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90185

NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

For Supervisor's use only

Level 1 Physics, 2008

90185 Demonstrate understanding of electricity and magnetism

Credits: Five
9.30 am 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 2–11 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 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.

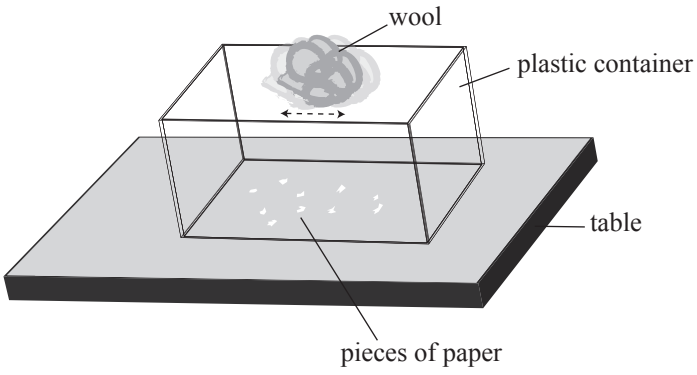
$$V = IR \qquad P = IV \qquad P = \frac{E}{t} \qquad R_T = R_1 + R_2 + \ldots$$

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

QUESTION ONE: ELECTRIC CHARGES

(a) In terms of movement of charge, explain the difference between a conductor and an insulator.

A transparent plastic container is placed over a few small pieces of paper on a table. The top surface of the container is then rubbed with a piece of wool as shown in the diagram below.



Rubbing causes the surface of the container to be negatively charged. During rubbing, the pieces of paper are attracted to the top part of the container, and when the wool is removed, the pieces of paper remain attached to the top part of the plastic container.

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(b) The magnified diagram below shows a part of the plastic container where a piece of paper is attracted to it.

On the diagram draw the charge distribution on the **plastic** and on the piece of **paper**.

(c) Explain why the pieces of paper are attracted to the top part of the container.

(d) The plastic container is left untouched for a while.

Describe what happens to the pieces of paper and explain why.

Description

Explanation

Two metal coated polystyrene spheres hang by insulating threads from a stand. Both spheres touch each other. One of the spheres is briefly touched with the positively charged wool, as shown in Diagram 1. The wool is taken away after touching the sphere

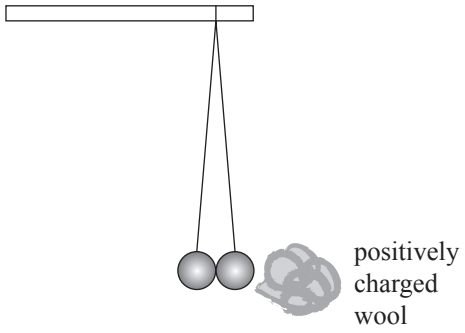

Diagram 1

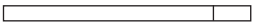

Diagram 2

(e) Complete Diagram 2 to show the **positions** of the spheres after the wool is taken away.

Explain why the spheres remain in the positions as shown by your answer.

QUESTION TWO: ELECTRIC CIRCUITS

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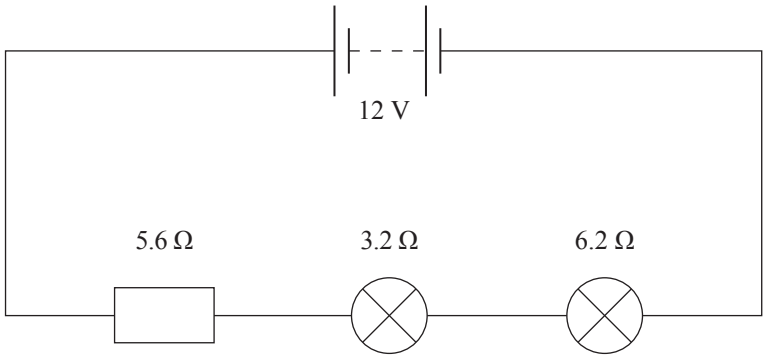
The circuit diagram below is used in the dashboard of a car. It consists of two bulbs and a resistor, which are connected in series with a 12 V battery.



(a) Calculate the **combined resistance** of the two bulbs and the resistor.

combined resistance _____

(b) Calculate the **current** through the circuit.

current _____

(c) Calculate the **voltage** across the **5.6 Ω resistor**.

voltage _____

(d) Calculate the **power** output of the **3.2 Ω bulb**.

power _____

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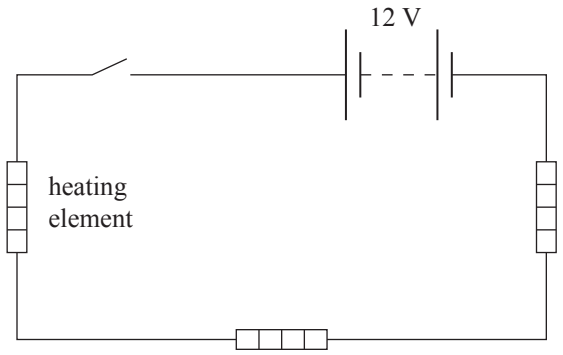
(e) The dashboard lights are turned on for **30 minutes**.

