4.3 Electric circuits

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01. 0625_m23_qp_42 Q: 7

(a) Define potential difference (p.d.).

.....

..... [2]

(b) **(i)** State the equation which defines electromotive force (e.m.f.) *E*.

[1]

(ii) The e.m.f. of a battery is 9.0 V. The battery is in a circuit.

Calculate the work done by the battery when it moves a charge of 30 C around a complete circuit.

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work done = ... [2]

(c) A circuit consists of a d.c. power supply, a lamp and a thermistor.

(i) Draw a circuit diagram of these components connected in series.

[2]

(ii) Explain what happens in the circuit you have drawn in **(c)(i)** when the temperature of the thermistor is increased.

.....

.....

..... [2]

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02. 0625_s23_qp_41 Q: 7

Fig. 7.1 shows a circuit that contains a battery, a switch, a voltmeter and three 40 Ω resistors, R_1, R_2 and R_3.

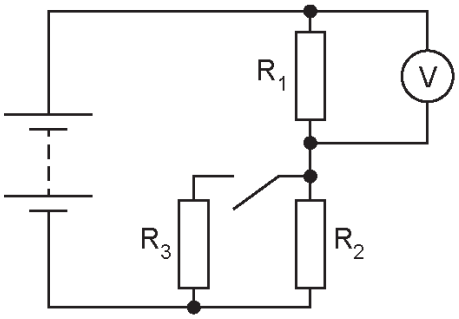

Fig. 7.1

The switch is open and resistors R_1 and R_2 form a potential divider.

(a) Describe what is meant by a potential divider.

.....

.....

..... [2]

(b) The reading on the voltmeter is 7.5 V.

(i) Calculate the electromotive force (e.m.f.) of the battery.

e.m.f. = ... [1]

(ii) The switch is closed.

Calculate the resistance of the complete circuit.

resistance = ... [3]

(c) Calculate the reading on the voltmeter when the switch is closed.

reading = ... [2]

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03. 0625_s23_qp_42 Q: 8

(a) **(i)** State what is meant by a magnetic field.

.....

..... [1]

(ii) Define the direction of a magnetic field.

.....

..... [1]

(b) Fig. 8.1 shows a negatively charged metal sphere.

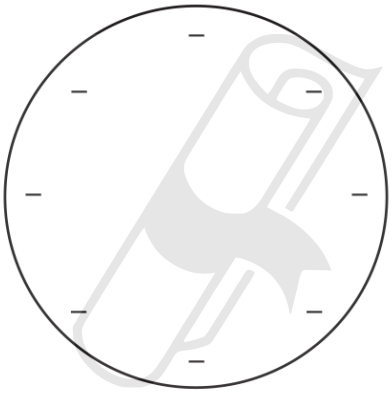

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Fig. 8.1

On Fig. 8.1, draw **four** lines to show the electric field and its direction. [2]

(c) Fig. 8.2 shows a circuit.

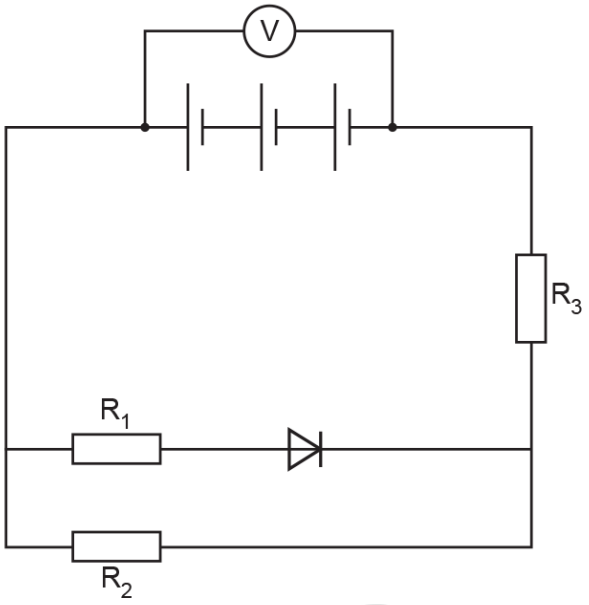

Fig. 8.2

The three cells are identical and have zero resistance.
The resistors R_1, R_2 and R_3 are identical.
The reading on the voltmeter is 6.0 V.
When the diode is conducting, it has zero resistance and zero potential difference (p.d.) across it.

(i) Determine the e.m.f. of one cell.

e.m.f. = ... [1]

(ii) Determine the ratio of the p.d. across R_2 to the p.d. across R_3.

..... [1]

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(iii) All the cells are reversed.

1. State and explain the change in current in R_1.

.....

..... [1]

2. Determine the new value of the ratio of the p.d. across R_2 to the p.d. across R_3.

..... [1]

04. 0625_w23_qp_41 Q: 8

A cylinder is made of modelling clay. The modelling clay is an electrical conductor.

Fig. 8.1 shows the cylinder.

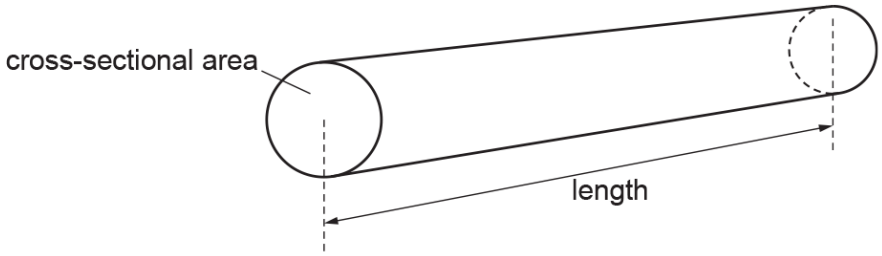

Fig. 8.1

The cylinder is connected into a circuit.

Fig. 8.2 shows that the circuit also includes a battery of electromotive force (e.m.f.) 9.0 V and a resistor P.

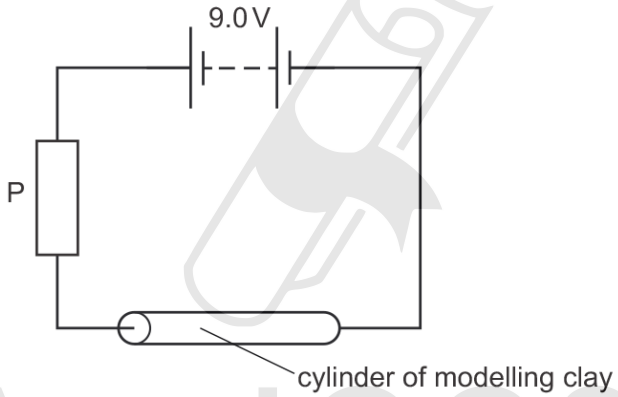

Fig. 8.2

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The resistance of P is 4.0 Ω. The current in P is 1.5A.

(a) Calculate:

(i) the magnitude *X* of the charge that flows through P in 600 s

X = ... [2]

(ii) the resistance of the cylinder of modelling clay.

resistance = ... [3]

(b) The cylinder is removed from the circuit and replaced with a new cylinder made of the same modelling clay.

The new cylinder is twice the length and has half the cross-sectional area of the first cylinder.

Calculate the time that it now takes for a charge of magnitude *X* to flow through resistor P.

time = ... [4]

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05. 0625_w23_qp_42 Q: 6

Fig. 6.1 shows the circuit diagram for a flashlight (torch).

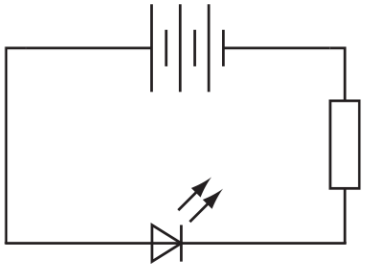

Fig. 6.1

The electromotive force (e.m.f.) of the battery is 4.5 V. The circuit contains a 60 Ω fixed resistor. The current in the light-emitting diode (LED) is 0.020 A.

