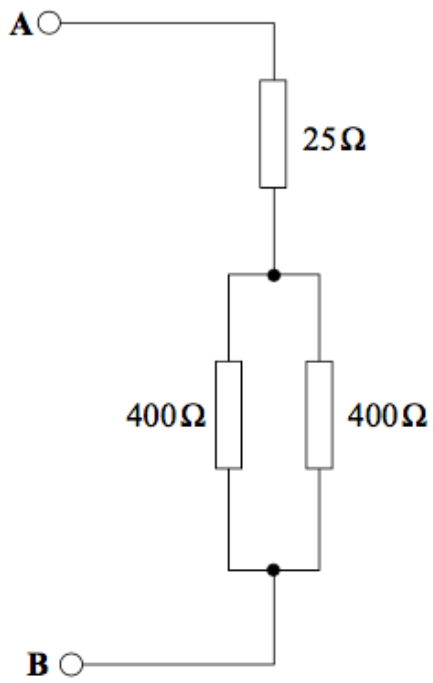
1)

Figure 5 shows an arrangement of resistors.

Figure 5



(a) Calculate the total resistance between terminals **A** and **B**.

answer = ... Ω

(2 marks)

(b) A potential difference is applied between the two terminals, **A** and **B**, and the power dissipated in each of the 400 Ω resistors is 1.0 W.

(b) (i) Calculate the potential difference across the 400 Ω resistors.

answer = ... V

(b) (ii) Calculate the current through the 25 Ω resistor.

answer = ...A

(b) (iii) Calculate the potential difference applied to terminals **A** and **B**.

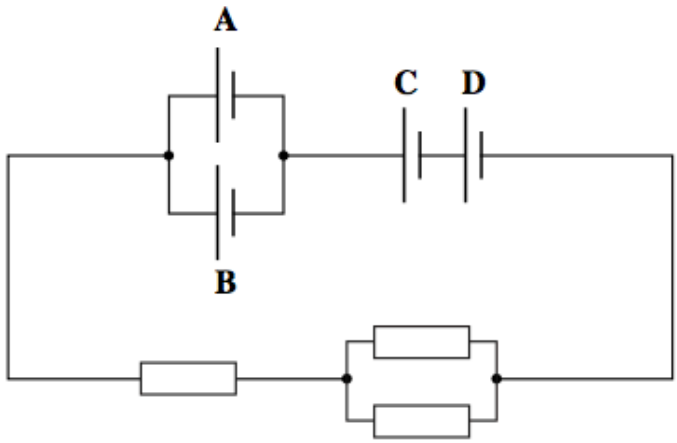
answer = ... V

(6 marks)

2)

The circuit in **Figure 2** contains four identical new cells, **A**, **B**, **C** and **D**, each of emf 1.5 V and negligible internal resistance.

Figure 2



(a) The resistance of each resistor is 4.0 Ω.

(a) (i) Calculate the total resistance of the circuit.

answer = ... Ω
(1 mark)

(a) (ii) Calculate the total emf of the combination of cells.

answer = ... V
(1 mark)

(a) (iii) Calculate the current passing through cell **A**.

answer = ... A

(2 marks)

(a) (iv) Calculate the charge passing through cell **A** in five minutes, stating an appropriate unit.

answer = ...

(2 marks)

(b) Each of the cells can provide the same amount of electrical energy before going flat. State and explain which two cells in this circuit you would expect to go flat first.

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(3 marks)

3)

X and **Y** are two lamps. **X** is rated at 12 V 36 W and **Y** at 4.5 V 2.0 W.

(a) Calculate the current in each lamp when it is operated at its correct working voltage.

