Solution 6·1 & 6·2 Year 1
Answer 1

(16 marks)

(a) When the sliding contact is in contact with Point A only, is the circuit a series or parallel circuit? Circle the correct response: (1 mark)

Series Parallel

Description	Marks
Series	1
Total	**1**

(b) When the sliding contact is in contact with both Points A and B, is the circuit a series or parallel circuit? Circle the correct response: (1 mark)

Series Parallel

Description	Marks
Parallel	1
Total	**1**

(c) The siren has a resistance of 3.00 Ω. If the circuit is powered by a 9.00 V battery, calculate the current, in amperes, when only the siren is operating. (2 marks)

Description	Marks
$I = V \div R$ $= 9 / 3$	1
3.00	1
Total	**2**

(d) When both the lamp and the siren are on, the current supplied by the battery is 1.5 times higher than when the siren is on by itself.

(i) Determine the current, in amperes, in the operating lamp. (3 marks)

Description	Marks
Total current is 1.5×3 $= 4.5$ A	1
Current through lamp $4.5 - 3.0$ $= 1.50$	2
Total	**3**

(ii) Calculate the resistance, in ohms, of the operating lamp. (2 marks)

Description	Marks
$R = V \div I$ $= 9.00 / 1.50$	1
$R = 6.00$	1
Total	**2**

Solution 6·1 & 6·2 Exam Q Year 11
Answer 1 continued

(e) The contact is first placed so that only the lamp comes on. The contact is then moved so that only the siren comes on. Which of these two components has the greater power consumption? Explain. (4 marks)

Description	Marks
siren	1
Potential difference (V) is the same for each of the components	1
$P = VI$ so if 'V' is the same, $P \propto I$ The siren has the larger current therefore draws the greater power	1–2
Total	**4**

(f) Calculate the total power drawn from the battery when both components are switched on. Include the correct unit in your answer. (3 marks)

Description	Marks
$P = VI$ $= 9.00 \times 4.5$	1
40.5	1
W	1
Total	**3**

Answer 2

(5 marks)

(a) Do the arrows on the diagram indicate conventional current or electron current? Circle the correct response. (1 mark)

Conventional current Electron current

Description	Marks
electron current	1
Total	**1**

(b) Calculate the current, in amperes, in the ammeter shown in the circuit diagram above. Show **all** workings. (4 marks)

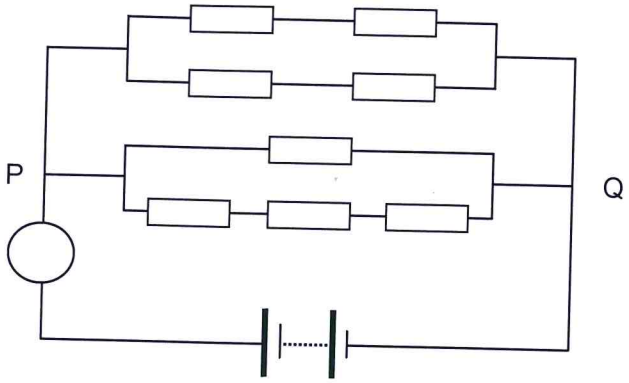
Description	Marks
$150 + 100 = 250$ $\frac{1}{R_p} = \frac{1}{250} + \frac{1}{150}$ $R_p = 93.75$	1–2
$R_T = 93.75 + 50$ $= 143.75$	1
$I = V/R$ $= 12/143.7$ $= 0.0835$	1
Total	**4**

Solution 6.1 & 6.2 Year 11

Answer 3

(7 marks)

Eight equal value resistances are connected between P and Q. The resistance of each of these resistors is 10.0 Ω.



10.0 V

(a) Calculate the total resistance of the circuit, excluding the meter and the power source.