(a) Calculate the potential difference (p.d.) across the LED.

p.d. = ... [2]

(b) Explain why the LED does **not** light up if the battery is reversed.

.....

..... [1]

(c) The chemical energy stored in the battery is 1050 J.

Show that the flashlight operates for approximately 3 h.

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[2]

(d) Calculate the total charge that flows through the LED in 3600 s.

charge = ... [2]

06. 0625_w23_qp_43 Q: 6

(a) On Fig. 6.1, sketch the current–voltage graph of a filament lamp and explain its shape.

Fig. 6.1

explanation .....

.....

[3]

(b) Fig. 6.2 shows an electric circuit.

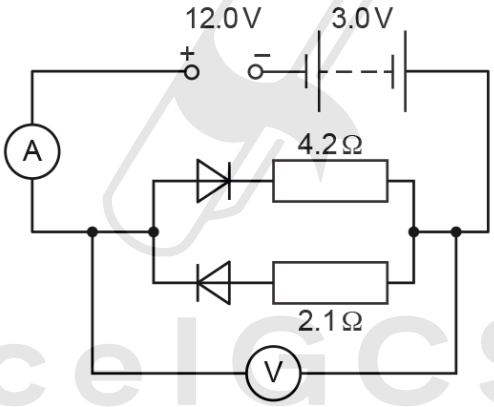

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Fig. 6.2

(i) Calculate the reading on the voltmeter.

voltmeter reading = ... [2]

(ii) Calculate the current in the 4.2 Ω resistor.

current = ... [2]

(iii) Determine the current in the 2.1 Ω resistor.

current = ... [1]

(iv) Determine the reading on the ammeter.

ammeter reading = ... [1]

(v) Calculate the electrical power transferred in the 4.2 Ω resistor.

power = ... [2]

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07. 0625_m22_qp_42 Q: 7

Fig. 7.1 shows a circuit including a 12 V battery and two identical lamps.

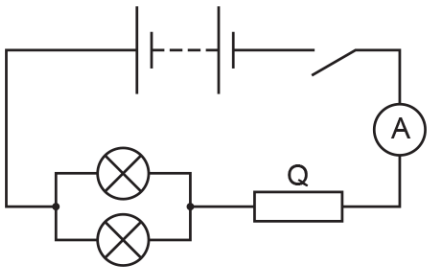

Fig. 7.1

(a) The 12 V battery consists of cells connected in series. Each cell in the battery has an electromotive force (e.m.f.) of 1.5 V.

Determine how many cells are in the battery.

number of cells = ... [1]

(b) **(i)** When the switch is closed, the ammeter reading is 2.4 A.

Calculate the total resistance of the circuit.

resistance = ... [2]

(ii) Each lamp has a resistance of 3.0 Ω.

Calculate the resistance of Q.

resistance of Q = ... [2]

(c) **(i)** On Fig. 7.1, draw the symbol for a voltmeter that measures the potential difference (p.d.) across the two lamps. [1]

(ii) Calculate the power supplied to **one** lamp.

power = ... [3]

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08. 0625_s22_qp_42 Q: 9

Fig. 9.1 shows a circuit with a 3-position switch.

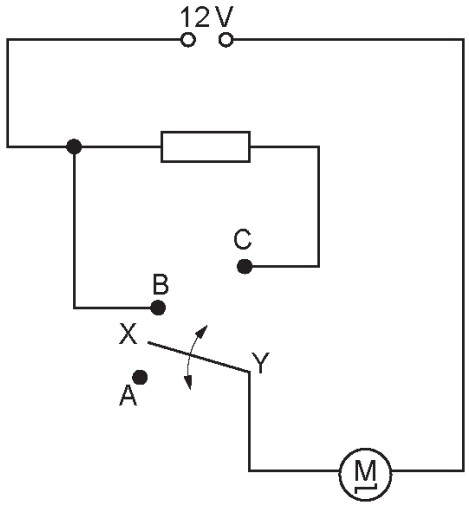

Fig. 9.1

The moving part of the switch is always connected to point Y around which it pivots. The other end of the moving part, labelled X, can be connected to one of the points A, B or C.

(a) The resistance of the motor is 2.0 Ω and the resistance of the resistor is 3.0 Ω.

Determine the current in the motor when the switch is connected to:

(i) point A

current = ... [1]

(ii) point B

current = ... [2]

(iii) point C.

current = ... [2]

(b) Two resistors of resistance 2.0 Ω and 3.0 Ω are connected in parallel.

Calculate the combined resistance of the resistors in this arrangement.

resistance = ... [3]

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09. 0625_s22_qp_43 Q: 8

(a) Fig. 8.1 shows a circuit.

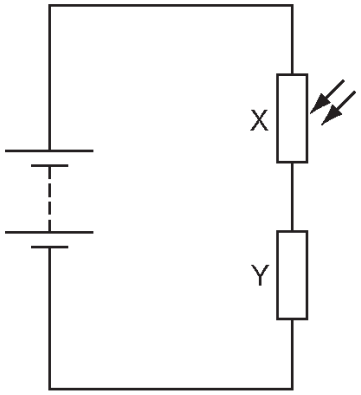

Fig. 8.1

(i) State the name of component X.

..... [1]

(ii) The potential difference (p.d.) across component Y is measured with a voltmeter.

On Fig. 8.1, draw the symbol for the voltmeter and its connections to the circuit. [1]

(iii) The electromotive force (e.m.f.) of the battery is 12 V.

Component Y has a resistance of 400 Ω.

In a brightly lit room, the resistance of component X is 350 Ω.

1. Calculate the current in the circuit.

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current = ... [2]

2. Calculate the p.d. across component Y.

p.d. = ... [1]

(iv) In a dark room, the resistance of component X is very large.

State the effect this will have on the p.d. across component Y.

..... [1]

(b) Suggest a practical use for component X.

..... [1]

10. 0625_w22_qp_41 Q: 8

The unit of the two electrical quantities electromotive force (e.m.f.) and potential difference (p.d.) is the volt (V).

(a) State **one** other similarity between e.m.f. and p.d.

.....

..... [1]

(b) State **one** difference between e.m.f. and p.d.

.....

..... [1]

(c) A battery consists of four cells, each of e.m.f. 1.2 V, in series.

(i) Calculate the e.m.f. of the battery.

e.m.f. = ... [1]

(ii) The battery is connected in a circuit with four 12 Ω resistors. Fig. 8.1 is the circuit diagram.

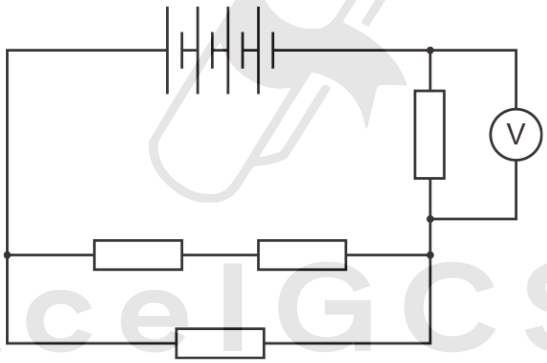

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Fig. 8.1

Calculate the total resistance of this arrangement of resistors.

resistance = ... [3]

(iii) Calculate the reading on the voltmeter in Fig. 8.1.

reading = ... [2]

11. 0625_m21_qp_42 Q: 8

(a) Define electromotive force (e.m.f.).

.....

..... [1]

(b) Fig. 8.1 shows a source E of e.m.f. 60 V in a circuit.

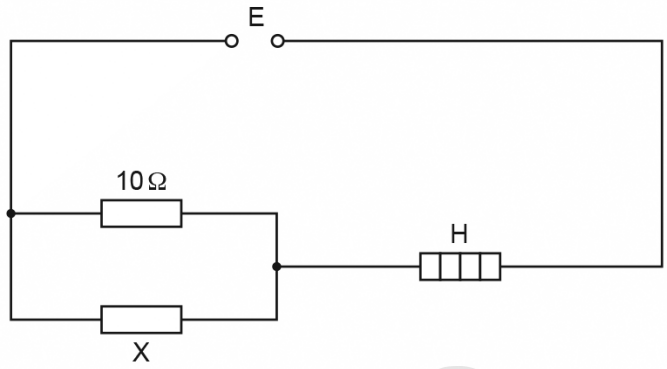

Fig. 8.1

The heater H has a resistance of 22.5 Ω and the potential difference (p.d.) across it is 45 V.

