Chem 1210

Final

Spring 2002

150 points

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Name_____

Instructions:

This is a closed book, closed notebook test. You may not discuss this exam with anyone, either during or after the exam, until it has been graded and returned to you in class. You may not use any outside materials - including Periodic Tables - on this exam, <u>except</u> a single 3" x 5" index card and an English-foreign language dictionary if necessary. You may use a calculator to help you compute the correct answer but may not retrieve or view any reference materials that may be stored in your calculator. <u>Please be honest!</u>

Each question is worth 5 points. All questions are of equal value.

Potentially Useful Information (?)

Molecular Geometry				
total pairs	**bonding pairs**	**nonbonding pairs**	**geometry**	**hybridization**
2	2	0	linear	sp
3	3	0	trigonal planar	sp2
3	2	1	bent	sp2
4	4	0	tetrahedral	sp3
4	3	1	pyramidal	sp3
4	2	2	bent	sp3
5	5	0	tbp	dsp3
5	4	1	seesaw	dsp3
5	3	2	t-shaped	dsp3
5	2	3	linear	dsp3
6	6	0	octahedral	d2sp3
6	5	1	square pyramidal	d2sp3
6	4	2	square planar	d2sp3

1 mole = 6.02 x 10^{23}		**PV = nRT**	**R = 0.0821 (L·atm/mol·K)**	
$(P_1V_1/n_1T_1) = (P_2V_2/n_2T_2)$			**PV = gRT/M_m**	**$^oC + 273 = K$**
1 atm = 760 mm Hg = 760 T = 101,325 Pa			**$P_{tot} = P_1 + P_2 + P_3 + ...$**	
E = hυ	**c = λυ**	**c = 2.998 x 10^{10} cm/s**	**$M_1V_1 = M_2V_2$**	**M = mol/L**
w/w % = [solute (g) / solution (g)] x 100			**pH = pK_a + log $[A^-]$ / [HA]**	
w/v % = [solute (g) / solution (mL, L)] x 100			**pH = -log $[H^+]$**	**pK_a = -log K_a**
v/v % = [solute (mL, L) / solution (mL, L)] x 100			**h = 6.626 x 10^{-34} J·s**	

1. If dU = +32 kJ for a certain process, that process

A. Occurs rapidly
B. Is exothermic
C. Is endothermic
D. Cannot occur
E. Requires a catalyst

2. What is the specific heat of ethanol if 6560 J of heat are required to raise the temperature of a 90.0 g sample from 25.0°C to 55.0°C?

A. 112 J/g·°C
B. 3.18 J/g·°C
C. 2.43 J/g·°C
D. 1.22 J/g·°C
E. 0.985 J/g·°C

3. What is the quantity of heat evolved when 100.0 g of liquid water is formed from the reaction of hydrogen gas and oxygen gas? $H_{2\,(g)} + \frac{1}{2}\, O_{2\,(g)} \Rightarrow H_2O_{(l)}$ $dH^o = -285.8$ kJ

A. -285.8 kJ
B. -28580 kJ
C. -51.44 kJ
D. -2297 kJ
E. -1586 kJ

4. All of the following would be expected to have enthalpy of formation values of zero <u>except</u>

A. $CH_{4\,(g)}$
B. $Br_{2\,(l)}$
C. $F_{2\,(g)}$
D. $O_{2\,(g)}$
E. $S_{8\,(s)}$

5. Given the following data

$N_{2\,(g)} + 3/2\ O_{2\,(g)} \Rightarrow N_2O_{3\,(s)}$ dH = 83.7 kJ
$N_{2\,(g)} + O_{2\,(g)} \Rightarrow 2\ NO_{(g)}$ dH = 180.4 kJ
$\frac{1}{2}\ N_{2\,(g)} + O_{2\,(g)} \Rightarrow NO_{2\,(g)}$ dH = 33.2 kJ

what is dH for the reaction $N_2O_{3\,(s)} \Rightarrow NO_{(g)} + NO_{2\,(g)}$

A. -207.1 kJ
B. -39.7 kJ
C. 24.3 kJ
D. 39.7 kJ
E. 207.1 kJ

6. Calculate the standard heat of formation (dH^o_f) of liquid methanol from the measured heat of combustion of liquid methanol and from the standard heats of formation of carbon dioxide gas (-394 kJ/mol) and liquid water (-286 kJ/mol):

$2\ CH_3OH_{(l)} + 3\ O_{2\,(g)} \Rightarrow 2\ CO_{2\,(g)} + 4\ H_2O_{(l)}$ dH = -1454 kJ

A. -478 kJ
B. -239 kJ
C. -178 kJ
D. 239 kJ
E. 478 kJ

7. The maximum number of electrons that can occupy a d orbital is

A. 2
B. 4
C. 8
D. 10
E. 18

8. The maximum number of electrons that can be accommodated in a p subshell is

A. 2
B. 4
C. 6
D. 8
E. 10

9. The number of orbitals in an f subshell is

A. 1
B. 2
C. 3
D. 5
E. 7

10. Which of the following electron configurations is not possible?

A. 1s2 2s2 2p3
B. 1s2 2s2 2p6
C. 1s2 2s2 2p2
D. 1s2 1p2
E. 1s2 2s2 2p6 3s1

11. Atoms of element X have the electron configuration 1s2 2s2 2p6 3s2 3p4. The formula of the compound most likely to be formed with aluminum is

