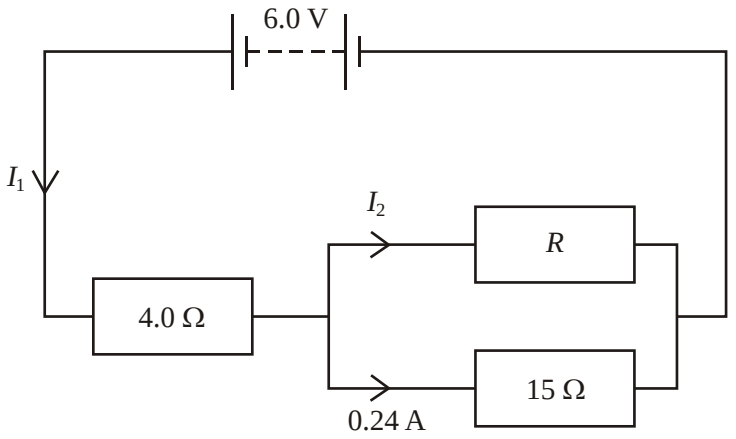
Resistor Network Questions

1. The circuit shows a battery of negligible internal resistance connected to three resistors.



(a) Calculate the potential difference across the 15 Ω resistor.

.....

Potential difference = …….

(1)

(b) Calculate the current I_1 in the 4.0 Ω resistor.

.....

.....

.....

I_1 = …….

(3)

(c) Calculate the current I_2 and the resistance R.

.....

.....

.....

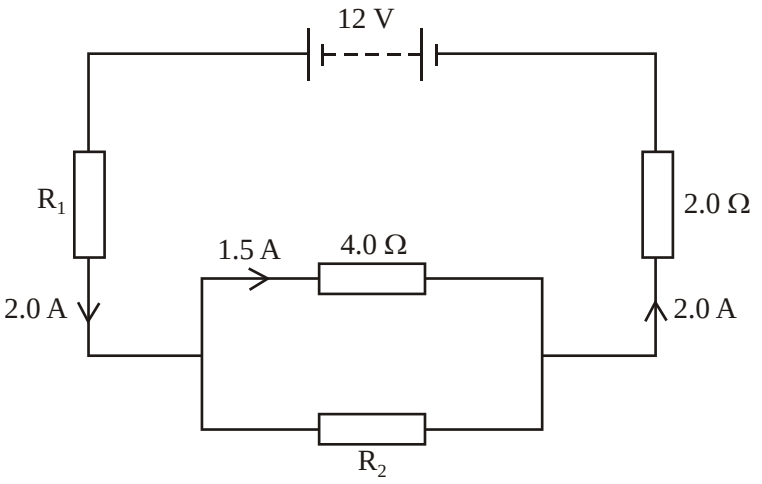
I_2 = …….

R = …….

(3)

(Total 7 marks)

2. The circuit diagram shows a 12 V d.c. supply of negligible internal resistance connected to an arrangement of resistors. The current at three places in the circuit and the resistance of two of the resistors are given on the diagram.



(a) Calculate the potential difference across the 4.0 Ω resistor.

.....

.....

Potential difference = ...

(1)

(b) Calculate the resistance of resistor R_2.

.....

.....

.....

Resistance of R_2 = ...

(2)

(c) Calculate the resistance of resistor R_1.

.....

.....

.....

.....

.....

Resistance of R_1 = ...

(3)

(Total 6 marks)

3. State the word equation that is used to define charge.

……

……

(1)

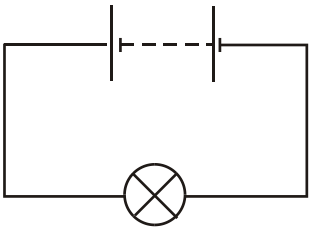
Define potential difference.

……

……

(1)

A 9.0 V battery of negligible internal resistance is connected to a light bulb.



Calculate the energy transferred in the light bulb when 20 C of charge flows through it.

……

……

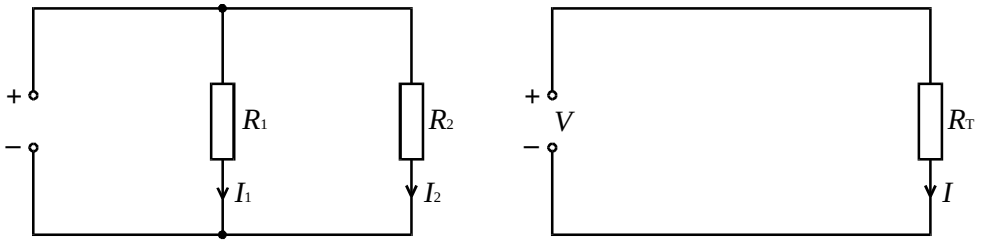
……

Energy = ...

