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90937

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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Physics, 2014

90937 Demonstrate understanding of aspects of electricity and magnetism

2.00 pm Tuesday 25 November 2014
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of electricity and magnetism.	Demonstrate in-depth understanding of aspects of electricity and magnetism.	Demonstrate comprehensive understanding of aspects of electricity and magnetism.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Resource Sheet L1–PHYSR.

In your answers use clear numerical working, words and/or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 15

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QUESTION ONE: JUMPING JACK TOY

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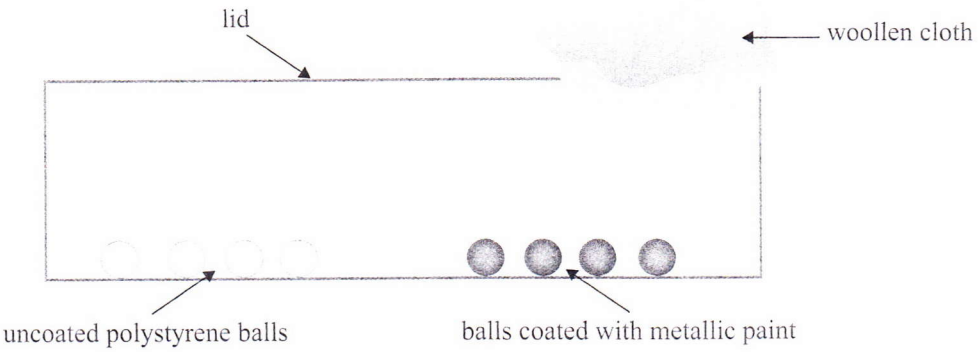
A toy consists of small polystyrene balls inside a sealed plastic container. Some of the polystyrene balls are uncoated and others are coated with metallic paint. All the balls are uncharged and they have the same mass.



When a child rubs the lid of the container with a woollen cloth, the lid becomes negatively charged. The balls now jump up and stick to the lid of the container.

(a) Explain how the lid of the container becomes negatively charged.

As the child ~~rubs~~ rubs the lid of the container with a woollen cloth, electrons are transferred from woollen cloth to the lid. Thus making the lid negatively charged and the woollen cloth positively charged.

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(b) Explain why the balls jump up and stick to the lid of the container.

Because the woollen cloth is now positively charged and the lid is negatively charged due to friction according to the laws of attraction opposites attract so balls stick to the lid of the container.

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(c) After a short time some of the balls begin to fall down.

(i) State which type of balls – uncoated polystyrene, or polystyrene coated with metallic paint – will fall first.

metalic coated polystyrene.

(ii) Explain your answer.

with the uncoated polystyrene and woollen cloth because these are two insulators it creates good friction thus attracting the balls much longer whereas the metalic coated polystyrene is a conductor it can transfer electrons within and without, causing induction which leads to repulsion of the ball causing it to fall first.

A

(d) Some balls are still stuck to the lid of the container.

Explain what happens to the balls that are still stuck to the lid when a child touches the lid of the container with his bare hand.

when the child touches the lid of the container, because the finger is a conductor it absorbs the electrons therefore making it a positive charge which allows it to repel and fall. This process is called earthing or grounding. It takes the excess electrons to make it neutral.

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QUESTION TWO: HEATERS AND TOASTERS

A heating element inside a heater in a camper van is labelled as "200 W; 12 V", and it is connected across a 12 volt battery.

(a) Calculate the resistance of the heating element.

$R = \frac{V}{I} = 12V$ $I = \frac{P}{V}$ $\frac{200}{12} = 16.6a$.

$R = \frac{12}{16.6} = 0.72$.

