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NEW ZEALAND QUALIFICATIONS AUTHORITY
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Level 1 Physics 2020

90937 Demonstrate understanding of aspects of electricity and magnetism

9.30 a.m. Thursday 3 December 2020
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.

Useful information for calculation questions is available on the Resource Sheet.

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: ELECTROSCOPES

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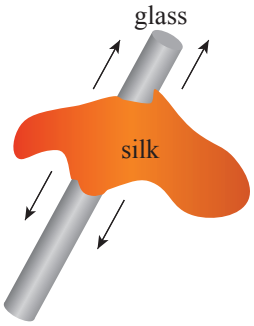

(a) When a glass rod is rubbed with silk, the glass will become positively charged.

What is the name of this process?

(b) A spark can be generated between two surfaces if there is a sufficient buildup of charge on one surface.

Calculate the power of the spark if the energy transferred was 12.5 millijoules (12.5×10^{-3} J) and the spark lasted for 1.5 milliseconds (1.5×10^{-3} s).

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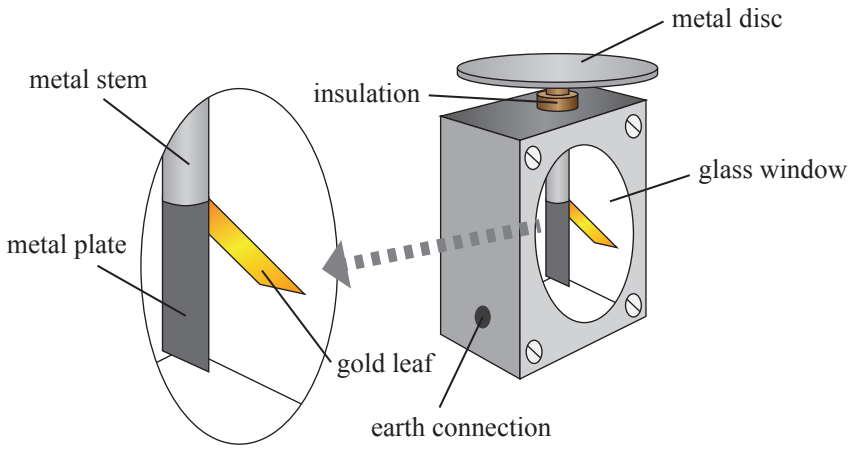
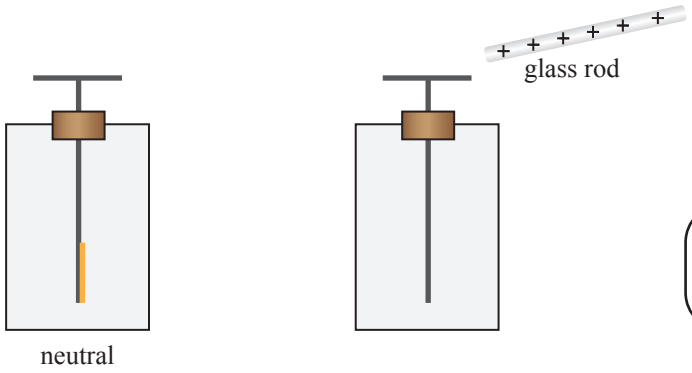
(c) An electroscope is a scientific instrument used to detect the presence of an electric charge. The electroscope shows a charge by the separation of the gold leaf at the bottom of the device. When a charged glass rod is brought close to the metal disc, the leaf moves away from the metal plate.



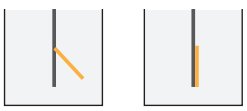
Explain the movement of charge that makes the leaf move away from the metal plate.

Start by drawing, on the diagrams below, the charges on a neutral electroscope (below left) and then, when a positive glass rod is near (below right), show the position * of the gold leaf and the charges on the electroscope.



