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90185

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 1 Physics, 2007

90185 Demonstrate understanding of electricity and magnetism

Credits: Five
9.30 am Friday 30 November 2007

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 2–11 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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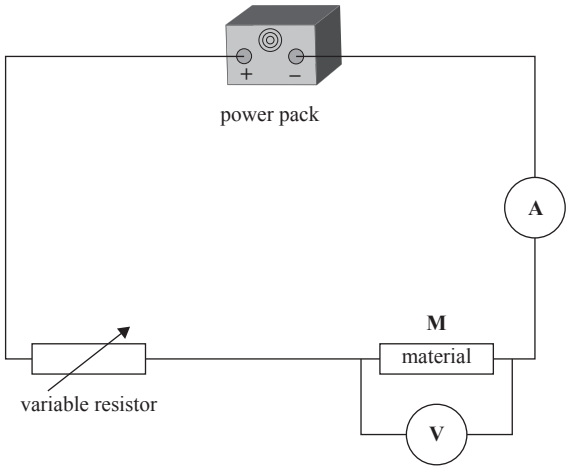
You may find the following formulae useful.

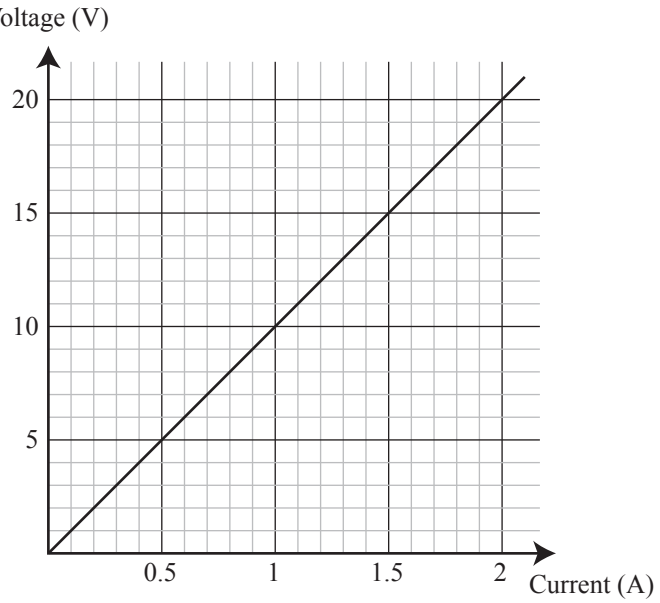
$$V = IR \qquad P = IV \qquad P = \frac{E}{t} \qquad R_T = R_1 + R_2 + \ldots$$

$$B = \frac{\mu_0}{2\pi}\frac{I}{d}$$

QUESTION ONE: CIRCUITS

A rheostat (variable resistor), an ammeter and a conducting material (M) are connected in series with a power pack to investigate the relationship between the voltage across a conducting material, and the current through it. A voltmeter is connected in parallel with the conducting material, as shown in the diagram.





The above graph shows how the current through the conducting material changes as the voltage across it varies.

(a) From the graph, calculate the resistance of the conducting material.

resistance = _____

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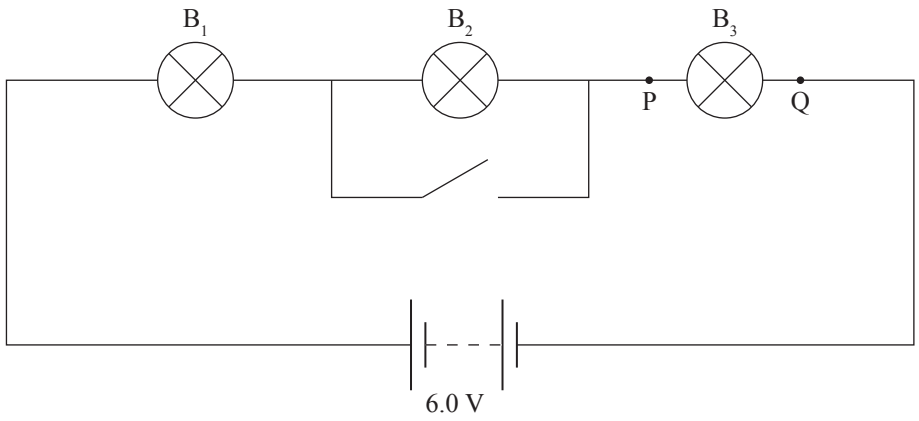
The power pack is set at **16.0 V**. When the variable resistor is set halfway along, the voltmeter reads **4.0 V**.

