Unit 12 · Radioactivity

WORKSHEET

Full marks 44

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 44

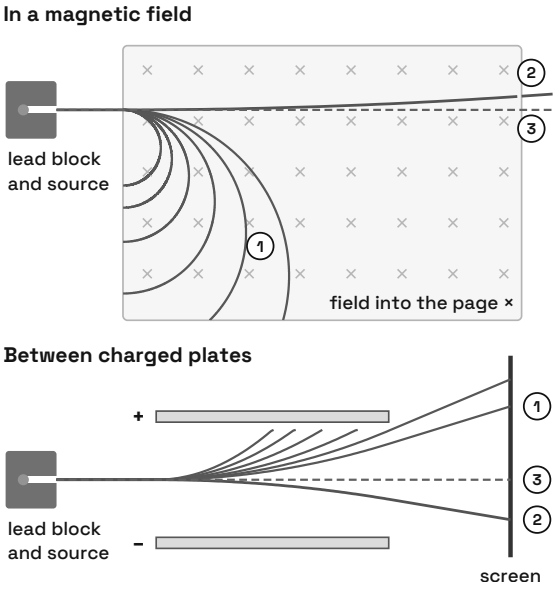
1 Key words [3]

Match each word in Column A with its description in Column B. Write the letter in the box. One description in Column B is not needed. Each match carries 0.5 mark.

Column A		Column B
1. radioisotope	☐	**a.** the nucleus left after the change
2. daughter nucleus	☐	**b.** a small badge that records the dose received
3. alpha particle	☐	**c.** an electron knocked off the atom's outer electrons
4. beta particle	☐	**d.** 2 protons and 2 neutrons, stuck tightly together
5. gamma ray	☐	**e.** a fast electron made when a neutron turns into a proton
6. dosimeter	☐	**f.** an isotope with unstable nuclei
		g. an electromagnetic wave with no charge and no mass

2 Label the diagram [3]

The diagram shows the three radiations from a source in a lead block, in a magnetic field and between charged plates. Name each numbered beam: alpha, beta or gamma. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. An alpha particle is the same as: [1]

a. a hydrogen nucleus
b. a helium nucleus
c. an electron
d. a neutron

ii. When a nucleus gives out a beta particle, its: [1]

a. mass number goes down by 1
b. atomic number goes down by 1
c. atomic number goes up by 1 and its mass number stays the same
d. atomic number and mass number both stay the same

iii. Between two oppositely charged plates, beta particles bend: [1]

a. towards the negative plate
b. towards the positive plate
c. neither way
d. first one way, then the other

iv. The source in a household smoke detector gives out: [1]

a. alpha particles
b. beta particles
c. gamma rays
d. X-rays

v. The SI unit used for the dose of radiation a person receives is the: [1]

a. becquerel
b. joule
c. sievert
d. curie

4 Very short answers [4]

Write very short answers to the following questions.

a. What is contamination? [1]

b. What thickness of lead cuts the gamma rays of cobalt-60 to half? [1]

c. Food sterilized with gamma rays is safe to eat. Why? [1]

d. A nucleus gives out only a gamma ray. What changes in it? [1]

5 Short answers [8]

Write short answers to the following questions.

a. Alpha particles have the least penetrating power, though they have the greatest ionizing power. [2]

b. Gamma rays, not alpha particles, are used to treat a tumor deep inside the body. [2]

c. A factory wants a gauge to keep paper an even thickness. Which radiation should the gauge use? Why not the other two? [2]

d. Which radiation is most dangerous outside the body, and which inside it? Give the reason for each. [2]

6 Long answers [8]

Write long answers to the following questions.

a. How can you show by experiment that alpha particles are positive, beta particles negative and gamma rays uncharged? Draw a labeled diagram. [4]

b. Describe the methods of safely handling and storing radioactive materials. **[4]**

7 Numerical problems **[10]**

Solve the following problems. Show your working.

a. Write the equations for (i) the alpha decay of uranium-238 ($Z = 92$; element 90 is thorium, Th) and (ii) the beta decay of iodine-131 ($Z = 53$; element 54 is xenon, Xe). **[2]**

Answer:

b. Neptunium-237 ($Z = 93$) decays through a chain of alpha and beta decays to bismuth-209 ($Z = 83$). How many alpha and how many beta particles are given out? **[3]**

Answer:

c. A radiographer stands 1 m from a gamma source, where the dose rate is 36 μSv per hour. She steps back to 3 m. Find the new dose rate, and the dose she receives in 2 hours there. **[2]**

Answer:

d. A worker in a hospital's nuclear medicine department receives 2 μSv per hour on average at work. She works 8 hours a day for 250 days a year. Find her yearly dose in millisieverts, and compare it with the limit of 20 mSv a year for radiation workers. **[3]**

Answer: _____

8 Think **[3]**

A student says, "Lead stops gamma rays, so a 1 cm lead apron makes a gamma source completely safe." What is wrong with this, and what does 1 cm of lead really do to cobalt-60's gamma rays?

9 Activity: Chart of the three radiations (Practical 23) (not marked)

Fill in the chart from memory, then check it against the unit.

Property	Alpha (α)	Beta (β)	Gamma (γ)
What it is			
Charge			
Mass			
Stopped or reduced by			
Ionizing power			
In an electric field			
What it does to Z and A			
One use, with the reason			

Why is the order of ionizing power the opposite of the order of penetrating power?