



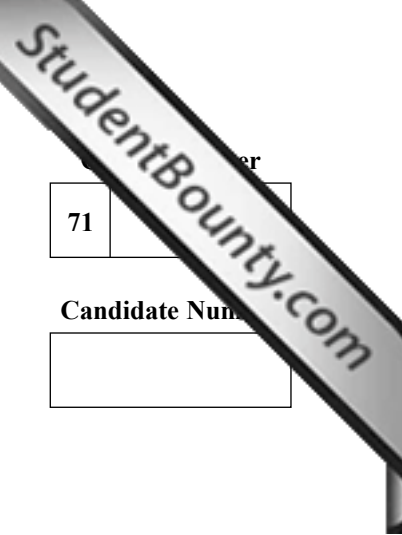
General Certificate of Secondary Education
2010

Science: Physics

Paper 1
Higher Tier

[G7604]

FRIDAY 28 MAY, MORNING



71	er
Candidate Number	
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TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

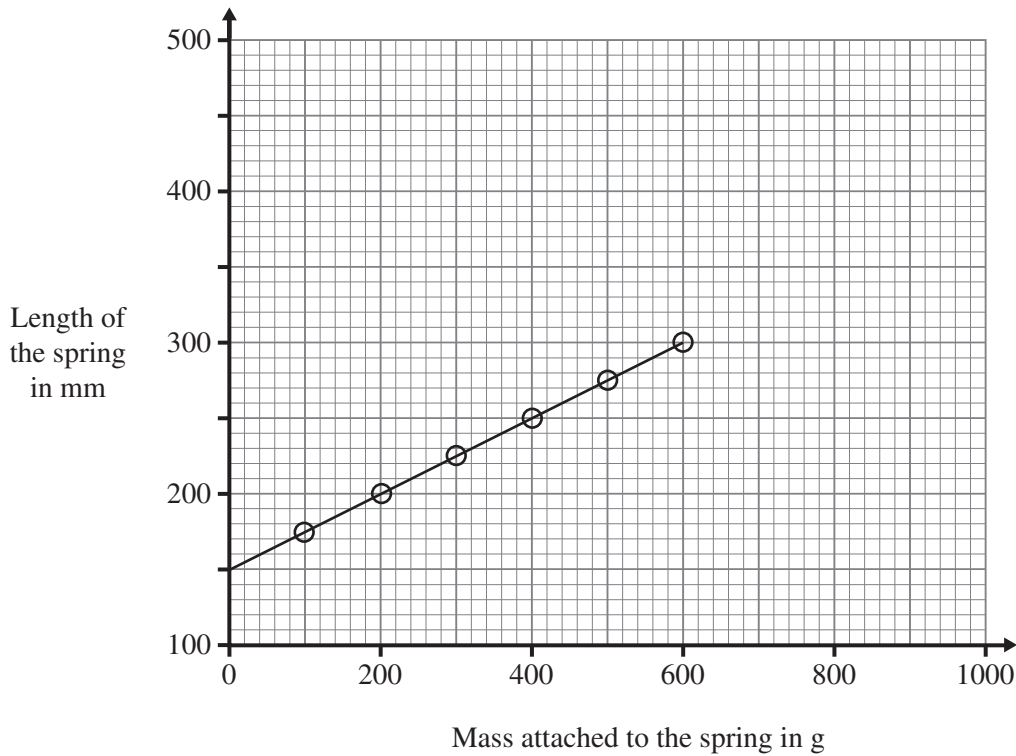
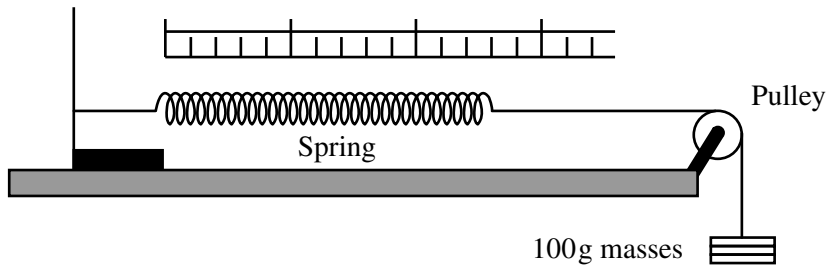
INFORMATION FOR CANDIDATES

The total mark for this paper is 125.
Quality of written communication will be assessed in question **1(b)(iii)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Details of calculations should be shown.
Units must be stated with numerical answers where appropriate.

