

4.3 Electric circuits

01. 0625_s20_qp_61 Q: 2

A student determines the resistances of some filament lamps.

Fig. 2.1 shows the first circuit she uses.

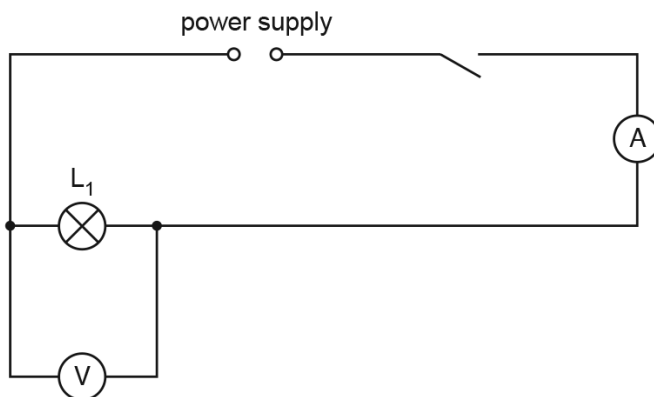


Fig. 2.1

- (a) (i) Record the potential difference V_1 across the lamp L_1 , as shown on the voltmeter in Fig. 2.2.

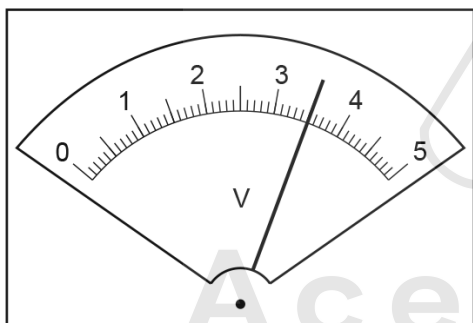


Fig. 2.2

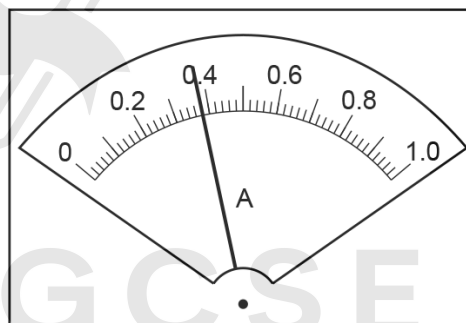


Fig. 2.3

$V_1 = \dots\dots\dots$ V [1]

- (ii) Record the current I_1 in the circuit, as shown in Fig. 2.3.

$I_1 = \dots\dots\dots$ A [1]

- (iii) Calculate the resistance R_1 of the filament of lamp L_1 . Use the equation $R_1 = \frac{V_1}{I_1}$. Include the unit.

$R_1 = \dots\dots\dots$ [2]

- (b) The student disconnects the voltmeter. She connects lamp L_2 in series with lamp L_1 . She connects the voltmeter across lamp L_2 .

She measures the current I_2 in the circuit and the potential difference V_2 across lamp L_2 .

$$I_2 = \dots\dots\dots 0.30\text{A} \dots\dots\dots$$

$$V_2 = \dots\dots\dots 1.7\text{V} \dots\dots\dots$$

Calculate the resistance R_2 of the filament of lamp L_2 . Use the equation $R_2 = \frac{V_2}{I_2}$.

$$R_2 = \dots\dots\dots$$

The student disconnects the voltmeter. She connects lamp L_3 in series with lamps L_1 and L_2 . She connects the voltmeter across lamp L_3 .

She measures the current I_3 in the circuit and the potential difference V_3 across lamp L_3 .

$$I_3 = \dots\dots\dots 0.26\text{A} \dots\dots\dots$$

$$V_3 = \dots\dots\dots 1.2\text{V} \dots\dots\dots$$

Calculate the resistance R_3 of the filament of lamp L_3 . Use the equation $R_3 = \frac{V_3}{I_3}$.

$$R_3 = \dots\dots\dots$$

[1]

- (c) Calculate $R_1 + R_2 + R_3$. Give your answer to a suitable number of significant figures for this experiment.

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$$R_1 + R_2 + R_3 = \dots\dots\dots$$

[1]

- (d) Some students make suggestions about the results of the experiment.

Suggestion **A**: $R_1 + R_2 + R_3$ should be equal to $3 \times R_1$.

Suggestion **B**: $R_1 + R_2 + R_3$ should be less than $3 \times R_1$.

Suggestion **C**: $R_1 + R_2 + R_3$ should be greater than $3 \times R_1$.

State which suggestion **A**, **B** or **C** agrees with your results. Justify your answer by reference to your results.

statement

justification

.....

[2]

4.3. *ELECTRIC CIRCUITS*

- (e) Draw a circuit diagram to show the circuit used in part (b) with all three lamps connected in series.

[3]

[Total: 11]



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02. 0625_s20_qp_63 Q: 2

Some students investigate a circuit containing different combinations of resistors. Part of the circuit they are using is shown in Fig. 2.1.

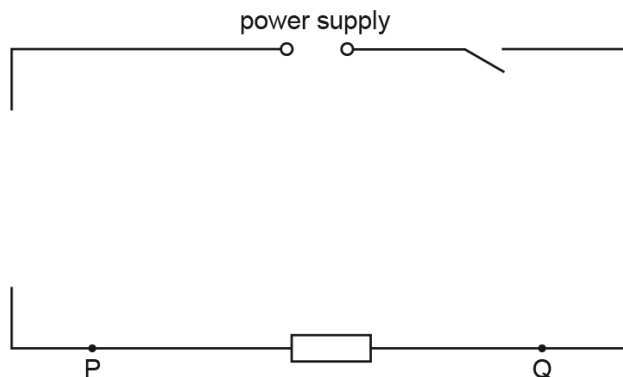


Fig. 2.1

(a) (i) On Fig. 2.1, complete the circuit to show:

- an ammeter connected to measure the current in the circuit
- a voltmeter connected to measure the potential difference (p.d.) across terminals P and Q.

[2]

(ii) A student measures the potential difference V_1 across terminals P and Q and the current I_1 in the circuit.

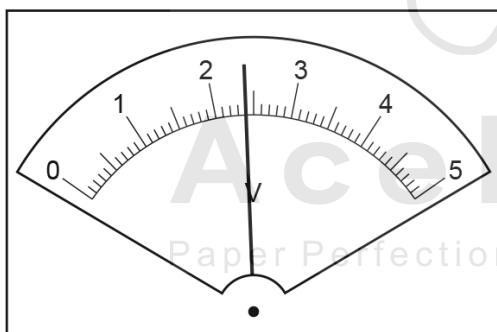


Fig. 2.2

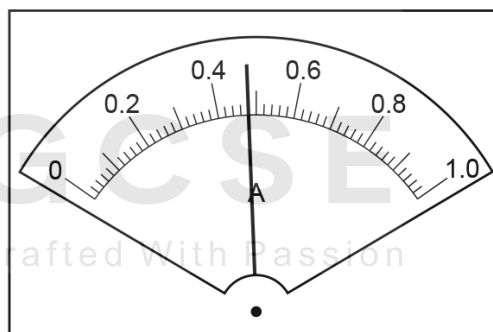


Fig. 2.3

Read the values of V_1 and I_1 shown on the meters in Fig. 2.2 and Fig. 2.3.

$V_1 = \dots\dots\dots$ V

$I_1 = \dots\dots\dots$ A

[2]

4.3. ELECTRIC CIRCUITS

(iii) Calculate a resistance R_1 using your values from (a)(ii) and the equation $R_1 = \frac{V_1}{I_1}$.

$R_1 = \dots\dots\dots$ [1]

(b) The student connects two resistors in series between terminals P and Q, as shown in Fig. 2.4.



Fig. 2.4

He measures the potential difference V_2 across terminals P and Q and the current I_2 in the circuit.

$V_2 = \dots\dots\dots 2.7 \dots\dots\dots$ V

$I_2 = \dots\dots\dots 0.26 \dots\dots\dots$ A

Calculate a resistance R_2 using these values and the equation $R_2 = \frac{V_2}{(I_2 \times 2)}$.

$R_2 = \dots\dots\dots$ [1]

(c) The student connects the two resistors in parallel between terminals P and Q, as shown in Fig. 2.5.

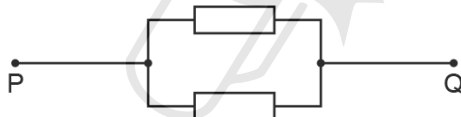


Fig. 2.5

He measures the potential difference V_3 across terminals P and Q and the current I_3 in the circuit.

$V_3 = \dots\dots\dots 2.3 \dots\dots\dots$ V

$I_3 = \dots\dots\dots 0.94 \dots\dots\dots$ A

Calculate a resistance R_3 using these values and the equation $R_3 = \frac{(V_3 \times 2)}{I_3}$.

$R_3 = \dots\dots\dots$ [1]

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- (d) Another student suggests that R_1 , R_2 and R_3 should be equal.
State whether your results support this suggestion. Justify your statement with reference to your results.

statement

justification

..... [2]

- (e) (i) A student wants to determine R_1 by using a potential divider to vary the potential difference in the circuit. Draw the symbol for a potential divider.

[1]

- (ii) Briefly explain how the use of a potential divider may give a more reliable value for R_1 than using the procedure carried out in (a).

.....
.....
..... [1]

[Total: 11]

4.3. ELECTRIC CIRCUITS

03.0625_s19_qp_63 Q: 3

Some students are investigating a circuit containing different resistors.

They are using the circuit shown in Fig. 3.1.

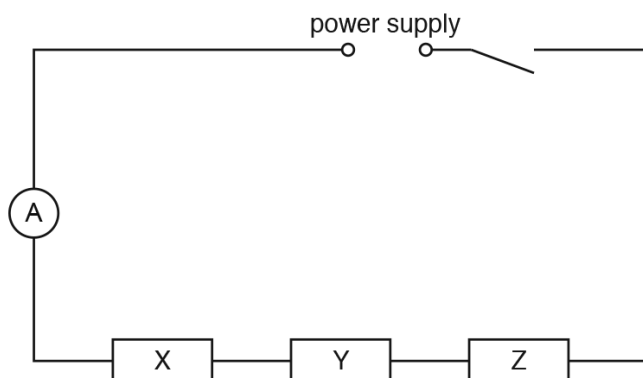


Fig. 3.1

- (a) On Fig. 3.1, draw the symbol for a voltmeter connected to measure the potential difference V across resistor X. [1]
- (b) A student connects the voltmeter as described in (a) and measures the current I in the circuit and the potential difference V across resistor X.

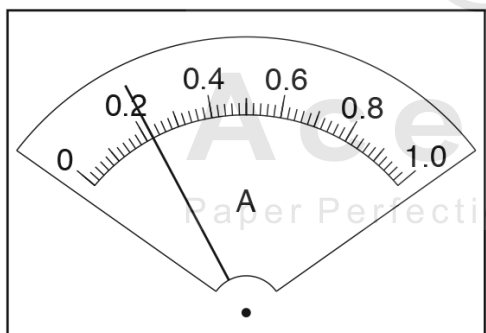


Fig. 3.2

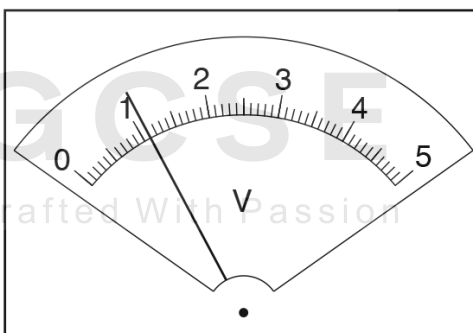


Fig. 3.3

Read, and record in Table 3.1, the values of I and V shown on the meters in Fig. 3.2 and in Fig. 3.3.

Table 3.1

resistor combination	$I/$	$V/$	$R/$
X			
X and Y	0.23	3.3	
X, Y and Z	0.21	5.0	

The student connects the voltmeter to measure the potential difference V across the combination of resistors X and Y together and then X, Y and Z together. Her readings are shown in Table 3.1.

Complete the headings in Table 3.1.

[3]

- (c) A student suggests that the current should remain constant when the voltmeter is used to measure potential differences across the different combinations of resistors. State whether the readings in Table 3.1 support this suggestion. Justify your answer by reference to the readings.

statement

justification

.....

.....

[1]

- (d) (i) Calculate, and record in Table 3.1, the resistance R of each combination of resistors. Use the readings from Table 3.1 and the equation $R = \frac{V}{I}$.

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[2]

- (ii) For resistors in series, the total resistance of the combination is the sum of the individual resistances. Use your results from Table 3.1 to calculate the resistances R_Y and R_Z of resistors Y and Z.

$R_Y =$

$R_Z =$

[1]

4.3. ELECTRIC CIRCUITS

- (e) (i) The circuit components are to be rearranged so that
- resistors X, Y and Z are in parallel
 - the ammeter will measure the current in the circuit
 - the voltmeter will measure the potential difference across the resistors.

In the space below, draw a diagram of this circuit.

[2]

- (ii) One student sets up the circuit as described in (e)(i). She measures the current I_p in the circuit and the potential difference V_p across the resistors. She uses these values to calculate the resistance R_p of the resistors in parallel.

$R_p = \dots\dots\dots 2.31 \dots\dots\dots \Omega$

Use the student's result and your result from Table 3.1 to compare R_p with the resistance R_s of the three resistors connected in series. Tick the box next to the description that most closely matches the results.

- $R_p = R_s$
- $R_p = 10R_s$
- $10R_p = R_s$
- None of these descriptions apply

[1]

[Total: 11]

04. 0625_w19_qp_61 Q: 2

A student investigates the resistance of lamps.

