Unit 2 Review Outline   Name: Answer Key

1. Identify the number of subatomic particles in each of the following:

Symbol	Name	# of protons	# of electrons	# of neutrons	Atomic #	Mass #	Atomic mass
^{88}Sr	Strontium-88	38	38	50	38	88	87.62
$^{110}_{47}Ag$	silver-110	47	47	63	47	110	107.868
$^{34}_{16}S$	Sulfur-34	16	16	18	16	34	32.066

2. A sample of chromium atoms was identified to have two isotopes; ^{52}Cr and ^{56}Cr. One of the isotopes is stable and one is radioactive. Which one is stable and which is radioactive? Explain your answer.

Chromium has an atomic mass of 51.996 a.m.u, which should represent stable isotopes with mass numbers around 52. Cr-52 would be stable and Cr-56 would be radioactive because it has a mass number 4 more than the atomic mass.

3. Why are mass numbers always whole numbers and atomic masses are commonly not?

Mass numbers represent specific isotopes of an element. Isotopes have certain number of neutrons so #n° and #p⁺ should be a whole number. Atomic masses are weighted averages of naturally occurring isotopes, which then ends up being non-whole numbers

4. Nitrogen has two naturally occurring isotopes, N-14 and N-15. The atomic mass of nitrogen is 14.007 amu. Which isotope is more abundant in nature? Explain your answer.

N-14 should be the most abundant because the atomic mass (weighted average) is very close to 14 (14.007) and further from 15.

5. What is the average atomic mass of silicon if 92.21 % of its atoms have a mass of 27.977 amu, 4.07 % have a mass of 28.976 amu, and 3.09 % have a mass of 29.974 amu? How does it compare to the accepted value?

$AM = (0.9221 \cdot 27.977) + (0.0407 \cdot 28.976) + (0.0309 \cdot 29.974)$

$= 27.903$ amu   accepted is 28.086 amu ; too low ; total abundance is not 100%

6. What is the electromagnetic spectrum?

The compilation of all electromagnetic waves that are emitted from the sun. These all vary by wavelengths (λ), frequencies (ν) and energy of the photons/quanta (E)

7. The half-life of chromium-51 is 28 days. If the sample contains 227 grams, how much chromium would remain after 77 days?

$N_t = N_0(\frac{1}{2})^{t/t_{1/2}}$

$= 227 \cdot (\frac{1}{2})^{77/28} = 33.7g$ Cr-51 is left

8. A certain wave has a frequency of 2.34 x 10^8 Hz. Find the wavelength, the energy of a photon, and the type of E.M.R.

$\nu = 2.34 \times 10^8 s^{-1}$

$\lambda = \frac{2.998 \times 10^8 m/s}{2.34 \times 10^8 s^{-1}} = 1.28 m$; radio wave

$E = 6.626 \times 10^{-34} J \cdot s \cdot 2.34 \times 10^8 s^{-1} = 1.55 \times 10^{-25} J$

9. Visible light is created when electrons fall to the second energy level in an atom. Explain how red light photons are produced as compared to blue light photons.

Electrons that fall shorter distances (3→2 or 4→2) would release lower energy photons whereas electrons that fall farther distances (6→2, 7→2) will release higher energy photons. Red light has longer λ + lower energy so that would be a 3→2 fall where blue being higher energy would be a longer drop (6→2)

10. Write the electron configurations and orbital diagrams for the following:

a) Phosphorus

EC: $1s^2 2s^2 2p^6 3s^2 3p^3$

OD: ⇅ : ⇅ , ⇅ ⇅ ⇅ : ⇅ , ↑ ↑ ↑

b) Vanadium

EC: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

OD: ⇅ : ⇅ , ⇅ ⇅ ⇅ : ⇅ , ⇅ ⇅ ⇅ , ↑ ↑ ↑ _ _ : ⇅

c) Niobium

EC: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^3$

OD: ⇅ : ⇅ , ⇅ ⇅ ⇅ : ⇅ , ⇅ ⇅ ⇅ , ⇅ ⇅ ⇅ ⇅ ⇅ : ⇅ , ⇅ ⇅ ⇅ , ↑ ↑ ↑ _ _ : ⇅

11. The electron configuration and orbital diagram for Niobium above list the sequence of orbitals in a different order. Why is this?

Electron configurations arrange e- by energy ('order of filling') whereas orbital diagrams group them by energy levels

12. Draw a sketch for each of the 5 major atomic models we discussed in class (Dalton through Quantum).