Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Physics

Paper 1
Higher Tier

[G7604]

G7604

WEDNESDAY 25 MAY, MORNING

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

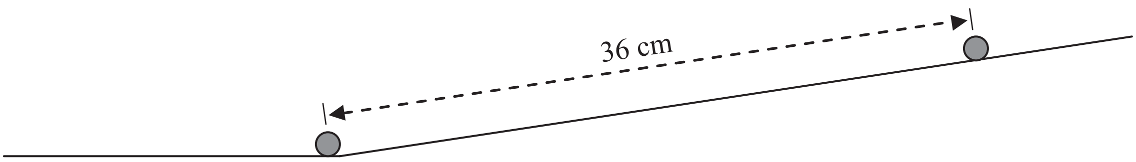
Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 125.
Quality of written communication will be assessed in question **2(e)**.
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	

1 A marble is rolled up a **smooth** slope as shown in the diagram below.



From the moment it leaves the person's hand it takes 3 seconds to come to **rest**.
In this time it travels a distance of 36 cm.

(i) Calculate the average speed of the marble.

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

Average speed = ____________________ cm/s [3]

During this motion, the marble moves with uniform deceleration.

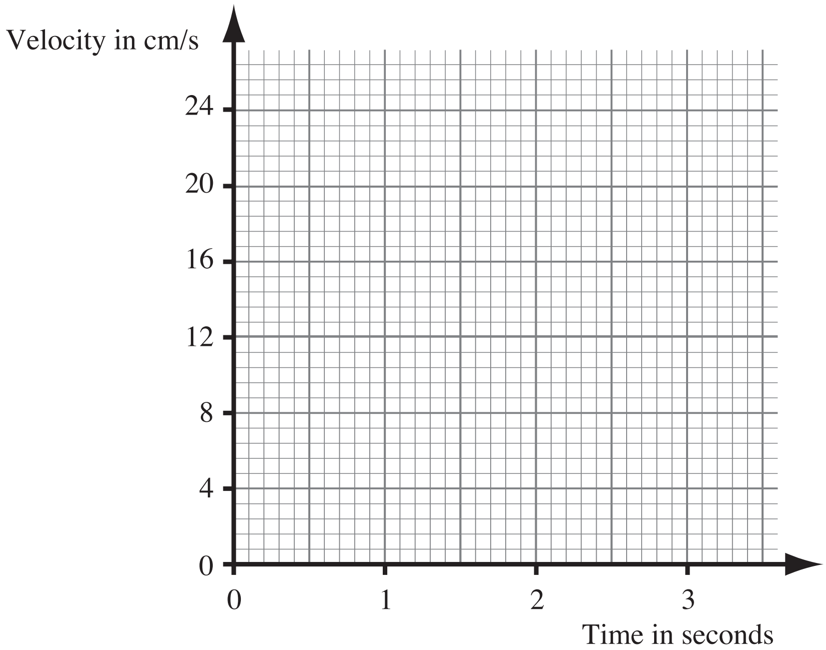
(ii) Use your answer to part **(i)** to calculate the initial velocity of the marble.

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

Initial velocity = ____________________ cm/s [2]

Examiner Only	
Marks	Remark

(iii) On the grid below, draw, **carefully**, the velocity–time graph for the marble during the three seconds of its motion.



[3]

(iv) Calculate the deceleration of the marble.

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

Deceleration = _________________ cm/s^2 [3]

(v) Use your answer to part **(iv)** to calculate the size of the force slowing the marble down. The mass of the marble is 75 g.

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

Force = __________________________ N [6]

Examiner Only

Marks	Remark

(vi) What provides the force to slow the marble down?
Remember the slope is smooth so any frictional force is assumed to be negligible.

____

____ [1]

(vii) When the marble comes to rest, it immediately starts to accelerate down the slope. It takes 3 seconds to roll back to its starting point. What does this tell you about the size of the acceleration down the slope compared to the deceleration when it rolled up the slope?

