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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.

Achievement

TOTAL 13

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QUESTION ONE: JUMPING JACK TOY

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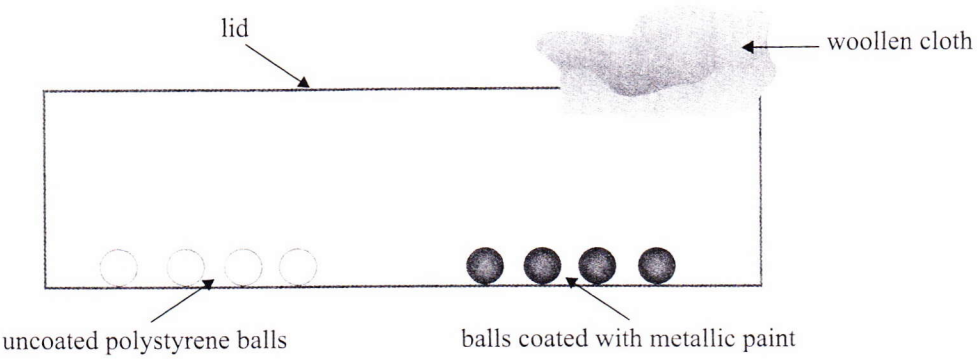
A toy consists of small polystyrene balls inside a sealed plastic container. Some of the polystyrene balls are uncoated and others are coated with metallic paint. All the balls are uncharged and they have the same mass.



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.

because negative electron charges are rubbed of onto the lid from the cloth making the lid have an overall negative charge

M

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

because the positive charge of the balls is attacted to the negative charge of lid and because opposites attract to eachother the balls will jump and and stick to the lid.

A

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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.

~~uncoated~~ coated with metalic paint

(ii) Explain your answer.

because the metalic coated balls have a uniform charge distribation with the charge density spread out evenly over the surface. this will mean it will have less charges in contact than the uncoated ball with an unformal charge distribation which will have more charges in contact so will stay on longer

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.

the charge will leap to him and becomes earthed making the balls fall down

a

A4

$V = IR$ $P = IV$ $R = \frac{V}{I}$ $I = \frac{P}{V}$

QUESTION TWO: HEATERS AND TOASTERS

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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.

$I = \frac{P}{V} = \frac{200}{12}$

$I = 16.6$

$R = \frac{V}{I} = \frac{12}{16.6} = 0.72\ \Omega$

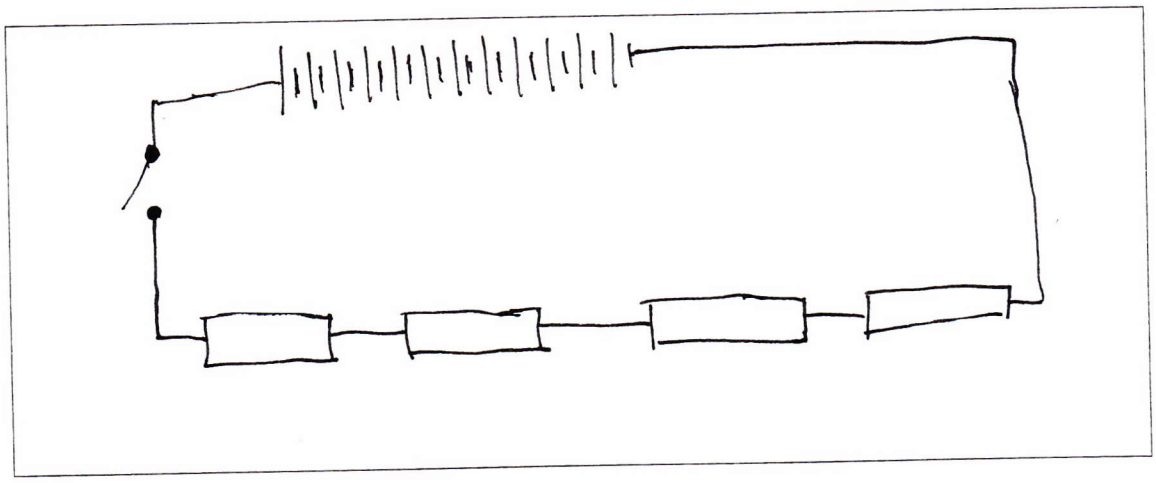
Resistance: $0.72\ \Omega$

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.

