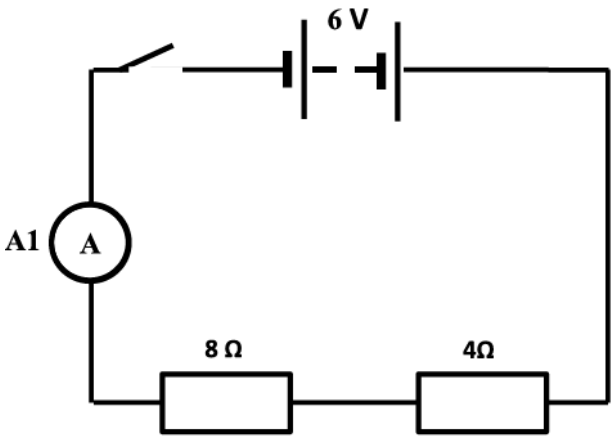
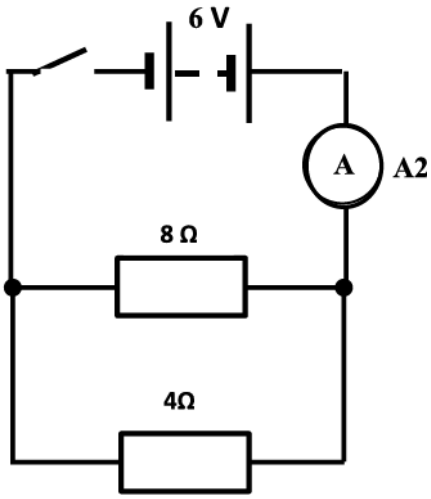
1(a). Lydia is comparing series and parallel circuits in a class practical.



Circuit A



Circuit B

Lydia switches on both circuits.

Put a tick (✓) in the box next to the correct answer.

The reading on A_1 is less than the reading on A_2. ☐

The total resistance in circuit B is 6 Ω. ☐

The p.d. across the 8 Ω is the same in both circuits. ☐

The p.d. across A2 is very large ☐

[1]

(b). Lydia replaces the 4 Ω resistor with a 6 Ω resistor in each circuit.
Complete the following table to show whether each statement is now true for the two circuits.

Put ticks (✓) in the correct boxes.

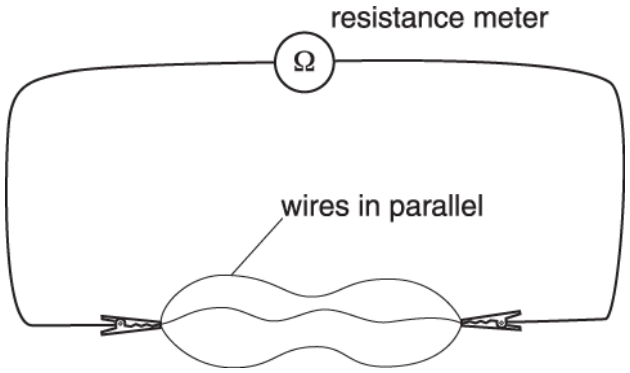
Statement	True for circuit A	True for circuit B	True for both
The current from the battery decreases			
Each unit of charge does less work on the 8 Ω resistor			
The current in the 8 Ω resistor does not change			

[3]

2. Sarah is investigating the resistance of wires connected in parallel.

She uses three wires that are all the same as each other.

She connects the three wires in parallel and uses a resistance meter to measure the resistance.



Sarah does this again for two wires in parallel.

These are her results:

Number of wires in parallel arrangement	Resistance (?)
2	6
3	4

Sarah thinks that there is a correlation between the number of wires and the resistance of the parallel arrangement.

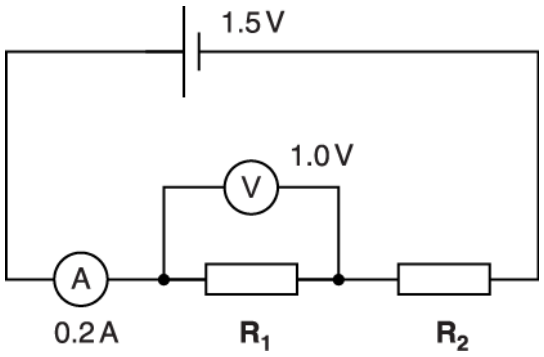
Explain the correlation in Sarah's results and describe ways she could improve this investigation.

The quality of written communication will be assessed in your answer.

