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NZQA

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Level 1 Physics, 2015

90937 Demonstrate understanding of aspects of electricity and magnetism

9.30 a.m. Thursday 19 November 2015
Credits: Four

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

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 L1–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 room for any answer, use the extra space 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.

Not Achieved

TOTAL 4

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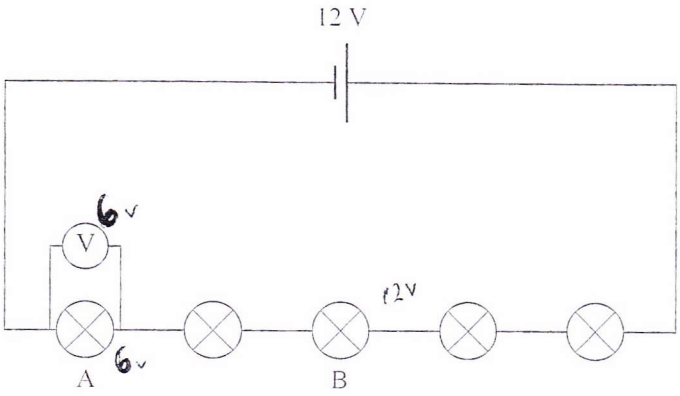
QUESTION ONE: DC ELECTRICITY

A road-side stall in a street fair is lit with five **identical** 6.0 V bulbs. The bulbs are connected in series to a 12 V battery, and in this circuit the resistance of each bulb is 2.5 Ω. A voltmeter is connected across the bulb A, as shown in the diagram below.

Circuit 1



(a) (i) What is the reading on the voltmeter?

[redacted] 6V

(ii) Give an explanation for part (i).

because it is a series circuit, the 12 V powered by electrical current travels from one place to another the number of volts stays 12 until it reaches bulb A which splits into 2 pathways (V & bulb A). Therefore the 12 V will split in half, 6 going through (A) & 6 going through (V)

(b) Calculate the current through the circuit.

[redacted]

$P = IV$

for a the answer needs to recognise that supply voltage (12V) splits up between components in series. The 6V is an ideal operating voltage, but not always the actual voltage.

Current:

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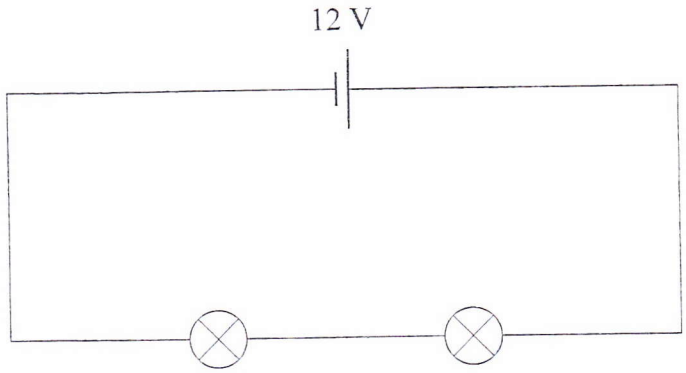
(c) In the following circuit, two **identical** 6.0 V bulbs, similar to the ones used in Circuit 1, are connected in series across a 12 V battery.

Circuit 2



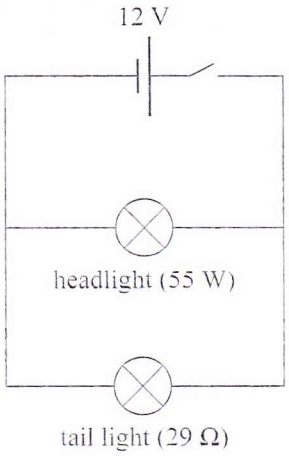
Compare the brightness of bulbs in this circuit to the brightness of bulbs in Circuit 1.

Explain your answer.