Calculate the **energy** supplied by the **battery** for 30 minutes.

energy _____

(f) Some modern cars have food warmers to keep small amounts of drinks and food warm during travel. A food warmer in a car produces **36 joules per second** of heat energy. It has three **identical** heating elements connected in series to a **12 volt** battery as shown in the diagram below.

http://freshpromotions.com.au/img/productImages/D250_lrg.jpg



Calculate the **resistance** of **each** heating element when the food warmer is switched on.

resistance _____

QUESTION THREE: MAGNETS

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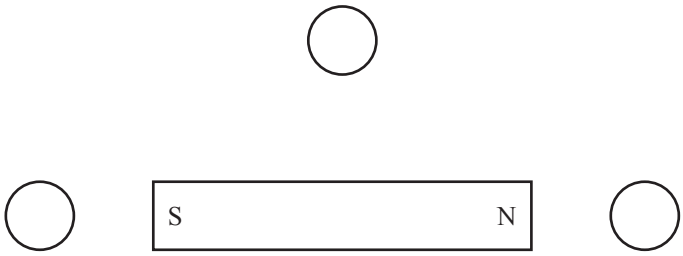
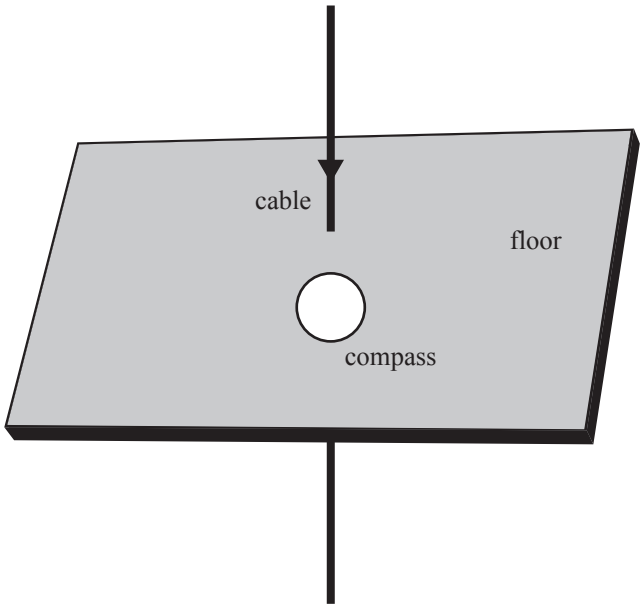
(a) The diagram below shows a bar magnet and three circles, which represent three positions for a compass.



On the above diagram, inside each circle, draw an **arrow** to show which way the compass needles point.

(b) The diagram below shows a power cable that carries a large current through a factory floor. The direction of the current is into the floor. The white circle represents a compass.



On the above diagram, inside the circle, draw an **arrow** to show which way the compass needle would point. (Ignore the effects of the earth's magnetic field.)

Explain why the compass needle points in the direction as shown by your answer.

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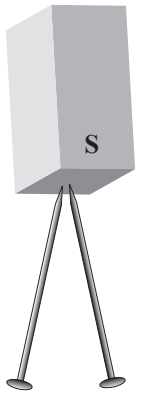
(c) The centre of the compass needle is **0.038 m** from the wire and the strength of the magnetic field at this point is $\mathbf{6.5 \times 10^{-5}}$ **T**. The current through the wire is **12.4 A**.

Calculate the **value** of the constant $\boldsymbol{\mu_o}$.

μ_o _____

(d) When the sharp ends of two iron nails are hung from the south pole of a bar magnet, the nail heads repel each other as shown in the diagram on the right.



Explain why the nail heads repel each other when they are attracted to the magnet, as shown in the diagram.

QUESTION FOUR: APPLICATIONS OF PHYSICS IDEAS

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Wind Generator

On a farm an electric water pump and a wind turbine generator are connected by a power cable. The output voltage of the wind turbine generator is **250 V** and it produces **1.8 kW** of power when the turbine is rotating at full speed.

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http://ec2.images-amazon.com
http://www.emeng.gentlyhosting.co.uk/Cooling/Images/WaterPump.JPG

(a) Calculate the **current** through the power cable, when the turbine is rotating at full speed.

current _____

(b) The power cable that connects the water pump to the wind turbine generator has a resistance of **0.45 Ω**. The turbine is rotating at full speed.

Calculate the **power lost** as heat in the cable due to its resistance.

power loss _____

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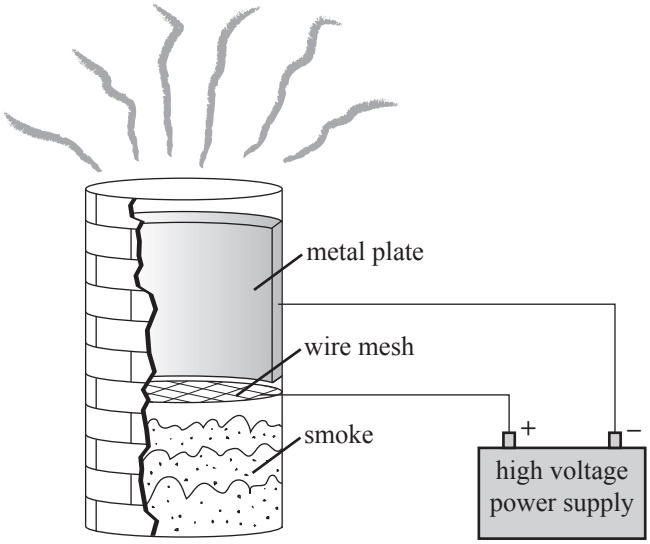
Clean Air

Coal-burning power stations and large factories produce vast amounts of smoke pollution. The smoke contains large amounts of ash and dust particles. They are removed using electrostatic precipitators.

An electrostatic precipitator uses static electricity to remove dust particles from smoke. The diagram shows a simple electrostatic precipitator. It consists of a **positively** charged **wire mesh** placed across the path of smoke in the chimney. Inside the chimney is a **metal plate** and it is **negatively** charged. The smoke particles are rising up the chimney.



(c) Explain how the above set-up will help to remove ash and dust particles from the smoke as it moves up the chimney.

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

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Question number