

Unit 2 Review

Atomic Structure/Isotopes/weighted average atomic mass

1. The 3 particles which make up an atom are:

a. _____ b. _____ c. _____

2. The electrical charges associated with subatomic particles are:

a. _____ b. _____ c. _____

3. The number of protons in one atom of an element determines the atom's _____, and the number of electrons determines the _____ of the element.

4. The atomic number tells you the number of _____ in one atom of an element. It also tells you the number of _____ in a neutral atom of that element. The atomic number gives the "identity" of an element as well as its location on the periodic table. No two different elements will have the _____ atomic number.

5. The _____ of an element is the average mass of an element's naturally occurring atom, or isotopes, taking into account the _____ of each isotope.

6. The _____ of an element is the total number of protons and neutrons in the _____ of the atom.

7. The mass number is used to calculate the number of _____ in one atom of an element. In order to calculate the number of neutrons you must subtract the _____ from the _____.

8. Given the following hyphen notation, write the nuclear notation for the following:

Lithium-6 _____

Iron-58 _____

Oxygen-17 _____

Krypton-78 _____

Bromine-79 _____

Copper-65 _____

Mercury-200 _____

Helium-3 _____

9. If an atom has 27 protons:

How many electrons does it have? _____ 27 _____

How many of its electrons in p orbitals? _____

How many electrons are in its valence energy level? _____

10. Give the element symbol of and the number of electrons in a neutral atom of:

Uranium _____

11. Rubidium has two common isotopes, ^{85}Rb and ^{87}Rb . If the abundance of ^{85}Rb is 72.2% and the abundance of ^{87}Rb is 27.8%, what is the average atomic mass of rubidium?

12. Uranium has three common isotopes. If the abundance of ^{234}U is 0.01%, the abundance of ^{235}U is 0.71%, and the abundance of ^{238}U is 99.28%, what is the average atomic mass of Uranium?

13. Titanium has five common isotopes: ^{46}Ti (8.0%), ^{47}Ti (7.8%), ^{48}Ti (73.4%), ^{49}Ti (5.5%), ^{50}Ti (5.3%). What is the average atomic mass of titanium?

14. Fluorine has the following isotopes: F- 18, F-19, and F-31. Based on its weighted average atomic mass, which isotope is most common?

Historical Atomic Theory/Models

(From your book)

15. In the gold foil experiments, Rutherford observed that many alpha (α) particles passed straight through the foil. However, a small percentage were deflected. Which conclusion best supports this experiment?

- All small particles are positively charged
- Atoms are composed mostly of empty space
- Gold foil does not have a uniform composition
- Not all Nuclear particles behave the same way
- Use the table below to answer the question.

16. The atomic theory was published in 1808 by

- John Dalton
- JJ Thompson
- James Chadwick
- Ernest Rutherford

17. Current theories about the atom are very different from the atomic theory proposed by John Dalton almost 200 years ago. Which statement **Best** explains which changes were made to Dalton's atomic theory?

- New discoveries showed that Dalton did not use the scientific method.
- Dalton's theory was replaced temporarily with an incorrect theory.
- Scientists modified Dalton's theory to include newly discovered evidence.
- Scientists rejected old theories, before developing new ones.

18. Who showed that maybe a particle could have a wavelength _____

19. Who showed that our information about exactly where electrons are located would always be limited _____

20. Who is the element Sg named after and what is his claim to fame?

21. How was Mendeleev's table of elements different from today's modern Periodic Table of Elements as organized by Mosley?

22. Who wrote this equation: $E = h \cdot \text{freq}$

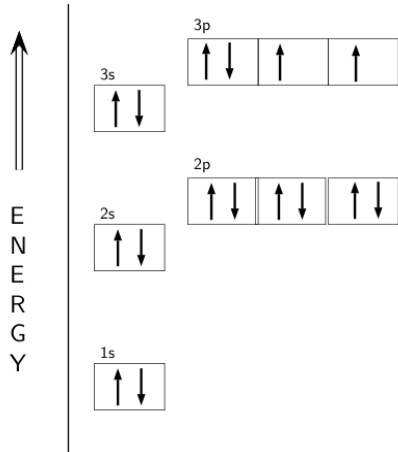
23. Who used the colors of the hydrogen spectrum to figure out a planetary model of the atom