Calculate:

(i) the power of the heater

power = ... [3]

(ii) the p.d. across resistor X

p.d. = ... [2]

(iii) the current in the 10 Ω resistor.

current = ... [2]

[Total: 8]

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12. 0625_s21_qp_41 Q: 8

A student sets up a circuit that includes a 12 V battery, an 800 Ω resistor, a voltmeter and a thermistor. Fig. 8.1 is an incomplete circuit diagram because the symbol for the thermistor is missing.

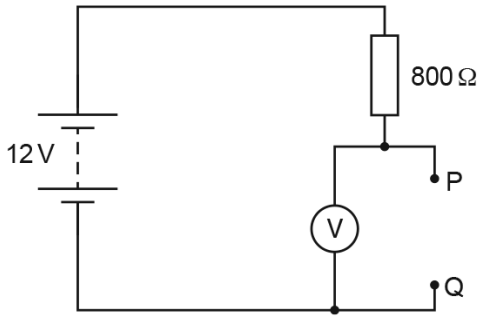

Fig. 8.1

The thermistor is connected between terminals P and Q.

(a) Complete Fig. 8.1 by drawing the symbol for a thermistor between terminals P and Q. [1]

(b) The 12 V battery consists of eight identical cells connected in series.

Calculate the electromotive force (e.m.f.) of each cell.

e.m.f. = ... [1]

(c) The reading on the voltmeter is 8.0 V.

(i) Determine the resistance of the thermistor.

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resistance = ... [3]

(ii) A few hours later, the student notices that the reading on the voltmeter is greater.

Explain what can be deduced from this observation.

.....

.....

.....

..... [3]

[Total: 8]

13. 0625_s21_qp_42 Q: 10

(a) Fig. 10.1 shows the potential difference–current graph for a circuit component K.

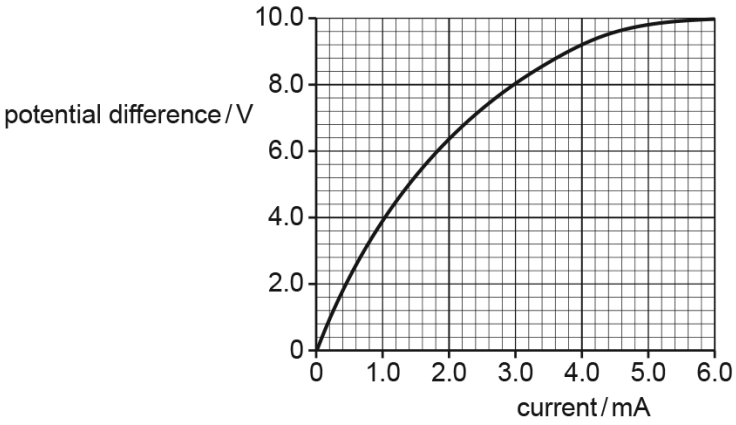

Fig. 10.1

Calculate the resistance of component K when the current in it is 4.0 mA.

resistance = ... [2]

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(b) Fig. 10.2 shows a circuit containing component K.

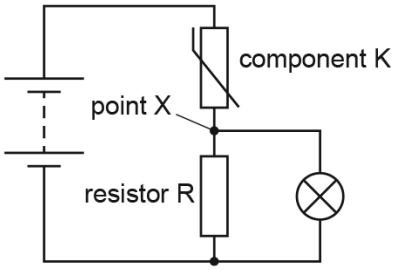

Fig. 10.2

At low temperature, component K has a much greater resistance than resistor R.

At high temperature, component K has a much smaller resistance than resistor R.

State and explain the effect on the lamp when the temperature changes from very low to very high.

Refer to the voltage at point X in your explanation.

statement .....

explanation .....

.....

.....

.....

..... [4]

(c) State the name of component K.

..... [1]

[Total: 7]

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14. 0625_s21_qp_43 Q: 7

(a) Define *electromotive force* (*e.m.f.*).

.....

.....

..... [2]

(b) Fig. 7.1 shows a circuit.

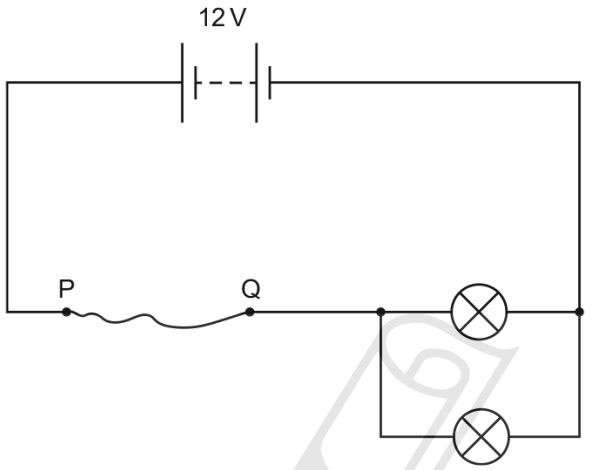

Fig. 7.1

The two lamps shown are identical. Each lamp has a potential difference (p.d.) of 3.0 V across it and a current of 2.0 A in it. PQ is a length of uniform metal wire. The resistance of PQ is *R*.

(i) Calculate the value of *R*.

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R = ... [3]

(ii) Another piece of wire is made of the same metal as PQ. The length of the new piece of wire is twice the length of PQ. The diameter of the new piece of wire is twice the diameter of PQ.

Calculate the resistance of the new piece of wire.

resistance = ... [3]

[Total: 8]

15. 0625_w21_qp_41 Q: 8

A circuit contains two fixed resistors and a light-dependent resistor (LDR). Fig. 8.1 shows that the power supply is a 9.0 V battery.

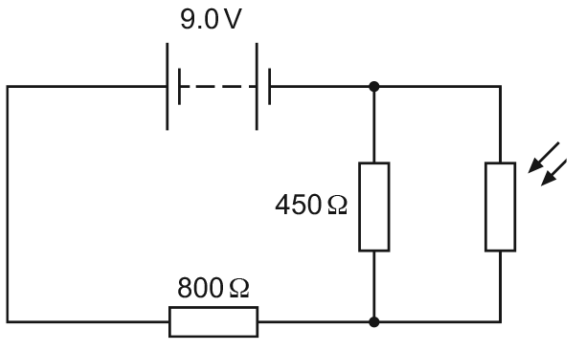

Fig. 8.1

The current in the 450 Ω resistor is 0.012 A.

(a) State what is meant by electric current.

.....

..... [1]

(b) The current in the LDR is I_1 and the current in the 800 Ω resistor is I_2.

Complete the equation that relates the current in the 450 Ω resistor to I_1 and I_2.

current in the 450 Ω resistor = ... [1]

(c) Calculate the power dissipated in the 800 Ω resistor.

power = ... [4]

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(d) The brightness of the light that is incident on the LDR increases.

Explain what happens to the potential difference (p.d.) across the 450 Ω resistor.

.....

.....

.....

..... [3]

[Total: 9]

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16. 0625_w21_qp_42 Q: 9

(a) Fig. 9.1 shows a cell of electromotive force (e.m.f.) 1.5V and a battery of e.m.f. 6.0V connected in series.

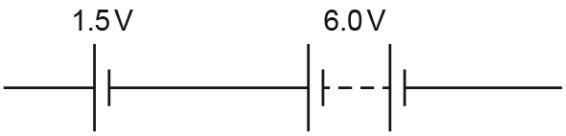

Fig. 9.1

Calculate the combined e.m.f. of the cell and the battery.

e.m.f. = ... [1]

(b) The combined resistance of the three resistors shown in Fig. 9.2 is 4.4Ω.