Circuit 2 will shine brighter because it only needs to share it's 12V battery with 2 bulbs, as opposed to circuit 1 who has to share a 12V battery with 5 bulbs & a voltmeter. When the light is turned on & the bulbs are functioning, circuit 2 contains the most effective use of brightness as it has the least amount of bulbs. Circuit 1 may flicker or shine less bright as the 12V is under pressure as the current needs to travel through many bulbs.

a

(d) The diagram below shows the wiring of the headlight and the tail light in a quad bike. Both bulbs are designed to work across a 12 V battery. When the switch is turned on, the power output of the headlight is 55 W and the working resistance of the tail light is 29 Ω.



(i) Calculate the total current drawn from the battery when the switch is closed.

V = IR

for a the answer needs to rearrange V=IR to R=V/I in order to calculate resistance of the tail light.

Total current:

(ii) The headlight has printed on it "12 V, 55 W".

What does "12 V, 55 W" mean?

it was 12 volts & 55 watts

QUESTION TWO: STATIC ELECTRICITY

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Zoe uses a plastic brush to groom her dog. She notices that on dry days the hair sticks out after she has brushed it, as shown in the picture below.

www.pamperedpuppy.com/doggydesktops/

(a) Explain what causes the dog's hair to stick out after Zoe has removed the brush.

Static electricity, caused when certain materials rub together (like Zoes plastic hair brush & the dogs fur). This allows for electrons from Zoes plastic brush to transfer onto the dogs fur. This causes the dogs hair to stick up.

a

(b) After brushing, Zoe notices that when she holds the brush closer to the dog, the hair moves towards the brush.

Because it allows ~~Because~~ more ~~the~~ electrons ~~are~~ ~~better~~ to be transferred from the brush to the fur when ~~expected~~ Zoe holds the brush closer. The dogs fur starts off positively charged with more protons that electrons, once the brush comes into contact & transfers these electrons Zoes dogs fur will be negatively charged. The uncharged material (zoes dogs fur) now becomes charged as the result of transfer of electrons (static electricity

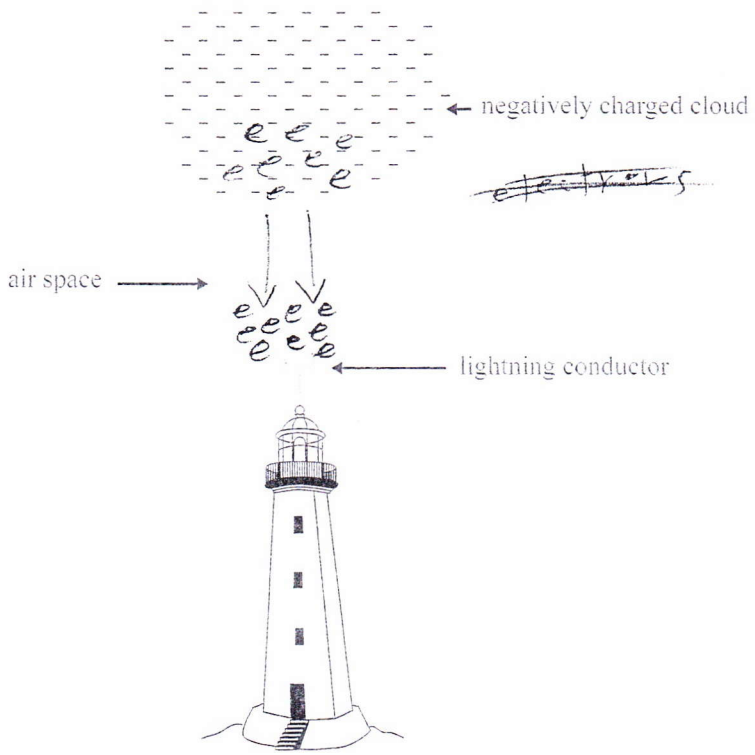
for a the answer needs to describe the hair and brush becoming oppositely charged due to charge transfer

(c) Explain what would happen to her dog's hair if Zoe now strokes it with her bare hand.

Nothing, no static electricity would take place because our skin is positively charged like the dogs fur so like charges will repell.

for a the answer needs to describe the hair losing its charge to Zoe's hand

(d) The diagram shows a large, negatively charged thundercloud passing over a lighthouse with a lightning conductor.



