

Name KEY M (Print last name in CAPS)

SECTION \_\_\_\_\_ (same as your lab section)

1.	Read each question carefully before answering.
2.	Mark the choice that best answers the question or completes the statement.
3.	Use the scantron provided. Use a no. 2 pencil and clearly mark your choice. If you change an answer, completely erase your previous mark.
4.	Answer each question. There is no penalty for guessing. However, multiple answers are graded as incorrect, and blank answers are graded as incorrect.
5.	On the scantron, fill in your last name, first name and initial. Blacken the corresponding letters.
6.	Fill in your ID, the department=CHEM, Course no. = 101, and Section= your lab section. Blacken the corresponding letters and numbers.
7.	If you want your score posted by a portion of your ID# mark A under the option column. They will be posted on the bulletin board where you got your seat assignment.
8.	Use the test for scratch paper.
9.	Mark your answers on the test so you can check them with the key when it is posted.
10.	<b>***Turning in a blank scantron results in a grade of zero.***</b>
11.	Turn in both the scantron and the exam, have your ID and your calculator ready to be checked.
12.	Work at a steady pace and you will have ample time to finish.
13.	The keys will be posted on my class web page as soon as possible. You may check your grade at the class web site. <b>Your password is the middle 5 numbers of your student ID followed by the first letter of your last name in CAPS.</b> Be patient and give the webmaster time to enter all of this information.

There are 35 questions for 125 points. Good Luck!

M

## Possibly Useful Information

$$1 \text{ cal} = 4.184 \text{ J}$$

$$M = \frac{\text{mol solute}}{L \text{ soln}}$$

$$M_1V_1 = M_2V_2$$

$$q = \text{mass} \times \text{sp ht} \times \Delta T$$

$$\left(\frac{w}{w}\right) \% = \frac{\text{mass solute}}{\text{total mass}} \times 100$$

$$d = \text{mass/vol}$$

$$\text{Volume} = \ell \times h \times w$$

$$\lambda v = c$$

$$E=h\nu$$

$$\lambda = \frac{h}{mv}$$

$$PV = nRT$$

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$1 \text{ atm} = 101.325 \text{ kPa}$$

$$P_{\text{total}} = P_A + P_B + P_C + \dots$$

$$P_A = X_A P_{\text{total}}$$

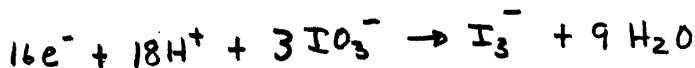
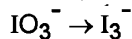
$$\frac{\text{Rate A}}{\text{Rate B}} = \sqrt{\frac{\text{MW(B)}}{\text{MW(A)}}}$$

$$\frac{\text{time A}}{\text{time B}} = \sqrt{\frac{\text{MW(A)}}{\text{MW(B)}}}$$

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{\text{vap}}}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right)$$

[illegible]

Q.1 When the following  $\frac{1}{2}$  - reaction is balanced in acidic solution, what is the coefficient of  $\text{H}_2\text{O}$ ?

$$\text{IO}_3^- \rightarrow \text{I}_3^-$$


- a) 1      b) 2      c) 3      d) 6      **e) 9**

Q.2 What mass of NaOH is required to react exactly with 25.0 mL of 1.2 M  $\text{H}_2\text{SO}_4$ ?

- a) 1.2 g
- b) 1.8 g
- ☒ c) 2.4 g
- d) 3.5 g
- e) none of these



$$0.025 \times 1.2 = 0.030 \text{ mol } \text{H}_2\text{SO}_4 \times \frac{\textcircled{2} \text{ NaOH}}{\textcircled{1} \text{ H}_2\text{SO}_4}$$

$$= 0.060 \text{ mol NaOH} \times \frac{40.00 \text{ g}}{1 \text{ mol NaOH}}$$

$$= \underline{2.4 \text{ g NaOH}}$$

Q.3 The physical change of going from solid phase to liquid phase is called,

- a) Condensation
- b) Evaporation
- ☒ c) Melting
- d) Sublimation
- e) Deposition

Q.4 It is found that 250.0 mL of a gas at STP has a mass of 1.00 g. What is the molar mass of this gas?

$$PV = nRT = \frac{g}{mw} RT$$

☒ a)

$$89.6 \frac{g}{mol}$$

b)

$$28.0 \frac{g}{mol}$$

c)

$$14.0 \frac{g}{mol}$$

d)

$$22.4 \frac{g}{mol}$$

e)

$$11.2 \frac{g}{mol}$$

$$mw = \frac{gRT}{PV} = \frac{1.00 g \times 0.08206 L \cdot atm \times 273.15 K}{1 atm \times 0.250 L}$$

$$mw = 89.658 \Rightarrow \underline{89.6 g/mol}$$

$$\text{or } \frac{1g}{x} = \frac{1 mol}{22.414 L} \therefore x = \frac{22.414}{0.250} = 89.656 g/mol$$