(b) Combine the information from the graph to calculate the resistance of the **variable resistor** when it is set halfway along.

resistance = _____

Three **identical** bulbs B_1, B_2 and B_3 are connected in series across a **6.0 volt** battery. A switch is connected across the bulb B_2 as shown in the diagram.



(c) When the switch is **open**, the current through the circuit is **0.40A**.

Calculate the **power** output of **each** bulb.

power = _____

(d) The switch across the bulb B_2 is now **closed**.

Describe the effect on the **brightness** of each bulb.

B_1 _____

B_2 _____

B_3 _____

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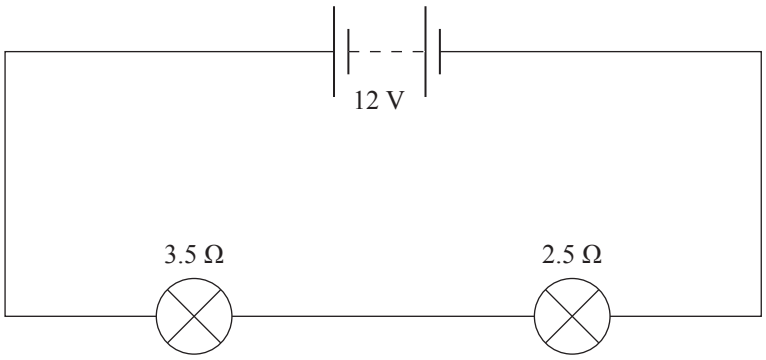
(e) Explain why the **brightness** of the bulb B_3 changes when the switch is **closed**.

(f) The switch across B_2 is still **closed**.

Calculate the **voltage** between the points **P and Q**.

voltage = _____

Two bulbs of resistance **3.5 Ω** and **2.5 Ω** are connected in series with a **12 volt** battery, as shown in the diagram.



(g) Calculate the power developed in the **3.5 Ω bulb**.

power = _____

QUESTION TWO: ELECTRIC CHARGES

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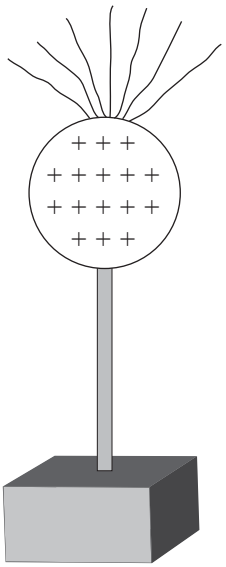
A neutrally-charged polythene rod, when rubbed with a woollen cloth, becomes negatively-charged.

(a) Explain, in terms of conservation of charges, how the polythene rod becomes negatively-charged when rubbed.

A small bunch of strands of hair is attached to the dome of a Van de Graaff generator. When the generator is turned on, the dome becomes positively charged, and the strands of the hair stand on their ends, as shown in the diagram.



(b) Explain why the strands of the hair stand on their ends **spread out**, as shown in the above diagram.

(c) Explain why the strands of the hair fall **slowly** when the generator is **switched off**.

