

# Exam 1a

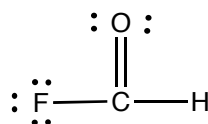
## Chem 1142

### Spring 2011

Name: \_\_\_\_\_

**MULTIPLE CHOICE.** [3 pts ea.] Choose the best response on the scantron sheet. **[33 pts total.]**

Q1. What type of hybrid orbital is required on the central carbon atom in the following molecule:

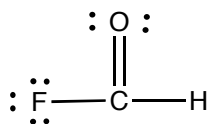


- a)  $sp$                       b)  $sp^2$                       c)  $sp^3$                       d)  $sp^3d$                       e)  $sp^3d^2$

Q2. The angle between  $sp$  hybrid orbitals is:

- a)  $180^\circ$                       b)  $120^\circ$                       c)  $109.5^\circ$                       d)  $90^\circ$                       e)  $60^\circ$

Q3. The number of sigma and pi bonds in the following molecule is:



- a) 1  $\sigma$ , 3  $\pi$                       b) 2  $\sigma$ , 2  $\pi$                       c) 3  $\sigma$ , 1  $\pi$                       d) 4  $\sigma$                       e) 4  $\pi$

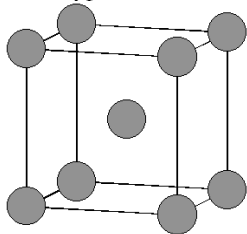
Q4. Which of the following molecules are capable of hydrogen bonding among themselves:

- a)  $\text{C}_2\text{H}_6$                       b)  $\text{HI}$                       c)  $\text{KF}$                       d)  $\text{BeH}_2$                       e)  $\text{CH}_3\text{NH}_2$

Q5. Which of the following substances forms an amorphous crystal in the solid state:

- a) Ice                      b) Glass                      c) Quartz                      d) Graphite                      e) Ammonia

Q6. Which type of unit cell is shown below?



- a) Simple cubic                      b) Face-centered Cubic                      c) Body-centered cubic  
d) Tetragonal                      e) Monoclinic

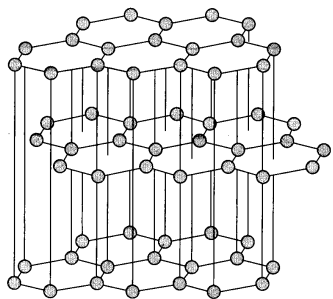
Q7. Which of the following substances would be most likely to dissolve in  $\text{CCl}_4$ ?

- a)  $\text{NaNO}_3$                       b)  $\text{HCl}$                       c)  $\text{NH}_3$                       d)  $\text{CH}_3\text{OH}$                       e)  $\text{Br}_2$

Q8. Which of the following aqueous solutions would have the greatest boiling point?

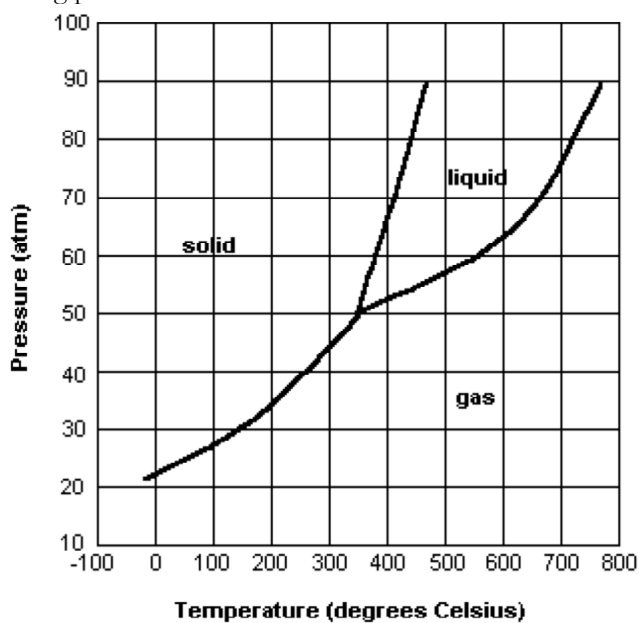
- a) 0.100 m  $\text{C}_6\text{H}_{12}\text{O}_6$                       b) 0.080 m  $\text{NaCl}$                       c) 0.070 m  $\text{CaCl}_2$   
d) 0.050 m  $\text{NaC}_2\text{H}_3\text{O}_2$                       e) pure water

Q9. Which substance has the following solid-state structure?