(5 marks)

Description	Marks
$R_{PQ1} = R+R = 2R = 20\ \Omega$	1
$R_{PQ2} = R+R = 2R = 20\ \Omega$	1
$R_{PQ3} = R = 10\ \Omega$	1
$R_{PQ4} = R + R + R = 3R = 30\ \Omega$	1
$R_{total} = R_{PQ1} // R_{PQ2} // R_{PQ3} // R_{PQ3}$ $1/R_t = 1/2R + 1/2R + 1/R + 1/3R = 14/6R \Rightarrow R_t = 6R/14 \Rightarrow R_t = 4.29\ \Omega$	1
	Total 5

(b) The circle represents a meter. What is the reading on this meter (include the unit)?

(2 marks)

Description	Marks
$I = V/R_t = 10 / 4.29 = 2.33$ A	1–2
	Total 2

Answer 4

When the resistance of the potentiometer (R_p) increases (the resistance of R_2 and globe R_3 remaining the same), which of the following happens (ignore the resistance of the globe)?

Description	Marks
(iii) The reading of the voltmeter increases and the globe is darker.	1
the reading of the voltmeter increases because R_p increases	1
globe is darker – as R_p increases and V is constant $\frac{V}{R}$ current must decrease (alternatively power must decrease)	1
	Total 3

Solution 6.1 & 6.2

Year 11

Answer 5

(4 marks)

(a) Sketch a diagram of a circuit that has a total resistance of 15.0 Ω, consisting of only 10.0 Ω resistors. Include a power supply and a switch in your circuit. (2 marks)

(b) Calculate the potential difference required to provide a total current of 1.50 A through the circuit. (2 marks)

Description	Marks
(a) R1 + (R2 in parallel with R3)	1
Switch and power in series (diagram)	1
(b) V=IR=1.5 × 15	1
=22.5V	1
	Total 4

Answer 6

(15 marks)

A set of 16 party lights is purchased to decorate the back patio of a house for a birthday party. When all lights are functional they draw a current of 3.20 A from the 24.0 V transformer supplied. When one globe is removed, half of the globes go out, leaving the other half working. When one of these working globes is removed, the remaining seven working globes go out.

(a) Explain why the other seven globes went out when the second globe was removed, but not when the first globe was removed. (2 marks)

Description	Marks
The two lines are in parallel so only one side goes out	1
The remaining globes are in series, remove one and stop the current flow	1
	Total 2

(b) Draw a simple circuit diagram to show how to wire all 16 globes to the 24 V power supply. (2 marks)

Description	Marks
2 parallel lines of	1
8 globes in series	1
	Total 2

(c) Determine the voltage across each globe. (2 marks)

Description	Marks
$V_T = 8 \times V$; $V = V_T/8 = 24/8$	1
V = 3.00V	1
	Total 2

(d) Determine the current through each globe. (2 marks)

Description	Marks
I through each strand is ½ of 3.20 A	1
I = 1.60A	1
	Total 2

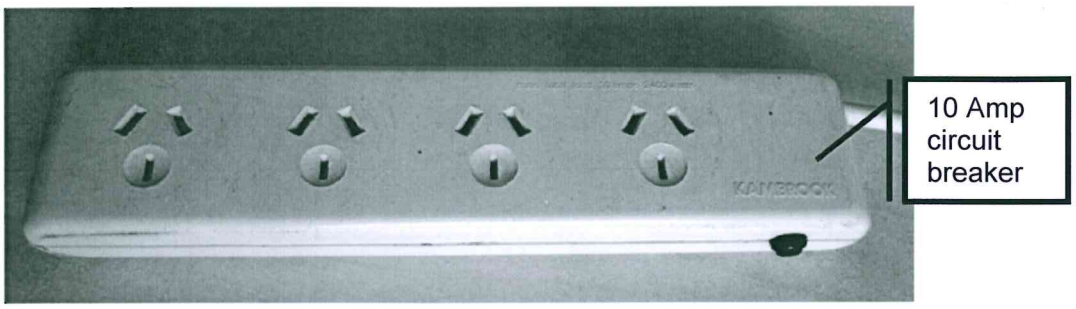
(e) Calculate the power consumed by each globe. (2 marks)

Description	Marks
P = VI	1
P = 3.00 × 1.60 = 4.80 W	1
	Total 2

Solution 6.1 & 6.2
Answer 6 continued

Year 11

(f) If you wanted to have more than one set of lights, you might use a power board similar to the one below. This power board has a 10.0 A circuit breaker built into it, as shown in the picture.



