My Question Paper

1.

(a) Complete the sentences below using words from the box. [3]
Each word may be used **once, more than once, or not at all**.

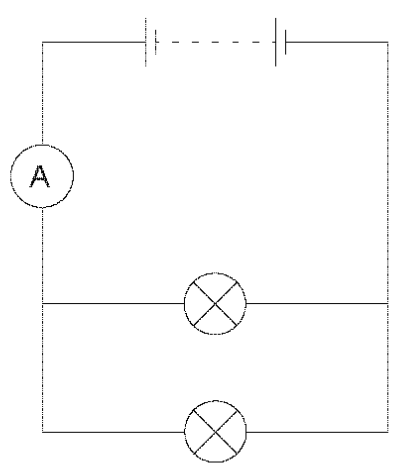
voltage	power	current

(i) An ammeter measures the ..... through a circuit.

(ii) When lamps are connected in series they all have the same ..... through them.

(iii) When lamps are connected in parallel they all have the same ..... across them.

(b) Two identical lamps, each of resistance 8Ω are connected in parallel. They are connected to a 12 V battery.



(i) Use the equation:

$$\text{current} = \frac{\text{voltage}}{\text{resistance}}$$

to calculate the current through one lamp. [2]

current = ... A

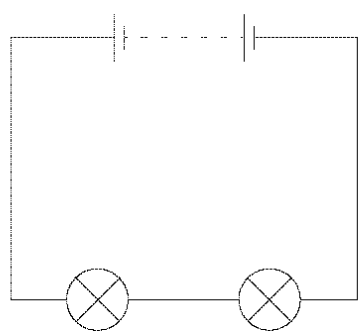
(ii) What is the reading on the ammeter? [1]

..... A

(iii) Use an equation from page 2 to calculate the power of one lamp. [3]

power = ... W

(c) The same two lamps are now connected in series with the same battery.
The resistance of the circuit has now increased so it is **four times bigger** than when the lamps were in parallel.



Describe fully the effect this has on the current through the battery. [2]

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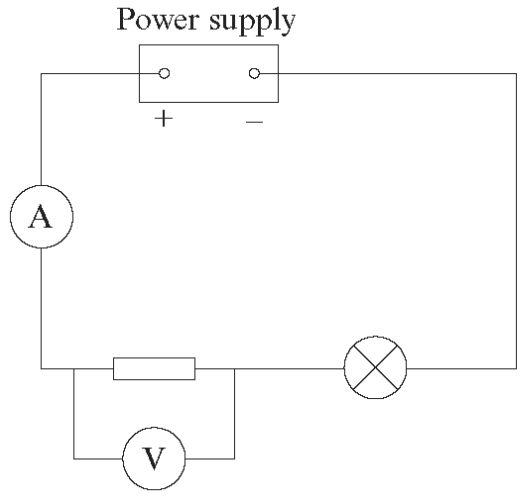
2. A student measures the voltage across a resistor and the current through it using the circuit below.

