**General Certificate of Secondary Education
2012**

Science: Double Award (Modular)

Paper 3
Higher Tier

[G8206]

G8206

FRIDAY 15 JUNE, AFTERNOON

7674.05**R**

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
Total Marks	

1 **(a)** Two men pull a roller over a football pitch.

The diagram below represents the forces that are exerted.

50 N ← Roller → 200 N

→ 200 N

Handle
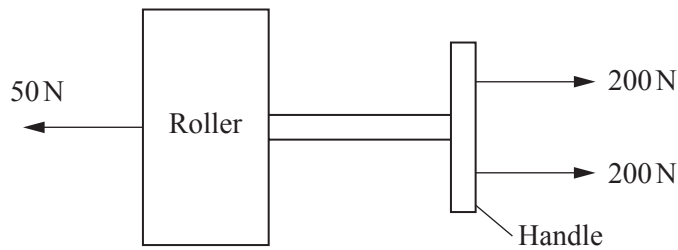
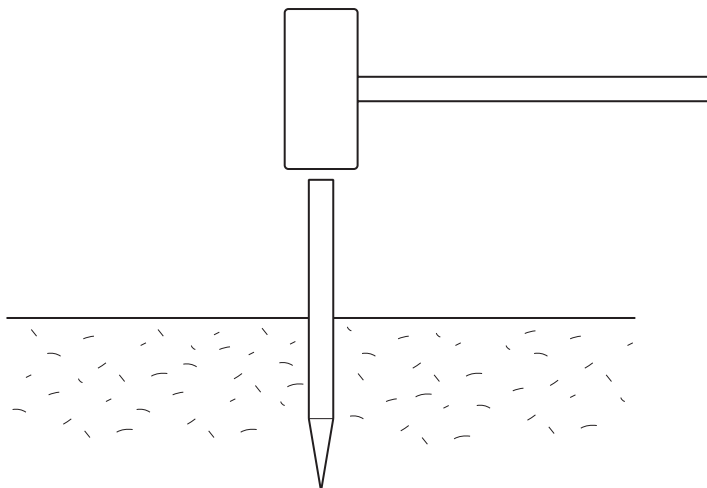The men exert a force of 200 N each and the opposing forces add up to 50 N.

Calculate the acceleration of the roller if its mass is 500 kg.

You are advised to show your working out.

Acceleration = _____ m/s^2 [4]

(b) A hammer is used to drive a stake into the ground.

One strike of the hammer drives the stake a distance of 0.2 m into the ground. The average resistance force exerted by the ground is 320 N.

(i) Show that the work done on the stake is 64 J.

[2]

(ii) Assume that the kinetic energy of the hammer is 64 J at the point of impact and that the mass of the hammer is 0.5 kg.

Calculate the velocity of the hammer at impact.

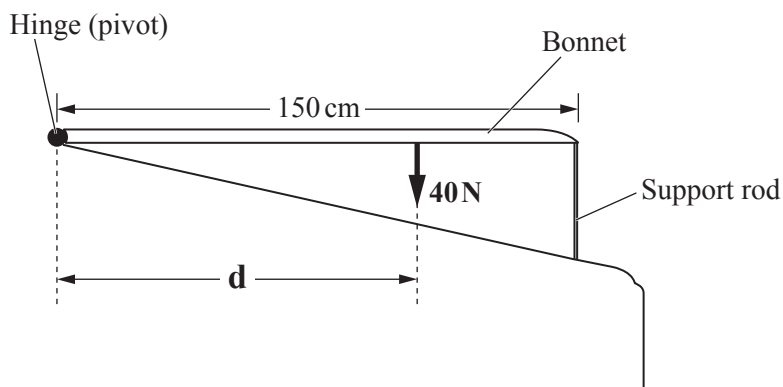**You are advised to show your working out.**

Velocity = _____ m/s [3]

(c) (i) State the Principle of Moments.