(i) How many sets of these party lights can operate from the power board before the circuit breaker is overloaded? (2 marks)

(ii) Explain the purpose of the circuit breaker. (2 marks)

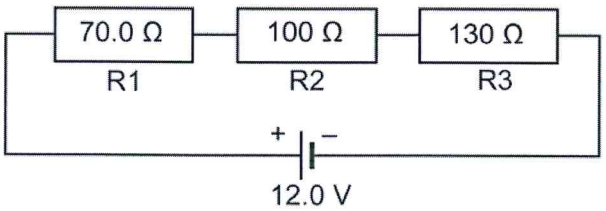
(iii) Is the circuit breaker connected to the power circuit in series or in parallel? (1 mark)

Description	Marks
(i) Current drawn must be less than 10 A	1
So 3 sets of party lights would draw 3 × 3.2 = 9.6A	1
(ii) protects from overloading /over heating	1
By breaking the circuit when too much current is drawn	1
(iii) Must be in series with circuit	1
	Total 5

Answer 7

(4 marks)

Three resistors R1, R2 and R3 are connected in series as shown below. Calculate the current in amperes through R3.

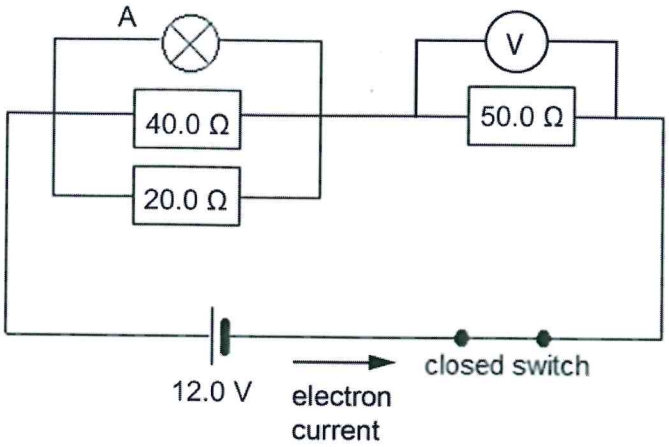


Description	Marks
Total resistance = 70 + 100 + 130 = 300 Ω	1
I_{total} = V/R	1
I_{total} = 12/300	1
I_{total} = 0.0400	1
Total	**4**

Solution 6·1 & 6·2 Year 11
Answer 8

(16 marks)

During a practical lesson a group of students constructed a circuit that contained a 40.0 Ω resistor, a 20.0 Ω resistor and a lamp ('A') in parallel with each other. This combination was then placed in series with a 50.0 Ω resistor, as shown below. The lamp had a resistance of 40.0 Ω and the circuit was connected to a power pack set on 12.0 V. For this question, assume that Lamp A was an ohmic resistor.



(a) On the diagram above, use an arrow to indicate the direction of electron current in this circuit. (1 mark)

Description	Marks
anticlockwise	1
Total	**1**

(b) Calculate the total resistance of the circuit. (4 marks)

Description	Marks
$\frac{1}{R_{parallel}} = \frac{1}{20} + \frac{1}{40} + \frac{1}{40}$	1
$R_{parallel}$ = 10 Ω	1
R_{total} = 10 + 50	1
= 60.0 Ω	1
Total	**4**

(c) Calculate the total current in the circuit. (2 marks)

Description	Marks
I = V/R = 12/60	1
I = 0.200 A	1
Total	**2**

(d) The students then used a voltmeter to measure the potential difference across the 50.0 Ω resistor.

