ELECTRIC Circuits Test

Name: ..... SOLUTIONS ..... /47 50.

Multiple Choice (1 mark each) **(13 marks)**

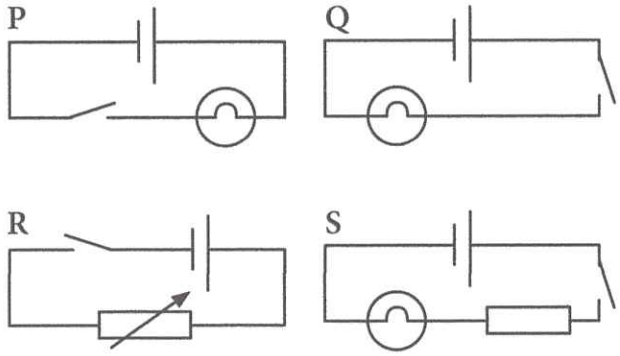
1. Circle the best answer for each of the multiple choice questions below:

Quantity measured	Units used
1 – potential difference	X – amperes
2 – current	Y – volts
3 – resistance	Z – ohms

The combination from the table above that correctly links the electrical quantities we measure with the units used for measuring them is:

A 1 and X, 2 and Y, 3 and Z.
B 1 and Z, 2 and Y, 3 and X.
C 1 and Y, 2 and X, 3 and Z.
D 1 and Y, 2 and Z, 3 and X.

2. Which diagram is the correct representation of a simple circuit involving a source of potential difference, a variable resistor, a switch and some copper conducting wires?



A P
B Q
C R
D S

3. There are many devices which can or must be included in an electric DC circuit. To simplify things, 'symbols' are used to identify the devices. Four such symbols are shown in the table.

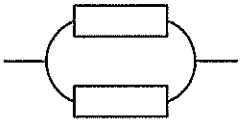
Symbol	A	B	C	D
Meaning	conductor	potential difference	switch	resistor

One of these symbols is incorrect. It is the one labelled:

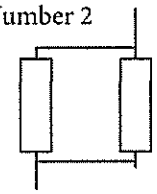
A A.
B B.
C C.
D D.

4. Which diagram shows an example of two resistors connected in series?

Number 1



Number 2



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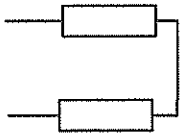
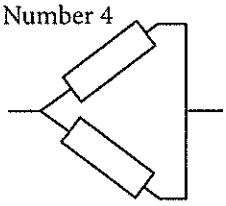


Number 4



A Number 1
B Number 2
C Number 3
D Number 4

5. Electricity can often be compared to the flow of water through a hose. Which combination in the table gives the best matched comparisons between water flow and electrical flow?

Water terms	**Electrical terms**
P – pressure in water	X – resistance
Q – amount of water that flows	Y – potential difference
R – a 'kink' in a hose which restricts the flow	Z – current

A P and Y, Q and X, R and Z
B P and Y, R and X, Q and Z
C P and X, Q and Y, R and Z
D P and Z, Q and Y, R and X

6. If a P.D. (potential difference) of 12 volts applied to the ends of a piece of wire causes a current of 2 amperes to flow through the wire, then it would be true to say that:

A the wire has a resistance of 24 ohms and when a P.D. of 24 volts is applied to the wire, a current of 4 amperes would flow.

B the wire has a resistance of 6 ohms and when a P.D. of 24 volts is applied to the wire, a current of 4 amperes would flow.

C the wire has a resistance of 6 ohms but when a P.D. of 24 volts is applied, its resistance drops markedly.

D the resistance of the wire is 6 volts and when a P.D. of 36 volts is applied to it, then a current of 6 amperes will flow.