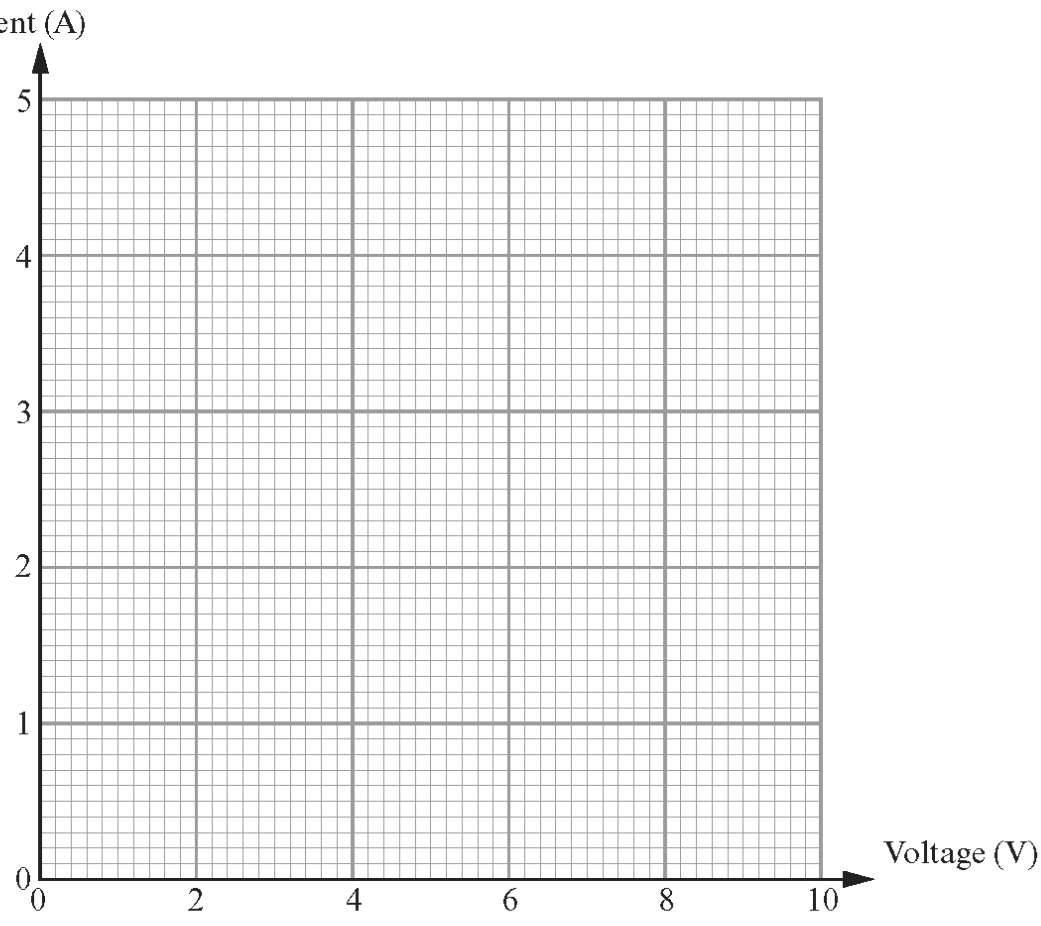


(a) The ammeter in the diagram reads **3.0 A** and the voltmeter reads **9.0 V**.

(i) Write down the size of the current that flows through the **lamp**. [1]

Current = ... A

(ii) Plot these ammeter and voltmeter readings as a **point** on the grid below. [1]



(iii) Draw the graph **line** for the resistor on the grid opposite. [1]

(b) (i) Use the equation:

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of the resistor when the voltage is 9.0 V. [3]

Resistance = ...

Unit of resistance .....

(ii) Use an equation from page 2 to calculate the power of the resistor when the voltage is 9.0 V. [3]

Power = ...

Unit of power .....

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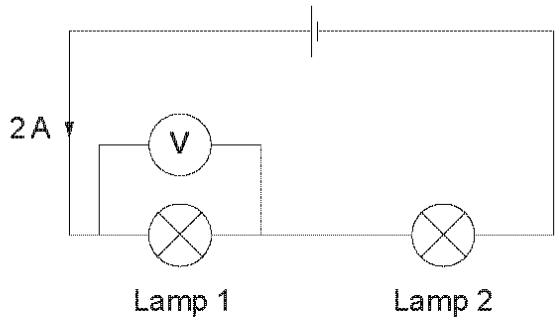
3. A student sets up the following circuit:



The current through lamp 1 is 2 A and the voltmeter reading is 4 V.

