

Homework 4: Radiation

1. An atom of helium consists of electrons, neutrons and protons.

The nucleus contains

- A electrons only
- B neutrons and electrons
- C protons and electrons
- D protons and neutrons
- E protons, neutrons and electrons

2. A student makes the following three statements.

- I Alpha particles produce much greater ionisation density than beta particles or gamma rays.
- II Alpha particles are fast moving electrons.
- III Alpha particles can be stopped by a piece of paper.

Which of these statements is/are correct?

- A I only
- B II only
- C III only
- D I and III only
- E I, II and III

3. During ionisation an atom becomes a positive ion.

Which of the following has been removed from the atom?

- A An alpha particle
- B An electron
- C A gamma ray
- D A neutron
- E A proton

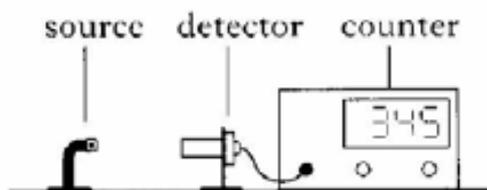
4. Which row correctly describes alpha, beta and gamma radiations?

	α	β	γ
A	electrons from the nucleus	helium nucleus	electromagnetic radiation
B	electromagnetic radiation	helium nucleus	electrons from the nucleus
C	helium nucleus	electromagnetic radiation	electrons from the nucleus
D	helium nucleus	electrons from the nucleus	electromagnetic radiation
E	electromagnetic radiation	electrons from the nucleus	helium nucleus

5. Which row in the table shows how the mass and charge of an alpha particle compares to the mass and charge of a beta particle?

	<i>Mass of an alpha particle compared to mass of a beta particle</i>	<i>Charge on an alpha particle compared to charge on a beta particle</i>
A	larger	same
B	larger	opposite
C	same	same
D	smaller	opposite
E	smaller	same

6. Measurements of the count rate from a radioactive source were taken using the apparatus shown below.



A sheet of paper, 2 mm of aluminium and 15 cm of lead were placed in turn between the radioactive source and the detector.

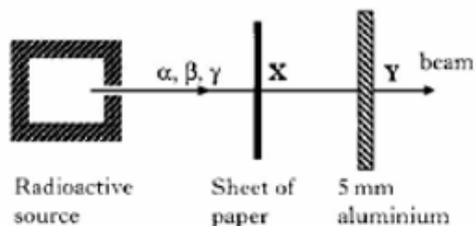
Information about the count rate obtained with and without the absorbers is given in the following table.

Absorber	Corrected count rate (counts per second)
None	80
1 sheet of paper	65
2 mm of aluminium	35
15 mm lead	5

The radiation emitted by the source is

- A α only
- B β only
- C α and β only
- D β and γ only
- E α , β and γ

7. A radioactive source emits α , β and γ radiations in a beam as shown.



The main radiation(s) in the beam at X and Y are

	Position X	Position Y
A	α and β	β
B	β and γ	β
C	α and γ	γ
D	α and β	α
E	β and γ	γ

8. The activity of a radioactive source is measured in

- A joules
- B becquerels
- C sieverts
- D grays
- E watts

9. A student writes the following statements about the activity of a radioactive source.

- I The activity decreases with time.
- II The activity is measured in becquerels.
- III The activity is the number of decays per second.

Which of these statements is/are correct?

- A I only
- B II only
- C I and II only
- D II and III only
- E I, II and III

10. For a particular radioactive source, 240 atoms decay in 1 minute.
The activity of this source is

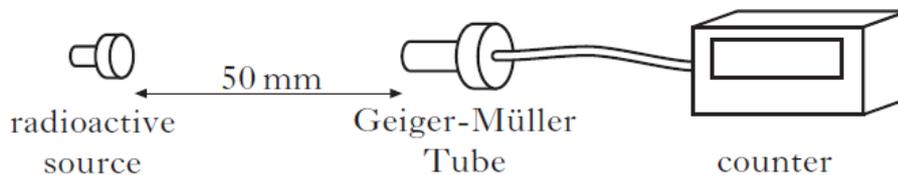
- A 4 Bq
- B 180 Bq
- C 240 Bq
- D 300 Bq
- E 14 400 Bq.

11. It is possible to determine the age of a prehistoric wooden boat by measuring the activity of radioactive carbon-14.



The activity of a piece of wood from the boat is $300 \mu\text{Bq}$.

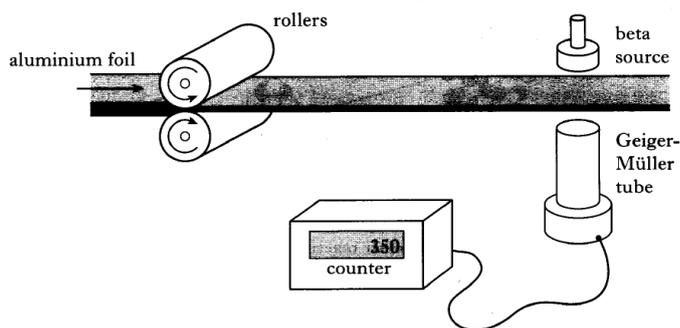
- Calculate how many atoms of carbon-14 decay in 1 day.
 - Carbon-14 emits beta particles. State what a beta particle is.
 - A radioactive source emits alpha particles. State what an alpha particle is.
 - State how the ionisation density of alpha particles compares with that of beta particles.
- (e) A student sets up an experiment as shown.



The student places a 3 mm sheet of aluminium between the radioactive source and the Geiger-Müller Tube. The count rate is observed to decrease and the student concludes that the radioactive material is emitting beta radiation.

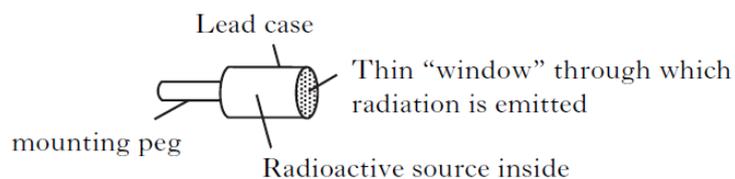
Suggest **one** reason why her conclusion may be incorrect.

12. A roller mill produces thin sheets of aluminium foil. The thickness of the foil is checked using a source of beta radiation, a Geiger-Müller tube and a counter as shown below.



- State what happens to the count rate when the thickness of the foil increases.
- Explain why an alpha source is **not** suitable for this system.
- Radioactive sources give off radiation that cause ionisation.
 - State what is meant by ionisation.
 - Give **two** precautions that should be taken when handling radioactive sources.

13. A radioactivity kit includes three radioactive sources each made up as shown.



Information about these sources is given in the table below.

	<i>Radiation emitted</i>	<i>Radioactive Element</i>
Source 1	Alpha	Americium 241
Source 2	Beta	Strontium 90
Source 3	Gamma + Beta	Cobalt 60

(a) (i) Describe an experiment to show which is the alpha emitting source.

Your description must include:

- equipment used
- measurements taken
- an explanation of the results.

(ii) The radioactive material in Source 3 emits both beta and gamma radiations. Describe how the window of the casing could be modified so that the beta radiation is stopped.