2

90257

902570

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 2 Physics, 2008

90257 Demonstrate understanding of electricity and electromagnetism

Credits: Five
2.00 pm Tuesday 25 November 2008

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 answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

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 2–9 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.

For Assessor's use only	**Achievement Criteria**		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles. ☐	Give descriptions or explanations in terms of phenomena, concepts, principles and / or relationships. ☐	Give concise explanations that show clear understanding in terms of phenomena, concepts, principles and / or relationships. ☐
Solve straightforward problems. ☐	Solve problems. ☐	Solve complex problems. ☐
Overall Level of Performance (all criteria within a column are met) ☐		

© New Zealand Qualifications Authority, 2008
All rights reserved. No part of this publication may be reproduced by any means without the prior permission of the New Zealand Qualifications Authority.

You are advised to spend 50 minutes answering the questions in this booklet.

Assessor's use only

You may find the following formulae useful.

$$E = \frac{V}{d} \qquad F = Eq \qquad \Delta E_p = Eqd$$

$$I = \frac{q}{t} \qquad V = \frac{\Delta E}{q} \qquad V = IR$$

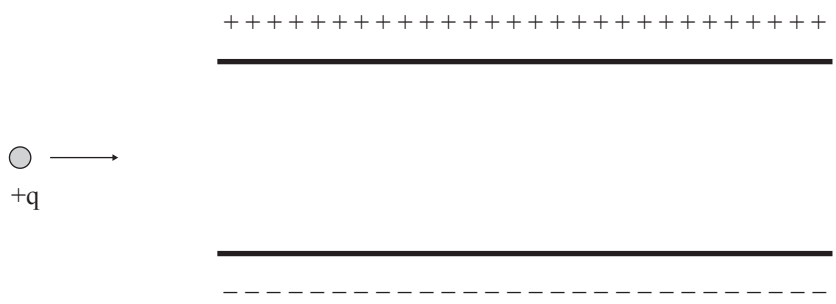
$$P = IV \qquad P = \frac{\Delta E}{t}$$

$$R_T = R_1 + R_2 + \ldots \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$F = BIL \qquad F = Bqv \qquad V = BvL$$

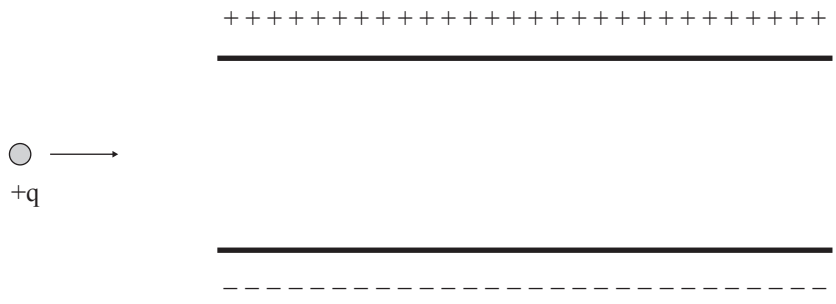
QUESTION ONE: CHARGED PARTICLES

A velocity sorter is an apparatus that can be used to obtain a stream of charged particles, all travelling with the same velocity. The diagram below shows a simplified velocity sorter. A stream of protons is made to pass between two parallel charged plates.



(a) On the diagram above, **use arrows** to draw the electric field between the plates.

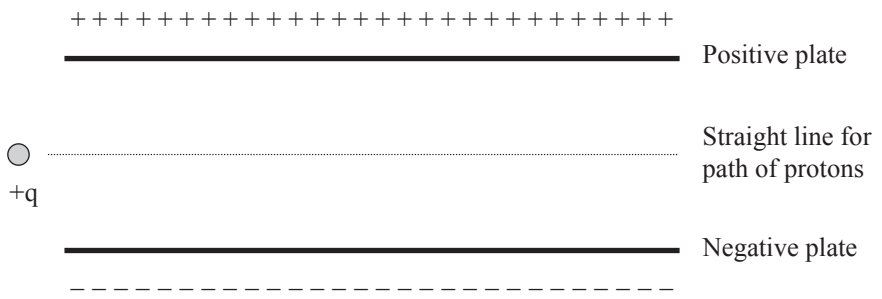
(b) On the diagram below, draw the path of the proton in the field.



