Name: _____

Circuits

Questions

Date:

Time:

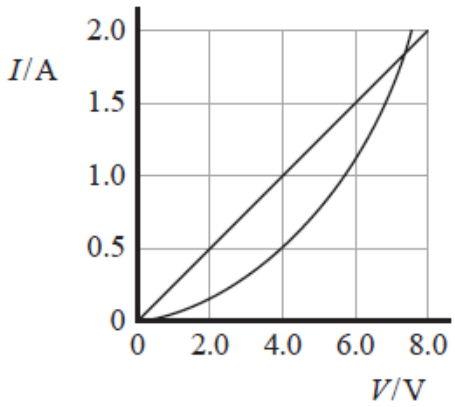
Total marks available:

Total marks achieved: _____

Questions

Q1.

The current-potential difference graphs for a resistor and a thermistor are shown.



The resistor and thermistor are connected in series to a 6 V battery.

What is the current, in amps, in the resistor?

(1)

☒ **A** 0.5

☒ **B** 1.0

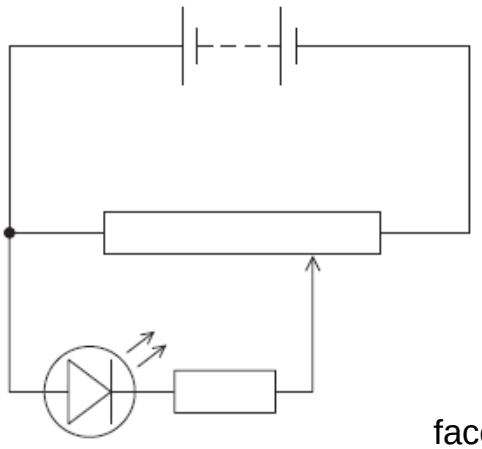
☒ **C** 1.5

☒ **D** 2.0

(Total for question = 1 mark)

Q2.

A student wanted to plot a graph of current against potential difference for a light emitting diode (LED). He used the circuit shown.



Add an ammeter and a voltmeter to the circuit diagram that would enable the data to be collected.

(1)

(Total for question = 1 mark)

Q3.

A student is deriving an equation for the total resistance of resistors in series.

She writes the following steps but does not justify them.

Step 1 $V = V_1 + V_2$
Step 2 $but\ V = IR$
Step 3 $so\ IR = I_1R_1 + I_2R_2$
Step 4 $but\ I = I_1 = I_2$
Step 5 $Therefore\ R = R_1 + R_2$

Which step is justified using conservation of charge?

(1)

☒ **A** Step 1

☒ **B** Step 2

☒ **C** Step 3

☒ **D** Step 4

(Total for question = 1 mark)

Q4.

An electric torch uses two 1.5 V cells. The torch bulb is marked 2.4 V, 270 mA.

What is the resistance of the torch bulb?

☒ **A** 0.81Ω

☒ **B** 0.65Ω

☒ **C** 8.9Ω

☒ **D** 11Ω

(Total for question = 1 mark)

Q5.

A hair dryer is used for 3 minutes. The operating current is 6 A.

What charge flows in this time?

(1)

☒ **A** 0.03 C

☒ **B** 2 C

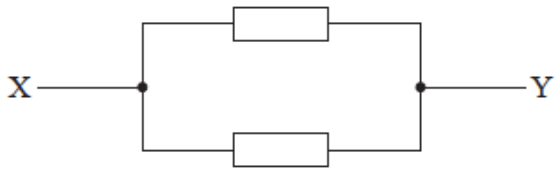
☒ **C** 18 C

☒ **D** 1080 C

(Total for question = 1 mark)

Q6.

The two resistors shown each have resistance *R*.



Which expression gives the correct resistance between point X and point Y?

(1)

☒ **A** $\frac{R}{2}$

☒ **B** R

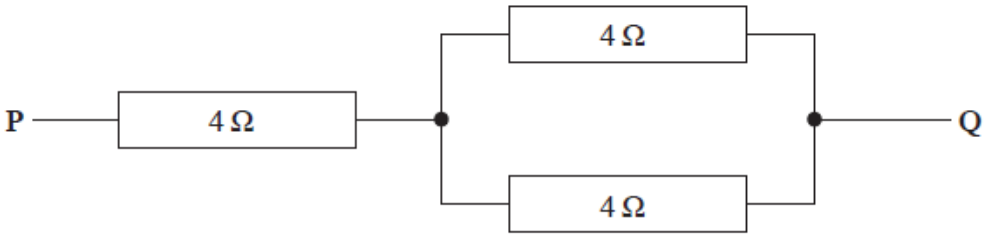
☒ **C** $2R$

☒ **D** R^2

(Total for question = 1 mark)

Q7.

The diagram shows a combination of three identical resistors.



What is the combined resistance between P and Q?

☒ **A** 4 Ω

☒ **B** 6 Ω

☒ **C** 8 Ω

☒ **D** 12 Ω

(Total for question = 1 mark)

Q8.

A rechargeable cell stores a maximum energy of 4200 J. The cell has an e.m.f. of 1.5 V and after 2.0 hours use the cell is completely discharged.

Assuming the e.m.f. stays constant, the charge passing through the cell during this time is

☒ **A** 1400 C

☒ **B** 2800 C

☒ **C** 5600 C

☒ **D** 6300 C

(Total for question = 1 mark)

Q9.

The current in a filament lamp is 250 mA.

How much charge flows through the lamp in 3 minutes?

