C101 Exam 3
Version 01

Instructions for filling out your answer sheet:

1. Use a #2 pencil only.
2. Print your **LAST NAME** and then your **FIRST NAME** in the name field, and then blacken in the bubbles that correspond to the letters of your name. Leave a space between your last and first name; blacken in the blank circle below the blank space.
3. In the Version column, blacken in the version number of the exam.

This is Version 01 Note: You must fill in the zero and the one.

4. Fill in your IU username in the username column and then blacken in the corresponding circles.
5. Fill in only ONE answer for each multiple choice question. If multiple answers are given, no points can be awarded; therefore, make sure you erase your answers well.
6. Do not make stray marks in any other portions of the answer sheet.
7. Failure to follow the above instructions will delay the posting of your grade. If you do not bring problems to our attention within one week, we reserve the right to not make adjustments. It is your responsibility to be about entering your IU username and version number correctly.

You have two hours to complete the exam. This exam has 35 questions (30 multiple choice at 2 points each and 5 short answer for 40 points and up to 6 points bonus) for a total of 106 out of 100 points.

1. **Legibly put your whole name on the first and last page of the exam in the bank for name.**
2. **Circle you discussion AI's name.**
3. **Fill out your scantron completely with correct version number.**

Avogadro's # = 6.022×10^{23} things/mol

1 atm = 760 torr = 760 mmHg

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

$PV = nRT$

$\mathrm{d} = \frac{\mathrm{P}(MM)}{RT}$

$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$

M1V1 = M2V2

$M = \frac{mol}{L}$

At STP, 1 mol = 22.4 L

$\Delta T_b = \frac{K_b \times mol\ solute\ particles}{kg\ solvent}$

$\Delta T_f = \frac{K_f \times mol\ solute\ particles}{kg\ solvent}$

$K_w = 1.0 \times 10^{-14} = [H_3O^+][OH^-]$

$pH = -log[H_3O^+]$

$[H_3O^+] = 10^{-pH}$

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.933	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.732	32 Ge Germanium 72.61	33 As Arsenic 74.922	34 Se Selenium 78.09	35 Br Bromine 79.904	36 Kr Krypton 84.80
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.29
55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

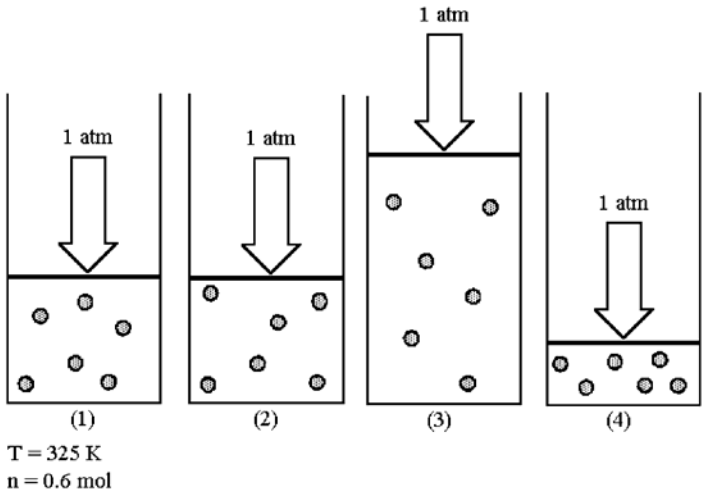
Lanthanide Series	57 La Lanthanum 138.906	58 Ce Cerium 140.115	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.24	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.966	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.50	67 Ho Holmium 164.930	68 Er Erbium 167.26	69 Tm Thulium 168.934	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

1) The number of moles of hydrogen gas present in a 1,500 mL container at 298 K and 2.0 atm pressure is _____.
   A) 0.52 moles
   B) 0.12 moles
   C) 0.26 moles
   D) 0.65 moles

2) 1.86 moles of a gas occupy 245 L at 281 °C under a pressure of 0.346 atm. When the pressure is increased to 0.886 atm while keeping the same temperature, the new volume will be _____.
   A) 95.7 L
   B) 627 L
   C) 47.8 L
   D) 799 L

3) The density of carbon dioxide as STP is _____.
   A) 5.62 g/ L
   B) 1.96 g/ L
   C) 3.94 g/ L
   D) 0.46 g/ L

4) Assume that you have a sample of gas in a cylinder with a moveable piston, as shown in diagram (1). The initial pressure, number of moles, and temperature of the gas are noted on the diagram. Which diagram (2)–(4) most closely represents the result of doubling the temperature while keeping the pressure and number of moles of gas constant?



