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90257

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 2 Physics, 2006

90257 Demonstrate understanding of electricity and electromagnetism

Credits: Five
2.00 pm Monday 20 November 2006

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 2–10 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.

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) ☐		

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

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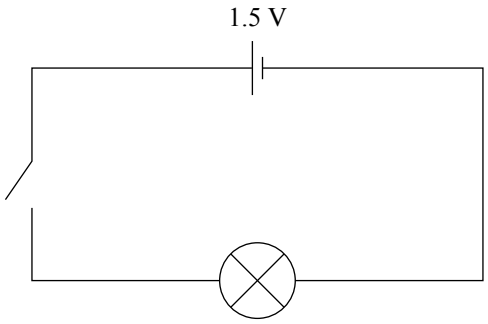
You may find the following formulae useful.

$E = \frac{V}{d}$	$F = Eq$	$\Delta E_p = Eqd$
$I = \frac{q}{t}$	$V = \frac{\Delta E}{q}$	$V = IR$
$P = IV$		$P = \frac{\Delta E}{t}$
$R_T = R_1 + R_2 + \ldots$		$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$F = BIL$	$F = Bqv$	$V = BvL$

QUESTION ONE: DC ELECTRICITY

Tom was out camping one weekend. He had taken some spare 1.5 volt cells with him. The diagram below shows the circuit diagram for Tom's torch.



(a) How many joules of **energy** does the cell supply to each coulomb of charge that flows out of the cell?

(b) When the cell is switched on, the resistance of the lamp is 5.00 Ω.

Calculate the **current** flowing through the lamp.

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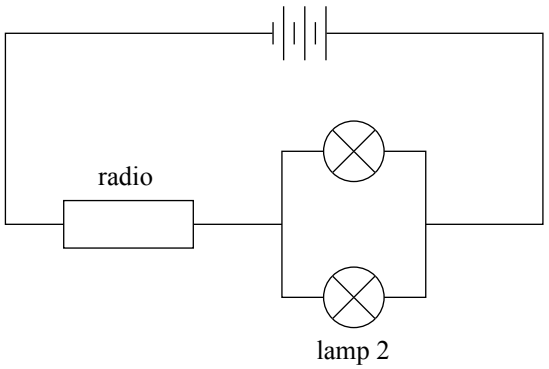
(c) State the meaning of the term **resistance** in terms of electron flow.

(d) One evening, Tom used the torch for 3 minutes.

Calculate the number of coulombs of charge that flowed through the **lamp** in 3 minutes.

Tom wanted to use his radio as well as have lights on in his tent. He used three of his 1.5 V cells and connected the circuit as shown below.



(e) Calculate the **total voltage** supplied by the cells.

The resistance of each lamp is now 4.00 Ω and the resistance of the radio is 14.0 Ω.

(f) Calculate the **total resistance** of the circuit. Express your answer to the correct number of significant figures.

(g) Calculate the **voltage** across lamp 2.

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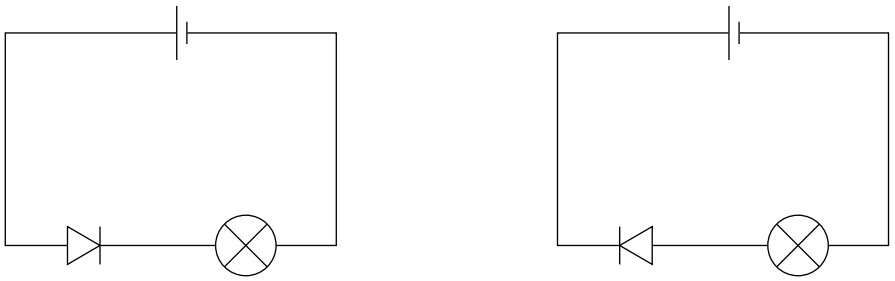
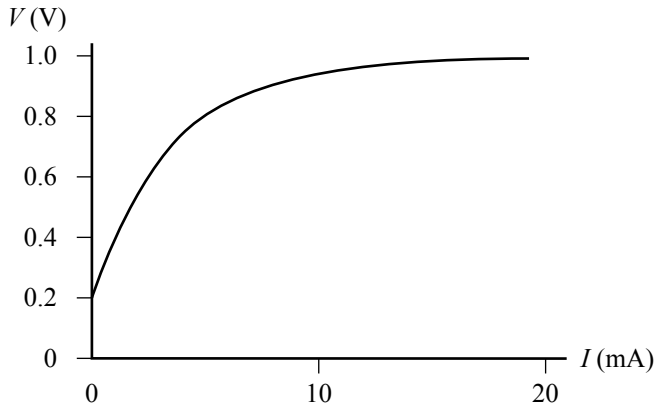
The diagram below shows two possible ways in which a diode may be connected in a circuit.



lamp A lamp B

(h) With reference to the diagrams above, state which lamp **glows** when the diode is connected in the circuit. **Explain** the behaviour of **each** of the lamps, in terms of the resistance of the diode.

