Exam 3a
Chem 1141
Fall 2008

Name:_____

MULTIPLE CHOICE. [3 pts ea.]

Q1. The SI unit of pressure is the pascal (Pa). It is defined as being equal to:

a) 1 Pa = 1 N b) 1 Pa = 1 N/s c) 1 Pa = 1 N/m^2

d) 1 Pa = 1 m^2/N e) 1 Pa = 1 m/s

Q2. Which of the following elements is *not* found as a diatomic gas under regular conditions on earth:

a) nitrogen b) helium c) hydrogen d) oxygen e) fluorine

Q3. The volume of a gas is directly proportion to its absolute temperature. This is commonly known as:

a) Avogadro's law b) Boyle's law c) Charles' law

d) Gay-Lussac's law e) van der Waal's law

Q4. Given the following chemical equation:

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

What volume of hydrogen gas is required to fully react with 3.0 L of nitrogen gas at STP?

a) 1.0 L b) 3.0 L c) 4.5 L d) 6.0 L e) 9.0 L

Q5. Which pressure is the largest:

a) 1 atm b) 1 mmHg c) 1 torr d) 1 Pa

Q6. A 4.50 g sample of metal absorbs 76.0 J of heat, and changes in temperature from 24.0 ºC to 155.1 ºC. What is the specific heat capacity of the metal?

a) 0.129 J/g·ºC b) 0.341 J/g·ºC c) 1.45 J/g·ºC

d) 14.2 J/g·ºC e) 89 J/g·ºC

Q7. Which chemical equation corresponds to the standard enthalpy of formation of $C_8H_{15}Cl(l)$?

a) $C_8H_{15}Cl(l) + 11½\ O_2(g) \rightarrow 8\ CO_2(g) + 7\ H_2O(l) + HCl(aq)$

b) $2\ C_8H_{15}Cl(l) + 23½\ O_2(g) \rightarrow 16\ CO_2(g) + 15\ H_2O(l) + Cl_2(g)$

c) $C_8H_{15}Cl(l) \rightarrow 8C(s, graphite) + 15H(g) + ½\ Cl_2(g)$

d) $C_8H_{15}Cl(l) \rightarrow 8C(s, graphite) + 7½\ H_2(g) + ½\ Cl_2(g)$

e) $8C(s, graphite) + 7½\ H_2(g) + ½\ Cl_2(g) \rightarrow C_8H_{15}Cl(l)$

Q8. A chemical reaction that absorbs heat is said to be:

a) Exoergic b) Endoergic c) Exothermic d) Endothermic

Q9. Which of the following standard enthalpy of formation values is not zero at 25 ºC?

a) Na(s) b) Ne(g) c) $CH_4(g)$ d) Hg(l) e) $H_2(g)$

Q10. Calculate ΔH° for the reaction:

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

given that ΔH_f° for $H_2O(l)$ is –285.8 kJ/mol.

a) –285.8 kJ/mol b) +285.8 kJ/mol c) +142.9 kJ/mol
d) –142.9 kJ/mol e) +571.6 kJ/mol

Q11. A particle of light is called a(n):

a) Proton b) Electron c) Quantum d) Positron e) Photon

Q12. Which form of electromagnetic (EM) radiation has the *longest* wavelength?

a) Radio b) Ultraviolet c) Visible d) X-Ray e) Infrared

Q13. Which set of quantum numbers for an electron in an atom is *not* allowed:

a) $n = 3$, $l = 2$, $m_l = -1$, $m_s = +½$ b) $n = 1$, $l = 0$, $m_l = 0$, $m_s = -½$
c) $n = 4$, $l = 1$, $m_l = 0$, $m_s = +½$ d) $n = 1$, $l = 1$, $m_l = 0$, $m_s = -½$
e) $n = 8$, $l = 6$, $m_l = -3$, $m_s = +½$

Q14. Atoms of neon are paramagnetic.

a) TRUE b) FALSE

Q15. Atoms of oxygen are paramagnetic.

a) TRUE b) FALSE

Q16. [8 pts.] Write the *full* electron configuration for

i) oxygen.

ii) copper

iii) chlorine

Q17. [6 pts.] Draw an orbital diagram for an atom of phosphorus.