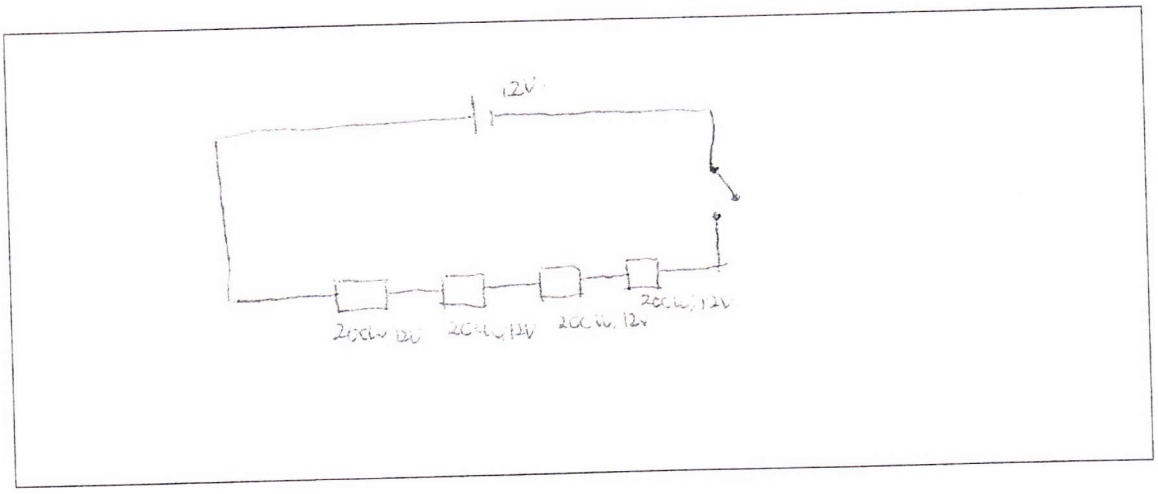
Resistance: 0.72 Ω.

M

(b) Four of these heating elements, each labelled as "200 W; 12 V", are now connected together in series with a switch and a 12 volt battery.

(i) In the space given below, draw the circuit diagram for the four heating elements in series with a switch and the 12 volt battery.

Use the symbol for a resistor to represent heating elements in your circuit diagram.



(ii) Explain why the same current flows through all heating elements when the switch is turned on.

Because they are all in one loop they must share the same voltage (12V), therefore they have the same current. Also in a series circuit all the current are the same.

Also when the switch is on, it is now a complete circuit of one loop allowing the same current to flow through.

M

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(c) Even though the power rating for each element is 200 W, the combined power of the four heating elements in **series** is not 800 W, when connected to a 12 V battery.

Use physics concepts to explain why the combined power of the four elements in series is not 800 W.

P = I x V. ~~I~~ I. 16.6 a. V = 12.

16.6 x 12 = 199.2.

66.6

In a series, the current are all the same. This determines how much power is used. ~~Therefore as they race the same the total decrease~~ Also as it is a series circuit it means that they all share the voltage supply so therefore the (total current) = 16.6 x (total) voltage) = 199.2.

M

(d) A household toaster consists of four heating elements that are connected in **parallel**. The toaster is connected to the 240 V mains supply. When the toaster is switched on, a current of 2.5 A is drawn from the mains supply.

Calculate the electrical energy used by a **single** heating element in the toaster when it is turned on for 2 minutes.

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http://www.ohgizmo.com/wp-content/uploads/2010/05/kenwood_toaster.jpg

power = I x V.

2.5 x 240 = 600w. = P.

E = P x t.

600w x 2.120. = 72,000 ~~watts~~ joules.

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Energy: 72, 000 joules.

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QUESTION THREE: ELECTRIC BELL

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Adapted from: http://upload.wikimedia.org/wikipedia/commons/c/c1/DoorBell_001.jpg

The photo shows the internal parts of an electric bell. When the bell is turned on, a current of 0.16 A flows through the wire X that connects the bell to the power supply.

(a) Calculate the magnetic field strength due to the current, at a distance of 1.0 cm from the wire X.

$$\frac{2 \times 10^{-7} \times 0.16}{1.0} = 3.2$$

a

Magnetic field strength: 0.000000032 tesla (T)

(b) The electric bell has two coils of wire, A and B, connected in series. When the bell is turned on, a current of 0.16 A flows through the coils, and the total power used by both coils is 1.92 W. Coil A has a resistance of 32 Ω.