7. Two resistors, each 10 ohms, are connected (a) in series and afterwards (b) in parallel with a source of potential difference. A true statement about their effects when combined in the different ways and then placed in a circuit is:

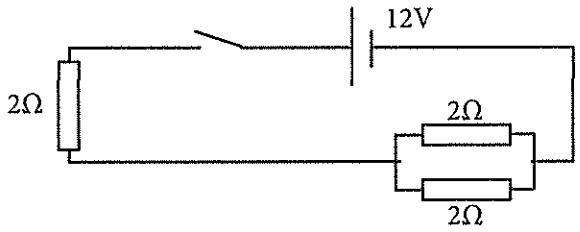
A the (a) type connection would cause the total resistance to be less than 10 ohms.

B the (b) type connection would make the total resistance of the combination 20 ohms.

C there is no difference between the (a) and (b) type connections on the total resistance.

D the (a) type connection would double the 10 ohm resistance in the circuit, while the (b) type would halve it.

8. A circuit is set up with a 12V power supply, a switch and three 2 ohm resistors, as shown in the diagram.



For this circuit, it is true to say that (a) the total resistance, (b) the current flowing through, and (c) the power of the circuit are, respectively:

A 6 ohm, 2 amp, 24 watt.

B 4 ohm, 3 amp, 12 watt.

C 3 volt, 4 amp, 48 watt.

D 3 ohm, 4 amp, 48 watt.

9. A circuit is made from a battery and 4 light bulbs. The battery will go flat quickest when:

A all of the lights are wired in series

B some of the lights are wired in series and some in parallel

C all the lights are wired in parallel

D it can't be determined unless the resistance of the light bulbs is known

10. The main energy transfer that takes place in a filament light bulb is:

A electrical to thermal

B electrical to light

C thermal to electrical

D light to electrical

11. Which slot of an Australian power point connects (via some wiring) to a copper stake planted in the ground?

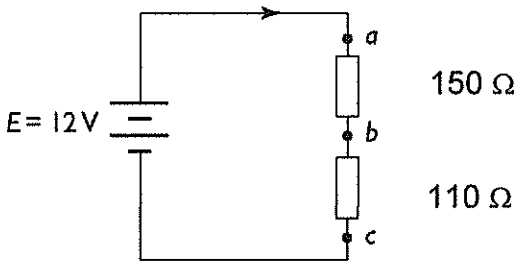
A the top left slot.

B the fuse.

C the slot with vampire blood on it.

D the lower slot.

12. What is the effective resistance of this circuit?



A 260 Ω

B 63.5 Ω

C 269 Ω

D 360 Ω

13. The minimum amount of current (flowing through the human body for half a second) that is required to produce instant paralysis is:

A 20 mA. death

B 50 mA.

C 150 mA.

D 250 mA. 200 mA

Short Answer 37. **(36 marks)**

1 A battery in a circuit has current of 2.0 A passing through it.

a How many coulombs of charge pass through the battery in 10 seconds? (1)

$Q = I \times t$

$= 2 \times 10 = 20\,C$

b If the battery has an EMF of 1.5 V, how many joules of energy does it provide to the circuit each second? (2)

$E = VIt = 1{\cdot}5 \times 2 \times 1 = 3\,J$

2 How much energy will a 150 W globe use in 3 days of operation? (2)

$E = P \times t$

$E = 150 \times 3 \times 24 = 10\,800$ Whr or $3{\cdot}89 \times 10^7\,J$

$= 10{\cdot}8$ kwh

b An electricity company charges 80c per kilowatt hour (kW h) of electricity consumed. How much does it cost to use the above globe? (2)

$C = 10{\cdot}8 \times 0{\cdot}80$

$= \$8{\cdot}64$ or 864^c.

