Name: KEY Date: _____ Block : _____

CA #1 Study Guide – **Atomic Structure, Isotopes, Nuclear Energy, Ions, Oxidation #, Electron Configuration, ER Spectrum, Light and Equations, Periodic Trends.**

1. How many total subatomic particles (p, n & e's) are in an O-16 atom? P=8 N=8 e=8

2. The # of P determines what element a particle is, the # of N determines the isotope of that element, and the # of e determines the particle's overall charge.

3. An atom has a mass # of 62 and has 33 neutrons, and 28 electrons write the isotopic notation: $^{62}_{29}Cu^{+1}$

4. A particle has 13 p, 14 n, and 10 e. What is its mass #? 27 What is the charge? +3 What element is it? Al

Isotope Name	Nuclear Symbol	Atomic Number	Mass Number	Charge	# of Protons	# of Electrons	# of Neutrons
5. Sulfur-32	$^{32}_{16}S^{-2}$	16	32	-2	16	18	16
6. Nickel-60	$^{60}_{28}Ni^{+4}$	28	60	+4	28	24	32
7. Nitrogen-16	$^{16}_{7}N^{-3}$	7	16	-3	7	10	9

8. Locate the following elements on the periodic table. Fill in the rest of the table:

Element Symbol	Element Name	Metal or Nonmetal?	Number of Valence Electrons	Gain or Lose to become stable?	Oxidation Number
K	Potassium	metal	1	lose	+1
Ga	Gallium	metal	3	lose	+3
Be	Beryllium	metal	2	lose	+2
I	Iodine	nonmetal	7	gain	-1

9. Where is most of the mass of an atom found? Where is most of the volume of an atom found?
mass - Nucleus Volume - electron cloud

10. What do isotopes of an atom have in common? How are isotopes of an atom different from one another?
All isotopes have the same number of protons, but they each have a different number of neutrons.

11. Explain what must happen in order for an ion to have a positive charge. What about a negative charge?
Positive - atom loses electrons (cation) Negative - atom gains electrons (anion)

12. Determine the maximum number of electrons present in each of the first four energy levels.
1st = 2 2nd = 8 3rd = 18 4th = 32

13. What do we call the horizontal rows? What do these rows tell us about the atoms?
Periods. All atoms in a period are in the same energy level

14. What do we call the vertical columns? What do these tell us about the atoms?
Groups/Families. They have the same # of valence electrons

15. The atomic number indicated what about the atom?
The number of protons in an atom.

16. What subatomic particle determines the behavior, or properties, of an atom?
The number of electrons

17. Explain how the mass number is different from the average atomic mass:
The mass # is the amount of protons and neutrons whereas the average atomic mass is the average of all isotopes according to their abundance in nature.

18. Write a list of the three types of radioactive decay. Include all information that compares these to each other (relative amount of energy, penetrating power—what can it be stopped by?, what particle is ejected from the nucleus?).

Alpha (α) – lowest energy, can be stopped by paper. $^{4}_{2}He$ ejected from nucleus

Beta (β) – medium energy, can be stopped by aluminum foil. $^{0}_{-1}e$ ejected.

Gamma (γ) – high energy, can be stopped by lead/concrete. Energy wave ejected

19. What are the two main types of nuclear reactions? Include all information that compares these to each other (location, atoms involved, whether a chain reaction occurs).

Fission – when a heavy nucleus is hit with a neutron and splits. This releases 2 daughter nuclei, neutrons, and energy! This is a chain reaction that occurs in power plants and bombs.

Fusion – when 2 light nuclei (like hydrogen) combine. This happens in sun/stars

20. What happens to the mass number and atomic number of an atom that undergoes beta decay?

mass # – doesn't change atomic # – increases by 1

21. What happens to the mass number and atomic number of an atom that undergoes alpha decay?

mass # – decreases by 4 atomic # – decreases by 2

22. Write a nuclear equation for the alpha decay of Plutonium-244 $^{244}_{94}Pu \rightarrow {}^{4}_{2}He + {}^{240}_{92}U$

23. Write a nuclear equation for the beta decay of Carbon-14 $^{14}_{6}C \rightarrow {}^{0}_{-1}e + {}^{14}_{7}N$

24. What are some examples of practical uses for radioactive elements? (Alpha, Beta, Gamma)

α – smoke detectors β – medical scans γ – sterilization

25. Determine the percentage of a radioactive isotope that remains after 3 half lifes.

12.5%

26. What is Einstein's Equation? What does each variable represent? What does his equation describe?

$E=mc^2$ E = energy m = mass c = speed of light This is the amount of energy converted from "lost mass."

