Year 11 Physics

Marks / 47

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

End of unit test

Electricity.

Short answer section – 33 marks

1. (3 marks)

Compare and contrast two different electrical safety devices used in the home and state the effectiveness in different situations.

* **Name two safety devices. (1mark)**
* **What they do. (1mark)**
* **Comparing how they different and their advantages over one another. (1mark)**

1. (3 marks)

## Which of the following voltage – current graphs best represents a non-ohmic conductor? (1 mark)

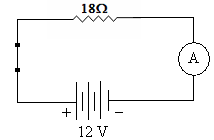
**A B C D**

## Why did you select this graph? (2 marks)

**For an Ohmic resister; V = IR therefore  and as R is constant, V ∝ I and you produce a straight line through (0,0).**

**In non-ohmic resistors, the resistance changes as the PD increases therefore producing a curved line. Only C has a curved line.**

1. (1 mark)

Label the following circuit to show the direction of **electron** current.

1. (4 marks)

A lightning bolt contains 6.0 x 109 J of energy, which is enough to power a city. If it transfers 30 C of charge to the Earth in 1.5 ms.

## What was the potential difference produced by the lightning bolt? (2 marks)

**W = 6 x 109 J W = Vq**

**q = 30 C **

**t = 1.5 x 10-3 s V = 2.0 x 108 V**

**q = It**

## What is the average power dissipated during the strike? (2 marks)

**P = VI **

** P = 4 x 1012 W**

**therefore**

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1. (4 marks)

A rechargeable battery was charged at a constant current of 600 mA for 9 hours. The average cell potential difference during the re-charge was 1.6V.

## Calculate the amount of charge that passed through the cell (2 marks)

**I = 600 x 10-3 A q = It**

**t = 9 x 60 x 60 = 600 x 10-3 x 32 400**

**= 32 400 s = 19 440**

**V = 1.6 V q = 1.94 x 104 C**

## Calculate the amount of work done by the charging device. (2 marks)

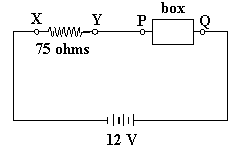
**W = Vq**

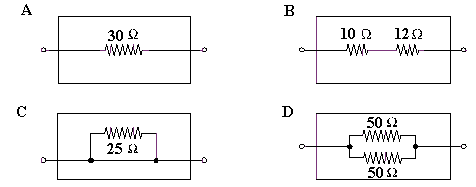
**= 1.6 x 1.94 x 104**

**W = 3.11 x 104 J**

1. (3 marks)

A student completes a circuit that includes a mystery box as shown below.



If the potential difference between X and Y is 9.0 volts, which of the following boxes (A - D) is in the circuit? **For full marks, show working below.**

Answer: **D**

**VT = V (X-Y) + V (P-Q)  A = 30 Ω**

**12 = 9 + V (P-Q) B = 10 + 12 = 22 Ω**

**V (P-Q) = 3.0 V therefore need 25 Ω resistance C: 25 Ω in parallel with**

**wire (very low resistance)**

**so RT very low**

**I = 0.12 A D = (50-1 + 50-1)-1 = 25 Ω**

1. (4 marks)

The element of an electric jug has a resistance of 60.0 Ω and draws a current of 3.75 A, there is 1.05 kg of water at a temperature of 20°C is in the jug. How long will it take to bring the water to the boil (100°C)? Give your answer in **minutes**.

**m = 1.5 kg Q = mcΔT**

**ΔT = 100 – 20 = 1.05 x 4180 x 80**

**= 800C = 351120 J (1 mark)**

**R = 600 Ω V = IR**

**I = 3 A = 3.75 x 60.0**

**= 225 V (1 mark)**

**Heat energy = electrical energy**

**Q = W = VIt (1 mark)**

**351 120 = 225 x 3.75 x t**

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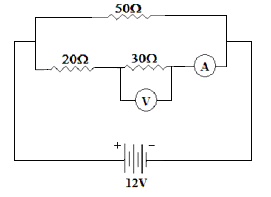
**t = 6.94 minutes. (1 mark)**

1. (2 marks)

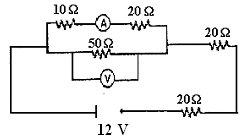
You are given the following components.