QUESTION THREE: MAGNETS

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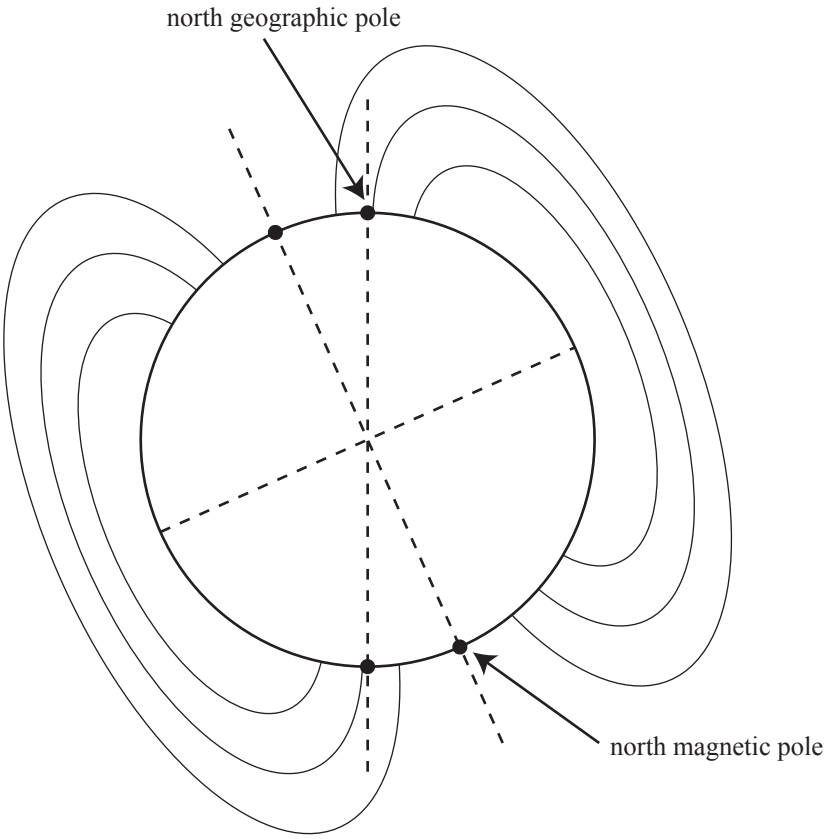
The Earth behaves like a giant magnet. The diagram below shows the Earth and its magnetic field.



(a) Describe what is meant by the term " magnetic field".

(b) Draw **arrows** on the above diagram to show the **directions** of the magnetic field lines.

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The diagram below shows a soft iron rod and a battery. A piece of insulated copper wire is to be wound onto the soft iron rod in such a way that the end marked 'X' becomes a north pole, when the ends of the copper wire are connected to the terminals of the battery.

(c) Complete the above diagram to show how you would wind the copper wire onto the soft iron rod so that the end '**X**' of the soft iron rod becomes a **north pole**.

(d) Explain how you would check that the end **'X'** is a **north pole**.

_____

_____

_____

QUESTION FOUR: APPLICATIONS OF PHYSICS IDEAS

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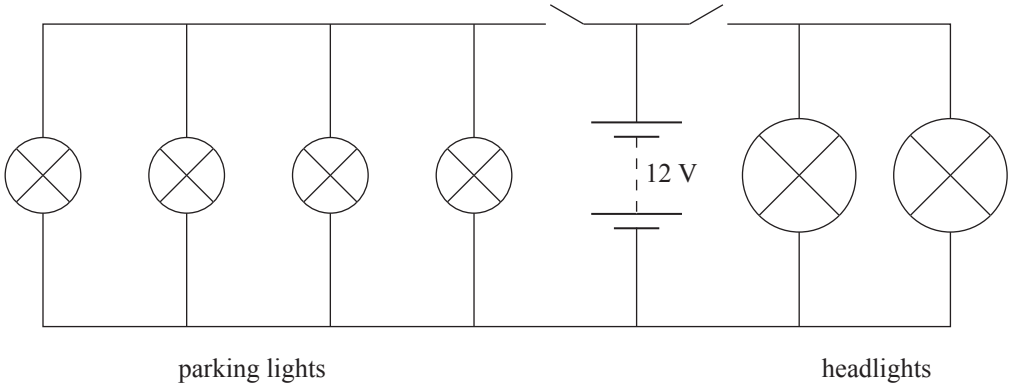
Car Electric Circuits

A car has **two** headlights and **four** parking lights. The headlights are **60 W** each, and the parking lights are **21 W** each. All the lights are connected to a **12 V** battery, as shown in the diagram below.