_____

_____ [2]

(ii) The bonnet of a truck is held in a horizontal position by a support rod.
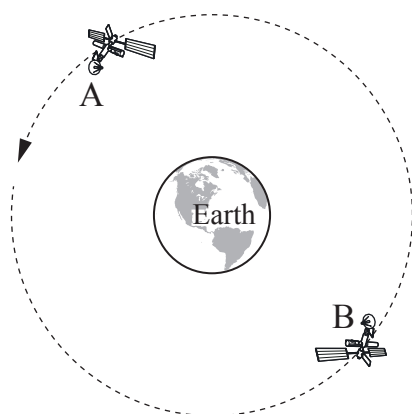

The support rod exerts an upward force of 24 N and the bonnet has a weight of 40 N. Calculate the distance **d** of the centre of gravity of the bonnet from the hinge.

You are advised to show your working out.

Distance = _____ cm   [4]

2 The diagram shows two satellites A and B orbiting the Earth on the same circular path and in the same direction.

(a) (i) Draw an arrow on satellite A to show the direction of the force acting on it due to the Earth. [1]

(ii) Satellite B has a greater mass than satellite A. How does the force on satellite A compare with the force on satellite B?

Tick (✓) the correct answer.

The force on A is greater than the force on B.	
The force on A is equal to the force on B.	
The force on A is less than the force on B.	

[1]

(iii) Name the force on the satellites which keeps them moving in a circle.

_____ [1]

(iv) The radius of satellite A's orbit is reduced. How will this affect the force between satellite A and the Earth?

Tick (✓) the correct answer.

The force on A will decrease.	
The force on A will remain the same.	
The force on A will increase.	

[1]

(v) Draw an arrow on satellite B to show the direction of its velocity. [1]

The Sun is a star.

(b) (i) What is the name given to a collection of stars?

_____ [1]

(ii) There are four stages in the formation of a star.

Use the numbers 1, 3 and 4 to complete the order in which the stages occur.

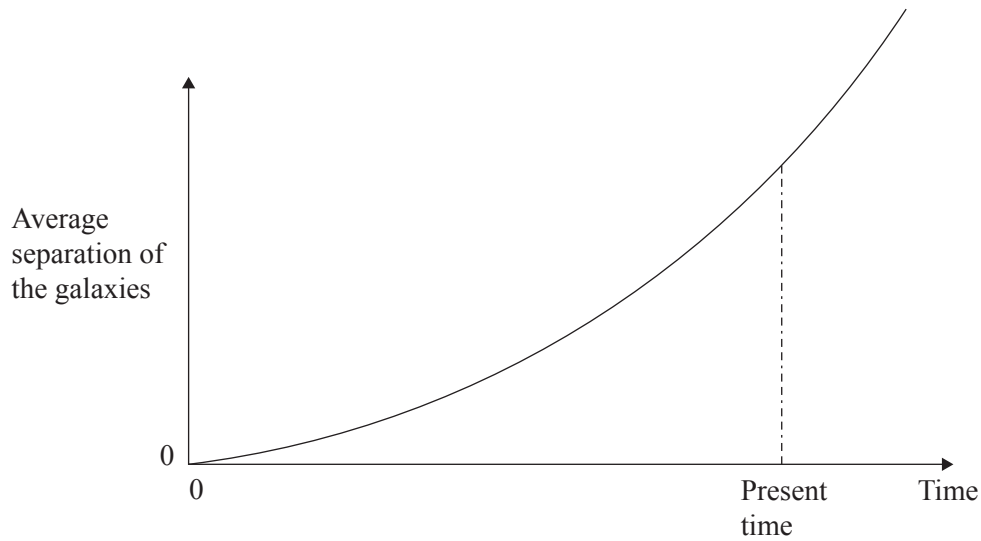| Gas ball begins to spin	2
Hydrogen particles are pulled together by gravitational forces	
The star generates energy	
The temperature rises	

[2]

(iii) State two types of radiation emitted by a star.

1. _____

2. _____ [2]

(c) The Big Bang theory explains the origin and expansion of the universe.

The graph above shows how the average separation of the galaxies has increased over time, according to the Big Bang theory.

(i) What other feature of the graph supports the Big Bang theory?

_____ [1]

(ii) Name the other scientific theory which attempts to explain the origin of the universe.