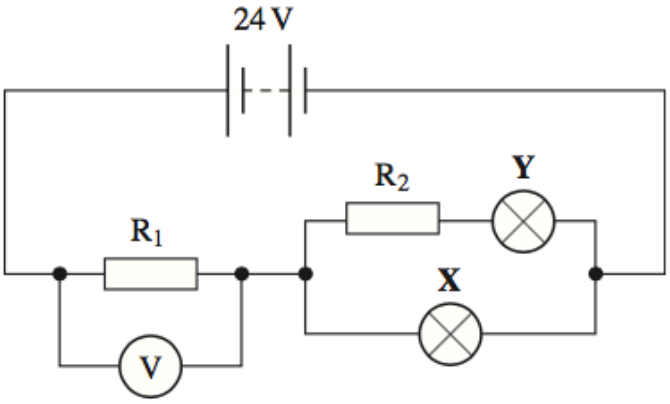
X ..... A

Y ..... A

(2 marks)

(b) The two lamps are connected in the circuit shown in **Figure 1**. The battery has an emf of 24 V and negligible internal resistance. The resistors, R_1 and R_2 are chosen so that the lamps are operating at their correct working voltage.

Figure 1



(b) (i) Calculate the pd across R_1.

answer V
(1 mark)

(b) (ii) Calculate the current in R_1.

answer ..... A
(1 mark)

(b) (iii) Calculate the resistance of R_1.

answer ..... Ω
(1 mark)

(b) (iv) Calculate the pd across R_2.

answer V
(1 mark)

(b) (v) Calculate the resistance of R_2.

answer ..... Ω
(1 mark)

(c) The filament of the lamp in **X** breaks and the lamp no longer conducts. It is observed that the voltmeter reading decreases and lamp **Y** glows more brightly.

(c) (i) Explain without calculation why the voltmeter reading decreases.

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(2 marks)

(c) (ii) Explain without calculation why the lamp **Y** glows more brightly.

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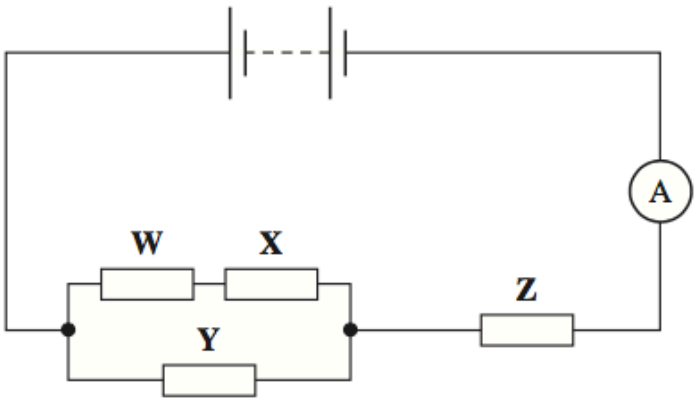
(2 marks)

4)

The circuit shown in **Figure 6** shows an arrangement of resistors, **W**, **X**, **Y**, **Z**, connected to a battery of negligible internal resistance.

Figure 6



The emf of the battery is 10 V and the reading on the ammeter is 2.0 A.

(a) (i) Calculate the total resistance of the circuit.

answer = ... Ω

(1 mark)

(a) (ii) The resistors **W**, **X**, **Y**, and **Z** all have the same resistance. Show that your answer to part (a) (i) is consistent with the resistance of each resistor being 3.0 Ω.

answer = ... Ω
(3 marks)

(b) (i) Calculate the current through resistor **Y**.

answer = ... A
(2 marks)

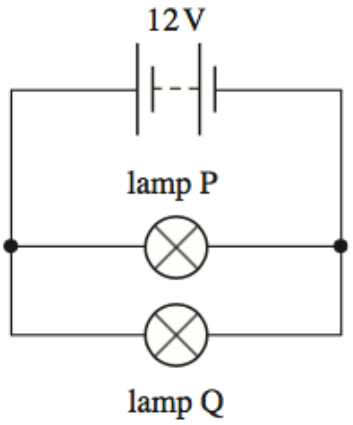
(b) (ii) Calculate the pd across resistor **W**.

answer = ... V
(2 marks)

5)

A battery of negligible internal resistance is connected to lamp P in parallel with lamp Q as shown in **Figure 2**. The emf of the battery is 12 V.

