Stations review

2.a : Students know the nucleus of the atom is much smaller than the atom yet contains most of its mass.

1) Diagram a generic model of the atom and label the protons, neutrons, nucleus, electrons, and electron shells.

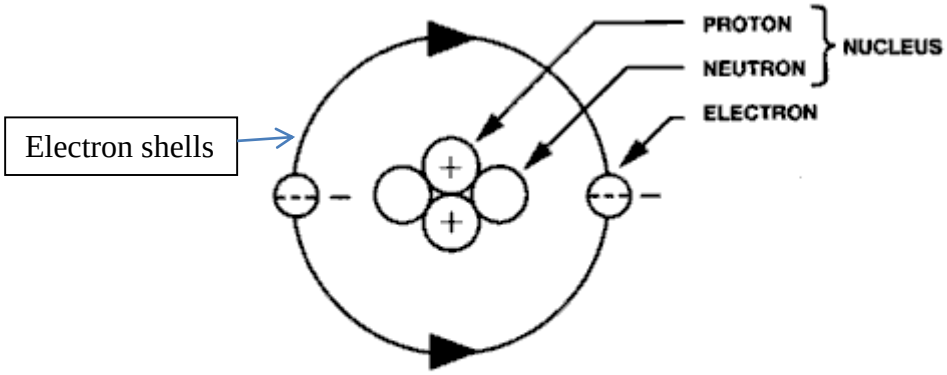

Figure 2-I. A Typical Atom

2) Where is most of the mass of the atom? ":the nucleus

3) What does this mean about the mass of an electron?
If most of the mass of the atom is in the nucleus, the electron must have very little mass because it is not in the nucleus.

4) What will most likely happen if a scientist shoots a particle at an atom? Why?
The particle will most likely go straight through the atom. The atom is mostly empty space.

5) How many neutrons does Arsenic have? (round the mass)
Atomic mass = 75. Atomic number = 33. Neutrons = 75 – 33 = 42.

6) If an element starts to accumulate a lot of negative charge, it can gain multiple electrons. How would this effect the mass of the sample?
Since electrons have almost no mass, gaining electrons would have very little effect on the mass of the atom.

2.b : Students know protons and neutrons in the nucleus are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.

1) What two forces are at work in the nucleus of an atom?

The nuclear strong force and electromagnetic force.

2) Which of the two forces you identified in question 1 is responsible for holding the nucleus together?

The nuclear strong force is responsible for holding the nucleus together.

3) The nucleus of the atom is very hard to split apart. It wasn't accomplished until the mid-20th century. Why are nuclear reactions so difficult to do?

The nuclear strong force is very strong, and a lot of energy must be used to break up an atom simply because of how strong the nuclear strong force is.

4) Pick an element that is most likely radioactive. How do you know it is probably radioactive?

Anything with an atomic number of 83 or higher is radioactive. When an atom has a lot of protons, the protons will repel against each other through the electromagnetic force and make it harder for the nucleus to stay together.

5) What would happen to an atom if the nuclear strong force suddenly stopped working? *Explain*

The protons in the nucleus would have nothing to force them together, and would violently explode away from each other because they repel each other through the electromagnetic force.

2.c : Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions.

1) What is an isotope?

An isotope is an element with a specific mass (not always the average). It still has the same number of protons, just a different number of neutrons and thus a different mass.

2) What does it mean when something is radioactive?

For something to be radioactive means that it is unstable and will emit high energy particles.

3) Write the isotopic notation for:
   a. Uranium-238
      $^{238}_{92}U$
   b. Hydrogen-1
      $^{1}_{1}H$
   c. Hydrogen-3
      $^{3}_{1}H$
   d. The most common isotope of Sodium
      $^{23}_{11}Na$

4) Potassium-39 is a stable isotope of potassium but potassium-40 is unstable. Which do you think is easier to find in the ground and why?

Potassium-39 will be easier to find in the ground. Potassium-40 is unstable and will therefore break down over time until there isn't any left.

5) If you have a sample of Uranium-238 that is undergoing radioactive decay, will it ever stop being radioactive? Explain

Eventually, yes the uranium will stop being radioactive. After the uranium has decayed down to a stable atom, there will be no need for the uranium to decay further.

2.d : Students know the three most common forms of radioactive decay (alpha, beta, and gamma) and know how the nucleus changes in each type of decay.

1) Complete the chart:

Type of Decay	Isotopic Symbol	Charge	Mass	Protection needed
Alpha	$^{4}_{2}\mathbf{He}$	**+2**	4 amu	paper
Beta	$^{0}_{-1}e$	-1	**~0 amu (technically 0.000548 amu)**	**Cardboard/foil**
Gamma	$^{0}_{0}\gamma$	0	**0 amu**	Thick lead / concrete

2) Solve for X in each equation:

a. $^{130}_{53}\mathrm{I} \rightarrow {}^{0}_{-1}\mathrm{e} + X$

$^{130}_{54}Xe$

b. $^{240}_{92}\mathrm{U} \rightarrow {}^{236}_{90}\mathrm{Th} + X$

c. $^{7}_{3}\mathrm{Li} + {}^{4}_{2}\mathrm{He} \rightarrow X$

$^{4}_{2}He$

$^{11}_{5}B$

3) Write a nuclear equation for the alpha decay of Plutonium-244.

$$^{244}_{94}Pu \rightarrow {}^{4}_{2}He + {}^{240}_{92}U$$