(i) On the diagram, draw the charge distribution in the **air space** between the lightning conductor and the charged cloud.

(ii) Explain what causes the charges to be distributed as shown in your diagram.

electrons are being transferred from the cloud to the lighthouse & because there is a lightning conductor, current electricity can be passed through. This conductor is most likely made out of metal, as metals are used for conducting current electricity. As this cloud is transferring current electricity to the lighthouse, the lighthouse is gaining electrons therefore becoming negatively charged. The conductor allows for electrons to hit preventing lightning from damaging

(iii) Lightning strikes can damage the structure of a building. The lightning conductor protects the building from lightning strikes.

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Explain how the lightning conductor gives protection to the building from lightning strikes.

In your explanation you should include:

- the type of material used for a lightning conductor
- why this material is used as the lightning conductor
- how the lightning conductor works.

material used for conducting electricity are mostly metals (copper, steel and others). This material allows for current electricity to flow through from one place to another. It stops the lightning from damaging the building as it is a barrier because if the lightning hit the (e.g.) wooden roof first, since it is not a conductor, it won't conduct electricity away from the building. An insulator stops the flow or prevents the flow of electrical current, insulators are usually non-metals.

4

N2

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QUESTION THREE: MAGNETIC EFFECTS

The diagram below shows the **geographic** north and south poles of the Earth.

Adapted from: http://jeweell.com/data_images/out/75/1134759-earth.jpg

(a) The Earth behaves like a giant magnet and creates a magnetic field around itself.

Describe what is meant by the term "magnetic field".

A magnetic pull between the 2 ends of our earth (north & south). This creates an atmosphere on earth, the two unlike charges attracting eachother.

(b) A compass needle on Earth points in the direction as shown in the diagram.

(i) On the above diagram, using letters "N" and "S", label the north and the south poles of the **compass needle**.

(ii) Explain why the compass needle points in the direction shown in the diagram.

Because North is upwards & south is downwards. Both ends are cold but gradually get warmer going int the middle. The compass needle is slightly tilted because earth is tilted on an axis.

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(c) The diagram below shows two magnetic north poles placed close to each other.

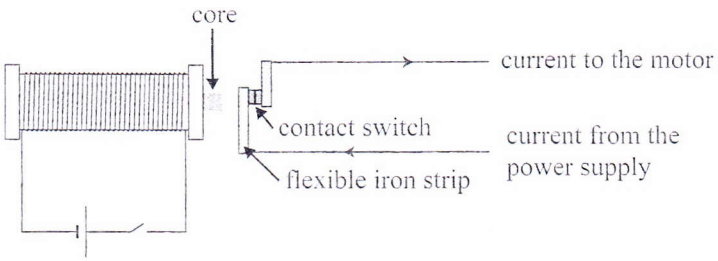
REPELL

On the diagram, draw lines to show the **pattern** of the magnetic field formed between the two north poles.

Use **arrows** to indicate the direction of the magnetic field.

n

(d) The diagram shows an electromagnetic relay switch used to **switch off** an electric motor in a factory. The relay consists of a coil outside an inner core. It is placed at a fixed distance from a contact switch, which turns the electric motor on or off. One arm of the switch is made from a flexible iron strip, and is placed near the core of the electromagnetic relay.



(i) Name a suitable material for the core, and give a reason for your answer.

~~metal like wood~~ a metal like steel to conduct the electrical current to flow through it.

for a the answer needs to recognise that iron is suitable for the core rather than steel (this is because iron becomes demagnetised when current is turned off)

(ii) The switch is now turned on.

Explain how the relay works.

Electrical current flows through the core & the voltage runs vertically going round the core.

for a need to explain that the current cause the core to become magnetised

Question Three continues on the following page.

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(iii) When the motor is operating, the current-carrying cable to the motor produces a magnetic field of 1.6×10^{-5} T at a distance of 25 cm from the cable.

Calculate the size of the current in the cable.

$k = 2.0 \times 10^{-7}$ T m A^{-1}

for a need to rearrange B = kI/d to get I = Bd/k and substitute to find I

Current: .....

n

N1