She uses the circuit shown in Fig. 2.1.

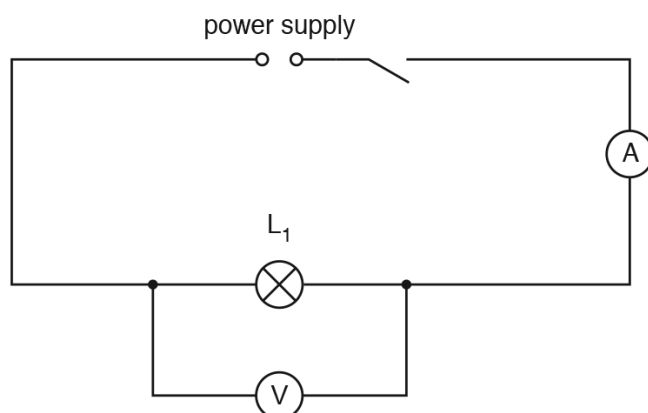


Fig. 2.1

(a) She records the potential difference V_1 across the lamp L_1 and the current I_1 in the circuit. The meters are shown in Fig. 2.2 and Fig. 2.3.

(i) Write down the meter readings.

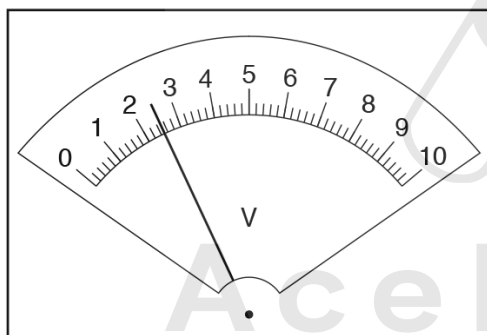


Fig. 2.2

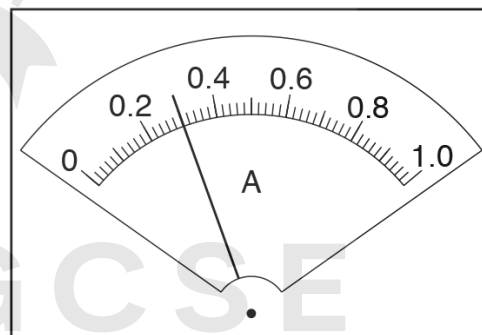


Fig. 2.3

$V_1 = \dots\dots\dots$

$I_1 = \dots\dots\dots$

[3]

(ii) Calculate the resistance R_1 of the lamp L_1 using the equation $R_1 = \frac{V_1}{I_1}$.

$R_1 = \dots\dots\dots$ [1]

4.3. ELECTRIC CIRCUITS

(b) The student connects a lamp L_2 in series with lamp L_1 .

She records the potential difference V_2 across lamps L_1 and L_2 and the current I_2 in the circuit.

$$V_2 = \dots\dots\dots 2.4\text{V}$$

$$I_2 = \dots\dots\dots 0.21\text{A}$$

Calculate the combined resistance R_2 of lamps L_1 and L_2 connected in series, using the equation $R_2 = \frac{V_2}{I_2}$.

$$R_2 = \dots\dots\dots [1]$$

(c) She connects a lamp L_3 in series with lamps L_1 and L_2 .

She records the potential difference V_3 across the three lamps and the current I_3 in the circuit.

She calculates the combined resistance R_3 .

$$V_3 = \dots\dots\dots 2.4\text{V}$$

$$I_3 = \dots\dots\dots 0.17\text{A}$$

$$R_3 = \dots\dots\dots 14.1\Omega$$

A student suggests that the resistance R_3 of the three lamps connected in series should be given by the equation $R_3 = 3 \times R_1$. State whether the results agree with this suggestion. Justify your answer by reference to the results.

statement

justification

.....

.....

[2]

(d) Complete the circuit diagram in Fig. 2.4 to show:

- the three lamps connected in parallel
- the voltmeter connected to measure the potential difference across the lamps
- a variable resistor connected to control the current in all three lamps.

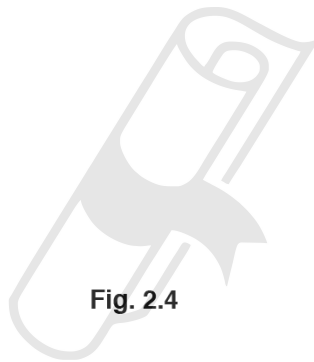
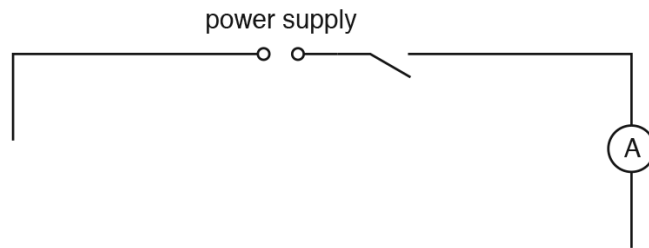


Fig. 2.4

[3]

[Total: 10]

4.3. ELECTRIC CIRCUITS

05.0625_m18_qp_62 Q: 3

A student is investigating a circuit containing different lamps. She is using the circuit shown in Fig. 3.1.

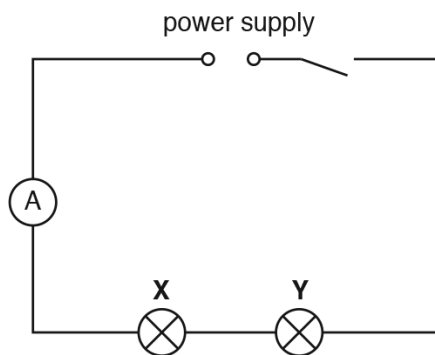


Fig. 3.1

- (a) On Fig. 3.1, draw a voltmeter connected so that it measures the potential difference (p.d.) across lamp X. [1]
- (b) The student uses the ammeter to measure the current in the circuit.

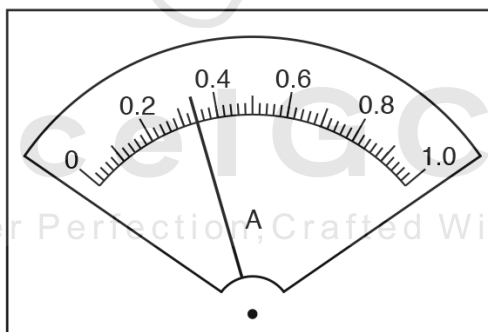


Fig. 3.2

Record the current I_S in the circuit, as shown in Fig. 3.2.

$I_S = \dots\dots\dots$ [1]

- (c) (i) The student uses the voltmeter to measure the p.d. V_X across lamp **X** and then reconnects the voltmeter to measure the p.d. V_Y across lamp **Y**.

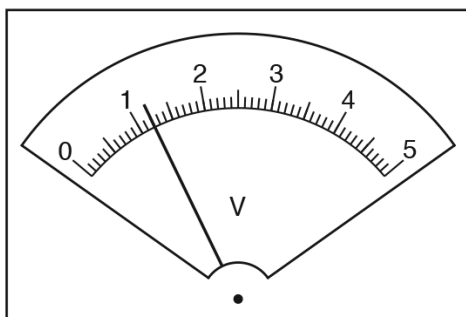


Fig. 3.3

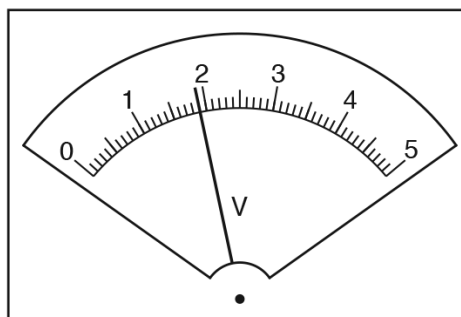


Fig. 3.4

Record the value of the p.d. V_X across lamp **X**, shown in Fig. 3.3.

$$V_X = \dots\dots\dots$$

Record the value of the p.d. V_Y across lamp **Y**, shown in Fig. 3.4.

$$V_Y = \dots\dots\dots [1]$$

- (ii) She then measures the p.d. V_S across both lamps in series.

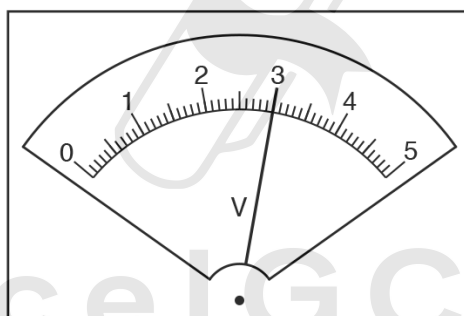


Fig. 3.5

Record the value of the p.d. V_S across both lamps in series, shown in Fig. 3.5.

$$V_S = \dots\dots\dots [1]$$

4.3. ELECTRIC CIRCUITS

- (iii) A student suggests that V_S should be equal to $(V_X + V_Y)$.
State whether the readings support this suggestion. Justify your statement with reference to the results.

statement

justification

.....

.....

[2]

- (d) Calculate the resistance R_1 of lamp **X**. Use the readings from (b) and (c)(i) and the equation $R_1 = \frac{V_X}{I_S}$.

$R_1 = \dots\dots\dots \Omega$ [1]

- (e) (i) The circuit components are to be rearranged so that
- lamps **X** and **Y** are connected in parallel
 - the ammeter measures the current in lamp **X** only
 - the voltmeter measures the p.d. across the lamps.

Draw a circuit diagram of this arrangement.

[2]



(ii) The student sets up the circuit as described in (e)(i).

She measures and records the current in lamp **X** and the p.d. across the lamps.

She then calculates a new resistance R_2 for lamp **X** in this parallel circuit.

$$R_2 = \dots\dots\dots 8.3 \Omega \dots\dots\dots$$

The student notices that lamp **X** is very bright in this parallel circuit, but it was dim in the series circuit in (a).

Suggest how temperature affects the resistance of a lamp.
Justify your suggestion by reference to the value of R_1 from (d) and the value of R_2 .

.....

[2]

[Total: 11]



4.3. ELECTRIC CIRCUITS

06. 0625_s18_qp_61 Q: 2

A student is investigating resistance.

She uses the circuit shown in Fig. 2.1.

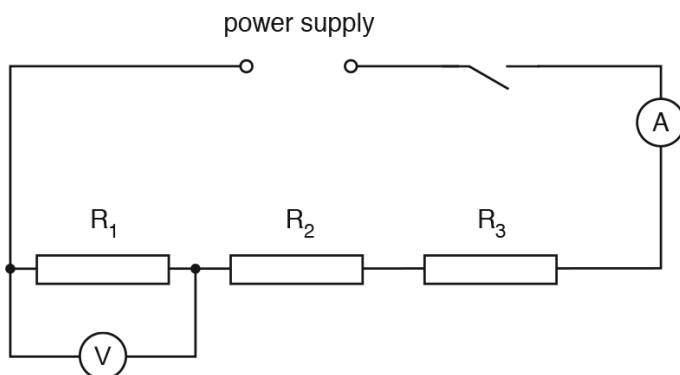


Fig. 2.1

- (a) She measures the potential difference V_1 across the resistor R_1 and the current I in the circuit.

Figs. 2.2 and 2.3 show the voltmeter and ammeter readings.

- (i) Write down the readings shown on the meters in Figs. 2.2 and 2.3.

$V_1 =$

$I =$

[2]

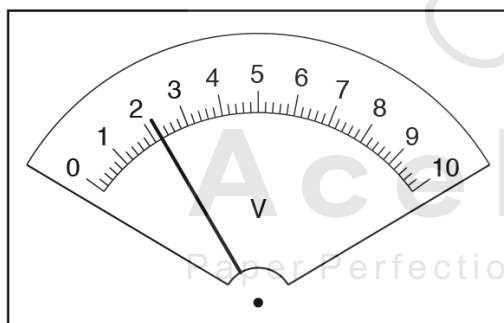


Fig. 2.2

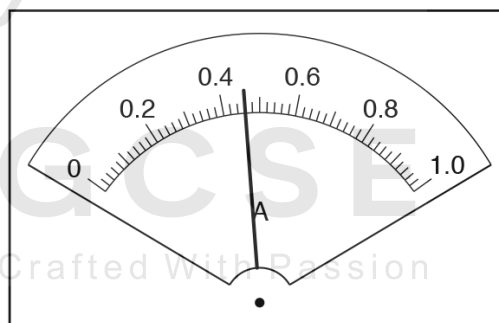


Fig. 2.3

(ii) Calculate the resistance of the resistor R_1 using the equation $R_1 = \frac{V_1}{I}$.

$R_1 = \dots\dots\dots$ [1]

(b) The student measures the potential difference across each resistor in turn. She calculates values for the resistance R_2 and R_3 of the resistor R_2 and of the resistor R_3 . She records her values as:

$R_2 = \dots\dots\dots 4.75 \Omega$

$R_3 = \dots\dots\dots 4.81 \Omega$

State whether the results suggest that the three resistors have the same value of resistance. Justify your statement by reference to the results.

statement $\dots\dots\dots$

justification $\dots\dots\dots$

$\dots\dots\dots$

$\dots\dots\dots$

[2]

(c) Calculate the combined resistance R of resistors R_1 , R_2 and R_3 connected in series, using the equation $R = R_1 + R_2 + R_3$. Give your answer to a suitable number of significant figures for this experiment.

$R = \dots\dots\dots$ [2]

(d) The student checks her result by connecting the voltmeter across all three resistors connected in series. Tick the potential difference reading you would expect to be closest to the reading she obtains.

