Atomic Energy Study Guide Name: KEY

1. A photon has an energy of 4.00×10^{-19} J. Determine each of the following.

E

a. the frequency of the radiation.

$\nu = ?$ Hz

$E = 4.00 \times 10^{-19}$ J

$E = h\nu$

$\nu = \frac{E}{h} = \frac{4.00 \times 10^{-19} \text{ J}}{6.626 \times 10^{-34} \text{ J}\cdot\text{s}}$

$\nu = 6.04 \times 10^{14} \frac{1}{s} = \boxed{6.04 \times 10^{14} \text{ Hz}}$

b. the wavelength of the radiation

$\lambda = ?$ m

$\nu = 6.04 \times 10^{14} \frac{1}{s}$

$c = \lambda\nu$

$\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} \frac{m}{s}}{6.04 \times 10^{14} \frac{1}{s}} = \boxed{4.97 \times 10^{-7} \text{ m}}$

2. A photon of light has a wavelength of 3.20×10^{5} m. Determine each of the following.

λ

a. the frequency of the radiation.

$\nu = ?$ Hz

$\lambda = 3.20 \times 10^{5}$ m

$c = \lambda\nu$

$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \frac{m}{s}}{3.20 \times 10^{5} \text{ m}} = 938 \frac{1}{s} = \boxed{938 \text{ H}}$

b. the energy of the photon.

$E = ?$ J

$\nu = 938 \frac{1}{s}$

$E = h\nu$

$E = (6.626 \times 10^{-34} \text{ J}\cdot\text{s})(938 \frac{1}{s})$

$\boxed{E = 6.22 \times 10^{-31} \text{ J}}$

3. High frequency = **short/long** (circle one) wavelength = **low/high** (circle one) energy

Using the following data:

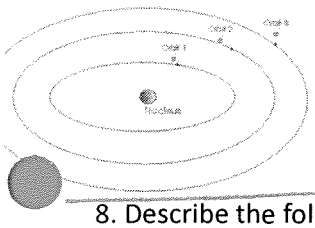
	Compound	Color emitted when heated
A	Barium Nitrate	Yellow
B	Potassium Nitrate	Violet
C	Calcium Nitrate	Orange
D	Copper (II)Sulfate	Green
E	Lithium Carbonate	Red

4. Which compound produces the longest wavelength? E = lowest E

5. Which compound produces the highest energy? B

6. Which compound produces the lowest frequency? E

7. Using the image to the left explain why copper emits green light.



e- will absorb E and move up in E level (excited state) when e- moves to lower E level, E is released in the form of light. The color emitted corresponds to a certain quantum of E and depends on the ΔE levels.

8. Describe the following terms, provide examples when applicable.

a. photon "packet" (quantum) of light

b. radioactivity unstable nucleus decays into more stable nuclei

mass # ↘

c. nuclear symbol $^{A}_{Z}X$ ← element symbol

atomic # → Z

d. hyphen notation element name – mass #

9. Fill in the table

Radiation Type	Mass	Greek Symbol	Identity	Shielding
ALPHA	4	α	$^{4}_{2}He$	paper, skin
BETA	0	β	$^{0}_{-1}\beta$	Heavy clothing, glass, metals, plastic
GAMMA	0	γ	photon	lead or concrete

11. Identify the strongest type of radiation that can be blocked by each material (beta particles, gamma rays, or alpha particles)

a) a piece of paper α b) a sheet of aluminum β c) a piece of lead γ

12. Write the equations for the following processes:

a. The alpha decay of iridium-174

$^{174}_{77}Ir \rightarrow ^{170}_{75}Re + ^{4}_{2}He$

b. The beta decay of platinum-199

$^{199}_{78}Pt \rightarrow ^{199}_{79}Au + ^{0}_{-1}\beta$

13. Complete the following reactions:

a. $^{203}_{80}Hg \rightarrow ^{0}_{-1}\beta + ^{203}_{81}Tl$

b. $^{149}_{64}Gd \rightarrow ^{4}_{2}He + ^{145}_{62}Sm$

c. $^{99}_{43}Tc \rightarrow ^{0}_{-1}\beta + ^{99}_{44}Ru$

d. $^{237}_{93}Np \rightarrow ^{4}_{2}He + ^{233}_{91}Pa$

14. Actinium-226 has a half-life of 29 hours ($t_{1/2}$). If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

$\frac{58 \text{ hrs}}{29 \text{ hrs}} = 2$ Half Lives

100 mg $\xrightarrow{1}$ 50 mg $\xrightarrow{2}$ 25 mg

15. The half-life of isotope X is 2.0 years ($t_{1/2}$). How many years would it take for a 4.0 mg (start) sample of X to decay and have only 0.50 mg (end) of it remain?

4.0 mg $\xrightarrow{1}$ 2.0 mg $\xrightarrow{2}$ 1.0 mg $\xrightarrow{3}$ 0.5 mg

3 Half Lives = 3 × 2.0 yrs = 6.0 yrs

16. Three grams (start) of Bismuth-218 decay to 0.375 grams (end) in one hour. What is the half-life ($t_{1/2}$?) of this isotope?

3 g $\xrightarrow{1}$ 1.5 g $\xrightarrow{2}$ 0.75 g $\xrightarrow{3}$ 0.375 g

3 Half Lives in 1 hr ∴ $t_{1/2} = \frac{1 \text{ hr}}{} = 0.33$ hr