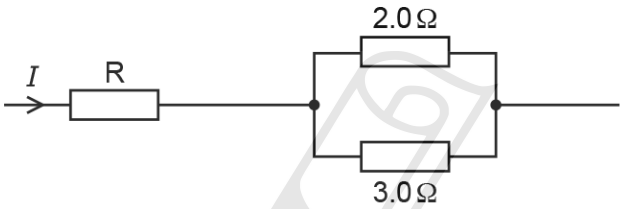

Fig. 9.2

(i) Calculate the resistance of resistor R.

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resistance = ... [3]

(ii) The current I in Fig. 9.2 is 0.94A.

Calculate the potential difference (p.d.) across the combination of resistors.

p.d. = ... [2]

17. 0625_w21_qp_43 Q: 9

Fig. 9.1 shows current–potential difference (p.d.) graphs for a resistor, a thermistor and a filament lamp.

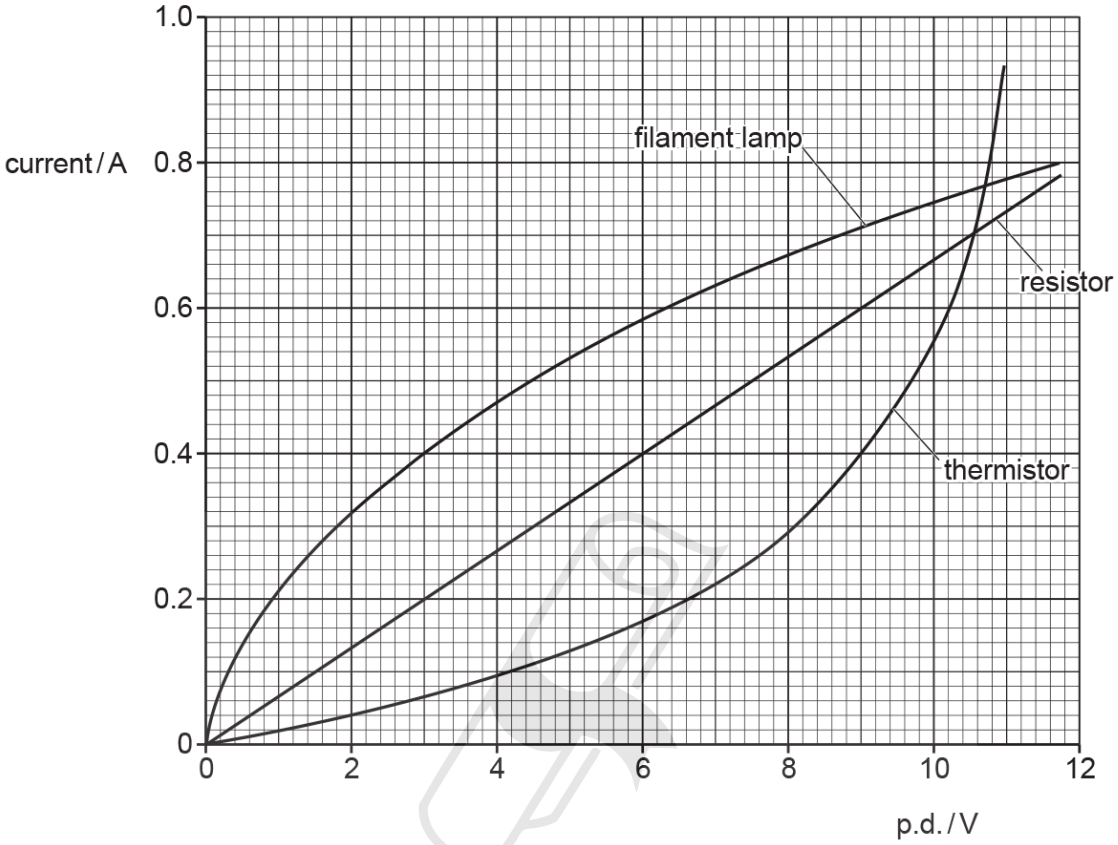

Fig. 9.1

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The resistor, the thermistor and the filament lamp are connected in series with a power supply.

(a) (i) Draw a circuit diagram for this circuit.

[2]

(ii) Add a voltmeter to your circuit diagram in **(a)(i)** in a correct position to measure the p.d. across the resistor. [1]

(iii) Using the graph in Fig. 9.1, determine the p.d. across the terminals of the power supply when the p.d. across the resistor is 6.0 V.

p.d. across terminals of power supply = ... [4]

(b) Describe a practical use for a thermistor.

.....

..... [1]

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18. 0625_m20_qp_42 Q: 8

Fig. 8.1 shows a circuit.

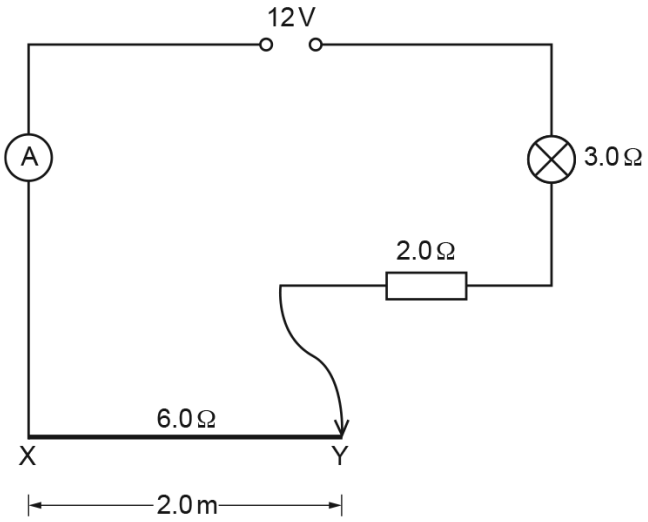

Fig. 8.1

The lamp has a resistance of 3.0Ω. Line XY represents a uniform resistance wire of resistance 6.0Ω.

(a) Calculate the reading on the ammeter.

ammeter reading = ... [2]

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(b) Fig. 8.2 shows the circuit with a different connection to the resistance wire and an added resistor. The length XY of the whole resistance wire is 2.0 m. The contact is made at Q where the distance XQ is 0.60 m.

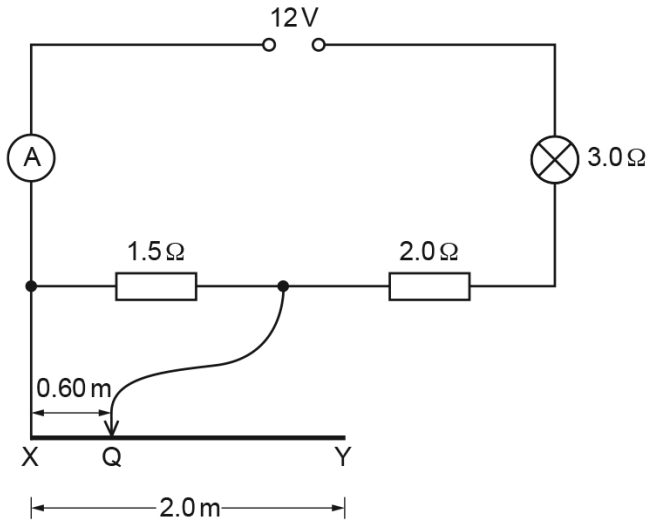

Fig. 8.2

Calculate the resistance of the circuit.

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resistance = ... [4]

[Total: 6]

19. 0625_s20_qp_41 Q: 8

The power supply used in an electric vehicle contains 990 rechargeable cells each of electromotive force (e.m.f.) 1.2 V.

The cells are contained in packs in which all the cells are in series with each other. The e.m.f. of each pack is 54 V.

(a) Calculate the number of packs in the power supply.

number of packs = ... [2]

(b) When in use, each pack supplies a current of 3.5 A.

(i) Calculate the rate at which each cell is transferring chemical energy to electrical energy.

rate of energy transfer = ... [2]

(ii) The packs are connected in parallel to supply a large current to drive the electric vehicle.

