

Parallel Circuits

Mark Scheme



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1. In a parallel circuit, components are connected across separate branches, meaning the total current splits but the potential difference remains the same across each branch.

- a) The circuit in the figure below shown contains three ammeters A_1 , A_2 and A_3 .
Which ammeter has the largest reading?

A – is the only correct answer.	1 mark
	Total: 1 mark

- b) A student connects a 9 V battery to three identical lamps connected in parallel.
What is the potential difference across the second lamp?

C – is the only correct answer.	1 mark
	Total: 1 mark

- c) A student set up a parallel circuit with two branches using one resistor on each branch.
The figure below shows the two resistors connected in a circuit.
What is the total resistance of the circuit?

A – is the only correct answer.	1 mark
	Total: 1 mark

- d) A $10\ \Omega$ resistor and a $40\ \Omega$ resistor are connected in parallel.
Which statement about the total combined resistance of this arrangement is correct?

A – is the only correct answer.	1 mark
	Total: 1 mark

- e) The figure below shows a parallel circuit.
Which labelled component in the circuit shown controls the brightness of lamp X?

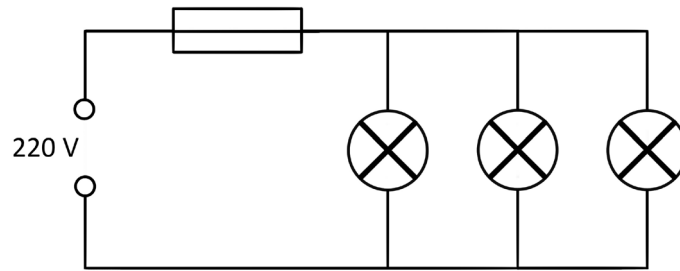
B – is the only correct answer.	1 mark
	Total: 1 mark

- f) A parallel circuit has two branches. The total current leaving the power supply is 1.5 A.
What is the current flowing through the second branch?

B – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 6 marks)

2. The figure below shows 3 lamps and a fuse connected in a parallel circuit to a power supply.



The potential difference of the supply is 220 V. Each lamp has a power rating of 110 W.

- a) Calculate the current flowing through one of the lamps.

$I = P \div V$	$I = 110 \div 220$	$I = 0.5 \text{ A}$	1 mark
			Total: 1 mark

- b) Calculate the total current flowing through the fuse when all 3 lamps are switched on.

0.5 A	1 mark
	Total: 1 mark

- c) The rating of the fuse is 5.0 A.

Calculate the maximum number of these lamps, all in parallel, that could be connected without the fuse melting.

$5 \div 0.5$	1 mark
= 10 lamps	1 mark
	Total: 2 marks

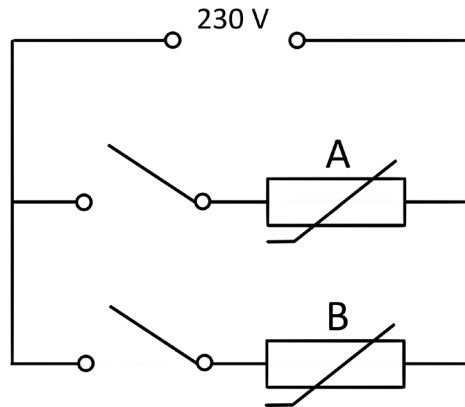
- d) While the circuit is switched on, the filament of one of the lamps breaks, so the lamp goes out.

State and explain the effect of this broken lamp on the brightness of the remaining two lamps.

The brightness will stay the same / there will be no effect.	1 mark
Because the potential difference across the remaining lamps is still 220 V (and the resistance of those lamps hasn't changed)	1 mark
	Total: 2 marks

(Total for Question 2 is 6 marks)

3. The electrical circuit in a temperature control system contains two thermistors, A and B, connected in parallel. The figure below shows the circuit.



When both switches are closed, the current in thermistor A is 0.15 A.

- a) Calculate the power developed in thermistor A.

