Name of the Student:_____
Max. Marks : 20 Marks **Time : 20 Minutes**

Q1.

Radioactive isotopes emit different types of nuclear radiation.

(a) What does an alpha particle consist of?

Tick (✓) **one** box.

2 protons and 2 electrons	☐
2 protons and 2 neutrons	☐
4 protons	☐
4 neutrons	☐

(1)

(b) What is a beta particle?

Tick (✓) **one** box.

An electron	☐
A neutron	☐
Electromagnetic radiation	☐

(1)

(c) A krypton (Kr) nucleus decays into a rubidium (Rb) nucleus by emitting a beta particle.

What is the correct equation for this decay?

Tick (✓) **one** box.

$^{85}_{36}Kr + {}^{0}_{-1}e \longrightarrow {}^{85}_{37}Rb$ ☐

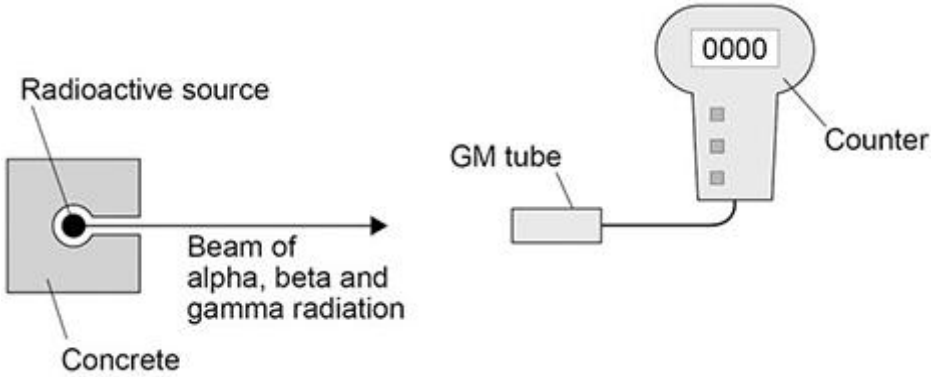
$^{85}_{36}Kr \longrightarrow {}^{85}_{37}Rb + {}^{0}_{-1}e$ ☐

$^{85}_{37}Rb \longrightarrow {}^{85}_{36}Kr + {}^{0}_{-1}e$ ☐

(1)

(d) The figure below shows an experiment to demonstrate how alpha, beta and gamma radiation penetrate different materials.

The experiment takes place in a vacuum.



Three different materials are used:

- a sheet of paper
- a 0.5 cm thick sheet of aluminium
- a 10 cm block of lead.

Each material is placed one at a time between the radioactive source and the GM tube.

The GM tube and counter show whether the material has stopped the radiation.

Complete below table to show how alpha, beta and gamma radiation penetrate the materials in the figure above.

Use the words **Yes** and **No**.

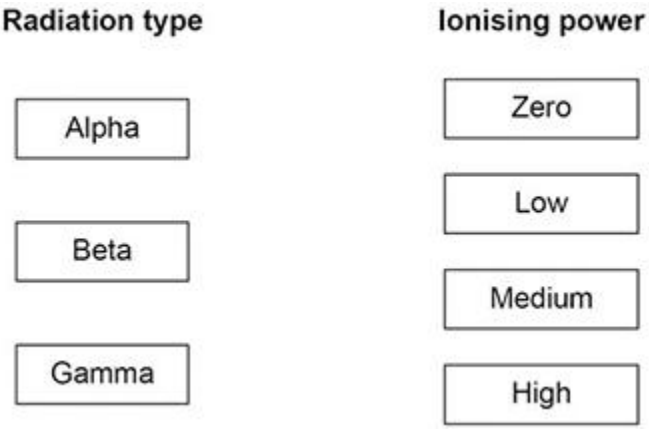
Part of below table has been completed for you.

Type of radiation	**Most radiation is stopped by:**		
	the sheet of paper	**the sheet of aluminium**	**the block of lead**
Alpha			Yes
Beta	No		
Gamma		No	

(3)

(e) Alpha, beta and gamma radiation have different ionising powers.

Draw **one** line from each radiation type to the correct ionising power.



(3)

(f) Some sources of background radiation are natural and other sources are man-made.

Which of the following is a man-made source of background radiation?

Tick (✓) **one** box.

Cosmic rays ☐

Nuclear accidents ☐

Rocks ☐

(1)

(g) The average background radiation dose per year in the UK is 2.0 millisieverts.

A dental X-ray gives a patient a radiation dose of 0.005 millisieverts.

Calculate how many dental X-rays would be the same as the average background radiation dose per year.

_____

_____

_____

Number of dental X-rays = _____

(2)

(Total 12 marks)

Q2.