   A) diagram (2)
   B) diagram (3)
   C) diagram (4)
   D) cannot be determined

5) An unknown gaseous substance has a density of 1.06 g/L at 31 °C and 371 torr. Its molecular weight is _____.
   A) 27 g/mol
   B) 81 g/mol
   C) 54 g/mol
   D) 108 g/mol

6) Find the number of liters occupied by 3.0 g of nitrogen gas at STP.
   A) 0.13 L
   B) 2.4 L
   C) 67 L
   D) 7.5 L

7) Which end, the polar end or the nonpolar tail, of a detergent molecule is attracted to water?
   A) both the polar end and the nonpolar tail
   B) the nonpolar tail
   C) neither the polar end nor the nonpolar tail
   D) the polar end

8) What is the molarity of 3.68 mL of a solution containing 0.0025 moles of calcium chloride?
   A) 0.68 M
   B) 6.8×10^{-4} M
   C) 1.5 M
   D) 6.8×10^{-3} M

9) To prepare 500. mL of 0.5 *M* NaOH from a stock of 5.0 *M* NaOH one needs to _____.
   A) dilute 250 mL 5.0 *M* NaOH with enough water to a total of 500. mL solution
   B) dilute 50 mL 5.0 *M* NaOH with enough water to a total of 500. mL solution
   C) dilute 50 mL 5.0 *M* NaOH with 500. mL water
   D) dilute 375 mL 5.0 *M* NaOH with 500. mL water

10) 7.5 g of calcium carbonate in 150 mL of aqueous solution will provide a _____ *M* solution.
   A) 2.0 M
   B) 0.10 M
   C) 0.50 M
   D) 1.0 M

11) 500 mL 0.4 *M* aluminum nitrate solution contains _____ moles of aluminum ions and _____ moles of nitrate ions.
   A) 0.2; 0.4
   B) 0.2; 0.6
   C) 0.2; 0.2
   D) 0.6; 0.2

12) 10.0 mL of 0.40 *M* hydrochloric acid neutralizes _____ mL of 0.20 *M* magnesium hydroxide solution. Write out balanced neutralization (exchange) reaction before solving question.
A) 5.0 mL
B) 10. mL
C) 20. mL
D) 40. mL

13) Which of the following "adjustments" can be made to a chemical reaction system to increase the rate of reaction?
A) add a catalyst
B) increase the concentrations of the reactants
C) increase the reaction temperature
D) All of the above will increase the rate of reaction.
E) None of the above will increase the rate of reaction.

14) If the kinetic energy of the reactant molecules is not high enough to overcome the activation energy barrier, _____.
A) the products will form at a slower rate
B) the reverse reaction will occur
C) the reaction will occur anyway
D) no reaction takes place

15) In a catalyzed reaction the activation energy is _____ when compared to the uncatalyzed reaction.
A) higher
B) identical
C) lower
D) either higher or lower depending on the reaction

16) If the concentration of B is doubled while the concentration of A is unchanged, the rate will _____.

$$A\ (g) + 3B\ (g) \rightarrow C\ (g) + 2D\ (g)$$

$$\text{Rate} = k[A][B]^3$$

A) stay the same
B) double
C) be increased by a factor of 6
D) be increased by a factor of 8

17) Doubling the concentration of A leads to doubling the rate, while doubling the concentration of B has no effect on the rate. The rate equation is, therefore, _____.

$$A + B \rightarrow C$$

A) Rate = $k[A]^2$
B) Rate = $k[A]^2[B]$
C) Rate = $k[A]$
D) Rate = $k[A][B]$

18) The following set of data was obtained by the method of initial rates for the reaction:

$$(H_3C)_3CBr + OH^- \rightarrow (H_3C)_3COH + Br^-$$

What is the value of the rate constant, *k*?(hint: first use the kinetics data to solve for the rate equation.)

$[(H_3C)_3CBr]$ (M)	$[OH^-]$ (M)	Initial Rate (M/s)
0.25	0.25	1.1×10^{-4}
0.50	0.25	2.2×10^{-4}
0.50	0.50	2.2×10^{-4}

A) $4.4 \times 10^{-4}\ s^{-1}$
B) $8.8 \times 10^{-4}\ s^{-1}$
C) $1.8 \times 10^{-4}\ s^{-1}$
D) none of these

19) Which statement is true about equilibrium?
A) The reverse reaction rate is greater than the forward reaction rate.
B) The forward reaction rate is equal to the reverse reaction rate.
C) The forward reaction rate is greater than the reverse reaction rate.
D) The concentration of reactants is equal to the concentration of products.
E) Both B and D.