(2)

(Total 4 marks)

4. The power supplies in the two circuits shown below are identical.



Write down the relationship between I_1, I_2 and I which must hold if the combined resistance of the parallel pair, R_1, and R_2, is to equal R_r.

.....

.....

(1)

Hence derive the formula for the equivalent resistance of two resistors connected in parallel.

.....

.....

.....

.....

.....

(3)

Use your formula to show that the resistance between the terminals of a low-resistance component is hardly changed when a high-resistance voltmeter is connected in parallel with it.

.....

.....

.....

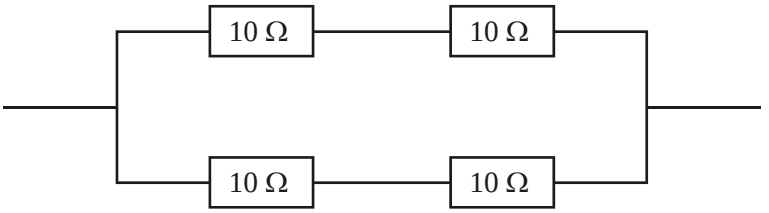
.....

.....

(2)

(Total 6 marks)

5. Four 10 Ω resistors are connected as shown in the diagram.



Calculate the total resistance of the combination.

.....

.....

.....

.....

Total resistance = ...

(3)

Comment on your answer and suggest why such a combination of resistors might be used.

.....

.....

.....

(2)

(Total 5 marks)

6. A cell of negligible internal resistance is connected in series with a microammeter of negligible resistance and two resistors of value 15 kΩ and 25 kΩ. The current is 150 μA.
Draw a circuit diagram of the arrangement.

(1)

Show that the e.m.f. of the cell is 6.0 V.

.....

.....

.....

(2)

A voltmeter is now connected in parallel with the 25 kΩ resistor. Draw a diagram of the new circuit.

(1)

When the voltmeter is connected the reading on the microammeter increases to 170 μA.
Calculate the resistance of the voltmeter.

.....

.....

.....

.....

.....

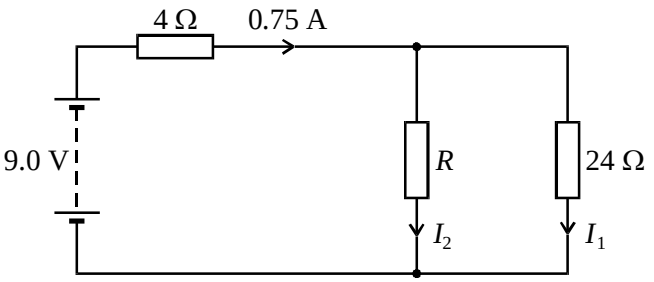
.....

Resistance = ...

(3)

(Total 7 marks)

7. The circuit shows a battery of negligible internal resistance connected to three resistors.



Calculate current I_1.

.....

.....

.....

I_1 = ...

(3)

Calculate resistance R

.....

.....

R = ...

(2)

(Total 5 marks)

8. A torch has three identical cells, each of e.m.f. 1.5 V, and a lamp which is labelled 3.5 V, 0.3 A.
Draw a circuit diagram for the torch.

(2)

Assume that the lamp is lit to normal brightness and that the connections have negligible resistance. Mark on your diagram the voltage across each circuit component and the current flowing in the lamp.

(3)

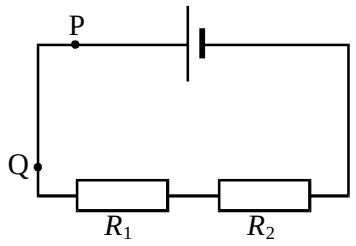
Calculate the internal resistance of one of these cells.

Resistance = ...……

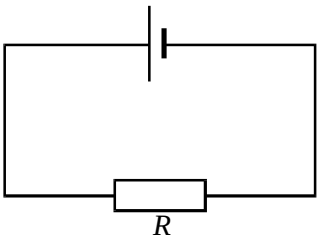
(3)

(Total 8 marks)

9. The resistors R_1 and R_2 in circuit (i) are equivalent to a single resistor R in circuit (ii).



(i)



(ii)

Prove that $R = R_1 + R_2$

.....