$\frac{V_1}{3}$

V_1

$3V_1$

[1]

4.3. *ELECTRIC CIRCUITS*

(e) Complete the circuit diagram in Fig. 2.4 to show

- the three resistors connected in parallel
- the voltmeter connected to measure the potential difference across the resistors
- a variable resistor connected to control the current in all three resistors.

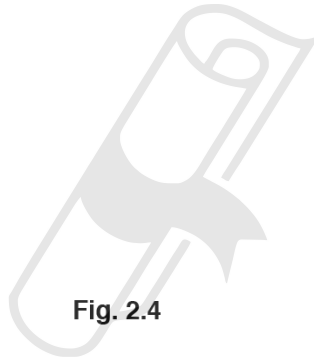
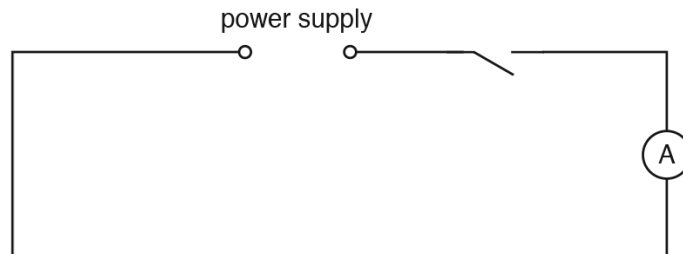


Fig. 2.4

[3]

[Total: 11]

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07. 0625_w18_qp_62 Q: 2

A student is investigating the power of two lamps.

The circuit is shown in Fig. 2.1.

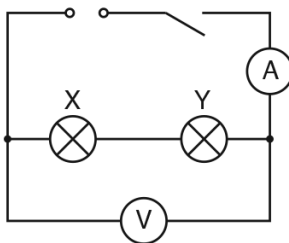


Fig. 2.1

- (a) (i) Record the potential difference (p.d.) V_T across the lamps and the current I_T in the circuit, as shown in Fig. 2.2 and Fig. 2.3.

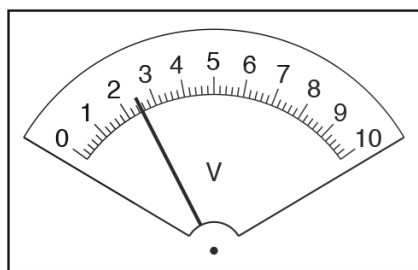


Fig. 2.2

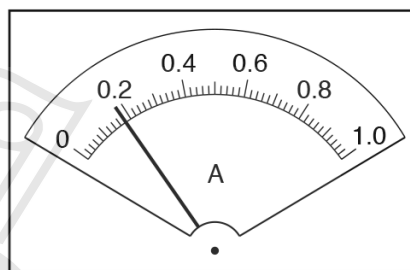


Fig. 2.3

$V_T = \dots\dots\dots$ $I_T = \dots\dots\dots$ [2]

- (ii) Calculate the power P_T produced by the lamp filaments, using the equation $P_T = V_T I_T$.

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$P_T = \dots\dots\dots$ [1]

4.3. ELECTRIC CIRCUITS

- (b) The student connects the voltmeter across lamp X only. She records the p.d. V_X across lamp X and the current I_X in the circuit.

$$V_X = \dots\dots\dots 1.3 \dots\dots\dots \text{V}$$

$$I_X = \dots\dots\dots 0.18 \dots\dots\dots \text{A}$$

She repeats the procedure with the voltmeter connected across lamp Y only.

$$V_Y = \dots\dots\dots 1.2 \dots\dots\dots \text{V}$$

$$I_Y = \dots\dots\dots 0.18 \dots\dots\dots \text{A}$$

- (i) Calculate the power P_X produced by the lamp filament X using the equation $P_X = V_X I_X$, and calculate the power P_Y produced by the lamp filament Y using the equation $P_Y = V_Y I_Y$.

$$P_X = \dots\dots\dots$$

$$P_Y = \dots\dots\dots$$

[1]

- (ii) State and explain briefly whether the two values for power P_X and P_Y are the same within the limits of experimental accuracy.

statement

explanation

.....

[2]

- (c) The student repeats the experiment using two other lamps. She notices that one lamp is dimly lit, but the other lamp does not light at all.

The p.d. V_T across the lamps is the same as in (b), but the current I_T in the circuit is approximately half of the original value.

The student concludes that the filament of one of the lamps is broken.

State whether you agree with the student and give a reason for your answer.

statement

reason

.....

[2]

(d) Draw a circuit diagram to show the circuit in Fig. 2.1 rearranged so that:

- the lamps are connected in parallel
- a variable resistor is connected to control the total current in the circuit
- the ammeter will measure the total current in the circuit
- the voltmeter will measure the p.d. across the lamps.



[3]

[Total: 11]

4.3. ELECTRIC CIRCUITS

08.0625_w17_qp_61 Q: 1

A student is investigating resistance using the circuit shown in Fig. 1.1.

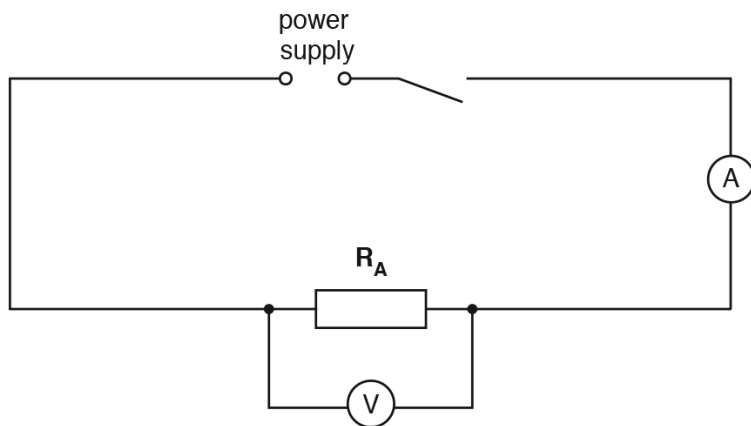


Fig. 1.1

- (a) The student measures the potential difference V_1 across the resistor R_A and the current I_1 in the circuit. Figs. 1.2 and 1.3 show the voltmeter and ammeter scales.

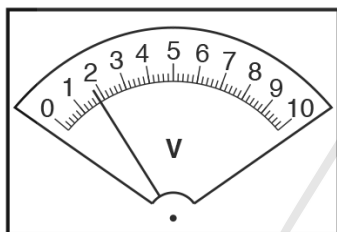


Fig. 1.2

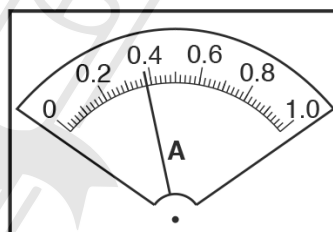


Fig. 1.3

- (i) Write down the readings shown on the scales in Figs. 1.2 and 1.3.

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$V_1 = \dots\dots\dots$
 $I_1 = \dots\dots\dots$

- (ii) Calculate the resistance R_1 of the resistor R_A using the equation $R_1 = \frac{V_1}{I_1}$.

$R_1 = \dots\dots\dots$ [1]

- (b) The student connects a resistor R_B in series with R_A .

She measures the potential difference V_2 across the two resistors R_A and R_B combined and the current I_2 in the circuit.

$$V_2 = \dots\dots\dots 1.8V$$

$$I_2 = \dots\dots\dots 0.19A$$

Calculate the resistance R_2 of resistors R_A and R_B combined in series, using the equation

$$R_2 = \frac{V_2}{I_2}.$$

$$R_2 = \dots\dots\dots [1]$$

- (c) The student connects a third resistor R_C in series with R_A and R_B .

She measures the potential difference V_3 across the three resistors and the current I_3 in the circuit.

$$V_3 = \dots\dots\dots 1.7V$$

$$I_3 = \dots\dots\dots 0.13A$$

- (i) Calculate the resistance R_3 of resistors R_A , R_B and R_C combined in series, using the equation $R_3 = \frac{V_3}{I_3}$.

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$$R_3 = \dots\dots\dots$$

4.3. ELECTRIC CIRCUITS

- (ii) On Fig. 1.4, draw a line for the needle on the ammeter to show the reading of 0.13A.

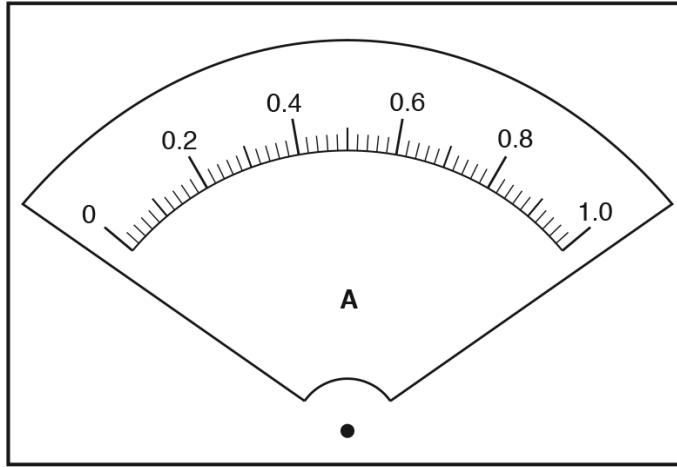


Fig. 1.4

[1]

- (d) A student suggests that $R_3 = 3 \times R_1$.

State whether the results agree with this suggestion. Justify your answer by reference to the results.

statement

justification

.....

.....



[1]

- (e) Another student suggests that the three resistors R_A , R_B and R_C each have the same value of resistance.

Explain how you could use the circuit shown in Fig. 1.1 to check this suggestion.

.....

.....

[1]

(f) Complete the circuit diagram in Fig. 1.5 to show:

- the three resistors connected in parallel
- the voltmeter connected to measure the potential difference across the resistors
- a variable resistor connected to control the current in all three resistors.

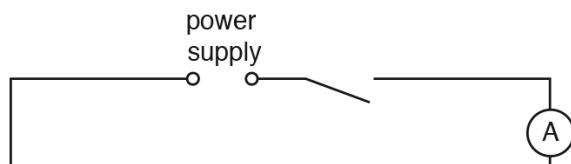


Fig. 1.5

[2]

(g) The circuit in Fig. 1.5 could be used to determine the combined resistance of three resistors connected in parallel.

Suggest a reason for connecting a variable resistor in the circuit.

.....
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[1]

[Total: 10]

4.3. ELECTRIC CIRCUITS

09.0625_w17_qp_63 Q: 2

A student is investigating a circuit containing resistors.

She is using the circuit shown in Fig. 2.1.

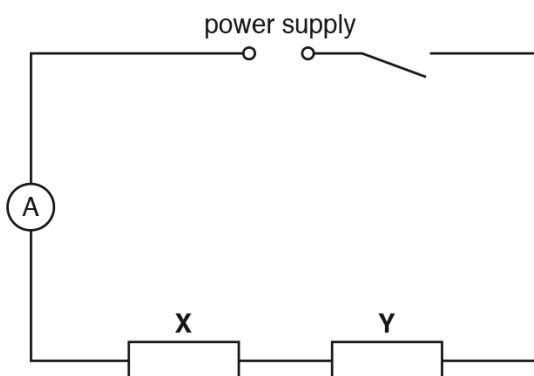


Fig. 2.1

- (a) On Fig. 2.1, show a voltmeter connected so that it measures the potential difference across resistor X. [1]
- (b) The student uses the ammeter to measure the current I_S in the circuit.

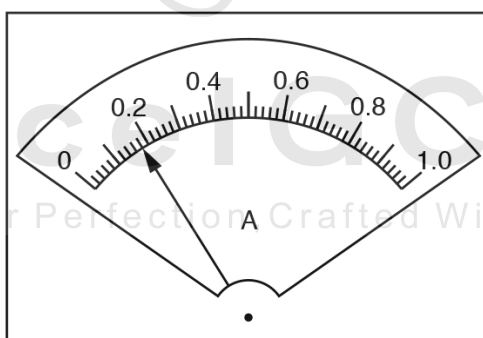


Fig. 2.2

Record the current I_S , as shown on the ammeter in Fig. 2.2.

$I_S = \dots\dots\dots$ [1]

- (c) (i) The student uses the voltmeter to measure the potential difference V_X across resistor **X** and then reconnects it to measure the potential difference V_Y across resistor **Y**.

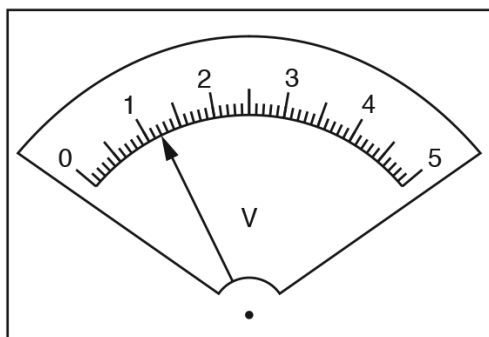


Fig. 2.3

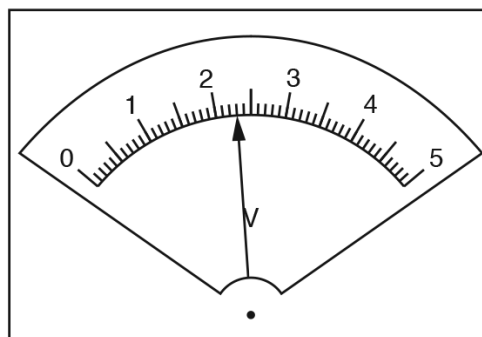


Fig. 2.4

- Record the value of the potential difference V_X across resistor **X**, shown in Fig. 2.3.

$V_X = \dots\dots\dots$

- Record the value of the potential difference V_Y across resistor **Y**, shown in Fig. 2.4.

$V_Y = \dots\dots\dots$

[1]

- (ii) She then measures the potential difference V_S across the combination of both resistors.