____ [1]

(viii) For the total journey, up the slope and back to its starting position, what is:

(1) the average **speed** of the marble? ____________________ cm/s

(2) the average **velocity** of the marble? _____________ cm/s [2]

(ix) At one point in its motion the marble has a speed of 0.2 m/s. Calculate its momentum at this point. The mass of the marble is 75 g.
Remember to state the correct unit for momentum.

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

Momentum of marble = ____________________ [4]

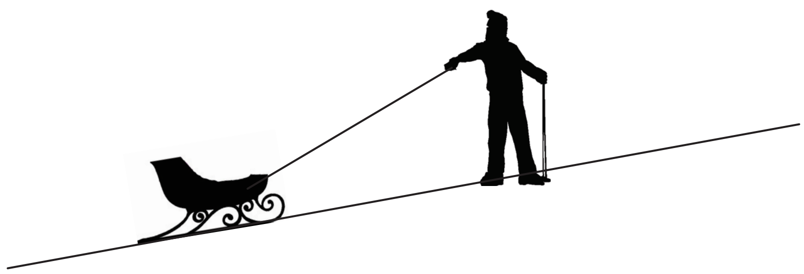
Examiner Only	
Marks	Remark

2 **(a)** In the blank table below write the names of three renewable sources of energy and three non-renewable sources of energy.

Renewable source of energy	**Non-renewable source of energy**

[3]

(b) Desmond and his sleigh have a total mass of 90 kg. He does 14 580 J of useful work pulling his sleigh and raising himself to the top of a snow covered hill.



(i) Write down the gravitational potential energy of Desmond and his sleigh, at the top of the hill.

Gravitational potential energy = ______________ J [1]

(ii) Use your answer to **(i)** to calculate the vertical height of the hill.

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

Vertical height of the hill = __________________ m [4]

Examiner Only	
Marks	Remark

(iii) Desmond now sits on the sleigh and returns to the bottom of the hill.
At the bottom of the hill both are moving with a speed of 15 m/s.
Calculate the kinetic energy of Desmond and the sleigh.
The mass of Desmond and his sleigh is 90 kg.

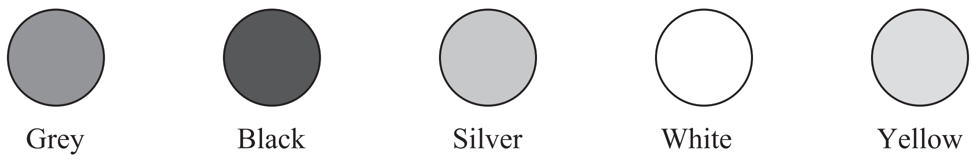
You are advised to show clearly how you get your answer.

Kinetic energy = ______________________ J [3]

(iv) How much energy is wasted during the descent?

Energy wasted = ______________________ J [2]

(c) Several identical metal balls are heated until they are very hot and all at the same temperature. However, each ball is a different colour as shown below.



(i) Which ball gives out most heat radiation per second?

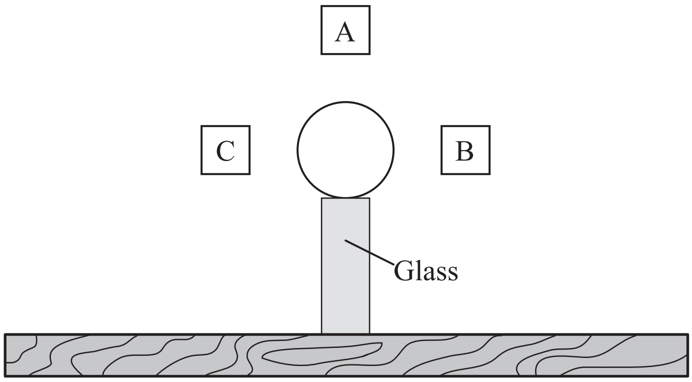
______________________ [1]

(ii) To which part of the electromagnetic spectrum does the heat radiation belong?