Explain why it is necessary to use thick wires to carry this current.

.....

.....

.....

..... [3]

[Total: 7]

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20. 0625_s20_qp_42 Q: 8

(a) A light-emitting diode (LED) is a diode that emits light when there is a current in it. Draw a circuit diagram showing an LED, connected so that it is lit, in series with a battery and a fixed resistor. Use standard electrical symbols.

[4]

(b) The p.d. across the LED when lit is 3.1 V and the current in the LED is 0.030 A.

Calculate the value of the resistance of the LED when lit.

resistance = ... [2]

(c) Fig. 8.1 shows a power supply of e.m.f. 10.5 V connected in series with a lamp and a heater. The p.d. across the lamp is 2.1 V and the current in the lamp is 1.5 A.

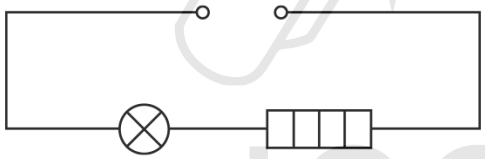

Fig. 8.1

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Calculate:

(i) the resistance of the heater

resistance = ... [2]

(ii) the power of the heater.

power = ... [2]

[Total: 10]

21. 0625_w20_qp_42 Q: 10

Fig. 10.1 shows an incomplete electrical circuit.

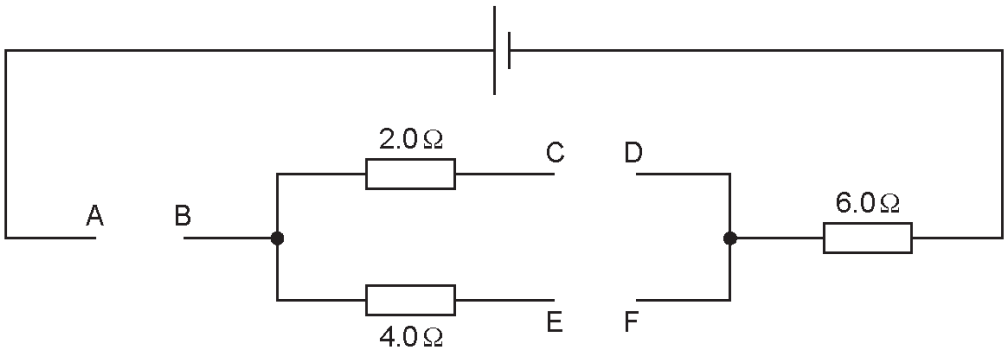

Fig. 10.1

(a) (i) A student completes the circuit and measures the current in the 6.0Ω resistor.

On Fig. 10.1, draw an ammeter symbol in one gap and straight lines to indicate wires in the other gaps to show how the student should do this. [1]

(ii) A voltmeter is connected to measure the potential difference (p.d.) across the 4.0Ω resistor.

On Fig. 10.1, draw a voltmeter symbol connected in the correct position. [2]

(iii) With the circuit completed, the current in the 2.0Ω resistor is 2.5A.

Calculate the current in the 6.0Ω resistor.

current = ... [4]

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(b) Fig. 10.2 shows the same electrical circuit with an alternating current (a.c.) power supply and a wire in the gap AB.

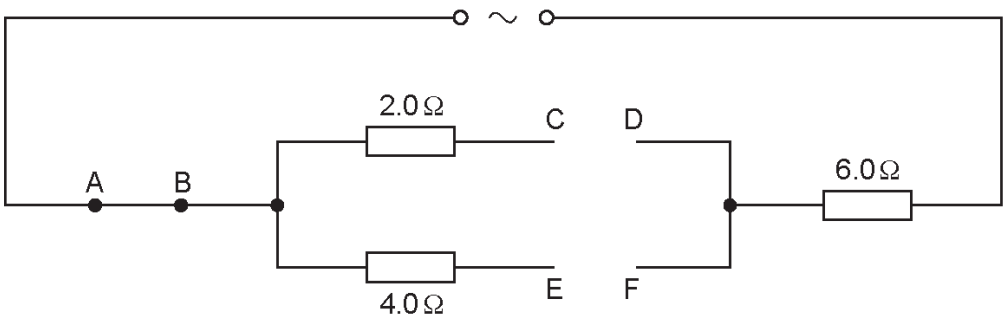

Fig. 10.2

On Fig. 10.2, draw a diode symbol in one gap and a straight line to indicate a wire in the other gap so that there is a current from right to left in the 4.0 Ω resistor and an alternating current in the 2.0 Ω resistor. [2]

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22. 0625_m19_qp_42 Q: 9

Fig. 9.1 shows current-potential difference (p.d.) graphs for a resistor and for a thermistor.

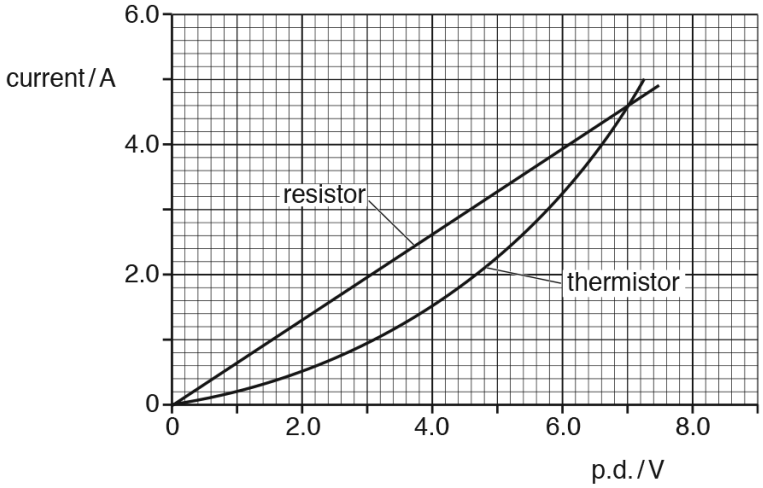

Fig. 9.1

(a) Calculate the resistance of the thermistor when the p.d. across it is 7.0 V.

resistance = ... [2]

(b) In Table 9.1, tick the boxes that indicate the effect on the resistances of the resistor and of the thermistor when the p.d. across them is increased from 0 to 7.0 V.

Table 9.1

component	resistance increases	resistance is constant	resistance decreases
resistor			
thermistor			

[2]

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(c) The thermistor and the resistor are connected in **parallel** to a 7.0 V supply.

Calculate:

(i) the current from the supply

current = ... [2]

(ii) the energy transferred from the supply in 5.0 minutes.

energy = ... [2]

[Total: 8]

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23. 0625_s19_qp_41 Q: 7

Fig. 7.1 shows a circuit diagram that includes component X.

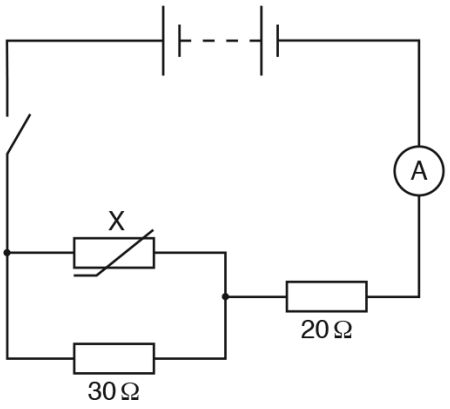

Fig. 7.1

(a) State the name of component X.

..... [1]

(b) The electromotive force (e.m.f.) of the battery is E. The switch is closed.

The potential difference (p.d.) across the 30 Ω resistor is V_{30}.
The p.d. across the 20 Ω resistor is V_{20}.
The p.d. across component X is V_X.

State an equation that relates V_X to:

(i) V_{30}

..... [1]

(ii) E and V_{20}.

..... [1]

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(c) The e.m.f. of the battery is 6.0 V and the resistance of component X is 15 Ω.