[6]

3(a). Tim also connects resistors in series and parallel.

He sets up this series circuit.



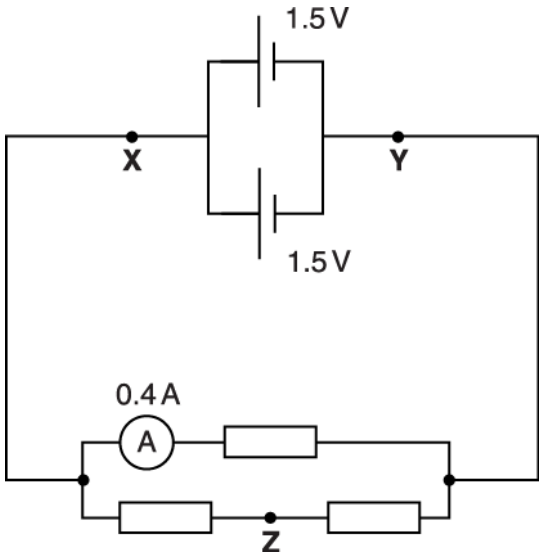
(i) Calculate the resistance of R_1.

resistance of R_1= _____ Ω **[1]**

(ii) What is the voltage across R_2?

voltage across R_2= _____ V **[1]**

(b). He sets up this parallel circuit.



(i) What is the voltage between points **X** and **Y**?

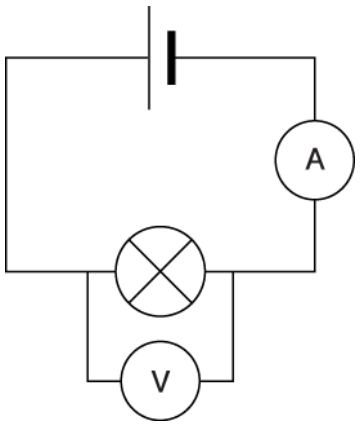
voltage = _____ V **[1]**

(ii) All the resistors have the same resistance.

What is the current through point **Z**?

current = _____ A **[1]**

4(a). Jason sets up the following circuit.



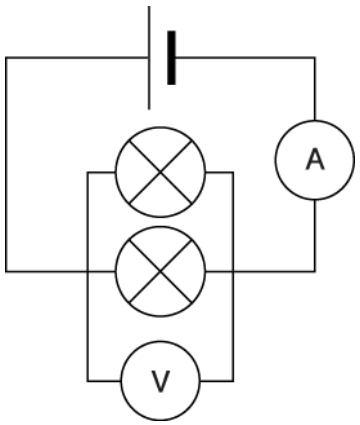
Jason measured the voltage across the lamp to be 1.5 V, and the current through it to be 0.5 A.

Draw a line from each **quantity** to the correct **value**.

quantity	value
	0.33
power (W)	0.75
	1.00
resistance (Ω)	2.00
	3.00

[2]

(b). Jason adds another identical lamp to the circuit, in parallel with the first one.



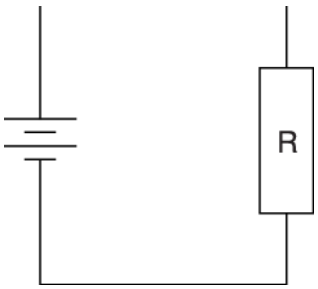
State and explain what happens to the readings on the meters.

--- [3]

5(a). Anna is investigating resistors.

She connects a resistor to a battery, an ammeter and a voltmeter to measure the resistance of the resistor.

Complete the circuit that she should use.



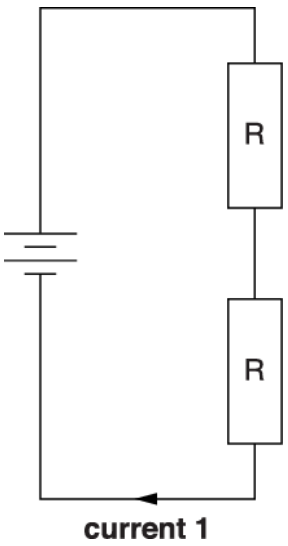
[2]

(b). The current she measures through the resistor, R, in part (a) is 0.2 A.

She then makes changes to her circuit using the same battery and resistor as in part (a).

The following circuits all use resistors and batteries identical to the ones used in part (a).