Figure 2



(a) Lamp P is rated at 12 V 36 W and lamp Q is rated at 12 V 6 W.

(a) (i) Calculate the current in the battery.

answer = ... A
(2 marks)

(a) (ii) Calculate the resistance of P.

answer = ... Ω
(1 mark)

(a) (iii) Calculate the resistance of Q.

answer = ... Ω

(1 mark)

(b) State and explain the effect on the brightness of the lamps in the circuit shown in **Figure 2** if the battery has a significant internal resistance.

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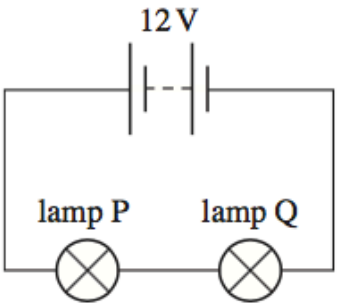
(3 marks)

(c) The lamps are now reconnected to the 12 V battery in series as shown in **Figure 3**.

Figure 3



(c) (i) Explain why the lamps will not be at their normal brightness in this circuit.

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(2 marks)

(c) (ii) State and explain which of the lamps will be brighter assuming that the resistance of the lamps does not change significantly with temperature.

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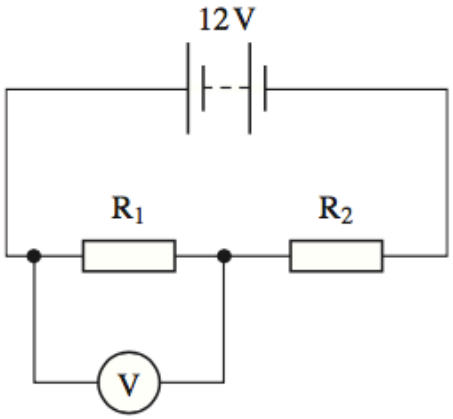
(3 marks)

6)

Figure 4 shows two resistors, R_1 and R_2, connected in series with a battery of emf 12 V and negligible internal resistance.

Figure 4



(a) The reading on the voltmeter is 8.0 V and the resistance of R_2 is 60 Ω.

(a) (i) Calculate the current in the circuit.

answer = ... A

(2 marks)

(a) (ii) Calculate the resistance of R_1.

answer = ... Ω

(1 mark)

(a) (iii) Calculate the charge passing through the battery in 2.0 minutes. Give an appropriate unit for your answer.

answer = ... unit = ...

(2 marks)

(b) In the circuit shown in **Figure 4** R_2 is replaced with a thermistor. State and explain what will happen to the reading on the voltmeter as the temperature of the thermistor increases.

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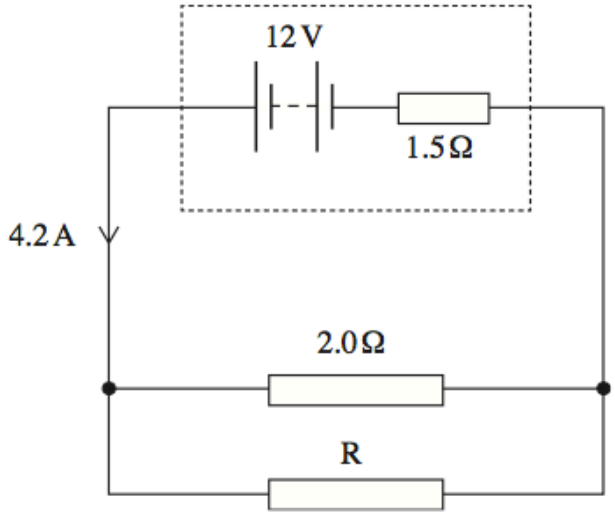
(3 marks)

7)

The circuit in **Figure 3** shows a battery of electromotive force (emf) 12 V and internal resistance 1.5 Ω connected to a 2.0 Ω resistor in parallel with an unknown resistor, R. The battery supplies a current of 4.2 A.