20) As the following reaction reaches equilibrium, A $\rightleftharpoons$ B, which of the following statements best describes the rate of the forward reaction as it approaches equilibrium? The intial concentration A is 1.0 M and the intial concentration of B is 0 M.
A) The rate remains constant.
B) The rate slows down, then increases, as equilibrium is approached.
C) The rate increases as equilibrium is approached.
D) The rate decreases as equilibrium is approached.

21) Calculate the equilibrium concentration of N_2 for the following reaction.

$$N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$$

The equilibrium constant K_{eq} is 0.055 and the concentration of H_2 is 1.20 *M* and the concentration of NH_3 is 0.225 *M* at equilibrium.
A) 0.0915 *M*
B) 0.915 *M*
C) 3.41 *M*
D) 0.533 *M*

22) For which of the following values of an equilibrium constant, K_{eq}, would you expect the equilibrium to lie farthest to the right?
A) 1.46×10^{-4}, at 20 °C
B) 10.6, at 20 °C
C) 0.491, at 20 °C
D) 1.04, at 20 °C

23) The equilibrium constant expression for the reaction is _____.

$$CaCO_3\ (s) \rightleftharpoons CaO\ (s) + CO_2\ (g)$$

A) $K_{eq} = [CO_2]\,[CaO] / [CaCO_3]$

B) $K_{eq} = [CaCO_3] / [CO_2]\,[CaO]$

C) $K_{eq} = [CaO] / [CaCO_3]$

D) $K_{eq} = [CO_2]$

24) For the following endothermic reaction, what condition will increase the yield of product?

$$N_2\ (g) + 2H_2\ (g) \rightleftharpoons N_2H_4\ (g)$$

A) high temperature, low pressure

B) low temperature, low pressure

C) high temperature, high pressure

D) low temperature, high pressure

25) Which of the following solutions would you expect **not** to conduct electricity?

A) NaCl in water

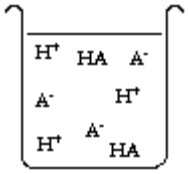
B) H_2SO_4 in water

C) HCl in water

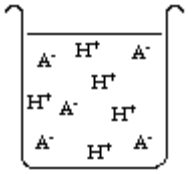
D) CO in water

26) The compound HA is an acid that is soluble in water. Which of the "beakers" below shows HA behaving as a **strong acid** in water?

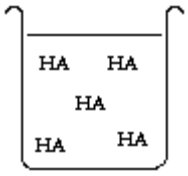
A)



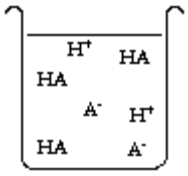
B)



C)



D)



27) The acid in the forward reaction is _____.

$$HCO_3^- + H_2O \rightarrow H_2CO_3 + OH^-$$

A) HCO_3^-
B) H_2O
C) OH^-
D) H_2CO_3

28) Acidic solutions _____.
A) have a pH = 7
B) have a lower concentration of hydronium ions than hydroxide ions
C) have a high pH
D) have a higher concentration of hydronium ions than hydroxide ions
E) Both B and C

29) Which solution is the most acidic solution?
A) a solution whose pH = 1.3
B) a solution whose $[H_3O^+] = 0.050$
C) a solution whose $[OH^-] = 2.0 \times 10^{-13}$
D) All of the above have the same degree of acidity.

30) A drop of a full unit in the pH scale _____.
A) reduces the acidity 10×
B) reduces the acidity 2×
C) increases the acidity 10×
D) increases the acidity 2×

31) Acetic acid, (CH_3CO_2H), has a freezing point of 16.7 °C and a boiling point of 118 °C.

a) (2 pts) Draw the heating curve for acetic acid on the graph below. Graph temperature (°C) vs Heat added.

b) (1 pt) Why does the temperature not increase as the substance is being heated at the horizontal portions of the curve?

c) (3 pts) What is the new freezing point of acetic acid if 0.080 moles of NaCl is added to 125 g of acetic acid? The K_f for acetic acid is 3.9°C*kg solvent/mol solute. (answer with two sig figs.)

