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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Physics, 2012

90937 Demonstrate understanding of aspects of electricity and magnetism

2.00 pm Monday 26 November 2012
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 2–10 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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You are advised to spend 60 minutes answering the questions in this booklet.

QUESTION ONE: ELECTROSTATIC DUSTERS

A cleaner uses an electrostatic duster to clean an office. The electrostatic duster is designed to pick up dust particles easily from surfaces. The duster has fine nylon fibres attached to a stem, which is made of a non-conducting material, as shown in the diagram below.

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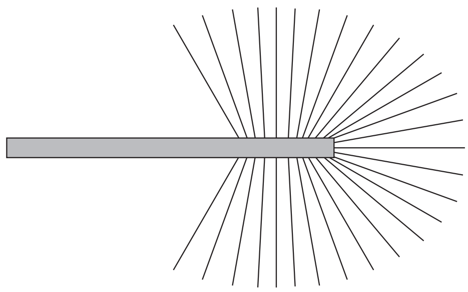
www.atlasgraham.com/img/prod/4f2ad5472512e.jpg

(a) While dusting a table, the fibres on the duster become positively charged.

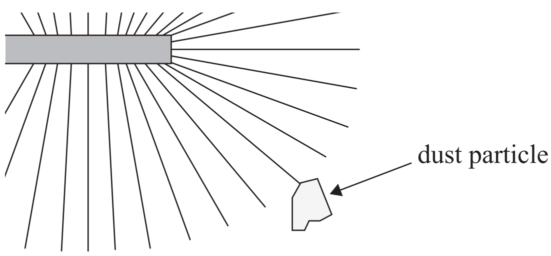
Describe what causes the fibres to become charged.

(b) When the cleaner lifts the duster off the table surface he notices that the nylon fibres on the duster point away from each other, as shown in the diagram on the right.



Explain why the nylon fibres on the duster point away from each other.

(c) When the charged duster is brought close to a dusty surface, the dust particles jump up and stick to the nylon fibres on the duster. The diagram below shows a dust particle attached to a fibre.



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Explain why the dust particle jumps up towards the nylon fibres on the duster and sticks to it.

You may draw the charge distribution on the previous diagram to illustrate your answer.

(d) The cleaner is wearing synthetic clothing. As he moves around, his body becomes positively charged. When the cleaner is just about to touch a metal door knob, he sees a spark between his finger, and the metal door handle.

(i) Describe what a spark is.

(ii) Explain how his body becomes electrically neutral when he touches the door knob.

(iii) The voltage between his body and the metal door knob is 9000 V. When the cleaner is just about to touch the metal door knob, an average current of 2.5×10^{-7} A flows between his finger and the door knob for 0.0015 s.

Calculate the energy transferred by the spark.

Energy

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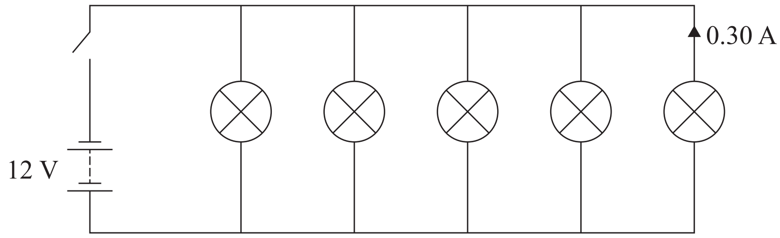
QUESTION TWO: THE MECHANIC'S LIGHT

A car mechanic uses a rechargeable torch, which contains five identical 12 V light bulbs. The bulbs are connected to a 12-volt battery, as shown in the diagram below.



(a) (i) State the name that describes the arrangement of bulbs in the circuit shown above.

(ii) Explain why bulbs connected in this way will be bright.

(b) The current through each bulb is 0.30 A.

By calculating the current through the battery, calculate the **total resistance** of the circuit.

Resistance

(c) (i) The voltage across each bulb is 12 V and the current through each is 0.30 A.

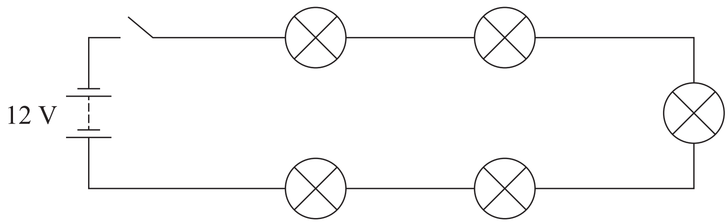
Calculate the total power output of the torch.

Power output

(ii) One of the light bulbs in the torch 'blows' and stops working.

Explain what effect this would have on the total brightness of the torch.

(d) Explain how the brightness of the bulbs would change if the bulbs were connected to the battery, as shown below.



