High Demand Questions QUESTIONSHEET 1

The chart below shows the change in mass number and atomic number of an atom for different types of radioactive decay.

	change in atomic number	change in mass number
A	-1	0
B	-2	-4
C	0	0
D	+1	0

(a) Write down the letter which shows how the mass number and atomic number change for the following:

(i) emission of an alpha particle

..... [1]

(ii) emission of a beta particle

..... [1]

(iii) emission of gamma radiation

..... [1]

(b) Complete the equation below to show the decay of $^{238}_{92}U$ to an isotope of thorium (Th) when it emits an alpha particle. [2]

$^{238}_{92}U \rightarrow$

(c) $^{238}_{92}U$ and $^{235}_{92}U$ are both forms of uranium.

(i) What do we call different forms of the same element?

..... [1]

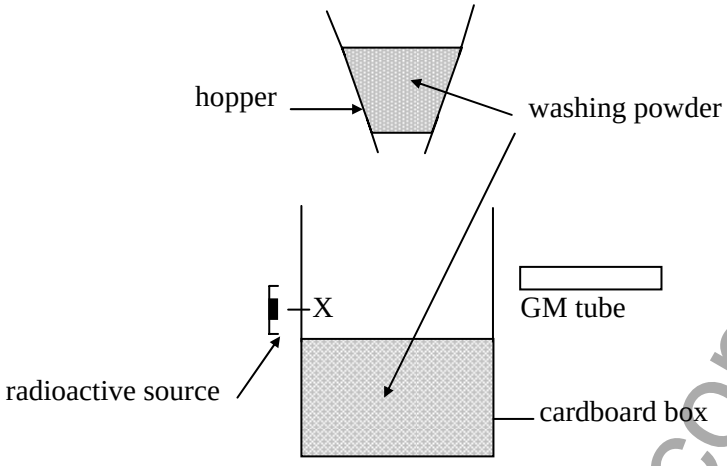
(ii) Describe how their nuclei differ from each other.

..... [1]

TOTAL / 7

High Demand Questions QUESTIONSHEET 2

A radioactive source is used in a factory to monitor the level of washing powder in cardboard boxes as they move along a conveyer belt.



(a) A beta source is used.
Why is an alpha source unsuitable?

..... [1]

(b) Why could a gamma source not be used?

..... [1]

(c) Explain what happen when the level of powder in the box reaches X.

.....

.....

.....

..... [4]

TOTAL / 6

High Demand Questions QUESTIONSHEET 3

Before Lord Rutherford's alpha particle scattering experiment in 1909, the atom was thought of as something like a 'plum pudding'.

(a) Describe the 'plum pudding' model.

.....

..... [2]

(b) We now think of the atom as having a positively charged nucleus surrounded by negatively charged electrons. Briefly describe how Rutherford's experiments provided the evidence for this model.

.....

.....

.....

.....

.....

..... [5]

(c) Nuclear reactors make use of a process called nuclear fusion.
How does nuclear fusion result in a release of energy?

.....

.....

.....