32) Given the following **exothermic** reaction: $CO\ (g) + 2H_2\ (g) \rightleftharpoons CH_3OH\ (g)$

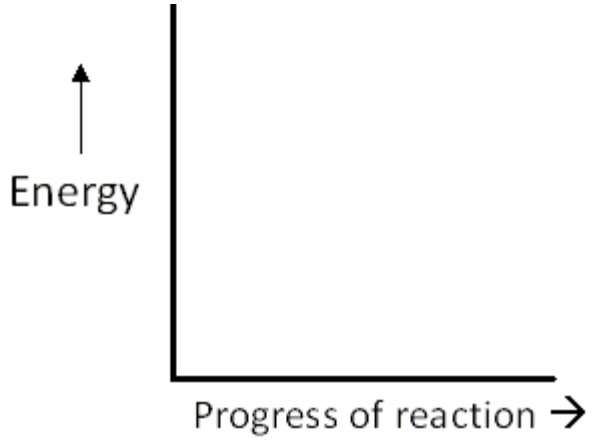
a) (2 pts) write the equilibrium constant expression for this reaction:

K_{eq} =

b) (4 pts) List 4 things that can be done to this system in equilibrium to cause it to shift to the **right**.

1	2
3	4

33) (8 pts) Consider the reaction: A → B that has an activation energy of 50 kJ/mol and an overall reaction energy of +30 kJ/mol.



a) Roughly draw the energy profile for this reaction.

b)Label the **reactants, products, E_a, ΔE_{rxn} and transition state.**

c) Is this reaction endothermic or exothermic?

d) Which rate is faster? rate forward or rate reverse

f) With a dotted line, show what the energy profile will look like if this reaction is run with a catalyst.

g) **BONUS** (1 pt): What is the E_a of the reverse reaction (include units)? _____

34) When zinc metal is added to aqueous hydrochloric acid, a single discplacement reaction takes place and aqueous zinc chloride ($ZnCl_2$), and hydrogen gas (H_2) are produced.

a) (2 pts) Write the complete balanced equation showing all states for this reaction.

b) (4 pts) How many liters of hydrogen gas could be produced when 100.0 mL of 2.0 M HCl reacts with an excess of zinc metal at STP? (2 sig figs)

c) (4 pts) How many liters of hydrogen gas could be produced when 30.0 g of zinc reacts with excess HCl at 25 °C and 0.96 atm? (2 sig figs)

35) 100.0 mL of a 0.35 M sodium hydroxide is combined with 400.0 mL of a 0.025 M solution of iron(III) nitrate, and a precipitate if formed and isolated according to the balanced equation below:

$$3NaOH(aq) + Fe(NO_3)_3\ (aq) \rightarrow 3NaNO_3\ (aq) + Fe(OH)_3\ (s)$$

a) (6 pts) Calculate the theoretical yield (in grams) of the precipitate:

b) (2 pts) Calculate the percent yield if 0.75 g of precipitate is isolated

c) (2 pts) What is the excess reactant?_____Is the resulting solution acidic or basic?_____

Bonus Question (5 pts): What is the molar concentration of the excess reactant at the end of the reaction?

Calculate the following for the resulting solution. Show work for credit.

$[OH^-]$ =	$[H_3O^+]$ =	pH

Name: _____ Short Answer Total

Q31: _____/6

Q32: ____/6

Q33: ____/8

Q34: _____/10

Q35: _____/10

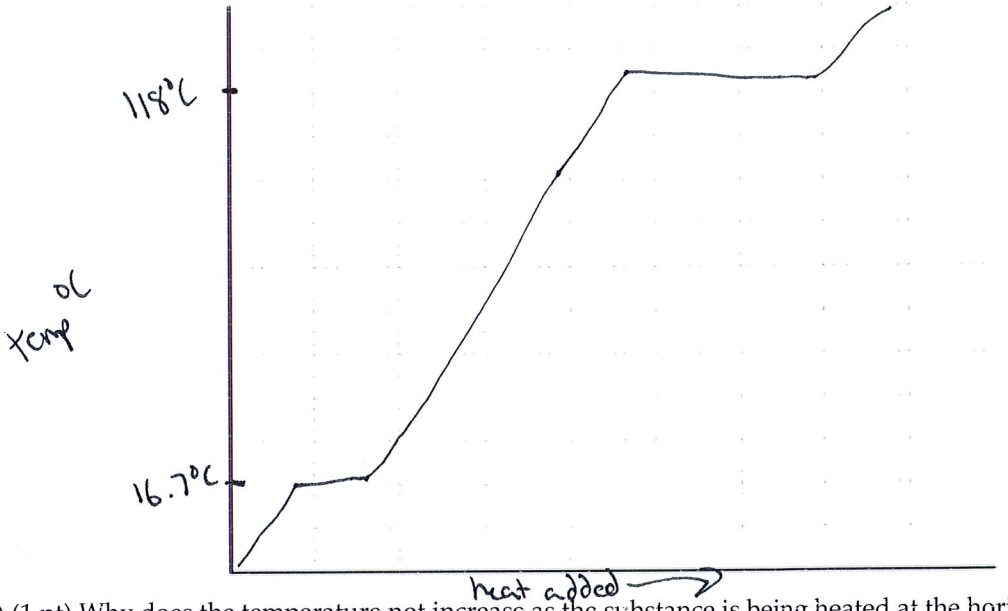
Total: _____/40 (possible 46 pts)