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

* Options for leaf position:



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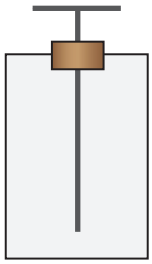
(d) A negatively charged electroscope can be grounded. This can occur when a person touches the metal disk, causing the leaf to fall against the stem.

Using the diagrams below, explain why the leaf falls against the stem.

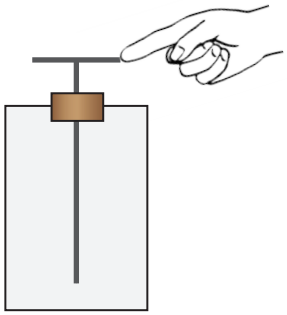
In your answer:

- draw the charge distribution on each electroscope diagram below
- draw the relative position of the leaf in each diagram to show the movement of charge *
- explain the movement of the leaf due to charge distribution.

Negatively charged electroscope

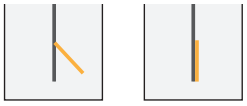


grounding / earthing



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

* Options for leaf position:



QUESTION TWO: PLAY-DOH CIRCUITS

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Harrison learned in school that Play-Doh is a conductor.

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

(b) Harrison wants to create a **series** circuit.

In the space below, draw a **series** circuit with the following components:

- 9 V battery
- open switch
- 2 identical light bulbs
- voltmeter wired to measure the battery voltage
- ammeter.

If you need to redraw your circuit, use the box on page 11.

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(c) (i) Harrison is interested in how much energy a light bulb uses in the series circuit from (b).

Calculate the energy used by ONE light bulb in ONE hour, if the overall resistance of the circuit is 150 Ω.

Start by calculating the total current in the circuit.

(ii) An average 9 V battery can supply 500 mA (500×10^{-3} A) for one hour before becoming "flat".

How many hours could Harrison leave the light bulbs on before his 9 V battery becomes "flat"?

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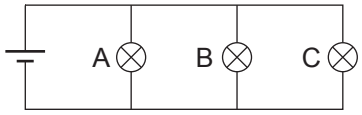
(d) Harrison creates a **parallel circuit.** It has three light bulbs, A, B, and C, as shown in the diagram below.



Bulbs A and B have the same resistance, while bulb C has half the resistance.

What would Harrison notice about the brightness of the light bulb C compared to A and B? Explain why.

QUESTION THREE: ELECTROMAGNETISM

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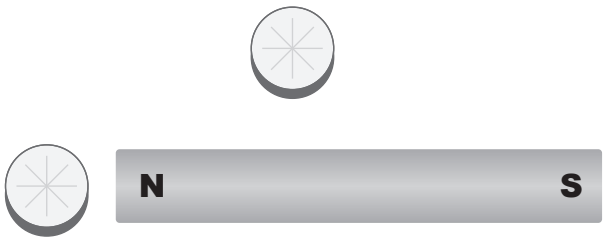
(a) Bringing a compass close to a magnet will move the needle of the compass in the direction of the magnetic field.

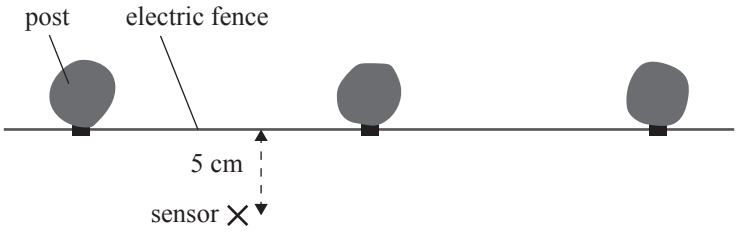
Draw the direction of the plotting compasses with arrows to represent the needle of the compass while in the positions shown below.



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

(b) Electric fences are used extensively around New Zealand to keep livestock in their paddocks. An electric fence sends pulses of current through the wire. The wire is attached to the post using a plastic clip, as shown.

When the current flows through a wire, it creates a magnetic field. When a sensor was placed 5 cm from the wire, it was found to have a magnetic field strength of 80 nanotesla (8.0×10^{-8} T).