(a) (i) Use the information above and the equation:

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of lamp 1. [2]

Resistance = ... Ω

(ii) Use the information above and the equation:

$$\text{power} = \text{voltage} \times \text{current}$$

to calculate the power of lamp 1. [2]

Power = ... W

(iii) State the current through lamp 2. [1]

Current = ... A

(b) The student adds another lamp in series with lamps 1 and 2. Choose words from the box to complete the following sentences. Each word or phrase may be used **once, more than once or not at all**.

increase	decrease	stay the same

(i) When the extra lamp is added, it causes the current through lamp 1 to

..... and the battery voltage to ..... . [2]

(ii) The extra lamp causes the circuit resistance to ..... . [1]

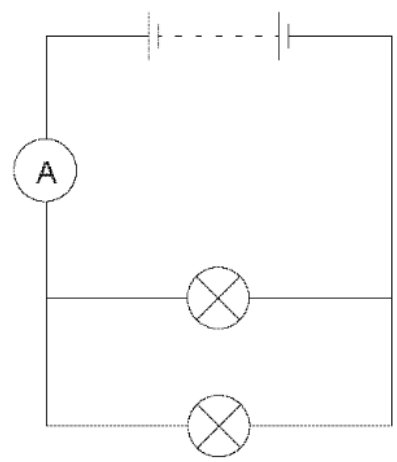
(c) In houses the lamps are connected in parallel instead of series as in the circuit opposite. Give **two** reasons why. [2]

1. .....

2. .....

10

4. Two identical lamps, each having a constant resistance of $8\,\Omega$ are connected as shown.
In this circuit the lamps each have a power output of 18 W.



(a) (i) Use an equation from page 2 to calculate the current through each lamp. [3]

current = ... A

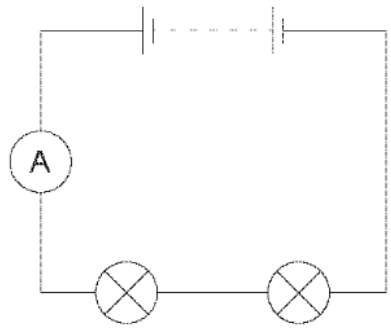
(ii) Write down the reading on the ammeter. [1]

..... A

(iii) Use the equation $V = IR$ to calculate the voltage of the battery. [2]

voltage = ... V

(b) The same two lamps are now connected in series with the same battery.



(i) Explain why the ammeter reading has decreased. [2]

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(ii) Calculate the power dissipated by each lamp in **this** circuit, given that the current is 0.75 A. [2]

power = ... W

(iii) Give a reason why lamps are connected in parallel rather than in series in domestic circuits. [1]

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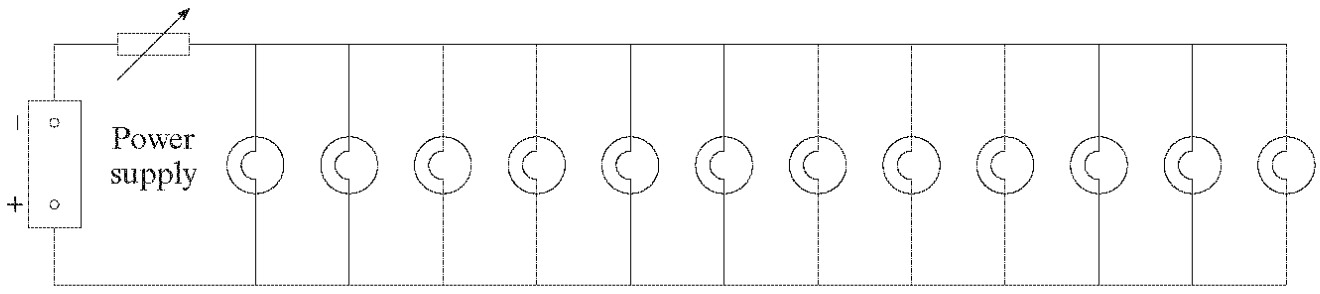
5. A light fitting consists of twelve 40 W lamps connected in parallel. They are connected to the 230 V mains in a circuit in series with a single dimmer switch.



(a) Use an equation from page 2 to calculate the current through each lamp, when all the lamps are operating at normal brightness. [2]

Current = ... A

(b) The lamps are dimmed. At one dimmer switch setting, the resistance of the dimmer switch is 82 Ω and the power loss in the dimmer switch is 118 W.