Calculate:

(i) the total resistance of the circuit

resistance = ... [3]

(ii) the ammeter reading.

reading = ... [2]

(d) The temperature of component X increases.

State and explain what happens to the ammeter reading.

.....

.....

..... [2]

[Total: 10]

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24. 0625_s19_qp_42 Q: 10

Fig. 10.1 shows a circuit containing a filament lamp of resistance 0.30 Ω and two resistors, each of resistance 0.20 Ω.

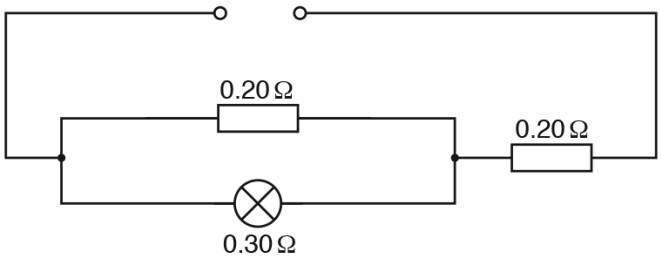

Fig. 10.1

(a) Calculate the combined resistance of the lamp and the two resistors.

resistance = ... [3]

(b) The potential difference (p.d.) of the supply is increased so that the current in the lamp increases.

State and explain any change in the resistance of the lamp.

Statement .....

Explanation .....

.....

[2]

[Total: 5]

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25. 0625_w19_qp_43 Q: 9

Fig. 9.1 shows a circuit containing an LED and two resistors in parallel, each of resistance *R*.

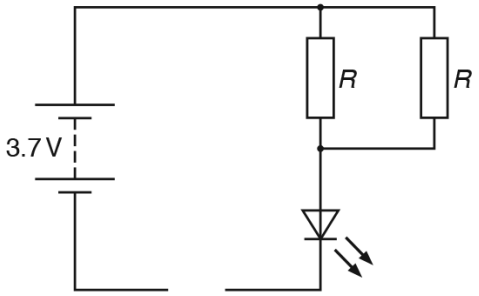

Fig. 9.1

The normal operating voltage of the LED is 2.1 V and the normal current is 0.19 A.

(a) (i) The potential difference (p.d.) across the LED is measured with a voltmeter.

On Fig. 9.1, draw the symbol for this voltmeter connected to the circuit. [1]

(ii) The current in the LED is measured with an ammeter.

On Fig. 9.1, draw the symbol for this ammeter connected to the circuit. [1]

(b) Calculate the value of *R* when the LED is operating normally.

R = ... [5]

[Total: 7]

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26. 0625_m18_qp_42 Q: 9

Fig. 9.1 shows current-potential difference graphs for a resistor and for a lamp.

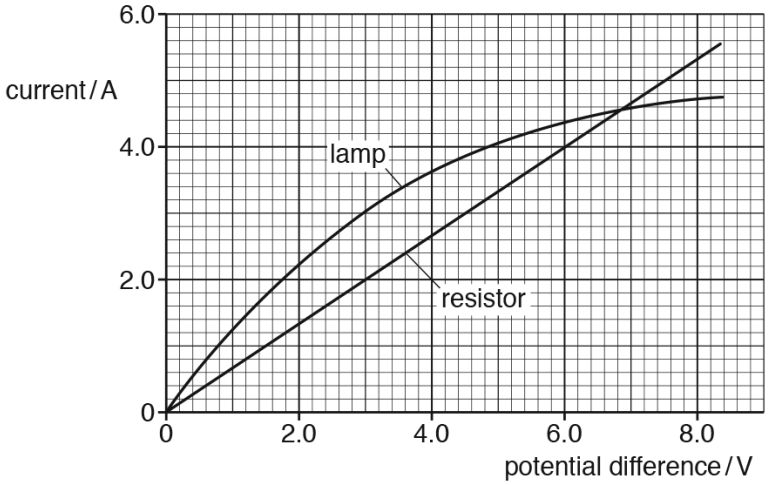

Fig. 9.1

(a) (i) The potential difference (p.d.) applied to the resistor is increased. Tick the box that indicates the effect on the resistance of the resistor.

- ☐ resistance increases
- ☐ resistance is constant
- ☐ resistance decreases

[1]

(ii) The potential difference (p.d.) applied to the lamp is increased. Tick the box that indicates the effect on the resistance of the lamp.

- ☐ resistance increases
- ☐ resistance is constant
- ☐ resistance decreases

[1]

(b) The p.d. across the lamp is 6.0 V. Calculate the resistance of the lamp.

resistance = ... [2]

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(c) The lamp and the resistor are connected in **parallel** to a 6.0 V supply.

Calculate the current from the supply.

current = ... [2]

(d) The lamp and the resistor are connected in **series** to another power supply. The current in the circuit is 4.0 A.

Calculate the total p.d. across the lamp and the resistor.

p.d. = ... [2]

[Total: 8]

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27. 0625_s18_qp_41 Q: 7

(a) State, in terms of their structure, why metals are good conductors of electricity.

.....

.....[1]

(b) A cylindrical metal wire W_1, of length l and cross-sectional area A, has a resistance of 16 Ω.

A second cylindrical wire W_2 having length $\frac{l}{2}$ and cross-sectional area $2A$, is made from the same metal.

Determine

(i) the resistance of W_2,

resistance of W_2 = ...[2]

(ii) the effective resistance of W_1 and W_2 when connected in parallel.

resistance of parallel pair = ...[2]

(c) The parallel pair of resistors in **(b)(ii)** is connected to a battery that is made from three cells in series, each of electromotive force (e.m.f.) E. There is a current in each resistor.

(i) State the e.m.f. of the battery.

.....[1]

(ii) The current in the battery is I_B, the current in W_1 is I_1 and the current in W_2 is I_2.

Place a tick (✓) in **one** box to indicate how these three currents are related.

- ☐ $I_1 > I_2 > I_B$
- ☐ $I_1 > I_B > I_2$
- ☐ $I_2 > I_1 > I_B$
- ☐ $I_2 > I_B > I_1$
- ☐ $I_B > I_1 > I_2$
- ☐ $I_B > I_2 > I_1$
- ☐ $I_1 = I_2 = I_B$

[1]

[Total: 7]

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28. 0625_s18_qp_42 Q: 8

Fig. 8.1 shows a circuit that contains a battery of electromotive force (e.m.f.) 6.0 V, an ammeter, a 20 Ω resistor and component X.

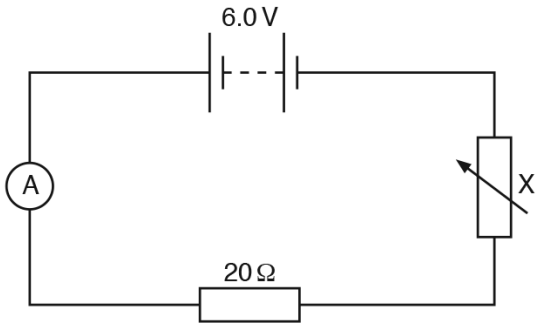

Fig. 8.1

(a) (i) State the name of component X.

.....[1]

(ii) The potential difference (p.d.) across the 20 Ω resistor is measured with a voltmeter.

On Fig. 8.1, draw the symbol for this voltmeter connected to the circuit. [1]

(b) The p.d. across the 20 Ω resistor is varied from zero to 6.0 V. For each value of p.d. a corresponding current is measured.

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On Fig. 8.2, draw a line to indicate how the current measured by the ammeter depends on the p.d. across the 20 Ω resistor.