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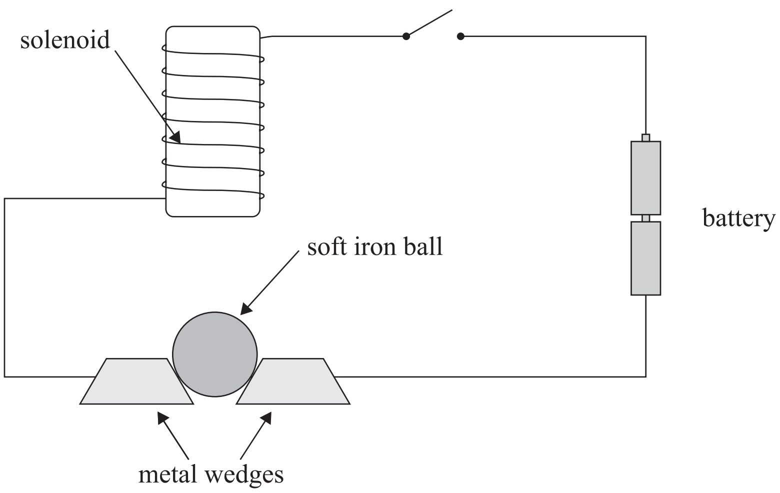
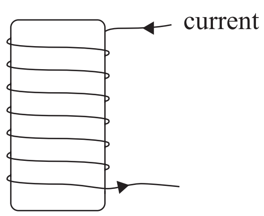
QUESTION THREE: THE BOUNCING TOY

The diagram below shows the design of a bouncing ball toy. The soft iron ball rests between two fixed-metal wedges and is free to move up and down. The metal wedges, the solenoid and the switch are connected in series to a battery.



(a) The diagram below shows the direction of the current through the solenoid when the switch is turned on.

(i) On the diagram below, use letters N and S to mark the north and the south poles of the solenoid.



(ii) Describe the rule you have used to identify the north and the south poles of the solenoid.

(b) Describe and explain what the ball does when the switch is turned on.

(c) The soft iron ball is replaced with a similar-sized aluminium ball.

Explain what the ball does now when the switch is turned on.

(d) Now the number of turns on the solenoid is doubled. The length of the solenoid is unchanged, and the same current passes through the coil.

State how this affects the strength of magnetic field.

Explain your answer.

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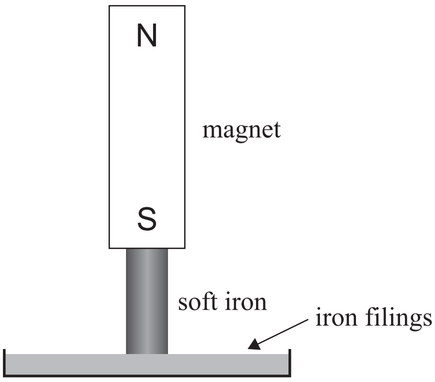
QUESTION FOUR: MAGNETIC FIELDS

The diagram below shows two identical magnets with their north poles placed close together.

(a) On the above diagram, draw lines to show the **shape** and **direction** of the magnetic field between the magnets.

(b) On the same diagram, use the letter 'X' to indicate the position where the magnetic field strength is zero, and explain why such a point exists.

(c) A piece of soft iron is attached to a permanent magnet, and then dipped into a dish of iron filings, as shown in the diagram below.



(i) On the diagram use letters 'N' and 'S' to label the poles of the ends of the piece of the soft iron.

(ii) The soft iron and the magnet are then moved away from the dish of iron filings.

Explain what happens to the iron filings on the piece of soft iron when the magnet is removed from it.

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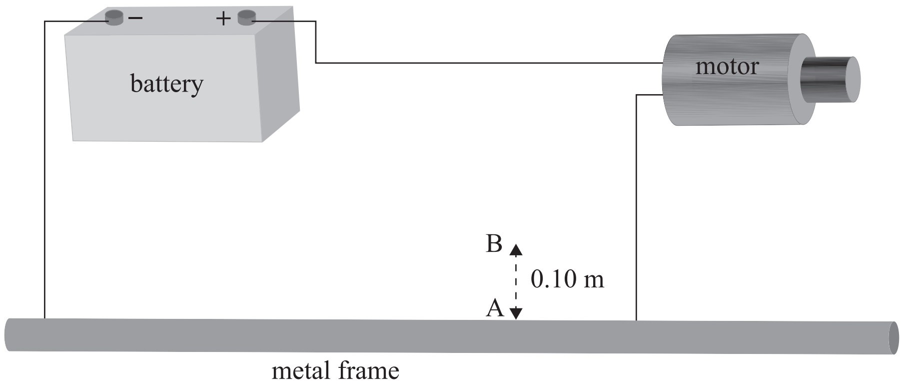
(d) A starter motor in a car is connected to a 12 V battery as shown below. The total resistance of the circuit is 0.15 Ω.

$k = 2.0 \times 10^{-7}$ T m A^{-1}.

The diagram below shows the wiring of the starter motor to the battery.



(i) On the above diagram, draw the magnetic field pattern formed around the metal frame at point A, when the starter motor is switched on.

Draw arrows to indicate the direction of the magnetic field.

(ii) Calculate the strength of the magnetic field at a point B, 0.10 m from point A, when the starter motor is switched on.

Give an appropriate unit with your answer.

Magnetic field strength ______________ unit ______________

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

QUESTION NUMBER

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