1

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90937

909370

NEW ZEALAND QUALIFICATIONS AUTHORITY
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Level 1 Physics, 2016

90937 Demonstrate understanding of aspects of electricity and magnetism

2.00 p.m. Tuesday 15 November 2016
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 room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 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 09

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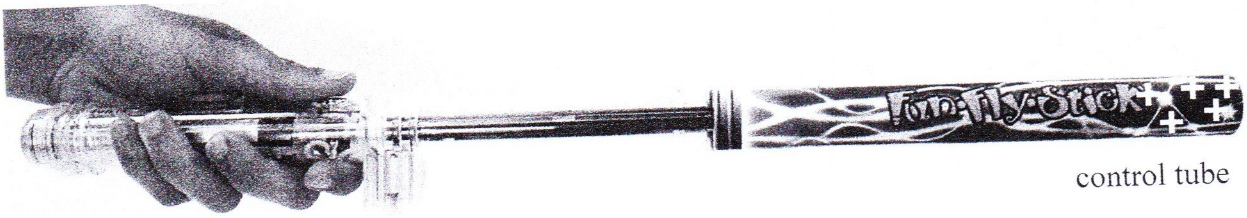
QUESTION ONE: STATIC ELECTRICITY WITH THE FUN-FLY-STICK

The Fun-Fly-Stick is a hand-held battery-operated toy that is similar to a Van de Graaff generator. It has a rubber belt inside, which when in motion, redistributes charge, which leads to the control tube becoming **positively charged**.

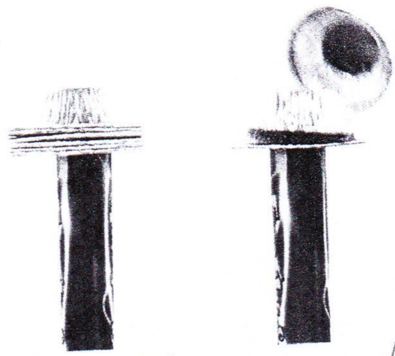


(a) Describe, in terms of movement of charge, the difference between a conductor and an insulator.

An insulator keeps charges in whereas a conducter lets the charge flow easily.

a

(b) Small aluminium cupcake pans are placed on top of the control tube. The control tube is then turned on, and the pans quickly move upward, away from the control tube.



Explain why the aluminium cupcake pans move away once the control tube is turned on.

Because same charges move away from each other, the two positively charged objects (control tube and cupcake pan) move away as they are both positively charged which pushes the two objects away from each other.

a

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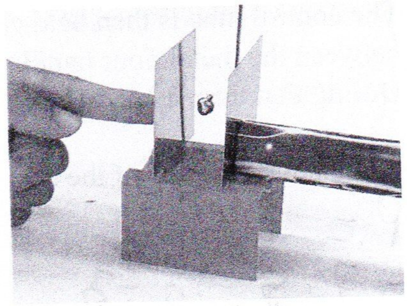
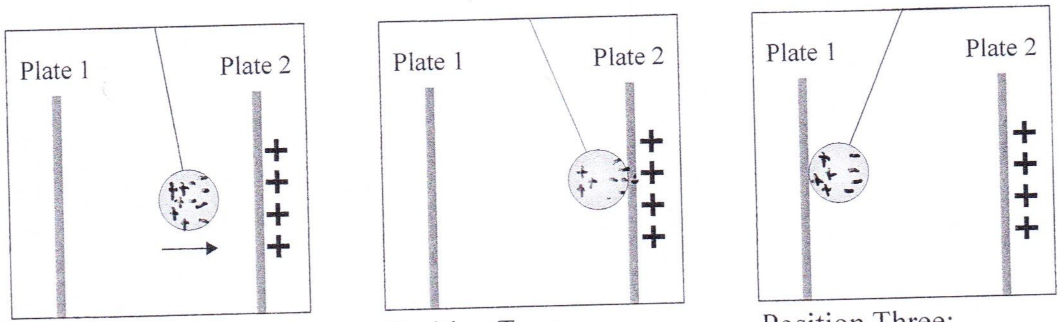
(c) A neutral metal bead is then suspended by a nylon string between two metal plates in a plastic holder. The Fun-Fly-Stick is held to touch the outside of one plate while a student's finger touches the other plate.