_____ [1]

(iii) State two reasons, not related to cost, why it is difficult to send a manned spacecraft to another planet outside our solar system.
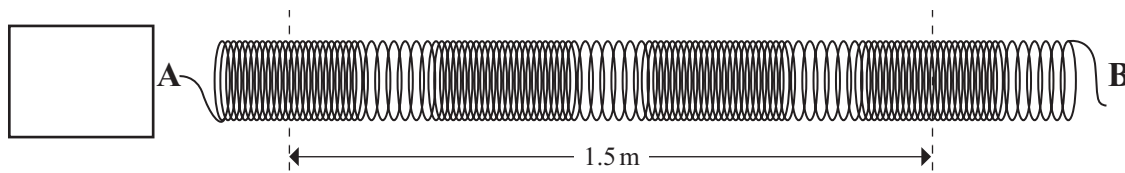
1. _____

2. _____ [2]

(iv) What nuclear process in stars generates energy?

_____ [1]

3 **(a)** Shauna uses a stretched slinky to make longitudinal waves.

A 〰〰〰〰〰〰〰〰〰 B

|← 1.5 m →|

(i) What do the longitudinal waves transfer from **A** to **B**?

_____ [1]

(ii) In the box, draw a double-headed arrow to indicate the direction Shauna would have to move end **A** to make longitudinal waves. [1]

(iii) Shauna sends 18 waves along the slinky in 6 seconds. How many waves does she make in 1 second?

_____ [1]

(iv) Use your answer to part **(iii)** to state the frequency of the waves.

Frequency = _____ Hz [1]

(v) What is the wavelength of the longitudinal waves?

Wavelength = _____ m [1]

(vi) Use your answers to parts **(iv)** and **(v)** to calculate the speed of the longitudinal waves.

You are advised to show your working out.

Speed = _____ m/s [3]

(vii) Give another example of a longitudinal wave.

_____ [1]

(b) Transverse waves can also be made with a slinky spring.
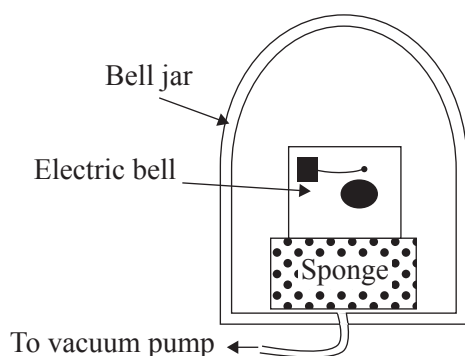
    (i) How would the vibrations of the slinky spring be different if Shauna made a transverse wave?

    _____ [1]

    (ii) Give another example of a transverse wave.

                           _____ [1]

(c) An electric bell is set ringing inside a bell jar.

Bell jar

Electric bell

Sponge

To vacuum pump

When the hammer strikes the gong, sound is produced.

    (i) Why is sound produced by the gong?

    _____ [1]

    (ii) What happens to the loudness of the sound from the gong when the vacuum pump is switched on?

    _____ [1]

    (iii) What does this experiment demonstrate about sound waves?

    _____ [1]

    (iv) If the experiment is repeated without the sponge, the sound of the electric bell can always be heard. Explain why this is so.

    _____

    _____ [1]

(d) What are the frequency limits of human hearing?

    (i) Lower limit = _____ Hz   [1]

    (ii) Upper limit = _____ Hz   [1]

    (iii) How, if at all, does the upper limit change with increasing age?

    _____ [1]

    (iv) What damage can long exposure to loud sound cause to the ears?

    _____ [1]

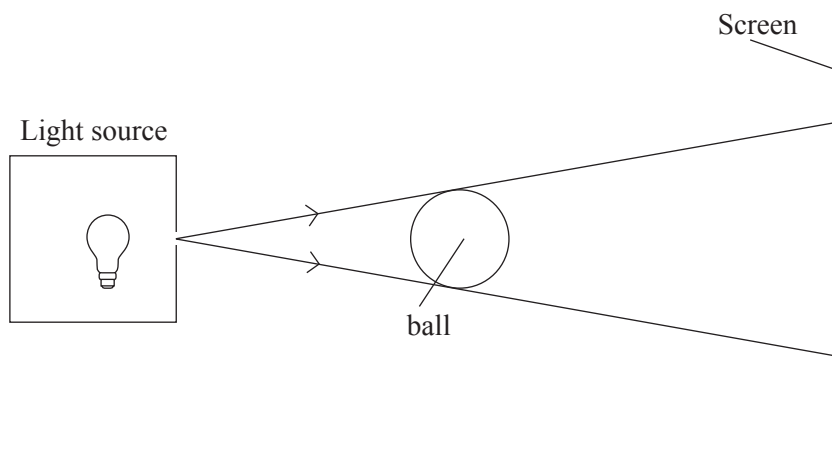   **(v)** How can people who operate very noisy machines reduce damage to their ears?

