	**A1**
10(b)(ii)	adds 55 to candidate's previous line	**B1**
10(b)(iii)	I = V / R in any form OR V / R	**C1**
	(I = 4.5 / 75 =) 0.060 A	**A1**
10(c)(i)	reference to 55 Ω resistor	**B1**
10(c)(ii)	reference to 60 Ω resistor	**B1**

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