Atoms of different elements have different properties.

(a) Which of the following is the same for all atoms of the same element?

Tick (✓) **one** box.

Atomic number ☐

Mass number ☐

Neutron number ☐

(1)

(b) Which of the following is different for isotopes of the same element?

Tick (✓) **one** box.

Number of electrons ☐

Number of neutrons ☐

Number of protons ☐

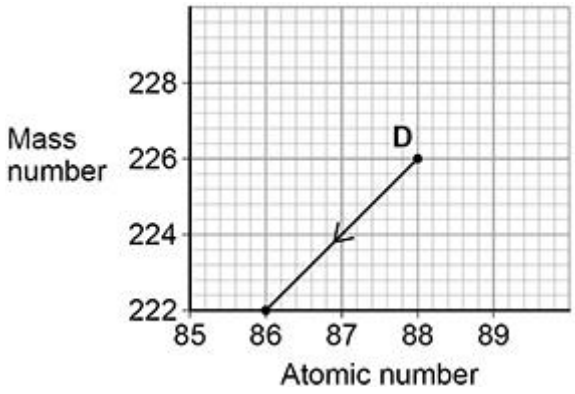
(1)

(c) A nucleus emits radiation.

Figure 1 shows how the mass number and the atomic number change.

The nucleus is labelled **D**.

Figure 1



Which type of radiation is emitted when nucleus **D** decays?

Tick (✓) **one** box.

Alpha ☐

Beta ☐

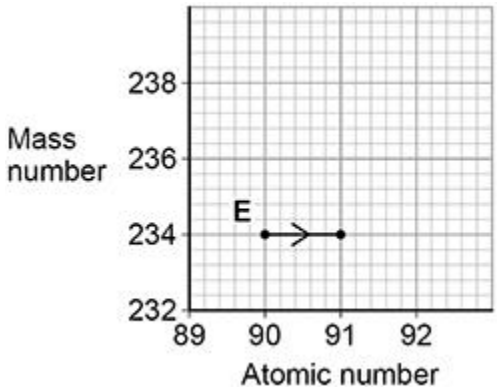
Neutron ☐

(1)

(d) Nucleus **E** also emits radiation.

Figure 2 shows how the mass number and the atomic number change for nucleus **E**.

Figure 2



Which type of radiation is emitted when nucleus **E** decays?

Tick (✓) **one** box.

Alpha ☐

Beta ☐

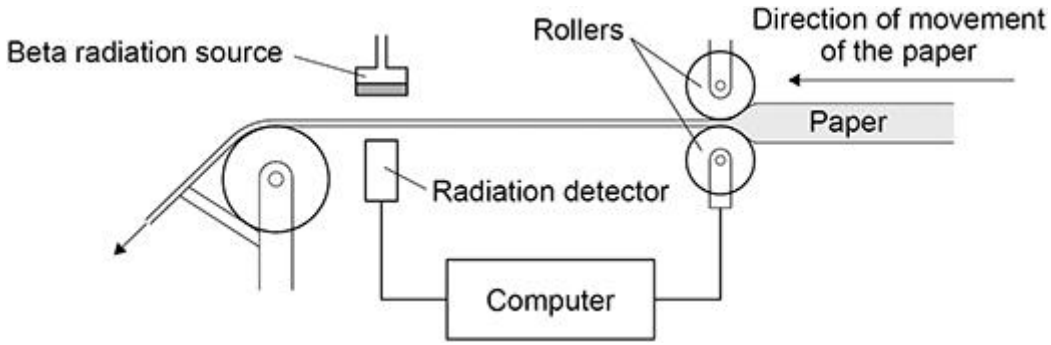
Neutron ☐

(1)

Beta radiation can be used to monitor the thickness of paper during production.

Figure 3 shows how the radiation is used.

Figure 3



The computer uses information from the radiation detector to change the size of the gap between the rollers.

(e) Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once or not at all.

decrease	stay the same	increase

The thickness of the paper between the beta source and the detector increases.

The reading on the detector will _____.

This is because the amount of radiation absorbed by the paper will _____.

(2)

(f) All radioactive elements have a half-life.

What is meant by 'half-life'?

Tick (✓) **one** box.

The time it takes for all the nuclei in a radioactive sample to split in half.	☐
The time it takes for the count rate of a radioactive sample to halve.	☐
The time it takes for the radiation to travel half of its range in air.	☐

(1)

(g) Why should the radiation source used in **Figure 3** have a long half-life?

Tick (✓) **one** box.

So the activity of the source is approximately constant.	☐
So the amount of radiation decreases quickly.	☐
So the radiation has a long range in air.	☐

(1)

(Total 8 marks)