27. What are the collective of colored wavelengths given off by elements when they are excited?

Emission spectrum

28. What type of spectrum is the inverse of question 16, and removes all the excited wavelengths from the spectrum?

Absorption spectrum

29. Describe what occurs when light is produced. Use the terms *energy levels, electron, wavelength, and photon.* when an electron falls from a higher to lower energy level, energy is released as a photon with a specific wavelength and frequency.

30. What is frequency?

The # of waves to cross a point in one second

31. What is wavelength?

The length of a wave from crest to crest

32. What is the relationship between frequency and wavelength?

Inverse – as one increases the other decreases

33. What is the relationship between frequency and energy?

Direct – as one increases so does the other.

34. List all sublevels, their respective number of orbitals and the maximum number of electrons they can hold.

s = 1 orbital = $2e^-$ p = 3 orbitals = $6e^-$ d = 5 orbitals = $10e^-$ f = 7 orbitals = $14e^-$

35. Write the complete electron configuration for Vanadium:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

36. Write the complete electron configuration for Plutonium:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^2\ 4d^{10}\ 5p^6\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^6\ 7s^2\ 4f^5\ 6d^1$

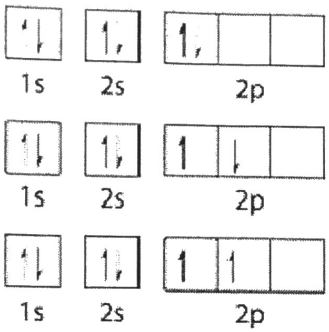
37. Write the complete electron configuration for Boron:

$1s^2\ 2s^2\ 2p^1$

38. Write the complete electron configuration for Cobalt:

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

39. In the following orbital diagrams, determine if they are written correctly. If they are, list the element. If they are not, then list the violation.



Electrons need their own orbital

Electrons need the same spin

carbon

40. What is atomic radius? Which element on the periodic table has the greatest atomic radius?

The size of the atom. Francium is the largest atom.

41. What is ionization energy? Which element on the periodic table has the greatest ionization energy?

The energy needed to remove an electron from an atom. Helium has the highest.

42. What is electronegativity? Which element on the periodic table has the greatest electronegativity?

The ability of an atom to attract a pair of electrons. Fluorine has the highest.

43. Using these three elements; answer the following questions: **Calcium, Arsenic, Bromine**

A) Which will have the lowest electronegativity?

Calcium

B) Which element would have the greatest nuclear pull (force)?

Bromine

C) Would Calcium's ion be larger or smaller than the original atom?

Smaller

44. Using these three elements; answer the following questions: **Oxygen, Selenium, Sulfur**

A) Rank these elements from the lowest to highest electronegativity:

Selenium, sulfur, oxygen

B) Rank these elements from smallest to largest atomic radii:

Oxygen, sulfur, selenium

C) Would Oxygen's ion be larger or smaller than the neutral atom?

Larger

45. What causes nuclear pull in increase as you move across a period?

More protons in the nucleus pulling on the same valence shell

46. Explain what the "Shielding Effect" is.

The core electrons shield the valence electrons from the pull of the positively charged nucleus

47. **HONORS:** If a wave has a wavelength of 2.71×10^{-5} m, determine the frequency of the wave. ($C = 3.0 \times 10^8$ m/sec)

$$f = \frac{c}{\lambda} = \frac{3.0 \times 10^8 \frac{m}{s}}{2.71 \times 10^{-5}\ m} = 1.11 \times 10^{\frac{13}{15}}\ Hz$$

48. **HONORS:** Determine the energy of the above wave using Planck's constant. (6.625×10^{-34} J * sec)

$$E = hf = (6.625 \times 10^{-34}\ J \cdot s)(1.11 \times 10^{15}\ s^{-1}) = 7.35 \times 10^{-19}\ J$$