.....

.....

.....

.....

(3)

In a real circuit it is usually assumed that there is no potential difference between two points, such as P and Q in diagram (i), which are on the same connecting lead. Explain why this is usually a good approximation.

.....

.....

.....

(2)

In what circumstances might the approximation break down?

.....

.....

(1)

A laboratory lead consists of 16 strands of fine copper wire twisted together. Each strand is 30 cm long with a diameter of 0.15 mm. Calculate the potential difference across the lead when it is carrying a current of 2.0 A.

(The resistivity of copper = 1.7×10^{-8} Ωm**)**

.....

.....

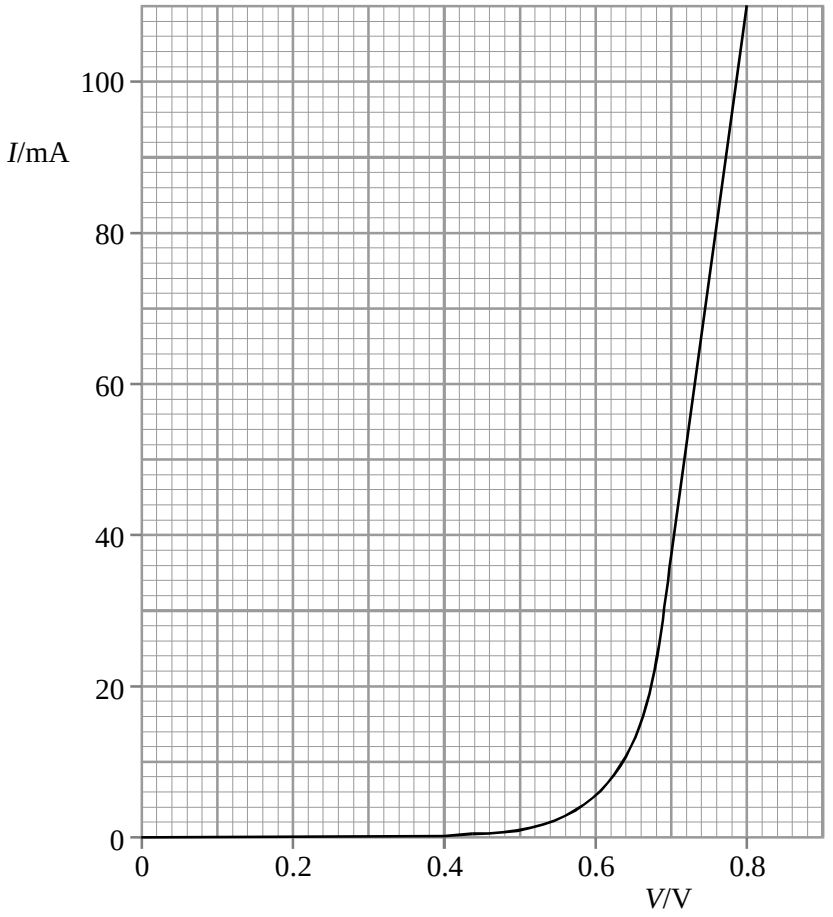
.....

Potential difference =.....

(4)

(Total 10 marks)

10. The graph shows the current-voltage characteristic of a semiconductor diode.



State, with a reason, whether the diode obeys Ohm's law.

.....

.....

(1)

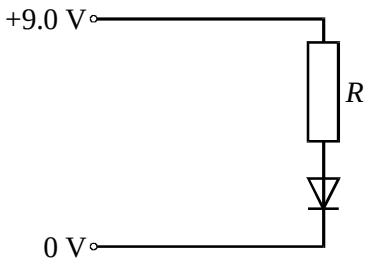
Show that when the voltage across the diode is 0.74 V its resistance is about 9 Ω.

.....

.....

(2)

When the diode is connected in the following circuit, the voltage across it is 0.74 V.



Calculate the value of the resistance *R*.

.....

.....

.....

R = ...

(3)

Electronic circuit designers often use a simple model of this type of diode. This "model diode" has the following properties:

(i) For any voltage below +0.7 V it does not conduct at all.

