

# 1

90937



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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.**

**TOTAL**

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

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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.

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- (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.




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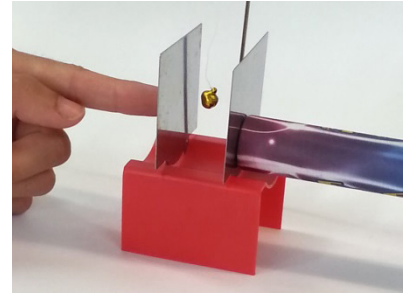


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- (c) A neutral metal bead is then suspended by a nylon string between two metal plates in a plastic holder. The Fun-Fly-Stick is held to touch the outside of one plate while a student's finger touches the other plate.

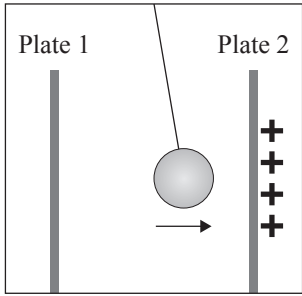


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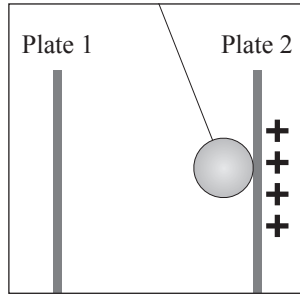
The control tube is turned on, and the metal bead is given an initial push towards the right plate. The metal bead then bounces repeatedly back and forth between both plates.

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

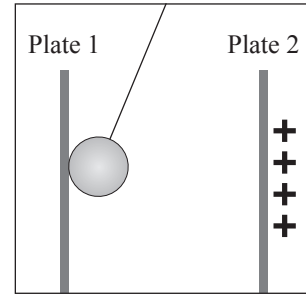
*If you need to redraw this, use the diagrams on page 10.*



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.

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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  $1.5 \times 10^{-5}$  J.

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

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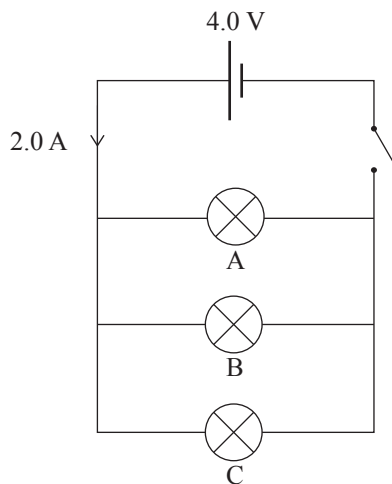
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Power: \_\_\_\_\_ mW

## QUESTION TWO: CIRCUITS WITH A CHILDREN'S TOY

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



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

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

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- (b) A **total** current of  $2.0 \text{ A}$  is drawn from the cell.

- (i) Show, by **calculation or reasoning**, that the voltage across bulb B is  $4.0 \text{ V}$ .

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- (ii) Calculate the power used by bulb B.

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Power: \_\_\_\_\_ W

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

(i) Calculate the current in this new circuit.

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Current: \_\_\_\_\_ 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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### 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.
- (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.

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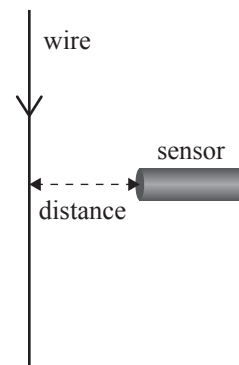


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- (c) A straight wire is connected to a circuit with a voltage supply of 30 V. The total resistance of the circuit is  $2.0 \Omega$ . A sensor measures a magnetic field strength of  $3.2 \times 10^{-5} \text{ T}$  caused by the current through the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

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

Give your answer in cm.




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Distance: \_\_\_\_\_ cm



- (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.

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- (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.

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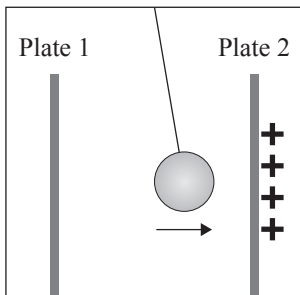
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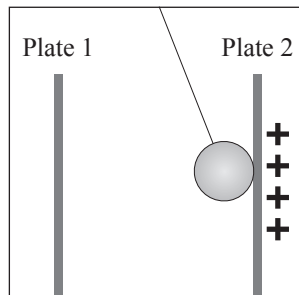
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**SPARE DIAGRAMS**

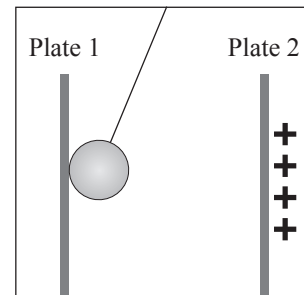
If you need to redraw your diagrams from Question One (c)(i), draw them below. Make sure it is clear which answer you want marked.