Figure 3



(a) (i) Show that the potential difference (pd) across the internal resistance is 6.3 V.

(1 mark)

(a) (ii) Calculate the pd across the 2.0 Ω resistor.

pd V
(1 mark)

(a) (iii) Calculate the current in the 2.0 Ω resistor.

current ..... A
(1 mark)

(a) (iv) Determine the current in R.

current ..... A
(1 mark)

(a) (v) Calculate the resistance of R.

R ..... Ω

(1 mark)

(a) (vi) Calculate the total resistance of the circuit.

circuit resistance ..... Ω

(2 marks)

(b) The battery converts chemical energy into electrical energy that is then dissipated in the internal resistance and the two external resistors.

(b) (i) Using appropriate data values that you have calculated, complete the following table by calculating the rate of energy dissipation in each resistor.

resistor	rate of energy dissipation / W
internal resistance	
2.0 Ω	
R	

(3 marks)

(b) (ii) Hence show that energy is conserved in the circuit.

.....

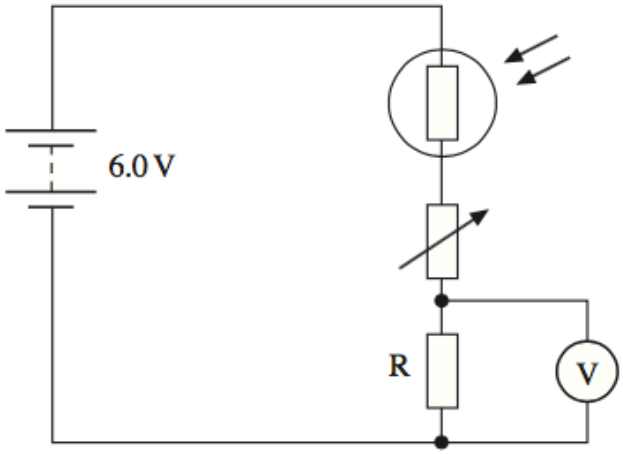
.....

(2 marks)

8)

Figure 4 shows a 6.0 V battery of negligible internal resistance connected in series to a light dependent resistor (LDR), a variable resistor and a fixed resistor, R.

Figure 4



(a) For a particular light intensity the resistance of the LDR is 50 kΩ. The resistance of R is 5.0 kΩ and the variable resistor is set to a value of 35 kΩ.

(a) (i) Calculate the current in the circuit.

current ..... A
(2 marks)

(a) (ii) Calculate the reading on the voltmeter.

voltmeter reading V
(2 marks)

(b) State and explain what happens to the reading on the voltmeter if the intensity of the light incident on the LDR increases.

.....

.....

.....
(2 marks)

(c) For a certain application at a particular light intensity the pd across R needs to be 0.75 V. The resistance of the LDR at this intensity is 5.0 kΩ.

Calculate the required resistance of the variable resistor in this situation.

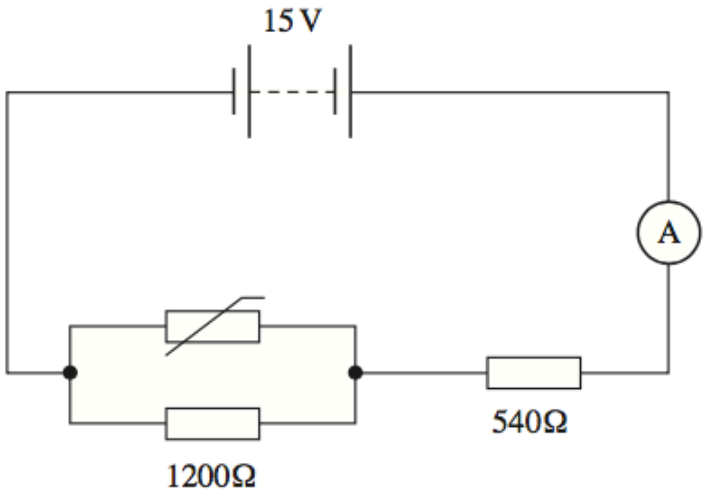
resistance ..... Ω

(3 marks)

9)

The circuit shown in **Figure 3** shows a thermistor connected in a circuit with two resistors, an ammeter and a battery of emf 15 V and negligible internal resistance.