    _____ [1]

4 **(a) (i)** Indicate with a tick (✓) on the table below whether the object is luminous or non-luminous.

Object	Luminous	Non-luminous
Star		
Moon		
Planet		
White paper		

[4]

The diagram below shows a shadow of a ball being formed on a screen by a point source of light.
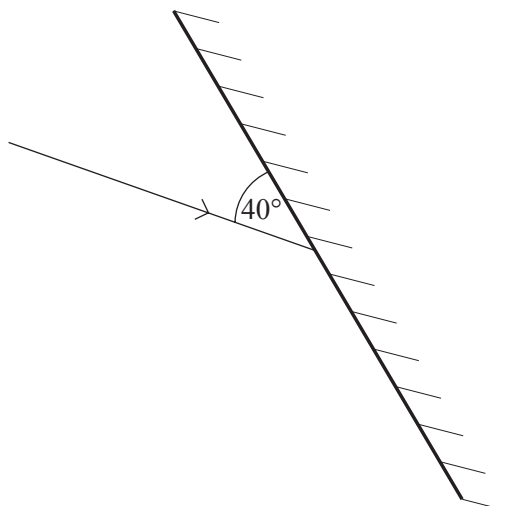

(ii) Which statement below best describes the shadow formed on the screen?

A The shadow is uniformly black.

B The shadow contains partial shadow AND uniformly black shadow.

C The entire shadow is partial shadow.

Answer _____ [1]

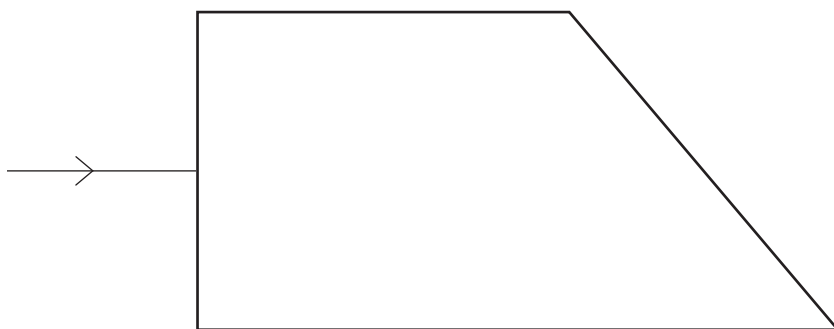A ray of light is incident on a plane mirror as shown.

40°

(b) (i) Draw and label the normal. [1]

(ii) What size is the angle of reflection?

Angle of reflection = _____ ° [1]

Different shapes of glass prism are often used to change the direction of light rays.

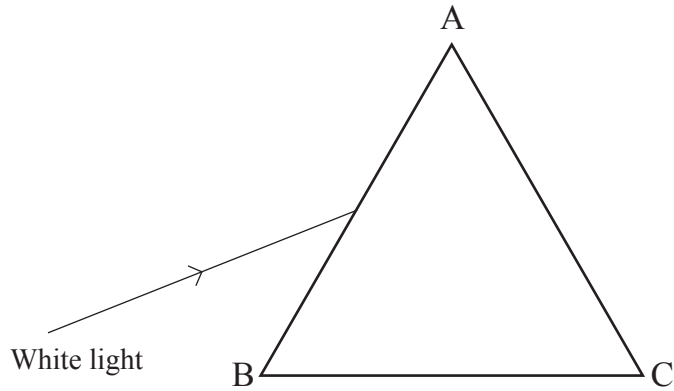**(c) (i)** Continue the path of the ray shown until it emerges into the air.

[3]

(ii) Does the speed of light increase, decrease or remain the same as it enters the glass?