Answer Key
Testname: F18 C101 E3

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

31) Acetic acid, (CH_3CO_2H), has a freezing point of 16.7 °C and a boiling point of 118 °C.

a) (2 pts) Draw the heating curve for acetic acid on the graph below. Graph temperature (°C) vs Heat added.



b) (1 pt) Why does the temperature not increase as the substance is being heated at the horizontal portions of the curve? all heat is being used to go through the phase change (s→l or l→g) this requires energy to break intermolecular forces.

c) (3 pts) What is the new freezing point of acetic acid if 0.080 moles of NaCl is added to 125 g of acetic acid? The K_f for acetic acid is 3.9°C*kg solvent/mol solute. (answer with two sig figs.)

NaCl → $Na^+ + Cl^-$

mol solute = 0.080 mol NaCl × 2 = 0.16 mol solute (½ pt)

$125\ g \times \frac{1\ kg}{1000\ g} = 0.125\ kg$ solvent (½ pt)

$$\Delta T_f = \frac{3.9°C \frac{kg\ solvent}{mol\ solute} \times 0.16\ mol\ sol.particles}{0.125\ kg\ solvent} = 4.992°C$$ (1 pt)

new $T_f = T_f - \Delta T_f = 16.7°C - 4.992°C = 11.7°C$ (1 pt)

32) Given the following **exothermic** reaction: $CO\ (g) + 2H_2\ (g) \rightleftharpoons CH_3OH\ (g) + heat$

a) (2 pts) write the equilibrium constant expression for this reaction:

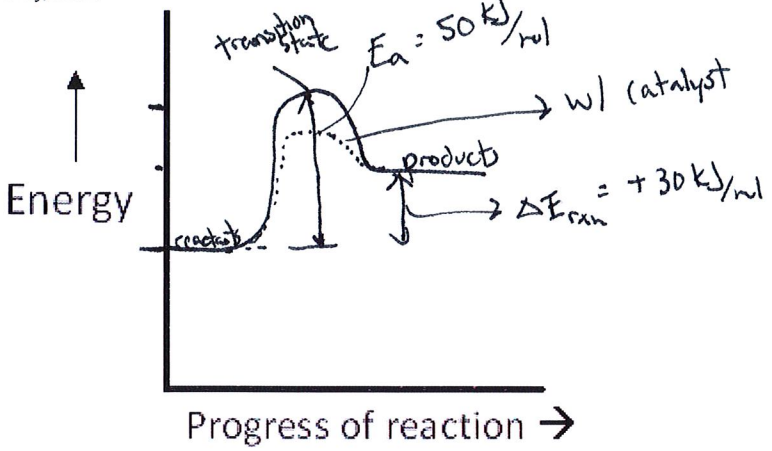
$$K_{eq} = \frac{[CH_3OH]}{[CO][H_2]^2}$$

b) (4 pts) List 4 things that can be done to this system in equilibrium to cause it to shift to the **right**.

1 pt each

1 add CO (g)	2 add H_2 (g)
3 remove CH_3OH (g)	4 remove heat
increase pressure	decrease volume

33) (8 pts) Consider the reaction: A → B that has an activation energy of 50 kJ/mol and an overall reaction energy of +30 kJ/mol.



a) Roughly draw the energy profile for this reaction. 1pt

b) Label the **reactants, products, E_a, ΔE_{rxn} and transition state.** ½ ½ 1 1 1

1pt c) Is this reaction endothermic or exothermic?