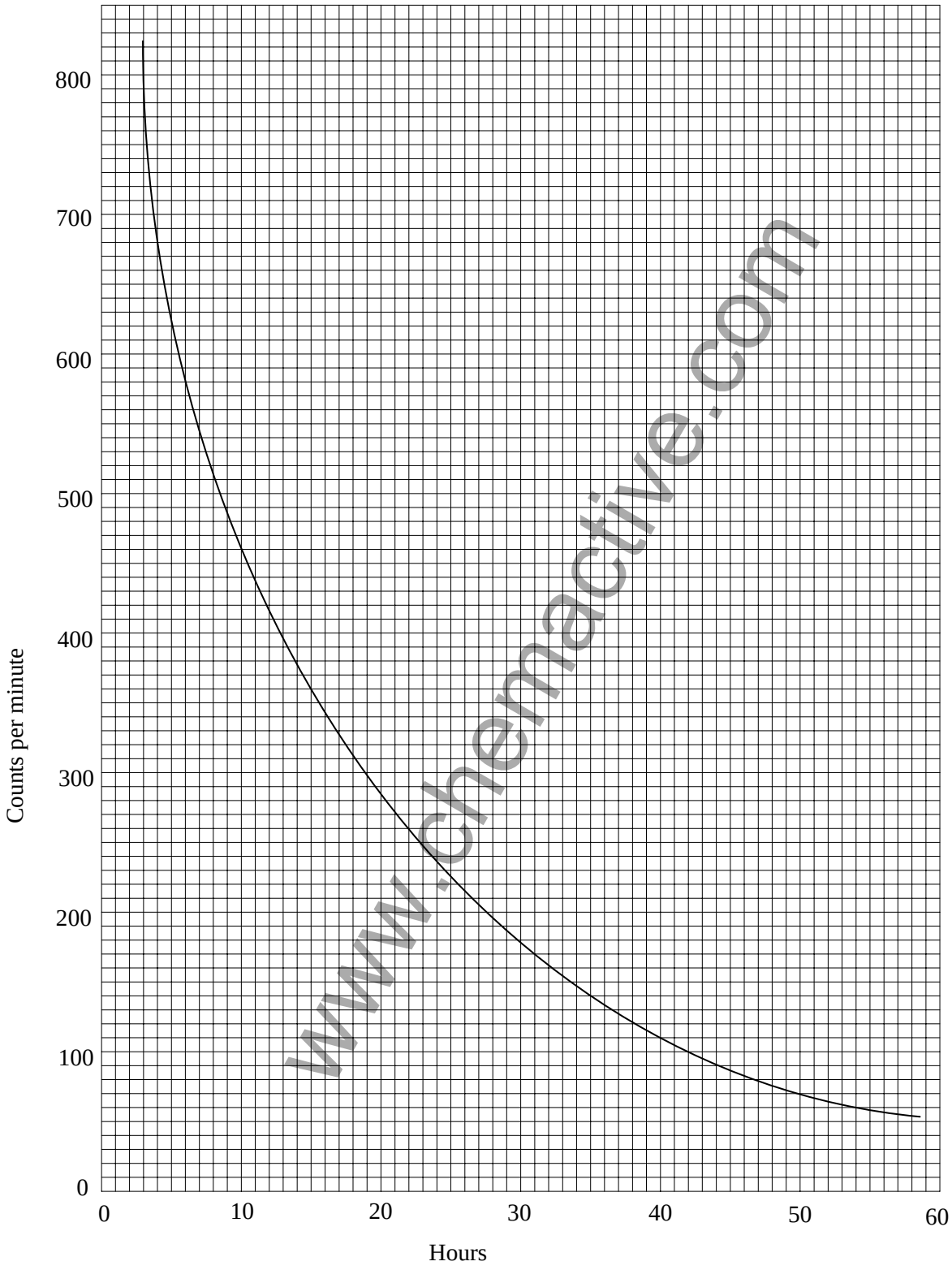
..... [4]

TOTAL / 6

GCSE PHYSICS **RADIOACTIVITY**

High Demand Questions QUESTIONSHEET 4

Paul is a medical physicist. He uses an iodine-123 tracer in diagnosis of thyroid problems.



The graph shows the decay curve for iodine-123.

(Continued...)

QUESTIONSHEET 4 CONTINUED

(a) Explain what is meant by the half-life of a radioactive substance.

.....

..... [1]

(b)(i) Using the graph, write down the half-life of iodine-123.

..... [1]

(ii) What is the count rate after 24 hours?

..... [1]

(c)(i) If 0.08 g of iodine-123 in solution is injected into a patient, what is the maximum amount still in the body after 39 hours?

.....

..... [1]

(ii) Why is it unlikely to actually be this much?

..... [1]

(d) (i) Iodine-123 is a gamma emitter.
Another isotope, iodine-131, with a half-life of 8 days is a beta emitter.
Give **two** reasons why iodine-131 is not suitable as a tracer in the body.

.....

..... [2]

(ii) Complete the equation for the decay of iodine-131 to form xenon (Xe).

$^{131}_{53}\text{I}$

.....

.....