24. According to Schrodinger's model of the atom:

- we know exactly where electrons are
- we know the most likely locations of electrons
- we don't know much about the location of electrons because they are moving

Electron Configuration/Orbital notation/Lewis Dot Valence electrons

Use the diagram below to answer the question



25. What element is represented by the orbital energy diagram?

- phosphorus
- sulfur
- titanium
- selenium

26. Which have the largest number of unpaired electrons in p orbitals in their ground-state electron configurations?

- N, P, As
- F, Cl, Br
- Ne, Ar, Kr
- Te, I, Xe

27. Which of the following have their valence electrons in the same energy level?

- K, As, Br
- B, Si, As
- N, As, Bi
- He, Ne, F

28. How many unpaired electrons are in an atom of Co in its ground state?

- 1
- 2
- 3
- 7

29. Which element is this: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$

30. Give the complete electron configuration for:

Zinc

31. Give the complete orbital notation for:

Potassium

32. True or false: an atom should have more orbitals than sublevels

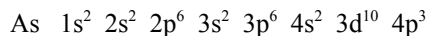
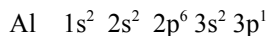
33. Let's say an atom has 52 electrons

- how many of those 52 electrons are in the fourth energy level _____
- how many of the 52 electrons are in p sublevels _____
- how many of the 52 electrons are in the fifth energy level _____

34. Provide the Lewis dot diagram around the following symbols:

Br Al Ca K

35. For the following elements, circle the electrons which will be involved in chemical reactions (valence electrons):



36. How many pairs/singles of electrons are in the highest energy level of an atom of antimony

_____ pairs and _____ singles

37. According to the Lewis dot diagrams, an atom of thallium has _____ electrons which are likely to be involved in chemical reactions.

38. Show the Lewis dot diagram for each of the following:

aluminum _____ sulfur _____ tin _____ gold _____

Quantum Numbers

39. The number of orbitals in a given subshell, such as the 5d subshell, is determined by the number of possible values of

- a) n
- b) l
- c) m_l
- d) m_s

40. What are the possible values of n and m_l for an electron in a 5d orbital?

- a) $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = 2$
- b) $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = -2, -1, 0, +1, +2$
- c) $n = 5$ and $m_l = 2$
- d) $n = 5$ and $m_l = -2, -1, 0, +1, +2$

41. How many electrons can a single orbital hold?

- a) 2 in the s sublevel
- b) 2
- c) stable octet
- d) 6 in the p sublevel

42. What are the possible values of n and m_l for an electron in a 4f sublevel?

- a) $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = 2$
- b) $n = 1, 2, 3, 4, \text{ or } 5$ and $m_l = -2, -1, 0, +1, +2$
- c) $n = 4$ and $m_l = +\frac{1}{2}, -\frac{1}{2}$
- d) $n = 4$ and $m_l = -3, -2, -1, 0, +1, +2, +3$

43. Which of the following is not a valid set of quantum numbers?

- a) $n = 2, l = 1, m_l = 0, \text{ and } m_s = -1/2$
- b) $n = 2, l = 1, m_l = -1, \text{ and } m_s = -1/2$
- c) $n = 3, l = 0, m_l = 0, \text{ and } m_s = 1/2$
- d) $n = 3, l = 2, m_l = -3, \text{ and } m_s = 1/2$

44. What are the possible values of l if $n = 5$?

- a) 5
- b) 0, 1, 2, 3, or 4
- c) -4, -3, -2, -1, 0, +1, +2, +3, or +4
- d) -5, -4, -3, -2, -1, 0, +1, +2, +3, +4, +5

45. What is the maximum number of orbitals in the 6th energy level?

- a) 9
- b) 16
- c) 49
- d) 98

Light/Energy/Frequency/Wavelength problems

46. The reactions occurring in the Sun produce visible light and ultraviolet radiation. Ultraviolet radiation (UV) can cause damage to the eyes and skin. Which answer explains why UV radiation can be harmful, but visible light is not?

