



L6th
A level Physics
Christmas Vacation Work
Electrical Circuits

How much work should you be doing over the 4 weeks that you have off?

- 2 hours of file tidying – get them perfectly ordered
- 1 hour for each teacher of consolidating notes – are you missing any flashcards etc?
- *55 minutes answering these questions*

What we are expecting to check when you return:

- ✓ These questions have been marked
- ✓ You have calculated your percentage and grade
- ✓ Written down the areas where you are still struggling. We will collate these and swiftly address these in clinic during the first few weeks of term.

Total: / 49marks	Grade (circle):
Topics that you are still struggling with and why:	A* = 75%
	A = 70%
	B = 65 %
	C = 60 %

Happy Christmas!





Section A - MULTIPLE CHOICE SECTION

Question 1

- 1 A child's toy is operated by a small motor. The potential difference across the motor is 6.0 V and the current in it is 0.20 A. The energy used by the motor in 120 s is

- ☐ A 2.40 J
- ☐ B 60.0 J
- ☐ C 144 J
- ☐ D 3600 J

(Total for Question 1 = 1 mark)

Question 2

- 2 The resistance of a length of copper wire is 6 Ω . A second piece of copper wire has twice the length and twice the cross-sectional area. The resistance of the second piece of copper wire is

- ☐ A 3 Ω
- ☐ B 6 Ω
- ☐ C 12 Ω
- ☐ D 24 Ω

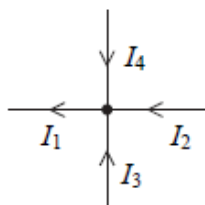
(Total for Question 2 = 1 mark)

Question 3

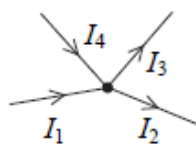
- 3 The diagrams show connected wires that carry currents I_1 , I_2 , I_3 and I_4 .

The currents are related by the equation $I_1 + I_2 = I_3 + I_4$

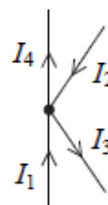
Identify the diagram that this equation applies to.



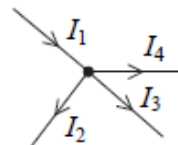
A



B



C



D

- ☐ A
- ☐ B
- ☐ C
- ☐ D

(Total for Question 3 = 1 mark)





Question 4

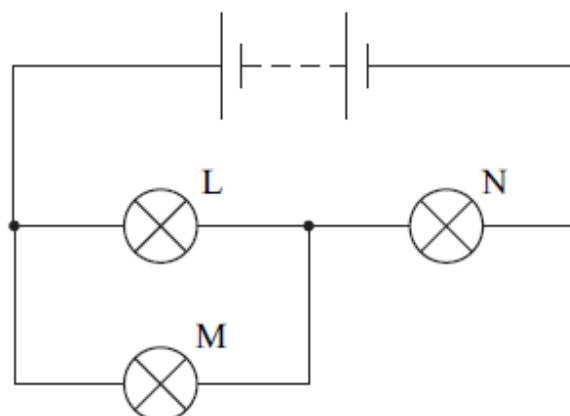
- 4 A 100 W lamp connected to the 230 V mains is replaced by a lamp which has twice the resistance. The power of the new lamp is

- ☐ A 25 W
☐ B 50 W
☐ C 200 W
☐ D 400 W

(Total for Question 4 = 1 mark)

Question 5

- 5 In the circuit shown, the battery has negligible internal resistance. L, M and N are identical lamps.



The filament of lamp M breaks. Identify the row of the table which shows the resulting changes in the brightness of lamps L and N.

		Lamp L	Lamp N
<input type="checkbox"/>	A	increases	stays the same
<input type="checkbox"/>	B	stays the same	decreases
<input type="checkbox"/>	C	decreases	increases
<input type="checkbox"/>	D	increases	decreases

(Total for Question 5 = 1 mark)





Question 6

6 Which of the following can be used as a unit of electrical resistance?

- ☐ A W A^{-2}
- ☐ B A V^{-1}
- ☐ C W V^{-2}
- ☐ D V C^{-1}

(Total for Question 6 = 1 mark)

Question 7

7 An electron is accelerated through a large potential difference and gains a kinetic energy of 47 keV. This energy expressed as joules equals

- ☐ A $7.5 \times 10^{-18} \text{ J}$
- ☐ B $7.5 \times 10^{-15} \text{ J}$
- ☐ C $2.9 \times 10^{20} \text{ J}$
- ☐ D $2.9 \times 10^{23} \text{ J}$

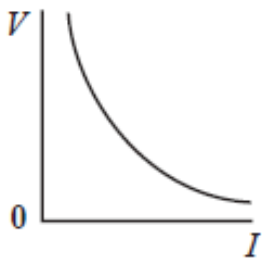
(Total for Question 7 = 1 mark)