*Read all the instructions before you draw the circuit.*

Use these components to draw an electrical circuit where the 30Ω and 20Ω resistors are in series. Place the 50Ω resistor in parallel with both of these resistors. Place the voltmeter to measure the potential difference of the 30Ω resistor only and the ammeter to measure the current of the 20Ω resistor only. The battery supplies energy to the whole circuit.



1. (9 marks)

A student has set up the following circuit in a practical examination.

Solve the following three questions and write your answers in the spaces provided:

## Determine the total resistance of the circuit: Answer: **58.8 Ω** (3 marks)

## What is the reading on the voltmeter? Answer: **3.83 V** (3 marks)

## What is the reading on the ammeter? Answer: **0.128 A** (3 marks)

**a. R (parallel) = (30-1 + 50-1)-1**

**= 18.75 Ω**

**RT = 18.75 + 20 + 20**

**RT = 58.75 Ω**

**b. **

**IT = 0.20426 A**

**V50Ω = IT x R (parallel)**

**V50Ω =0.20426 x 18.75 = 3.82979 V**

**so V50Ω = 3.83 V**

**OR Find V of one 20Ω in series section**

**V = IR**

**= 0.20426 x 20**

**= 4.0851 V**

**Now two 20Ω resistors in series so this**

**section has a total PD of**

**4.0851 x 2 = 8.1702 V**

**PD (parallel section) = PDT – PD(series)**

**= 12 – 8.1702**

**= 3.82979 V**

**so V50Ω = 3.83 V**

**c. **

**I50Ω = 0.076596 A**

**Now current for top of parallel section**

**= IT – I50Ω**

**= 0.20426 – 0.076596**

**I = 0.128 A**

**OR V (parallel) = 3.82979 V**

**R (parallel branch) = 30 Ω**

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**I = 0.128**

**Comprehension section – 14 marks**

When estimating numerical answers, show your working or reasoning clearly. Include appropriate units.

1. (14 marks)

## In what way are e-bikes ‘good for the environment’? (2 marks)

**In contrast to petrol driven vehicles, e-bikes produce no undesirable emissions such as methane and carbon dioxide so do not contribute directly to polluting the atmosphere. However because the battery is charged from the mains it could be argued that in the production of the mains electricity, greenhouse gases were produced.**

## In what way are e-bikes ‘good for your health’? (2 marks)

**Cycling is a form of exercise that can be undertaken by a wide range of people. Good diet and exercise are recognised as essential things you need to have to promote good health. Cycling increases aerobic performance as well as providing low impact forces on legs and arms. E-bikes allow older people and people with less strength to participate in an activity that they would otherwise be unable to do.**

## If the e-bike’s 200 W electric motor is working at its stated power, calculate the current it would be drawing from the lithium ion battery. (2 marks)

**P = V I**

**200 = 36 x I**

**I = 200 / 36**

**I = 5.56 A**

## Amp hours (Ah), when applied to batteries, provides an approximate indication of how long a battery is capable of delivering a particular current (A). For instance a battery rated at 10 Ah could deliver 5A for 2 hours when connected to an appliance. If the typical e-bike described in the article, draws 3A on a ride, calculate how long the battery will deliver enough power to propel the bike. (2 marks)

* **The 10 Ah battery can deliver the equivalent of 10 A for 1 hour**
* **If the battery is delivering 3A then it will deliver power for 10 / 3 = 3.33 hours.**

## Explain what would happen to the power output of the motor when the rider was using the pedal assist function and how would this change the distance the rider could travel. (2 marks)

**When engaging the pedal assist function the power output of the motor would decrease. This would conserve the battery’s energy so the distance the rider could travel using the motor would increase.**

## After a ride the cyclist discovers the battery is completely discharged. If the battery is connected to a 36 V charger that delivers a steady current of 2.0 A to the battery for 2.0 hours, calculate the quantity of charge that is delivered to the battery. (2 marks)

**I = q / t**

**2.0 = q / (2 x 60 x 60)**

**q = 2 x 2 x 60 x 60**

**Quantity of charge = 1.4 x 104 C**

## Estimate the electrical resistance in the e-bike electrical system when the 200 W motor is being driven by its 10 Ah battery. (2 marks)

**P = V2 / R**

**200 = 362 / R**

**R = 362 / 200**

**R = 1296 / 200**

**= 6.5 **