Q.5 Use the Ideal Gas Law to predict the relationship between n and T as pressure and volume are held constant.

$$PV = nRT$$

$$constant = nT \therefore$$

- a)  $n \propto T$     ☒ b)  $n \propto \frac{1}{T}$     c)  $\frac{n}{T} = constant$     d)  $PT = nRV$     e)  $\frac{PV}{T} = R$

Q.6 A gas sample is held at constant pressure. The gas occupies 3.62 L of volume when the temperature is 21.6°C. Determine the temperature at which the volume of the gas is 3.45 L.

- a) 309 K    ☒ b) 281 K    c) 20.6 K    d) 294 K    e) 326 K

$$\frac{P_1 V_1}{n T_1} = \frac{P_2 V_2}{n T_2} \Rightarrow T_2 = \frac{V_2}{V_1} \times T_1$$

$$T_2 = \frac{3.45 L}{3.62 L} \times (21.6 + 273.15) K$$

$$T_2 = 280.9 = \underline{281 K}$$

Q.7 Which one of the following substances would exhibit dipole-dipole intermolecular forces?

- a)  $\text{CCl}_4$       b)  $\text{Cl}_2$       c)  $\text{N}_2$       **d)  $\text{NCl}_3$**       e)  $\text{CH}_4$

Q.8 Which would have a higher rate of effusion than  $\text{C}_2\text{H}_2$ ?

- $\approx 28$        $32$        $\approx 70$        $\approx 16$        $\approx 44$   
 a)  $\text{N}_2$       b)  $\text{O}_2$       c)  $\text{Cl}_2$       **d)  $\text{CH}_4$**       e)  $\text{CO}_2$

$$\text{molar mass } \text{C}_2\text{H}_2 = 26.037 \text{ g/mol}$$

Q.9 In the reaction  $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{H}_2\text{O}(\text{l})$ , how many moles of iron can be produced using 17.4 liters of hydrogen at STP?

- a) 0.518**      b) 1.17      c) 0.858      d) 11.6      e) 0.777

$$\frac{x \text{ moles}}{17.4 \text{ L}} = \frac{1 \text{ mol}}{22.414 \text{ L}}$$

$$\therefore x = \frac{17.4}{22.414} = 0.7763 \text{ moles } \text{H}_2 \times \frac{2 \text{ Fe}}{3 \text{ H}_2} = 0.5175 \text{ mol Fe}$$

Q.10 Which of the following substances show(s) significant hydrogen bonding? Give the "best" answer.

- a)  $\text{CH}_3\text{OH}$  **yes**  
 b)  $\text{PH}_3$   
 c)  $\text{NH}_3$  **yes**  
**d) a and c only**  
 e) a, b, and c

Q.11 Carbon tetrachloride has a vapor pressure of 680 torr at  $70^\circ\text{C}$ . Which temperature would most likely be its normal boiling point?

- a)  $50^\circ\text{C}$       b)  $70^\circ\text{C}$       c)  $135^\circ\text{C}$       **d)  $76^\circ\text{C}$**       e)  $16^\circ\text{C}$

*slightly greater than  $70^\circ\text{C}$*

- Q.12 A gaseous hydrocarbon weighing 0.290 g occupies a volume of 125 mL at 25 °C and 760 mm Hg. What is the molar mass of this compound?

- a) 113 g/mol  
 b)  $4.76 \times 10^3$  g/mol  
 c) 43.1 g/mol  
 d) 10.5 g/mol  
 e) 56.8 g/mol

$$PV = \frac{g}{mw} RT$$

$$mw = \frac{gRT}{PV} = \frac{(0.290)(0.0821)(25+273)}{(1)(0.125)}$$

$$= 56.76 \Rightarrow 56.8 \text{ g/mol}$$

- Q.13 The volume correction in the van der Waals equation is due to the fact that

- a) manometers are not reliable  
 b) gas molecules attract each other  
 c) gas molecules repel each other  
 d) gas molecules occupy a volume ←  
 e) none of these

- Q.14 What volume would be occupied by 4.4 g of oxygen gas, O<sub>2</sub>, at 0.40 atm and 125 °C?

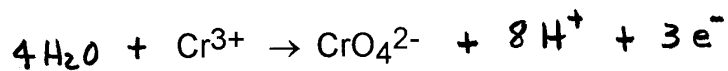
- a) 3.5 L  
 b) 11 L  
 c) 7.0 L  
 d) 112 L  
 e) 359 L

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(4.4/32.00)(0.0821)(125+273)}{0.40}$$

$$V = 11.23 \text{ L} \Rightarrow 11 \text{ L}$$

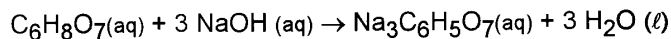
- Q.15 When the following  $\frac{1}{2}$  reaction is balanced in acid using the smallest integer coefficients, the sum of the coefficients(including moles of electrons) is ...



