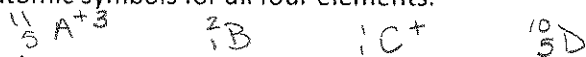


# Atoms, Electrons, and Nuclear Chemistry Review 2017

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 + neutrons = nucleus*
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: *electrons = electron cloud*

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.



7. Fill in the chart:

Isotope	# of protons	# of neutrons	# of electrons
${}^{57}_{26}\text{Fe}$	26	31	26
${}^{24}_{12}\text{Mg}^{+2}$	12	12	10
${}^{14}_6\text{C}$	6	8	6
${}^{12}_6\text{C}$	6	6	6
${}^{235}_{92}\text{U}$	92	143	92
${}^{35}_{17}\text{Cl}^{-1}$	17	18	18
${}^{74}_{33}\text{As}^{-3}$	33	41	36
${}^{156}_{64}\text{Gd}^{+}$	64	92	63

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





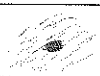
Isotope	Percent Abundance	Atomic Mass
Boron-10	19.78 %	10.013 amu
Boron-11	80.22 %	11.009 amu

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

9. Neon has three naturally occurring isotopes:  ${}^{20}\text{Ne}$  has a mass of 19.992 amu and an abundance of 90.48%,  ${}^{21}\text{Ne}$  has a mass of 20.994 amu and an abundance of 0.27%, and  ${}^{22}\text{Ne}$  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.  $^{36}_{17}\text{Cl}^-$
11. Write the symbol for the species with 3 protons, 3 neutrons, and 2 electrons.  $^6_3\text{Li}^+$
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? How many orbitals can be found in an s sublevel? p? d? f?
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<sup>-</sup> 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:

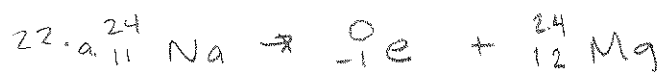
Scientist	Discovery/Theory	How did this change how people thought the atom looked?
Dalton	1st scientific theory of atoms	
Thomson	Discovered e <sup>-</sup>	need e <sup>-</sup> in atoms 
Rutherford	Discovered nucleus	 e <sup>-</sup> around nucleus
Bohr	e <sup>-</sup> in orbits around nucleus, energy levels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

22. Sodium-24 undergoes beta radiation. Its half-life is 15 hours.
- Write the equation for the beta decay of sodium-24.
  - If you start with 68.5 g of sodium-24, how much will be left after 90. hours?
23.  $^{235}\text{U}$  undergoes alpha radiation.
- Write the equation for the alpha decay of uranium-235.
  - What is the half-life of uranium-235 if a 875 g sample decays to 27.3 g in  $3.52 \times 10^9$  years?
24. Carbon-11 decays by positron emission.
- Write the nuclear chemistry equation.
  - 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.
- Write the equation.
  - 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. Aufbau -  $e^-$  in lowest energy first  
 Pauli - only  $2e^-$  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:  $[Ar] 4s^2 3d^9$



b.  $68.5\text{g}$  start  
 $90\text{ hrs}$   
 $15\text{ hrs}$

$$\frac{90\text{ hr}}{15\text{ hr}} = 6 \quad \frac{68.5\text{g}}{2^6} = \boxed{1.07\text{g}}$$



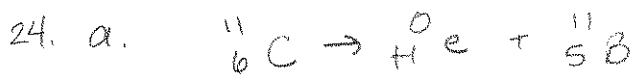
b.  $875\text{g}$   
 $27.3\text{g}$   
 $3.52 \times 10^9\text{ yr}$

$$\frac{875\text{g}}{27.3\text{g}} = 2^x$$

$$32 = 2^x$$

$$x = 5$$

$$\frac{3.52 \times 10^9\text{ yr}}{5} = \boxed{7.04 \times 10^8\text{ yr}}$$



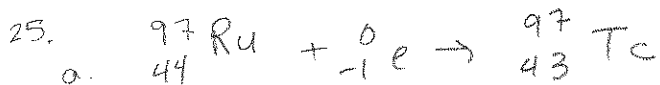
b. 20 min  
46 g  
2.9 g

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

$$16 = 2^x$$

$$x = 4$$

$$20\text{min} \cdot 4 = \boxed{80\text{min}}$$



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

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

$$25.0\text{g} \cdot 2^6 = 1600\text{g}$$

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