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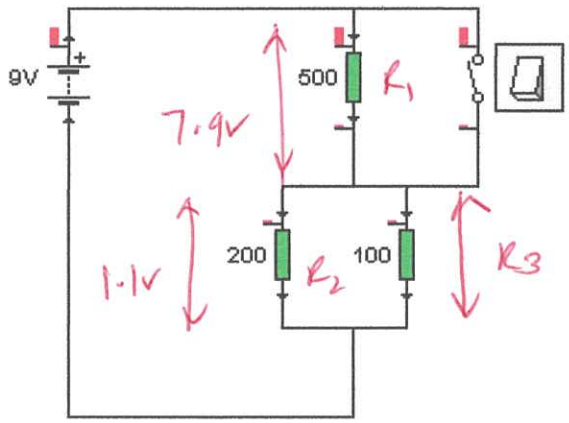
3. When a switch is open (off) it has an infinitely high resistance. When it is closed (on) it has a negligible resistance.



a) In the circuit above, when the switch is open (off) determine the current passing through the:

i) 500 ohm resistor

$\frac{1}{R_p} = \frac{1}{200} + \frac{1}{100}$ $R_T = 566.7$

$\frac{1}{R_p} = \frac{3}{200}$ $I_T = \frac{V}{R} = \frac{9}{566.7} = 0.016A$.

$R_p = \frac{200}{3} = 66.7\Omega$.

(2)

ii) 200 ohm resistor

$V_1 = I_1 \times R_1 = 0.016 \times 500 = 7.9V$

$I_2 = \frac{V_2}{R_2} = \frac{1.1}{200} = 0.005A$

(2)

b) When the switch is closed (on) determine the current passing through the:

i) 500 ohm resistor

0A (short circuit).

(1)

ii) 200 ohm resistor

$I = \frac{V}{R} = \frac{9}{200} = 0.045A$

(2)

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4. Explain why each of the following affects the resistance of a conductor:

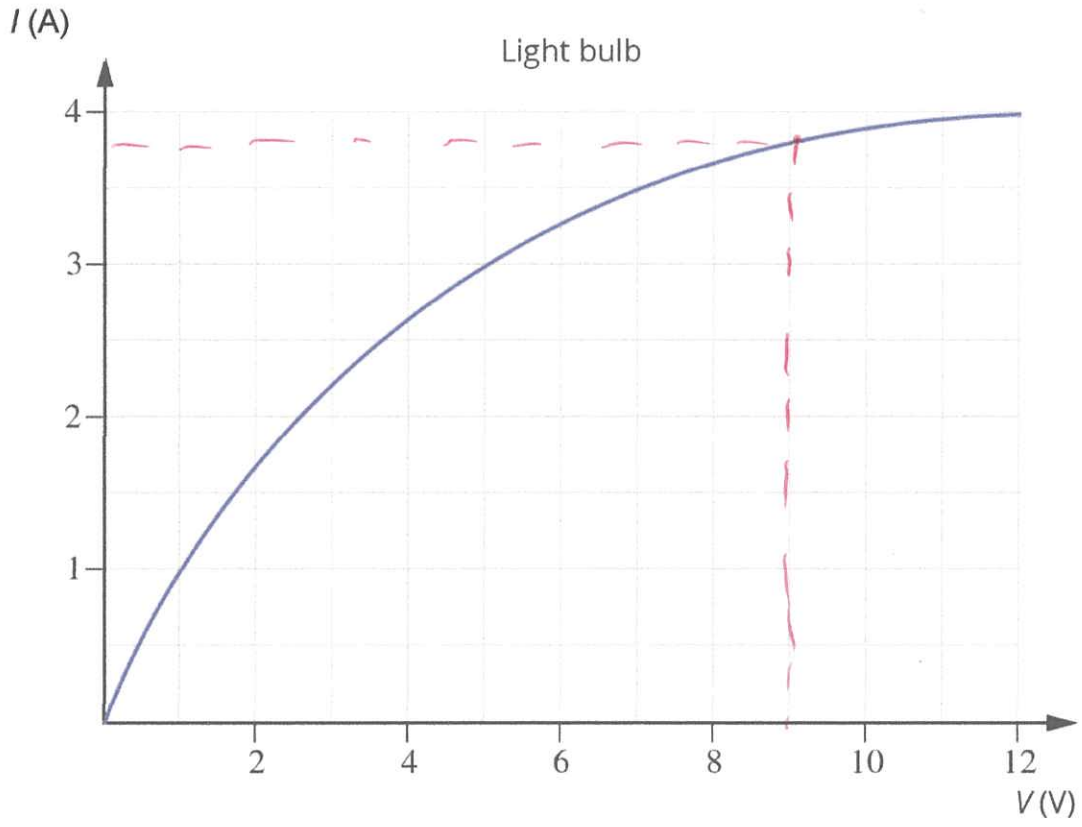
(a) Length of the conductor

Longer wire is greater resistance as the electrons have to pass through more of the metal lattice. (1)

(b) Cross sectional area of the conductor.