☒ **A** 0.75 C

☒ **B** 45 C

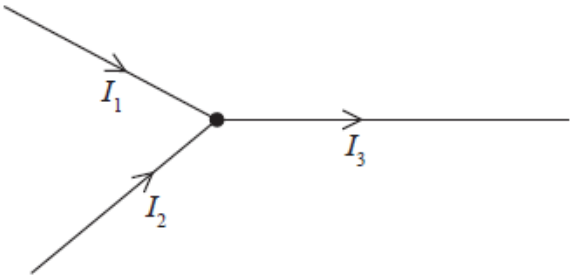
☒ **C** 750 C

☒ **D** 45 000 C

(Total for question = 1 mark)

Q10.

The diagram shows the current in part of an electrical circuit.



State the relationship between I_1, I_2 and I_3 and explain it in terms of charge.

(3)

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(Total for question = 3 marks)

Q11. Explain why an ammeter

- must be placed in series to measure current through a component
- must have a very low resistance.

(3)

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(Total for Question = 3 marks)

Q12.

A mobile phone is powered by a lithium-ion battery. The information shown is taken from the battery.

3.82 V
6.91 W h

The mobile phone, when purchased, was supplied with a charging plug marked 1 A, 5V. The mobile phone owner lost the original charging plug and replaced it with a charging plug marked 0.5 A, 5 V.

original charging plug
1A, 5 V

replacement charging plug
0.5A, 5 V

By evaluating the information given, discuss the suitability of using the replacement charging plug for this mobile phone. Include references to possible benefits, disadvantages and risks associated with using the replacement charging plug.

(4)

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(Total for question = 4 marks)

Q13.

A mobile phone is powered by a lithium-ion battery. The information shown is taken from the battery.

3.82 V
6.91 W h

(i) The watt-hour (W h) is an alternative unit for energy.

Show that the maximum energy that can be stored by the battery is about 25kJ. 1 W h = 3600J

(1)

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(ii) Calculate the maximum charge that the battery can provide.

(2)

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Maximum charge = ...

(iii) The mobile phone 'runs out of charge'.

Calculate the minimum time taken, in hours, for the battery to fully recharge.

charging current = 0.90 A

(3)

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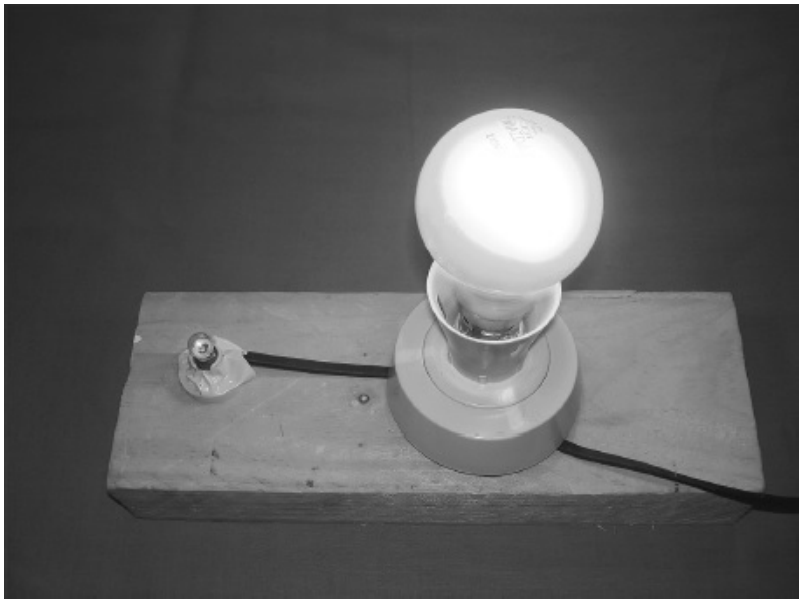
Minimum time = ... hours

(Total for question = 6 marks)

Q14. The photograph shows a piece of apparatus in which a mains light bulb and a torch bulb are both connected to the mains.



Students were surprised to see both bulbs shining normally when the apparatus was switched on.

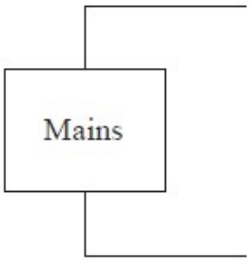
It is impossible to tell from looking at the apparatus whether the bulbs are connected in series or in parallel.

To test this, the apparatus was switched off and the mains bulb was removed. When it was switched on again the torch bulb did not light up. When this was repeated, removing the torch bulb, the mains bulb did not light up.

When the circuit was tried again with both bulbs, they still operated normally.

(a) Complete the circuit diagram to show how the bulbs are connected and explain why they must be connected in this way and not the alternative.

(3)



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(b) The mains bulb is marked 40 W, 230 V.

(i) Show that the current in the mains bulb is about 0.2 A when it is operating normally.

(2)

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(ii) Calculate the resistance of the mains bulb when it is operating normally.

(2)

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Resistance = ...

(iii) The torch bulb is marked 2.5 V, 0.20 A.

Calculate the resistance of the torch bulb when it is operating normally.

(2)

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Resistance = ...

(c) Explain, with reference to both current and potential difference, why it is possible to operate both bulbs at the same time from the same power supply.

(2)

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(d) Earlier in the question you were asked to calculate the resistances of the bulbs when operating normally.

Explain the effect on the resistances of the bulbs if they are operated at a much smaller current so that neither bulb lights up.

(4)

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(Total for Question = 15 marks)