..... [2]

TOTAL / 9

GCSE PHYSICS **RADIOACTIVITY**

High Demand Questions QUESTIONSHEET 5

The table below shows a list of radionuclides, their half-lives and the types of radiation emitted.

radionuclide	No of protons	No of neutrons	half-life	radiation emitted
$^{220}_{86}$Rn			54.5 s	alpha
$^{24}_{11}$Na			15 hr	gamma
$^{32}_{15}$P			14 days	beta
$^{90}_{38}$Sr			28 yr.	beta
$^{14}_{6}$C			5700 yr.	beta & gamma

(a) In the appropriate spaces in the table, write down the numbers of protons and neutrons in each nucleus. [5]

(b) Many radioactive substances have industrial, and scientific uses.
Choose the most suitable substances for the following tasks.

(i) finding the age of prehistoric remains

..... [1]

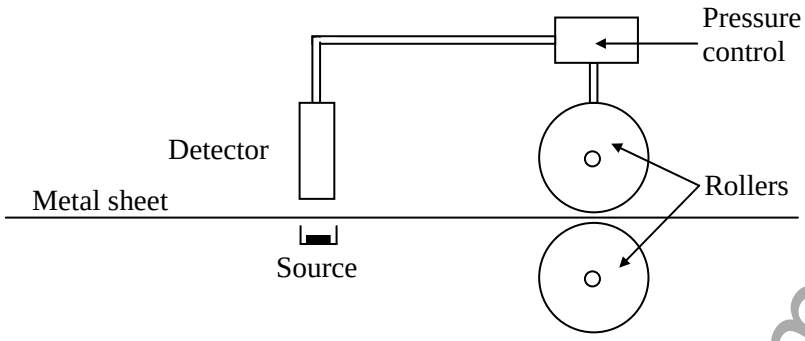
(ii) tracing leaks in oil pipes

..... [1]

TOTAL / 7

High Demand Questions QUESTIONSHEET 6

A source, which emits beta radiation, is used in a factory to control thickness of sheet metal as it is being rolled.



(a) Name a suitable detector.

..... [1]

(b)Explain how this arrangement controls the metal thickness.

.....

.....

.....

.....

..... [5]

(c)One worker suggests that an alpha source would be safer to use.
Why is this not a sensible idea?

.....

..... [1]

TOTAL / 7

GCSE PHYSICS **RADIOACTIVITY**

High Demand Questions QUESTIONSHEET 7

Freya is excavating a prehistoric site.
She finds human bones in the ground and decides to send them for carbon dating.

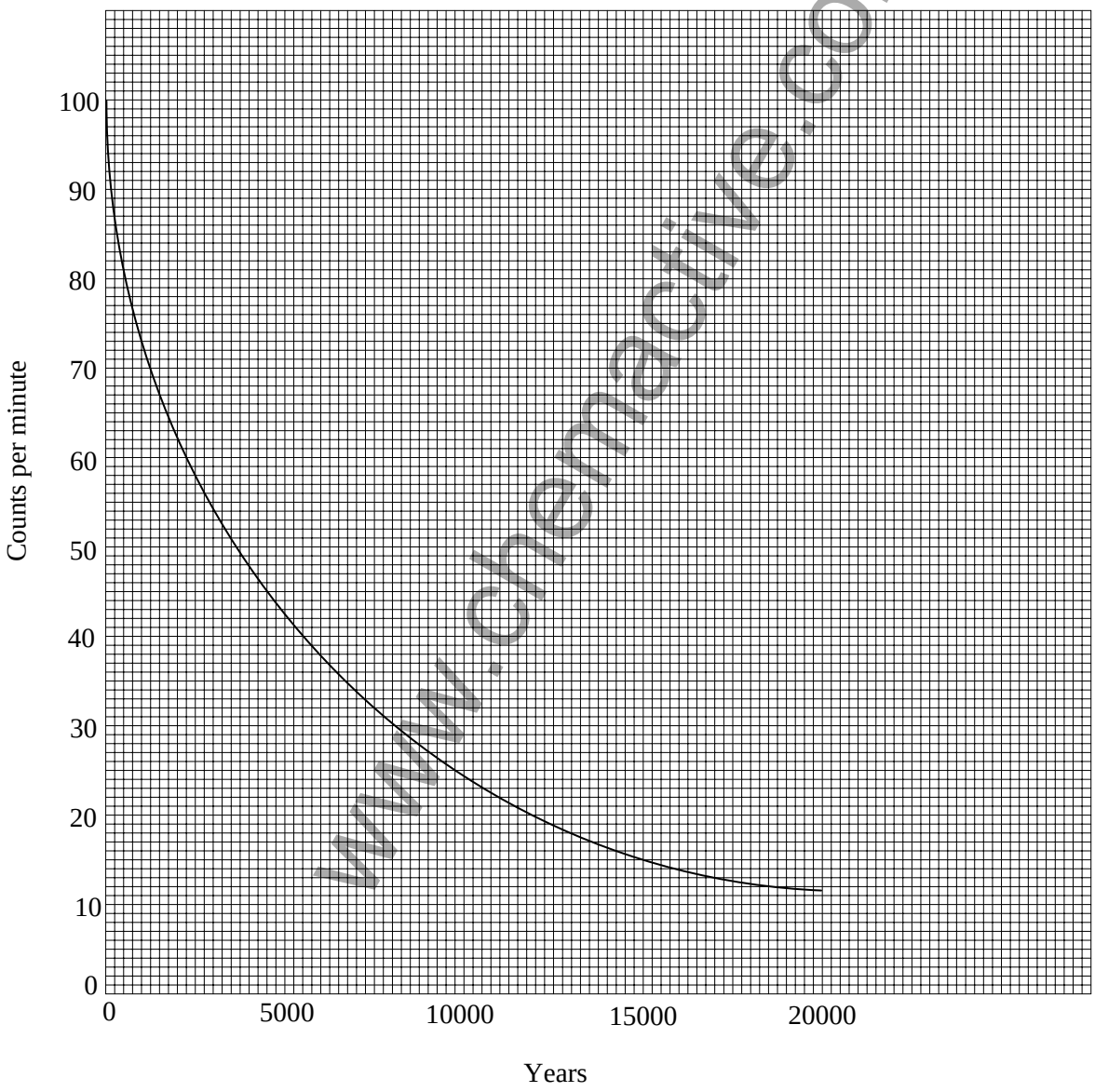
(a) (i) Which isotope of carbon is measured in carbon dating?