____ [1]

Examiner Only	
Marks	Remark

One very hot ball is then placed on a glass support as shown below.
Three heat sensors, A, B and C, are now positioned around the ball.
Each sensor is the same distance from the ball.



(iii) Explain fully why the reading on sensor A is highest.

____

____ [2]

(d) Hot takeway food is often placed in a container made of aluminium foil. The aluminium foil is shiny on both the inside and the outside surfaces.

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Explain, in detail, how the container keeps the food hot.

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____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(e) Copper is a good conductor of heat. Glass is a poor conductor of heat. Describe, carefully, the mechanism by which heat is transferred in each of these materials, naming the particles that play an important role in the process.

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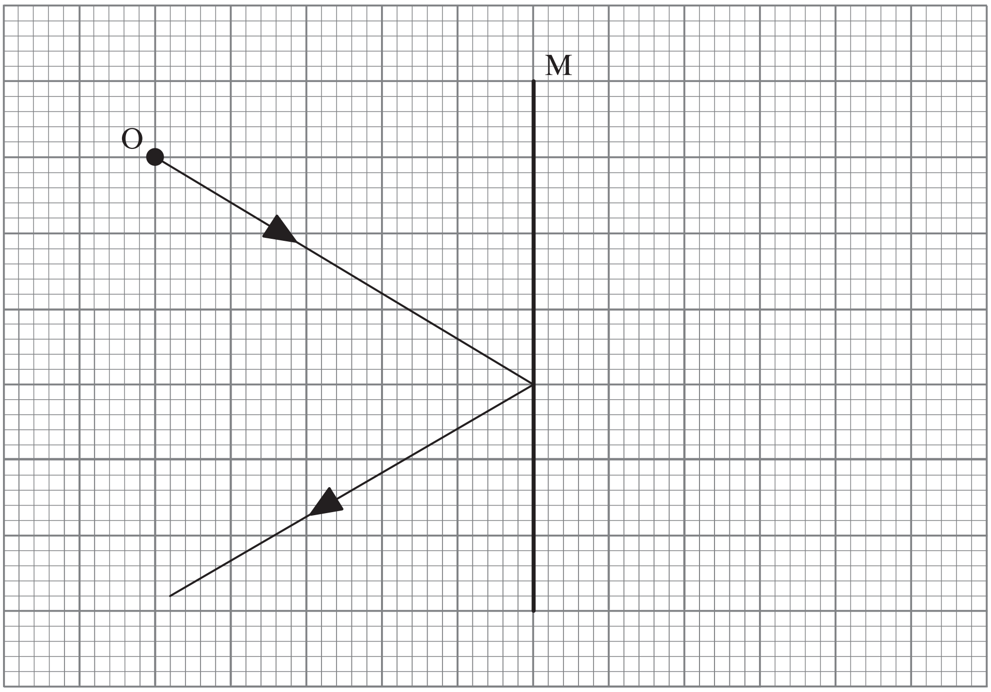
____ [4]

Quality of written communication [2]

3 **(a)** A ray of light from the object O is reflected from a plane mirror M as shown in the diagram below.

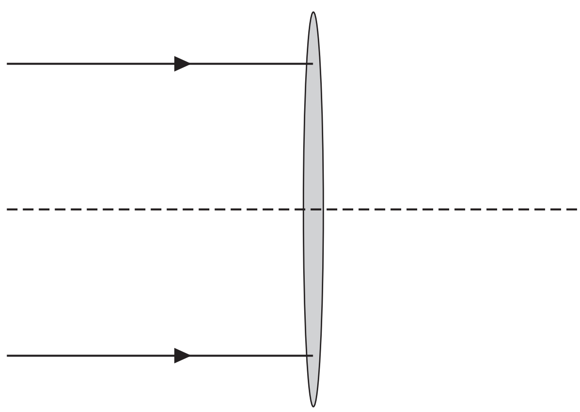


On the diagram:

(i) Mark, as accurately as you can, the position of the image of the object O. Label the image I. [1]

(ii) Draw a second ray of light from O to show how the image is formed by the mirror. [2]

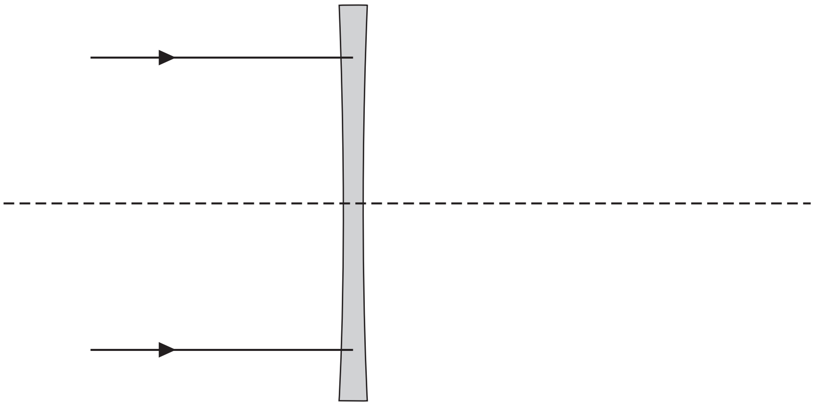
(b) **(i)** Complete the diagram below to show how parallel rays of light are refracted by a converging (convex) lens. Mark the focal length of the lens.



[2]

Examiner Only	
Marks	Remark

(ii) Complete the diagram below to show how parallel rays of light are refracted by a diverging (concave) lens.



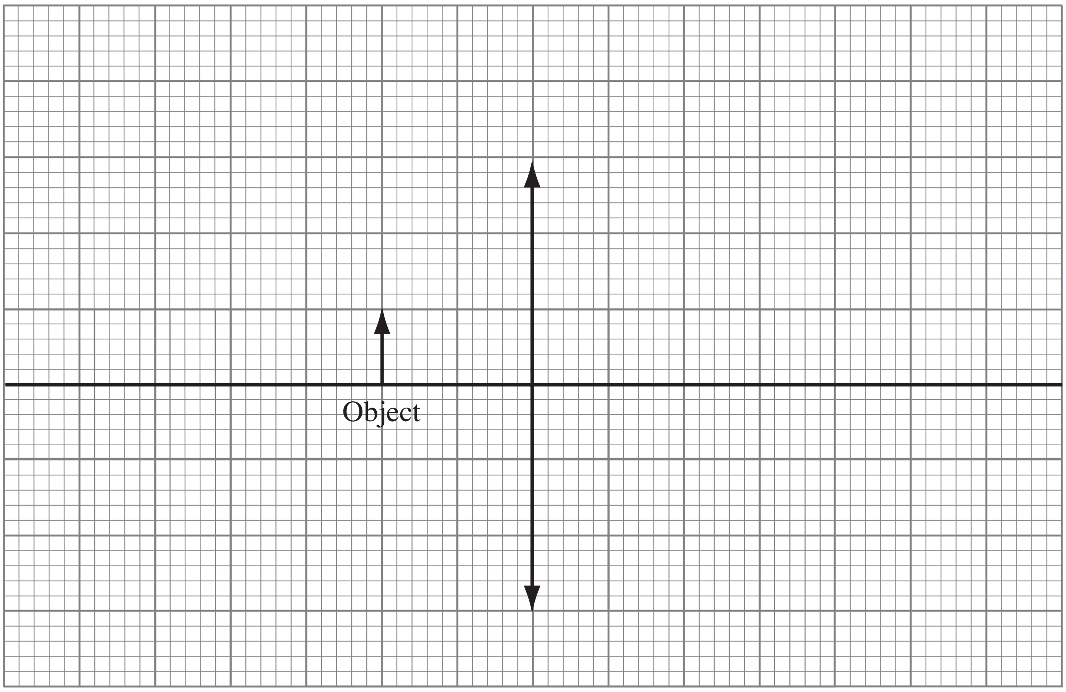
[1]

(iii) Describe how you would measure the focal length of a converging (convex) lens using a distant object.

