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QUALIFY FOR THE FUTURE WORLD
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Level 2 Physics 2021

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 2–11 in the correct order and that none of these pages is blank.

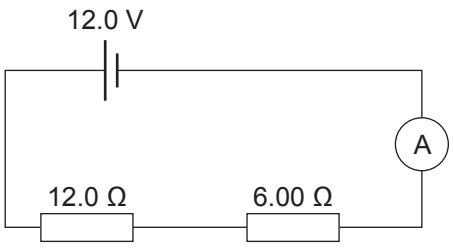
Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

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

QUESTION ONE: CIRCUITS

Bob is investigating circuits in the laboratory and starts with the circuit shown below.

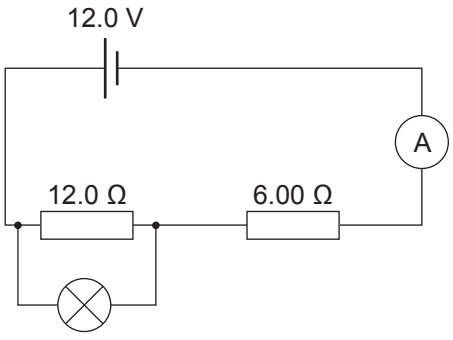
The voltage across the 12.0 Ω resistor is 8.00 V.



(a) Calculate the current in the circuit.

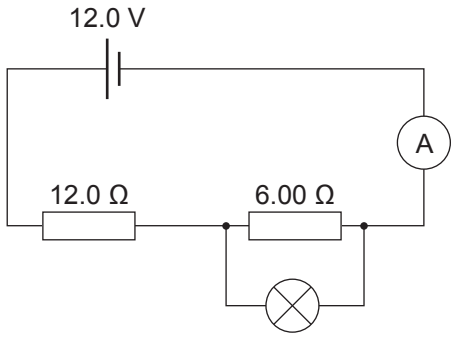
(b) Calculate the amount of energy converted to heat in one hour in the 6.00 Ω resistor.

(c) Bob has a lamp that operates normally only when connected to 8.00 V. He connects it in parallel with the 12.0 Ω resistor.



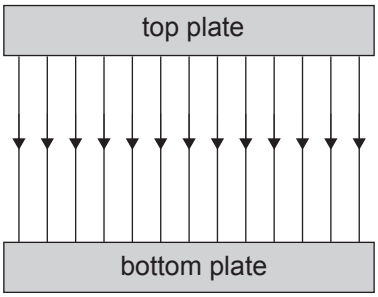
Without further calculation, explain why Bob's lamp will not operate normally when connected this way.

(d) Bob finds another lamp that has resistance of 4.57 Ω. He connects this lamp in the original circuit in parallel with the 6.00 Ω resistor.



Calculate the voltage across this lamp.

QUESTION TWO: ELECTRIC FIELDS



The electric field lines between two parallel plates are shown above.

If you need to redraw your response, use the diagram on page 9.

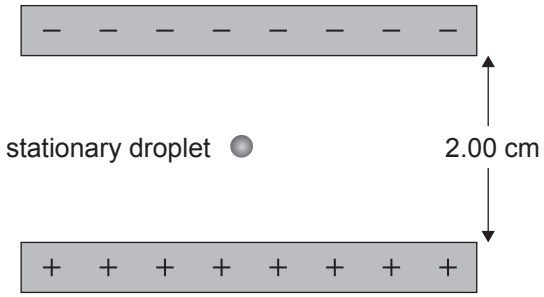
(a) Clearly label the positive plate on the above diagram.

(b) Describe the field between the plates and explain how the diagram shows this.

(c) An experiment is carried out on the surface of the Earth ($g = 9.8$ m s^{-2}) where a charged droplet of mass 5.87×10^{-10} kg is held stationary between a **different** set of parallel plates.

The voltage across the plates is 240 V.

The distance between the plates is 2.00 cm.



(i) Add labelled arrows to show the TWO forces acting on the stationary droplet.

If you need to redraw your response, use the diagram on page 9.

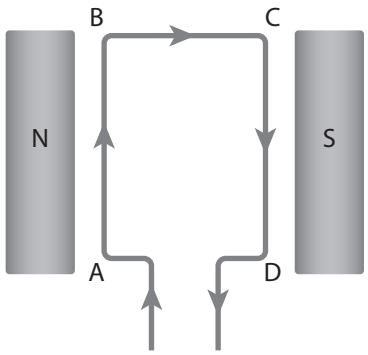
(ii) Calculate the number of elementary charges on the stationary droplet.

You should start by calculating the weight of the droplet by using $F_w = mg$.

Elementary charge: $+1.61 \times 10^{-19}$ C

QUESTION THREE: MOTORS AND GENERATORS

The diagram below shows a simple electric motor. The direction of the conventional current through the wire is shown by the arrows.



