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90937

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NZQA

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SUPERVISOR'S USE ONLY

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.

Merit

TOTAL 15

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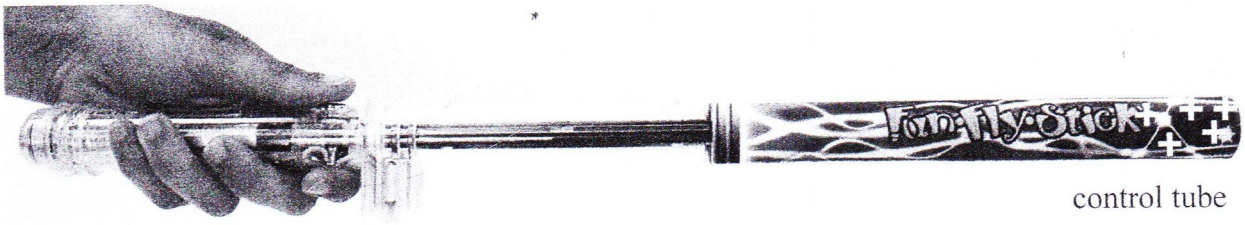
QUESTION ONE: STATIC ELECTRICITY WITH THE FUN-FLY-STICK

ASSESSOR'S USE ONLY

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**.



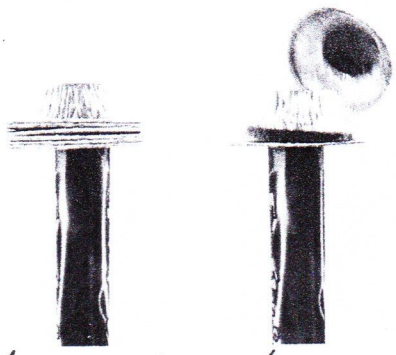
control tube

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

a conductor allows the movement of charge in the material, whilst an insulator doesn't allow charge to move.

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.



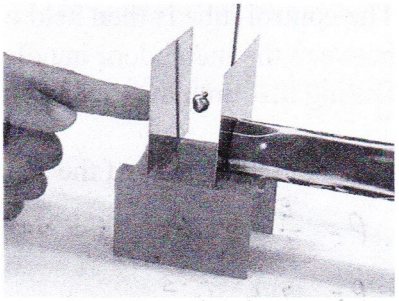
Explain why the aluminium cupcake pans move away once the control tube is turned on.

when the control tube is turned on, the control tube becomes positively charged, this causes the ~~neutrons~~ electrons in the aluminium pans to be attracted to the positive charge in the control tube, this, then causes the pans to become positively charged, also because like charges repel, this makes the cupcake pans move away.

a

ASSESSOR'S USE ONLY

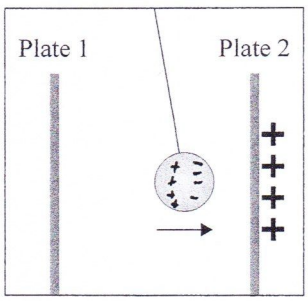
(c) A neutral metal bead is then suspended by a nylon string between two metal plates in a plastic holder. The Fun-Fly-Stick is held to touch the outside of one plate while a student's finger touches the other plate.



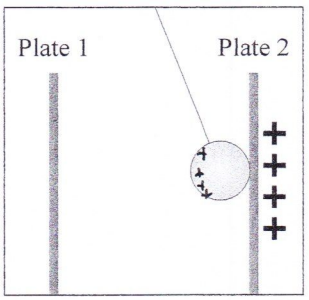
The control tube is turned on, and the metal bead is given an initial push towards the right plate. The metal bead then bounces repeatedly back and forth between both plates.

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

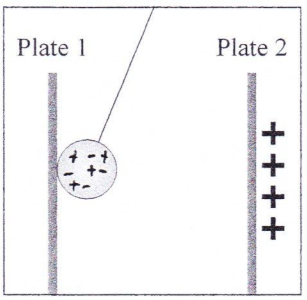
If you need to redraw this, use the diagrams on page 10.



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.

when the metal bead makes inital contact with positively charged plate 2, its electrons are attracted to the positive charge, and are transferred to the plate, this then leaves the bead with a positive charge, so it is repelled away from plate 2 and makes contact with plate 1, when the bead makes contact with plate one, ~~it~~ is it equilizes itself due to being grounded through the student, this ~~induces a positive charg~~ then the ball is no longer ~~attracted to the p~~ repelled by plate 2 so bounces off and starts the cycle again.

m

(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.