_____ [1]

White light enters a prism.

A

White light

B   C

A prism may be used to split white light into its component colours.

(d) (i) What is this process called?

_____ [1]

(ii) List the component colours produced **beginning with** the colour nearest the corner C.

_____ [2]

(iii) What name is given to this group of colours?

_____ [1]

The box contains the names of some electromagnetic waves.

| Ultraviolet | Gamma rays | Microwaves | Radio waves | Infrared |

(e) (i) Which one has the shortest wavelength?

_____ [1]

(ii) Which one comes from a coal fire?

_____ [1]

(iii) Which one can be used to sterilise medical equipment?

_____ [1]

(iv) Which one can cause skin cancer?

_____ [1]

(v) Which one has the longest wavelength?

_____ [1]

5 **(a)** James was wearing a woollen sweater and a nylon shirt. When he removes the sweater he sees a spark.
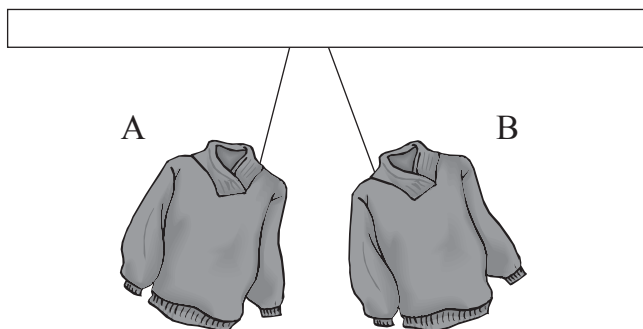
(i) Explain fully in terms of charge movement how the sweater became charged.

_____

_____ [2]

Quality of written communication [1]

When two charged sweaters (A and B) were suspended on threads they moved apart as shown below.

A   B

(ii) What does this indicate about the charges on the sweaters?

_____ [1]

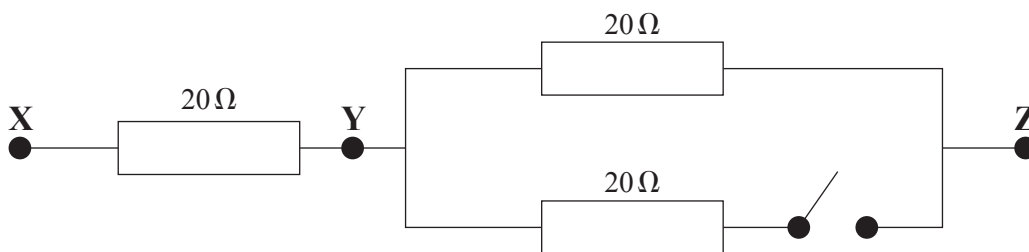**(iii)** Explain your answer to part **(ii)**.

_____ [1]

(b) A charge of 0.6 C is transferred from a charged sweater through a conductor in 0.2 seconds.
What current flows through the conductor?

You are advised to show your working out.

Current = _____ A   [3]

(c) Three 20 Ω resistors are connected as shown below.

Complete the following table to show the total resistance between the different points for the switch settings indicated.

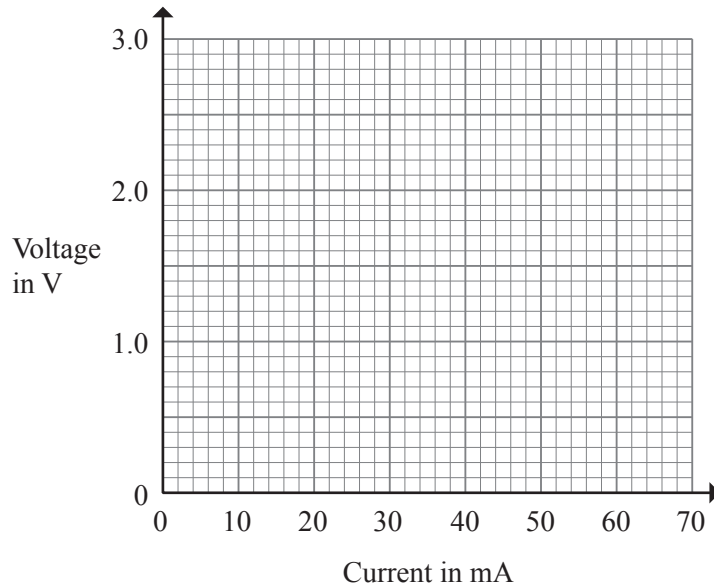| Points	Switch	Resistance in Ω
Y and **Z**	Closed	
X and **Z**	Open	
X and **Z**	Closed	

