91173

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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 2 Physics, 2012

91173 Demonstrate understanding of electricity and electromagnetism

2.00 pm Wednesday 14 November 2012
Credits: Six

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of electricity and electromagnetism.	Demonstrate in-depth understanding of electricity and electromagnetism.	Demonstrate comprehensive understanding of electricity and electromagnetism.

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 attempt ALL the questions in this booklet.

Make sure that you have Resource Sheet L2–PHYSR.

In your answers use clear numerical working, words and / or diagrams as required.

Numerical answers should be given with an appropriate SI unit.

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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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QUESTION ONE: 12 V LAMPS

The photograph alongside is of two lamps.

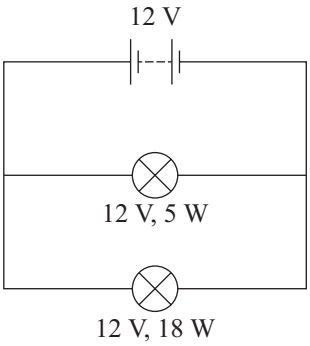
The label on one of the lamps reads 12 V 5 W.

(a) State what 12 V 5 W means.

The label on the second lamp reads 12 V 18 W. The two lamps are connected in parallel to a 12 V power supply, as shown below.

(b) State which of the two lamps will be brighter.

Give reasons for your answer.



(c) Calculate the effective resistance of the circuit.

(d) With reference to the circuit diagram on page 2, calculate the energy transferred by the 18 W lamp if it is left on for 3 minutes.

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QUESTION TWO: MORE 12 V LAMPS

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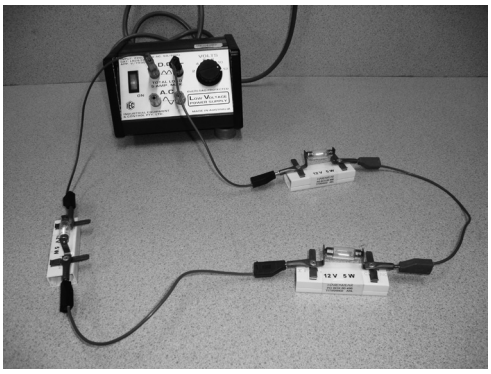
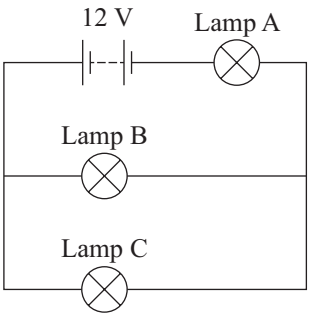
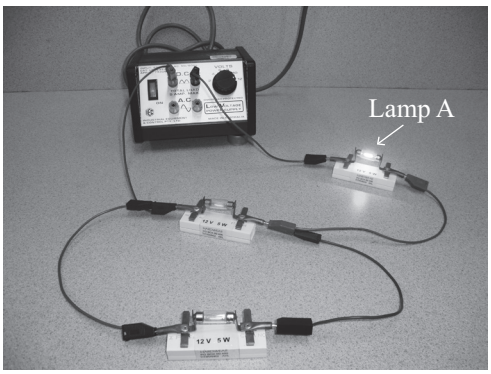
Jason connects three identical (12 V, 5 W) lamps in series to a 12 V power supply. He notices that all three of them glow with the same brightness.

(a) Explain why the lamps all glow with the same brightness.



Jason then reconnects the circuit, as shown in the diagram and photograph below.





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(b) Calculate the **current drawn** from the power source when the circuit is connected as shown in the diagram on page 4 (Lamp A in series with the source, Lamp B and Lamp C parallel to each other).

Begin your answer by calculating the resistance of each lamp.

(c) Jason notices that the three lamps no longer all glow with the same brightness. Lamp A is brighter than Lamp B and Lamp C.

Discuss why Lamp A is **brighter** than Lamps B and C, even though they are all identical lamps (12 V, 5 W).

You may use calculations to justify your answer.

QUESTION THREE: STATIC ELECTRICITY

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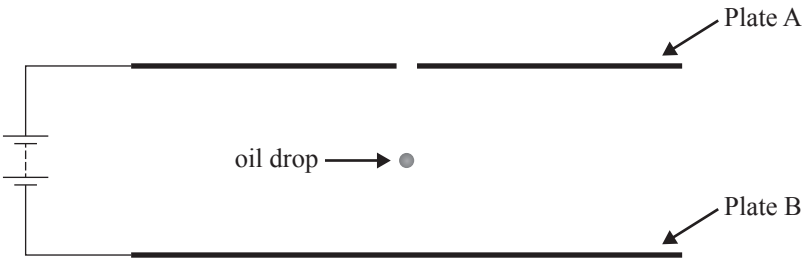
An experiment performed by Robert Millikan in 1909 determined the size of the charge on an electron. Millikan put a charge on a tiny drop of oil, and measured how strong an applied electric field had to be in order to stop the oil drop from falling. The diagram below shows a simplified version of the apparatus he used:



Millikan used x-rays to produce a negative charge on the oil drops.