Larger cross section allows more space for electrons to pass through so less resistance. (1)

5. A light bulb with the I-V characteristics shown below is connected to a 9 V battery.



What power is dissipated in the bulb?

$P = V \times I$

$= 9 \times 3.75 = 33.75\ W$

(2 marks)

6. Christmas tree lights consist of a string of bulbs that can be wired in either series or parallel.

a Which way is best and why? (2 marks)

Parallel (1), 1 bulb goes out (1) off. rest remain on, all bulbs dissipate max^{m} power, supply voltage not divided.

b If the bulbs are wired in parallel, what happens to the total resistance of the circuit as more bulbs are added? (1 mark)

resistance decreases.

c Each bulb is rated at 3 V, 1.6 W and is wired in parallel. A 13 A fuse is placed immediately after the 3 V power supply. What is the maximum number of bulbs that can be used so that the fuse doesn't melt? (2 marks)

$I = \frac{P}{V} = \frac{1.6}{3} = 0.53\ A.$

In parallel add current

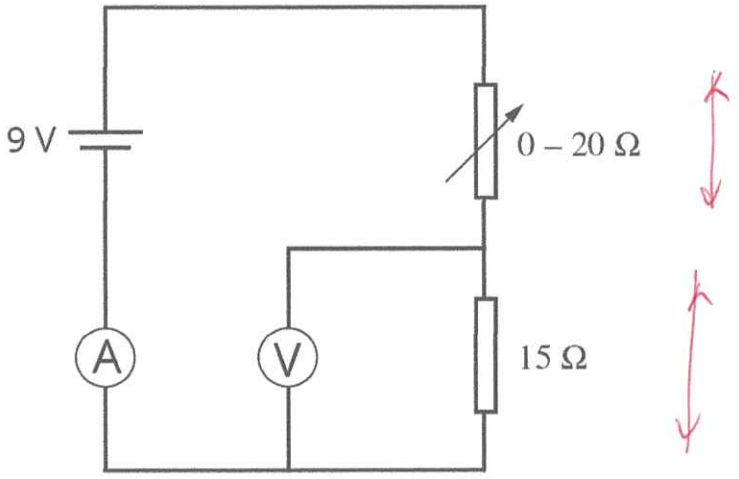
$\frac{13}{0.53} = 24.38$

→ can connect 24 bulbs $I = 12.7\ A.$

d If the bulbs are wired in series, what happens to the total resistance of the circuit as more bulbs are added? (1 mark)

Resistance increases.

7. A light bulb with the I-V characteristics shown below is connected to a 9 V battery.



$V_0 = \frac{15}{35} \times 9 =$

a What is the possible range of readings on the ammeter?

$I = \frac{9}{15} = 0.6A$

$I = \frac{9}{(15+20)} = 0.26A$

Range (0.26 – 0.6 A) (2)