(i) Calculate the current in the wire.

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(ii) A typical electric fence has a current of 30 mA (30×10^{-3} A).

Explain whether you would need to increase, decrease, or keep the same voltage so the current is that of a typical electric fence.

(c) Explain why the clip that attaches the wire to the post is made from plastic, and what might happen if the wire was attached directly onto the wooden fence post.

Question three continues on the following page.

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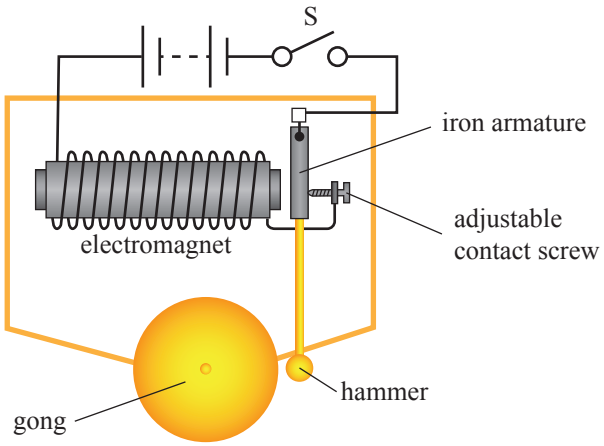
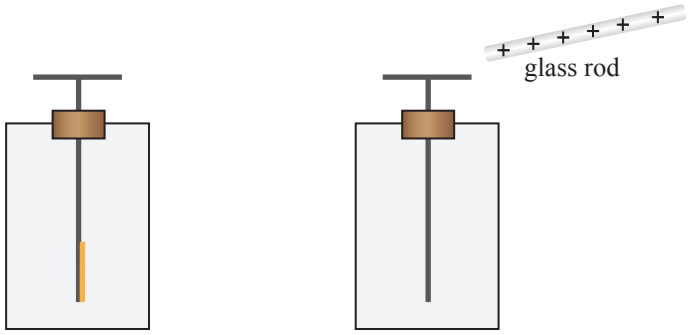
(d) The schematic diagram below shows the circuit of an electric bell. The electric bell makes a repetitive sound by the hammer continually hitting the gong.

Explain the process that causes the hammer to continually hit the gong when the switch is closed.



SPARE DIAGRAMS

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



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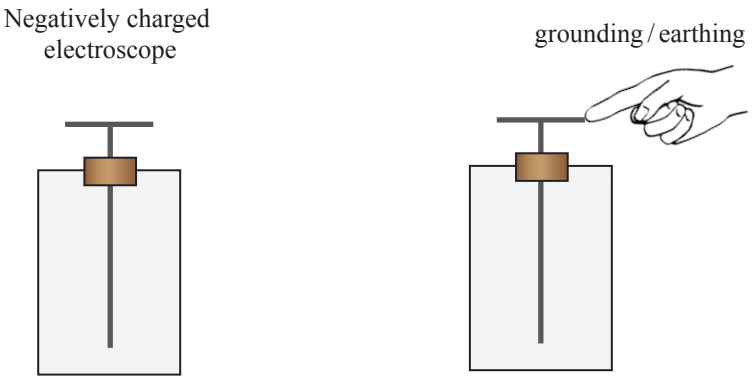
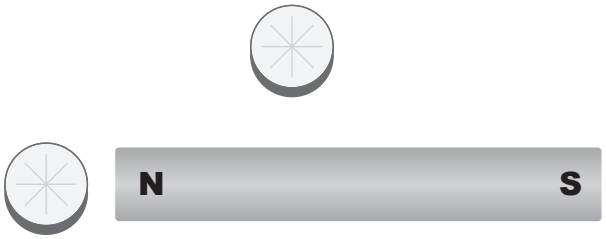
If you need to redraw your diagram from Question One (d), draw it below. Make sure it is clear which answer you want marked.



If you need to redraw your diagram from Question Two (b), 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.



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

QUESTION NUMBER

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