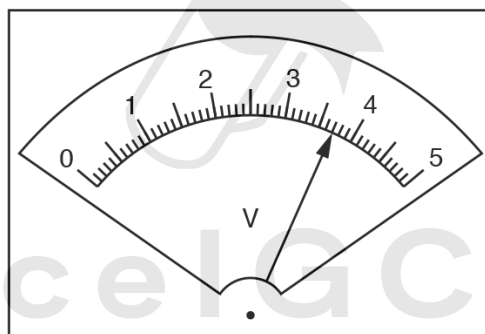


Fig. 2.5

Record the value of the potential difference V_S across the combination of both resistors, shown in Fig. 2.5.

$V_S = \dots\dots\dots$ [1]

4.3. ELECTRIC CIRCUITS

(iii) A student suggests that V_S should be equal to $(V_X + V_Y)$.

State whether the readings support this suggestion. Justify your statement with reference to the results.

statement

justification

.....

.....

[2]

(d) Calculate the resistance R_S of the combination of resistors, using the readings from (b) and (c)(ii) and the equation

$$R_S = \frac{V_S}{I_S}$$

$R_S =$ [2]

(e) (i) The circuit components are to be rearranged so that:

- resistors X and Y are in parallel
- the ammeter will measure the total current in the circuit
- the voltmeter will measure the potential difference across both resistors.

In the space below, draw a diagram of this circuit using standard electrical symbols.

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(ii) The student sets up the circuit as described in (e)(i).

She measures and records the total current I_p in the circuit and the potential difference V_p across the resistors.

$$I_p = \underline{0.81} \text{ A}$$

$$V_p = \underline{3.6} \text{ V}$$

The resistance of two resistors connected in parallel is less than the resistance of the same two resistors connected in series.

State whether the readings indicate that she has set up the circuit correctly. Explain your answer.

suggestion

explanation

.....

.....

[1]

[Total: 11]



4.3. ELECTRIC CIRCUITS

10. 0625_s16_qp_63 Q: 4

The class is investigating a circuit containing two lamps in series.

They are using the circuit shown in Fig. 4.1.

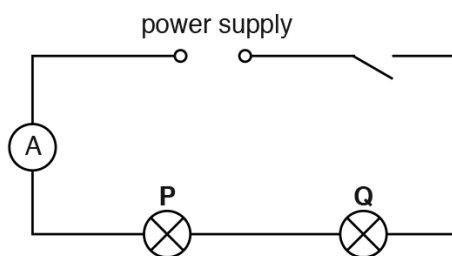


Fig. 4.1

- (a) On Fig. 4.1, use the standard symbol to show a voltmeter connected to measure the potential difference (p.d.) across lamp P. [1]
- (b) Record the current I in the circuit, as shown on the ammeter in Fig. 4.2.

$I = \dots\dots\dots$ [2]

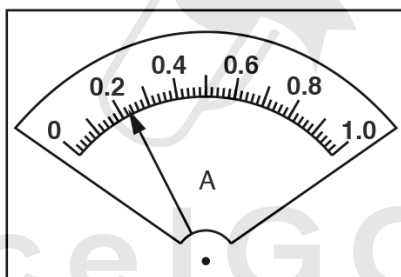


Fig. 4.2

- (c) Fig. 4.3 shows the readings on voltmeters connected to measure the potential difference across each lamp.

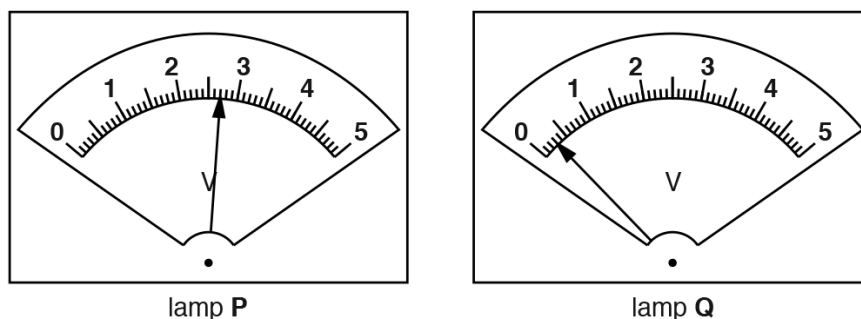


Fig. 4.3

In Table 4.1, record the potential difference V_P across lamp **P** and the potential difference V_Q across lamp **Q**.

Table 4.1

lamp	potential difference / V	observation of brightness
P	$V_P = \dots\dots\dots$	very bright
Q	$V_Q = \dots\dots\dots$	not glowing

[1]

- (d) Table 4.1 also shows the brightness of each lamp.

- (i) A student thinks that, as lamp **Q** is not glowing, its filament must have broken.

State one piece of evidence from the results in (b) and (c) that shows this cannot be the case.

.....
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[1]

- (ii) The working potential difference for each lamp to be at its full brightness is 2.5V.

Suggest how the results for V_P and V_Q might help to explain the observations of the brightness of the lamps.

.....

[2]

4.3. ELECTRIC CIRCUITS

- (e) Calculate the total resistance R of the lamps in the circuit, using the equation

$$R = \frac{(V_P + V_Q)}{I} .$$

$$R = \dots\dots\dots[2]$$

- (f) A student measures the potential difference V_S across the power supply.

$$V_S = \dots\dots\dots 3.1V \dots\dots\dots$$

He suggests that V_S should be equal to $V_P + V_Q$.

State whether the measurements support this suggestion. Justify your statement by reference to the results.

statement

justification

.....

[2]

[Total: 11]

11. 0625_w16_qp_61 Q: 4

A student is investigating resistors connected in parallel.

The following apparatus is available to the student:

ammeter

voltmeter

power supply

variable resistor

switch

connecting leads

a box of identical resistors.

Plan an experiment to investigate how the combined resistance of the resistors, connected in parallel, depends on the number of resistors.

You should:

- draw a diagram of the circuit you could use to determine the resistance of resistors connected in parallel (show only two resistors in your diagram),
- explain briefly how you would carry out the investigation,
- draw a table or tables, with column headings, to show how you would display your readings. You are **not** required to enter any readings into the table.

4.3. ELECTRIC CIRCUITS

12. 0625_s15_qp_61 Q: 3

The class is investigating the resistance of lamp filaments in series and parallel circuits.

Fig. 3.1 shows the first circuit used.

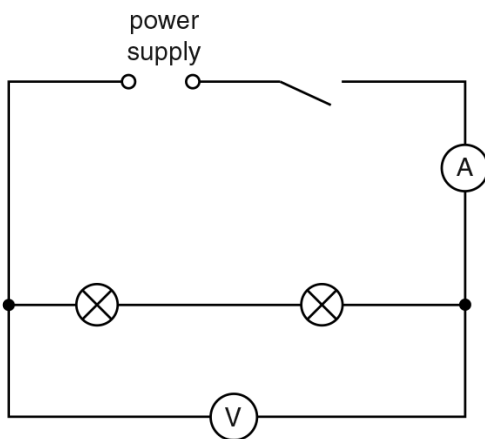


Fig. 3.1

(a) (i) Write down the readings shown on the meters in Figs. 3.2 and 3.3.

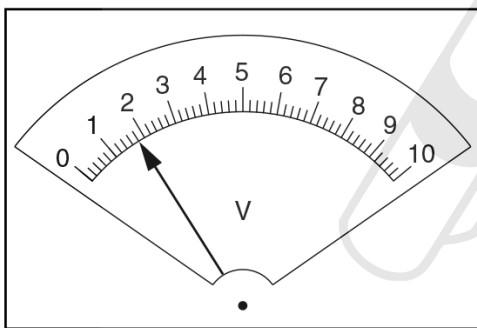


Fig. 3.2

$V_S = \dots\dots\dots$

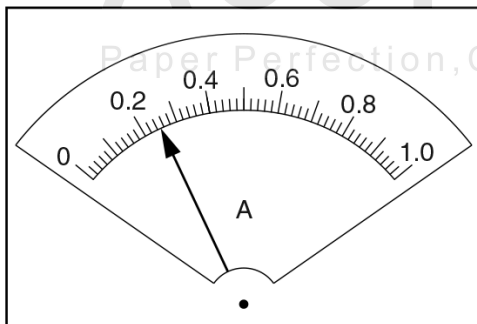


Fig. 3.3

$I_S = \dots\dots\dots$ [2]

(ii) Calculate the resistance R_S of the lamp filaments using the equation $R_S = \frac{V_S}{I_S}$.

$R_S = \dots\dots\dots$ [1]

- (b) The student rearranges the circuit so that
- the lamps are in parallel
 - the ammeter will measure the total current in the circuit
 - the voltmeter will measure the potential difference across the lamps.
- (i) Draw a diagram of this circuit using standard circuit symbols.

[2]

- (ii) The student measures the potential difference V_P across the lamps and the current I_P in the circuit.

$$V_P = \dots\dots\dots 2.0V$$

$$I_P = \dots\dots\dots 0.60A$$

Calculate the resistance R_P of the lamp filaments using the equation $R_P = \frac{V_P}{I_P}$.

$$R_P = \dots\dots\dots$$

- (iii) Calculate the ratio $\frac{R_S}{R_P}$.

$$\frac{R_S}{R_P} = \dots\dots\dots [1]$$

4.3. ELECTRIC CIRCUITS

(c) A student wishes to investigate whether the ratio $\frac{R_S}{R_P}$ for the two lamps is the same under all conditions.

(i) Suggest a variable that you could change in order to obtain further sets of readings.

.....

(ii) Explain briefly how you would change this variable.

.....

.....

[2]

[Total: 8]



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13. 0625_s15_qp_62 Q: 3

The class is investigating the resistance of lamps.

Fig. 3.1 shows the first circuit used.

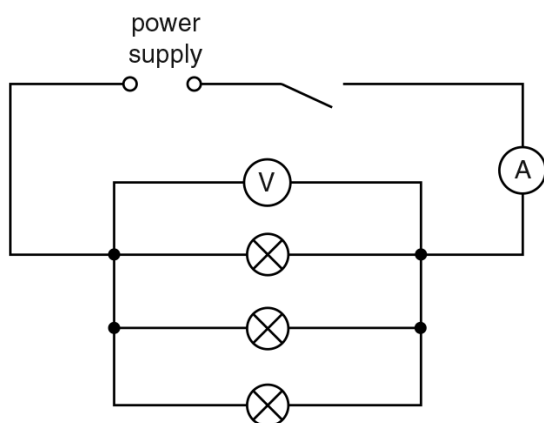


Fig. 3.1

- (a) A student measures the potential difference V_p across the lamps and the current I_p in the circuit. The readings are shown in Figs. 3.2 and 3.3.

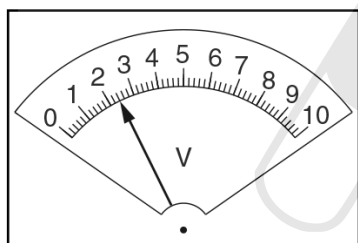


Fig. 3.2

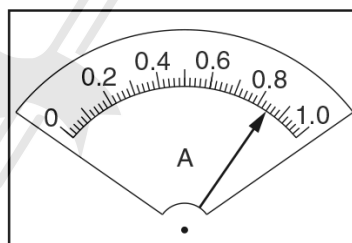


Fig. 3.3

- (i) Write down the readings shown on the meters.

$V_p = \dots\dots\dots$

$I_p = \dots\dots\dots$ [2]

- (ii) Calculate the resistance R_p of the lamp filaments using the equation $R_p = \frac{V_p}{I_p}$.

$R_p = \dots\dots\dots$ [1]

4.3. ELECTRIC CIRCUITS

- (b) The student rearranges the circuit so that
- the lamps are in series
 - the ammeter will measure the total current in the circuit
 - the voltmeter will measure the potential difference across all three lamps.

In the space below, draw a diagram of this circuit using standard circuit symbols.

[2]

- (c) The student measures the potential difference V_S across the lamps and the current I_S in the circuit in (b).

$V_S = \dots\dots\dots 2.5V \dots\dots\dots$

$I_S = \dots\dots\dots 0.22A \dots\dots\dots$

Calculate the resistance R_S of the lamp filaments using the equation $R_S = \frac{V_S}{I_S}$.

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$R_S = \dots\dots\dots$ [1]

- (d) (i) A student wishes to vary the current in the first circuit, shown in Fig. 3.1, using a variable resistor.

In the space below, draw the standard circuit symbol for a variable resistor.

[1]

- (ii) On Fig. 3.1, label with X a suitable position in the first circuit for a variable resistor used to vary the current in all the lamps. [1]

[Total: 8]

14. 0625_w15_qp_62 Q: 3

The class is investigating the combined resistance of resistors in series and parallel arrangements.

The circuit is shown in Fig. 3.1.

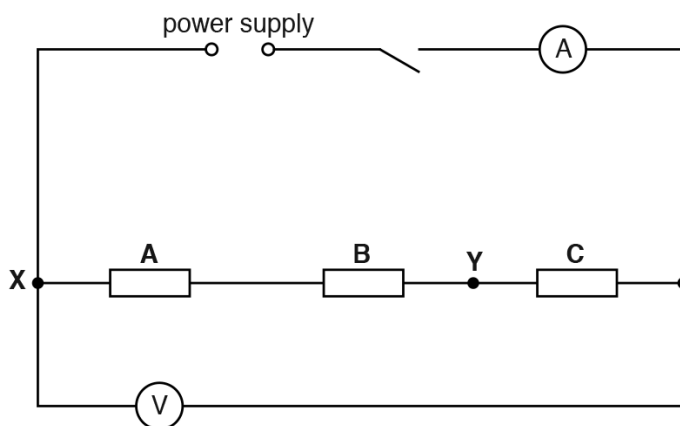


Fig. 3.1

- (a) (i) Record the potential difference V_1 across the resistors and the current I_1 in the circuit, as shown in Figs. 3.2 and 3.3.