(i) Use an equation from page 2 to calculate the current through the dimmer switch. [3]

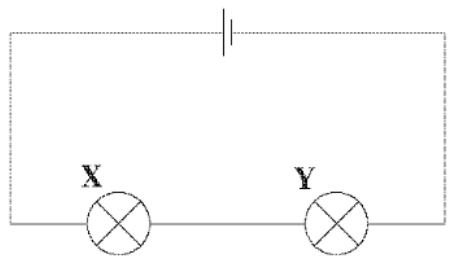
Current = ... A

(ii) Calculate the power produced by each lamp at this dimmer switch setting. [3]

Power = ... W

8

6. Two filament lamps, **X** and **Y**, are connected in series. Lamp **Y** is brighter than lamp **X**.



Choose and write down an equation from page 2 to explain why lamp **Y** is brighter than lamp **X**. [Hint: consider power] [4]

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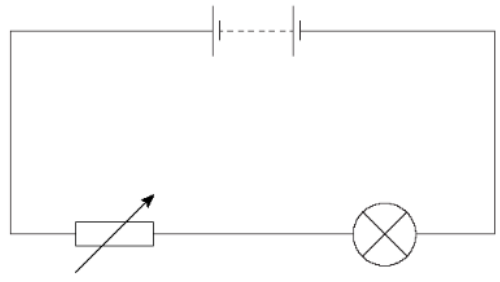
4

7. The diagram shows a lamp connected to a battery and a variable resistor.



(a) (i) Describe how the circuit is used to obtain a **series of measurements** of the voltage across the lamp and the current through it. **You should add symbols to the circuit** of any additional components you would use. [4]

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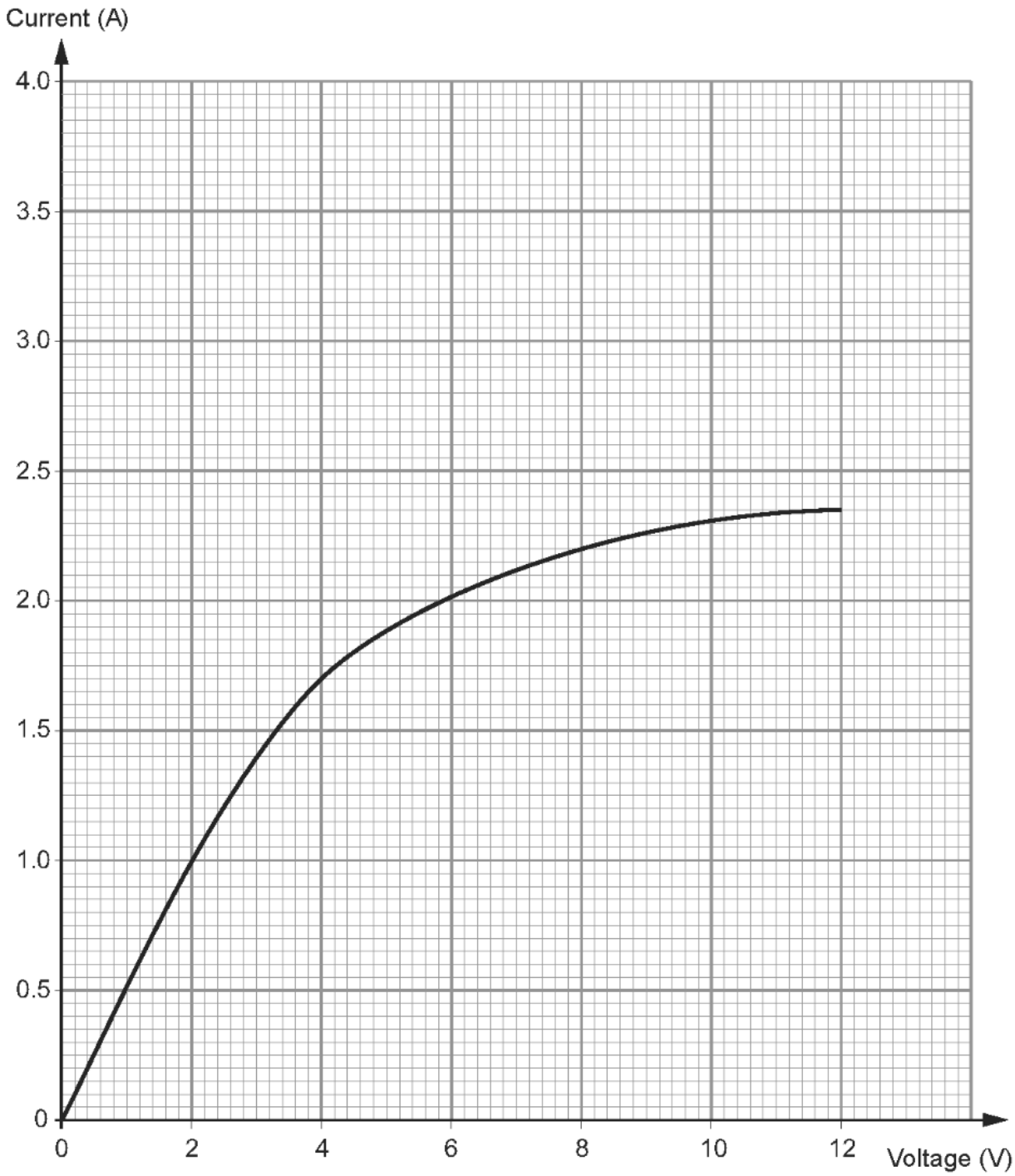
(ii) The results for the lamp are shown on the graph below.