[3]

(d) A pupil investigates the variation of current with voltage for a resistor. The results are given below.

| Voltage in V	0	0.8	1.2	1.8	2.0	2.8
Current in mA	0	20	30	40	50	70

(i) Plot the points on the grid. [1]

(ii) Draw the best fit straight line through the points. [1]

(iii) Use your graph to find the voltage when the current is 60 mA

Voltage = _____ V [1]

(iv) Convert 60 mA to A. Remember 1 mA = 0.001 A

Current = _____ A [1]

(v) Use your answer to parts **(iii)** and **(iv)** to calculate the resistance of the resistor.

You are advised to show your working out.
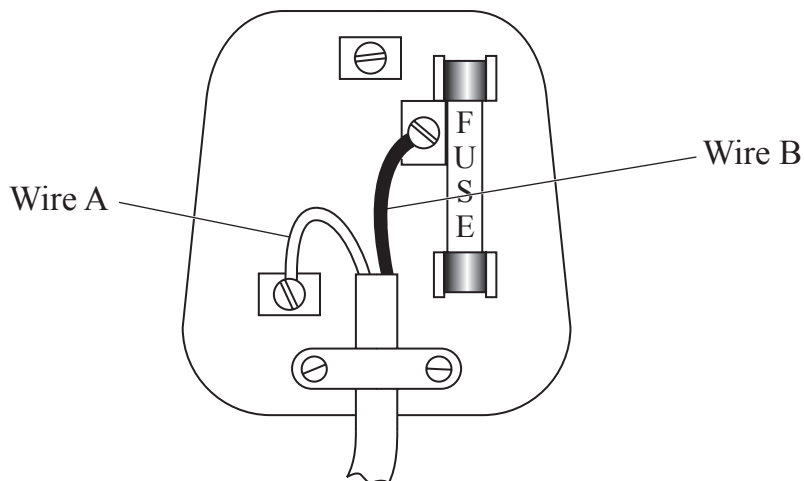
Resistance = _____ Ω [3]

(e) Sketch below a graph to show how voltage varies with current for an electric light bulb.

Voltage

0

0

Current

[2]
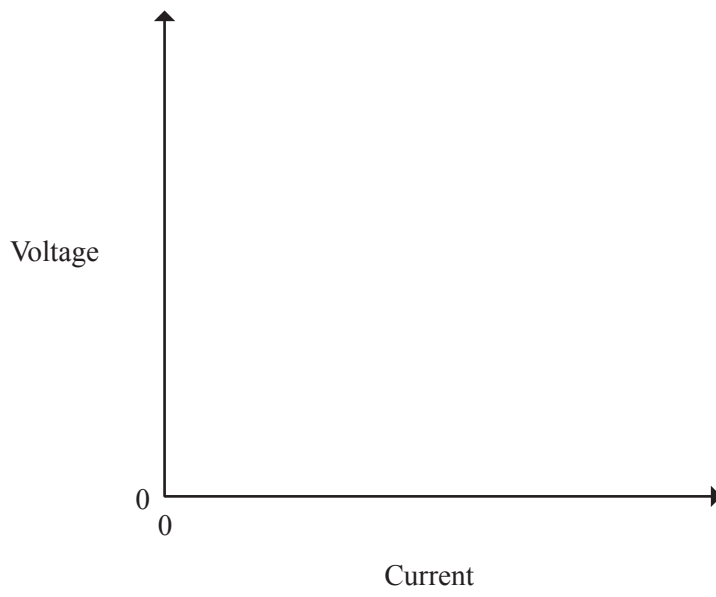
6 The diagram shows the wiring in an electrical plug.

(a) (i) Which terminal has no wire connected?

_____ [1]

Identify the two wires, A and B, and give their colours.