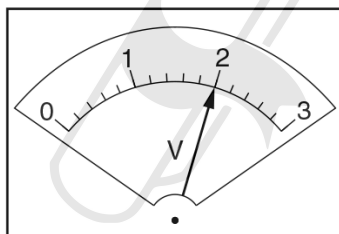


Fig. 3.2

$V_1 = \dots\dots\dots$

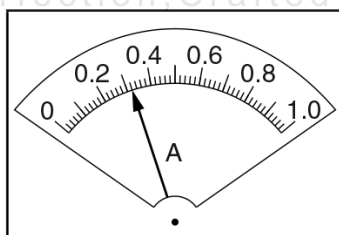


Fig. 3.3

$I_1 = \dots\dots\dots$

[2]

4.3. ELECTRIC CIRCUITS

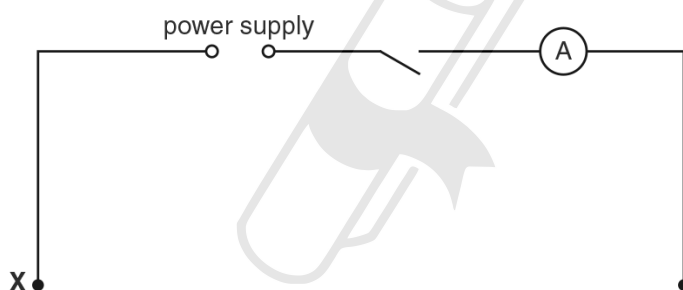
(ii) Calculate the combined resistance R_1 of the resistors using the equation $R_1 = \frac{V_1}{I_1}$.

$R_1 = \dots\dots\dots$ [1]

(b) A student rearranges the circuit shown in Fig. 3.1. He follows these instructions:

- Disconnect resistors **A** and **B**.
- Connect together the resistors **A** and **B** in parallel.
- Connect one side of this parallel combination to the resistor **C** at the point labelled **Y** in Fig. 3.1.
- Connect the other side of the parallel combination to the point labelled **X** in Fig. 3.1.
- Do not make any other changes to the circuit.

On Fig. 3.4, complete the diagram of this new circuit using standard circuit symbols.



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Fig. 3.4

[2]

- (c) Using the new circuit, a student measures the potential difference V_2 across the three resistors and the current I_2 in the circuit.

$$V_2 = \dots\dots\dots 2.1\text{V}$$

$$I_2 = \dots\dots\dots 0.69\text{A}$$

- (i) Calculate the combined resistance R_2 of the resistors using the equation $R_2 = \frac{V_2}{I_2}$.

$$R_2 = \dots\dots\dots$$

- (ii) Calculate the ratio $\frac{R_1}{R_2}$.

$$\frac{R_1}{R_2} = \dots\dots\dots [2]$$

- (d) R_1 should equal $2 \times R_2$ when all three resistors are identical.

State whether the results indicate that the resistors are identical. Justify your answer by reference to the results.

statement

justification

.....
 [2]

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[Total: 9]

4.3. ELECTRIC CIRCUITS

15. 0625_w15_qp_63 Q: 4

The class is studying the resistance of identical wires connected in parallel.

The circuit is set up as shown in Fig. 4.1, with a crocodile clip connected to the right-hand end of wire **A**.

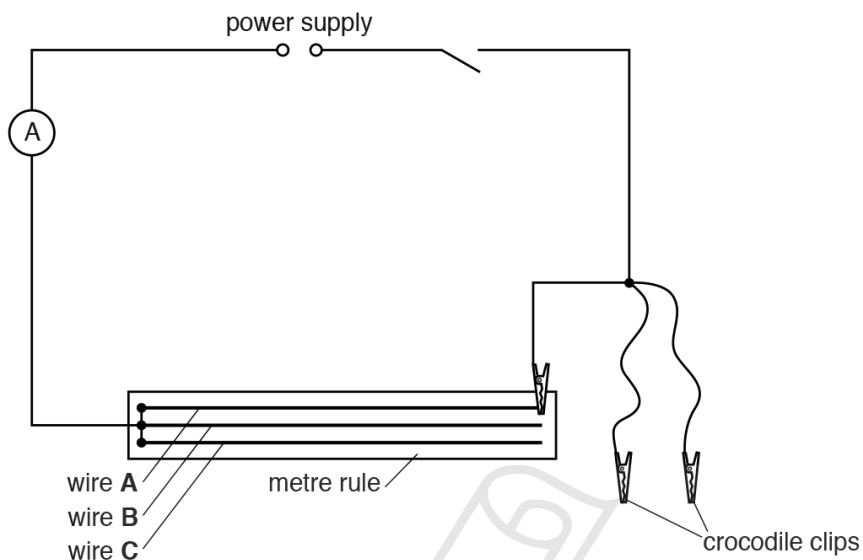


Fig. 4.1

- (a) On Fig. 4.1, use the appropriate symbol to show a voltmeter connected to measure the potential difference across wire **A**. [1]
- (b) In Table 4.1, write down the potential difference V and the current I for wire **A** as shown in Figs. 4.2 and 4.3.

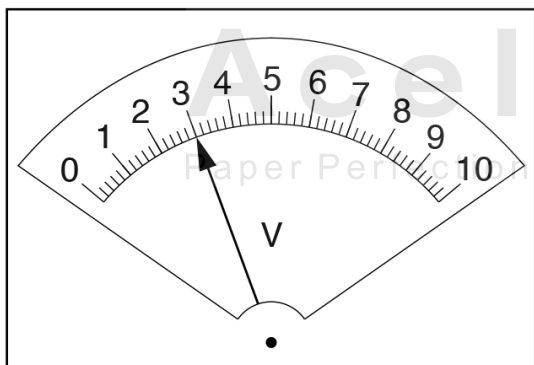


Fig. 4.2

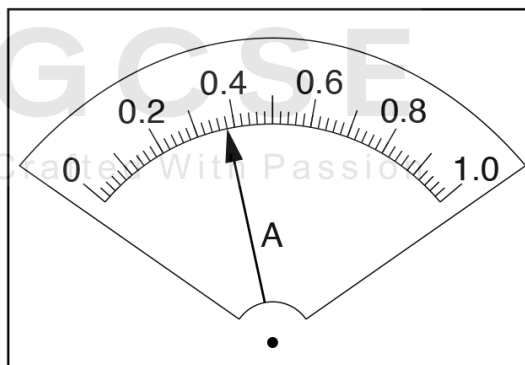


Fig. 4.3

Table 4.1

wire combination	V/V	I/A
A only		
A and B in parallel	2.9	0.77
A, B and C in parallel	2.6	0.98

[1]

- (c) The other crocodile clips are used, first to connect wires **A** and **B** in parallel, and then wires **A, B** and **C** in parallel. The readings for each circuit are shown in Table 4.1.

On Figs. 4.4 and 4.5, draw arrows to show the meter readings for the circuit in which wires **A** and **B** are connected in parallel.

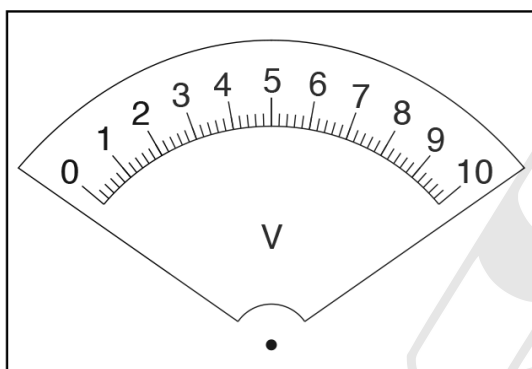


Fig. 4.4

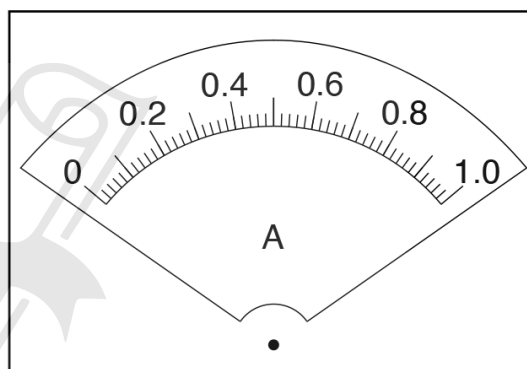


Fig. 4.5

[1]

- (d) Calculate, and record below, the resistance R of each wire combination, using the equation $R = \frac{V}{I}$.

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resistance of wire **A** $R_1 = \dots\dots\dots$

resistance of wires **A** and **B** in parallel $R_2 = \dots\dots\dots$

resistance of wires **A, B** and **C** in parallel $R_3 = \dots\dots\dots$

[3]

4.3. ELECTRIC CIRCUITS

- (e) (i) A student suggests that when 2 identical wires are connected in parallel, their resistance should be equal to 1/2 of the resistance of a single wire.

State whether your findings agree with this suggestion.

Justify your answer by reference to your results, giving values to support your justification.

statement

.....

justification

.....

[2]

- (ii) Use your results to suggest the relationship that should exist between R_3 and R_1 .

.....

.....[1]

[Total: 9]



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16. 0625_w14_qp_63 Q: 5

Some IGCSE students are finding the resistance of a lamp in two different electrical circuits.

(a) Circuit 1 is shown in Fig. 5.1.

circuit 1

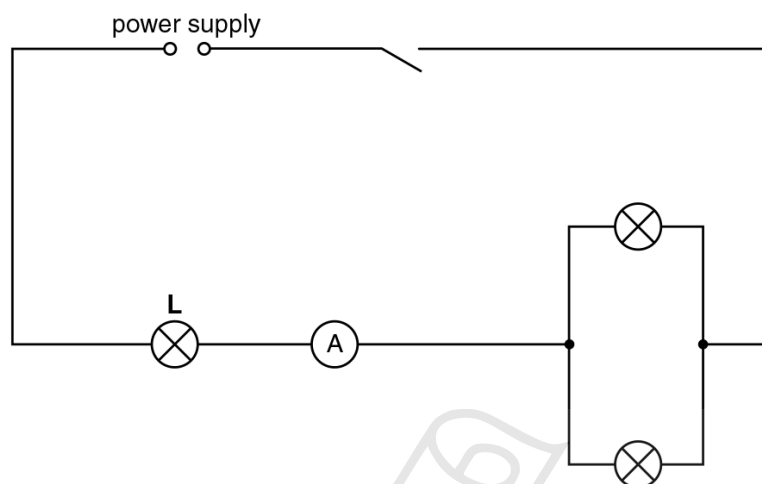


Fig. 5.1

On Fig. 5.1, draw a voltmeter connected to measure the potential difference across lamp **L**. [1]

(b) The switch is closed.

Fig. 5.2 shows the readings on the voltmeter and ammeter measuring the potential difference and the current for lamp **L**.

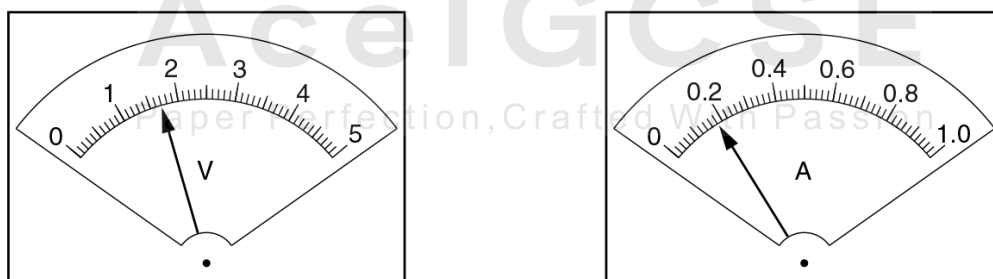


Fig. 5.2

Read, and record in Table 5.1, the potential difference V and the current I .

Table 5.1

circuit	$V/$	$I/$	$R/$	appearance of lamp L
1				bright
2	0.91	0.12		dim

(c) The circuit is reconnected as shown in Fig. 5.3.

circuit 2

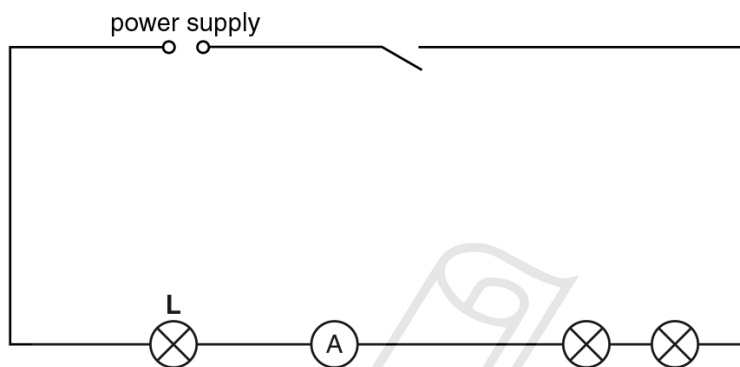


Fig. 5.3

The potential difference V and the current I for lamp **L** in this circuit are shown in the table.

- (i) Using the equation $R = \frac{V}{I}$, calculate and record in the table the resistance R of lamp **L** when connected in each circuit.
 - (ii) Complete the column headings in the table. [4]
- (d) A student suggests that, as the same lamp **L** is used throughout the experiment, its resistance in each circuit should be the same.

State whether the findings agree with this idea. Justify your answer by reference to the results.

statement

.....

justification

.....

.....

[1]

- (e) Theory suggests that the resistance of a lamp increases when its temperature rises.