A **resistor** has a resistance of 4Ω. **Draw a line** on the graph above to show the current through it and the voltage across it up to 12 V. [3]

(b) (i) Use the graph and an equation from page 2 to find the power of the lamp when it has the same resistance as the resistor. [3]

..... W

(ii) Compare the resistances of the lamp and resistor when a voltage of 12 V is applied to each. Give a reason for your answer. [2]

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12

Marking Scheme

1.

Question			Marking details	Marks
2.	(a)	(i)	current	
		(ii)	current	
		(iii)	voltage	3
	(b)	(i)	subs $\frac{12}{8}$ (1) = 1.5 [A] (1)	2
		(ii)	3 [A] **ecf - answer must be double the answer to (b)(i)**	1
		(iii)	12 (1) $\times$ 1.5 (1)**(ecf must be 12 x answer to (b)(i))** = 18 [W] (1)	3
	(c)		reduces current (1) by factor of 4 / to 0.75 A (1) **Don't accept** slows down current	2
			Question total	**[11]**

2.

Question			Marking details	Mark
2.	(a)	(i)	3 [A]	1
		(ii)	Point at coordinates (9, 3) ± ½ small square division (ignore any other points that are plotted.	1
		(iii)	Straight(ish) line from origin through (9,3) ± ½ small square division (allow **ecf**)	1
	(b)	(i)	$\frac{9}{3}$ (1) = 3 (1) Ohms or Ω (1) If 3/9 written no marks for substitution and answer can be awarded.	3
		(ii)	9 x 3 (1) = 27 (1) Watts or W or J/s (1)	3
			Question total	[9]

3.

Question			Marking details	Marks
4.	(a)	(i)	$\frac{4}{2}$ (1) = 2 [Ω] (1)	2
		(ii)	2 x 4 (1) = 8 [W] (1)	2
		(iii)	2 [A]	1
	(b)	(i)	Decreases (1) stays the same (1)	2
		(ii)	Increase	1
	(c)		Bulbs can be switched separately / don't go out if one breaks (1) bulbs stay bright [when more added] / same voltage / current doesn't decrease or resistance doesn't increase (1) **OR** converse arguments about series circuits	2
			Question total	**[10]**

4.

