Name:_____ Per:_____

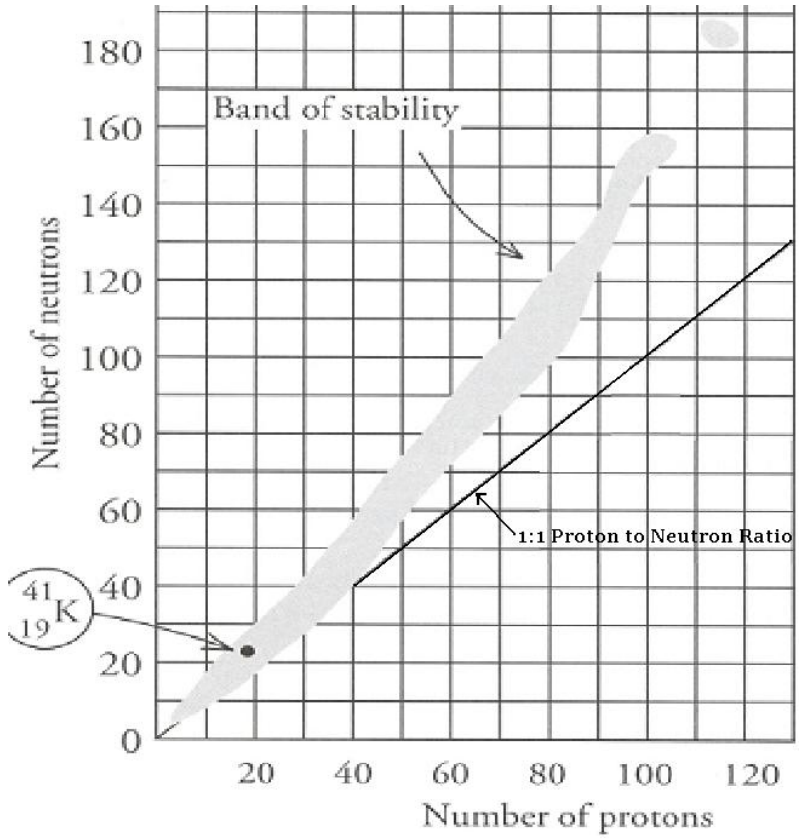
Worksheet- Band of Stability

Objective: Determine if an atom is "stable", "unstable (aka radioactive)", or "does not exist" based on its position on the graph below.

Background Info: Isotopes of elements found in nature are all located within the gray area on the graph below called the **band of stability**. Those elements found in the **middle** of the "band" have a very **stable nucleus**, while those elements on the **outer edges** of the band have an **unstable nucleus** and are said to be **"radioactive"**. However, some combinations of protons and neutrons in the nucleus are so unstable that they cannot even exist long enough to be recognized as elements and these fall outside the band of stability.

Instructions: **a)** Determine the # of subatomic particles each element contains **b) Locate** & **plot** where the following atoms would be on the graph below. **Label** each atom after it has been plotted (ex: see Potassium- 41)

$^{24}_{12}Mg$	$^{142}_{60}Nd$	$^{195}_{77}Ir$	$^{81}_{35}Br$	$^{238}_{92}U$	$^{191}_{77}Ir$
# P=	# P=	# P=	# P=	# P=	# P=
# e=	# e=	# e=	# e=	# e=	# e=
#n =	#n =	#n =	#n =	#n =	#n =



Questions to Answer:

1. Did any of your atoms land outside the gray area? Explain why or why not.

2. How can there be two different atoms of iridium? How are they different?

3. Would a small atom (less than 40 protons) be found in nature if it has the same number of protons & neutrons (1:1 ratio)? Explain.

4. Would a large atom (more than 40 protons) be found in nature if it has the same number of protons & neutrons (1:1 ratio)? Explain.

5. Two of the atoms you plotted are naturally radioactive, that is, their nuclei fall apart over time. Which two do you think they are? What is your reasoning?

6. Imagine a chemist was trying to create an atom with 60 protons and a mass number of 155. Would this be possible? Why or why not? (**SHOW** where it would fall on the graph).

7. If an element had 90 protons, how many neutrons would be a good number for it to have in order to be considered a stable element? What element would this be? (**SHOW** where it would fall on the graph).

Worksheet- Nuclear Decay

1. Instructions: Fill in the table below for each type of decay– alpha (α), beta (β), and gamma (Y)

Parent Isotope	Particle emitted	New, Daughter isotope	Alpha, Beta, or gamma Decay?	# of protons lost or gained by "parent"	Change in mass number
a. $^{226}_{88}Ra \rightarrow$	$^{4}_{2}He$ +	$^{222}_{86}Rn$	*Alpha*	*Lost 2*	*minus 4*
b. $^{214}_{84}Po \rightarrow$	$^{4}_{2}He$ +	$^{210}_{82}Pb$			
c. $^{47}_{20}Ca \rightarrow$	$^{0}_{-1}e-$ +	$^{47}_{21}Sc$			
d. $^{148}_{64}Gd \rightarrow$	$^{4}_{2}He$ +	$^{144}_{62}Sm$			
e. $^{14}_{6}C \rightarrow$	$^{0}_{-1}e-$ +	$^{14}_{7}N$			
f. $^{148}_{64}Gd \rightarrow$	$^{0}_{0}Y$ +	$^{148}_{64}Gd$			

2. What changes take place in the nucleus when an alpha particle is emitted?

3. What is the identity of an alpha particle?

4. What changes take place in the nucleus when a beta particle is emitted?

5. Which particle is associated with beta decay?

6. Fill in the missing parts of these nuclear reactions: **(numbers** & **elements)**

a) $^{40}_{\_\_}\text{\_\_\_} \rightarrow {}^{0}_{-1}e + {}^{40}_{20}Ca$	b) $\text{\_\_\_\_\_} \rightarrow {}^{4}_{2}He + {}^{226}_{88}Ra$	c) $^{35}_{14}Si \rightarrow {}^{0}_{-1}e +$ ____
d) $^{238}_{92}U \rightarrow {}^{4}_{2}He +$ ____	e) $^{110}_{53}I \rightarrow$ _____ $+ {}^{106}_{51}Sb + {}^{0}_{0}Y$	f) $^{140}_{56}Ba \rightarrow$ _____ $+ {}^{140}_{57}La$

7. Write equations for: a) The alpha (α) decay of radon- 198 _____ → _____ + _____

b) The beta (β) decay of uranium-237 _____ → _____ + _____

c) Plutonium- 244 undergoes gamma decay _____ → _____ + _____

9. Does the identity of an atom change during radioactive decay? Why or why not?

10. How does the "Law of Conservation of Matter" explain how you write nuclear equations?

11. List the 3 types of radiation (α, β, γ) in order from least penetrating to most penetrating.

12. Why would you expect alpha particles to be less able to penetrate materials than beta?

13. Why are alpha particles and beta particles deflected in opposite directions in an electric field? Why are gamma rays not deflected?