..... [1]

(ii) Why is the element carbon chosen as the one to measure?

..... [1]

(b) The graph below shows the decay curve for radioactive carbon



(Continued...)

(i) The count rate at A is 100 counts per minute.
What time period would a sample having this count rate come from?

..... [1]

(ii) The analysis of Freya's sample gave a count rate of 60 counts per minute.
How old is the sample?

..... [1]

(iii) If the sample was know to date from 0 AD, what count rate would you expect?

..... [1]

(iv) What is the half-life of this carbon isotope?

..... [1]

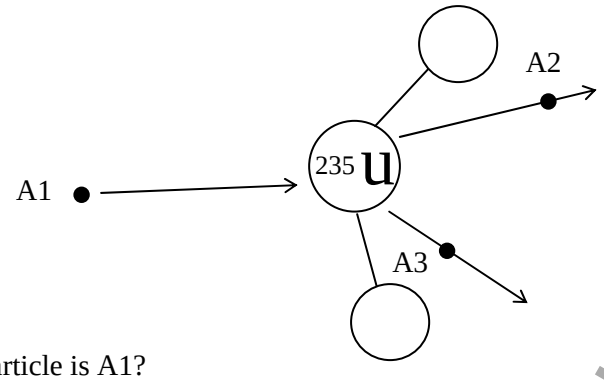
(c) Freya believes that there may have been civilizations in the world more than 10 000 years ago.
Give **two** reasons why carbon dating would be unsuitable for testing any samples from this period.

.....

..... [2]

High Demand Questions QUESTIONSHEET 8

The diagram below shows a nucleus of uranium-235 undergoing nuclear fission.



(a) (i) What type of particle is A1?