The control tube is turned on, and the metal bead is given an initial push towards the right plate. The metal bead then bounces repeatedly back and forth between both plates.



(i) Complete the following diagrams showing the charge distribution on the metal bead in the following three positions.

If you need to redraw this, use the diagrams on page 10.



Position One: Moving towards Plate 2

Position Two: Touching Plate 2

Position Three: Touching Plate 1

(ii) Explain why the metal bead bounces back and forth between both plates.

The opposite charges of the metal plates cause the beads to become charged. Because negative charges are attracted to positive charges the beads negative charges become attracted to the positively charged fun stick which makes the beads ~~cha~~ negative charges go to one side getting attracted to the Fun stick. The positive charges on the metal bead get attracted to the negative charges on the other metal plate causing the bead to go back and forth between ~~the~~ plates

n

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(d) The control tube is then held close to a metal door handle. A small electrical spark was seen between the metal door handle and the Fun-Fly-Stick. The spark lasted for a time of 0.002 s. During that time the total energy transferred by the spark was 1.5×10^{-5} J.

Calculate the power of the spark, and write your answer in milliwatts.

$P = E/t \quad P = 1.5 \times 10^{-5} / 0.002$

$= 7.5 \times 10^{-3}$

Power: 7.5 mW

m

A3

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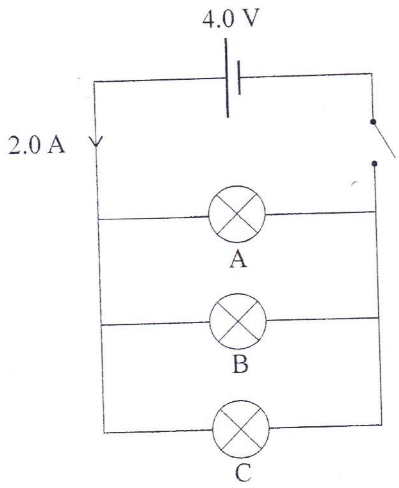
QUESTION TWO: CIRCUITS WITH A CHILDREN'S TOY

A children's toy contains three bulbs which each have an identical **resistance of 6.0 Ω**. The bulbs are connected to a 4.0 V cell, as shown in the diagram below.



(a) (i) State the name given to this arrangement of bulbs in a circuit.

parallel circuit

(ii) Give ONE advantage of connecting the bulbs together in this way.

If one bulb goes the ~~whole circuit will stay, unlike a pa series circuit~~ other bulbs will continue to work

a

(b) A **total** current of 2.0 A is drawn from the cell.

(i) Show, by **calculation or reasoning**, that the voltage across bulb B is 4.0 V.

$V = IR \qquad V = 2 \times 6 = 12 \div 3 = 4$

~~Thre~~ each bulb gets 4 volts

(ii) Calculate the power used by bulb B.

$P = IV = 2 \times 4 = 8$ watts

n

Power: 8 W

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(c) The same three bulbs are then re-wired so that the **total resistance of the circuit is 18 Ω.**

(i) Calculate the current in this new circuit.