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

Examiner Only	
Marks	Remark

1 (a) John sets up the apparatus shown below. He uses it to discover how the length of the spring changes as he increases the force stretching it. He changes this force by adding 100 g masses to a length of string attached to the spring. The graph below shows some of John's results.



(i) With reference to the graph, explain why the **length** of the spring is **not** directly proportional to the mass attached to it.

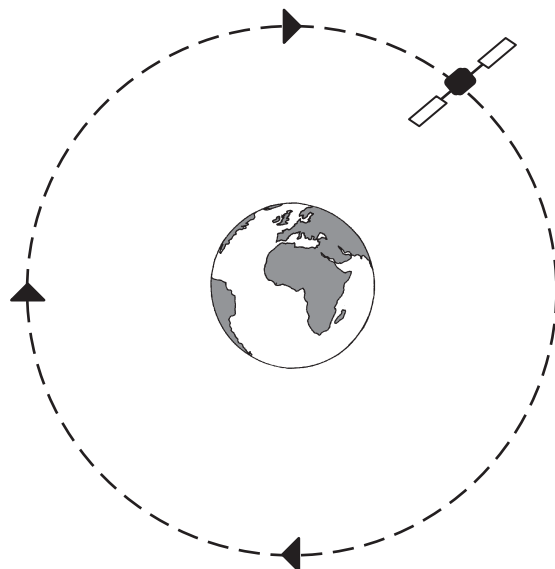
_____ [1]

(ii) Use the graph to find the **extension** of the spring for each 100 g mass added.

Extension for each 100 g mass = _____ mm [1]

(iii) John discovers that the spring obeys Hooke's law for masses up to a maximum of 800 g. On the grid, continue the graph to show its shape up to 800 g and from 800 g to 1000 g. [2]

(b) The diagram shows a satellite in orbit around the Earth.



- (i) The satellite takes 1.5 **hours** to complete one orbit. The distance it travels in one orbit is 40 000 km.
Calculate its average speed in kilometres per hour.
You are advised to show clearly how you get your answer.

Speed = _____ km/h [3]

- (ii) The satellite has a mass of 150 kg.
Calculate its momentum. Give your answer in kgm/s.
You are advised to show clearly how you get your answer.

Momentum = _____ kgm/s [4]

Examiner Only

Marks Remark

(iii) Explain why a satellite's velocity is different from its speed.

[1]

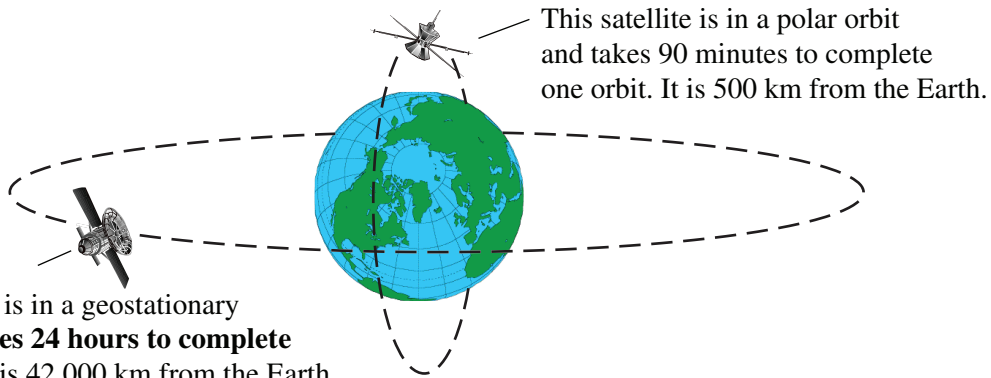
Quality of written communication

[1]

(iv) What is the average velocity for one complete orbit?

[1]

(c) The diagram below shows two satellites circling the Earth in different orbits. The satellites have the **same mass**. The centripetal force needed to keep each satellite in orbit is provided by the gravitational attraction of the Earth.



(i) How does the size of the centripetal force acting on each satellite compare? Explain your answer.

[2]

(ii) State a possible use for the satellite that is in a polar orbit.