Length AB = 5.0 cm

Length BC = 2.0 cm

Length CD = 5.0 cm

Magnetic field strength between magnets = 4.7×10^{-3} T

Current in wire = 2.3 A

(a) Calculate the value of the force on side AB.

(b) For each part of the wire, state the direction of the force as either:

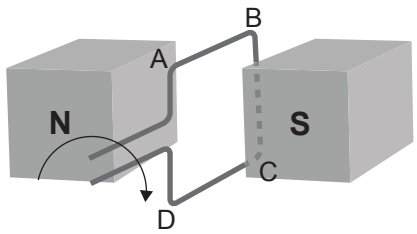
left (←), **right** (→), **up** (↑), **down** (↓), **out of the page**, **into the page**, **no force**.

Direction of force on AB: _____

Direction of force on BC: _____

Direction of force on CD: _____

(c) The diagram below shows a simple generator. The coil contains **60 turns** of wire and is rotated clockwise.



Length AB = 5.0 cm

Length BC = 2.0 cm

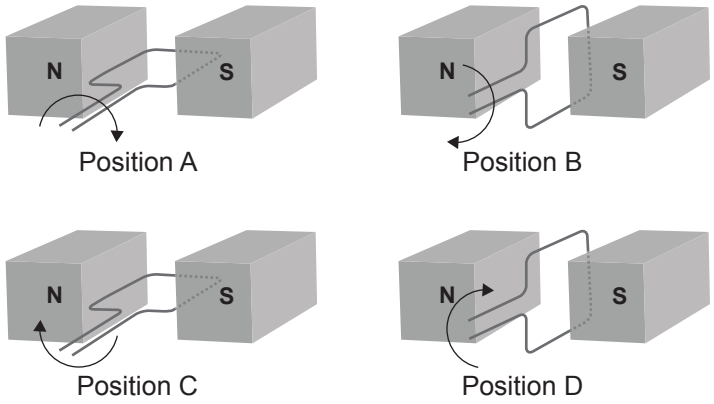
Length CD = 5.0 cm

Magnetic field strength = 4.7×10^{-3} T

Calculate the value of the induced voltage in the coil when the wire AB is cutting the field at 6.2 m s^{-1}.

Question Three continues on the next page.

(d) The diagrams below show the coil in the generator being rotated clockwise.



(i) In which position(s) of the four positions labelled A to D above would:

the largest voltage be generated?_____

no voltage be generated?_____

(ii) Use physics principles to explain your answer to part (i).

(iii) Clearly indicate on each appropriate diagram(s) the direction of any electron movement caused by charge separation when the coil rotates.

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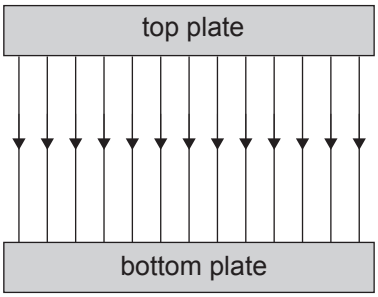
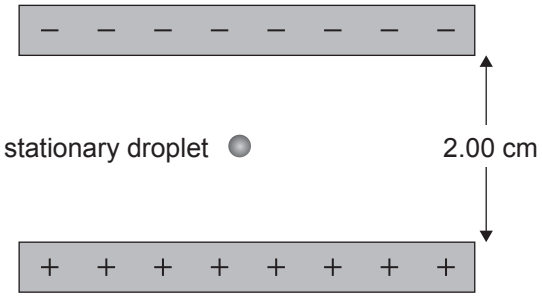
If you need to redraw your response, use the diagram on page 9.

SPARE DIAGRAMS

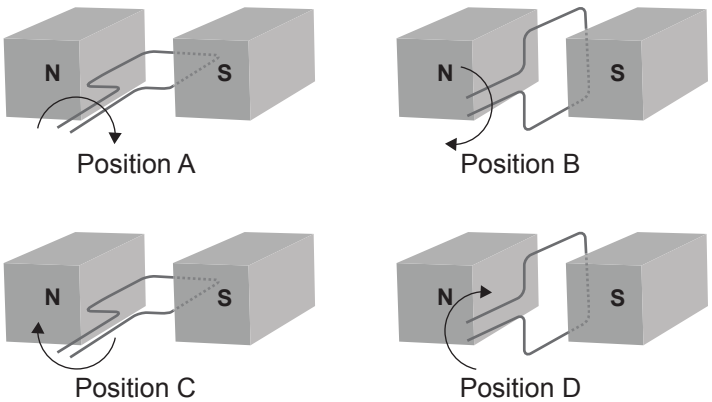
If you need to redraw your response to Question Two (a), use the diagram below. Make sure it is clear which answer you want marked.



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



If you need to redraw your response to Question Three (d)(iii), 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

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