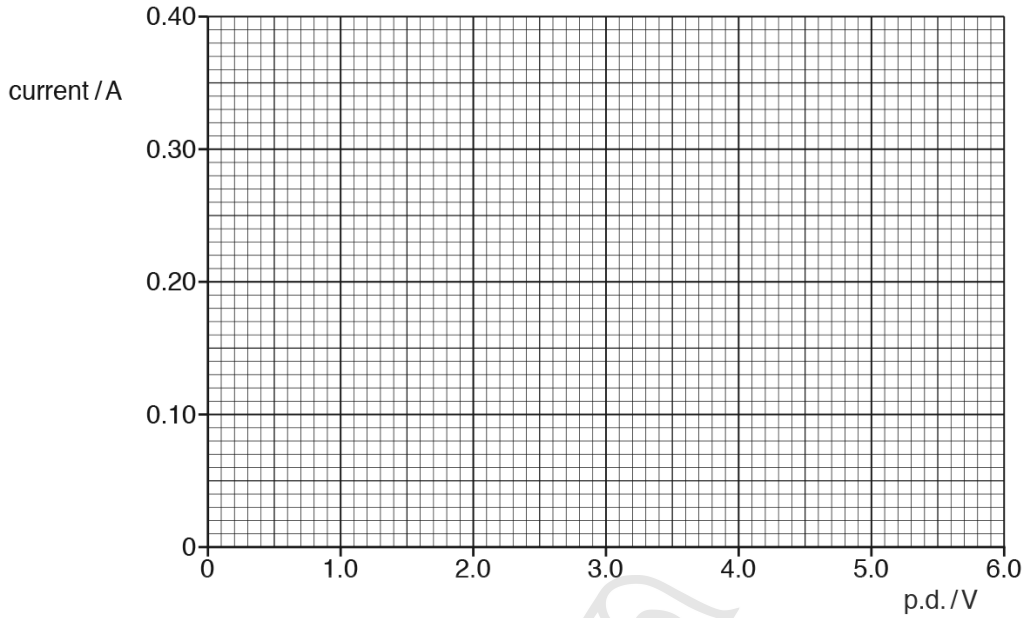

Fig. 8.2

[3]

(c) A second resistor is connected into the circuit in parallel with the 20 Ω resistor.

(i) State how the combined resistance of the two resistors in parallel compares with the resistance of each of the resistors on its own.

.....

.....[1]

(ii) The p.d. across the two parallel resistors is changed and the current in the battery for each value of the p.d. is measured. A second line could be drawn on Fig. 8.2 to indicate how the current measured by the ammeter depends on the p.d. across the two resistors in parallel.

State how the second line differs from the original line. You are **not** expected to draw this second line.

.....

.....[1]

[Total: 7]

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29. 0625_s18_qp_43 Q: 9

Fig. 9.1 shows a circuit that includes a battery of electromotive force (e.m.f.) 12 V.

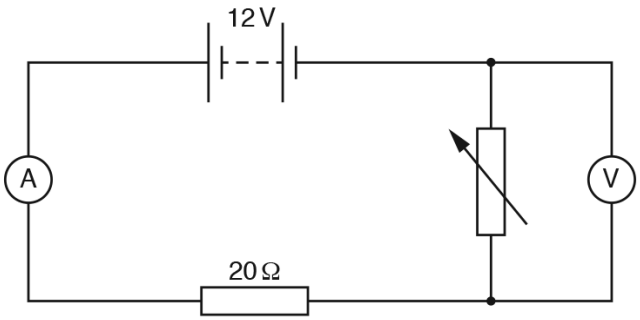

Fig. 9.1

The reading on the ammeter is 0.15 A.

(a) Calculate the resistance of the circuit.

resistance = ...[2]

(b) The variable resistor is adjusted so that its resistance decreases.

(i) State what happens to the reading on the ammeter.

.....[1]

(ii) State and explain what happens to the reading on the voltmeter.

.....

.....

.....[2]

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(c) The battery is formed from cells of electromotive force (e.m.f.) 1.5 V.

(i) Explain, in terms of electrical energy, what is meant by an *electromotive force* (*e.m.f.*) *of 1.5 V*.

.....

.....[2]

(ii) State how many 1.5 V cells are connected in series to form the battery.

.....[1]

[Total: 8]

30. 0625_w18_qp_41 Q: 9

Fig. 9.1 shows the symbol for a 12 V battery.

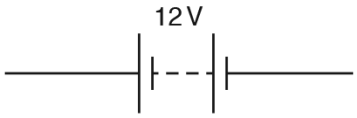

Fig. 9.1

(a) Two lamps are connected in parallel with the battery. On Fig. 9.1, using the correct symbols, complete the circuit diagram. [1]

(b) One of these lamps has a resistance of 6.0 Ω.

Calculate, for this lamp:

(i) the current

current = ...[1]

(ii) the power.

power = ...[2]

(c) The power of the other lamp is 36 W.

Calculate the total energy delivered to this lamp in 20 hours.

energy = ...[3]

[Total: 7]

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31. 0625_w18_qp_42 Q: 7

Fig. 7.1 shows three identical lamps and an ammeter connected to a power supply.

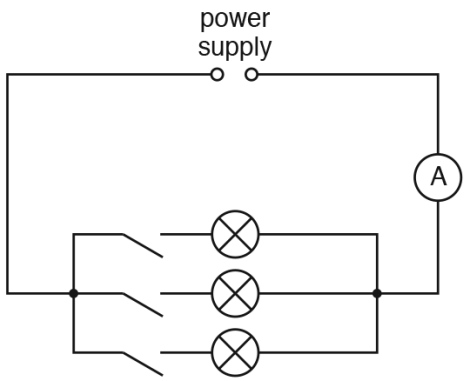

Fig. 7.1

The switches are closed. Each lamp is rated at 60 W and operates at its normal working voltage of 110 V.

(a) Calculate:

(i) the current in each lamp

current = ...[2]

(ii) the current in the ammeter

current = ...[1]

(iii) the voltage of the power supply.

voltage = ...[1]

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(b) (i) Calculate the resistance of the filament of one of the lamps when working normally.

resistance = ...[2]

(ii) Another lamp X has a filament with twice the resistance of each lamp in the circuit of Fig. 7.1. The material and the temperature of the filament in lamp X is the same as the filaments in the lamps in Fig. 7.1.

In Table 7.1, tick any box in the right-hand column that shows a possible difference between the filament of lamp X and a filament of one of the lamps in the circuit.

Table 7.1

X has half the length	
X has twice the length	
X has one quarter the area of cross-section	
X has half the area of cross-section	
X has two times the area of cross-section	
X has four times the area of cross-section	

[2]

[Total: 8]

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32. 0625_w18_qp_43 Q: 8

A 9.0 V battery is connected to a 120 Ω resistor in series with wire P.
Fig. 8.1 shows a voltmeter connected across the 120 Ω resistor.

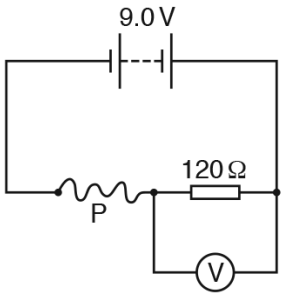

Fig. 8.1

(a) State the energy changes that are taking place in the circuit.

.....

.....

.....[2]

(b) The reading on the voltmeter is 2.4 V.

Calculate:

(i) the current in the 120 Ω resistor

current = ...[2]

(ii) the potential difference (p.d.) across wire P

p.d. = ...[1]

(iii) the resistance of wire P.

resistance = ...[1]

(c) Wire P has a diameter d and a length l. A second piece of wire Q is made of the same material as P.
The diameter of wire Q is 0.50 × d and its length is 5.0 × l.

Calculate the resistance of wire Q.

resistance = ...[4]

[Total: 10]

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33. 0625_m17_qp_42 Q: 9

Fig. 9.1 shows a graph of current against potential difference (p.d.) for a filament lamp.