.....[1]

(ii) Continue the diagram to show what happens when particles A2 and A3 meet more uranium nuclei. [1]

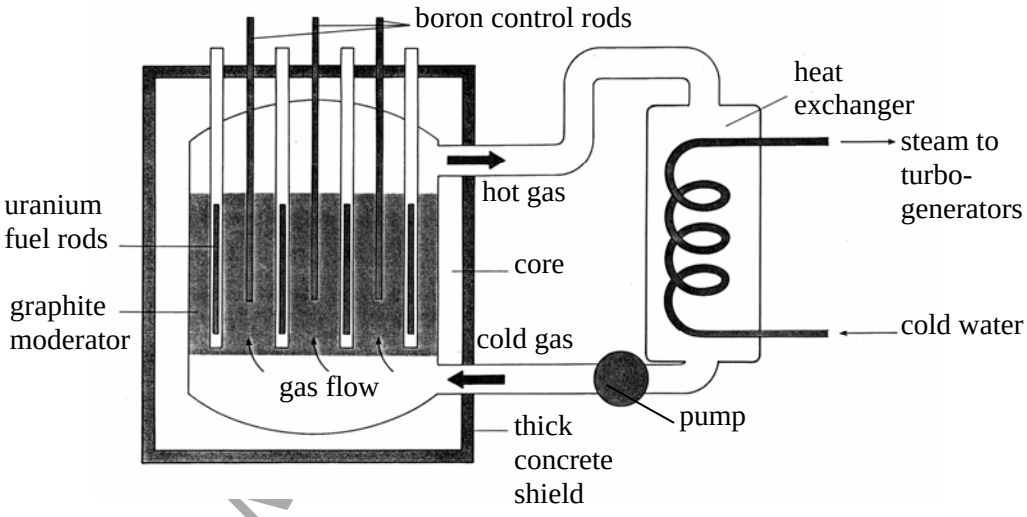
(iii) What type of reaction has been started?

.....[1]

(iv) What is produced in nuclear fission which makes it very useful for electricity generation?

.....[1]

(b) The diagram below shows a nuclear reactor.



(i) What happens to the heated coolant?

.....

.....[2]

(ii) What is the purpose of the layer of concrete around the reactor?

.....[1]

(iii) What is the purpose of the control rods?

.....[1]

TOTAL / 8

Medium Demand Questions QUESTIONSHEET 9

(a) Choose words from this list to complete the sentence below

electrons molecules elements protons
neutrons crystal nucleus

An atom is made up of a tiny ..... which contains ..... and

..... It is surrounded by a cloud of ..... [4]

(b) Explain what is meant by radioactivity.

.....

.....

..... [4]

TOTAL / 8

(a) Complete the following table

type of radiation	**composition**	**speed**	**electrical charge**
alpha		slow	positive
	electron	fast	
gamma			

[6]

(b) Radiation comes from the atomic nucleus, which only contains protons and neutrons.
Explain how beta radiation arises.

.....

.....

..... [3]

TOTAL / 9

(a) Radiation can be detected by photographic film.
Workers in the radiation industry wear photographic film badges.
Explain the purpose of these badges.

.....

..... [1]

(b) (i) Name a device commonly used to measure radioactivity.

..... [1]

(ii) The device works by detecting the ionisation of a gas in a tube.
Explain the meaning of the word 'ionisation'.

.....

.....

..... [3]

A Geiger-Muller tube is attached to a ratemeter to measure the activity of a radioactive sample.
A student records the measurements at two-minute intervals.

time interval (min)	0 - 2	2 - 4	4 - 6	6 - 8	8 - 10
counts per second	87	92	81	84	80

(a) Why do the measurements vary?

.....

..... [2]

(b) Calculate the average measurement in a two-minute period.

.....

..... [2]

(c) (i) When the source is removed, the ratemeter continues to register a count.
What is the origin of this count?

..... [1]

(ii) Is the average measurement of this count likely to be higher or lower than that with the source present?

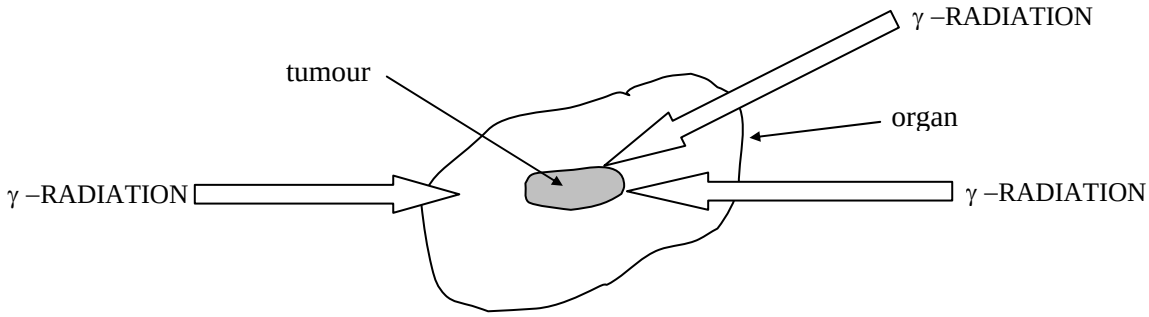
..... [1]