(i)



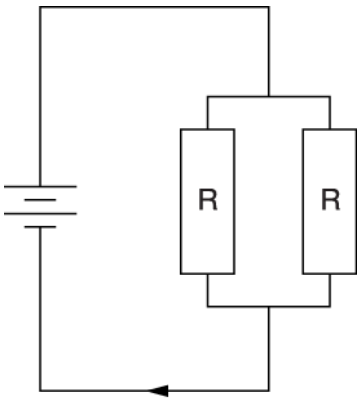
What is current 1?

Put a (ring) around the correct value.

0.1 A 0.2 A 0.3 A 0.4 A

[1]

(ii)



current 2

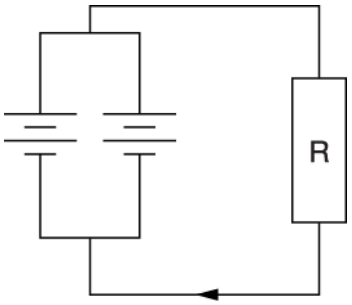
What is current 2?

Put a (ring) around the correct value.

0.1 A 0.2 A 0.3 A 0.4 A

[1]

(iii)



current 3

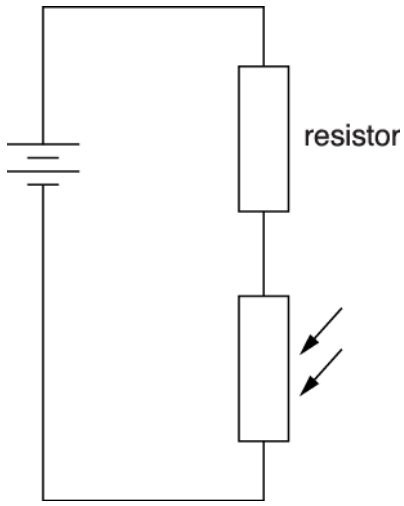
What is current 3?

Put a (ring) around the correct value.

0.1 A 0.2 A 0.3 A 0.4 A

[1]

(c). Anna sets up the circuit shown using a resistor, an LDR and a battery.



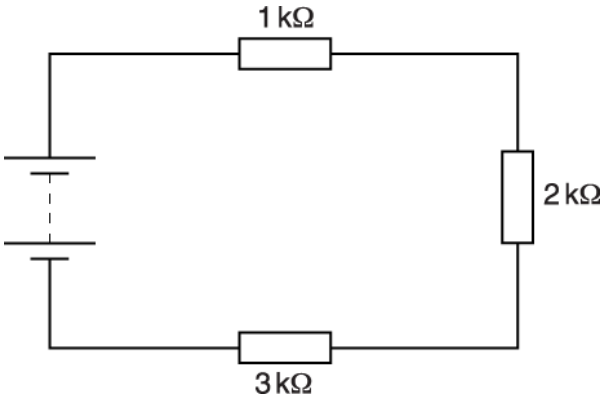
She finds that when she shines a torch on the LDR the voltage across the resistor increases.

Explain why the voltage increases.

---

[3]

6(a). Tim does an experiment using a circuit with three resistors in series.



(i) Which resistor will have the largest potential difference across it? _____

[1]

(ii) Which statement best explains this? Put a tick (✓) in the box next to the correct answer.

The same battery voltage causes a larger current to flow through a smaller resistance than through a bigger one.	☐
More work is done by the charge moving through a large resistance than through a small one.	☐
A change in the resistance of one component will result in a change in the potential difference across all the components.	☐
The current through each component is the same as if it were the only component present.	☐

[1]

(iii) The total potential difference across the three resistors is equal to the potential difference across the battery. Explain this statement, using the idea of work done.

_____

_____

_____

_____ [2]

(b). In another experiment, Tim is using 100 kΩ and 200 kΩ resistors.

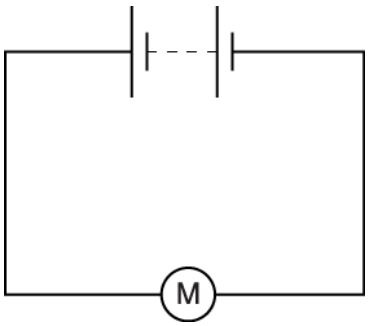
Which arrangement of resistors will have the **smallest** total resistance?

Put a tick (✓) in the box next to the correct answer.

100 kΩ on its own	☐
100 kΩ and 200 kΩ in series	☐
100 kΩ and 100 kΩ in parallel	☐
100 kΩ and 100 kΩ in series	☐

[1]

(c). Tim builds a circuit to test a motor.



He decides to increase the voltage.