Explain whether the observations in Table 5.1 support this.

.....
.....
..... [1]

- (f) It is possible to change the current in this type of experiment by using a variable resistor rather than rearranging the circuit.

In the space below, draw a circuit with a power supply, a lamp, an ammeter and a variable resistor used for this purpose.



[2]

[Total: 9]

4.3. ELECTRIC CIRCUITS

17.0625_s13_qp_62 Q: 3

The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

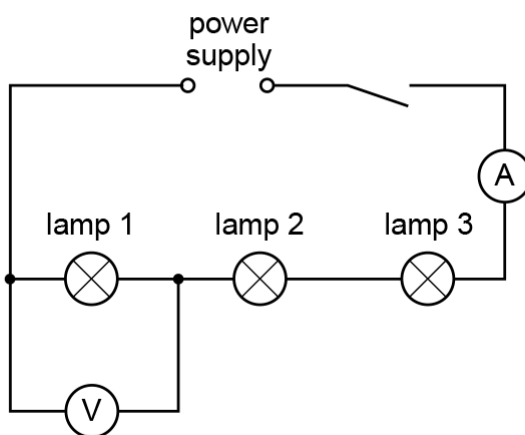


Fig. 3.1

A student measures the potential difference V_1 across lamp 1 and the current I in the circuit.

(a) (i) Using Fig. 3.2, record the student's readings.

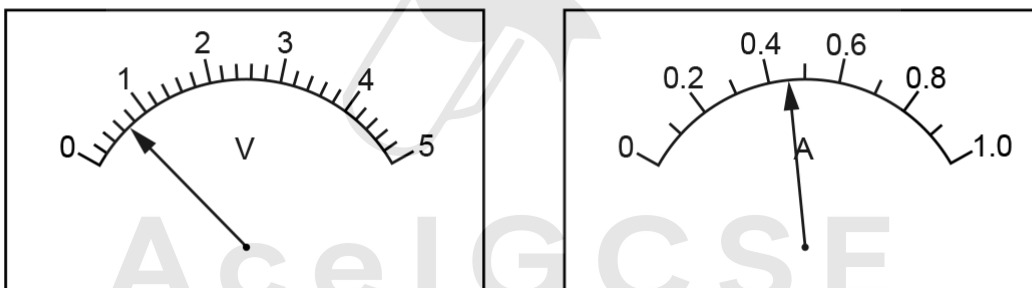


Fig. 3.2

$V_1 = \dots\dots\dots$

$I = \dots\dots\dots$

[2]

(ii) Calculate the resistance R_1 of lamp 1 using the equation $R_1 = \frac{V_1}{I}$.

$R_1 = \dots\dots\dots$ [1]

- (b) The student uses the voltmeter to measure the potential difference V_2 across lamp 2, and the potential difference V_3 across lamp 3.

- (i) Using Fig. 3.3, record the student's reading of V_2 .

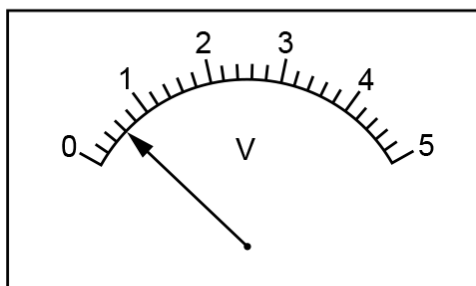


Fig. 3.3

$V_2 = \dots\dots\dots$

- (ii) Using Fig. 3.4, record the student's reading of V_3 .

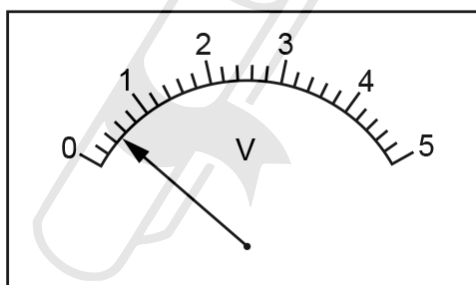


Fig. 3.4

$V_3 = \dots\dots\dots$

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[1]

- (c) Calculate the total potential difference V_T across the three lamps using the equation $V_T = V_1 + V_2 + V_3$.

$V_T = \dots\dots\dots$ [1]

4.3. ELECTRIC CIRCUITS

- (d) The student rearranges the circuit so that the lamps are in parallel with each other and the ammeter is connected to measure the total current I_T in the circuit.

He connects the voltmeter to measure the potential difference V_p across the lamps.

In the space below, draw a circuit diagram of this new circuit using standard symbols.



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[2]

- (e) The student measures the potential difference V_p and the current I_T , and calculates the total resistance R_p of the lamps arranged in parallel.

$$R_p = \dots\dots\dots 2.1 \Omega \dots\dots\dots$$

The student suggests that R_p should be equal to $\frac{R_1}{3}$.

State whether the results support this suggestion and justify your answer by reference to the results.

statement

justification

.....

[1]

- (f) Another student suggests that R_p should not be equal to $\frac{R_1}{3}$ because the lamp filaments are hotter when the lamps are connected in parallel than when the lamps are connected in series.

State one piece of evidence, that you would see during the investigation, that shows that the lamp filaments are hotter in the parallel circuit.

.....

..... [1]

[Total: 9]



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4.3. ELECTRIC CIRCUITS

18.0625_s13_qp_63 Q: 3

Students in the IGCSE class are investigating the resistance of electric circuits with parallel branches.

The apparatus has been set up as shown in Fig. 3.1.

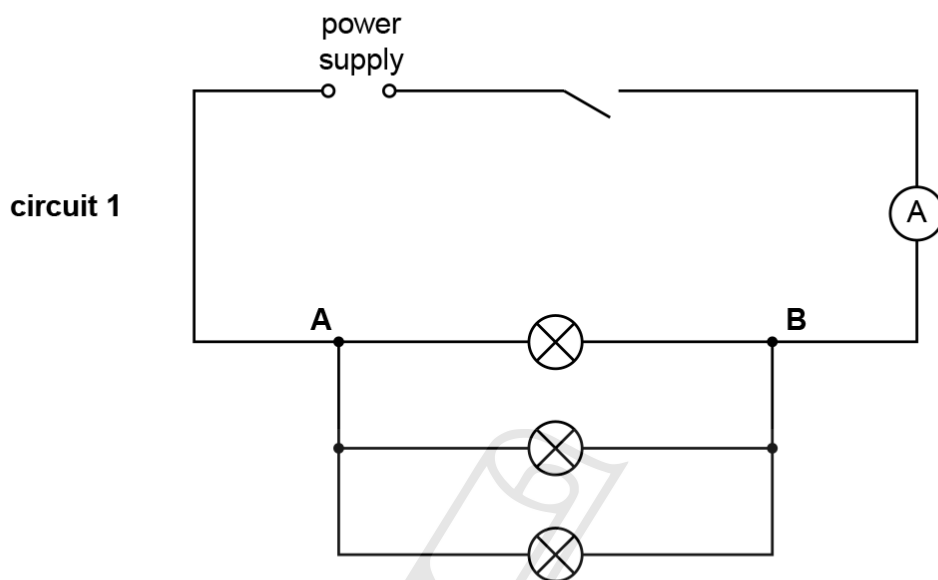


Fig. 3.1

The current in the circuit and the potential difference across the combination of lamps connected between **A** and **B** are to be measured.

- (a) On Fig. 3.1, draw the symbol for a voltmeter, connected to measure the potential difference V between **A** and **B**.

[1]

- (b) The values of potential difference V across AB and current I for **circuit 1** are recorded in Table 3.1.

The lamps are then reconnected as shown in Fig. 3.2 and then Fig. 3.3 and the experiment is repeated.

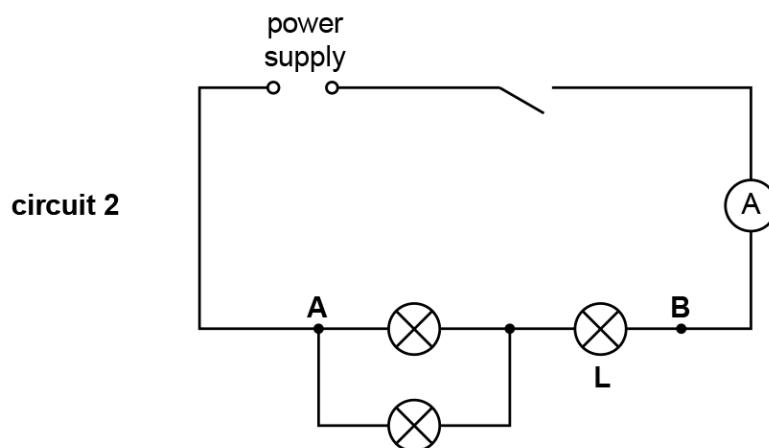


Fig. 3.2

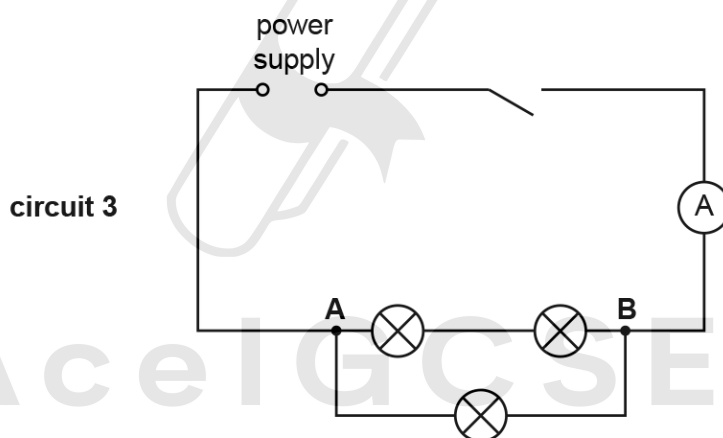


Fig. 3.3

- (i) Calculate, and record in the table, the total resistance R of each combination of lamps, using the equation $R = \frac{V}{I}$. [2]
- (ii) Complete the column headings in the table. [1]

Table 3.1

circuit	$V /$	$I /$	$R /$
1	1.81	0.70	
2	1.76	0.22	
3	1.72	0.44	

4.3. ELECTRIC CIRCUITS

- (c) If each of the lamps had the same resistance, the total resistance of the lamps in circuit 3 would be twice the total resistance of the lamps in circuit 1.

State whether the results in the table show this to be the case. Justify your answer by reference to the results.

statement

justification

[2]

- (d) An IGCSE student wants to measure the potential difference across the lamp marked L in circuit 2.

On the diagram for circuit 2, Fig. 3.2, show how a voltmeter should be connected to measure this potential difference.

[1]

[Total: 7]



19. 0625_w13_qp_61 Q: 3

The IGCSE class is investigating the power of lamps in a circuit.

Fig. 3.1 shows the circuit used.

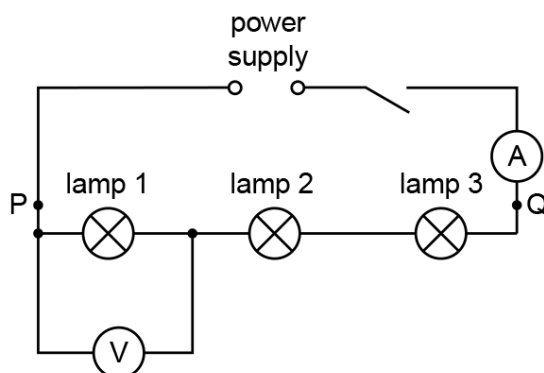


Fig. 3.1

- (a) A student measures the potential difference V_1 across lamp 1 and the current I in the circuit. The meters are shown in Fig. 3.2.

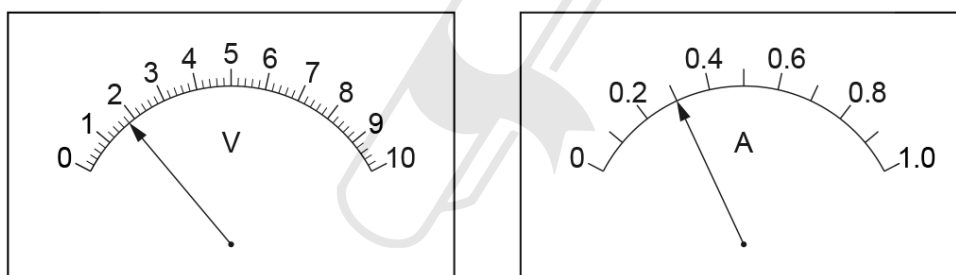


Fig. 3.2

- (i) Write down the readings shown on the meters in Fig. 3.2.

$V_1 =$

$I =$

- (ii) Calculate the power P_1 of lamp 1 using the equation $P_1 = IV_1$.

$P_1 =$

4.3. ELECTRIC CIRCUITS

- (iii) The student reconnects the voltmeter to measure the potential difference V_2 across lamp 2 and then V_3 across lamp 3.

Write down the readings shown on the meters in Figs. 3.3 and 3.4.

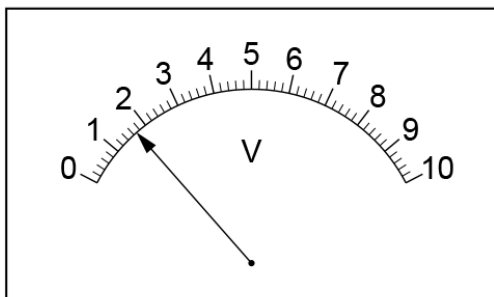


Fig. 3.3

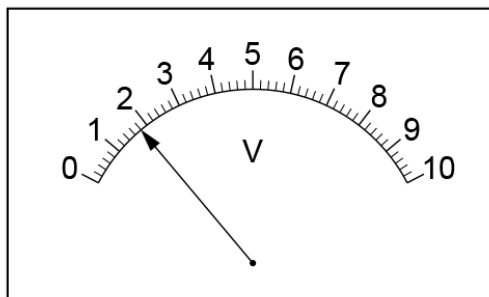


Fig. 3.4

$V_2 = \dots\dots\dots$

$V_3 = \dots\dots\dots$

- (iv) Calculate the power for each lamp using the equation $P = IV$.