Question 8

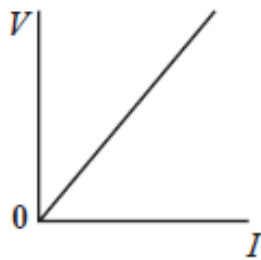




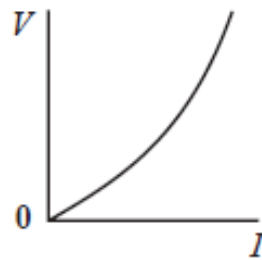
8 Which one of the following graphs correctly shows the relationship between potential difference (V) and current (I) for a filament lamp?



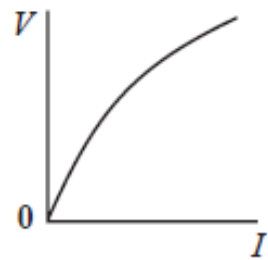
A



B



C



D

☐ A

☐ B

☐ C

☐ D

(Total for Question 8 = 1 mark)

Section B - LONG ANSWER SECTION

Question 9

a) A cell of e.m.f. 1.5 V is connected to a lamp of resistance $80\ \Omega$. The current in the circuit is 17 mA.

Calculate the internal resistance of this cell

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.....

.....

Internal resistance =

(3)

b) Explain, in terms of energy, the difference between potential difference (p.d.) and electromotive force (e.m.f.)

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(2)

(Total for Question 9 = 5 marks)

Question 10

- a) The photograph shows a marble statue. The statue is protected by a lightning conductor.



During a storm, a flash of lightning passes between a cloud and the lightning conductor. As a result a current of 15000 A flows for a time of 3.0×10^{-2} s.

- i) Calculate the charge that flows in the lightning conductor during this time

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.....
.....
Charge =.....

(2)

- ii) The lightning conductor is 1 m taller than the statue and is made from copper, which has a resistivity of $1.7 \times 10^{-8} \Omega\text{m}$. The lightning conductor has a cross-sectional area of $1.5 \times 10^{-4} \text{m}^2$ and a resistance of $2.7 \times 10^{-3} \Omega$.

Calculate the height of the statue and state an assumption that you have made

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Height of statue =.....

Assumption:.....

(4)

- b) Suggest why the lightning conductor is taller than the statue

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.....
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(1)

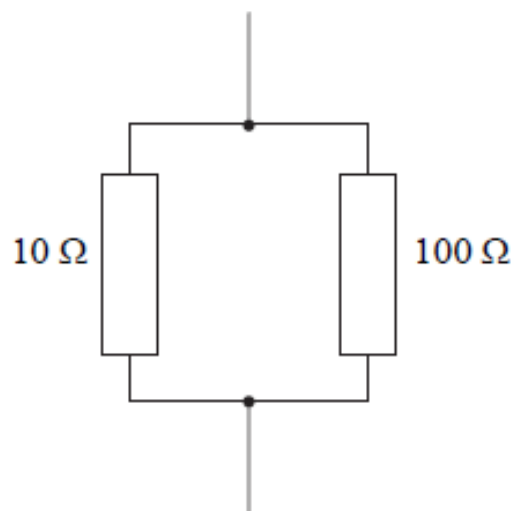
(Total for Question 10 = 7 marks)





Question 11

Two resistors are connected in parallel.



- a) Calculate the resistance of the combination.

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Resistance =

(2)

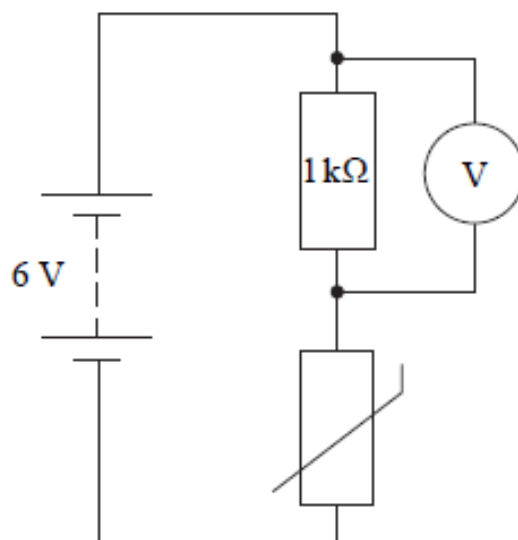
- b) This resistance combination is used in an electrical circuit. A student measures the potential difference across the combination with a high resistance voltmeter. Explain why the resistance of the combination is hardly changed by the addition of the voltmeter.