(c) **Explain why** the proton follows this path.

Assessor's use only

In order for the protons to travel in a **straight line**, a velocity sorter also has a magnetic field.



(d) The proton is travelling through a magnetic and electric field.

State the direction of the magnetic field that would allow the protons to go in a straight line.
Choose your answer from:

towards the top of the page	*towards the bottom of the page*
left	*right*
into the page	*out of the page.*

Assessor's use only

(e) Explain the effect (if any) of the **speed of the proton** on the size of the **electric force**, and on the size of the **magnetic force** acting on the proton.

Effect of speed of proton on **electric force** _____

Effect of speed of proton on **magnetic force** _____

(f) The voltage between the plates is 220 V. The plates are 5.0 cm apart.

Calculate the size of the **electric force** on the proton. Charge on proton = 1.60×10^{-19} C. Give your answer to the correct number of significant figures.

Force = _____

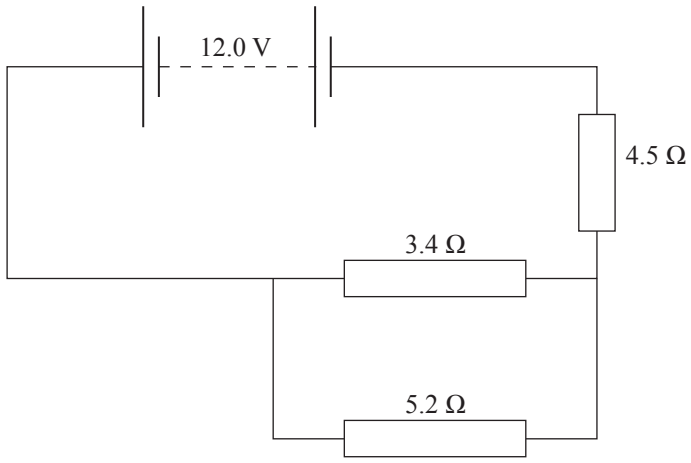
(g) 3.5×10^{15} protons enter the field in 10 s.

Calculate the size of the current.

QUESTION TWO: DC ELECTRICITY

Assessor's use only

Martha and Mere connected the following circuit using several resistors and a power supply.



(a) How much energy does the battery give to each Coulomb of charge?

(b) Show that the total resistance in this circuit is 6.56 Ω.

(c) Calculate the current through the 4.5 Ω resistor.

Current = _____

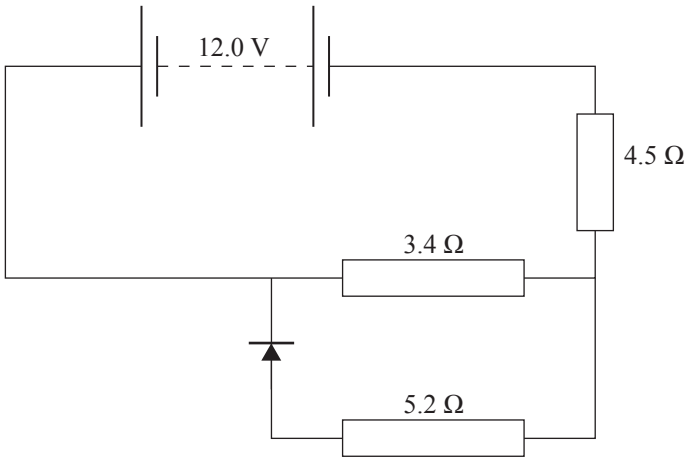
(d) Show that the voltage across the 3.4 Ω resistor is 3.8 V.

Voltage = _____

Assessor's use only

(e) State the voltage across the 5.2 Ω resistor. Give reasons for your answer.

Martha and Mere then reconnect their circuit by including a diode as shown in the circuit below.