$V = IR$ $R = I/V$

$R = 18$ $18/12 = 1.5A$

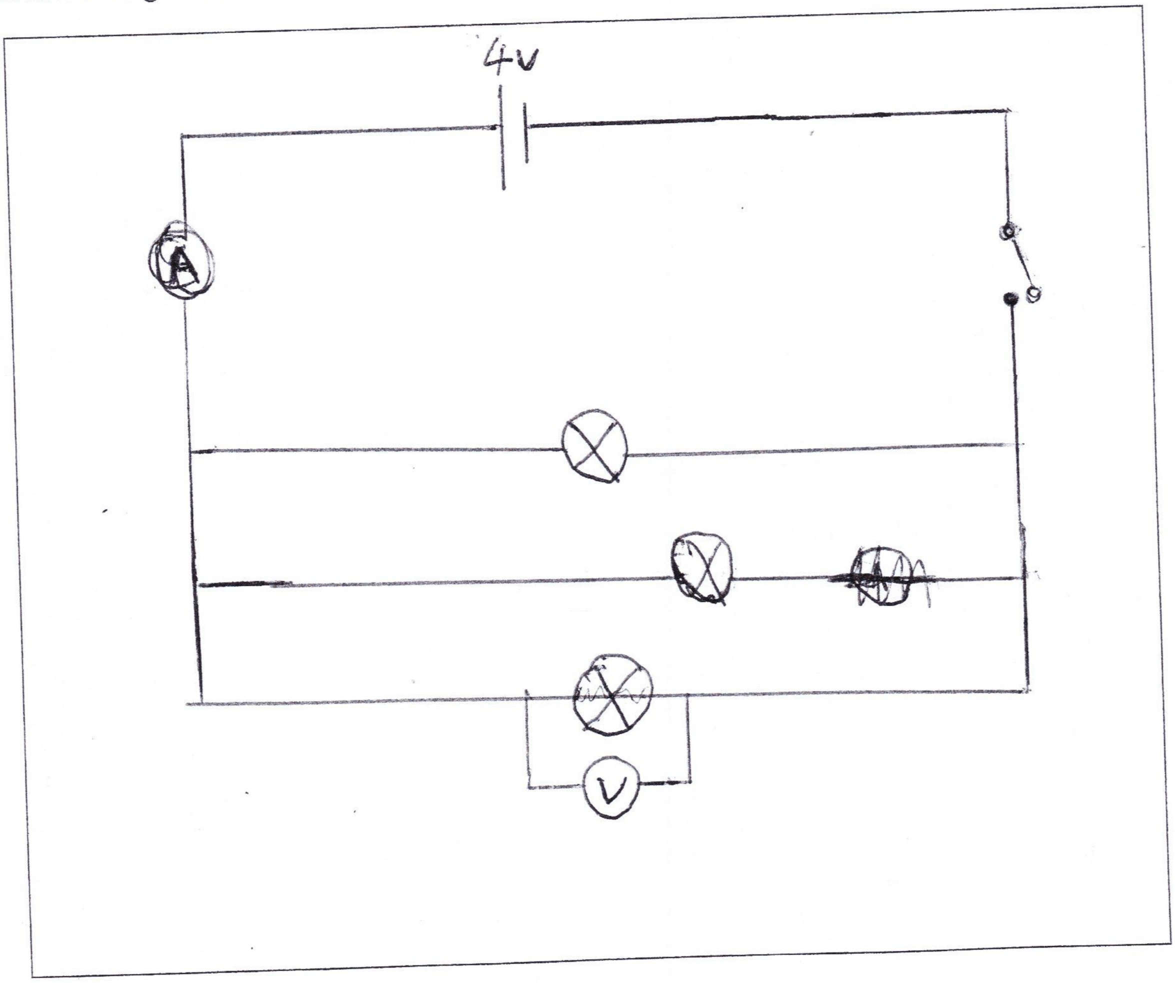
Current: 1.5 A

(ii) The new circuit includes:

- three bulbs
- one 4.0 V cell
- a switch
- an Ammeter for measuring the total current
- a Voltmeter for measuring the voltage across ONE bulb.

If you need to redraw this diagram, use the space on page 10.

Draw a diagram of the new circuit in the space below.



a

(d) Compare the power used by bulb B in this new circuit to the power used by bulb B in the previous circuit in part (b).

In your answer you should:

- calculate the new power used by bulb B
- state which circuit has the greater power used by bulb B
- explain the reasons why the power used has now changed.

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P = IV   1.9 × ~~4~~ = 6 ÷ 3 = 2 w

The greater power used by bulb B circuit is the first one as the second circuit has more resistance which decreases the power used by each bulb. The increased resistance in the circuit makes the amps put ~~out~~ decrease as there is more ~~[illegible]~~ ~~in the circuit power getting put to by pass the resistance.~~ resistance in the circuit, making it decrease the amount of power the light bulbs recieve.