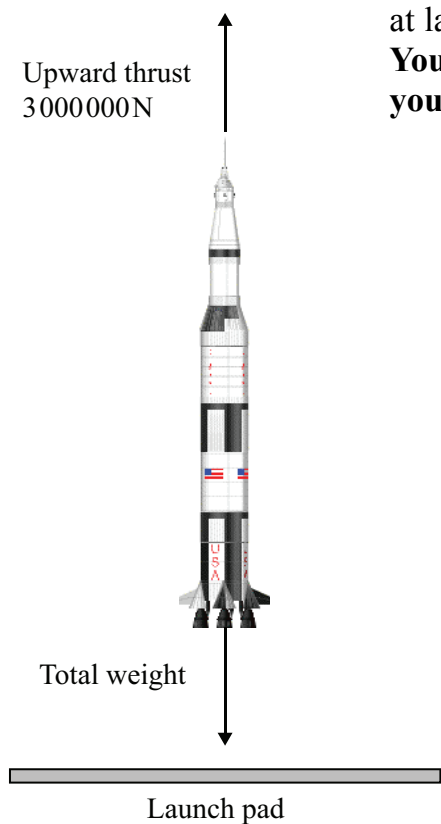
[1]

(iii) State a possible use for the satellite that is in a geostationary orbit.

[1]

Examiner Only	
Marks	Remark

- (d) The diagram shows a rocket just after its launch.
At launch, the rocket and contents have a total mass of 140 000 kg.
The engine produces an upward thrust of 3 000 000 N.



- (i) Calculate the resultant upward force on the rocket at launch.
You are advised to show clearly how you get your answer.

Resultant force = _____ N [3]

- (ii) Calculate the acceleration this resultant force produces at launch.
You are advised to show clearly how you get your answer.

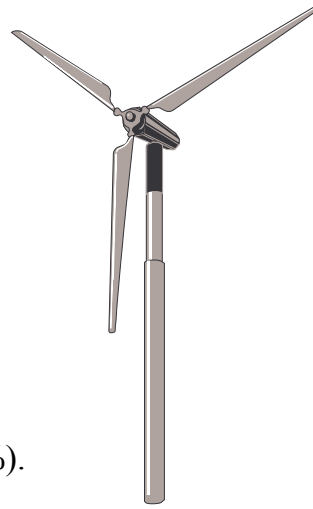
Acceleration = _____ m/s² [3]

- (iii) As the rocket moves upwards, the downward force becomes less, because fuel is being burnt off while the thrust remains the same.
How does the size of the acceleration change?

_____ [1]

Examiner Only	
Marks	Remark

- 2 (a) The use of wind turbines is on the increase. Wind turbines convert some of the kinetic energy of moving air into electricity.



- (i) The efficiency of a wind turbine is 0.3 (30%). Explain carefully what this means.

[2]

- (ii) The kinetic energy of 1 kg of air moving with a velocity of 6 m/s is 18 J. The efficiency value for this wind turbine is 0.3 (30%). Calculate the electrical energy generated from 1 kg of air moving with a velocity of 6 m/s.
You are advised to shown clearly how you get your answer.

Electrical energy = _____ J [2]

- (iii) Every second, 5 000 kg of air moving at 6 m/s passes through the wind turbine. Calculate the output electrical power of the wind turbine. Include the unit for power in your answer.
You are advised to show clearly how you get your answer.

Output electrical power = _____ [4]

Examiner Only	
Marks	Remark

(b) Global warming is seen by many as a major threat to many countries and peoples.

(i) Nuclear power is seen by some as a solution to the problem of global warming. Explain briefly why this is.

_____ [1]

(ii) State the main environmental disadvantage of using nuclear power to generate electricity and how it is dealt with.

_____ [2]

(iii) Uranium is used as the fuel in most nuclear power stations. How does the amount of uranium needed compare with the amount of coal or oil needed to fuel a power station with the same output power?

_____ [1]

(iv) All power stations, when they come to the end of their useful life, have to be de-commissioned. What does this mean? Describe the problems of decommissioning a nuclear power station compared with a power station that used fossil fuel.

