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90185

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 1 Physics, 2003

90185 Demonstrate understanding of electricity and magnetism

Credits: Five
9.30 am Thursday 20 November 2003

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 3.

If you need more space for any answer, use the page 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.

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Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Recall or describe phenomena, concepts or principles. ☐	Describe or explain how phenomena, concepts, principles, or relationships are interrelated. ☐	Explain or analyse phenomena in terms of concepts, principles, or relationships. ☐
Solve problems with direction. ☐	Solve problems by selection. ☐	Solve problems requiring more than one step or the synthesis of information. ☐
Overall Level of Performance (all criteria within a column are met) ☐		

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

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You may find the following formulae useful.

$F = BIL$	$V = IR$	$P = IV$	$P = \frac{E}{t}$	$R_T = R_1 + R_2$

QUESTION ONE: Electrostatics

Sally is a manager of a dress shop. It is important that Sally looks presentable for her job. She always brushes her hair thoroughly when she arrives at work but finds on dry days that her hair sticks out after she has brushed it.

(a) Use **electrostatics** to explain why Sally's hair sticks out after she has removed the brush.

(b) Sally's hair moves towards her brush if she holds it close to her hair after brushing. Explain why.

(c) Why does she **not** have this problem on damp days?

QUESTION TWO: DC Electricity

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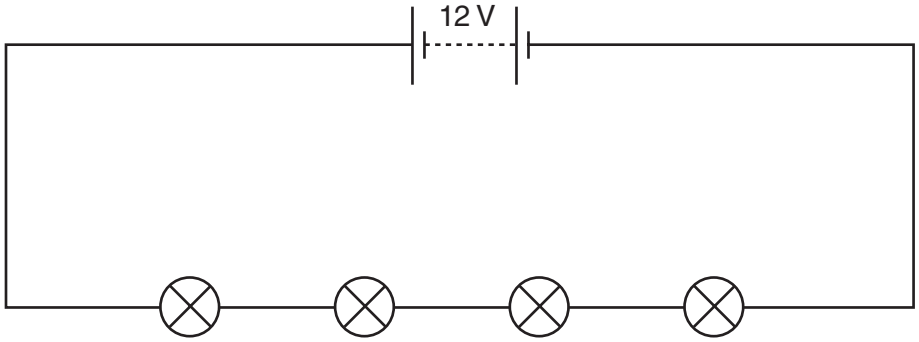
(a) Sally was setting up her clothes shop display window and wanted to place four small 6.0 V bulbs around a sign in the window. The resistance of each bulb is 3.0 Ω. She sets up the circuit shown below. The bulbs are connected to a 12 V battery.



(i) Given that the bulbs are identical, determine the voltage across each bulb.

Voltage = _____ V

(ii) Use $R_T = R_1 + R_2 + R_3 + R_4$ to calculate the resistance of this circuit.

Resistance = _____ Ω

(iii) Use V = IR to calculate the current in Sally's circuit.

Current = _____ A

(iv) Show that the current at which each bulb is **designed** to operate is 2.0 A.

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(v) Calculate the power at which each bulb in Sally's circuit on page 4 is **designed** to operate. Give a unit with your answer.

Maximum power = _____ _____ (unit)

(vi) Calculate the **actual** power output of each bulb in Sally's circuit.

Power = _____ _____ (unit)

(vii) Sally found that the bulbs in her circuit were very dim. Explain what factors determine the brightness of a bulb.

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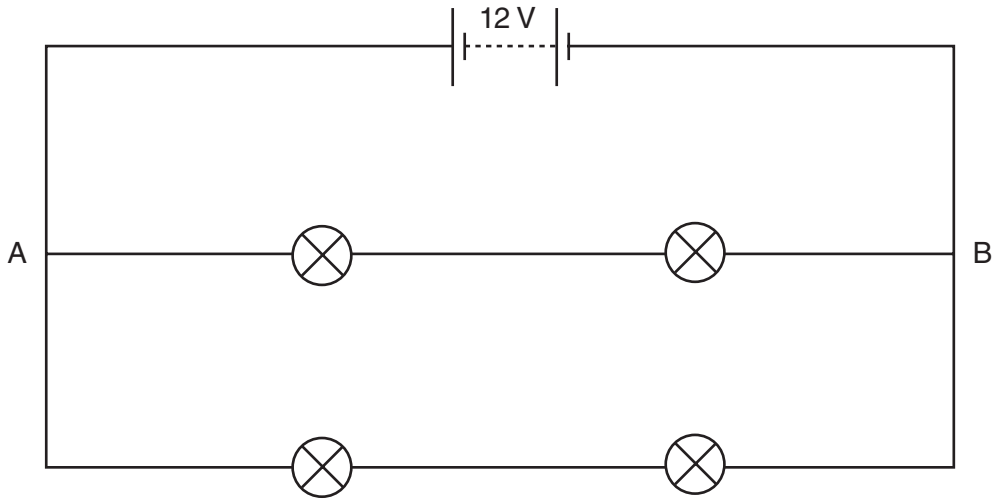
(b) Sally tried another circuit. This is shown below. She used the same 12 V battery and four 6.0 V, 3.0 Ω bulbs.



