Radioactivity Quiz

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Warm-up problems

1. Which type of radioactive emission

   (a) is positively charged?
   α

   (b) is not deflected by magnetic fields?
   γ

   (c) is the most penetrative?
   γ

   (d) is the most intensely ionizing?
   α

   (e) cannot pass through cardboard?
   α

   (f) does not cause a change in mass number or atomic number?
   γ

   (g) has the greatest mass?
   α

2. Uranium-235 and uranium-238 are isotopes of uranium, and they both have the proton number 92.

   (a) What do the numbers 235 and 238 represent?
   The number of (protons + neutrons) in a nucleus of the isotope.

   (b) What does 92 tell you about the nucleus of uranium?
   The number of protons a uranium nucleus is always 92.

   (c) How are the two isotopes different?
   The number of neutrons is different.

   (d) Uranium has 92 protons. How many neutrons are there in uranium-235 and uranium-238?
   Uranium-235 has 143 neutrons in its nucleus. Uranium-238 has 146 neutrons per nucleus.

   (e) How many electrons are there in an atom of uranium?
   In an atom (an atom is always neutral), 92 electrons balance out the charge on the 92 protons.

3. All the parts of this question are multiple choice.

   (a) The rate of radioactive decay can be increased by increasing the
   A temperature B pressure C light intensity D none of these
   D: Environmental conditions don't affect the rate of radioactive decay.

   (b) An alpha particle has a charge of
   A +1 B +2 C −1 D +4 E none of these
   B: There are 2 protons and 2 neutrons in an alpha particle, so the charge is +2.

   (c) A beta particle is
   A a helium nucleus B an electron from the nucleus C electromagnetic radiation D none of these
   B: A beta particle is released when a neutron changes into a proton, causing a fast moving electron to be ejected from the nucleus of the atom.

4. Complete the following equations for radioactive decay:

(a) Radon gas decays via α decay:

$$^{222}_{86}\text{Rn} \longrightarrow {}^{4}_{2}\alpha +$$

$$^{222}_{86}\text{Rn} \longrightarrow {}^{4}_{2}\alpha + {}^{218}_{84}\text{Po}.$$

(b) Iron-59 is an unstable isotope of iron which decays via β emission:

$$^{59}_{26}\text{Fe} \longrightarrow$$

$$^{59}_{26}\text{Fe} \longrightarrow {}^{0}_{-1}\beta + {}^{59}_{27}\text{Co}.$$

Extension problems

5. Paul says 'an ion is a bit like an isotope, it has one two few or one too many particles'. Explain whether Paul is right in thinking this, and how could you improve his understanding?

   Paul is right in thinking that too few or many particles in the atom is responsible for both ions and isotopes. However, with ions, it is an excess or deficiency of electrons that makes the atom charged overall (meaning we call it an ion instead of an atom). In isotopes, too few or many neutrons makes the atom heavier or lighter (and perhaps unstable causing radioactivity), but the charge is unchanged. Paul also seems to think that there is only one too few or too many of the electrons ort neutrons, whereas in fact, it can be any number (but small differences are more likely).