[4]

Examiner Only	
Marks	Remark

A converging (convex) lens is used as a magnifying glass.
An object is placed 2.0 cm from the lens as shown in the diagram below.
The diagram is full scale. The focal length of the lens is 3 cm.



(iv) Mark and label, on the diagram, the positions of the **two** focal points of the lens. [1]

(v) Using a ruler, draw rays on the diagram to find the position and height of the image. Mark and label the image formed and put arrows on the rays to show their directions. [5]

(vi) This type of image is described as virtual. Explain what this means.

____

____ [1]

(vii) What is the height of the image? ________________________ [1]

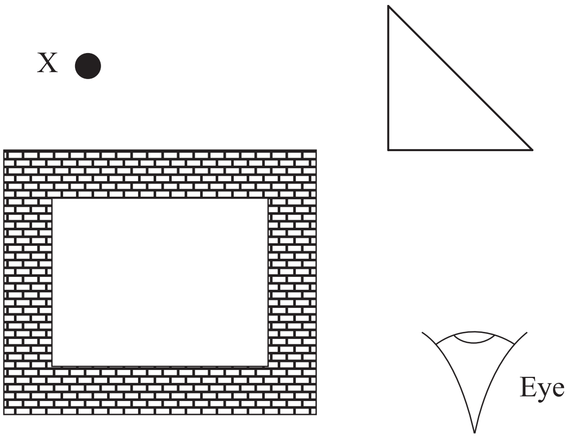
(viii) How far from the lens is the image formed? _______________ [1]

(ix) Mark the position where you would put your eye to see the image. [1]

Examiner Only	
Marks	Remark

(c) A glass prism can be used in place of a plane mirror to reflect light around a corner.

(i) Using a ruler, draw rays on the diagram below, to show how light can pass from the object at X to the eye, through the glass prism. [2]



(ii) Explain, fully, why the glass prism used in this way can act as a perfect mirror.

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____ [3]

Examiner Only	
Marks	Remark

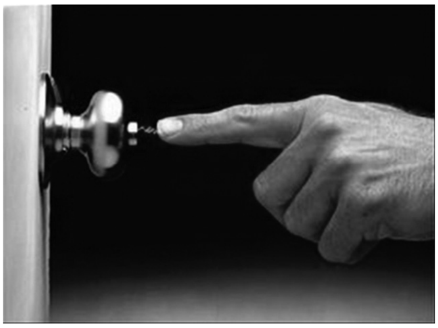
4 **(a)** After walking across a carpet, John became positively charged.

(i) Explain how John gained a **positive** charge.

____

____ [1]

John experienced a small spark when he put his finger to a metal door knob.



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(ii) Which one of the following statements was true? Tick the correct one.

(1) The spark was due to electrons jumping from John to the door knob. ☐

(2) The spark was due to electrons jumping from the door knob to John. ☐ [1]

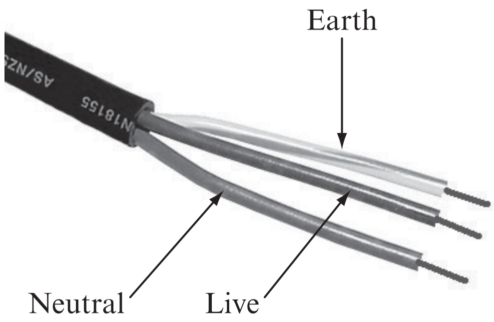
(iii) The spark lasted for 1 millisecond (0.001 s) and the total charge that travelled between the door knob and John was 8 microcoulombs (0.000008 C).
Calculate the current that was in the spark.