M

because the ~~elemen~~ components are all in series and not parallel there will be an equal current throughout the circut because there is only one path to follow the current will be the same in each heating element

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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.

because when connected in series components share the total voltage ~~area~~ so each will have a quater of the total voltage. So the total voltage through the circut will remain the same and the current does not change. the formula for power P = IV dictates that the overall combined power will not change but individual powers will change. as total power equals P = IV and both total I and V are consistant So will power

a

(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.

For copyright purposes, this image cannot be reproduced here.

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

because elements are in parallel and elements are the same as eachother the current will be divided equaly amongst the four

Current per element = ~~2.5~~ $\frac{2.5}{4}$ = 0.625A

a

and because the elements are in parallel each will have the full voltage of 240V

Power per element

P = I V

= 0.625 × 240

= 150 W

Energy: 150W

M5

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.

$B = \frac{KI}{d}$

$B = \frac{(2.0 \times 10^{-7}) \times 0.16}{1}$

$B = 0.0000006 \times 0.16$

$B = 0.000000096$

a

Magnetic field strength: 0.000000096 C

(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.

$R = \frac{V}{I}$ $V = \frac{P}{I}$

Calculate the resistance of coil B.

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

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

total resistance = 75 Ω

because it is ~~par~~ in series $R_T = R_1 + R_2$

$75 = 32 + (R_2)$

$\therefore R_2 = 43\ \Omega$

$B = 43\ \Omega$

e

Resistance: 43 Ω

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(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 switch is closed electrity will flow around the circut, the electricity will turn the electro magnet on

Question Three continues on the following page.

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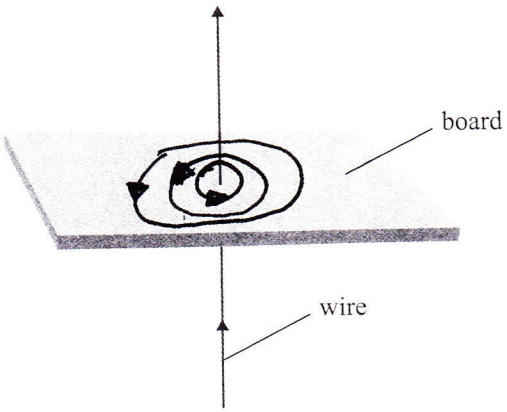
(d) A straight wire that carries a large current in the upward direction passes through a horizontal board, as shown in the diagram below.



(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.

using iron filings by placing them on the board and watching the way they turn and the pattern that is made

A4

Achieved exemplar for 90937 2014	Total Score	13

Q	Grade score	Annotation
1	4	b. This is A as it identifies that the opposite charges attract. To make this an M answer the separation of charge within the ball needs to be explained. c. This is an A answer as it correctly identifies which balls fall first. The discussion about uniform distribution of charge is not relevant here as it only applies when there are no other nearby charges. To obtain an M the answer needs to link the transfer of electrons from the lid to the metal being a conductor. d. This is an A answer as it identifies earthing as the key idea. To become an M the answer needs to identify earthing resulting in the neutralisation of the lid, and hence no force of attraction so the balls fall down.
2	5	c. This is an A answer. The answer identifies that power is related to V and I but fails to give a direction of change. To become an M the answer needs to identify that lower voltage and lower current mean lower power, not just change in power. d. This is an A answer as it correctly calculates a power. To become an M the answer needs to demonstrate an understanding of the link between energy and power.
3	4	a. This is an A answer. The transcription error from standard form to decimal has been overlooked. To become an M answer the units of d need to be converted to metres. b. This is an E answer. All steps are well communicated and logically set out. c. This is an N answer. There is insufficient evidence of understanding. To be an A answer it would need to indicate that turning the electromagnet on means that it becomes magnetised. d. This is an A answer as the diagram clearly shows the correct shape and direction. To become an M answer the use of of a compass to show both the shape and direction of the field needs to be described.