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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Physics 2023

91173 Demonstrate understanding of electricity and electromagnetism

Credits: Six

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of electricity and electromagnetism.	Demonstrate in-depth understanding of electricity and electromagnetism.	Demonstrate comprehensive understanding of electricity and electromagnetism.

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 L2–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.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

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QUESTION ONE: PARALLEL PLATES

A set of parallel plates 0.05 m apart are connected to 12 V.

(a) Show that the value of the electric field strength between the plates is 240, and state its unit.

Unit: _____

(b) On the diagram above, draw the electric field lines to represent the field between the plates.

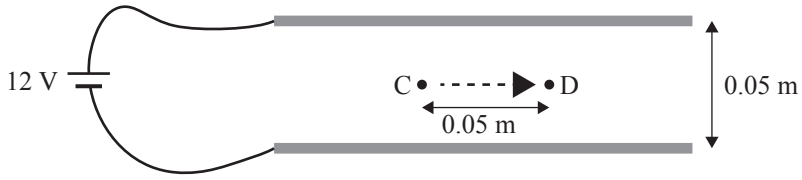
If you need to redraw your response, use the diagram on page 8.

(c) Use physics principles to explain how the electric force on an electron would vary as it moved from the negative plate to the positive plate.

(d) An electron is moved from point A to point B, as shown below.

(i) Calculate the change in electric potential energy as the electron moves from point A to point B on the diagram opposite below.

The electron is now moved 0.05 m from point C to point D.

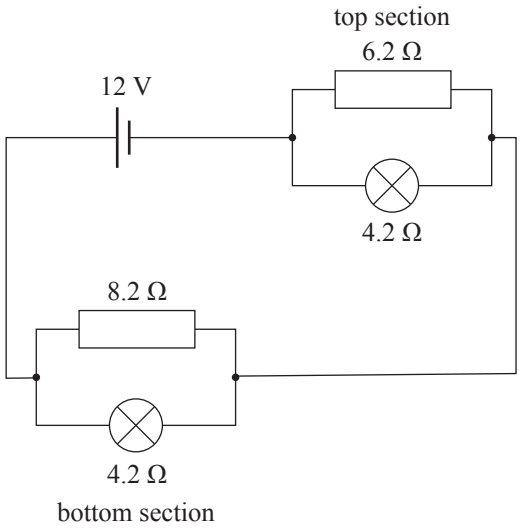


(ii) What is the change in electrical potential energy as the electron moved from point C to point D?

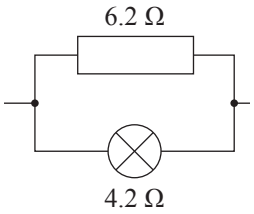
(iii) Use physics principles to explain any difference in the change in electrical potential energies found in parts (i) and (ii).

QUESTION TWO: CIRCUITS

A simplified version of the circuit in a camping oven is shown below. The oven consists of two sections.



(a) The top section has an element with 6.2 Ω resistance and a lamp with 4.2 Ω resistance.



Show that the total resistance of the top section is 2.5 Ω.

(b) Calculate the current flowing from the power supply to the oven when both sections are working.

(c) While both sections are working correctly, the lamp in the bottom section develops a fault and its resistance decreases.

Use physics principles to explain what happens to the brightness of the other lamp.

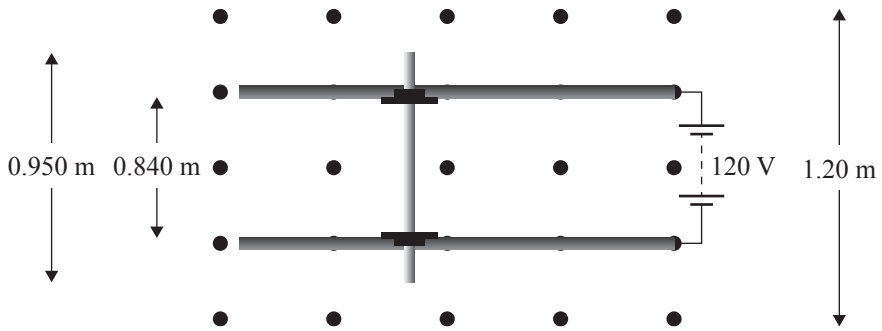
(d) The lamp in the bottom section now stops working.

