CHM 2046 Final Exam Spring '21

B 1) $K_p = K_c(RT)^{\Delta n}$ or $K_c = K_p(RT)^{-\Delta n}$

$K_c = K_p$ when $\Delta n = \emptyset$

I: $\Delta n = 3-5 = -2$
II. $\Delta n = 4-4 = \emptyset$
III. $\Delta n = 2-1 = 1$

A 2) $CH_3CHO \rightleftharpoons CH_4 + CO$
3.4 ⇌ 0.1 0.2

$Q = \frac{(0.2)(0.1)}{3.4} = 0.0059$

K = 0.02

Q<K K>Q shifts forward

C 3) I. $\Delta G = \Delta H - T\Delta S$
$= (+) - T(+)$ need high T for (−) ΔG
II. $\Delta G = \Delta H - T\Delta S$
$= (-) - T(-)$ need low T for (−) ΔG

A 4) rxn 1: $^2H + ^3H \rightarrow ^4He + ^1n$
5.0301 amu → 5.0113 amu lose mass = produce energy
$\Delta m = 5.0301 - 5.0113 = 0.0188$ amu $= 1.88 \times 10^{-5}$ kg
$\Delta E = \Delta mc^2 = (1.88 \times 10^{-5} kg)(3 \times 10^8 m/s)^2 = \boxed{1.7 \times 10^{12} J}$

rxn 2: $^{35}P + ^{197}Os \rightarrow ^{231}Pa + ^1n$
231.9417 amu → 232.0445 gain mass = absorb energy

E 5) $A_2 + B_2 \rightleftharpoons 2AB$

0.5M	0.5M	$\rightleftharpoons$	Ø
−X	−X	$\rightleftharpoons$	+2X
.5−X	.5−X	$\rightleftharpoons$	2X

$2X = 0.4$

is not an equilibrium rxn, would expect 1M AB

$1.778 = \frac{(2x)^2}{(.5-x)^2}$

$1.333 = \frac{2X}{.5-X}$

$.667 - 1.333X = 2X$

$X = 0.2M$

$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \times 100$

$= \frac{0.4}{1} \times 100 = \boxed{40\%}$

B 6)
- A) True, H_2A is stronger acid
- B) False, no H−A/H−B bond in oxoacids
- C) True, yes b/c oxoacids containing A are stronger than those containing B
- D) True, higher oxidation state = more acidic
- E) True, $K_b = 1 \times 10^{-10}$; $K_a > K_b$

C 7) $K^+ \rightarrow KOH \rightarrow$ strong base $\rightarrow$ neutral salt
$NO_2^- \rightarrow HNO_2 \rightarrow$ weak acid $\rightarrow$ basic salt (Basic)

$K^+ \rightarrow$ neutral (same reason as above)
$NO_3^- \rightarrow HNO_3 \rightarrow$ strong acid $\rightarrow$ neutral salt (neutral)

$NH_4^+ \rightarrow NH_3 \rightarrow$ weak base $\rightarrow$ acidic salt (acidic)
$NO_3^- \rightarrow$ neutral

$NH_4^+ \rightarrow$ acidic $NH_4^+ + H_2O \rightarrow NH_3 + H_3O^+$ $K_a = 5.6 \times 10^{-10}$
$NO_2^- \rightarrow$ basic $NO_2^- + H_2O \rightarrow HNO_2 + OH^-$ $K_b = 1.4 \times 10^{-11}$

$K_a > K_b$ (acidic)

B 8) $Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$

	Ca^{2+}	$2OH^-$
	0	0
	+S	+2S
	S	2S

$K_{sp} = (2s)^2 s = 4s^3 = 7.9 \times 10^{-6}$

$S = 0.0125$

$2S = 0.0251 = [OH^-]$

$pOH = -\log(.0251) = 1.6$

$pH = 14 - 1.6 = \boxed{12.40}$

D 9) ★Buffer★

$pH = pKa + \log\left(\frac{A^-}{HA}\right)$

$\left(\frac{20g\ NaHCOO}{1}\right)\left(\frac{1mol}{67.99g}\right)\left(\frac{1mol\ HCOO^-}{1mol\ NaHCOO}\right) = \frac{0.294mol}{2L} = 0.147M\ HCOO^-$

$3.5 = -\log(1.8 \times 10^{-4}) + \log\left(\frac{.147}{x}\right)$

$\log\left(\frac{.147}{x}\right) = -.2447$

$0.569 = \frac{.147}{x}$

$x = 0.258 = \boxed{[HCOOH] = 0.26M}$

E 10) $2H^+ + 2e^- \rightarrow H_2(g)$

$\left(\frac{11.3C}{s}\right)\left(\frac{1mol\ e^-}{96485C}\right)\left(\frac{1mol\ H_2}{2mol\ e^-}\right)\left(\frac{2mol\ H^+}{1mol\ H_2}\right)\left(73min \cdot 60\frac{s}{min}\right) = 0.513mol\ H^+$ reduced

$.552M = \frac{x}{1.25L}$ $x = 0.69mol\ H^+$ in solution

-0.513

$\frac{0.177mol\ H^+ \text{ still in solution}}{1.25L}$

$= 0.142M\ H^+$ $pH = -\log(.142) = \boxed{0.849}$

B 11) A) false, e^- always flow anode to cathode
✓B) true, electrolytic requires energy
C) false, this is true for voltaic/galvanic
D) false, oxidation is always at the anode

B 12) positron/e^- capture is for too light of isotopes compared to periodic table mass

per table

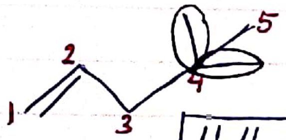
$^{67}Zn > ^{65}Zn$

✓ $^{115}Sn < ^{119}Sn$

$^{184}W \approx ^{184}W$

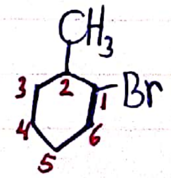
^{229}Th has $Z > 83$, would alpha decay

F 13)



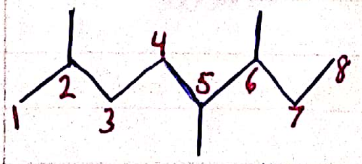
pentene
4,4-dimethyl
4,4-dimethyl-1-pentene

A 14)



1-bromo-2-methylcyclohexane

1,1,2-trimethylcyclopentane



2,5,6-trimethyloctane

B 15) A) false, pH ±1 pKa HSO_3^-
B) true, conjugate base reacts with incoming acid
C) false, 2 bases will not react
D) false, 2 acids will not react
E) false, $0.1 < \left[\frac{A^{2-}}{HA^-}\right] < 10$

C 16) need C's on a double bond to have an identical substituent