Position One:  
Moving towards Plate 2

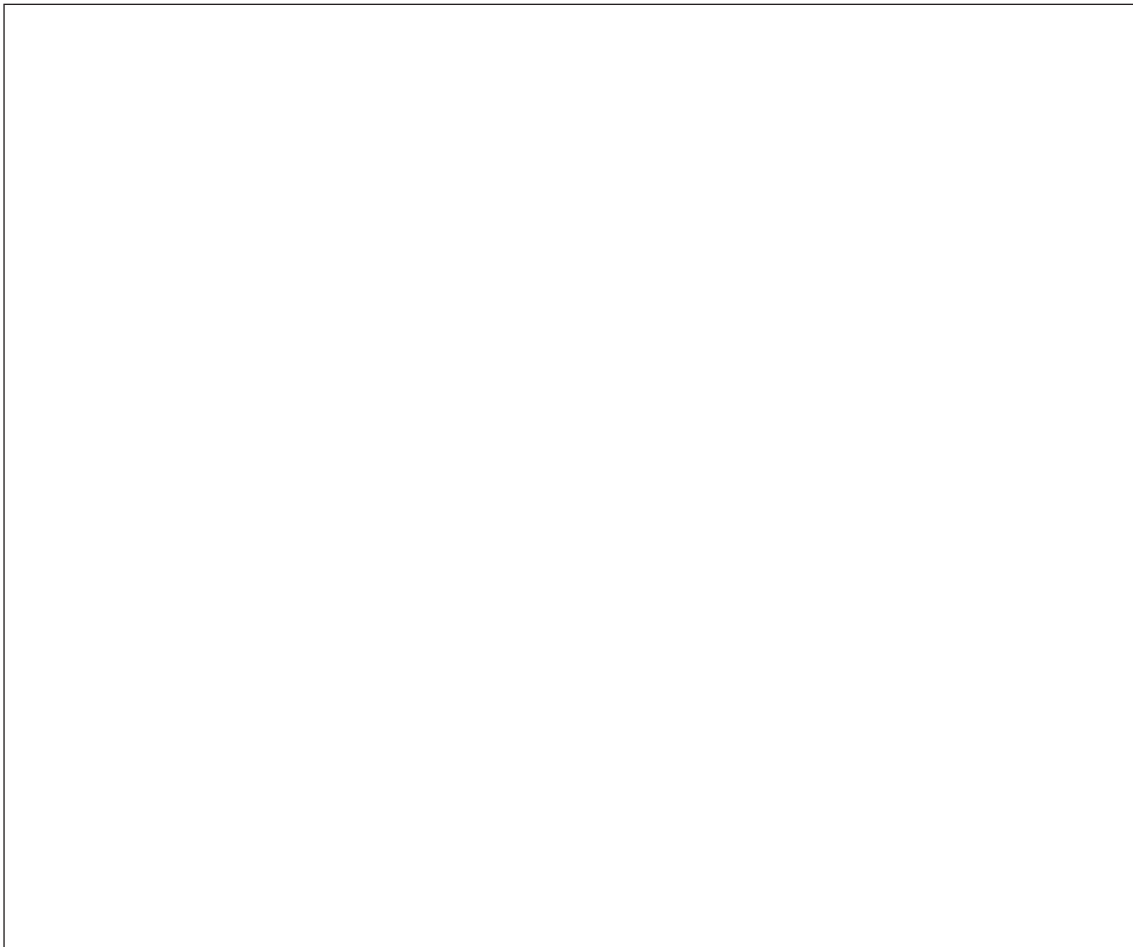


Position Two:  
Touching Plate 2



Position Three:  
Touching Plate 1

If you need to redraw your circuit diagram from Question Two (c)(ii), draw it below. Make sure it is clear which answer you want marked.



If you need to redraw your diagram from Question Three (a), draw it below. Make sure it is clear which answer you want marked.



If you need to redraw your diagram from Question Three (d)(i), draw it below. Make sure it is clear which answer you want marked.



**Extra paper if required.  
Write the question number(s) if applicable.**

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