1pt d) Which rate is faster? rate forward or rate reverse

1pt f) With a dotted line, show what the energy profile will look like if this reaction is run with a catalyst.

g) **BONUS** (2 pt): What is the E_a of the reverse reaction (include units)? 20 kJ/mol

34) When zinc metal is added to aqueous hydrochloric acid, a single discplacement reaction takes place and aqueous zinc chloride ($ZnCl_2$), and hydrogen gas (H_2) are produced.

a) (2 pts) Write the complete balanced equation showing all states for this reaction.

$$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$$

b) (4 pts) How many liters of hydrogen gas could be produced when 100.0 mL of 2.0 M HCl reacts with an excess of zinc metal at STP? (2 sig figs)

$$100.0\,mL\,HCl \times \frac{1\,L}{1000\,mL} \times \frac{2.0\,mol\,HCl}{1\,L\,HCl} \times \frac{1\,mol\,H_2}{2\,mol\,HCl} \times \frac{22.4\,L}{1\,mol} = 2.24\,L\,H_2 = 2.2\,L\,H_2$$

c) (4 pts) How many liters of hydrogen gas could be produced when 30.0 g of zinc reacts with excess HCl at 25 °C and 0.96 atm? (2 sig figs)

298K

$$30.0\,g\,Zn \times \frac{1\,mol\,Zn}{65.38\,g\,Zn} \times \frac{1\,mol\,H_2}{1\,mol\,Zn} = 0.459\,mol\,H_2$$

$PV = nRT$

$$V = \frac{nRT}{P} = \frac{0.459\,mol \times 0.08206\,\frac{L\cdot atm}{mol\cdot K} \times 298\,K}{0.96\,atm} = 11.69\,L = 12\,L\,H_2$$

35) 100.0 mL of a 0.35 M sodium hydroxide is combined with 400.0 mL of a 0.025 M solution of iron(III) nitrate, and a precipitate if formed and isolated according to the balanced equation below:

$$3NaOH(aq) + Fe(NO_3)_3\,(aq) \rightarrow 3NaNO_3\,(aq) + Fe(OH)_3\,(s)$$

a) (6 pts) Calculate the theoretical yield (in grams) of the precipitate:

$0.100\,L\ NaOH \times \frac{0.35\,mol\ NaOH}{1\,L} \times \frac{1\,mol\ Fe(OH)_3}{3\,mol\ NaOH} \times \frac{106.845\,g\ Fe(OH)_3}{1\,mol} = 1.25\,g\ Fe(OH)_3$ (2 pts)

$0.400\,L\ Fe(NO_3)_3 \times \frac{0.025\,mol\ Fe(NO_3)_3}{1\,L} \times \frac{1\,mol\ Fe(OH)_3}{1\,mol\ Fe(NO_3)_3} \times \frac{106.485\,g\ Fe(OH)_3}{1\,mol} = \boxed{1.07\,g\ Fe(OH)_3}$ (2 pts)

= theoretical yield (2 pts)

b) (2 pts) Calculate the percent yield if 0.75 g of precipitate is isolated

$\%\ yield = \frac{act}{theor} \times 100 = \frac{0.75\,g}{1.07\,g} \times 100 = \boxed{70\%}$ (2 pts)

c) (2 pts) What is the excess reactant? NaOH (1 pt) Is the resulting solution acidic or basic? basic (1 pt)

Bonus Question (5 pts): What is the molar concentration of the excess reactant at the end of the reaction?

$0.400\,L\ Fe(NO_3)_3 \times \frac{0.025\,mol\ Fe(NO_3)_3}{1\,L} \times \frac{3\,mol\ NaOH}{1\,mol\ Fe(NO_3)_3} = 0.03\,mol\ NaOH$ used up (1 pt)

$0.10\,L\ NaOH \times \frac{0.35\,mol}{L} = 0.035\,mol\ NaOH$ initial

leftover NaOH = $0.035 - 0.03 = 0.005\,mol$ NaOH left

$[NaOH] = \frac{mol\ NaOH}{L\ soln} = \frac{0.005\,mol}{0.500\,L} = \boxed{0.01\,M\ NaOH}$ (1 pt)

Calculate the following for the resulting solution. Show work for credit.

$[OH^-] = [NaOH] = 0.01\,M$	$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1.0 \times 10^{-14}}{0.01\,M} = \boxed{1 \times 10^{-12}\,M\ H_3O^+}$	$pH = -\log[H_3O^+] = -\log 1 \times 10^{-12} = \boxed{12}$
1 pt	1 pt	1 pt