A. AlX
B. AlX_2
C. Al_3X_2
D. Al_2X_3
E. Al_2X_5

12. Which of the following has the <u>smallest</u> atomic radius?

A. Ba
B. Ar
C. Ca
D. As
E. At

13. Sodium and potassium have similar physical and chemical properities. This is best explained by the fact that both elements

A. Have the same outer shell electron configuration
B. Are in the 1st period of the periodic table
C. Are active metals
D. Have relatively low atomic masses
E. Have relatively low ionization energies

14. The electron configuration of sulfide ion, S^{2-}, is

A. 1s2 2s2 2p6
B. 1s2 2s2 2p6 3s2
C. 1s2 2s2 2p6 3s2 3p2
D. 1s2 2s2 2p6 3s2 3p4
E. 1s2 2s2 2p6 3s2 3p6

15. All of the following atoms and ions are isoelectronic except

A. S^{2-}
B. Ar
C. K^{+}
D. Cl^{-}
E. Na^{+}

16. The smaller the difference in electronegativity:

1. The more ionic the bond
2. The more covalent the bond
3. The more polar the bond

B. 1 only
C. 2 only
D. 3 only
E. 1 and 3 only
F. 2 and 3 only

17. The central atom in which one of following molecules violates the octet rule?

A. N_2O
B. XeF_4
C. NH_4^{+}
D. NO_2^{-}
E. NO_2^{+}

18. In the Lewis structure for difluorodiazine, N2F2, the total number of lone electron pairs (i.e., nonbonding pairs) around the two nitrogen atoms is

A. 0
B. 1
C. 2
D. 3
E. 4

19. Which of the following is the best explanation for a covalent bond?

A. Electrons are simultaneously attracted by more than one nucleus
B. The overlapping of two electron filed orbitals having different energies
C. The overlapping of unoccupied orbitals of two or more atoms
D. A positive ion attracting negative ions
E. An interaction between outer shell electrons

20. From a consideration of the thiocyanate ion, SCN^-, in which carbon forms a double bond with the sulfur atom and a double bond with the nitrogen atom, the formal charges on the sulfur, carbon, and nitrogen atoms are, respectively

A. -1, 0, 0
B. 0, 0, -1
C. -1, +1, -1
D. -2, +1, 0
E. -2, 0, +1

21. For chlorine trifluoride the molecular geometry is a distorted version of which of the following?

A. Octahedral
B. Square planar
C. Trigonal pyramidal
D. Tetrahedral
E. Trigonal bipyramidal

22. All of the following have polar bonds and are polar molecules except

A. ClF_3
B. PF_3
C. CH_2F_2
D. BF_3
E. IF

23. Of the following molecules, the only one without a permanent dipole moment (i.e. not permanently polar) is

A. Water
B. Propanone
C. Carbon dioxide
D. Sulfur dioxide
E. Carbon monoxide

24. What hybrid orbitals of sulfur are involved in the bonding in sulfur dioxide?

A. sp
B. sp2
C. sp3
D. dsp2
E. d2sp3

25. A π bond (pi bond) is the result of

A. Overlap of two s orbitals
B. Overlap of an s orbital and a p orbital
C. Overlap of two p orbitals along the axes
D. Sidewise overlap of two parallel p orbitals
E. Sidewise overlap of two s orbitals

26. Neon atoms do not combine to form Ne_2 molecules, but neon can be converted from a gas to a liquid through which of the following intermolecular forces?

A. Dispersion
B. Dipole-induced dipole
C. Dipole-dipole
D. Hydrogen bonding
E. None of the above

27. Which of the following compounds can form hydrogen bonds?

A. CH_3NH_2
B. CH_3OCH_3
C. CH_3SH
D. CH_3Cl
E. HCl

28. Which of the following phase changes are endothermic?

1. Vaporization
2. Sublimation
3. Condensation

B. 1 only
C. 2 only
D. 3 only
E. 1 and 2 only
F. 2 and 3 only

29. The normal boiling point of a liquid is

A. The only temperature at which there can be an equilibrium between the liquid and gas states
B. The temperature above which the substance cannot exist as a liquid regardless of the pressure
C. The temperature at which the vapor pressure equals 760 T
D. The temperature at which gas molecules have more kinetic energy than molecules in the liquid phase
E. None of the above

30. Which of the following are colligative properties?

1. Vapor pressure elevation
2. Boiling point elevation
3. Vapor pressure lowering

B. 1 only
C. 2 only
D. 3 only
E. 1 and 2 only
F. 2 and 3 only

Answers Chem 1210 final

1. C
2. C
3. E
4. A
5. D
6. B
7. A
8. C
9. E
10. D
11. D
12. B
13. A
14. E
15. E
16. B
17. B
18. C
19. A
20. B
21. E
22. D
23. C
24. B
25. D
26. A
27. A
28. D
29. C
30. E