

Name: _____

June 19, 2012

Exam 3

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

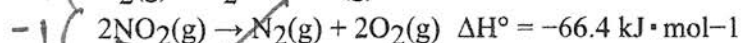
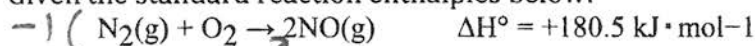
$c = 3.00 \times 10^8 \text{ m/s}$ $h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$ $N_A = 6.022 \times 10^{23}$ $\lambda = \frac{h}{mv}$

Formal Charge = (group number) - (non bonding e's) - 1/2(shared e's) $1 \text{ nm} = 10^{-9} \text{ m}$ $E = hv$

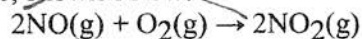
Show all work or reasoning to receive credit.

Problems 1-4 are 5 pts each.

1. Given the standard reaction enthalpies below:



calculate the standard reaction enthalpy for the oxidation of nitric oxide to nitrogen dioxide, shown below:



A) +114.1 kJ/mol

B) +246.9 kJ/mol

C) -114.1 kJ/mol

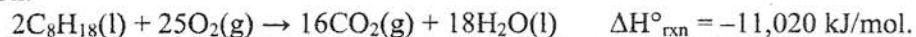
D) -294.6 kJ/mol

E) -246.9 kJ/mol

C

$$\begin{array}{r} -180.5 \\ + 66.4 \\ \hline -114.1 \text{ kJ} \end{array}$$

2. Octane (C_8H_{18}) undergoes combustion according to the following thermochemical equation:



Given that $\Delta H^{\circ}_f[CO_2(g)] = -393.5 \text{ kJ/mol}$ and $\Delta H^{\circ}_f[H_2O(l)] = -285.8 \text{ kJ/mol}$, calculate the standard enthalpy of formation of octane.

A) -210 kJ/mol

B) -11,230 kJ/mol

C) 22,040 kJ/mol

D) -420 kJ/mol

E) 420 kJ/mol

$$\Delta H_{\text{rxn}} = [16\Delta H_{f,CO_2} + 18\Delta H_{f,H_2O}] - [2\Delta H_{f,C_8H_{18}} + 25\Delta H_{f,O_2}]$$

$$2\Delta H_{f,C_8H_{18}} = [16(-393.5) + 18(-285.8)] - 0 - (-11,020)$$
$$= -420$$

$$\Delta H_{f,C_8H_{18}} = \frac{-420}{2}$$
$$= -210$$

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3. What is the frequency (s^{-1}) of electromagnetic radiation that has a wavelength of 0.53 m

- A A) 5.7×10^8 B) 1.8×10^9 C) 1.6×10^8 D) 1.3×10^{-33} E) 1.3×10^{33}

$$v = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \frac{m}{s}}{0.53 m} = 5.7 \times 10^8 s^{-1}$$

4. The energy of a photon that has a wavelength of 9.0 m is _____ J.

- A A) 2.2×10^{-26} B) 4.5×10^{25} C) 6.0×10^{-23} D) 2.7×10^9 E) 4.5×10^{-25}

$$E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s}) \left(3.00 \times 10^8 \frac{m}{s} \right)}{9.0 m} = 2.2 \times 10^{-26} \text{ J}$$

Problems 5-21 are 3 pts, except where noted.

5. Which of the following has the highest energy per photon?

- D A) red light B) orange light C) green light D) blue light
E) yellow light

6. Which quantum number determines the *shape* of an orbital?

- C A) principal B) magnetic C) azimuthal D) spin

7. The _____ quantum number defines the *orientation* of an orbital.

- B A) principal B) magnetic C) azimuthal D) spin

8. The _____ quantum number defines the *energy* of an orbital.

- A A) principal B) magnetic C) azimuthal D) spin

9. Which group in the periodic table contains elements with the valence electron configuration of ns^2np^2 4A?

A) 1A

B) 2A

C) 3A

D) 4A

E) 5A

10. Complete the following table (4 pts)

Subshell	Number of Orbitals	Value of azimuthal quantum number, l
f	7	3
d	5	2
s	1	0
p	3	1

11. Use the orbital diagram below to give the correct electron configuration for a ground-state nitrogen atom. (3 pt)



1s



2s



2p

12. Which element would be expected to have chemical and physical properties closest to those of sulfur?

A) B

B) N

C) Se

D) Sb

E) Cl

13. Which of the following has the largest increase between the third and fourth ionization energies?

A) Si

B) Mg

C) Al

D) Na

E) P

14. The three quantum numbers for an electron in a hydrogen atom in a certain state are $n = 3$, $l = 2$, $m_l = 1$. The electron is located in what type of orbital?

A) 4p

B) 3p

C) 3d

D) 4d

E) 4p

15. Which of the following elements has a ground-state electron configuration different from the predicted one?

- A) Ca **B) Cr** C) Xe D) Cl E) Ti

16. Give the ground state electron configurations for the following. Noble gas core abbreviations allowed. (6 pts)

- A) As $[Ar]4s^2 3d^{10} 4p^3$
B) Te^{2-} $[Xe]$ or $[Kr]5s^2 4d^{10} 5p^6$
C) Fe^{3+} $[Ar]3d^5$

17. Which of the following has the smallest radius?

- A) Be B) Li **C) F** D) O E) N

18. Which of the following has the largest radius?

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

19. From the data below, which element is likely to be a metal?

Element	First ionization energy, $\text{kJ}\cdot\text{mol}^{-1}$
1	1510
2	449
3	1718
4	2080
5	1047

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

20. Which of the elements has the least metal character?

- A) As B) Se **C) S** D) Sn E) Pb

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

- A) Ca B) K C) Se **D) Br** E) Ga

22. For each of the following pairs of ionic solids, which would have the largest lattice energy? (6 pt)

a. LiCl or NaCl

b. Al_2O_3 or CaO

c. CsI or LiF

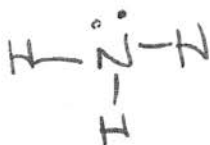
23. For each pair below, circle the element that has the *greatest* electronegativity? (4 pt)

a. F or Cl

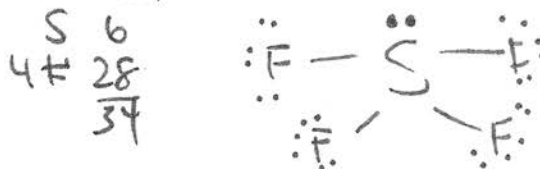
b. N or O

24. Draw the Lewis structures of the following compounds and ions: (6 pts)

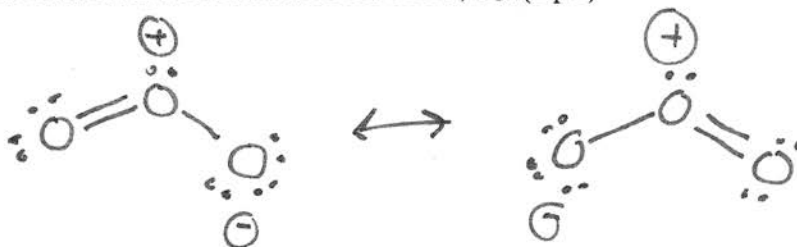
NH_3



SF_4



25. Draw resonance structures for ozone, O_3 . (6 pts)



26. Assign formal charges for one of the resonance structures of O_3 . (3 pts)

