Unit 24 · Radioactivity and Nuclear Reactions

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 34

1 Key words [4]

Write ✓ for a true statement and ✗ for a false one. Correct the false ones. Each carries 0.5 mark.

i. Radioactivity is a property of the nucleus, not of the atom's electrons. ☐

ii. Heating a radioactive sample makes it decay faster. ☐

iii. An alpha particle is a helium nucleus. ☐

iv. Gamma rays are bent most by a magnetic field. ☐

v. When a nucleus gives out a beta particle, its atomic number goes up by one. ☐

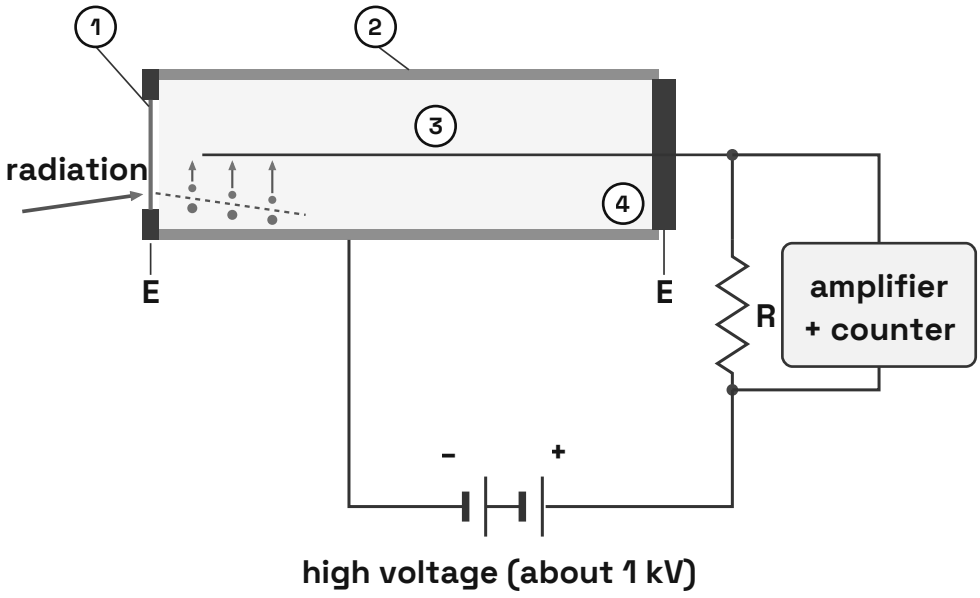
vi. The mean life of a substance is shorter than its half-life. ☐

vii. One curie is 3.7×10^{10} disintegrations per second. ☐

viii. Alpha particles are the most penetrating of the three radiations. ☐

2 Label the diagram [2]

The diagram shows a Geiger–Müller counter. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. Thorium-232 ($^{232}_{90}$Th) gives out an alpha particle. The new nucleus has: [1]

a. mass number 232 and atomic number 91
b. mass number 228 and atomic number 88
c. mass number 228 and atomic number 90
d. mass number 230 and atomic number 88

ii. Radon-222 has a half-life of 3.8 days. What fraction of a sample is left after 11.4 days? [1]

a. 1/3
b. 1/4
c. 1/8
d. 1/16

iii. Iodine-131 has a half-life of 8.0 days. Its mean life is about: [1]

a. 5.5 days
b. 8.0 days
c. 11.5 days
d. 16 days

iv. A hospital source has an activity of 2.0 Ci. In becquerels this is: [1]

a. 2.0×10^{6} Bq
b. 3.7×10^{10} Bq
c. 7.4×10^{10} Bq
d. 1.85×10^{10} Bq

v. Carbon-14 dating can find the age of: [1]

a. a granite rock
b. a wooden beam from an old temple
c. an iron sword
d. a piece of pottery's clay

4 Short answers [6]

Write short answers to the following questions.

a. Why does an alpha particle ionize a gas strongly but travel only a few centimeters in air? [2]

b. Alpha and beta particles are bent opposite ways in a magnetic field, and the beta particles much more. Why? [2]

c. Why can't we say when one particular radioactive nucleus will decay, though we can give a sample's half-life exactly? [2]

5 Long answer [4]

Write a long answer to the following question.

State the law of radioactive decay. Starting from it, show that $N = N_0 e^{-\lambda t}$, and find the relation between the half-life and the decay constant.

6 Numerical problems [10]

Solve the following problems. Show your working. Take Avogadro's number as 6.02×10^{23} per mole and 1 Ci = 3.7×10^{10} Bq.

a. A hospital orders 1.0 μg of iodine-131 (mass number 131, half-life 8.0 days). Find i. the number of atoms, ii. the decay constant in s^{-1}, iii. the activity in becquerels, and iv. the activity in curies. **[4]**

Answer:

b. Charcoal from an old fireplace in a cave gives 0.16 Bq per gram of carbon; living wood gives 0.23 Bq per gram. Carbon-14's half-life is 5730 years. How old is the charcoal? **[3]**

Answer:

c. Radon-222 has a half-life of 3.8 days. Find what percentage of a sample is left after 10 days, and how long it takes for only 10 % to be left. **[3]**

Answer: _____

7 Think [3]

Thorium-232 ($^{232}_{90}$Th) decays, through a chain of alpha and beta decays, to lead-208 ($^{208}_{82}$Pb). How many alpha and how many beta particles are given out? Explain your method.

8 Activity: The radioactive dating game (Activity 24.1) (not marked)

Open PhET's free *Radioactive Dating Game*. In its Dating Game section, use the probe to measure what is left in each object, and estimate its age.

Object	Isotope used	% left	Age
a skull			
a wooden house			
a rock			

Why can't carbon-14 date the rock?