(ii) Once the voltage reaches +0.7 V the diode can pass any size of current with no further increase in voltage.

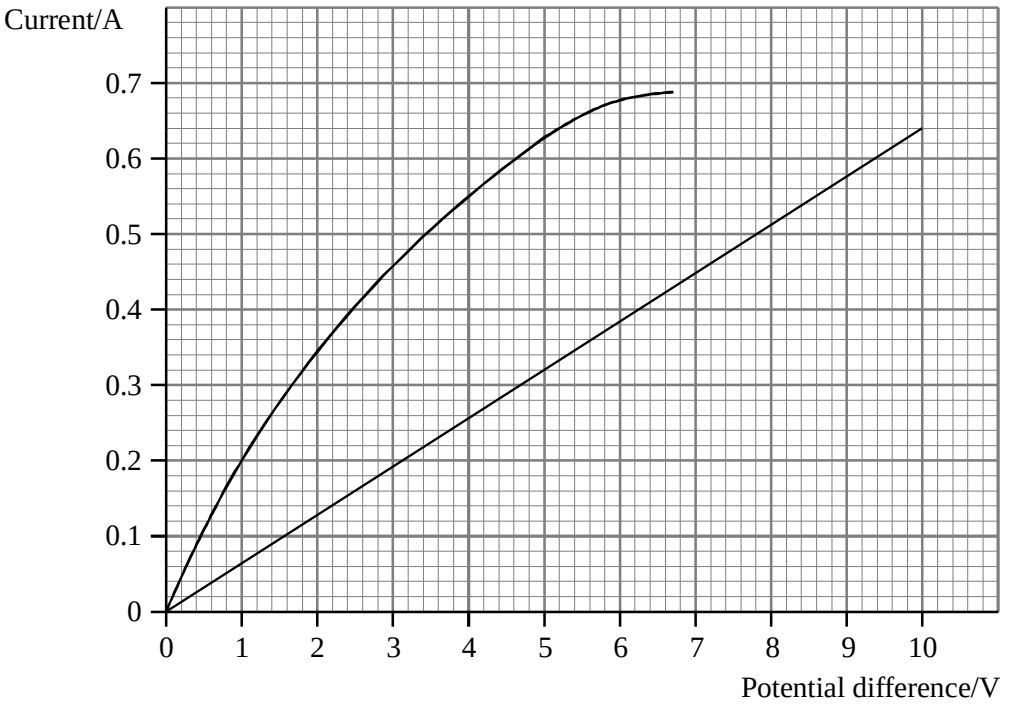
Add a second graph to the grid above to show the current-voltage characteristic of this model diode.

(2)
(Total 8 marks)

11. A student investigates how the current in a resistor varies as the potential difference across the resistor is varied. Draw a suitable circuit diagram for the investigation.

(3)

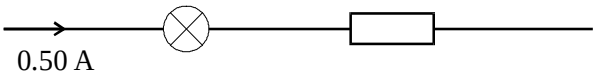
The graphs show the variation of current with potential difference for a filament lamp and for an ohmic resistor.



Label one graph **lamp** and the other graph **resistor.**

(1)

The lamp and resistor are connected in series as shown. There is a current of 0.50 A.



Use the graph to find the total potential difference across the combination.

.....

.....

.....

.....

Potential difference = ...

(2)

What is the resistance of the lamp under these conditions?

.....

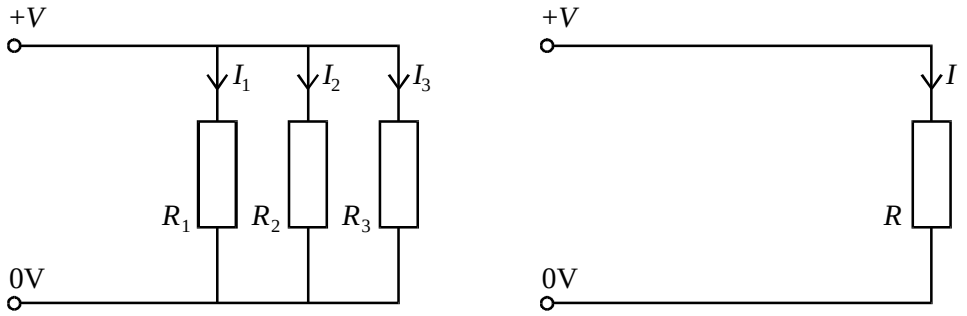
.....