TOTAL / 6

GCSE PHYSICS **RADIOACTIVITY**

Medium Demand Questions QUESTIONSHEET 13

Radiation is used in medicine to kill cancerous cells.



(a) What is the name we give to this treatment?

..... [1]

(b) What type of radiation is used?

..... [1]

(c) Three weak beams of radiation are used.
Explain why?

.....

.....

.....

..... [4]

TOTAL / 6

Medium Demand Questions QUESTIONSHEET 14

Sophie found a school radioactive source without a label.
She decided to measure its count rate under different conditions using a Geiger-Muller counter.
The table shows her results.

set up	counts per min
source + no absorber	451
source + 1 mm foil absorber	455
source + 10 mm aluminium absorber	18
no source or absorber	15

(a) (i) What was the count rate due to background activity?

..... [1]

(ii) Name **two** sources of background radiation.

.....

..... [2]

(b) What was the count rate due to the source alone?

..... [1]

(c) What type of radiation did the source emit?

..... [1]

(d) (i) Sophie then took further readings of count rate, without an absorber, at regular time intervals.
She plotted a graph of count rate against time.
What quantity might she be able to read from the graph?

..... [1]

(ii) Why is it likely that she would not actually be able to find this quantity?

.....

..... [2]

(e) Give **two** precautions that Sophie should take when handling radioactive sources.

.....

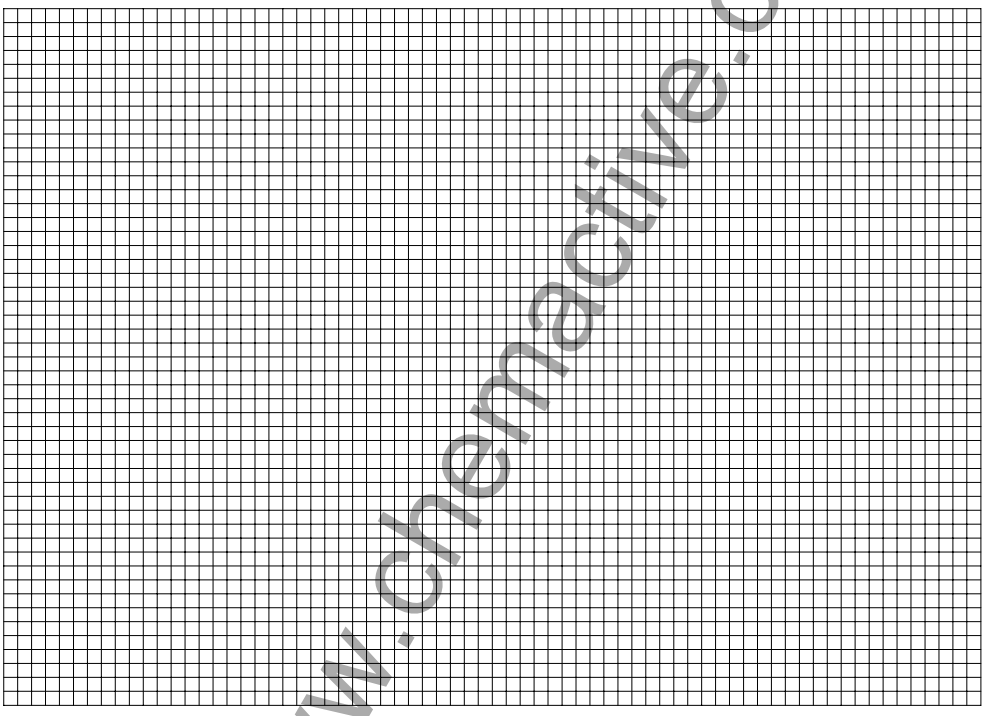
..... [2]

TOTAL / 10

Members of the public who do not work with radiation are allowed a certain dose per year.
The table shows the percentage of that dose that each medical x-ray gives.

x-ray source	**% of background radiation dose**
dental	1
chest	5
skull	3
pelvis	24
spine	40
leg	3
arm	2

(a) (i) Draw a bar graph to display the data. [4]



(ii) Jack has a chest x-ray.
How many dental x-rays would he need to have the same dose?