- a) Graphite      b) Quartz      c) Diamond      d) Glass      e) Sodium

Q10. The phase diagram for an unknown substance is shown below. Based on this phase diagram, what is the boiling point of this substance at 60 atm?



- a) 60 °C      b) 350 °C      c) 370 °C      d) 550 °C      e) 760 °C

Q11. The Henry's law constant for ethanol in water is  $160 \text{ M} \cdot \text{atm}^{-1}$  at 37 °C. What is the predicted partial pressure of ethanol vapor above an aqueous sample of ethanol whose molar concentration is  $1.7 \times 10^{-2} \text{ M}$ ?

(Note: this corresponds to a Blood Alcohol Concentration of 0.08, which is the legal definition of intoxication.)

- a)  $1.1 \times 10^{-4} \text{ atm}$       b) 9400 atm      c)  $5.5 \times 10^{-5} \text{ atm}$       d) 2.72 atm      e)  $1.7 \times 10^{-2} \text{ atm}$

### Short Response.

Show ALL work to receive credit.

Q12. [10 pts.] Calculate the % by mass, the molarity, and the molality of a solution made by mixing 12.0 g NaCl with 139.0 g H<sub>2</sub>O, such that its final volume is 141.0 mL. Show ALL work.



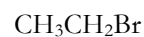
Q13. [2 pts.] The greater the molar heat of vaporization of a liquid, the greater is vapor pressure. True or false?

Q14. [5 pts.] What is the osmotic pressure of 0.100 M Ca(NO<sub>3</sub>)<sub>2</sub>(aq) at 37 °C?

Q15. [3 pts.] Under what circumstance will a gas not obey Henry's law? Give an example.

Q16. [8 pts.] Draw a diagram showing the formation of hydrogen bonds between molecules of  $\text{CH}_3\text{OH}$ . Clearly label the location of the hydrogen bonds in your diagram!

Q17. [8 pts.] EXPLAIN which of the following substances would have the GREATEST vapor pressure.



Q18. [8 pts.] If the osmotic pressure of 175. mL of an aqueous solution at 305 K containing 0.0341 g of solute is  $1.31 \times 10^{-3}$  atm, then what is the molar mass of the solute? The solute is a non-electrolyte.

Q19. [3 pts.] Why are metals good conductors of electricity?

## Old-Time Chemistry Corner

Q20. [10 pts.] Write formulas for the following substances:

i) sodium carbonate \_\_\_\_\_

ii) ammonium bromide \_\_\_\_\_

iii) iron(III) nitrate \_\_\_\_\_

iv) heptabromine octoxide \_\_\_\_\_

v) calcium sulfite dihydrate \_\_\_\_\_

Q21. [10 pts.] Predict the MOLECULAR geometry of SF<sub>4</sub>. Your answer should include a valid Lewis structure, and a sketch of the molecular geometry including approximate bond angles.

Explain whether SF<sub>4</sub> is polar or non-polar.

## Periodic Table of the Elements

IA	IIA											IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H 1.01																	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	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	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		
87 Fr [223]	88 Ra** [226]	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]		

$$1 \text{ atm} = 101,325 \text{ Pa} = 760 \text{ mmHg} = 760 \text{ torr}$$

$$R = 0.08206 \text{ L} \cdot \text{atm} / \text{mol} \cdot \text{K}$$

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

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$pM = dRT$$

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

$$E = h\nu$$

$$c = \nu\lambda$$

$$c = 3.00 \times 10^8 \text{ m/s}$$

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

$$E_n = -R_H (1/n^2)$$

$$R_H = 2.18 \times 10^{-18} \text{ J}$$

$$\Delta T_b = ik_b m$$

$$\Delta T_f = ik_f m$$

$$c = kP$$

$$R = 8.314 \text{ J/mol} \cdot \text{K}$$

$$pV = nRT$$

$$q = ms\Delta t = C\Delta t$$

$$N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$E = \frac{hc}{\lambda}$$

$$M_1 V_1 = M_2 V_2$$

$$\Pi = iMRT$$