- a. UV has higher energy radiation than visible light
- b. UV is made of smaller particles than visible light
- c. UV has a longer wavelength than visible light
- d. UV has more troughs than visible light

47. Calculate the wavelength of the yellow light emitted by a sodium street light/lamp if the frequency of radiation is 5.10×10^{14} Hz (5.10×10^{14} / s).

48. What is the wavelength of infrared light with a frequency of 7.7×10^{13} Hz?

49. Calculate the amount of energy for the following waves:

- A. a wave with a wavelength of 450 nanometers
- B. a wave with a frequency of 6×10^{10} Hz

Periodic Table groups and trends

50. Use two arrows on the periodic table, to show:

- a. **DECREASING** Atomic Radius (atomic size)
 - b. **DECREASING** Ionization Energy
 - c. **DECREASING** Electron Affinity
 - d. **DECREASING** Electronegativity
- Metallic Character

1																	18				
H																	He				
2	3	4											10	11	12	13	14	15	16	17	18
Li	Be											B	C	N	O	F	Ne				
3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18						
Na	Mg											Al	Si	P	S	Cl	Ar				
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18							
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr				
5	6	7	8	9	10	11	12	13	14	15	16	17	18								
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe				
6	7	8	9	10	11	12	13	14	15	16	17	18									
Cs	Ba	* La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn				
7	8	9	10	11	12	13	14	15	16	17	18										
Fr	Ra	** Lr	Rf	Db	Sg	Bh	Hs	Mt	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu	Uu				

* Lanthanide series
** Actinide series

51.**T or F**

- _____ The element in group 13, period 4 is gallium
- _____ Mendeleev left a space in the periodic table for the undiscovered element lithium.
- _____ Alkali metals react with water and form oxygen gas.
- _____ There are no naturally radioactive elements on earth; they are all man-made
- _____ Bromine is a halogen and a gas.
- _____ Barium's ending electron configuration is $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- _____ The most abundant element in the earth's crust is from group 13
- _____ The most abundant metal in the earth's crust is from group 16

Use the table below to answer the question.

Part of Mendeleev's Periodic Table—1869				
H = 1		Ni = Co = 59	Pd = 106.6	Os = 199
	Be = 9.4	Mg = 24	Cu = 63.4	Ag = 108
			Zn = 65.2	Cd = 112
				Hg = 200

Part of Modern Periodic Table				
26 Fe 55.845	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39
44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.868	48 Cd 112.41
76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.967	80 Hg 200.59

52. Dmitri Mendeleev placed groups of elements with similar chemical properties in rows in his periodic table. In the modern periodic table nickel (Ni), cobalt (Co), and osmium (Os) are not grouped together as Mendeleev suggested. Why did modern scientists change the location of these elements in the more recent version of the table?

- Categorizing elements by their characteristics resulted in groups of elements with similar properties.
- Obtaining more accurate atomic masses helped the scientists to group the elements with much greater accuracy.
- Placing elements with similar chemical properties diagonally in the periodic table more accurately grouped the elements.
- Ordering elements according to their atomic masses gave more accurate groupings of elements.

53. True or False:

Metals on the periodic table tend to lose electrons to become stable cations.

54. An atom contains seven valence electrons. Within which group of the periodic table will the element be located?

- group 1
- group 3
- group 15
- group 17

55. In which part of the periodic table can elements dependably be predicted to give up two electrons when forming bonds?
- Group 2 (IIA)
 - Period 2
 - Group 16 (VIA)
 - Period 6
56. Which of the groups of elements shown below have the most similar chemical properties?
- Mg, Ca, Sr
 - B, C, N
 - O, F, Ne
 - H, He, Li
57. The periodic table is divided into periods. The second period starts with lithium (Li) and ends with neon (Ne). What do all the elements in the second period have in common?
- They are all highly reactive.
 - They all have incomplete outer shells.
 - They all have two shells of electrons.
 - They are all gasses at room temperatures.
58. All of the elements in a particular group of the periodic table have the same
- electronegativities
 - ionization energies
 - number of valence electrons
 - number of protons
59. The reason that groups of elements on the periodic table have similar properties is because of the
- number of protons in the nucleus
 - electron arrangement around the nucleus
 - density of individual atoms
 - mass of the individual atoms
60. Rank the following elements by **increasing atomic radius**: carbon, aluminum, oxygen, potassium
61. Rank the following elements by **increasing electronegativity**: sulfur, oxygen, neon, aluminum
62. A scientist comparing oxygen and sulfur would find that oxygen has
- lower electronegativity and smaller atomic radius
 - higher electronegativity and smaller atomic radius
 - lower electronegativity and larger atomic radius
 - higher electronegativity and larger atomic radius

