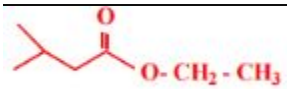
Polytechnic Tutoring Center

FINAL REVIEW Answer Key – CM 1023, Spring 2021

Disclaimer: This mock exam is only for practice. It was made by tutors in the Polytechnic Tutoring Center and is not representative of the actual exam given by the Academic Department.

1. 3-methylbutanoic acid + ethanol → ethyl 3 methylbutanoate



By product is water

2. a) ester b) amine c) alkene d) aldehyde e) ether f) ketone

3.

1st Soln $[H^+] = 10^{-pH} = 10^{-2}$ M
10.0 mL / 1000 = 0.0100 L
$(10^{-2}$ M) (0.0100 L) = $1.00*10^{-4}$ mol H^+

2nd Soln $H^+] = 10^{-pH} = 10^{-6}$ M
10.0 mL / 1000 = 0.0100 L
$(10^{-6}$ M) (0.0100 L) = $1.00*10^{-8}$ mol H^+

Combined Soln 0.0100 L + 0.0100 L = 0.0200 L
$1.00*10^{-4}$ mol + $1.00*10^{-8}$ mol = $1.00*10^{-4}$ mol
$1.00*10^{-4}$ mol / 0.0200 L = $5.00*10^{-3}$ M
pH = -log[H^+] = -log($5.00*10^{-3}$ M) = **2.30**

4.
T = toluene and B = benzene Assume 200 g total, 100 g each
100.0 g x (mol / 78.11 g) = 1.280 mol benzene
100.0 g x (mol / 92.14 g) = 1.085 mol toluene
total # moles = 2.365
benzene XB = 1.280 / 2.365 = **0.5412** toluene XT = 1.085 / 2.365 = **0.4588**
Ptotal = PT + PB Ptotal = XTPT* + XBPB* = (0.4588) (29.1 torr) + (0.5412) (94.6 torr) Ptotal= 51.20 + 13.35 = 64.55 = **64.6 torr**

5. A. C and D increase, A B and E decrease

B. ΔG=0= ΔH-ΔST
ΔS = 133.6 J/K·mol = 0.1336 kJ /K mol
T = ΔH/ΔS (131.3 kJ/mol) / 0.1336 kJ /K mol = **982.8 K**

6. a)2O_3↔3O_2 b) O* c) None d) ra = ka([O_3]^2-[O_2]^3/Kc)

7. a) ~30 katm liquid → solid (graphite)

~100 katm solid (graphite) → liquid

b)P<30katmsink
P > 100 katm Float

c)T~4500K

8.

	ion-ion	dipole-dipole	London (or dispersion) forces	hydrogen bonding	Highest b.p.: a) or b), and why ?
1 a) HF (g)		x	x	x	HF, H bonding
1 b) HCl (g)		x	x		
2 a) H_2S (l)		x	x		H_2Se, higher MW
2 b) H_2Se (l)		x	x		
3a)CH_3CH_2OH(l) (ethanol)		x	x	x	ethanol, H bonding
3b) CH_3OCH_3(l) (dimethyl ether)		x	x		

9. Kc = (3.36 * 0.08206 * 500) = 137.9

Eqn 2x(-1/2) $NO + \frac{1}{2} O_2 \rightarrow NO_2$ $K_2 = (5.9 \times 10^{-5})^{-1/2}$
Eqn 1x(-1/2) $NO_2 \rightarrow \frac{1}{2} N_2O_4$ $K_1 = (1.5 \times 10^{3})^{-1/2}$

$NO + \frac{1}{2} O_2 \rightarrow \frac{1}{2} N_2O_4$ $K = K_1 K_2$

$K_p = K_1 K_2 = 130.19 \times 0.02582 = 3.36$

$K_p = K_c (RT)^{\Delta n}$

$\Delta n = (\frac{1}{2}) - (1 + \frac{1}{2}) = -1$

10. Kc = $[NO]^2 * [Cl2] / [NOCl]^2$

	NOCl	NO	Cl_2
I	1.67M	-	-
C	-0.28*1.67M	+0.28*1.67M	-0.14*1.67M
E	1.20M	0.467M	0.233M

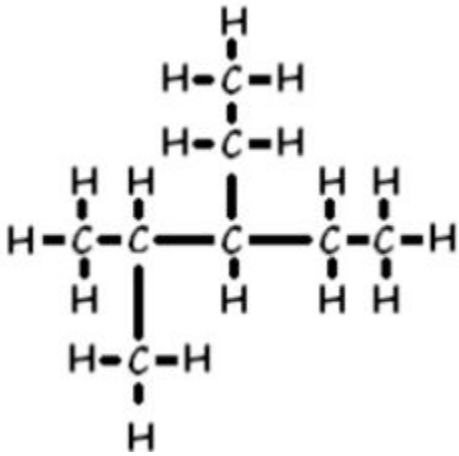
K_c = **0.0353**

11.

a. $\Delta G^o = -RT\ln K = -(8.314\ J/mol\ K)(298\ K)\ \ln(0.113) = -(8.314\ J/mol\ K)(298\ K)\ (-2.180)$
$\Delta G^o = +5401\ J/\ mol =$ **+5.40 kJ/mol**
b.
$\Delta G = \Delta G^o + RT \ln Q$
$Q = P^2_{NO2} / P_{N2O4} = 0.122^2 / 0.453 = 0.0328$
$\Delta G = +5401\ J/mol + (8.314\ J/mol\ K)(298\ K)\ \ln(0.0329) = (+5401 - 8462)\ J/mol$
$\Delta G = -3060\ J/mol$ = **-3.06 kJ/mol**
d. (-), Spontaneous, goes left to right, toward products

12. a) Rate= k [CH3COCH3][Br 2] b)0.0038/M.s

13. Achiral, no chiral carbons and is a superimposable mirror image



14. $[A] = [A]_o e^{-kt}$ $0.11M/0.60M = e^{-k(54min)}$ k = 0.03142 min -1

For 75% complete , $A = (1-0.75)A_o = 0.25A_o$
$0.25A_o/A_o=0.25=e^{-.03142t}$ t=44.1274=44min

15.

	$NH_3(aq)$ + $H_2O\ (l)$ →	$NH_4^+\ (aq)$ +	$OH^-(aq)$
Initial (M):	0.50	0.0	0.0
Change (M):	$-x$	$+x$	$+x$
Equilibrium (M):	$0.50 - x$	x	x

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]} \qquad 1.8 \times 10^{-5} = \frac{x^2}{0.50-x} \approx \frac{x^2}{0.50} \qquad \frac{3.0 \times 10^{-3}\,M}{0.50\ M} \times 100\% = 0.60\%$$

$$x^2 = 9.0 \times 10^{-6}$$

$$x = 3.0 \times 10^{-3}$$

$[OH^-] = 3.0 \times 10^{-3}$ M

pOH $= -\log(3.0 \times 10^{-3}) = 2.52$

pH = 14 – 2.52

pH = 11.48