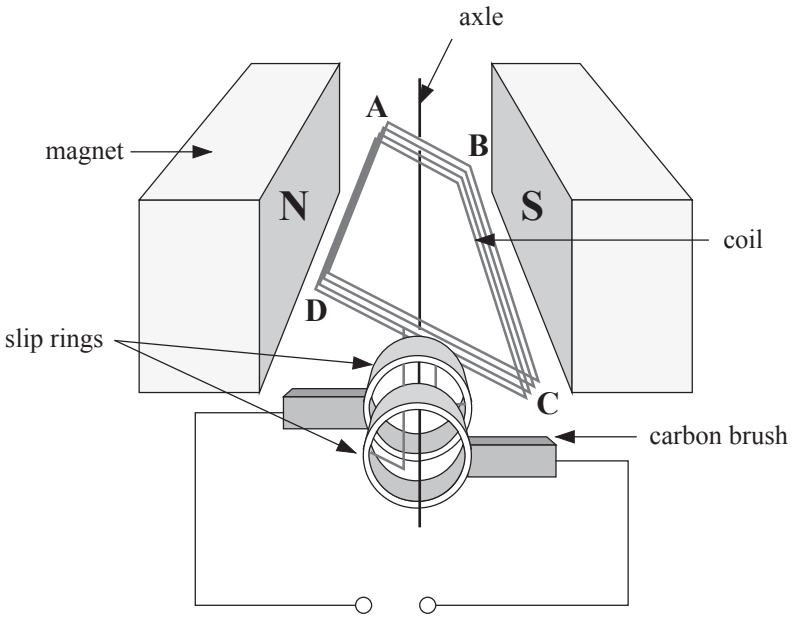
(f) Explain how adding the diode would affect the current through the 4.5 Ω resistor.

(g) Calculate the heat energy produced by the 3.4 Ω resistor in one minute when the diode is connected in the circuit as shown in the above diagram.

Energy = _____

QUESTION THREE: ELECTROMAGNETISM

Assessor's use only



The diagram above shows a wind-powered generator in a yacht. It comprises a rectangular coil of wire that is rotated in a magnetic field.

The width (AB) of the coil = 6.4 cm
The length (AD) of the coil = 14.6 cm
The strength of the magnetic field = 0.75 T
Speed of the long side of the coil = 20.0 cm s^{-1}
Number of turns of coil = 100 turns

(a) Calculate the maximum induced voltage across **one loop**.

Voltage = _____

(b) Describe three ways in which the size of the induced voltage across the length of the coil can be increased.

(1) _____

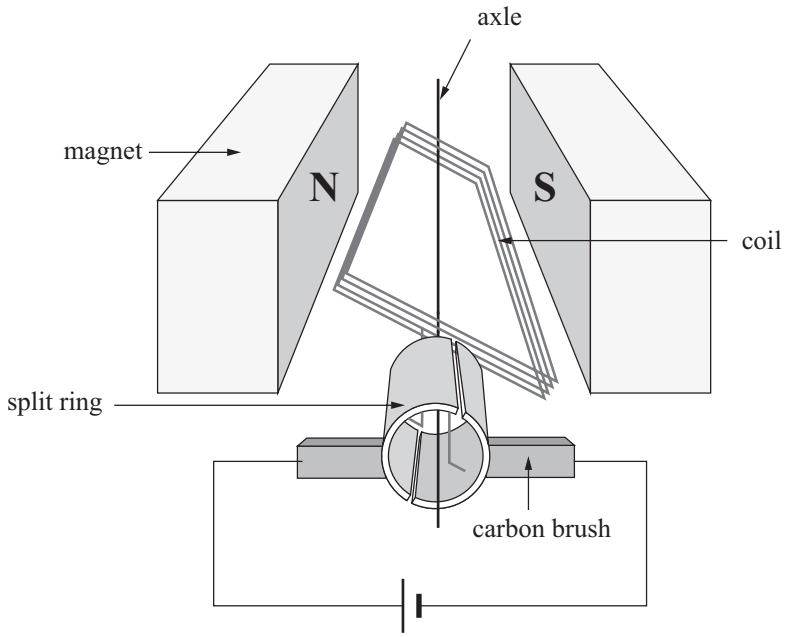
(2) _____

(3) _____

(c) State the position of the coil that produces the maximum voltage and explain why the size of the voltage changes as the coil rotates.

Assessor's use only

(d)



The generator can be modified to act as a DC motor by changing the **slip rings** to a **split ring**, as shown in the diagram above.
The motor is connected to a 12 V battery.
The coil has a resistance of 4.5 Ω.
The coil has 100 turns.

Calculate the maximum force acting on **one side** of the **coil**.

Extra paper for continuation of answers if required.
Clearly number the question.

Assessor's use only

Question number