$P_2 = \dots\dots\dots$

$P_3 = \dots\dots\dots$

[3]

- (v) Calculate the total power P_T for the three lamps using the equation $P_T = P_1 + P_2 + P_3$.

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$P_T = \dots\dots\dots$ [1]

The student connects the voltmeter across the three lamps and records the potential difference. He calculates the power P .

$P = \dots\dots\dots 1.61W$

Another student suggests that P_T should be equal to P .

State whether the results support this suggestion and justify your answer by reference to the results.

statement

justification

.....

- (c) (i) Draw a circuit diagram, similar to that in Fig. 3.1, to show:
- a variable resistor in series with the power supply,
 - three lamps in parallel with each other between **P** and **Q**,
 - a voltmeter connected to measure the potential difference across the lamps.
- Use standard symbols.



[2]

- (ii) State the purpose of the variable resistor in this circuit.

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[1]

[Total: 9]

4.3. ELECTRIC CIRCUITS

20. 0625_s12_qp_63 Q: 3

The IGCSE class is investigating resistor combinations in circuits.

The first circuit used is shown in Fig. 3.1.

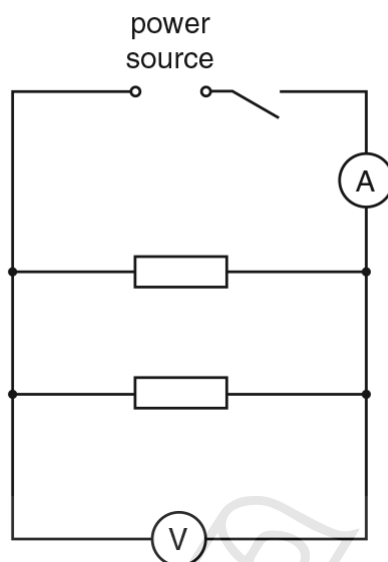


Fig. 3.1

- (a) A student measures the potential difference V_1 across the resistors and the current I_1 in the circuit. The readings are shown in Figs. 3.2 and 3.3.

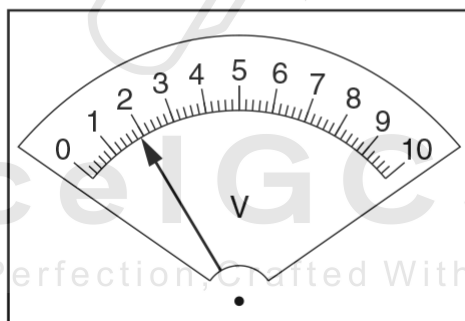


Fig. 3.2

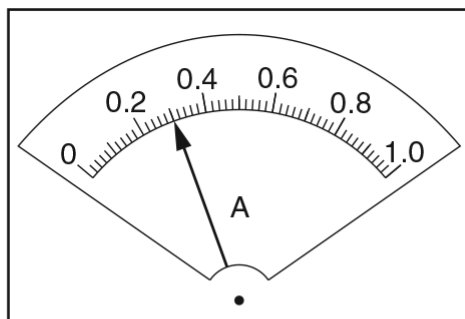


Fig. 3.3

- (i) Record the potential difference V_1 and the current I_1 .

$V_1 = \dots\dots\dots$

$I_1 = \dots\dots\dots$

- (ii) Calculate the total resistance R_p of the combination of the two resistors arranged in parallel using the equation $R_p = \frac{V_1}{I_1}$.

$$R_p = \dots\dots\dots$$

- (iii) Calculate $4R_p$.

$$4R_p = \dots\dots\dots [2]$$

- (b) The student rearranges the circuit so that the two resistors are connected in **series** and the voltmeter is connected to measure the potential difference across **both** resistors.

The new potential difference and current readings are $V_2 = 1.9\text{V}$ and $I_2 = 0.08\text{A}$.

Calculate the total resistance R_s of the combination of the two resistors arranged in series using the equation $R_s = \frac{V_2}{I_2}$.

$$R_s = \dots\dots\dots [1]$$

- (c) Theory suggests that $R_s = 4R_p$ if the two resistors have the same value. State whether your results indicate that the resistors have the same value. Justify your answer with reference to the results.

statement

justification

..... [1]

- (d) Using the circuit described in (b), the student replaces the two series resistors with two lamps.

In the space below, draw a circuit diagram of the new circuit using standard symbols.

4.3. ELECTRIC CIRCUITS

21.0625_w12_qp_61 Q: 3

The IGCSE class is investigating the potential differences across circuit components.

Fig. 3.1 shows the apparatus used.

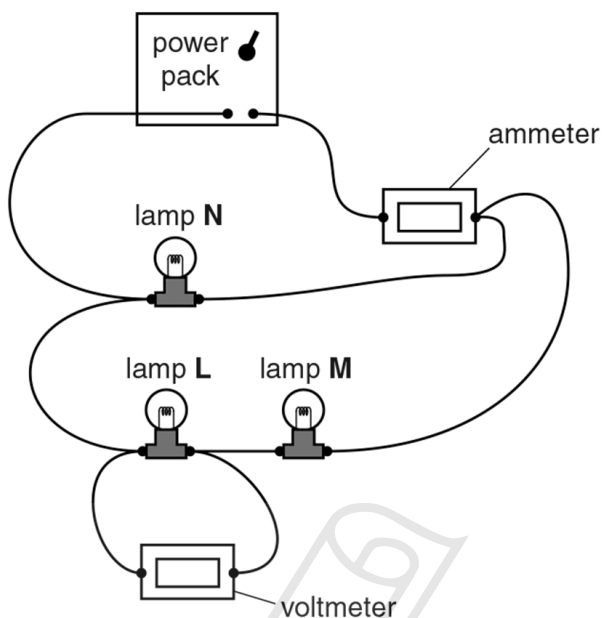


Fig. 3.1

(a) Draw a circuit diagram of the circuit shown in Fig. 3.1, using standard symbols.

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[3]

(b) A student records the current I_A , the potential difference V_L across lamp **L** and the potential difference V_M across lamp **M**.

$$I_A = \dots\dots\dots 0.65 \text{ A} \dots\dots\dots$$

$$V_L = \dots\dots\dots 0.9 \text{ V} \dots\dots\dots$$

$$V_M = \dots\dots\dots 1.0 \text{ V} \dots\dots\dots$$

(i) Calculate the potential difference V_A across lamps **L** and **M** using the equation $V_A = V_L + V_M$.

$$V_A = \dots\dots\dots$$

- (ii) Calculate R_A , the combined resistance of lamps **L**, **M** and **N**, using the equation

$$R_A = \frac{V_A}{I_A}.$$

$$R_A = \dots\dots\dots [2]$$

- (iii) On Fig. 3.2, draw a pointer showing the current $I_A = 0.65 \text{ A}$.

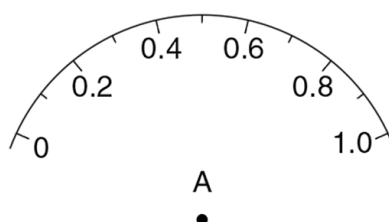


Fig. 3.2

[1]

- (c) The student rearranges the circuit so that the three lamps are in **series** with each other. He records the potential difference across each lamp in turn.

$$V_L = \dots\dots\dots 0.6\text{V} \dots\dots\dots$$

$$V_M = \dots\dots\dots 0.7\text{V} \dots\dots\dots$$

$$V_N = \dots\dots\dots 0.7\text{V} \dots\dots\dots$$

Calculate the potential difference V_B across the three lamps using the equation $V_B = V_L + V_M + V_N$.

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$$V_B = \dots\dots\dots$$

- (d) A student suggests that V_A should be equal to V_B .

State whether the results support this suggestion and justify your answer with reference to the results.

statement

justification

.....

[2]

[Total: 8]

4.3. ELECTRIC CIRCUITS

22. 0625_w12_qp_62 Q: 3

The IGCSE class is investigating current and potential difference using identical lamps in a circuit.

The circuit is shown in Fig. 3.1.

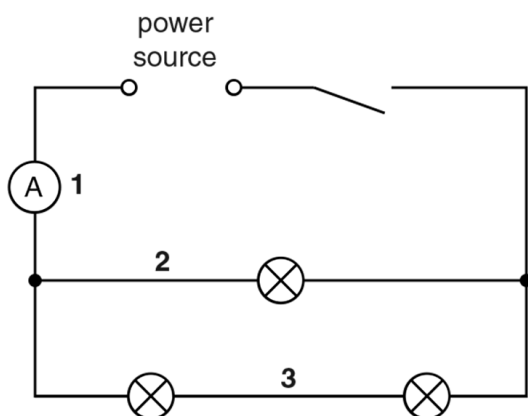


Fig. 3.1

- (a) On Fig. 3.1, draw the symbol for a voltmeter connected to measure the potential difference V across the combination of lamps. [1]
- (b) On Fig. 3.2, draw a pointer showing the voltmeter reading $V = 1.9V$.



Fig. 3.2

[1]

- (c) (i) A student measures the current at positions 1, 2 and 3 in the circuit. Record the current at each position as shown on the ammeters in Fig. 3.3.

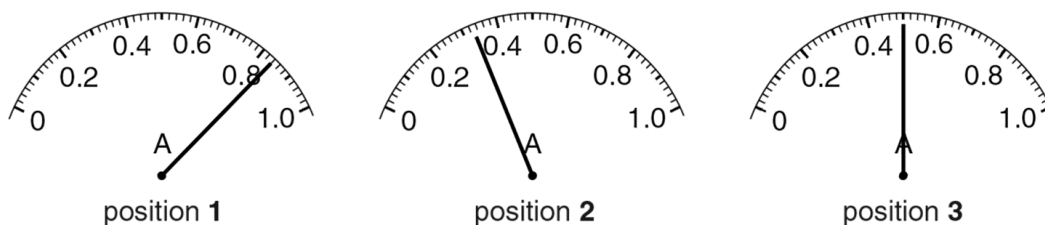


Fig. 3.3

$I_1 = \dots\dots\dots$

$I_2 = \dots\dots\dots$

$I_3 = \dots\dots\dots$

[1]

- (ii) Calculate the total current I_C in the combination of lamps using the equation $I_C = I_2 + I_3$.

$$I_C = \dots\dots\dots$$

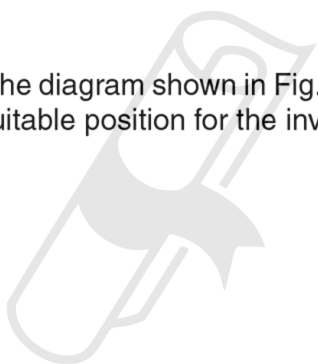
- (iii) Theory indicates that $I_1 = I_C$. Suggest why a student may find the two values to be different in this experiment.

.....

[1]

- (d) The student decides to investigate the effect of changing the current I_1 , using a variable resistor (rheostat).

In the space below, copy the diagram shown in Fig. 3.1, but with the addition of a variable resistor connected at a suitable position for the investigation.



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[2]

- (e) A student sets up the circuit as shown in Fig. 3.1. Neither of the two lamps in series glows. He suspects that one of the lamps is faulty.

Suggest how the apparatus may be used to find out which lamp is faulty.