(i) State the voltage across branch AB.

Voltage = _____ V

(ii) Calculate the resistance of branch AB and use this value to show that the current through the branch is 2.0 A.

_____

_____

_____

_____

_____

(iii) Calculate the power output of EACH bulb in the circuit above.

_____

_____

_____

_____

Power = _____ _____ (unit)

(iv) Explain what would happen to the **total** current from the power supply if Sally added a third parallel branch to the circuit on page 6, using two identical bulbs.

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QUESTION THREE: Electromagnetism

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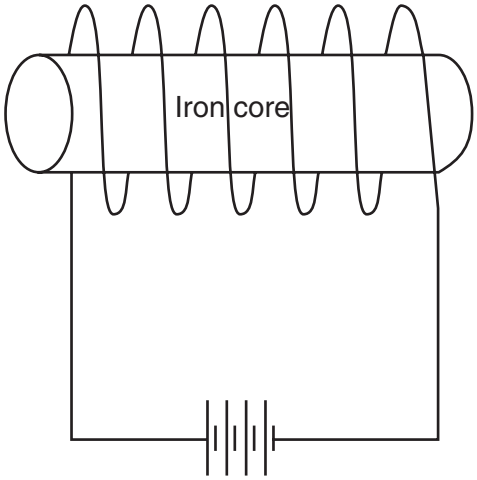
Sally's shop has a fire alarm installed. If the alarm is switched on a loud bell rings continuously. The bell circuit has an electromagnet in it.

(a) An electromagnet attached to a power supply is shown below.

(i) Sketch the magnetic field around the electromagnet. Your sketch should show clearly the **shape** and **direction** of the magnetic field.



(ii) Suggest TWO ways in which the **strength** of an electromagnet can be increased.