Substitution: $P = V \times I$ $P = 230 \times 0.15$	1 mark
Final answer: 34.5 W	1 mark
	Total: 2 marks

- b) The resistance of thermistor A is three times the resistance of thermistor B.

Determine the total resistance of the circuit.

Current in resistor B: $I_B = 0.15 \times 3 = 0.45$ A	1 mark
Determine total current: $I_{\text{total}} = 0.15 + 0.45 = 0.60$ A	1 mark
Use of Ohm's law: $R = V \div I$ $R = 230 \div 0.60$	1 mark
Final answer: $R = 383.3$	1 mark
	Total: 4 marks

(Total for Question 3 is 6 marks)

4. A homeowner is having an extension built on their house and needs to install three new ceiling lights.

The electrician explains that the ceiling lights should be wired in a parallel circuit, rather than a series circuit.

Compare the advantages and disadvantages of connecting the lights in a parallel circuit rather than a series circuit.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple, isolated statements are made about parallel or series circuits. For example, "if one breaks the others stay on" or "they are brighter." The physics principles are weakly applied.
Level 2	3 - 4	A relevant comparison that addresses both parallel and series circuits but may lack detail. The student might focus heavily on just the advantages of a parallel circuit, or make points without explaining the underlying circuit rules.
Level 3	5 - 6	A detailed, coherent, and logically structured comparison. The student discusses both advantages and disadvantages of using a parallel circuit for the ceiling lights, clearly contrasting them with a series circuit using correct physics terminology (e.g., potential difference, current).

Indicative content:	
Advantages of a parallel circuit (disadvantages of series): • If one ceiling light breaks / blows, the other two lights will stay on (because the branches provide separate paths for the current). • You can add individual switches to each branch, meaning the lights can be turned on and off independently of each other. • In a parallel circuit, every light gets the full potential difference of the mains power supply (230 V). • Therefore, the ceiling lights will be at their maximum / normal brightness. • (In contrast, in a series circuit the potential difference is shared, so the three lights would be very dim). • Adding more lights in parallel decreases the total resistance of the circuit. Disadvantages of a parallel circuit (advantages of series): • A parallel circuit requires much more wiring to create the separate branches (which is more expensive/difficult to install). • The total current drawn from the power supply is higher in a parallel circuit (because the total resistance is lower). • If too many parallel branches are added, the total current can become too high, which could cause the wires to overheat / create a fire hazard (or blow a fuse/trip a breaker).	
	Total: 6 marks

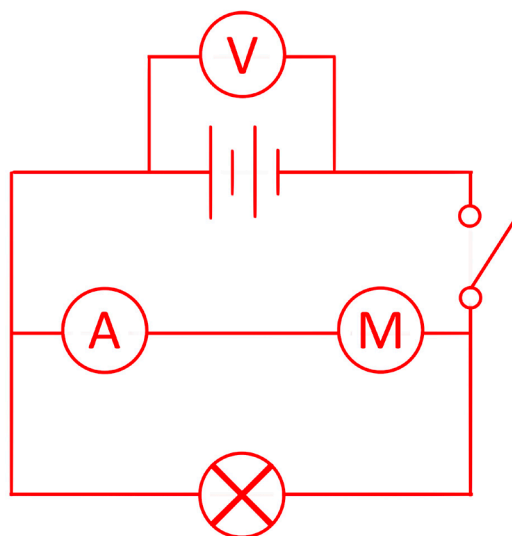
(Total for Question 4 is 6 marks)

5. A student is designing an electrical circuit for a model car.
The circuit must contain a battery, a motor, and a filament lamp.

Draw a circuit diagram for the student's design.

Your diagram should have the following:

- The motor and the filament lamp must be connected in parallel with each other.
- A single switch must be able to turn both the motor and the lamp on and off at the same time.
- An ammeter must be placed to measure the current flowing through the motor only.
- A voltmeter must be placed to measure the potential difference across the battery.



Accept any correct version of the above diagram.