Figure 3



(a) When the thermistor is at a certain temperature the current through the ammeter is 10.0 mA.

(a) (i) Calculate the pd across the 540 Ω resistor.

answer = ... V
(1 mark)

(a) (ii) Calculate the pd across the 1200 Ω resistor.

answer = ... V
(1 mark)

(a) (iii) Calculate the resistance of the parallel combination of the resistor and the thermistor.

answer = ... Ω

(2 marks)

(a) (iv) Calculate the resistance of the thermistor.

answer = ... Ω

(2 marks)

(b) The temperature of the thermistor is increased so that its resistance decreases.
State and explain what happens to the pd across the 1200 Ω resistor.

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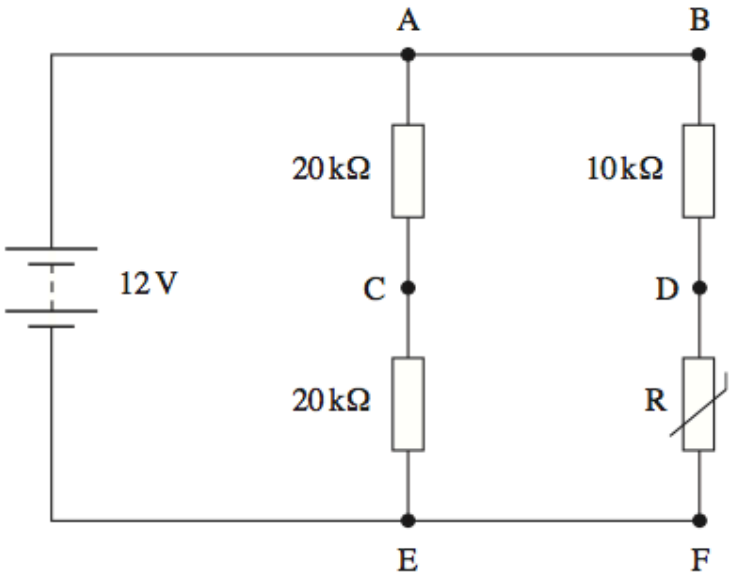
(3 marks)

10)

Figure 2 shows a 12 V battery of negligible internal resistance connected to a combination of three resistors and a thermistor.

Figure 2



(a) When the resistance of the thermistor is 5.0 kΩ

(a) (i) calculate the total resistance of the circuit,

total resistance = ... kΩ

(3 marks)

(a) (ii) calculate the current in the battery.

current = ... mA

(1 mark)

(b) A high-resistance voltmeter is used to measure the potential difference (pd) between points A–C, D–F and C–D in turn.
Complete the following table indicating the reading of the voltmeter at each of the three positions.

voltmeter position	pd / V
A–C	
D–F	
C–D	

(3 marks)

(c) The thermistor is heated so that its resistance decreases. State and explain the effect this has on the voltmeter reading in the following positions.

(c) (i) A–C .....

.....

.....

.....

(2 marks)

(c) (ii) D–F .....

.....

.....

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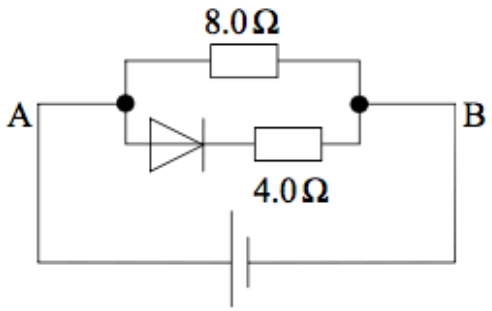
(2 marks)

11)

Figure 1 shows an arrangement of a semiconducting diode and two resistors.