$P = \frac{E}{t}$ $P = 1.5 \times 10^{-5} \div 0.002$

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

$P = 7.5$ mW

Power: 7.5 mW

ASSESSOR'S USE ONLY

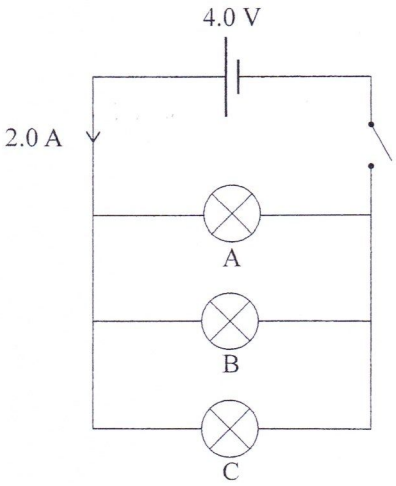
m

M5

QUESTION TWO: CIRCUITS WITH A CHILDREN'S TOY

ASSESSOR'S USE ONLY

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

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

when a single bulb fails, the rest of them 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.

$V = IR$ $V = (2.0 \div 3) \times 6$

$V = 4V$

(ii) Calculate the power used by bulb B.

$P = IV$

$P = (2.0 \div 3) \times 4$

$P = 2.67\ W$

m

Power: 2.67 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.

$V = IR \quad R = V/I \quad I = V/R \quad I = 4/18 \quad I = 0.22\,A$

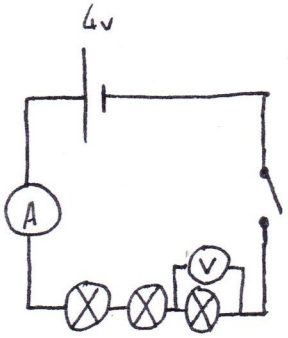
Current: 0.22 A

(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.



(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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New power = IV

np = 0.22 × 4 np = 0.88 w

old power = 2.67w

therefore the old circuit has the greater power

the power has changed due to a decrease in current, the decrease in current is due to the bulbs now being in series. and

eg

I = V/R I = 4/18 I = 0.22

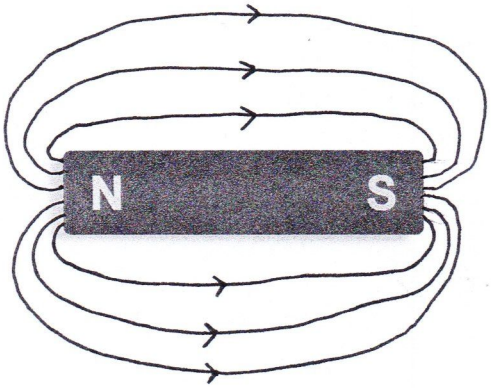
a

M5

QUESTION THREE: MAGNETIC FIELDS

ASSESSOR'S USE ONLY

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.

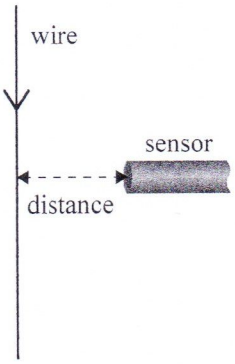
a

(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.

the strength of the magnetic field changes due to the distance from the poles, the field is stronger closer to the poles, the diagram shows this because the field lines emitate from the poles

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.

$B = kI/d$ $d = kI/B$ $d = (2 \times 10^{-7}) \times (30/2) \div 3.2 \times 10^{-5}$

$d = 0.093750$ m

m

Distance: 9.375 cm

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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.

because ~~like poles~~ the north poles repel and the ~~are~~ for the north pole to be where it is the current has to travel in the way shown due to the right hand grip rule.

(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.

It will point directly up/down in the middle of the ~~two~~ magnetic fields, this is because both magnets are attracting the south side of the compass and repelling the north side of the compass.

m

M5

Merit exemplar 2016

Subject:	Physics	Standard:	90937	Total score:	15

Q	Grade score	Annotation
1	M5	These answers earned a score of M5 as they have explained the charging and repulsion of the bead in terms of electron transfer and correctly calculated a power and converted to given units. To obtain a higher score the student needs to clearly indicate that electrons are transferred, not just attracted, in part (b). In part (c) the neutralization of the bead through grounding involves electrons being transferred to the bead.
2	M5	The correct calculation of the power, using the idea that the current splits in a parallel circuit and correctly identifying that the circuit in part (c) is a series a circuit and drawing a correct circuit diagram earned these answers M5. To obtain a higher score the answer in part (d) needs to show an understanding that the voltage splits in a series a circuit and the power reduces as a result, or that the decrease in current is due to the increased resistance in the series circuit.
3	M5	This answer was worth a score of M5 as the distance calculation in part (c) was correct and there was a good explanation of the current direction due to like poles repelling and the right-hand grip rule. To obtain a higher score the answer needed to indicate how the spacing of the lines represents the field strength in part (b) or clearly indicated that the forces of attraction or repulsion are equal and opposite in part (d)(ii)