..... [1]

(iii) Name **two** ways in which radiation can damage the body.

.....

..... [2]

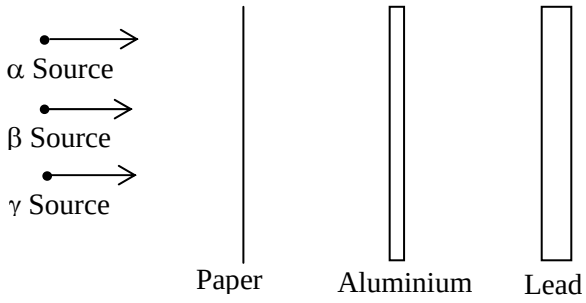
(b) Mary is a radiographer who routinely works with x-rays.
Give **two** precautions she must take to keep her exposure as low as possible.

.....

..... [2]

TOTAL / 9

Bilal did an experiment to measure the penetrating power of alpha, beta and gamma radiation.
The diagram shows a summary of his results.



(a) (i) Continue the arrows for each type of radiation. [1]

(ii) Bilal placed a strong magnet near each radiation beam.
State what would happen to each radiation beam.

.....

.....

..... [3]

(iii) Why do the results described in (ii) happen?

.....

..... [2]

(b) On a visit to a nuclear research laboratory, Bilal was shown a room containing a large cobalt-60 source.
Cobalt-60 is a gamma emitter.

(i) What would be the best material for the walls of the room?

..... [1]

(ii) State a precaution which should be taken by workers at the laboratory to reduce their dose of gamma radiation.

..... [1]

TOTAL / 8

Low Demand Questions QUESTIONSHEET 17

(a) Write down two ways in which radioactivity is harmful to humans.

.....

.....

.....

..... [2]

(b) A source of radiation is outside a person's body.
Which type of radiation is least dangerous to the person?
(Give a reason for your answer)

Type of radiation

..... [1]

Reason (one line)

..... [1]

(c) Describe how radioactivity can be used to sterilise medical equipment.

.....

.....

..... [2]

TOTAL / 6

Nuclear power stations generate electricity

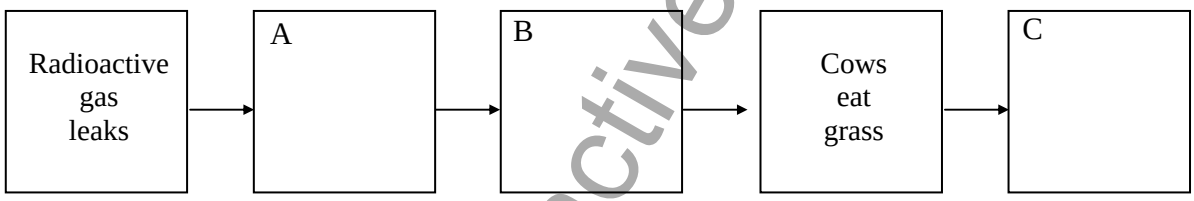
(a) Name a fuel that is used in a nuclear power station.

..... [1]

(b) When the Russian nuclear power station at Chernobyl suffered damage some years ago, there was a leakage of radiation into the environment.
People in the UK were advised not to drink milk.

(i) Complete the flow chart to show how the radiation could have got into UK milk.
Choose phrases from the list below. [3]

cows have calves **blown to UK** **leaks into sea**
settles on grass **cows produce milk**



(ii) State two other possible harmful effects of the radiation from Chernobyl.

.....

..... [2]

(iii) Why has the area around the Chernobyl power station been cleared for a very long time?

