Name: _____ June 21, 2016

Exam 3

The value of some useful constants: $K = (°C + 273.15°C)\left(\frac{1\,K}{1°C}\right)$ $1\,J = \frac{kg \cdot m^2}{s^2}$ 1 nm = 10^{-9} m

c = 3.00 x 10^8 m/s $h = 6.626 \times 10^{-34} J \cdot s$ $N_A = 6.022 \times 10^{23} mol^{-1}$ $\lambda\nu = c$ $E = h\nu$

$FC = Group\,\# - \left(\#\,unshared\ e^-s\right) - \frac{1}{2}\left(\#\,shared\ e^-s\right)$ 1 Hz = 1 s^{-1} $E = k\frac{|Q^+Q^-|}{r}$

Show all work or reasoning to receive credit.

1. Given the thermochemical equation $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$, $\Delta H°_{rxn} = -198$ kJ/mol, how much heat is evolved when 600. g of SO_2 is burned? (6 pt)

   A) 5.46 x 10^{-2} kJ B) 928 kJ C) 1.85 x 10^3 kJ D) 59,400 kJ

   E) 3.71 x 10^3 kJ

$600.0\,g\,SO_2 \times \frac{1\,mol\,SO_2}{64.07\,g\,SO_2} \times \frac{198\,kJ}{2\,mol\,SO_2} = 927$

Material

2. Given the following reactions

   $1\ (N_2(g) + 2O_2(g) \rightarrow 2NO_2(g) \quad \Delta H = 66.4\ kJ)$

   $-1\ (2NO(g) + O_2(g) \rightarrow 2NO_2(g) \quad \Delta H = -114.2\ kJ)$

   the enthalpy of the reaction of the nitrogen to produce nitric oxide

   $N_2(g) + O_2(g) \rightarrow 2NO(g)$

   is _____ kJ. (6 pt)

   A) 180.6 B) -47.8 C) 47.8 D) 90.3 E) -180.6

$N_2 + O_2 \rightarrow 2NO_2$ 66.4 kJ

$2NO_2 \rightarrow 2NO + O_2$ +114.2 kJ

$N_2 + O_2 \rightarrow 2NO$ $\Delta H = 180.6$ kJ

Chapter 6

3. What is the energy of one mole of photons of visible light having a wavelength of 4.89×10^2 nm? (6 pt)

a. 1.48×10^9 kJ b. 1.95×10^{-19} kJ c. 2.45×10^2 kJ d. 3.24×10^{-43} kJ

e. 4.06×10^{-22} kJ

$$\Delta E = h\nu = \frac{hc}{\lambda} = \frac{(6.626\times10^{-34}\ \text{J}\cdot\text{s})(3.00\times10^{8}\ \text{m/s})}{4.89\times10^{2}\ \text{nm}\times\frac{10^{-9}\ \text{m}}{\text{nm}}} \times \frac{6.022\times10^{23}}{\text{mol}} \times \frac{\text{kJ}}{1000\ \text{J}} = 245\ \text{kJ}$$

4.07×10^{-19} J

Answer:_____.

4. Which group in the periodic table contains elements with the valence electron configuration of ns^2np^2 _____? (4 pt)

A) 1A B) 2A C) 3A D) 4A E) 5A

5. Use the orbital diagram below to give the correct electron configuration for a ground-state nitrogen atom. (4 pt)

1s 2s 2p

6. Which of the following has the largest increase between, I_3 and I_4, the third and fourth ionization energies? (4 pt)

A) Si B) Mg C) Al D) Na E) P

7. Give the ground state electron configurations for the following. Noble gas core abbreviations allowed. (9 pts)

A) Cu $[Ar]4s^1 3d^{10}$

B) S^{2-} $[Ne]3s^2 3p^6 = [Ar]$

C) Ni^{2+} $[Ar]3d^8$

8. Which of the following species is isoelectronic with Kr? 36e⁻ (4 pt)

A) K^+ B) Cl^- C) Ar D) Xe E) Sr^{2+}

9. Which of the following has the smallest radius? (4 pt)

A) Na B) Mg C) Al D) P E) Cl

10. Which of following has the largest radius? (4 pt)

A) O^{2-} B) F^- C) N^{3-} D) Na^+ E) Al^{3+}

11. Which species has the greater radius, a I^- ion or a I atom? **Briefly** explain your choice of answer. (4 pt)

I^- is greater due to increased $e^- - e^-$ repulsions

12. From the data below, which element is likely to be a metal? (4 pt)

Element	First ionization energy, kJ/mol
1	2732
2	1086
3	1402
4	520
5	1314

A) 1 B) 2 C) 3 D) 4 E) 5

13. Which of the elements has the *least* metallic character? (4 pt)

A) F B) Se C) C D) Sn E) Pb

14. Of the following elements, which has the largest first ionization energy? (4 pt)

A) Ga B) Al C) Sr D) Cr E) Fr

15. Which of the following elements has the greatest electron affinity (largest positive value)? (4 pt)

A) Ca B) K C) Cl D) Br E) Ga

16. For each of the following groups of ionic solids, which would have the largest lattice energy? (8 pt)

a. Al_2O_3 CaS MgO NaCl

b. CsI LiF KBr NaCl

17. For each group below, circle the element that has the *greatest* electronegativity? (8 pt)

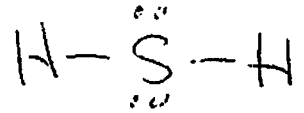
a. Br I F Cl

b. N C B O

18. Draw the Lewis structures of the following compounds: (6 pts)

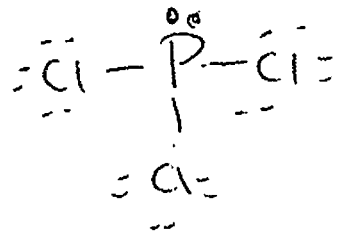
H_2S

S=6
2H=2
8e⁻



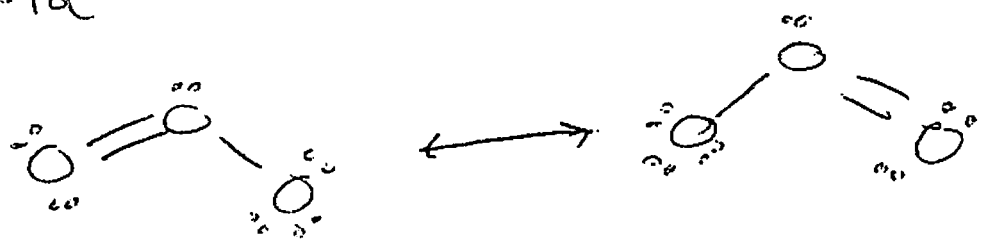
PCl_3

P=5
3Cl=21
26e



19. The ozone moleule, O_3, has two major resonance structures. Draw both resonance structures for ozone, including ***all formal charges***. . (7 pts)

O_3 = 18e⁻



0 +1 -1 -1 +1 0