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

Current = ______________ A [3]

Examiner Only	
Marks	Remark

(b) Electrical conductors and insulators play an important role in the use of electricity in the home.
The cable (flex) which is connected to a steam iron is shown in the diagram below.
The diagram shows the cable with the plug removed so that the three wires inside the cable are seen.



(i) Explain how the earth wire and fuse in the three pin plug protect the user from electric shock.
In your answer you should state:
1. which part of the iron the earth wire is connected to.
2. which part, other than the live pin, the live wire is connected to.

____

____

____

____

____

____ [5]

(ii) The steam iron has a power rating of 2200 W when used with a mains voltage of 240 V.
Calculate the current that flows through the steam iron.

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

Current = ____________________ A [3]

Examiner Only	
Marks	Remark

(c) When a bulb is connected to a 1.5 V cell it is lit to normal brightness.

(i) When the bulb is lit to normal brightness the current passing through it is 0.25A
Calculate the resistance of the bulb.

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

Resistance = _________ Ω [3]

(ii) In the space below, draw a circuit diagram to show how two such identical bulbs can be lit to normal brightness using **one** 1.5 V cell. Include in your circuit a single switch that can be used to turn **both** bulbs on or off.
Use the correct symbols for the cell, the bulbs and the switch.

[4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

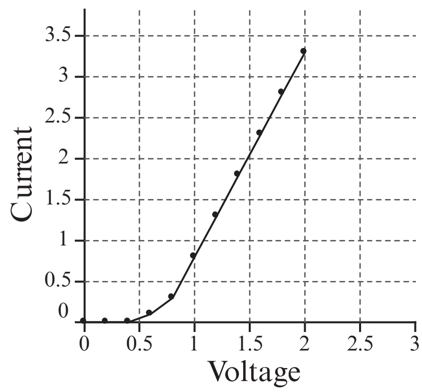
(d) Jenny is given a sealed box containing an electrical component. The box has two terminals which allow connections to be made to the component inside.

(i) Complete the diagram below showing the circuit that she needs to build in order to take a **number** of measurements of voltage and current for the component inside the box.

Sealed box

[4]

After taking a number of measurements, Jenny plots the voltage–current graph. The graph she obtains is shown below.



(ii) What component is inside the box?

_________________________ [1]

5 **(a)** The table below lists the particles that make up a **neutral** atom of the isotope of oxygen $^{17}_{8}O$.

(i) Complete the table showing the mass, charge, number and location of the particles within the atom. Some information has been added to the table.

Particle	Mass	Charge	Number	Location
Electron	$\frac{1}{1840}$			
Neutron				
Proton				

[6]

(ii) Oxygen has a number of isotopes. Circle the one which does not represent an isotope of oxygen.

$$^{16}_{8}O, \quad ^{17}_{8}O, \quad ^{17}_{9}O, \quad ^{18}_{8}O$$

[1]