(i) He tries adding an identical battery in **parallel** with the first battery.

What will happen to the voltage and the current in the circuit?
Put a tick (✓) in the box next to the correct answer.

voltage increases, current increases	☐
voltage increases, current stays the same	☐
voltage decreases, current increases	☐
voltage stays the same, current stays the same	☐

[1]

(ii) Tim tries using a transformer to change the voltage.
The transformer does not work in this circuit.
Explain why.

---

[2]

END OF QUESTION PAPER

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>a</td><td></td><td>The reading on A_1 is less than the reading on A_2</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>
<table>
<tr><th>Statement</th><th>True for circuit A</th><th>True for circuit B</th><th>True for both</th></tr>
<tr><td>The current from ……</td><td></td><td></td><td>✓</td></tr>
<tr><td>Each unit of charge does ……</td><td>✓</td><td></td><td></td></tr>
<tr><td>The current in the 8 ……</td><td></td><td>✓</td><td></td></tr>
</table>
</td><td>3</td><td>1 mark for each correct row</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>[Level 3]
States and explains the correlation AND describes at least two improvements.
Quality of written communication does not impede communication of the science at this level.

(5 – 6 marks)
[Level 2]
States the correlation AND describes two improvements.
Quality of written communication partly impedes communication of the science at this level.

(3 – 4 marks)
[Level 1]
States the correlation OR describes two improvements.
Quality of written communication impedes communication of the science at this level.

(1 – 2 marks)
[Level 0]
Insufficient or irrelevant science. Answer not worthy of credit.

(0 marks)</td><td>6</td><td>This question is targeted at grade D/C

Indicative scientific points may include:

Correlation:
Statement of correlation

• resistance decreases with more wires / paths / branches
• negative correlation

Explanation of correlation

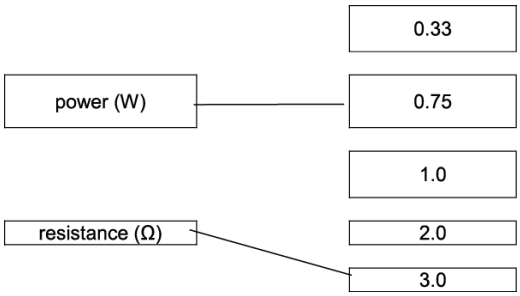
• more wires gives more paths for current / electrons / charge
• greater cross sectional area
• easier for current/electrons / charge to get through
• Use of V = IR

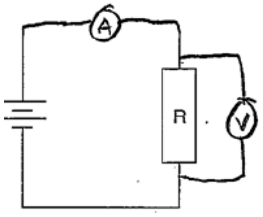
Improvements:

• more wires / longer wires / thicker wires / other wire types
• repeat readings
• find mean / average reading
• control variables (use same meter, leads, temperature)
• connect meter to known resistor
• description of other suitable correct method</td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
					• someone else could reproduce the experiment Use the L1, L2, L3 annotations in RM Assessor; do not use ticks. Examiner's Comments Most candidates were able to state the correlation and so access level 2, but did not attempt an explanation so could not access level 3. Many level 2 answers gave two improvements, such as repeating the experiment and using more or less wires, but some candidates could only be awarded the lower mark of 3 since they only gave one improvement. Vague statements such as 'get more results' were not credited. A few candidates gave an explanation in terms of more pathways for the current to be awarded a level 3. However, explanations in terms of collisions were not credited as they did not answer the question.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
3	a	i	5 (?)	1	Examiner's Comments The rules governing voltages and currents in series and parallel circuits are either not well known or candidates have difficulty applying them. Candidates answered this part the best. Some candidates had difficulty dividing by 0.2.
		ii	0.5 (V)	1	allow ½ Examiner's Comments Many candidates did not recognise the significance of both voltmeter readings in the question. Common wrong answers were 1.5 V and 1.0 V.
	b	i	1.5 (V)	1	allow 1½ Examiner's Comments The rules governing voltages and currents in series and parallel circuits are either not well known or candidates have difficulty applying them. Less than half the candidates were able to give the correct voltage. The most common wrong answer was 3.0 V.
		ii	0.2 (A)	1	allow ? Examiner's Comments Only a few candidates gave the correct answer. The most common wrong answer was 0.4 A.
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
4	a			2	Examiner's Comments The descriptions of the calculations were consistently answered correctly by all but the very weakest candidates
	b		V is the same / I gets bigger why voltage stays the same why current goes up (because resistance is lower)	3	e.g. voltage is the same – as the same number of batteries / cells current is higher – as resistance is lower resistance is lower – as more paths (for charges) current is higher as more paths (for charges) gains one mark if no mention of resistance **accept** higher level answers regarding internal resistance / delivery of current **ignore** mention of lamps and brightness Examiner's Comments Understanding of parallel circuits was very weak, with many candidates unable to differentiate between the voltage and the current correctly. Almost no responses were seen which considered the effect on the overall resistance of the circuit.
			Total	5	