(i) On the diagram on page 20, draw how they connected the voltmeter to the circuit. (1 mark)

Description	Marks
Shown on diagram, parallel to 50.0 Ω resistor	1
Total	**1**

(ii) Calculate the potential difference across the 50.0 Ω resistor. (2 marks)

Description	Marks
$V_{50} = I_{total} \times R_{50} = 0.20 \times 50$	1
$V_{50} = 10.0$ V	1
Total	**2**

(e) Determine the power dispersed in the 50.0 Ω resistor. (2 marks)

Description	Marks
$P = VI = 10 \times 0.20$	1
$P = 2.00$ W	1
Total	**2**

(f) The 20.0 Ω resistor was then removed from the circuit and replaced with another ohmic lamp, 'B', with a resistance of 20.0 Ω.

(i) Circle the correct response. Compared with Lamp B, Lamp A is now

brighter (the same brightness) dimmer (1 mark)

Description	Marks
Lamp A is the same brightness as Lamp B	1
Total	**1**

(ii) Explain your answer. (3 marks)

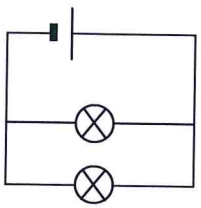
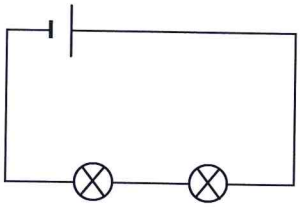
Description	Marks
In parallel so same potential difference	1
Same resistance (Lamp A) will have same current $I = V/R$	1
Brightness of lamp proportional to amount of current so same current in A results in same brightness	1
Total	**3**

Answer 9

(6 marks)

Complete **two (2)** circuit diagrams, which consist of one 1.5 V cell lighting two light globes.

(a) Draw one circuit with the light globes in parallel and the other with the light globes in series. (3 marks)

Description		Marks
Parallel 	Series 	
Cell correctly inserted in circuit		1
globes in parallel		1
globes in series		1
Total		**3**

Solution 6.1 & 6.2 Year 11

Answer 9 continued

(b) Assuming that all components are the same in each circuit, explain which circuit will have the brighter light globes. (3 marks)

Description	Marks
Parallel is brighter	1
There is a higher potential difference across each globe OR lower total resistance	1
So there is more current through each globe	1
Answers may correctly address power consumption, eg. parallel is dimmer if the power source has a limited power output.	
Total	**3**

Answer 10

(a) In the circle on the diagram above, clearly write the letter 'A' for ammeter or 'V' for voltmeter, indicating which meter should be correctly placed here. Explain why you have made this choice of meter. (3 marks)

Description	Marks
A	1
Ammeter measures current	1
Needs to be in series	1
Total	**3**

(b) R_2 has a resistance of 12.0 Ω. Given the total resistance of resistors R_1 and R_2 is 3.00 Ω, calculate the resistance of R_1. (3 marks)

Description	Marks
$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$	1
$\frac{1}{3} = \frac{1}{R_1} + \frac{1}{12.0}$	1
R_1=4.00 Ω	1
Total	**3**

(c) The cell provides 1.50 V of potential difference to the circuit, which has a total resistance, R_T of 9.24 Ω.

(i) On the diagram on page 22, use an arrow to indicate the direction of conventional current in this circuit.
Show through calculation that the current flowing through R_3 is 0.162 A. (3 marks)

Description	Mark
Clockwise	1
$I_T = V_T/R_T = 1.50/9.24$	1
Therefore $I_T = 0.162$ A is true	1
Total	**3**

(ii) Calculate the current flowing through R_2. (5 marks)

Description	Marks
$V_3 = I_T R_3 = 0.162 \times 6.24$	1
$V_3 = 1.01$ V	1
$V_{12} = V_T - V_3 = 1.50 - 1.01 = 0.489$ V	1
$I_2 = V_{12}/R_2 = 0.489/12.0$	1
= 0.0408 A (0.0406 if unrounded I_T used)	1
Total	**5**