Resistance = ...

(2)

(Total 8 marks)

12. Three resistors R_1, R_2 and R_3 are connected in parallel with each other. They could be replaced by a single resistor of resistance R.



Show that the resistance, R, of the equivalent resistor can be calculated from

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

.....

.....

.....

.....

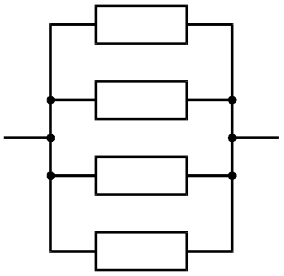
.....

.....

(3)

A student has four identical resistors each of resistance 10 Ω. She connects them to form the different networks shown below.

Calculate the equivalent total resistance of each network.



First network

.....

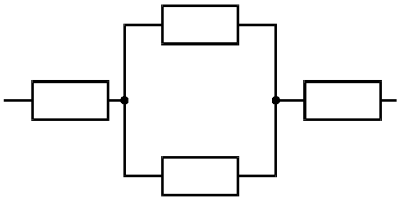
.....

.....

.....

.....

Total resistance = ...Ω



Second network

.....

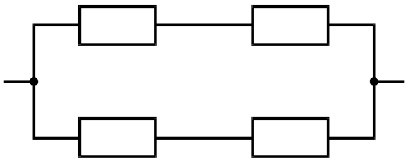
.....

.....

.....

.....

Total resistance = ...Ω



Third network

.....

.....

.....

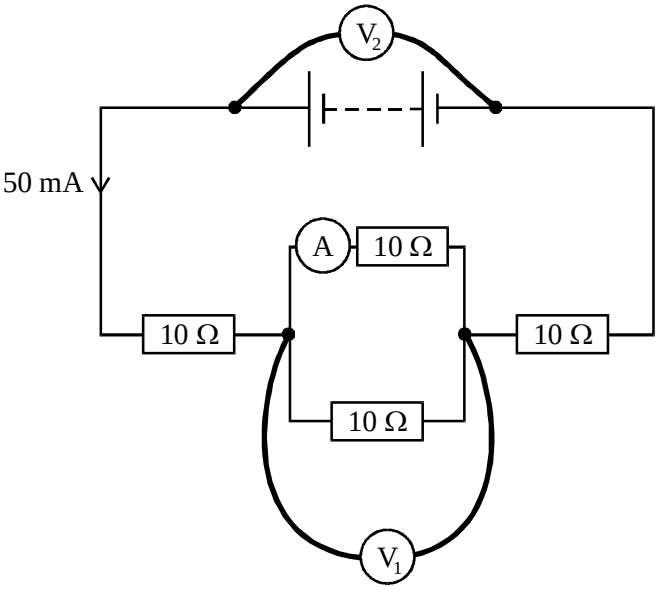
.....

.....

Total resistance = ...Ω

(3)

She then connects a battery across the second network and adds meters to make the circuit shown below. A current of 50 mA is drawn from the battery.



Determine the reading on each of the three meters.

Reading on ammeter A:

.....

Ammeter reading = ... mA

Reading on voltmeter V_1:

.....

Voltmeter reading = ... V

Reading on voltmeter V_2:

.....

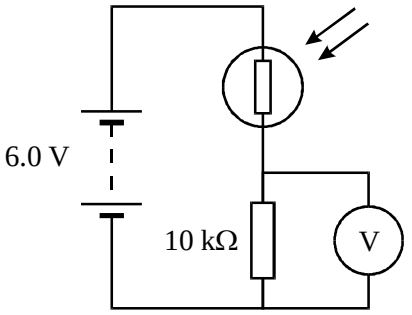
.....

Voltmeter reading = ... V

(5)

(Total 11 marks)

13. The following circuit can be used as a lightmeter.



The maximum value of resistance of the light-dependent resistor (LDR) is 950 kΩ.
What is the reading on the voltmeter for this resistance?

.....

.....

.....

Voltmeter reading = ...

The minimum value of resistance of the LDR is 1.0 kΩ. What is the reading on the voltmeter for this resistance?

.....

.....

.....

Voltmeter reading = ...

(3)

For this lightmeter the voltmeter is connected across the 10 kΩ resistor, rather than the LDR.
Explain how the readings on the voltmeter enable this circuit to be used as a lightmeter.

.....

.....

.....

.....

(2)
(Total 5 marks)