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MANA TOHU MĀTAURANGA O AOTEAROA

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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.

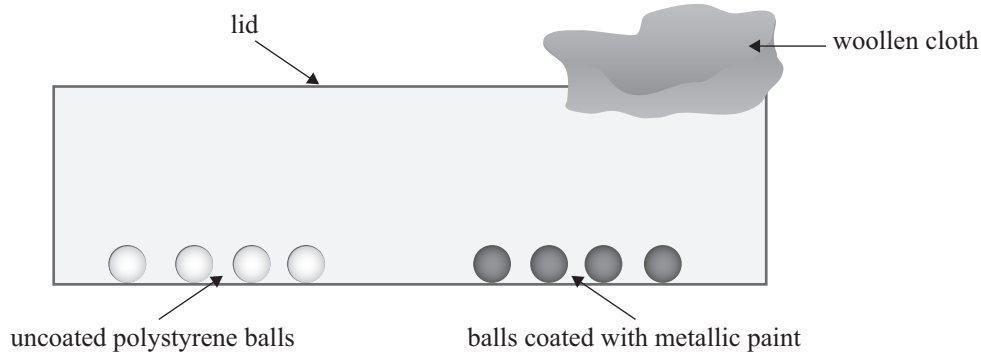
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

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QUESTION ONE: JUMPING JACK TOY

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.

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

(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.

(ii) Explain your answer.

(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.

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.

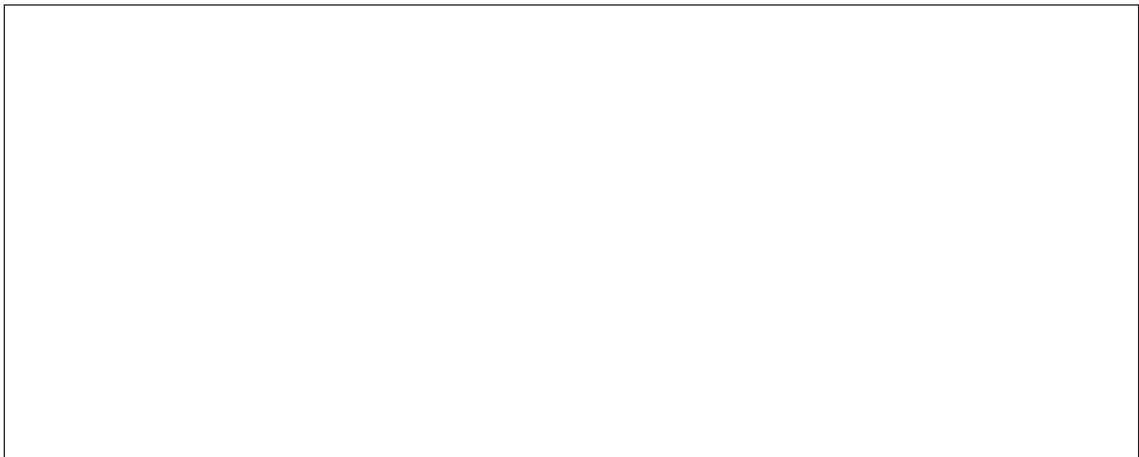
- (a) Calculate the resistance of the heating element.

Resistance: _____

- (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.

- (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.

- (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 reasons, this resource cannot be reproduced here.

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

Energy: _____

QUESTION THREE: ELECTRIC BELL

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.

Magnetic field strength: _____

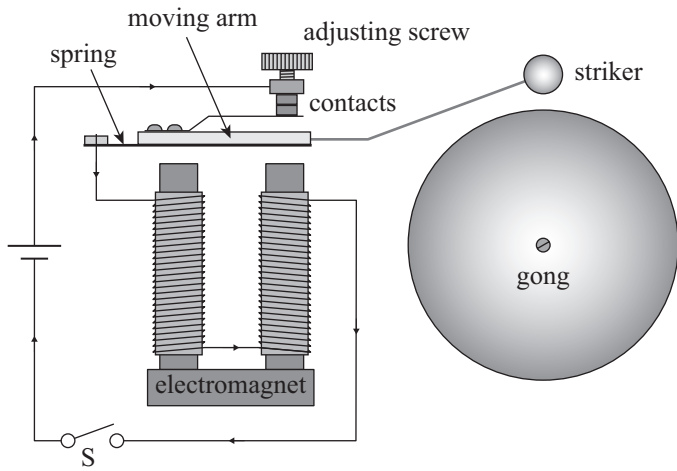
- (b) The electric bell has two coils of wire, A and B, connected in series. When the bell is turned on, a current of 0.16 A flows through the coils, and the total power used by both coils is 1.92 W. Coil A has a resistance of 32 Ω .

Calculate the resistance of coil B.

Resistance: _____

- (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.

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

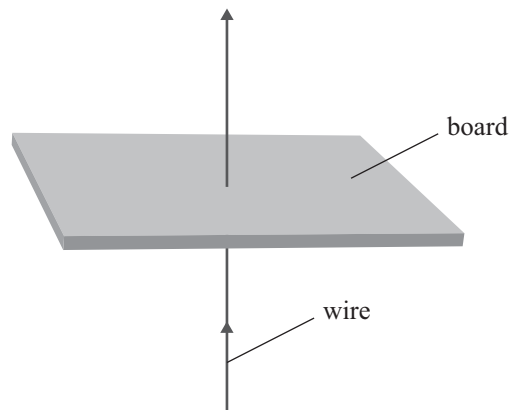


Adapted from: www.schoolphysics.co.uk/age11-14/glance/Electricity%20and%20magnetism/Electric_bell/index.html

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**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.

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