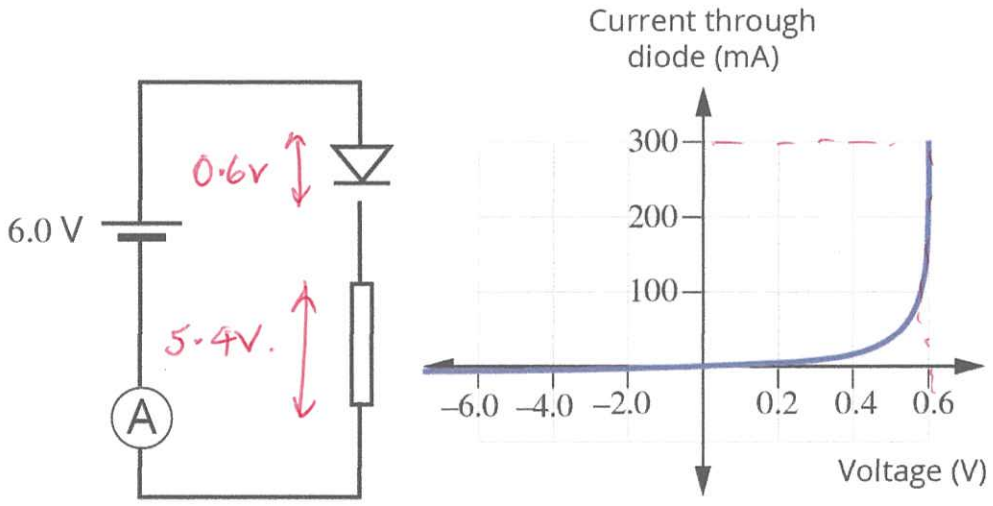
b What are the possible range of reading on the voltmeter

9V

$V_0 = \frac{15}{35} \times 9 = 3.9V.$

Range 3.9 → 9 V. (2)

8. A diode is connected to a circuit as shown.



a If the current in the circuit is 300 mA, what is the resistance value of the fixed resistor?

(3 marks)

$I = 300 \times 10^{-3}$ A

$R = \frac{V}{I} = \frac{5.4}{(300 \times 10^{-3})} = 18\ \Omega$

b What would be the reading on the ammeter if the diode is changed to be in reverse bias? Explain your answer. (1 marks)

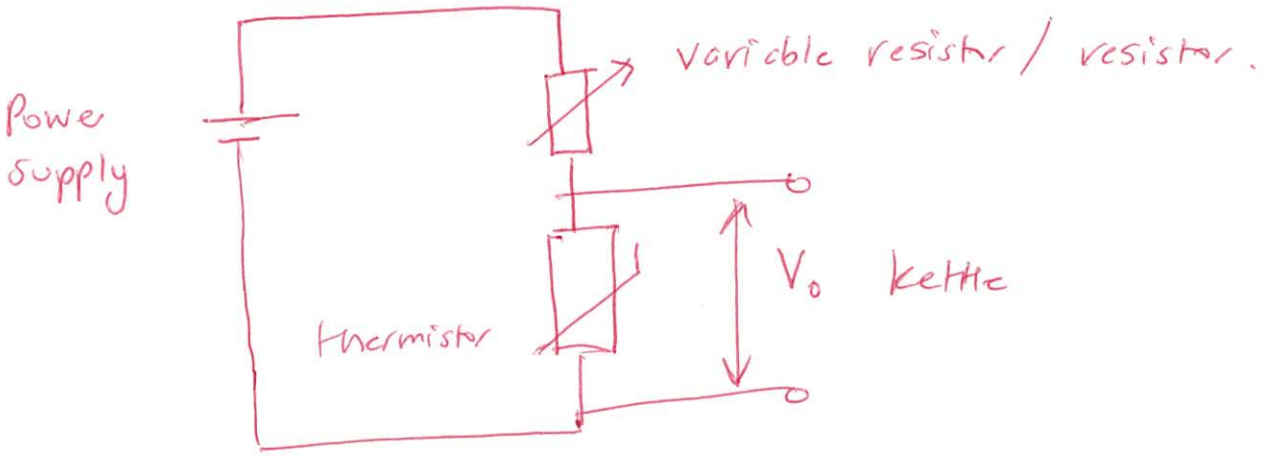
0A, diode has huge resistance so current doesn't flow

2

5

9. A thermistor (NTC) is to be used in a circuit that turns off a kettle when the water boils.

Draw a circuit diagram, clearly show as V_o where the kettle would be connected (2 marks)



Describe how it works. (2 marks)

When temp ↑, resistance ↓, V_o drops and switches kettle off.