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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.

Not Achieved

TOTAL 06

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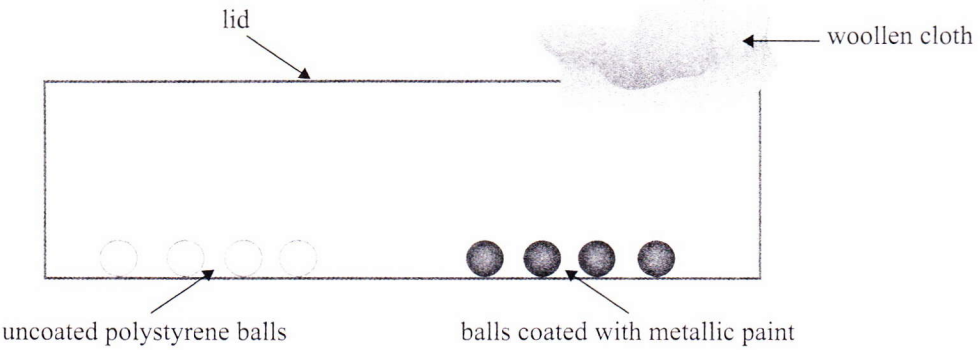
QUESTION ONE: JUMPING JACK TOY

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.

Because the elections have ~~moved away~~ been placed onto the container by the woollen cloth making it have more electrons than protons giving it a negative charge

a

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

because the balls will be positively charged and are attracted to the negatively charged lid as 2 opposite poles attract so the ball is freely moving and becomes attracted to the lid so it moves and sticks to it.

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.

polystyrene with metallic paint

(ii) Explain your answer.

because the balls are heavier due to the paint so they have less friction with the lid making them fall down after the force between the 2 poles becomes less strong.

n

(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 balls will fall down because when he touches it with his hand the lid transfers electrons to the boys hand which makes the negative pole not as strong as and the 2 forces cannot hold the ball up anymore so it falls down

a

A3

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.

$V = IR$

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

$= \frac{200}{12}$

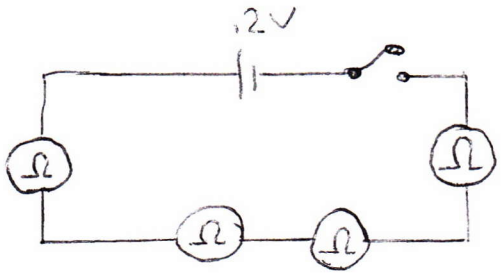
$= 16.667$

Resistance: 16.667 Ω

(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 it is in series and the current does not split so it all has the same current

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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 it stays at 200W because there is some resistance among the circuit so you dont add them up and because the circuit is series not parrabel.

N

(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.

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

$P = IV$
$= 2.5 \times 240$
$= 600$

$E = P \times T$
$= 72,000 W$.

M

Energy:

N2

QUESTION THREE: ELECTRIC BELL

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USE ON

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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.

$$B = \frac{kI}{d}$$
$$= \frac{2.0\times10^{-7} \times 0.16}{1}$$
$$= 3.2\times10^{-8}$$

a

Magnetic field strength: 3.2×10^{-8}

(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.

$V = IR$

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

$R = \frac{1.92}{0.16}$

$=$

n

Resistance: 12 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.

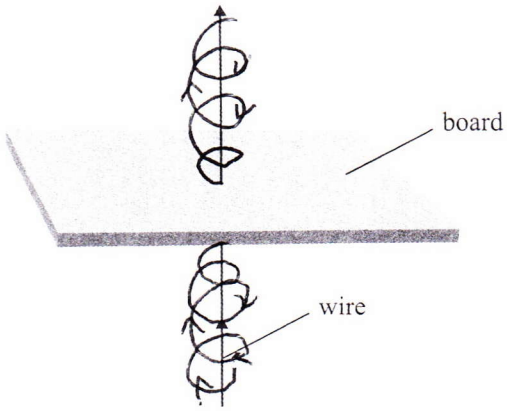
Explain in detail the process that causes the bell to sound repeatedly from the instant when the switch is closed.

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

Because the magnetic field of one coil pulls the bell towards it and the other repels it and one overpowers the other at different stages.

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.

place an opposite field close to this one and determine which way it moves are.

N

N1

Not Achieved exemplar for 90937 2014	Total Score	06

Q	Grade score	Annotation
1	3	a. An A answer. For M needs to identify friction as the cause of transfer of electrons. b. This is an A answer. For M the answer needs to identify the positive charge at the top of the ball comes from electrons repelled to the bottom of the ball. c. This is an N answer as it identifies the metallic balls correctly but does not identify metals are conductors as the important property in this question, this is needed for an A answer. d. This is an A answer as it identifies that electrons are transferred but it fails to identify where the electrons come from and the idea of neutralisation.
2	2	a. This answer is N as it fails to correctly calculate any physical quantity The power and resistance formulae have been confused. For an A answer the quantities need to be correctly identified and the formulae P=IV used to find the current. b. This is N answer. To become an A the correct symbol (a rectangle) needs to be used for resistors in the diagram. c. This is an N answer as there is insufficient evidence of understanding the factors affecting power. To obtain an A the answer needs to identify that resistors in series increase the total resistance
3	1	b. This is an N answer as there is no evidence of having correctly identified the appropriate quantities. An answer needs to first calculate the total voltage from P=IV c. This is an N answer. The answer fails to explain where the magnetic force comes from. An A answer would identify that the electric current causes the electromagnet to be magnetised, thus attracting the metal arm. d. This is an N answer. For A the answer needs to show the magnetic field as flat circles around the wire, not as a spiral.