Question			Marking details	Marks
3.	(a)	(i)	$P = I^2R$ 18 = $I^2$8 (1-sub), $I^2=\frac{18}{8}$ (1-manip), I = 1.5 [A] (1-answer) **Award 2 marks** for an answer of 2.25 [A] **Award 1 mark** if substitution precedes manipulation.	3
		(ii)	3 [A] **ecf - answer must be double the answer to (i)**	1
		(iii)	Either $V = IR$ V = 1.5 **(ecf)** × 8 (1-sub), = 12 [V] (1) **ecf must be 8 × answer to (i)** **Or** accept $P = VI$ so $V = \frac{18}{1.5}$ **(ecf)** (1-sub+manip) = 12 [V] (1) **ecf applies to 1.5 the value used must be the answer to (i)**	2
	(b)	(i)	**Either:** <u>Supply</u> voltage is unchanged / **current** (**don't accept** amps) has decreased (1) so the circuit resistance must have increased. (1) **The 2nd mark must be linked to the 1st mark.** **OR** voltage <u>across each bulb</u> has decreased (1) and so the **current** (**don't accept** amps) has decreased / but the resistance of each bulb has not changed (1) **The 2nd mark must be linked to the 1st mark.**	2
		(ii)	$P = I^2R$ = 0.75^2 × 8 (1 – sub) = 4.5 [W] (1) **Or** accept $P = VI$ = 6 (**ecf** from (a)(iii)) × 0.75 (1 – sub) = 4.5 [W] (1) **Or** accept $P = V^2 / R$ = 6^2 (**ecf** from (a)(iii)) / 8 (1 – sub) = 4.5 [W] (1)	2
		(iii)	Lamps are more powerful (brighter) [in parallel] / if one fails then the others will still work / they can be switched independently **Accept** they have the <u>supply</u> voltage across them	1
			Question total	**[11]**

5.

Question			Marking details	Mark
5.	(a)		Subs+manip 40/230 (1) $I = 0.17[4]$ [A] (1) [Do not accept 0.173 but accept 0.2]	2
	(b)	(i)	Subs+manip $I^2 = \frac{118}{82}$ (1) = 1.44 (1), I = 1.2 [A] (1) If 1.44 on the answer line then award 2 marks. If 1.43 used, no penalty for rounding I will = 1.19 [A] N.B. $\sqrt{1.4} = 1.18$	3
		(ii)	current through each lamp = $\frac{1.2(ecf)}{12}$ = 0.1 [A] (1) **Either** pd across dimmer = 1.2 x 82 = 98[.4] (1) pd across lamps = 230 – 98.4 **ecf** = 131.6 (accept 132) power = 131.6 **ecf** x 0.1**ecf** = 13.16 [W] (accept 13.2) (1) **OR** resistance of each lamp = $\frac{230}{0.174}$ = 1 322 (1) **ecf** for 0.174 Power = 0.1^2 **ecf** x 1 322 **ecf** = 13.22 [W] (1)	3
			Question total	**[8]**

6.

7.			$P=I^2R$ quoted (1), common current (1), so bigger P [has larger R] (1), Y has bigger R (1) **OR** $P = V$ x I **and** $V = IR$ must be given (1) ($V = IR$ can be implied) Common current (1) Bigger voltage across Y than X (1) Hence bigger R for Y (1) (Do not credit if more than one equation is written unless it is clear that the appropriate equation is used for the argument.)	4
			Question total	**[4]**
			Total for higher tier paper	**[60]**

7.

Question			Marking details	Marks
4.	(a)	(i)	Voltmeter drawn with correct symbol in parallel with the lamp (allow a line through the voltmeter and allow other voltmeters across other components) (1) Ammeter drawn with correct symbol in series with the resistor (1) The [variable] resistor is altered / changes the resistance / resistor changes the current / resistor changes the voltage (1) Take readings <u>each time</u> (1).	4
		(ii)	Any diagonally upwards straight line from origin [as for a resistor] (1) Diagonal line of correct gradient from origin award 2 marks. Calculation of I = 3 A (at foot of page) (1) Point (12, 3) plotted (1) (Point at (12, 3) implies 2nd mark so can be awarded).	3
	(b)	(i)	$P = IV$ or $P = I^2R$ (1) or implied with correct substitution Substitution (1) Answer = 20.25 [W] (1) to be taken from their graph Expected values are: 9 V(± 0.2) , I = 2.25 A (± 0.1)	3
		(ii)	Lamp has greater resistance (1) because it has the smaller current through it / allow calculations of 5.1 Ω [and 4 Ω] (1) Accept converse argument for resistor. (Any reference to power treat as being neutral.)	2
			Question total	**[12]**