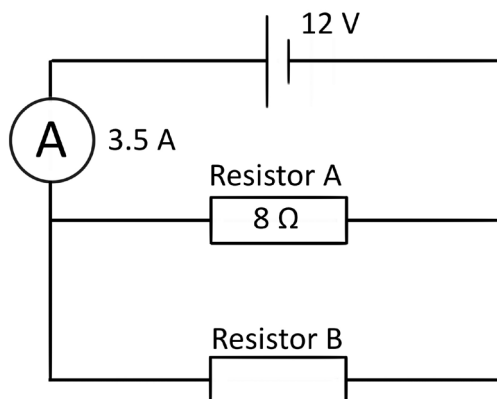
Circuit diagram to include the following:

- Correct symbols drawn for a battery, a motor (M in a circle), and a filament lamp (cross in a circle).
- The motor and filament lamp are drawn on separate, parallel branches.
- A switch is drawn on the main branch (so it is in series with the battery, controlling the whole circuit).
- An ammeter is drawn in series on the motor branch only.
- A voltmeter is drawn in parallel directly across the battery.

Total: 5 marks

(Total for Question 5 is 5 marks)

6. The circuit diagram shows two resistors, A and B, connected in parallel to a 12 V battery. The total current leaving the battery is 3.5 A. The resistance of resistor A is $8.0 \, \Omega$

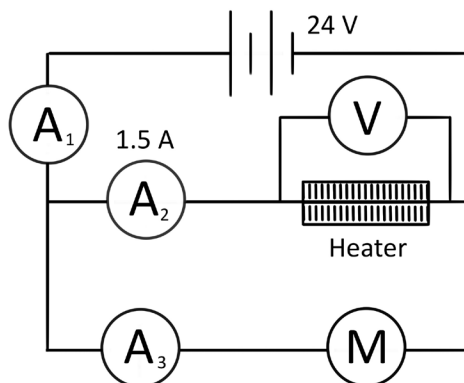


Calculate the total energy transferred by resistor B when the circuit is switched on for 5 minutes.
Use the correct physics equations from your data sheet.

Calculate current in resistor A: $I = V \div R$ $I = 12 \div 8$ $I = 1.5 \, \text{A}$	1 mark
Calculate current in resistor B: $I_B = I_{\text{total}} - I_A$ $I_B = 3.5 - 1.5$ $I_B = 2.0 \, \text{A}$	1 mark
Convert time to seconds: $t = 5 \times 60 = 300 \, (\text{s})$	1 mark
Substitution into energy equation: $E = V \times I \times t$ $E = 12 \times 2.0 \times 300$	1 mark
Final answer: 7200	1 mark
Total: 5 marks	

(Total for Question 6 is 5 marks)

7. A student builds the circuit shown in the figure below to investigate the properties of a heater and a motor connected in parallel.



- a) State the reading that should be shown on voltmeter V1.

24	1 mark
	Total: 1 mark

- b) Use your answer to part (a) and the reading on ammeter A2 to calculate the resistance of the heater.

$R = V \div I$	1 mark
$R = 24 \div 1.5$	1 mark
$R = 16 \Omega$	1 mark
	Total: 3 marks

- c) The electric motor in the bottom branch operates with a power output of 108 W.
Calculate the current flowing through the motor. This is the missing reading for ammeter A3.

$I = P \div V$	1 mark
$I = 108 \div 24$	1 mark
$I = 4.5 \text{ A}$	1 mark
	Total: 3 marks

- d) The student leaves the circuit switched on for 10 minutes.

Calculate the total charge that flows through the battery during this time.

$I_{\text{total}} = 1.5 + 4.5 = 6.0 \text{ A}$	1 mark
$t = 10 \times 60 = 600 \text{ s}$	1 mark
$Q = 3600 \text{ C}$	1 mark
	Total: 3 marks

- e) The student adds a third branch to the circuit containing a filament lamp.

Explain what happens to the total resistance of the circuit and the reading on ammeter A1.

The total resistance of the circuit will <u>decrease</u> .	1 mark
Because adding a parallel branch provides an additional path for current, so the total current / <u>reading on A1 will increase</u> .	1 mark
	Total: 2 marks

(Total for Question 7 is 13 marks)