Q18. [8 pts.] Calculate the frequency of light emitted from a hydrogen atom undergoing an electron transition from $n = 5$ to $n = 2$.

Q19. [5 pts.] A sample of an ideal gas whose volume is 45.6 mL at a temperature of 127 ºC is cooled down to –87 ºC. What will its new volume be?

Q20. [8 pts.] How much heat will be absorbed/released from the complete combustion of 34.0 g of pentane, $C_5H_{12}(l)$.

$$C_5H_{12}(l) + 8O_2(g) \rightarrow 5CO_2(g) + 6H_2O(l)$$

$\Delta H_f^o\ C_5H_{12}(l) = -146.9$ kJ/mol $\Delta H_f^o\ CO_2(g) = -393.5$ kJ/mol

$\Delta H_f^o\ H_2O(l) = -285.8$ kJ/mol

Q21. [5 pts.] 34.5 mL of 12.0 M HCl(aq) is added to 128 mL of H_2O. Calculate the final concentration of HCl. State any assumptions that you are making.

Q22. [10 pts.] What volume of $CO_2(g)$ will be formed by the reaction of 34.0 mL of 1.45 M HCl(aq) with 67.8 mL of 5.60 M $LiHCO_3(aq)$? The reaction is carried out at a temperature of 35 ºC, and a pressure of 0.987 atm. Be sure to start by writing out the *balanced* chemical equation!

Q23. [5 pts.] Name the following compounds:

a) Na_3PO_4

b) $Fe(NO_2)_2$

c) $MgF_2 \cdot 3H_2O$

d) B_3Cl_9

e) N_4O_8

Useful Information

1 atm = 101,325 Pa = 760 mmHg = 760 torr

$R = 0.08206$ L·atm/mol·K $\qquad R = 8.3145$ J/mol·K = 8.3145 kg·m^2/s^2·mol·K

$(p + an^2/V^2)(V - nb) = nRT \qquad pV = nRT$

$v_{rms} = \sqrt{\dfrac{3RT}{M}} \qquad pM = dRT \qquad q = ms\Delta t = C\Delta t$

$\Delta H^\circ_{rxn} = \Sigma n\Delta H_f^\circ(\text{products}) - \Sigma m\Delta H_f^\circ(\text{reactants})$

$E = h\nu \qquad c = \nu\lambda \qquad E = \dfrac{hc}{\lambda} \qquad N_A = 6.022 \times 10^{23}$ mol^{-1}

c = 3.00 x 10^8 m/s $\qquad h = 6.626 \times 10^{-34}$ J·s

$E_n = -R_H\,(1/n^2) \qquad R_H = 2.18 \times 10^{-18}$ J

$M_iV_i = M_fV_f$

Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1																	18
1 H 1.01	2											13	14	15	16	17	2 He 4.00
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3	4	5	6	7	8	9	10	11	12	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92160	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc [98]	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba* 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po [210]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113	114 [285]	115	116 [289]	117	118 [293]

*	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
**	89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]

TABLE 4.2 Solubility Rules for Common Ionic Compounds in Water at 25°C

Soluble Compounds	Exceptions
Halides (Cl^-, Br^-, I^-)	Halides of Ag^+, Hg_2^{2+}, and Pb^{2+}
Sulfates (SO_4^{2-})	Sulfates of Ag^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Hg_2^{2+}, and Pb^{2+}
Insoluble Compounds	**Exceptions**
Carbonates (CO_3^{2-}), phosphates (PO_4^{3-}), chromates (CrO_4^{2-}), and sulfides (S^{2-})	Compounds containing alkali metal ions and the ammonium ion
Hydroxides (OH^-)	Compounds containing alkali metal ions and the Ba^{2+} ion