The diagram below is a graph showing the voltage – current characteristics of a particular diode.



(i) Using the above graph, determine the voltage at which the diode will start to conduct.

(j) State what physical quantity is represented by the **gradient** of the graph line.

QUESTION TWO: CATHODE RAY TUBE

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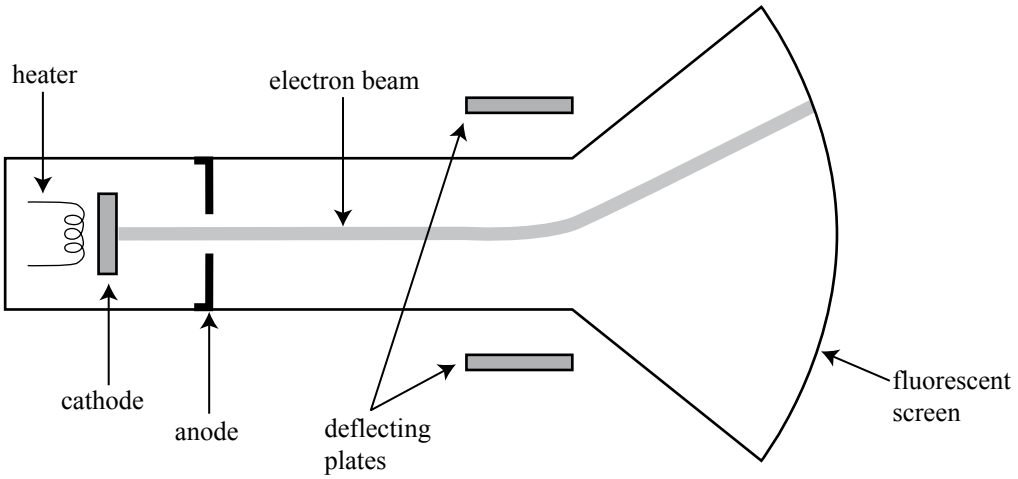
The diagram below shows the path of an **electron** moving through a cathode ray tube.



(a) On the diagram above, label the positive deflecting plate "+" .

(b) On the diagram above draw arrows to represent the **electric field** formed between the **deflecting plates.**

(c) The deflecting plates are maintained at a voltage of 45 V, and are 8.0 mm apart. Show that the **electric field strength** between the plates is 5625 V m^{-1}.

(d) Use TWO appropriate formulae from the list at the front of this paper to derive TWO different units for electric field strength, E.

(e) The charge on an electron is 1.6×10^{-19} C. Calculate the **electric force** on an electron between the plates.

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(f) **Explain** why the electron is losing **electric potential energy** while it is moving from the cathode (negative electrode) to the anode.

QUESTION THREE: ELECTROMAGNETISM

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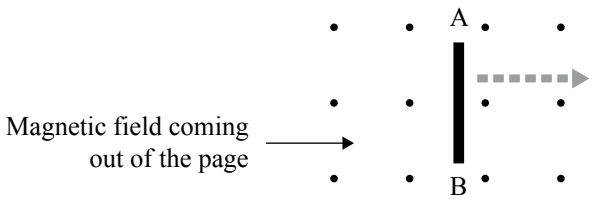
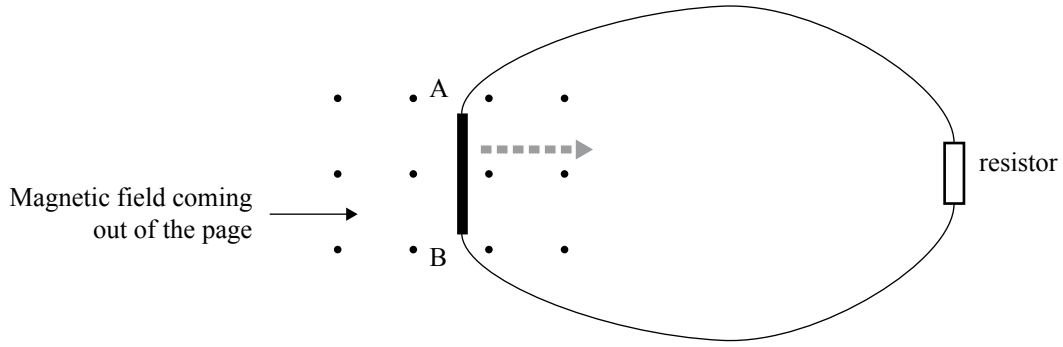


A metal rod AB is pushed from left to right so that it cuts across the magnetic field, as shown in the diagram above.

