Instructions: Show all work whenever a calculation is required! You will receive credit for <u>how</u> you worked each problem as well as for the correct answer. This exam is worth 50 points. BOX YOUR ANSWERS!

1. (3 pts) Which has the higher frequency, red light or blue light? (Circle: RED or BLUE) Which has the longer wavelength? (Circle: RED or BLUE) Which has the greater energy? (Circle: RED or BLUE)

2. (2 pts) In the Pfund series, excited electrons relax to level n = 5.

(a) What transition (n = _____ to n=5) would result in the longest wavelength?
(b) What transition (n = _____ to n=5) would result in the shortest wavelength?

3. (2 pt) Circle the electron transition that is associated with the largest *emission* of energy and put an X through the one that is not an emission.
   (A) $n = 2$ to $n = 1$ (B) $n = 5$ to $n = 3$
   (C) $n = 2$ to $n = 4$ (D) $n = 3$ to $n = 1$

4. (4 pts) Give the orbital designation (for example, 2s or 3p) for each of the following sets of quantum numbers

(a) n = 3, $l = 1$, $m_l = -1$
(b) n = 4, $l = 3$, $m_l = -2$
(c) n = 2, $l = 1$, $m_l = 0$
(d) n = 5, $l = 2$, $m_l = +2$

5. (3 pts) Which of the following sets of quantum numbers is/are not allowed?

(a) n = 2, $l = 2$, $m_l = -1$
(b) n = 5, $l = 3$, $m_l = -2$
(c) n = 6, $l = 1$, $m_l = -6$

6. (3 pts) Write the electron configuration for each of the following elements (use core notation):

(a) sulfur
(b) barium
(c) manganese

7. (3 pts) How many unpaired electrons are present in each of the following atoms?

(a) sodium
(b) sulfur
(c) argon

8. (3 pts) What is the element with the smallest atomic number to have a ground state electron in each of these orbitals?

(a) 4d
(b) 3s
(c) 5p

9. (3 pts) Classify each of the following electron configurations as "G" for "ground state", "E" for "excited state" or "NA" for "not allowed"

(a) $1s^2\, 2s^2\, 2p^6\, 3s^1$	G	E	NA
(b) $1s^2\, 2s^2\, 2p^6\, 3s^3$	G	E	NA
(c) $1s^2\, 2s^2\, 2p^6\, 3s^1\, 3p^2$	G	E	NA

10. (3 pts) Light with energy of 470 kJ/mol is in the ultraviolet region of the electromagnetic spectrum. Determine the wavelength of this light *in nm*.

11. (3 pts) For each series, circle the member with the greatest effective nuclear charge.

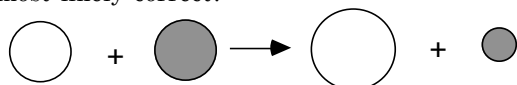|		
(a) K	Ca	Se
(b) N	P	As
(c) O	F	Ne

12. (3 pts) For each series, circle the member with the smallest atomic radius.

(a) Sc	Cr	Ni
(b) F	Ne	Na
(c) Be	Mg	Ca

13. (3 pts) Identify the ion from the electron configuration given.

(a) E^- $1s^2\,2s^2\,2p^6$
(b) E^{+2} $1s^2\,2s^2\,2p^6$
(c) E^{+2} $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^0\,3d^7$

14. (3 pts) Suppose a metal and non-metal react according to the figure. Which statement(s) is/are most likely correct?

(a) The non-shaded circle is the: Circle one: **metal** or **non-metal**

(b) The small shaded circle is: Circle one: **the cation** or **the anion** or **neither**.

(c) The reaction produces a compound that is: Circle one: **covalent** or **ionic**

15. (3 pts) For each series, circle the member with the largest first ionization energy.

(a) Sc	Cr	Ni
(b) B	N	F
(c) He	Kr	Rn

16. (3 pts) Regarding the first four ionization energies for aluminum,

(a) Write the equation that corresponds to the 2nd ionization energy:
(b) How does the 2nd ionization energy compare to the first? (Circle: **larger** or **smaller**)
(c) Between which two ionizations, is the jump in energy the largest? (Circle: **1st & 2nd** or **2nd & 3rd** or **3rd & 4th**)

17. (3 pts) For each series, circle the member with the largest electron affinity.

(a) S	Cl	Ar
(b) K	Rb	Cs
(c) Na	Na^+	

18. (BONUS! 1 point) Print your name here:

Your exam score (50 possible): _____

Determine your grade:
$A \geq 46.5$; $B+ \geq 43.5$; $B \geq 41.0$;
$C+ \geq 37.5$; $C \geq 34.00$; $D \geq 30.00$

Useful formulas, equations and constants:

$$c = \lambda\upsilon = 3 \times 10^8 \text{ m/s}$$

$$\Delta E = h\upsilon = hc/\lambda$$

$$h = 6.626 \times 10^{-34} \text{ J s}$$

$$N_A = 6.02 \times 10^{23}$$

Answers

1. BLUE has the higher frequency, RED has the longer wavelength, and BLUE has the greater energy.

2. (a) n = 6 to n=5; (b) n = infinity to n=5

3. largest *emission* of energy: $n = 3$ to $n = 1$; $n = 2$ to $n = 4$ is not an emission.

4. (a) 3p; (b) 4f; (c) 2p; (d) 5d

5. (a) and (c) are not allowed

6. (a) [Ne] $3s^2\,3p^4$; (b) [Xe] $6s^2$; (c) [Ar] $4s^2\,3d^5$

7. (a) one; (b) two; (c) zero

8. (a) Y; (b) Na; (c) In

9. (a); (b) NA; (c) E

10. 255 nm

11. (a) Se; (b) As; (c) Ne

12. (a) Ni; (b) Ne; (c) Be

13. (a) F^- ; (b) Mg^{+2}; (c) Co^{+2}

14. (a) non-metal; (b) the cation; (c) ionic

15. (a) Ni; (b) F; (c) He

16. (a) $Al^{+1} \rightarrow Al^{+2} + e^-$; (b) larger; (c) 3rd & 4th

17. (a) Cl; (b) K; (c) Na^+