Calculate the resistance of coil B.

$R = R_1 + R_2 + R_3$

$0.16 = I$, $1.92 = P$

$\frac{P}{I} = V$ $\quad \frac{1.92}{0.16} = 12V$

m

$\frac{V}{I} = R$ $\quad \frac{12V}{0.16} = 75\Omega$

Resistance: 75 Ω

(c) The diagram shows the circuit for an electric bell. The moving arm is made from metal and is attached to a spring. At the instant the switch is closed, the current flows through the circuit in the direction as shown in the diagram.

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Explain in detail the process that causes the bell to sound repeatedly from the instant when the switch is closed.

Adapted from: www.schoolphysics.co.uk/age11-14/glance/Electricity%20and%20magnetism/Electric_bell/index.html

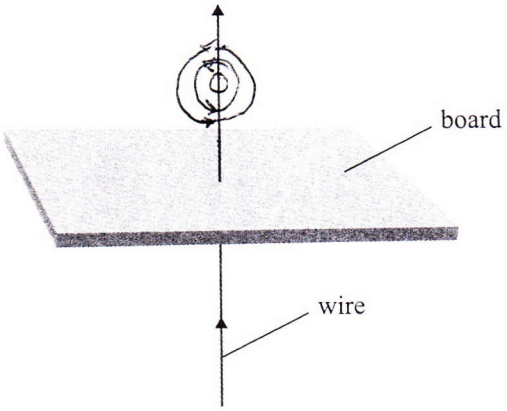
when the circuit is switched on the electromagnet becomes magnetized attracting the metal (striker) with the spring beneath it. The spring allows it to fling back creating a repetitive sound.

This is a relays circuit also. A relay is an operated switch which attracts the magnet when current is flowing and releases it when no current is flowing anymore. When it is turned on the electromagnet becomes magnetized therefore attracting the metal to it supported by the spring. This allows the strike to create the noise. When it is switched off the spring allows it to flick back. This makes it create a repeated sound.

M

Question Three continues on the following page.

(d) A straight wire that carries a large current in the upward direction passes through a horizontal board, as shown in the diagram below.



(i) On the diagram above, draw the **shape** and **direction** of the magnetic field produced by the current-carrying wire.

(ii) Describe how you would check this direction experimentally.

According to the right hand grip rule if you use ~~the~~ your thumb to point where the charge is flowing, then curl your fingers in on the wire the pointing direction of your fingers determines the direction of the magnetic field current.

a

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Merit exemplar for 90937 2014	Total Score	15

Q	Grade score	Annotation
1	4	a. This is an M answer as it links direction of electron transfer to chargin by friction. b. This is an A answer because the answer identifies opposites attract bu does not identify how the balls become charged on the top surface c. This is an A answer because it identifies metallic balls fall first and that they are conductors. The answer fails to explain the transfer of electrons to the balls. d. This is an A answer as it identifies earthing results in electron transfer and neutralisation. However the comment regarding it becoming positive and repelling to fall is incorrect.
2	6	b. This is an M answer. The diagram is correct and explanation shows that current only has a single loop. c. This is an N answer. Like many students this answer assumes that the current is unchanged from part a. This is incorrect as there are more components in series, thus increasing the total resistance. To receive a grade the answer needs to acknowledge that individual elements power will decrease as a result of decreased V or I, d. This is an M answer because the student has found the total energy fo 2 minutes but has failed to divide to obtain the energy of a single element.
3	5	a. This is an A answer as the units for d have not been converted to metres. b. This is an M answer because the total resistance has been calculated. To become an E the student would need to subtract the resistance of the other resistor as the two coils are in series. c. This is an M answer. The answer identifies the magnetization of the coil results in the arm being attracted allowing the gong to be struck. The idea that the contacts break turning the circuit off without the use of the switch is needed for E.