(a) Explain why the battery is connected as shown in the diagram.

(b) In terms of forces, state the conditions necessary for the oil drop to be held stationary between the horizontal plates.

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(c) On one occasion, Millikan used an oil drop of mass 2.54×10^{-5} kg with a charge of 3.6×10^{-9} C. The plates were 4.8×10^{-4} m apart.

Calculate the voltage needed to hold the oil drop stationary between the two plates.

Start by working out the weight force of the oil drop using $F_g = mg$ and $g = 9.8$ N kg^{-1}.

(d) Express your answer to Part (c) to the correct number of significant figures.

Give a reason for your choice of significant figures.

QUESTION FOUR: ELECTROMAGNETISM

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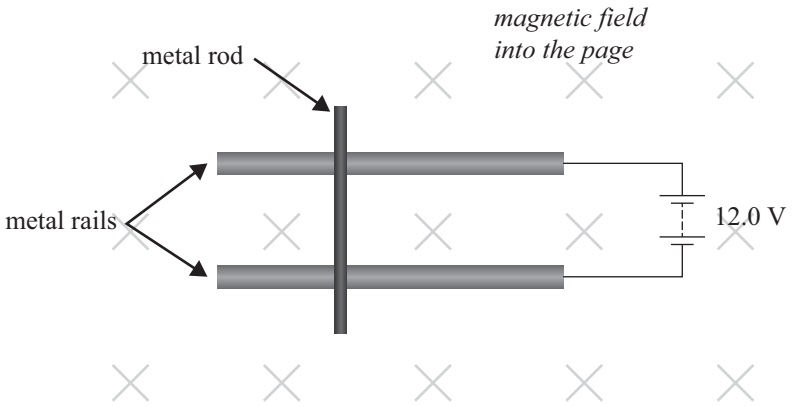
The diagram below shows a metal rod that is free to roll along, across two parallel metal rails. The rails and the rod are in a magnetic field that is directed into the page. The ends of the rails are connected to a 12.0 V power supply.



(a) **State and explain** what happens to the metal rod when the power supply is switched on.

(b) Calculate the electromagnetic force experienced by the metal rod when the power supply is switched on.

You are given the following information:

Strength of magnetic field	$= 0.85 \times 10^{-3}$ T
Length of metal rod	$= 25.0 \times 10^{-2}$ m
Distance between parallel metal rails	$= 18.5 \times 10^{-2}$ m
Resistance of wires, rails and rod	$= 35.4\ \Omega$
Voltage of power supply	= 12.0 V

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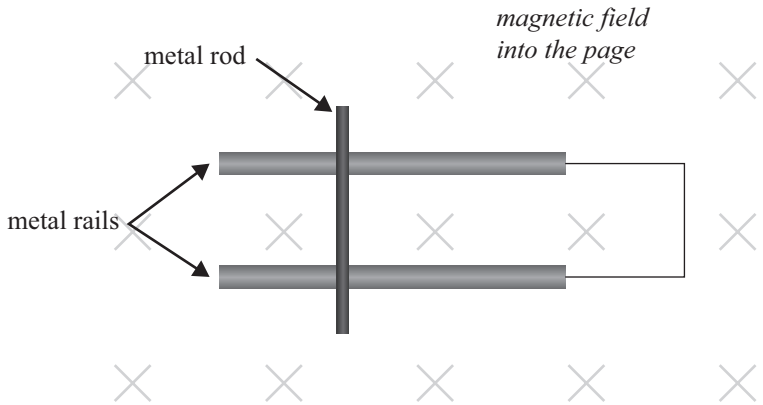
(c) The power supply is removed and a wire is connected to the metal rails. The metal rod is given a gentle push so that it rolls freely to the right, as shown in the diagram. The magnetic field is still directed into the page.



Calculate the voltage induced across the metal rod as it moves through the magnetic field.

You are given the following information:

Strength of magnetic field = 0.85×10^{-3} T
Length of metal rod = 25.0×10^{-2} m
Distance between parallel metal rails = 18.5×10^{-2} m
Speed of metal rod = 2.5 m s^{-1}

(d) Describe what happens to the movement of the metal rod as it continues to move through the magnetic field.

Explain your answer.

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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