Calculate the amount of energy converted to heat in two minutes by the 8.2 Ω resistor.

QUESTION THREE: ELECTROMAGNETISM

The diagram below shows a metal axle that is free to roll on two parallel metal rails. The rails and the axle are in a magnetic field. The ends of the rails are connected to a 120 V power supply.

Strength of magnetic field	$= 8.10 \times 10^{-3}$ T
Length of axle	= 0.950 m
Distance between parallel metal rails	= 0.840 m
Width of magnetic field	= 1.20 m
Total effective resistance	= 42.1 Ω
Voltage of power supply	= 120 V



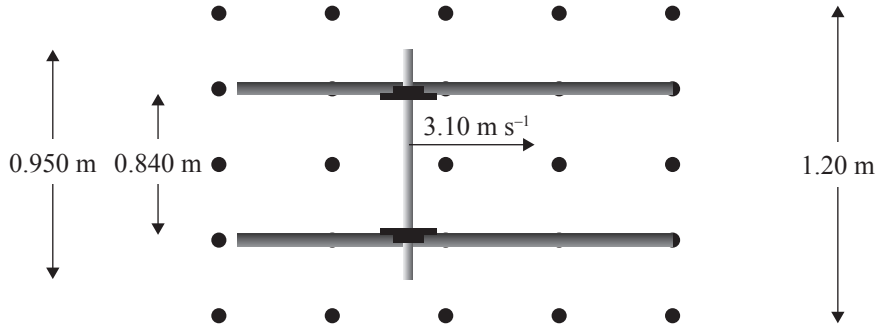
Source: https://upload.wikimedia.org/wikipedia/commons/7/76/Rollingstock_axle.jpg

(a) Draw an arrow on the diagram above to show the direction of the electromagnetic force that acts on the axle when the power supply is switched on.

If you think the direction of the force is out of the page, into the page, or there is no force, state this clearly.

(b) Calculate the strength of the magnetic force on the axle when the power supply is turned on.

(c) The power supply is removed, and the metal axle is given a push so that it is moving to the right at 3.10 m s^{-1}, as shown in the diagram.

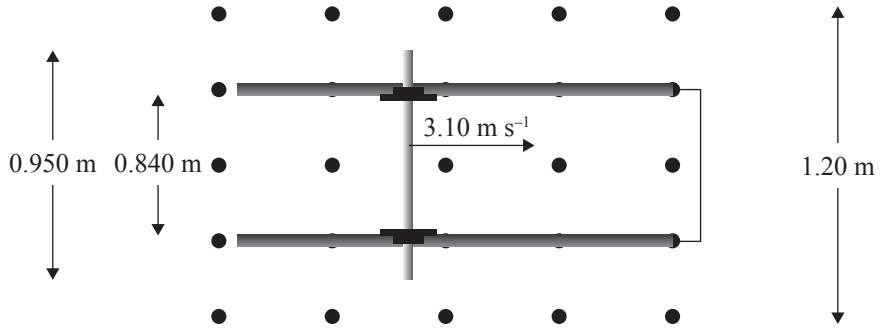


(i) Clearly mark the negative end of the axle on the diagram above.

(ii) Calculate the voltage induced in the axle immediately after it is set moving.

Question Three continues on the next page.

(d) With the power supply still disconnected, a wire is connected between the rails, and the axle is given a push so that it is moving to the right at 3.10 m s^{-1}.



Describe the motion of the axle after it is set moving.

Justify your answer using electromagnetism physics principles.

SPARE DIAGRAMS

If you need to redraw your response to Question One (b), use the diagram below. Make sure it is clear which answer you want marked.

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

QUESTION NUMBER

Extra space if required.
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QUESTION NUMBER

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