- a) 12  
 b) 15  
 c) 17  
 d) 16  
 e) 14

$$\sum 4 + 1 + 1 + 8 + 3 = 17$$

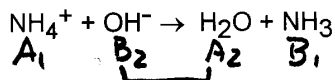
- Q.16 A soft drink contains an unknown amount of citric acid,  $C_6H_8O_7$ . If 100.0 mL of the soft drink requires 33.51 mL of 0.0102 M NaOH to completely neutralize the citric acid, how many grams of citric acid (molar mass = 192.13 g/mol) does the soft drink contain per 100 mL? The reaction is :



☒ a) 0.0219 g  
 b) 0.0660 g  
 c) 0.219 g  
 d) 0.657 g  
 e) 0.782 g

$(0.03351 L)(0.0102 \frac{mol}{L}) \times \frac{1 mol cit.}{3 mol NaOH} \times \frac{192.13 g}{1 mol cit.} =$   
 $= \underline{0.02189 g} \text{ citric acid}$

- Q.17 Choose the Brønsted-Lowry acids and bases in the following equation:



- a) acids  $NH_4^+$ ,  $OH^-$  bases  $H_2O$ ,  $NH_3$   
 b) acids  $H_2O$ ,  $OH^-$  bases  $NH_4^+$ ,  $NH_3$   
 c) acids  $NH_4^+$ ,  $OH^-$  bases  $H_2O$ ,  $NH_4^+$   
☒ d) acids  $NH_4^+$ ,  $H_2O$  bases  $OH^-$ ,  $NH_3$   
 e) acids  $NH_4^+$ ,  $NH_3$  bases  $H_2O$ ,  $OH^-$

- Q.18 In the following reaction:  $BF_3 + NH_3 \rightarrow BF_3-NH_3$ ,

$BF_3$  acts as a

- a) Lewis base  
 b) Brønsted acid  
☒ c) Lewis acid  
 d) Brønsted base  
 e) Arrhenius acid

- Q.19 Which of the following would you expect to have the highest boiling point?

- a)  $CH_3OH$     b)  $CH_4$     c)  $O_2$     ☒ d)  $C_2H_5OH$     e) Kr

Q.20 Calculate the density of  $\text{SO}_3$  gas at  $35^\circ\text{C}$  and 715 torr.

- a) 0.0285 g/L  
 b) 1.43 g/L  
 c) 2.15 g/L  
 (d) 2.98 g/L  
 e) 3.57 g/L

$$PV = nRT$$

$$P = \frac{n}{V} RT$$

$$\frac{n}{V} = \frac{P}{RT} = \frac{(715/760)}{(0.0821)(273+35)} = 0.0372 \frac{\text{mol}}{\text{L}} \times \frac{80.06 \text{ g}}{1 \text{ mol SO}_3}$$

$$\text{Density} = 2.978 \text{ g/L}$$

Q.21 Consider three 1-L flasks at STP. Flask A contains  $\text{NH}_3$  gas, flask B contains  $\text{NO}_2$  gas, and flask C contains  $\text{N}_2$  gas. Which flask contains the largest number of molecules?

- a) A      b) B      c) C      (d) all are the same      e) A & B

Q.22 The forces which exist between noble gas atoms in the solid and liquid phases

are :

- a) Hydrogen bonds  
 b) Ionic forces  
 c) Dipole-dipole forces  
 d) Ion-dipole forces  
 (e) Dispersion forces

Q.23 A sample of  $\text{N}_2$  gas effuses through a small hole in 19.0 s. How long would it take for a sample of  $\text{N}_2\text{O}_2$  (g) to effuse under the same conditions?

- (a) 27.8 s  
 b) 13.0 s  
 c) 8.87 s  
 d) 40.7 s  
 e) 19.0 s

$$\frac{\text{time N}_2\text{O}_2}{\text{time N}_2} = \sqrt{\frac{M_{\text{N}_2\text{O}_2}}{M_{\text{N}_2}}} = \sqrt{\frac{60}{28}} = 1.463$$

$$\text{time (N}_2\text{O}_2) = 1.463(19.0 \text{ s}) = 27.8 \text{ s}$$

Q.24 How many moles of  $\text{NaCl}$  are needed to make up 45 mL of a 0.0052 M  $\text{NaCl}$  solution?