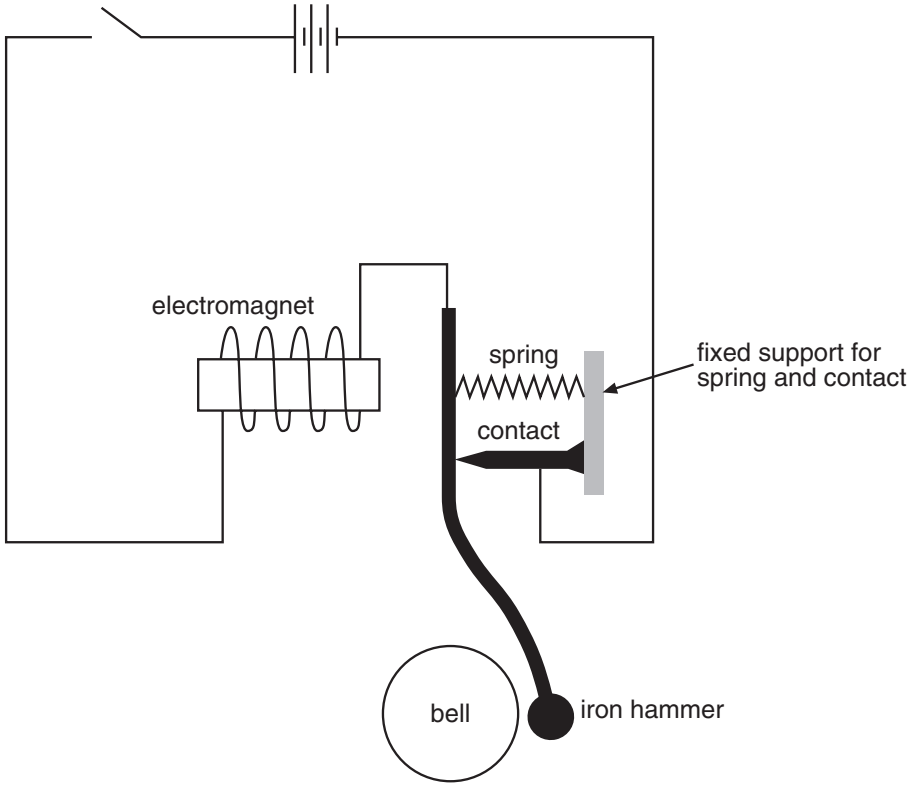
(1) _____

_____

(2) _____

_____

(b) Look at the electric bell circuit below. When the switch is closed, current flows through the electromagnet, around to the contact and back to the battery. The sound is made by the hammer repeatedly striking the bell. The spring normally pulls the hammer away from the bell, ensuring electrical connection between the hammer and the contact. The spring is easily extended to allow the hammer to strike the bell and break the connection with the contact.



(i) Explain why, at the instant that the switch is closed, the hammer strikes the bell.

(ii) Explain in detail the process that then causes the bell to sound repeatedly.

(c) Sally uses a computer in her shop. A DC motor makes the computer fan rotate to keep the computer cool. A simplified diagram of a DC motor is shown below.

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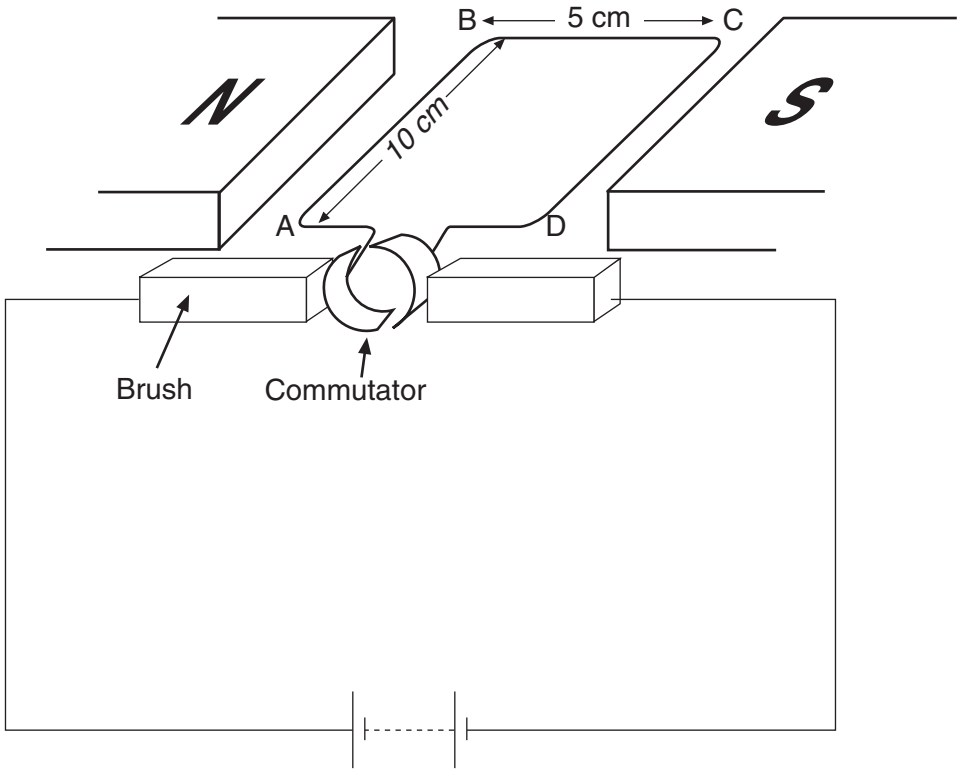

(i) With the commutator in the position shown, the current in the coil flows in the direction ABCD. State the **direction** of the **force** on wire AB.

_____

(ii) If the magnetic force on the wire is 0.050 N and the current through the wire is 2.0 A, calculate the magnetic field due to the magnets.

_____

_____

_____

_____

Magnetic field = _____ _____ (unit)

(iii) The motor can be made to spin faster.

Describe ONE change that will make the motor spin faster and fully explain how the speed of the motor is altered by this change.

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

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