_____ [2]

Examiner Only

Marks Remark

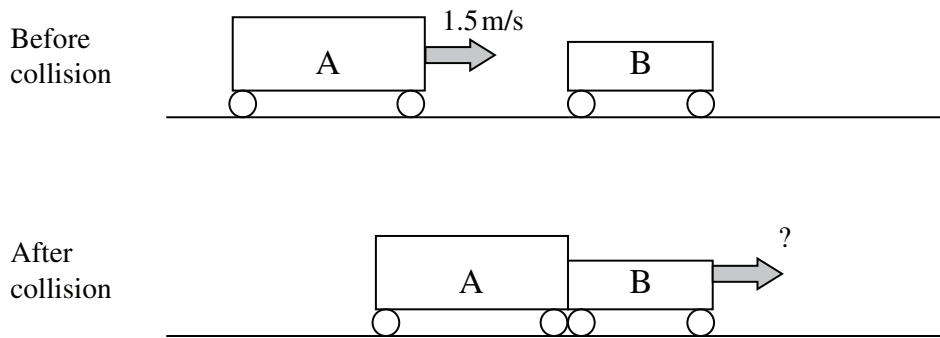
(c) (i) State the principle of conservation of momentum.

Examiner Only

Marks	Remark

_____ [1]

The principle of conservation of momentum is demonstrated in school laboratories using small trolleys like the ones shown below. When trolley A collides with trolley B they stick together and move together.



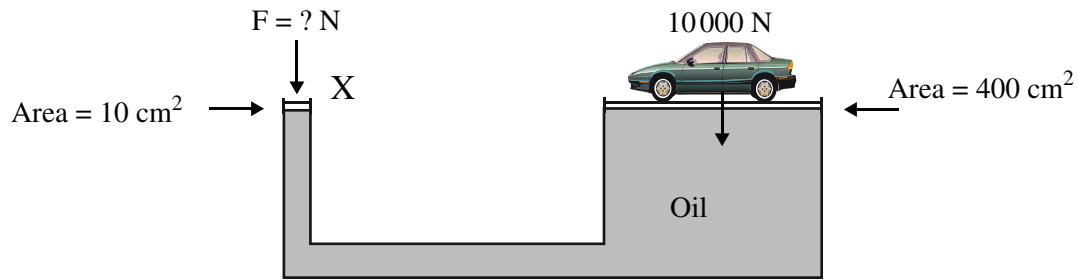
(ii) In one demonstration, trolley A has a mass of 500 g and is moving with a velocity of 1.5 m/s when it collides with trolley B, which is at rest. Trolley B has a mass of 250 g.

Calculate the velocity of the combined trolleys after the collision.

You are advised to show clearly how you get your answer.

Velocity after collision = _____ m/s [3]

- (d) The diagram below shows a hydraulic machine used to raise cars in a garage.



- (i) Explain how a force applied at the end marked X is able to raise the car.

[2]

The car weighs 10 000 N. The area of the small platform is 10 cm^2 and the area of the platform, on which the car sits, is 400 cm^2 .

- (ii) Calculate the force that must be applied to the smaller platform to just raise the car.
You are advised to show clearly how you get your answer.

Force = _____ N [5]

Examiner Only	
Marks	Remark

3 (a) (i) Explain what a luminous object is.

_____ [1]

(ii) Give an example of a luminous object.

_____ [1]

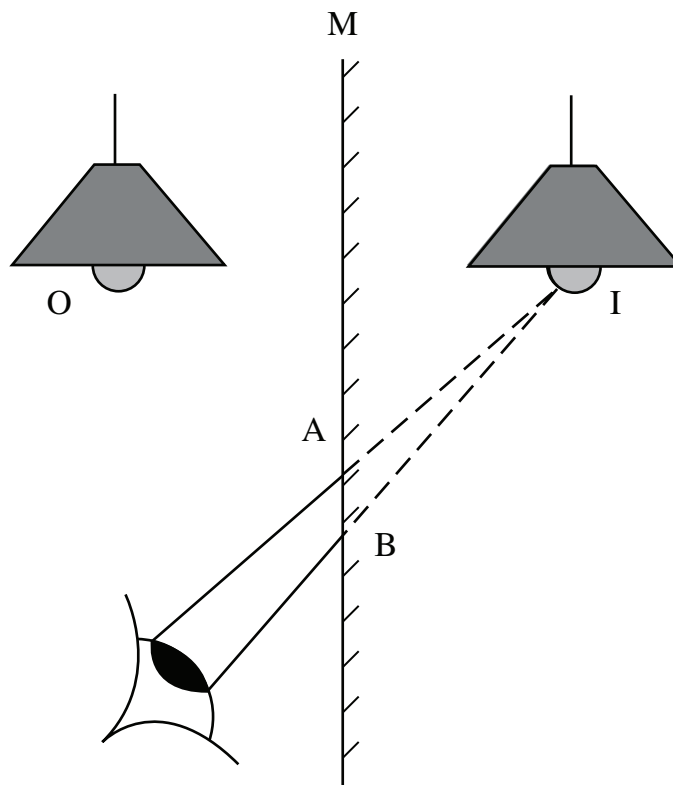
(iii) Explain what a non-luminous object is.