- a)  $4.6 \times 10^{-4}$  mol  
 b)  $5.0 \times 10^{-3}$  mol  
 c)  $1.7 \times 10^{-4}$  mol  
 d)  $6.0 \times 10^2$  mol  
 (e)  $2.3 \times 10^{-4}$  mol

$$0.045 \text{ L} \times 0.0052 \frac{\text{mol}}{\text{L}} = 2.34 \times 10^{-4} \text{ mol NaCl}$$

Q.25 The normal boiling point of  $\text{CS}_2$  is  $46^\circ\text{C}$ . Based upon this, the attraction between  $\text{CS}_2$  molecules is \_\_\_\_\_ than the attraction between  $\text{H}_2\text{O}$  molecules in the liquid state.

- a) equal to    b) greater    ☒ c) less    d) more information is needed to answer this

Q.26 The conjugate base of  $\text{HS}^-$  is,

- a)  $\text{HS}$     b)  $\text{HS}^{2-}$     c)  $\text{HS}^{2+}$     ☒ d)  $\text{S}^{2-}$     e)  $\text{H}_2\text{S}$

Q.27 A proton acceptor best describes,

- a) A Lewis acid  
b) A Lewis base  
c) A Brønsted-Lowry acid  
☒ d) A Brønsted-Lowry base  
e) An Arrhenius acid

Q.28 Which of the following is the strongest acid?

- a)  $\text{HCl}$     b)  $\text{HF}$     c)  $\text{HBr}$     ☒ d)  $\text{HI}$     e)  $\text{H}_2\text{CO}_3$

Q.29 Hydrogen bonding,

- a) is a special case of ionic bonding  
☒ b) is a special case of strong dipole-dipole interaction  
c) refers to the covalent bond of H to O  
d) is a weak dispersion force  
e) None of the above are correct statements.

Q.30 The point in a phase diagram in which the solid, liquid and gas exist in equilibrium is called the,

- a) critical point  
b) critical pressure  
c) normal pressure point  
☒ d) triple point  
e) condensation point



Q.31 Which of the following are correctly paired?

- a) critical point : solid phase
- b) hydrogen bonding:  $H_2$
- ☒ c) heat of fusion : melting a solid
- d) Clausius-Clapeyron Equation : ideal gas
- e) condensation point : STP

Q.32 Molecules that have strong cohesive forces will have,

- a) High vapor pressures
- ☒ b) Low vapor pressures
- c) Low boiling points
- d) Will be easily vaporized
- e) None of these are correct.

Q.33 Convert 421 kPa to atmospheres.

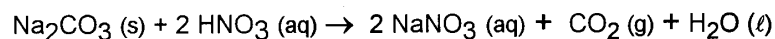
- a)  $4.27 \times 10^5$  atm
- b) 320 atm
- c) 0.554 atm
- d) 0.00415 atm
- ☒ e) 4.16 atm

$$421 \text{ kPa} \times \frac{1 \text{ atm}}{101.325 \text{ kPa}} = \underline{\underline{4.15 \text{ atm}}}$$

Q.34 Which of the following is an endothermic process?

- a) Combustion
- b) Acid-base neutralization reaction
- ☒ c) Fusion
- d) Condensation
- e) None of these are endothermic

Q.35 How many grams of  $Na_2CO_3$  (molar mass = 106.0 g/mol) are required for complete reaction with 25.0 mL of 0.155 M  $HNO_3$ ?



- a) 0.122 g
- ☒ b) 0.205 g
- c) 0.410 g
- d) 20.5 g
- e) 205 g

$$\begin{aligned} & (.025)(.155) \times \frac{(1) Na_2CO_3}{(2) HNO_3} \times \frac{106.0 g}{1 \text{ mol } Na_2CO_3} = \\ & = 0.20537 \Rightarrow \underline{\underline{0.205 g Na_2CO_3}} \end{aligned}$$

End of Test

KEY Ex3 FORM **M** Magnuson 101 21 Nov 2002

Total points = 125

Each question = 3.572 points

	1	<b>E</b>
	2	<b>C</b>
	3	<b>C</b>
	4	<b>A</b>
	5	<b>B</b>
	6	<b>B</b>
	7	<b>D</b>
	8	<b>D</b>
	9	<b>A</b>
	10	<b>D</b>
	11	<b>D</b>
	12	<b>E</b>
	13	<b>D</b>
	14	<b>B</b>
	15	<b>C</b>
	16	<b>A</b>
	17	<b>D</b>
	18	<b>C</b>
	19	<b>D</b>
	20	<b>D</b>
	21	<b>D</b>
	22	<b>E</b>
	23	<b>A</b>
	24	<b>E</b>
	25	<b>C</b>
	26	<b>D</b>
	27	<b>D</b>
	28	<b>D</b>
	29	<b>B</b>
	30	<b>D</b>
	31	<b>C</b>
	32	<b>B</b>
	33	<b>E</b>
	34	<b>C</b>
	35	<b>B</b>