(a) Describe what "**60 W**" means.

(b) Show that the **total power** drawn from the battery when all the lights are turned on is 204 W.

(c) Calculate the **energy** supplied by the battery if all the lights are turned on for **20 minutes**.

energy = _____

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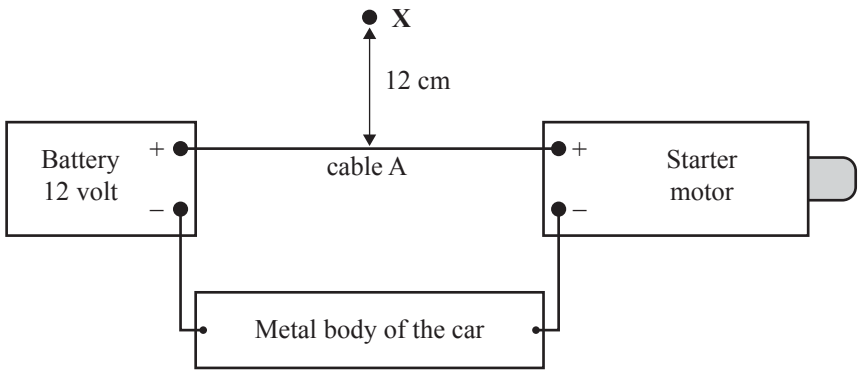
(d) Calculate the **combined** resistance of the **two headlights** when they are turned on.

resistance = _____

Cars use electric starter motors to start the car engine. An electric starter motor in a car is connected to a 12 volt battery as shown in the diagram.



The starter motor is turned on and a large current flows through cable A. The power output of the motor is **540 W**. The point **X** is **12 cm** from cable A.

(e) Calculate the **strength** of the magnetic field at the point X due to the current in cable A. The value of $\mu_0 = 1.26 \times 10^{-6}$ **Tm A**$^{-1}$.

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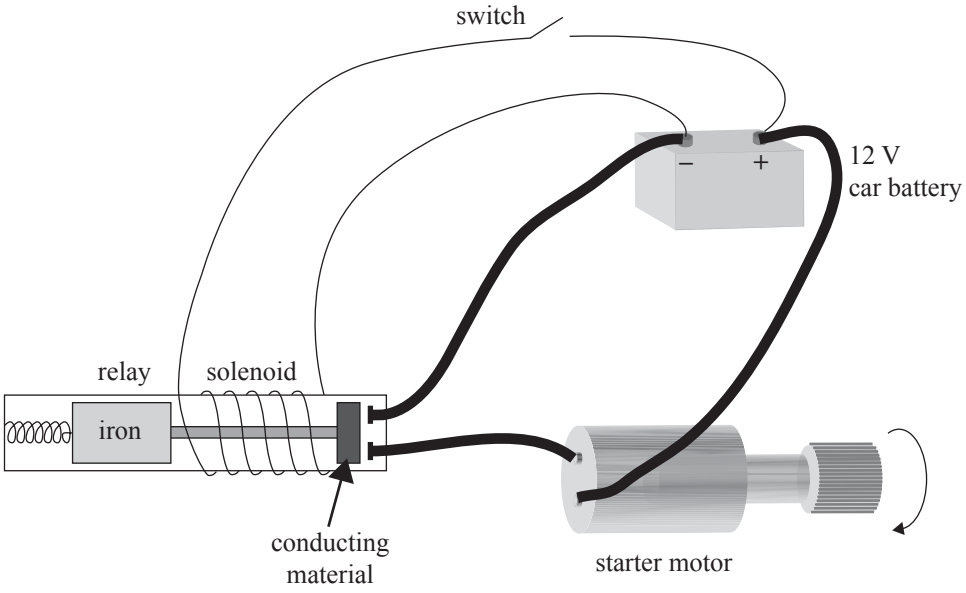
The starter motor is turned on using an electro-magnetic device called a "relay", which contains a solenoid. The diagram below shows the circuit diagram for the starter motor and the relay.



(f) Study the above diagram, and explain how the relay turns on the starter motor when the switch is closed.

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

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