.....
[1]

[Total: 7]

01. 0625_s20_MS_61 Q: 2

2(a)(i)	$V_1 = 3.5$	1
2(a)(ii)	$I_1 = 0.38$	1
2(a)(iii)	$R_1 = 9.21$ (ecf allowed)	1
	Unit Ω	1

(b)	$R_2 = 5.7$ and $R_3 = 4.6$, with consistent 2 sf	1
(c)	Total $R = 20$	1
(d)	Statement matches readings (Expect B)	1
	Justification with suitable numbers quoted	1
(e)	Three lamps in series, correct symbol	1
	Voltmeter across lamp L_3	1
	Other symbols and circuit correct	1

02. 0625_s20_MS_63 Q: 2

(a)(i)	correct voltmeter symbol in parallel with resistor	1
	correct ammeter symbol in series	1

(a)(ii)	$V_A = 2.4$ (V)	1
	$I_A = 0.48$ (A)	1
(a)(iii)	correct calculation of $R_A = 5(.0)$ / ecf	1
(b)	correct unit for $R - \Omega$	1
(c)	all R values to consistent 2 or consistent 3 significant figures	1
(d)	statement matching results	1
	justification matching statement with <u>values</u> from results used, e.g. within limits of experimental accuracy	1
(e)(i)	correct symbol for potentiometer	1
(e)(ii)	can obtain average value / plot a graph	1

03. 0625_s19_MS_63 Q: 3

(a)	correct voltmeter symbol in parallel with X	1
(b)	$I = 0.22$ (A)	1
	$V = 1.1$ (V)	1
	A, V, Ω	1
(c)	statement matching results <u>and</u> 'currents the same within limits of experimental accuracy' / owtte	1
(d)(i)	R values 5.0/ecf, 14(.3478), 24/(23.8095) (Ω)	1
	consistent 2 or consistent 3 sig figs	1
(d)(ii)	$R_V = 9.0$ (Ω) <u>and</u> $R_Z = 10$ (Ω)	1
(e)(i)	3 resistors in parallel arrangement <u>and</u> circuit symbols correct	1
	voltmeter and ammeter in correct arrangement <u>and</u> circuit symbols correct	1
(e)(ii)	$10R_P = R_S$	1

04. 0625_w19_MS_61 Q: 2

(a)(i)	$V = 2.5$	1
	$I = 0.3(0)$	1
	Both units correct	1
(a)(ii)	R_1 8.33 (ecf allowed)	1
(b)	R_2 11.4 with unit Ω	1
(c)	Statement matches results	1
	Justification matches statement	1
(d)	Lamps in parallel and correct symbol for lamp	1
	One voltmeter, with correct symbol, in parallel with lamps	1
	Variable resistor in correct position, with correct symbol	1

05. 0625_m18_MS_62 Q: 3

(a)	correct voltmeter symbol in parallel with lamp X	1
(b)	$I_s = 0.34$ (A)	1
(c)(i)	$V_x = 1.2$ (V) <u>and</u> $V_y = 1.9$ (V)	1
(c)(ii)	V_s present <u>and</u> correct units (A, V) seen in (b) and (c)	1
(c)(iii)	statement matching results	1
	justification matching statement with <u>use of comparative values</u> (e.g. 3.1 and 3.0 are within limits of experimental accuracy)	1
(d)	correct calculation of R_1 (3.5 / ecf)	1
(e)(i)	lamps in parallel arrangement	1
	all circuit elements in correct arrangement and all circuit symbols correct	1
	resistance increases with temperature	1
(e)(ii)	$R_2 > R_1$ <u>and</u> brighter lamp has higher temperature	1

06. 0625_s18_MS_61 Q: 2

(a)(i)	EITHER $V_1 = 2.2$ OR $I = 0.46$ correct	1
	Both values correct <u>and</u> correct units V and A	1
(a)(ii)	$R_1 = 4.78$ (Ω) (allow ecf from 2(a)(i))	1
(b)	Statement matches readings (Expect YES)	1
	Expect justification to include the idea of within the limits of experimental accuracy (but accept beyond limits, if ecf allowed for statement matching readings)	1
(c)	$R = 14.3$ OR 14.4; 2 or 3 significant figures required	1
	Unit Ω	1
(d)	$3V_1$	1
(e)	3 resistors in parallel	1
	Correct variable resistor symbol	1
	Voltmeter symbol correct <u>and</u> circuit correct	1

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07. 0625_w18_MS_62 Q: 2

(a)(i)	$V_T = 2.5(0)$ (V)	1
	$I_T = 0.18(0)$ (A)	1
(a)(ii)	0.45 (W)	1
(b)(i)	$P_X = 0.23$, $P_Y = 0.22$ and unit W	1
(b)(ii)	statement: Yes idea of within the limits of experimental accuracy	1
	explained: e.g. close enough, very close, not too far apart	1
(c)	statement: disagree / no	1
	low current not sufficient to make lamp glow / first lamp would not glow with no current / since there is a current (other lamp cannot be broken).	1
(d)	lamps and voltmeter in parallel	1
	correct symbols for lamps, ammeter and voltmeter	1
	variable resistor, correct symbol and position in a correct circuit	1

08. 0625_w17_MS_61 Q: 1

(a)(i)	1.8 (V)	1
	0.38 (A)	1
(a)(ii)	R_1 4.74 (4.737, 4.7)	1
(b)	$R_2 = 9.47$ OR 9.5 (2 or 3 significant figures required)	1
(c)	Pointer at 0.13	1
(d)	Statement YES or NO (owtte) Justification to include the idea of within (or beyond, ecf) the limits of experimental accuracy, matching the statement	1
(e)	Determine each resistance in turn	1
(f)	Three resistors in parallel, ONE voltmeter in parallel with resistors and correct symbols for voltmeter and resistors	1
	Variable resistor in series with the supply, correct symbol in a correct circuit	1
(g)	Repeat with different currents OR to obtain a range of readings	1

09. 0625_w17_MS_63 Q: 2

(a)	correct voltmeter symbol in parallel with X	1
(b)	$I_S = 0.18$ (A)	1
(c)(i)	$V_X = 1.2$ (V) AND $V_Y = 2.3$ (V)	1
(c)(ii)	correct units (A, V) seen in (b) and (c)	1
(c)(iii)	statement matching readings	1
	justification, with use of values seen, matching readings and statement e.g. '3.5 V and 3.7 V are within limits of expt accuracy'	1
(d)	correct calculation of R_s (20.6)	1
	2 / 3 sig figs and unit(Ω)	1
(e)(i)	resistors in parallel with correct symbol	1
	rest of circuit correct	1
(e)(ii)	valid suggestion AND explanation consistent with results	1

10. 0625_s16_MS_63 Q: 4

(a)	correct voltmeter symbol in parallel with lamp P	1
(b)	$I = 0.23$	1
	unit of A	1
(c)	$V_P = 2.7$ and $V_Q = 0.3$	1
(d)(i)	some current in the circuit, pd across lamp Q is small / not equal to supply voltage / reference to lamp P bright <u>and is in series</u>	1
(d)(ii)	V_P greater than / near working voltage	1
	V_Q <u>much</u> less than working voltage	1
(e)	$R = 13(.0)$ allow ecf	1
	2/3sig figs and unit of Ω	1
(f)	statement matches results	1
	some correct values used and reference to 'within limits of experimental accuracy' / owtte	1
		Total: 11

11. 0625_w16_MS_61 Q: 4

	MP1 On circuit diagram: one voltmeter in parallel with any component	1
	MP2 Circuit diagram correctly shows power supply, ammeter, unless in a branch, two or more resistors in parallel	1
	MP3 Circuit diagram: Correct symbols for ammeter, voltmeter and fixed resistor	1
	MP4 Repeat with a different number of resistors (in parallel)	1
	MP5 Table that includes columns for number of resistors, voltage/V and current/A	1
	MP6 & MP7 Then any two from: Resistance calculated (may be shown in table) Use low current (to stop resistors getting too hot)/switch off between readings Use at least 5 different combinations Repeat with different current or voltage or variable resistor setting Drawing a graph of number of resistors against combined resistance	2
		Total: 7

12. 0625_s15_MS_61 Q: 3

- (a) (i)** $V = 1.8$ [1]
 $I = 0.25$ AND both units correct, V and A [1]
(ii) R_S calculated correctly, e.c.f. **(i)**, expect $7.2 (\Omega)$ [1]
- (b) (i)** lamps in parallel and ammeter in a correct position [1]
voltmeter in correct position, with rest of circuit and symbols correct [1]
(ii)(iii) $R_P = 3.3$ or 3.33 with unit Ω and 2 or 3 significant figures AND R_S/R_P calculated [1]
- (c) (i)** voltage or p.d., accept current [1]
(ii) adjust power supply OR add resistor/variable resistor [1]

[Total: 8]

13. 0625_s15_MS_62 Q: 3

- (a) (i)** $V = 2.4(0)(V)$ [1]
 $I = 0.84 (A)$, both units correct [1]
(ii) $R_P = 2.86$ OR $2.9 (\Omega)$ ecf **(a)(i)** [1]
- (b)** lamps in series [1]
voltmeter and ammeter in correct position, with rest of circuit and symbols correct [1]
- (c)** $R_S = 11.4$ OR $11 (\Omega)$ NOT more than 3 sig. figs. [1]
- (d) (i)** correct symbol for variable resistor NOT potentiometer [1]
(ii) X correctly positioned [1]

[Total: 8]

14. 0625_w15_MS_62 Q: 3

- (a) (i) $V_1 = 2(.0)$ (V) [1]
 $I_1 = 0.32$ (A) [1]
- (ii) $R_1 = 6.25$ (Ω) OR e.c.f. (i) AND correct units V, A, Ω in (i) and (ii) [1]
- (b) correct arrangement of resistors [1]
correct position for voltmeter AND correct circuit symbols AND correct labelling of resistors **A**, **B** and **C** [1]
- (c) (i) 3.0/3.04/3.043 (Ω) [1]
- (ii) 2.1/2.05/2.06/2.07/2.08 OR e.c.f. AND no unit [1]
- (d) statement matches results [1]
justification including the idea of within (or beyond) the limits of experimental accuracy [1]

[Total: 9]

15. 0625_w15_MS_63 Q: 4

- (a) correct symbol for voltmeter AND shown connected in parallel [1]
- (b) 3(.0)(V) AND 0.38(A) [1]
- (c) arrows showing 2.8–3.0 V AND 0.76–0.78 A [1]
- (d) $R_1 = 7.9$ (OR e.c.f.), $R_2 = 3.8$, $R_3 = 2.7$ [1]
correct unit (symbol or word) [1]
consistently 2 sig. figs. OR consistently 3 sig. figs. [1]
- (e) (i) statement matches results with any relevant values quoted [1]
justification matching statement [1]
- (ii) R_3 should be $\frac{1}{3} \times R_1$ owtte [1]

[Total: 9]

16. 0625_w14_MS_63 Q: 5

- (a) voltmeter in parallel with lamp **L** and with correct symbol [1]
- (b)(c) table:
 $V = 1.7$ (V) [1]
 $I = 0.18$ (A) [1]
 $R = 9.4(4)$ ecf (b), 7.6/7.58 with 2 or 3 sig. figs. [1]
 all units correct (V, A, Ω) [1]
- (d) statement matches results, with matching justification which refers to values being 'too different' / 'difference beyond limits of experimental accuracy' owtte [1]
- (e) lamp in circuit 1 brighter than in circuit 2
and has greater resistance [1]
- (f) correct circuit symbol for variable resistor (rectangle with strike-through arrow only) [1]
 connected in correct series circuit [1]

[Total: 9]

17. 0625_s13_MS_62 Q: 3

- (a) (i) $V_1 = 0.7$ (V) [1]
 $I = 0.45$ (A) [1]
- (ii) $R_1 = 1.56$ or 1.6 (Ω) e.c.f. (i) [1]
- (b) $V_2 = 0.6$ (V) and $V_3 = 0.5$ (V) c.a.o. [1]
- (c) 1.8 (V) e.c.f. V_1, V_2, V_3 [1]
- (d) correct symbols for ammeter, lamp, voltmeter [1]
 correct parallel circuit with ammeter and voltmeter correctly connected [1]
- (e) statement matches candidate's results and idea of within/beyond limits of experimental accuracy or that values are too far apart / too different [1]
- (f) brighter [1]

[Total: 9]

18. 0625_s13_MS_63 Q: 3

- (a) correct symbol for voltmeter [1]
- (b) (i) 2.59, 8.00, 3.91 [1]
consistent 2 or 3 sig. figs. [1]
- (ii) units all correct (symbols or words) [1]
- (c) statement matches result (expect 'No') [1]
R figures quoted appropriately and matching statement [1]
(need to see too different o.w.t.t.e.)
- (d) correct parallel connection [1]

[Total: 7]

19. 0625_w13_MS_61 Q: 3

- (a) (i) 1.8 (V) [1]
0.3 (A) [1]
- (ii) $P_1 = 0.54$ (W) e.c.f. allowed [1]
- (iii)(iv)(v) $P_T = 1.59$ (or 1.6) W [1]
- (b) statement matches results (expect YES) e.c.f. allowed [1]
justification in terms of within or beyond limits of experimental accuracy o.w.t.t.e. [1]
- (c) (i) diagram: [1]
lamps in parallel, variable resistor in series with power supply, with correct symbols [1]
for variable resistor, lamps and voltmeter
one voltmeter correctly positioned
- (ii) vary current (or p.d.) [1]

[Total: 9]

20. 0625_s12_MS_63 Q: 3

- (a) (i) $V_1 = 1.9$ [1]
 $I_1 = 0.3$ [1]
 Units V and A both correct [1]
- (ii)/(iii) $R_P = 6.33$ and $4R_P = 25.3/25.2$ to 2 or 3 sig. figs. [1]
 Ω [1]
- (b) $R_S = 23.8 (\Omega)$ or $24 (\Omega)$ [1]
- (c) Correct statement (from candidate's work)
 with matching justification (idea of within or beyond experimental accuracy) [1]
- (d) Circuit: correct symbols for ammeter, voltmeter and lamp in correct series circuit [1]
- (e) (i) Change/control current/voltage [1]
 (ii) To obtain range of readings (or wtte) [1]
- [Total: 10]**

91. 0625_w12_MS_61 Q: 3

- (a) Correct symbols for ammeter, voltmeter and lamps [1]
 Ammeter and voltmeter in correct positions [1]
 Correct parallel circuit [1]
- (b) (i) and (ii) $V_A = 1.9(V)$ $R_A = 2.9(2) (\Omega)$ [1]
 Units V and Ω [1]
- (iii) Pointer at correct position (0.65) [1]
- (c) No mark awarded
- (d) Statement matches readings (expect YES) [1]
 Justified with idea of experimental inaccuracy [1]
 (expect 'close enough', owtte)
- [Total: 8]**

22. 0625_w12_MS_62 Q: 3

- (a) Voltmeter symbol and position correct [1]
- (b) Pointer in correct position [1]
- (c) (i) $I_1 = 0.84\text{ A}$, $I_2 = 0.33\text{ A}$, $I_3 = 0.50\text{ A}$, all correct no significant figures penalty
Unit at least once and not contradicted [1]
- (ii) No mark awarded
- (iii) Sensible comment about experimental inaccuracy
e.g. difficulty in reading meter/scale or meter has a zero error [1]
- (d) Circuit: correct symbol for variable resistor (not potential divider) [1]
Variable resistor in a correct position [1]
- (e) Workable solution, e.g. short circuit each in turn/exchange of lamp from other circuit
branch/put lamps in parallel and check/use voltmeter to check pd across bulbs plus what
is observed [1]

[Total: 7]



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