_____ [1]

(iv) Give an example of a non-luminous object.

_____ [1]

(b) The incomplete ray diagram below shows the image I of a lamp O, in a plane mirror M.



Draw on the diagram:

(i) the normals at points A and B.

[1]

(ii) the corresponding incident rays.

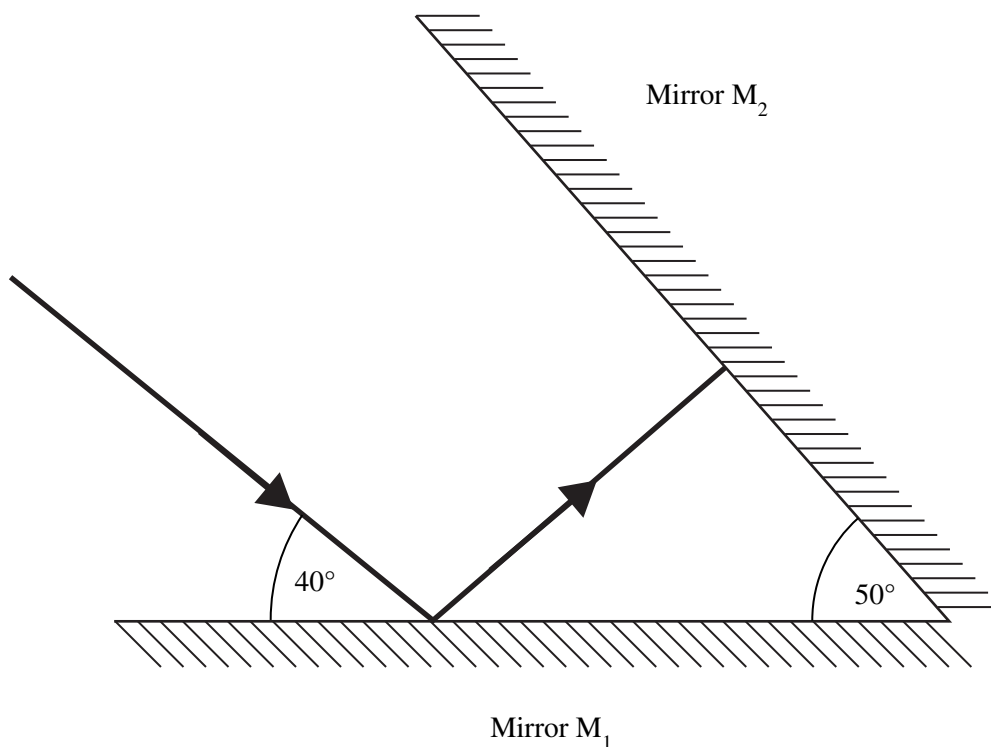
[1]

(iii) arrows to show the direction of the incident rays.

[1]

Examiner Only	
Marks	Remark

- (c) Two plane mirrors, M_1 and M_2 , are inclined at 50° to each other as shown in the diagram below. A ray of light strikes M_1 , so that the angle between the mirror and the ray is 40° .



- (i) Calculate the angle of incidence at M_1 .

Angle of incidence at $M_1 = \underline{\hspace{2cm}}$ [1]

- (ii) State the angle of reflection at M_1 .

Angle of reflection at $M_1 = \underline{\hspace{2cm}}$ [1]

- (iii) Calculate the angle of incidence at M_2 .