m

A3

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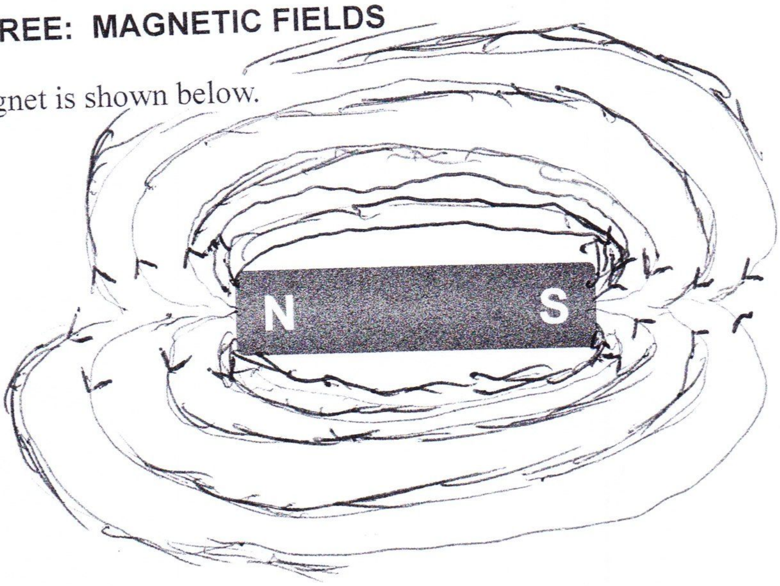
QUESTION THREE: MAGNETIC FIELDS

A simple bar magnet is shown below.



If you need to redraw this, use the diagram on page 11.

(a) On the diagram above, draw field lines to show the shape and direction of the magnetic field around the bar magnet.

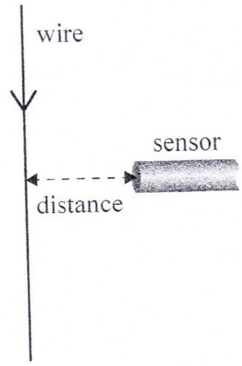
n

(b) Describe how the strength of the magnetic field changes around the bar magnet, and explain how the field lines in the diagram show this.

As the further away the lines are the weaker the magnets get, the feild lines show the magnet getting weaker as they are further apart the further away ~~from~~ the magnet it is

a

(c) A straight wire is connected to a circuit with a voltage supply of 30 V. The total resistance of the circuit is 2.0 Ω. A sensor measures a magnetic field strength of 3.2×10^{-5} T caused by the current through the wire.



Calculate the **distance** between the sensor and the wire.

Give your answer in cm.

$B = \frac{kI}{d}$ ~~$d = BKI$~~ ~~$3.2 \times 10^{-5} \times 2.0$~~

~~$d = 3.2 \times 10^{-5} \times 2.0 \times 10^{-7}$~~

$I = V/R = 30/2 = 15$

~~$d = 3.2 \times 10^{-5} \times 2 \times 10^{-7} \times 15$~~

$d = kI/B = \frac{2 \times 10^{-7} \times 15}{3.2 \times 10^{-5}} = 0.09375$

Distance: 0.09375 cm

m

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(d) A wire is wound around an iron nail and connected to a circuit to form an electromagnet. A student brings the electromagnet close to a permanent bar magnet and feels the two objects **repelling** away from each other.

If you need to redraw this, use the diagram on page 11.

(i) Draw the direction of the current through the coil of wire, and explain how you determined this direction.

The right hand grip rule was used to determine which way the current was going and where the poles were.

a

(ii) A small compass is then placed halfway between the electromagnet and the bar magnet. The electromagnet and the bar magnet have the same magnetic field strength.

Explain which direction the compass will point. Give reasons for your answer.

~~The compass will point towards the bar magnet as that is the closest north pole as the compass is attracted to the north, closest north pole~~ The compass will spin or not point to any magnet at all as the two magnets have the same strength and north poles next to each other.

A3

Achievement exemplar 2016

Subject:	Physics	Standard:	90937	Total score:	09

Q	Grade score	Annotation
1	A3	This answer was A3 as the answers show knowledge of conductors allowing flow of charge, the rules for forces of attraction and repulsion between charges and an ability to calculate power. To obtain a higher score the answer should refer to charging being the result of electron transfer.
2	A3	The answer recognises and a parallel circuit and gives an advantage of this type of circuit. While the incorrect circuit is drawn in part c(ii) the meters are drawn correctly connected. In part (d) the reduction in power is linked to reduced current (amps) due to an increase in resistance. To obtain a higher score in this question the student needs to show understanding of the rules for current and voltage in circuits and apply these in calculating power.
3	A3	The answers showed an understanding that the spacing of field lines represents the magnetic field strength and that the right-hand grip rule can be used to find the direction of the current. The answer to part (c) is correct despite not correctly changing units as unit conversion was demonstrated in question 1 (d). The obtain a higher score the student should take care in drawing the magnetic field, using clear solid lines that do not join or cross over each other and explain how they know which end of the electromagnet is north.