Figure 1



A 12.0 V battery is connected with its positive terminal to A and negative terminal to B.

a (i) Calculate the current in the 8.0 Ω resistor

.....

.....

.....

answer .....A

(2 marks)

(ii) Calculate the current in the 4.0 Ω resistor if the p.d. across the diode, when in forward bias, is 0.65 V expressing your answer to an appropriate number of significant figures.

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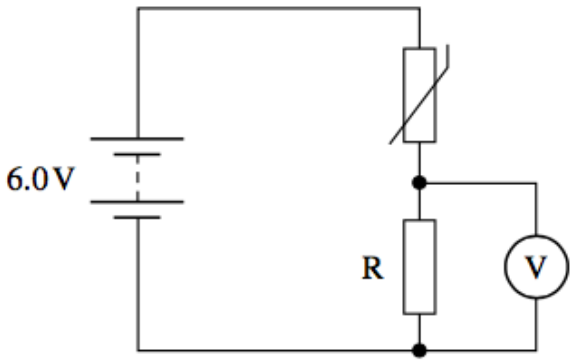
answer .....A

(3 marks)

(b) **Figure 1** shows a thermistor connected in series with a resistor, R, and battery of emf 6.0 V and negligible internal resistance.

Figure 1



When the temperature is 50 °C the resistance of the thermistor is 1.2 kΩ. The voltmeter connected across *R* reads 1.6 V.

(b) (i) Calculate the pd across the thermistor.

answer = ... V
(1 mark)

(b) (ii) Calculate the current in the circuit.

answer = ... A
(1 mark)

(b) (iii) Calculate the resistance of R quoting your answer to an appropriate number of significant figures.

answer = ... Ω

(2 marks)

(c) State and explain the effect on the voltmeter reading if the internal resistance of the battery in the circuit in part (b) was not negligible.

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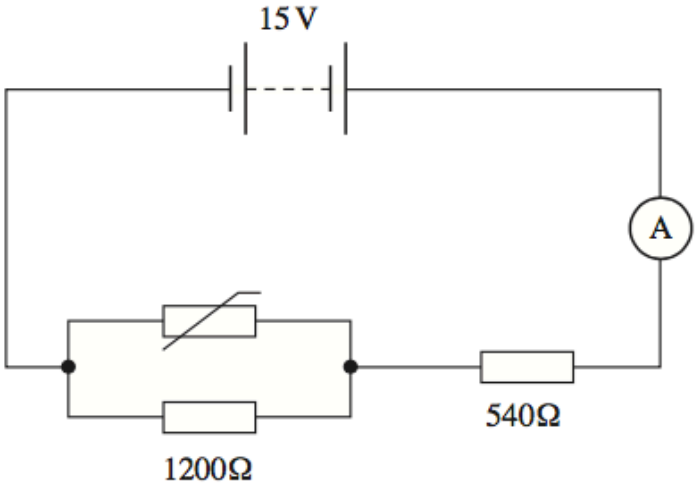
(2 marks)

12)

The circuit shown in **Figure 3** shows a thermistor connected in a circuit with two resistors, an ammeter and a battery of emf 15 V and negligible internal resistance.

Figure 3



(a) When the thermistor is at a certain temperature the current through the ammeter is 10.0 mA.

(a) (i) Calculate the pd across the 540 Ω resistor.

answer = ... V

(1 mark)

(a) (ii) Calculate the pd across the 1200 Ω resistor.

answer = ... V

(1 mark)

(a) (iii) Calculate the resistance of the parallel combination of the resistor and the thermistor.

answer = ... Ω

(2 marks)

(a) (iv) Calculate the resistance of the thermistor.

answer = ... Ω

(2 marks)

(b) The temperature of the thermistor is increased so that its resistance decreases.
State and explain what happens to the pd across the 1200 Ω resistor.

.....

.....

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.....

(3 marks)