Angle of incidence at $M_2 = \underline{\hspace{2cm}}$ [2]

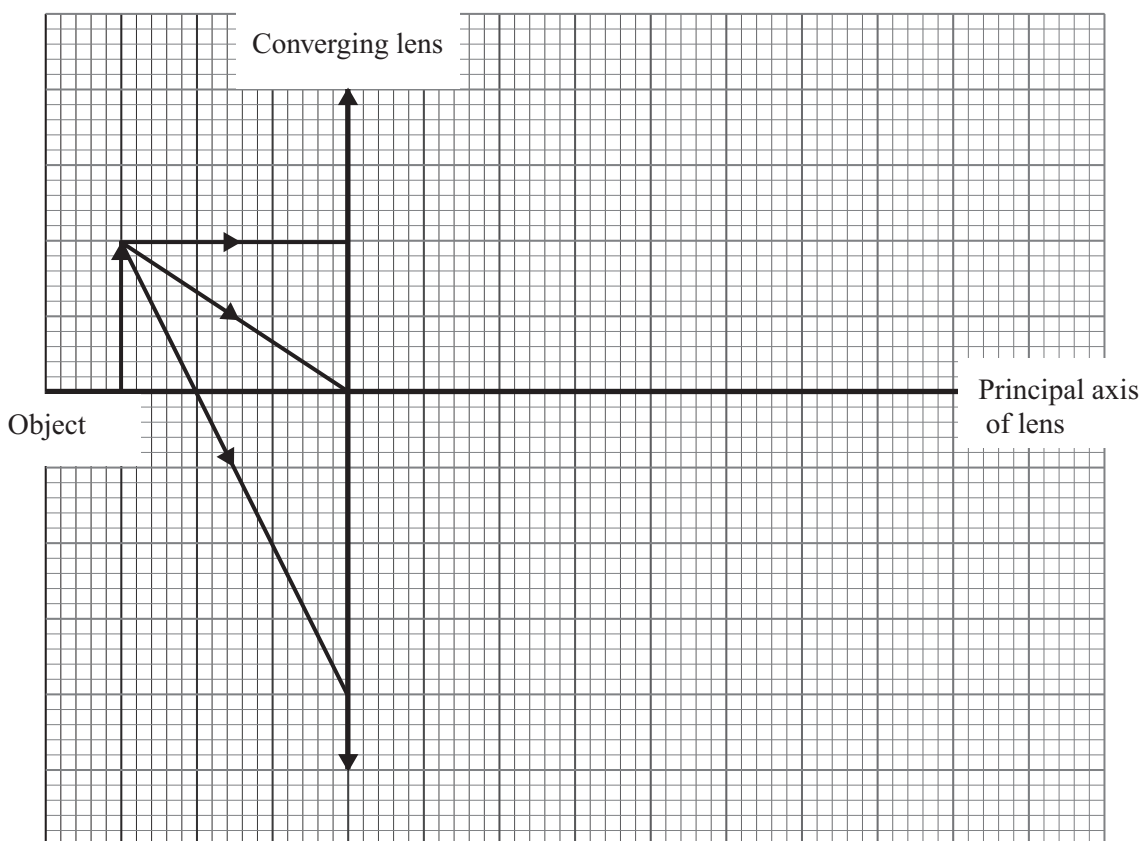
- (iv) Draw on the diagram an arrow to show the path of the reflected ray from M_2 . [1]

Examiner Only	
Marks	Remark

(d) (i) A converging lens has a focal length of 2 cm. Explain what this means.

[1]

Below is an incomplete full scale ray diagram.
 The ray diagram shows how a converging lens can be used in a slide projector. The object is 3 cm from the lens. The lens has a focal length of 2 cm.



(ii) Complete the ray diagram to show how the three rays form an image after refraction by the lens. [3]

(iii) How far is the image from the lens? [1]

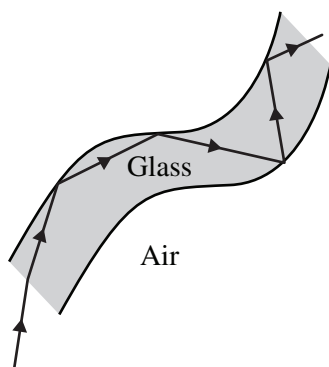
(iv) Underline which **three** of the following words best describe the image.
 real : inverted : virtual : magnified : diminished : erect [3]

Examiner Only	
Marks	Remark

(e) (i) State two conditions that are required before light undergoes total internal reflection at the boundary between two transparent materials.

1. _____
2. _____ [2]

Optical fibres are used in medicine. A typical fibre consists of a strand of glass. Light passes up the glass fibre by repeatedly undergoing total internal reflection as shown in the diagram below.



(ii) The critical angle at the glass-air boundary is 42° . Explain what this means.

