Atomic Energy Study Guide Name: Key

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

a. the frequency of the radiation.

$E = 4.00 \times 10^{-19}$ J
$\nu = ?$
$E = h\nu$
$h = 6.626 \times 10^{-34}$ J·s

$\frac{E}{h} = \frac{h\nu}{h}$ $\nu = \frac{E}{h}$

$\nu = \frac{4.00 \times 10^{-19} J}{6.626 \times 10^{-34} J \cdot s} = \frac{6.04 \times 10^{14}}{s}$

b. the wavelength of the radiation

$c = \lambda\nu$
$c = 3.00 \times 10^{8} \frac{m}{s}$

$\frac{c}{\nu} = \frac{\lambda\nu}{\nu}$ $\lambda = \frac{c}{\nu} = \frac{3.00 \times 10^{8} m \ s}{s \times 6.04 \times 10^{14}} =$

4.97×10^{-7} m

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

a. the frequency of the radiation.

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

$\frac{c}{\lambda} = \frac{\lambda\nu}{\lambda}$ $\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} m}{s \cdot 3.20 \times 10^{5} m} =$

$\frac{938}{s}$

b. the energy of the photon.

$E = h\nu$
$h = 6.626 \times 10^{-34}$ s

$E = 6.626 \times 10^{-34} \cdot s \times \frac{938}{s} = 6.22 \times 10^{-31}$ J

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

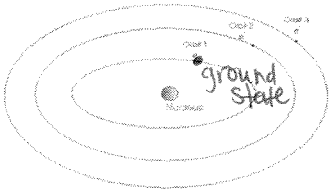
Using the following data:

	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? Lithium carbonate

5. Which compound produces the highest energy? Potassium Nitrate

6. Which compound produces the lowest frequency? Lithium carbonate



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

ground state e⁻ gains a Quantum of energy and goes up to a higher energy level (excited state). The e⁻ will eventually return to ground state giving of gained energy as a photon, which is green light

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

a. photon emitted energy given OFF as a wave

b. radioactivity unstable nuclei decays until stable

c. nuclear symbol mass# atomic# Element Symbol

d. hyphen notation element symbol — mass #

9. Fill in the table

Radiation Type	Mass	Greek Symbol	Identity	Shielding
ALPHA	4	α	$^{4}_{2}He$ (helium nucleus)	Paper / skin
BETA	0	β	$^{0}_{-1}e^-$ (electron)	Plastic, glass, light metal
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 alpha b) a sheet of aluminum Beta c) a piece of lead gamma

12. Write the equations for the following processes:

a. The alpha decay of iridium-174

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

b. The beta decay of platinum-199

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

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. If 100 mg of actinium-226 disintegrates over a period of 58 hours, how many mg of actinium-226 will remain?

$\frac{58\ hr}{29\ hr} = 2$

100mg → 50mg → 25mg (1, 2)

15. The half-life of isotope X is 2.0 years. How many years would it take for a 4.0 mg sample of X to decay and have only 0.50 mg of it remain?

4.0mg → 2.0mg → 1.0mg → 0.50mg (2.0yr 1, 2, 3)

2.0yr X 3 = 6 years

16. Three grams of Bismuth-218 decay to 0.375 grams in one hour. What is the half-life of this isotope?

3g → 1.5g → 0.75g → 0.375g (1, 2, 3)

$\frac{1\ hour}{3}$ = 0.33 hr or $\frac{60\ min}{3}$ = 20 min