(a) **Explain** clearly in terms of movement of electric charge, what would happen as the rod **starts** moving in the direction shown.



The rod is then connected by two wires to a resistor to a make a complete circuit.

(b) **Explain** what would now happen as the rod is moved through the magnetic field while the **resistor remains stationary**. In your explanation, include the direction of any charge flow.

(c) Calculate the **current** that would flow through the resistor, using the following information:

- Resistance of resistor = 2.0 Ω
- Strength of magnetic field = 0.80 T
- Length of rod in the magnetic field = 10.0 cm
- Speed with which the rod is being moved = 4.0 m s^{-1}

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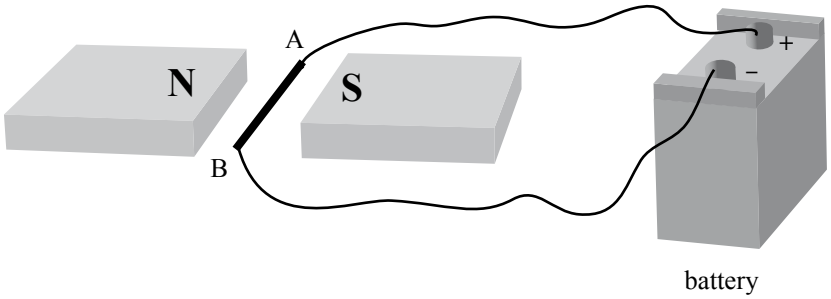

The metal rod, AB, is now connected to a battery, and placed between the poles of two magnets, as shown in the diagram above.

(d) Draw an arrow on the diagram above to show the **direction** of the **magnetic field** produced by the magnets.

(e) Using one of the terms: "left, right, up, down, into the page, out of the page", identify the direction of the **magnetic force** on the rod.

(f) **Explain** clearly why the rod experiences a **magnetic force** in the direction you have stated in (e).

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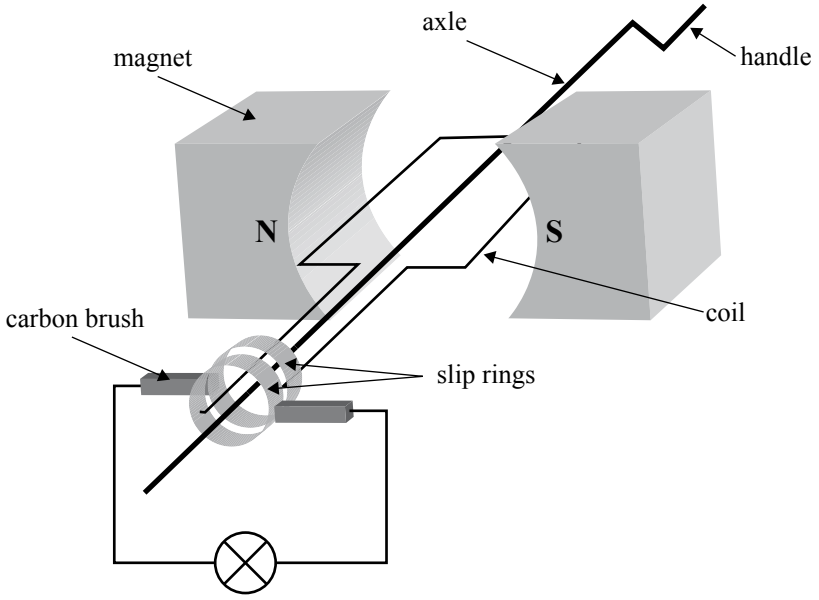
(g) Calculate the size of the **magnetic force** experienced by the rod, using the information given below:

Write your answer to the correct number of significant figures.

- Strength of the magnetic field = 0.90 T
- Current = 3.20 A
- Length of rod in the field = 10.0 cm



(h) The diagram above shows a generator. When the handle is turned, the coil spins.

Explain clearly why the lamp glows when the handle is turned rapidly.

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

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Question number	