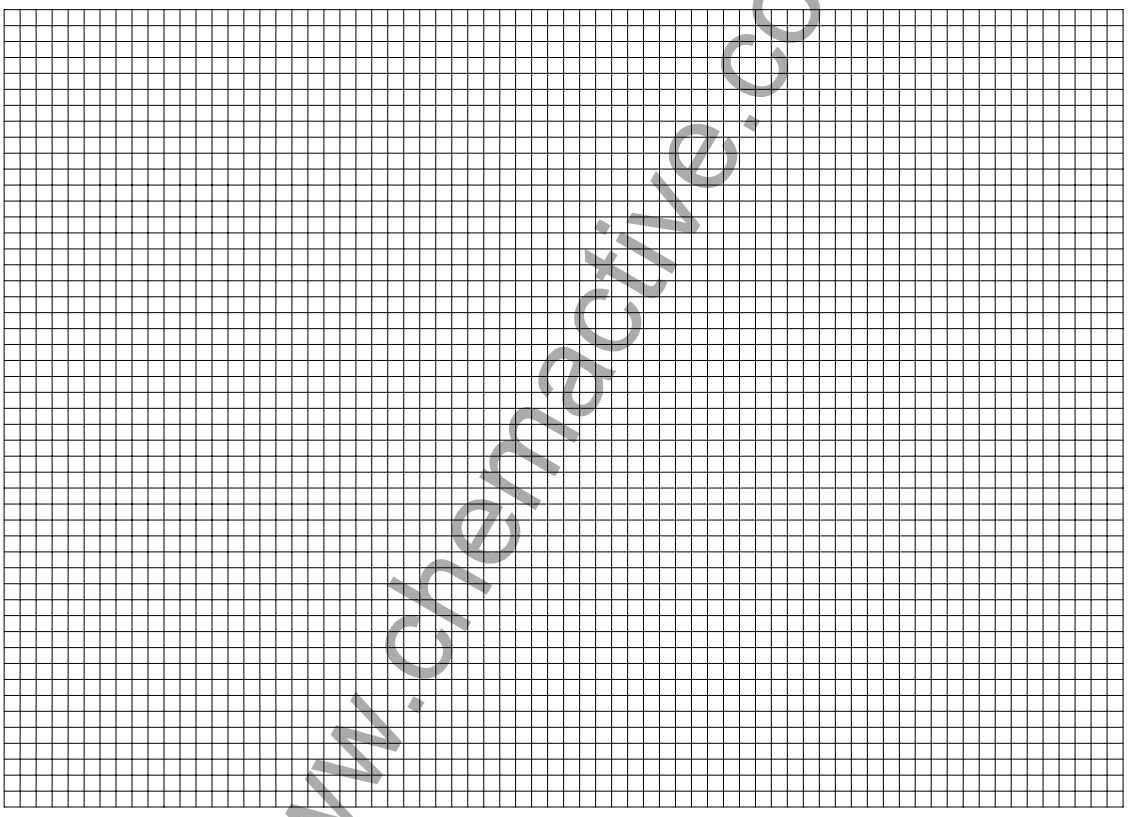
..... [1]

TOTAL / 7

Stephen is moving house. He would like to live in an area with low background radiation.. He looked at a table showing the average radiation levels from radon gas in air in different areas of the country.
The table is shown below.

area	**units of radiation dose per year**
Cornwall	60
Sussex	15
Derbyshire	65
Scottish Highlands	36
North Yorkshire	9

(a) (i) Display the data in a bar chart. [3]



(ii) Where would he obtain the lowest dose?

..... [1]

(iii) Why is radon gas present in air?

..... [1]

(b) Stephen had a holiday in the United States. His return flight gave him a radiation dose of 6 units.
How many return flights would he have to make to receive the equivalent of living in Cornwall for a year?

..... [2]

TOTAL / 7

Low Demand Questions QUESTIONSHEET 20

There is radiation all around us. Some is artificial, but the greater proportion is natural.

(a) (i) Give two sources of natural radiation.

.....

..... [2]

(ii) Give one source of artificial radiation.

..... [1]

(b) Nuclear reactors provide only a small amount of the energy used in this country, yet many people are worried about them.

(i) Give **two** arguments against the setting up of more nuclear power plants.

.....

.....

.....

..... [2]

(ii) Give **two** arguments in favour of setting up more nuclear power plants.

.....

.....

.....

..... [2]

(c) What two important uses do radioactive isotopes have in medicine?

.....

.....

.....

..... [2]