Atoms, Electrons, and Nuclear Chemistry Review 2017

1. What is the atomic number? - same as # protons; determines which element it is
2. What is the mass number? - protons + neutrons
3. Describe the location, charge, and relative mass of protons, neutrons and electrons in the modern electron cloud model of the atom. Draw a diagram including all of this information. protons +1 nucleus neutrons 0 nucleus electrons -1 electron cloud
4. Discuss how most of an atom is empty space. tiny nucleus, e⁻ take up all room
5. Define isotope. different # neutrons
6. Four elements are described below:

Element	# of protons	# of neutrons	# of electrons
A	5	6	2
B	1	1	1
C	1	0	0
D	5	5	5

A) Which elements are isotopes of each other? (2 pairs) A + D, B + C
B) How will elements A and D compare in terms of chemical/physical properties? same chem + phys properties
C) How will elements A and D compare in terms of atomic mass? A has mass # of 11, D mass # = 10
D) How will elements B and C compare in terms of charge? B has 0 charge, C has +1 charge
E) Draw atomic symbols for all four elements.
$^{11}_{5}A^{+3}$ $^{2}_{1}B$ $^{1}_{1}C^{+}$ $^{10}_{5}D$

7. Fill in the chart:

Isotope	# of protons	# of neutrons	# of electrons
$^{57}_{26}Fe$	26	31	26
$^{24}_{12}Mg^{+2}$	12	12	10
$^{14}_{6}C$	6	8	6
$^{12}_{6}C$	6	6	6
$^{235}_{92}U$	92	143	92
$^{35}_{17}Cl^{-1}$	17	18	18
★ $^{74}_{33}As^{-3}$	33	41	36
★ $^{156}_{64}Gd^{+}$	64	92	63

8. Boron has two naturally occurring isotopes, ^{10}B and ^{11}B. The percent abundance and atomic mass of each is given below. Using this data, determine the atomic mass of boron.

(10.013 amu)(.1978)
(11.009 amu)(.8022)

Isotope	Percent Abundance	Atomic Mass
Boron-10	19.78 %	10.013 amu
Boron-11	80.22 %	11.009 amu

9. Neon has three naturally occurring isotopes: ^{20}Ne has a mass of 19.992 amu and an abundance of 90.48%, ^{21}Ne has amass of 20.994 amu and an abundance of 0.27%, and ^{22}Ne has a mass of 21.991 amu and an abundance of 9.25%. Calculate the average atomic mass of neon.
(19.992 amu)(.9048)
(20.994 amu)(.0027)
(21.991 amu)(.0925)

10. Write the symbol for the species with 17 protons, 19 neutrons, and 18 electrons. $^{36}_{17}Cl^-$
11. Write the symbol for the species with 3 protons, 3 neutrons, and 2 electrons. $^{6}_{3}Li^+$
12. Use the quantum mechanical model to explain how electrons move about the nucleus. electrons are somewhere in electron cloud
13. How many electrons can a single atomic orbital hold? 2 How many orbitals can be found in an s sublevel? 1 p? 3 d? 5 f? 7
14. "s" sublevels can hold a total of 2 electrons. p sublevels can hold 6 electrons, while d sublevels can hold 10, and f sublevels can hold 14 electrons.
15. Which is bigger, the 3s sublevel or the 5s sublevel? How many electrons can each hold? 5s is bigger; 2e⁻ each
16. List the three rules for electron configurations.
17. Give electron configurations (longhand) for: Fe, Br, Ar, He, U, Ag, K, Ne.
18. Give shorthand electron configurations for: In, I, Rb, Au, Cu,
19. $1s^2 2s^2 2p^6 3s^2 3p^4$ is the electron configuration for which element? S
20. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$ is the electron configuration for which noble gas? Kr
21. Complete this chart of scientists:

Scientist	Discovery/Theory	How did this change how people thought the atom looked?
Dalton	1st scientific theory of atoms	
Thomson	Discovered e⁻	need e⁻ in atoms 
Rutherford	Discovered nucleus	 e⁻ around nucleus
Bohr	e⁻ in orbits around nucleus, energy levels	
Schrödinger	used math to describe e⁻ orbitals	quantum mech/ electron cloud 
Chadwick	discovered neutron	

22. Sodium-24 undergoes beta radiation. Its half-life is 15 hours.
    a. Write the equation for the beta decay of sodium-24.
    b. If you start with 68.5 g of sodium-24, how much will be left after 90. hours?
23. ^{235}U undergoes alpha radiation.
    a. Write the equation for the alpha decay of uranium-235.
    b. What is the half-life of uranium-235 if a 875 g sample decays to 27.3 g in 3.52×10^9 years?
24. Carbon-11 decays by positron emission.
    a. Write the nuclear chemistry equation.
    b. The half-life of carbon-11 is approximately 20 minutes. How long will it take a 46 g sample of carbon-11 to 2.9 g?
25. Ruthenium-97 undergoes electron capture.
    a. Write the equation.
    b. The half-life of ruthenium-97 is 2.84 days. If there are 25.0 g of the sample left after 17.0 days, how many grams were in the original sample?
26. Iridium-192 undergoes beta *and* gamma decay. Write the equation.

16. Aufau – e^- in lowest energy first

Pauli – only 2 e^- at most in each orbital / box

Hund – e^- go in orbitals of equal energy singly and with same spin until forced to double up

17. Fe: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

Br: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

Ar: $1s^2 2s^2 2p^6 3s^2 3p^6$

He: $1s^2$

U: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 5d^1 4f^{14} 5d^9 6p^6 7s^2 6d^1 5f^3$

Ag: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^9$

K: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

Ne: $1s^2 2s^2 2p^6$

18. In: [Kr] $5s^2 4d^{10} 5p^1$

I: [Kr] $5s^2 4d^{10} 5p^5$

Rb: [Kr] $5s^1$

Au: [Xe] $6s^2 5d^1 4f^{14} 5d^8$

Cu: [Ar] $4s^2 3d^9$

22. a. $^{24}_{11}Na \rightarrow {}^{0}_{-1}e + {}^{24}_{12}Mg$

b. 68.5g start

90. hrs

15 hrs

$\frac{90\,hr}{15\,hr} : 6$ $\qquad \frac{68.5g}{2^6} = \boxed{1.07\,g}$

23. a. $^{235}_{92}U \rightarrow {}^{4}_{2}He + {}^{231}_{90}Th$

b. 875g

27.3g

3.52×10^9 yr

$\frac{875g}{27.3g} = 2^x$ $\qquad \frac{3.52 \times 10^9\,yr}{5} = \boxed{7.04 \times 10^8\,yr}$

$32 = 2^x$

$x = 5$

24. a. $^{11}_{6}C \rightarrow {}^{0}_{+1}e + {}^{11}_{5}B$

b. 20 min
46 g
2.9 g

$\frac{46\,g}{2.9\,g} = 2^x$

$16 = 2^x$

$x = 4$

$20\,min \cdot 4 = \boxed{80.\,min}$

25. a. $^{97}_{44}Ru + {}^{0}_{-1}e \rightarrow {}^{97}_{43}Tc$

b. $t_{1/2} = 2.84\,day$
25.0 g left
17.0 days

$\frac{17.0\,day}{2.84\,day} = 6$ half lives

$25.0\,g \cdot 2^6 = 1600\,g$

$= \boxed{1.60 \times 10^3\,g}$

26. $^{192}_{77}Ir \rightarrow {}^{0}_{-1}e + \gamma + {}^{192}_{78}Pt$