- _____
- _____
- _____ [1]

(iii) State one medical and one non-medical application of the use of optical fibres.

- Medical application _____
- Non-medical application _____ [2]

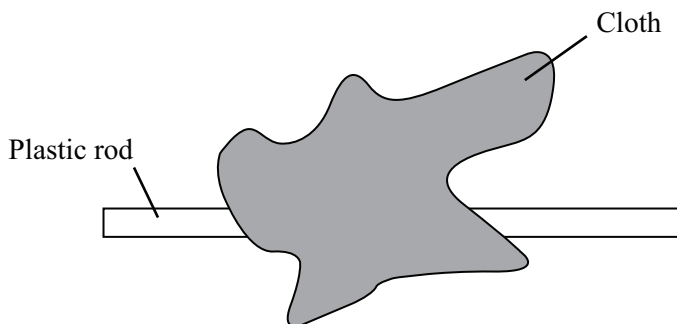
Examiner Only	
Marks	Remark

4 (a) Atoms contain electric charges.

(i) Explain how an atom is neutral.

[1]

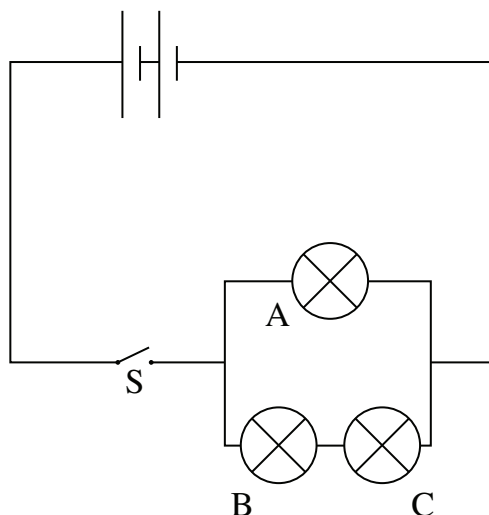
A cloth is rubbed on a plastic rod. This makes electrons move from the cloth to the rod.



(ii) What effect does the movement of the electrons have on the charge of the cloth and the charge of the plastic rod?

[2]

(b) The circuit shown in the diagram below is set up.



Examiner Only	
Marks	Remark

(i) On the circuit diagram, show how a voltmeter, using the correct symbol, should be connected to measure the voltage across lamp A. [1]

(ii) Mark, on the diagram, the positive terminal of the voltmeter. [1]

When the switch is closed, it is found that the current flowing in lamp A is 0.2 A and the current flowing in lamp B is 0.15 A.

(iii) What is the current flowing through the switch S?
You are advised to show clearly how you get your answer.

Current = _____ A [1]

Lamps B and C are **identical**. The voltage across lamp B is 1.4 V.

(iv) What is the voltage across lamp C?

Voltage = _____ V [1]

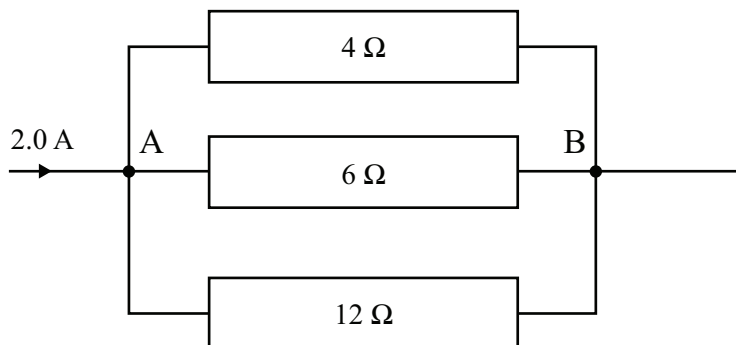
(v) What is the voltage across lamp A?
You are advised to show clearly how you get your answer.

Voltage = _____ V [2]

(vi) What is the resistance of lamp A?
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [3]

(c) Three resistors, 4 ohm, 6 ohm, and 12 ohm, are connected in parallel.



- (i) Calculate their combined resistance.
You are advised to show clearly how you get your answer.

Resistance = _____ Ω [3]

A current of 2 A flows towards the point A.

- (ii) Calculate the voltage across AB.
You are advised to show clearly how you get your answer.