(3)

(Total for Question 11 = 5 marks)

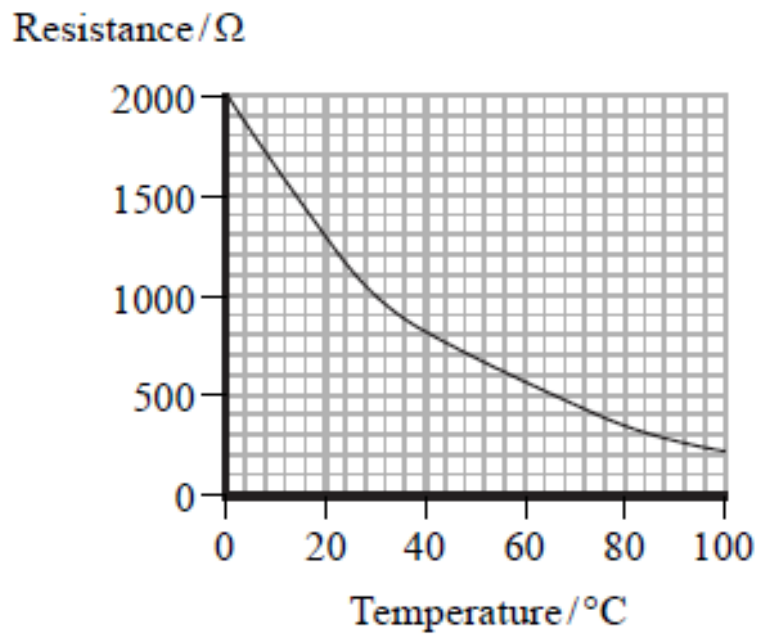
Question 12

The following circuit is used to monitor the temperature in a greenhouse. The battery has no internal resistance





- a) The graph shows how the resistance of the thermistor varies with temperature



- i) Use the graph to find the resistance of the thermistor at 20°C .

Resistance =

(1)

- ii) Calculate the reading on the voltmeter when the thermistor is at 20°C .

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Reading on the voltmeter =

(3)

- b) Explain what will happen to the reading on the voltmeter as the temperature of the greenhouse decreases

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(2)

(Total for Question 12 = 6 marks)

Question 13

A length of wire has a cross-sectional area of $3.1 \times 10^{-6} \text{ m}^2$. A current of 1.5 A flows through the wire when there is a p.d. of 3.0 V across it.

- a) Draw a diagram of the circuit you would use to check these current and p.d. values.

(2)





b) Calculate the rate at which energy is transferred to the wire

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Rate of energy transfer =

(2)

c) The wire has 1.0×10^{29} electrons per metre cubed.

Calculate the drift velocity of the electrons.

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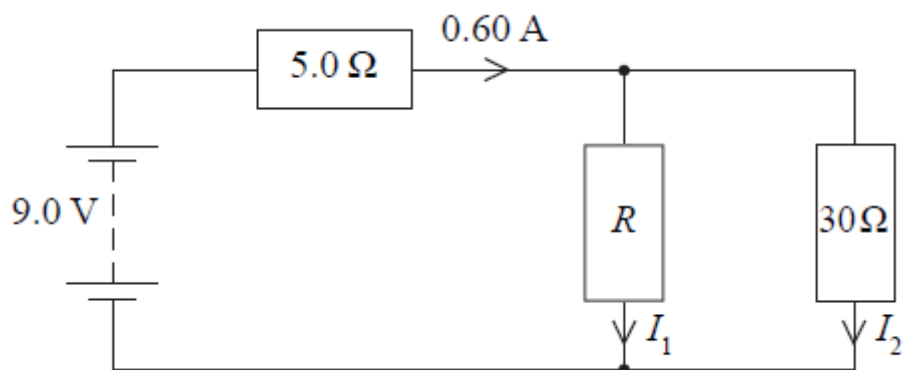
Drift velocity =

(2)

(Total for Question 13 = 6 marks)

Question 14

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





a) Calculate the potential difference across the $5\ \Omega$ resistor.

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Potential difference =

(2)

b) Calculate the current I_2 .

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Current in I_2 =

(2)

c) Calculate the resistance R .

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R =

(2)

(Total for Question 14 = 6 marks)

Question 15

Given a cylinder of conductive putty of length L , cross-sectional area A , and resistivity ρ , describe how you would use a voltmeter, ammeter and other standard laboratory equipment to determine a value for the numerical value of resistivity of the putty.

Your description should include:

- A labelled circuit diagram
- Details of the measurements you would make
- An account of how you would use your measurements to determine the result
- Details of how to improve the accuracy and precision of your measurements

(6)

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(Total for Question 15 = 6 marks)



THIS IS THE END OF THE PAPER