Ions/ Oxidation Numbers

Use the chart below to answer the question

Atom Data

Atom Sample	Protons	Neutrons	Electrons
1	11	11	10
2	11	12	10
3	12	11	10
4	12	12	10

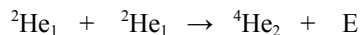
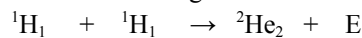
63. Which conclusion can be made about this group of atoms based on the data?
- all four atoms are ions because they have the same mass
 - all four atoms are isotopes because they have the same mass number
 - all four atoms are ions because the number of protons and electrons for each atom are unequal
 - all four atoms are isotopes because the number of protons and electrons for each are unequal
64. Which ion does magnesium usually form?
- an Mg^{2-} ion because the magnesium atom loses two protons.
 - an Mg^{2-} ion because the magnesium atom gains two protons.
 - an Mg^{2+} ion because the magnesium atom loses two electrons.
 - an Mg^{2+} ion because the magnesium atom gains two electrons.
65. Why would sulfur (S) be likely to react with magnesium (Mg)?
- The sulfur atom would gain the two it needs to complete its outer shell.
 - The sulfur atom would gain two electrons and be better balanced.
 - The sulfur atom would lose the inner two electrons and have one less shell.
 - The sulfur atom would lose two electrons and have six electrons in its two outer shells.
66. Atoms of representative elements with which characteristics are MOST likely to form a chemical bond with other atoms?
- an incomplete number of electrons in the outer energy levels
 - an incomplete number of electrons in the inner energy levels
 - extra neutrons in the nucleus
 - extra protons in the nucleus

Radioactive Decay/Half life

67. For the nuclear reaction ${}_{90}\text{Th}^{230} \rightarrow X + {}_{88}\text{Ra}^{226} + \text{Energy}$, which of the following is the correct value of X ?

- a. ${}_{-1}\beta^0$
- b. ${}_{+1}\text{p}^1$
- c. ${}_{2}\alpha^4$
- d. ${}_{0}\gamma^0$

68. The following are reactions which occur on the sun.



This is an example of:

- a. Fission
- b. Fusion
- c. Confusion
- d. None of the above

69. ${}_{94}\text{Pu}^{239} \longrightarrow {}_{77}\text{Ir}^{190} + {}_{17}\text{X}^{49} + \text{Energy}$

What type of nuclear reaction is shown above? _____

70. The emission of an alpha particle will:

- a. Change the atomic number, but not the atomic mass of an atom
- b. Change the atomic mass, but not the atomic number of an atom
- c. Change both the atomic number and atomic mass of an atom

71. Medical imaging technology requires radioactive isotopes. What kind of isotope is the MOST likely candidate for such medical imaging devices?

- a. unstable
- b. stable
- c. Low-mass
- d. bright green

72. If a 200 gram sample of carbon-14 undergoes radioactive decay with a half-life of 5715 years:

- a. How much sample will be left after 4 half lives?
- b. What percent of the original sample will remain after one half life?
- c. How many half lives does it take for 12.5% of the radioactivity to remain? What is the mass of C-14?

73. A 1215 gram sample of a radioactive element with a half life of 12.5 years is being studied. How much will remain after 4 half lives? How long will it take to completely lose its radiation?

74. Medical imaging technology requires radioactive isotopes. What kind of isotope is the MOST likely candidate for such medical imaging devices?

- a. unstable
- b. stable
- c. low-mass
- d. bright green