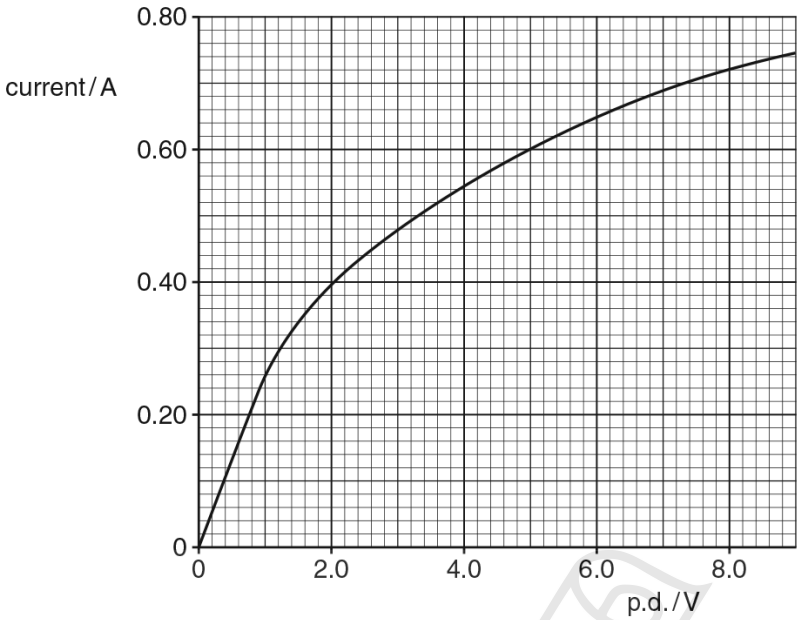

Fig. 9.1

(a) State what happens to the resistance of the filament of the lamp as the p.d. changes

(i) from 0 V to 1.0 V,

.....[1]

(ii) from 1.0 V to 8.0 V.

.....[1]

(b) At normal brightness, the p.d. across the lamp is 8.0 V.

Calculate, for normal brightness,

(i) the resistance of the lamp,

resistance = ...[3]

(ii) the power of the lamp.

power = ...[2]

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(c) Five of these lamps, operating at normal brightness, are connected in parallel to a power supply.

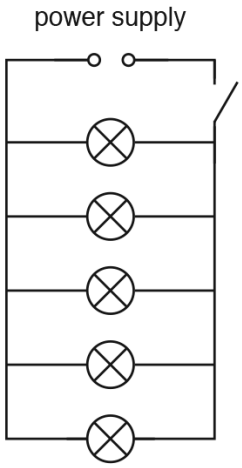

Fig. 9.2

Determine

(i) the electromotive force (e.m.f.) of the power supply,

e.m.f. = ...[1]

(ii) the current from the power supply.

current = ...[1]

[Total: 9]

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34. 0625_s17_qp_41 Q: 9

(a) The resistance of a circuit component varies with the brightness of the light falling on its surface.

(i) State the name of the component.

.....[1]

(ii) Draw the circuit symbol for this component.

[1]

(b) Fig. 9.1 shows a 6.0 V battery connected in series with a 1.2 kΩ resistor and a thermistor.

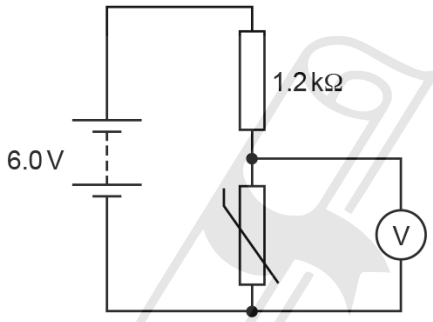

Fig. 9.1

(i) At a certain temperature, the resistance of the thermistor is 2.4 kΩ.

Calculate the reading on the voltmeter.

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voltmeter reading = ...[4]

(ii) The battery connected to the circuit in Fig. 9.1 is not changed.

Suggest a change that would cause the reading of the voltmeter to decrease.

.....[1]

[Total: 7]

35. 0625_s17_qp_42 Q: 8

Fig. 8.1 shows a 12.0 V power supply connected in a circuit.

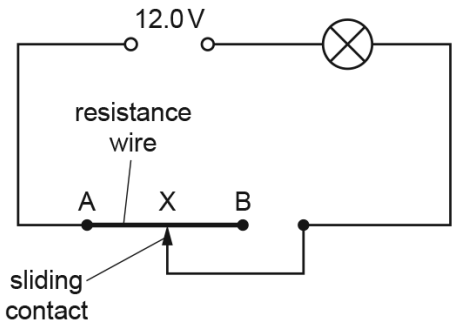

Fig. 8.1 (not to scale)

The circuit includes a lamp and a resistance wire AB of constant cross-sectional area. There is a sliding contact that can be moved between A and B.

(a) The rating of the lamp at normal brightness is 6.0 V, 9.0 W.

Calculate

(i) the current in the lamp at normal brightness,

current = ...[2]

(ii) the resistance of the lamp at normal brightness.

resistance = ...[2]

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(b) AB is 1.00 m long and has a resistance of 5.0 Ω. The lamp has normal brightness when the sliding contact is at X.

(i) The sliding contact is moved to B.

Explain, without a calculation, why the lamp becomes dimmer.

.....

.....

.....[1]

(ii) Calculate the distance AX for the lamp to have normal brightness.

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distance AX = ...[3]

[Total: 8]

36. 0625_s17_qp_43 Q: 9

A 12 V battery is connected in series to a 24 W lamp and to a parallel pair of identical resistors X and Y. Fig. 9.1 is the circuit diagram.

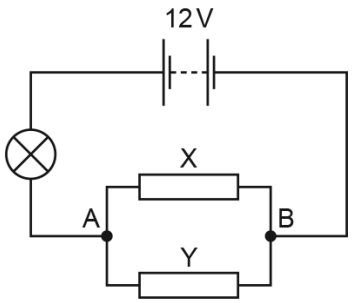

Fig. 9.1

The 24 W lamp lights at normal brightness when the potential difference (p.d.) across it is 6.0 V.

The lamp is at normal brightness.

(a) Calculate the resistance of the lamp.

resistance = ...[3]

(b) Determine

(i) the p.d. between A and B,

p.d. = ...[1]

(ii) the combined resistance of the parallel pair of identical resistors X and Y,

resistance = ...[1]

(iii) the resistance of X.

resistance = ...[2]

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(c) Resistor X is removed from the circuit in Fig 9.1.

Explain why the lamp becomes dimmer.

.....

.....

.....

.....[2]

[Total: 9]

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37. 0625_w17_qp_41 Q: 9

Fig. 9.1 shows a circuit with three 1.5 V cells.

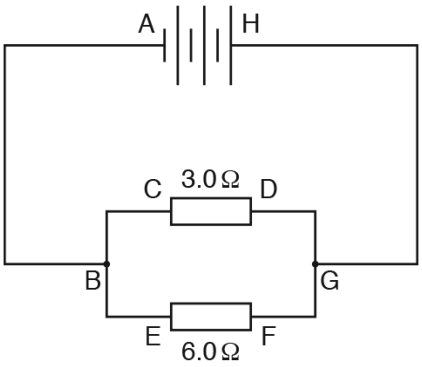

Fig. 9.1

(a) Calculate

(i) the total electromotive force (e.m.f.) of the cells,

e.m.f. = ...[1]

(ii) the total resistance of the circuit,

resistance = ...[3]

(iii) the current in the 3.0 Ω resistor.

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current = ...[2]

(b) State, using the letters in Fig. 9.1, how you would connect

(i) an ammeter to measure the total current in the circuit,

.....

.....[1]

(ii) a voltmeter to measure the potential difference (p.d.) across the 6.0 Ω resistor.

.....

.....[1]

[Total: 8]

38. 0625_w17_qp_42 Q: 8

Fig. 8.1 is a circuit diagram.

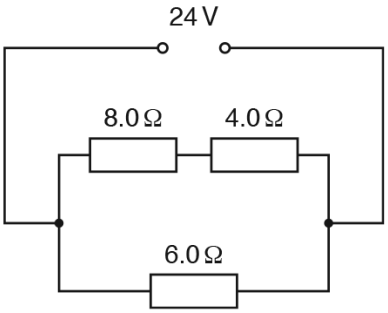

Fig. 8.1

Calculate

(a) the resistance of the circuit,

resistance = ...[4]

(b) the potential difference (p.d.) across the 8.0 Ω resistor.

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p.d. = ...[2]

[Total: 6]