Voltage = _____ V [3]

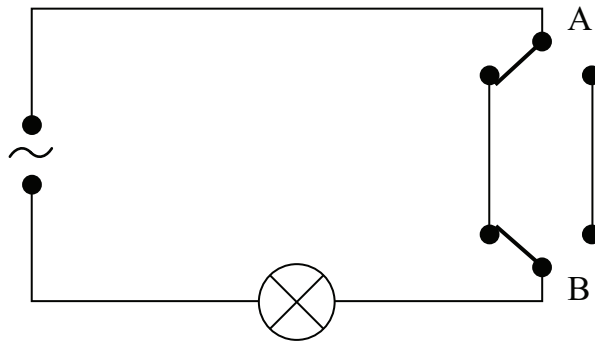
- (iii) What is the current flowing in the 4 ohm resistor?
You are advised to show clearly how you get your answer.

Current = _____ A [2]

Examiner Only

Marks Remark

(d) The circuit shown below is used in the home in a particular situation.



- (i) Name the type of switch used both at A and B.
 _____ [1]
- (ii) Where would you use such a circuit in the home?
 _____ [1]
- (iii) Describe briefly the advantage to the home-owner of such a circuit.

 _____ [1]
- (iv) On the circuit diagram, mark with the letter L, the live terminal of the power supply. [1]
- (v) On the circuit diagram, mark with the letter F, a suitable location for a fuse. [1]

Examiner Only	
Marks	Remark

5 (a) (i) Name the particles that are together in the **nucleus** of an atom.

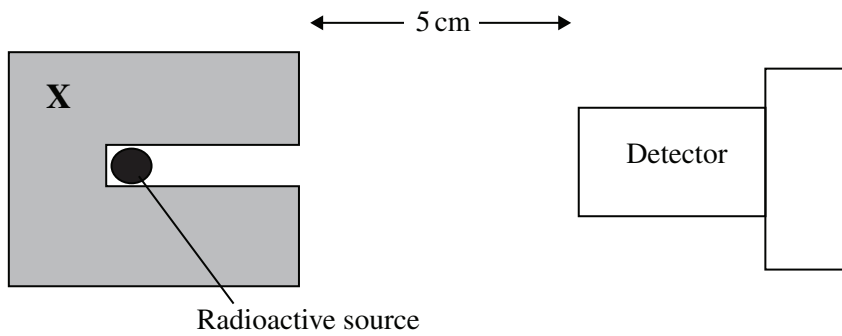
_____ [1]

An atom has an atomic number 3 and mass number 7.

(ii) What does this tell you about the particles that make up the nucleus?

_____ [2]

(b) A beta-emitting radioactive source is placed 5 cm from a detector, as shown in the diagram below. The radioactive source is surrounded by a substance **X** on all sides, except for a narrow opening on the right.



(i) Name the substance **X** surrounding the source.

_____ [1]

(ii) Give two reasons why the substance **X** is used in this way.

1. _____

2. _____

_____ [2]

(iii) Give one reason why even a weak radioactive source should be handled using tongs.

_____ [1]

You are provided with a number of aluminium squares, each 1 mm thick.

- (iv) Describe, briefly, how you would use the equipment shown opposite and the aluminium squares, to measure the range of the beta particles in aluminium.

[5]

- (c) Yttrium 90 is a beta emitter which decays to zirconium.

- (i) Complete the decay equation below for the beta decay of yttrium (Y) to zirconium (Zr).



- (ii) Yttrium has a half-life of 64 hours. Explain what this means.

[2]

Examiner Only	
Marks	Remark

- (iii) A radioactive source contains 2 micrograms of yttrium 90.
What mass of yttrium 90 remains after 192 hours?
You are advised to show clearly how you get your answer.

Mass = _____ micrograms [3]

- (d) Nuclear fission and nuclear fusion are two processes that release large amounts of energy.

- (i) Which one of them is the source of energy in stars?

_____ [1]

- (ii) What important peaceful use is made of the other process?

_____ [1]

The following statements are inaccurate descriptions of the processes of nuclear fission and nuclear fusion.

Nuclear fission is the splitting of a single atom into two lighter atoms.

Nuclear fusion is the joining of two heavy atoms to make a single atom.

- (iii) Correct each statement by writing the correct version in the spaces below.

Nuclear fission is _____

Nuclear fusion is _____

_____ [2]

Examiner Only

Marks Remark

THIS IS THE END OF THE QUESTION PAPER

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