Question			Answer/Indicative content	Marks	Guidance
5	a		correct symbol for ammeter in series with R (1) correct symbol for voltmeter in parallel with R or battery (1)	2	symbols are free-hand circles with a capital letter **ignore** lines through symbols e.g. an ammeter or voltmeter drawn on solid lines **ignore** small gaps next to symbols e.g. of answer gaining 2 marks:  (= 2 marks) **but** if no other mark awarded: **allow** 1 mark if both correct symbols for ammeter **and** voltmeter are seen **Examiner's Comments** The majority of candidates were able to draw the symbol correctly for an ammeter and put it in series with the resistor. Although the voltmeter symbol was drawn correctly its positioning was often incorrect, usually in series with the ammeter and resistor. Some candidates failed to get any marks as their symbols were incorrectly drawn, some as boxes.
	b	i	0.1A (first answer)	1	
		ii	0.4A (fourth answer)	1	
		iii	0.2A (second answer)	1	**Examiner's Comments** Very few candidates gave correct choices for all three parts of this question. Part (iii) was the one most candidates chose wrongly. Often parts (ii) and (iii) were interchanged.

Question			Answer/Indicative content	Marks	Guidance
	c		LDR resistance decreases (1) Either: voltage / pd across LDR decreases (1) Idea that resistor gets increased share / proportion of voltage (1) OR current in circuit increases (1) reference to V = IR for **resistor** (1) OR resistor now has greater proportion of total resistance (1) idea that resistor gets increased share / proportion of voltage (1)	3	**but** if no other mark awarded: **allow** 1 mark for linking increased voltage to increased resistance **or** decreased voltage to decreased resistance Examiner's Comments The majority of candidates failed to achieve any marks for this part. The action of an LDR is not known by many candidates. The most common misconception was that an LDR acted like a solar cell and put voltage into the circuit. Those candidates who correctly stated that the resistance of the LDR decreased when light was shone on it usually went on to say that the current increased but were not able to reason why the voltage across the resistor increased.
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
6	a	i	3 (k?)	1	**allow** identification on diagram **Examiner's Comments** Many candidates chose the correct resistance of 3 (k?). The most common incorrect answer was 1 (k?).
		ii	The same battery voltage causes a larger current to flow through a smaller resistance than through a bigger one. ( ) More work is done by the charge moving through a large resistance than through a small one. (?) A change in the resistance of one component will result in a change in the potential difference across all the components. ( ) The current through each component is the same as if it were the only component present. ( )	1	**Examiner's Comments** A minority of candidates chose the correct answer.
		iii	the work done on each unit of charge by the battery (1) must equal the work done by charge on the circuit components (1)	2	work done by the battery is the same as the work done by all the components = 1 mark **Examiner's Comments** The idea of potential difference being the work done on/by charge is generally not known by candidates. A few correctly mentioned work done by the battery on the charge passing through it, but even fewer went on to discuss work done by charge on the resistors. Many answers described how the pd is shared amongst the resistors without mentioning work done, or applied Kirchhoff's second law in terms of pd or merely quoted the question. Others tried unsuccessfully applying work done = force x distance to the situation.

Question			Answer/Indicative content	Marks	Guidance
	b		100 k? ; 100 k? and 200 k? in series ; 100 k? and 100 k? in parallel ? ; 100 k? and 100 k? in series	1	Examiner's Comments About half the candidates selected the correct answer.
	c	i	voltage increases current increases ; voltage increases current stays the same ; voltage decreases current increases ; voltage stays the same current stays the same ?	1	Examiner's Comments The majority of candidates chose an incorrect answer.
		ii	battery produces d.c. / this circuit is d.c. (1) a.c / varying current is required for transformer (to work) (1)	2	Examiner's Comments This was poorly answered by most candidates. Many thought that the transformer did not work because it was a series circuit, or the voltage was too low, or because there was a motor in the circuit. Those who gave a correct response usually stated that transformers require ac, but some failed to state that the battery gave dc.
			Total	8	