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

____

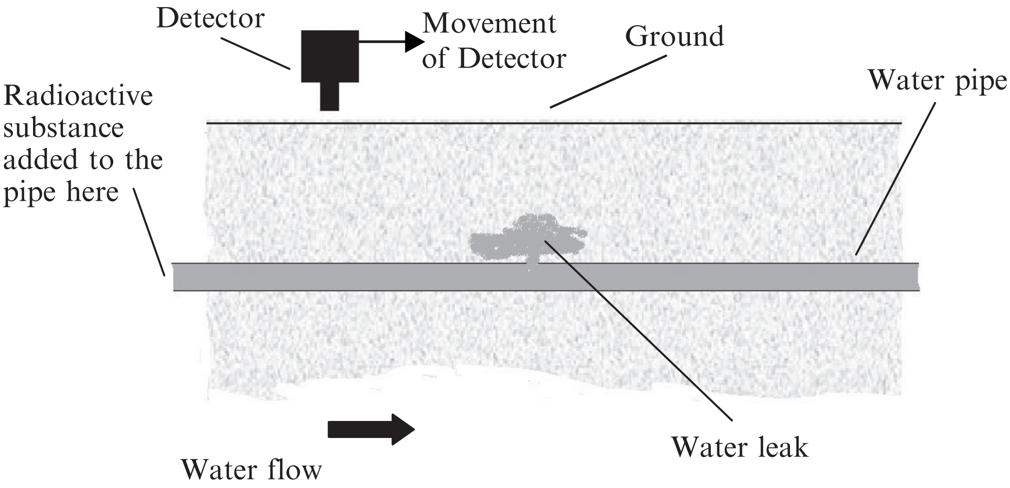
____

____ [1]

Examiner Only

Marks	Remark

(b) To help detect leaks in underground water pipes radioactive substances are sometimes used. The radioactive substance is added to the water in the pipe. A detector is moved along the ground as shown in the diagram below.



(i) How will the person using the detector know when the leak is directly below?

____

____

____ [1]

(ii) What is background activity?

____

____

____ [1]

(iii) The radioactive substance emits gamma radiation. Complete the equation below for the disintegration of the nuclei of this substance.

$$^{24}_{11}Na^{*} \longrightarrow {}^{\square}_{\square}Na + \square$$

[3]

Examiner Only	
Marks	Remark

(iv) The radioactive substance used has a half-life of 15 hours.
When introduced to the pipeline its activity is 1000 counts per second.
Calculate its activity after 45 hours.

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

Activity = ______________ counts per second [3]

(v) Why is it important to use a substance with a half-life of 15 hours, rather than one with a half-life of 1 minute or one with a half-life of 1 year?

____

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____

____

____

____

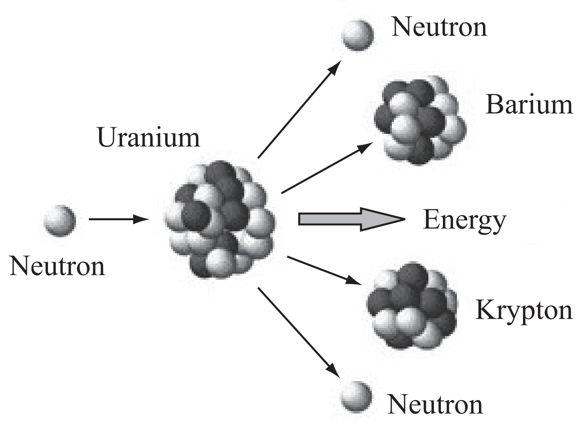
____ [3]

Examiner Only	
Marks	Remark

(c) Nuclear processes which result in the release of large amounts of energy are shown in the diagrams below. For each one state the name of the process, and give a brief description of what is happening.

Examiner Only	
Marks	Remark

(i)



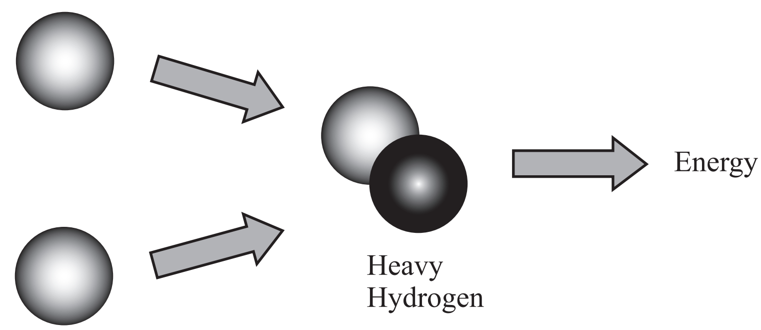
Name of process ___________________________________

What is happening?

____

____ [3]

(ii)



Name of process ___________________________________

What is happening?

____

____ [3]

THIS IS THE END OF THE QUESTION PAPER