(ii) Wire A is the _____ wire and it is a _____ colour. [1]

(iii) Wire B is the _____ wire and it is a _____ colour. [1]

(iv) Why is the fuse connected to wire B in the plug?

_____ [1]

When the plug shown above is connected to a hairdryer, it is still safe for use.

(v) What property of the hairdryer makes this possible?

_____ [1]

When a **three core** electrical cable passes through the metal body of an electrical appliance a rubber ring (grommet) is inserted in the entry hole. This is done as a precaution to protect the cable from the sharp edge of the hole.

Rubber ring (grommet)
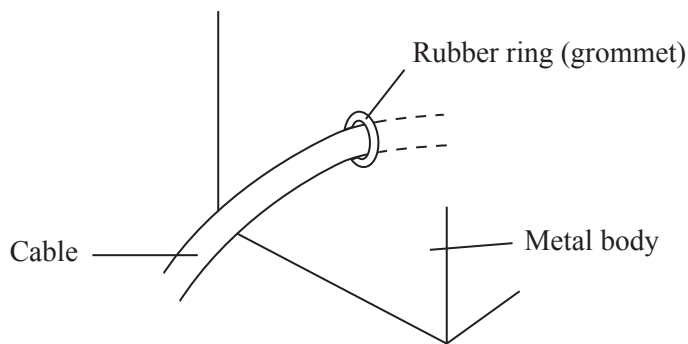
Cable

Metal body

With use this grommet can wear away and the edge of the metal body can cut through the insulation in the electric cable.
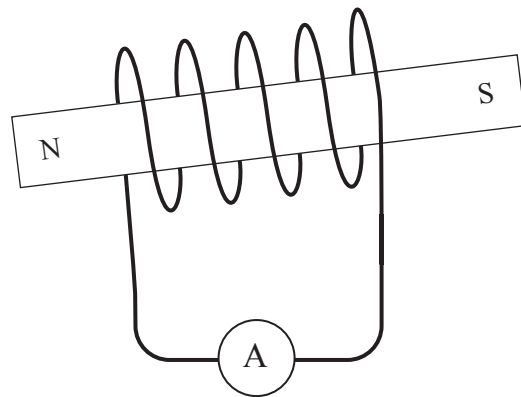
(b) (i) What makes this dangerous?

_____ [1]

(ii) Explain fully how earthing reduces the danger.
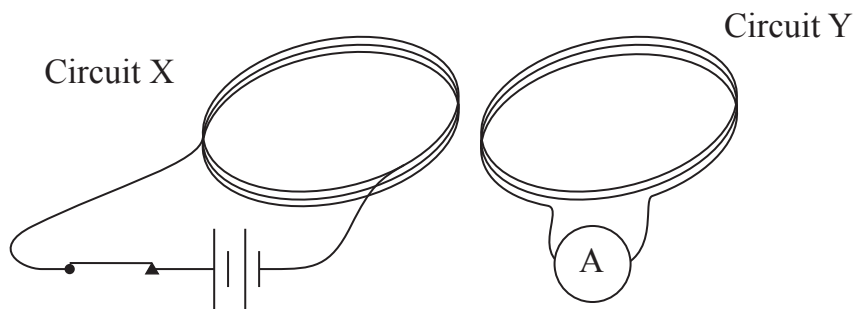
_____

_____

_____

_____ [3]

A coil of wire is connected to a very sensitive ammeter and a magnet is at rest inside the coil.

(c) (i) Why does no current flow in the coil?

_____ [1]

Another arrangement is shown below. No current flows in Circuit Y.

Circuit X

Circuit Y

A

(ii) State three practical ways that a current can be induced in Circuit Y.

1. _____

2. _____

3. _____ [3]

Step-up transformers are used in electricity transmission.

(d) (i) What quantity is "stepped up" by such a transformer?
Circle the correct answer.

current

power

energy

voltage [1]

(ii) Explain why such a transformer is used in electricity transmission.

_____

_____ [2]

A transformer changes the voltage from 132 kV to 25 kV. The 132 kV supply is connected to one side of the transformer which has 10 560 turns.

(e) How many turns has the other coil?

You are advised to show your working out.

Number of turns = _____ [4]

THIS IS THE END OF THE QUESTION PAPER