1] What is the pH of the solution prepared by mixing 25 mL of 0.024 *M* HF with 15 mL of 0.15 *M* NaF? Ka(HF)=1.5×10^{-4}

a) 4.39
b) 7.00
c) 7.39
d) 4.03
e) 2.97

$HF \rightarrow H^+ + F^-$

(6×10^{-4})	0	(2.25×10^{-3})
$(6\times10^{-4})-x$	x	$(2.25\times10^{-3})+x$

$\frac{(2.25\times10^{-3}+x)\,x}{6\times10^{-4}} = K_A$

$\frac{x^2+(2.25\cdot10^{-3})x}{6\times10^{-4}-x}$

4×10^{-5}

2] Determine the pH of 0.15 *M* benzoic acid (C_6H_5COOH) Ka(benzoic acid)=7×10^{-3}

a) 2.06
b) 1.49
c) 4.22
d) 7.00
e) 3.11

3] Calculate the pH at the halwaypoint for the titration of 100 mL of 0.1 *M* ethylamine ($C_2H_5NH_2$, Kb=4.2×10^{-4}) against 0.2 *M* nitric acid (HNO_3).

a) 7.00
b) 8.8
c) 10.6
d) 11.9
e) 9.7

4] If 10 mL of 0.2 *M* NaOH is added to 20 mL of 0.25 *M* acetic acid (CH_3CO_2H, Ka=1.8×10^{-5}), what is the pH of the resultant solution?

a) 4.56
b) 5.34
c) 3.22
d) 11.67
e) 6.12

$CH_3CO_2H + OH^- \rightarrow CH_3CO_2^- + H_2O$

5×10^{-3}	2×10^{-3}	0
3×10^{-3}	0	2×10^{-3}

$HCH_3CO_2 \rightarrow H^+ + CH_3CO_2^-$

3×10^{-3}	0	2×10^{-3}
$3\times10^{-3}-x$	x	$2\times10^{-3}+x$

$\frac{(2\times10^{-3}+x)\,x}{(3\times10^{-3})-x} = K_A$

THE DEBATE CLUB

5] For the reaction: $2Cl_2(g) + 2H_2O(g) \rightleftharpoons 4HCl(g) + O_2(g)$ at 600°C

K_p = 18.0 atm. A system contains 2.0 atm $Cl_2(g)$, 2.0 atm $H_2O(g)$, 4.0 atm HCl(g), and 1.0 atm $O_2(g)$ at 600°C. Which one of the following statements is correct?

a) Net reaction will occur from left to right

b) $K_c = K_p \cdot RT$

c) Net reaction will occur from right to left

d) No net forward or reverse reaction will occur

6] The solubility of magnesium carbonate ($MgCO_3$) in water at 20°C is 0.0089 mol/l, calculate Ksp for the salt.

a) 4.1×10^{-4}

b) 5.6×10^{-6}

c) 7.9×10^{-5}

d) 2.9×10^{-6}

e) 7.8×10^{-9}

$MgCO_3 \rightarrow Mg^{2+} + CO_3^{2-}$

0.0089 0 0

0.0089 (0.008

$K_{sp} =$

7] What mass of NH_4Cl (MM= 53.5 g/mol) must be added to 0.5 L of 0.45 M NH_3 to prepare a buffer solution with pH of 10.55? Assume no variation of volume, $K_b(NH_3) = 1.4 \times 10^{-4}$

a) 9.4 g

b) 4.7 g

c) 3.5 g

d) 7.6 g

e) 6.2 g

m = ?

$pK_A = 10.14$. $K_A = 7.14 \times 10^{-11}$

$pH = pK_A + \log \frac{[B]}{[A]}$

$0.4 = \log \frac{0.225}{x}$

0.225

$2.51x = 0.02$

0.00957

THE DEBATE CLUB

8] Imagine that the temperature is decreased for the following equilibrium

$$2\,SO_2\,(g) + O_2\,(g) \rightleftharpoons 2SO_3\,(g) \qquad \Delta H>0 \text{ endothermic}$$

What effect would be expected

a) no shift in the equilibrium occurs
b) the equilibrium shifts to the right
c) the equilibrium shifts to the left
d) no enough information to answer

9] In a titration, 20 mL of HCl requires 32 mL of 0.5 *M* $Mg(OH)_2$ for complete neutralization. Calculate the molar concentration of acid.

a) 0.64 M
b) 1.6 M
c) 1.92 M
d) 3.20 M
e) 1.60 M

10] Predict whether an aqueous solution of NH_4F is

$Ka(HF)=3.5\times10^{-4}$, $Kb(NH_3)=1.8\times10^{-5}$

a) acidic
b) basic
c) neutral
d) no enough information to answer

11] $Kp=3.1\times10^{-8}$ for $2H_2S\,(g) \rightleftharpoons 2H_2\,(g) + S_2\,(g)$, what is the equilibrium partial pressure of S_2 if H_2S, initially at 0.5 atm and H_2, initially at 0.01 atm, are allowed to come to equilibrium?

a) 8.8×10^{-3}
b) 1.3×10^{-3}
c) 7.75×10^{-5}
d) 3.1×10^{-6}
e) 2.85×10^{-4}

THE DEBATE CLUB

12] Consider the reaction : $CH_4\,(g) + 2\,O_2\,(g) \rightleftharpoons CO_2\,(g) + 2\,H_2O\,(l)$

Which of the following causes the equilibrium shown to shift to the reverse (left) direction?

a) removal of CH_4

b) removal of H_2O

c) addition of CH_4

d) decreasing the volume of the container

e) none of these

13] The percent dissociation is 4.45% in a 1 M solution of ethylamine ($CH_3CH_2NH_2$), calculate Kb?

a) 7.4×10^{-4}

b) 6.3×10^{-5}

c) 2.1×10^{-3}

d) 3.6×10^{-6}

e) 5.7×10^{-4}

$CH_3NH_2 \rightleftharpoons CH_3(CH_2)NH_3^+ + OH^-$

X X X

$\frac{X}{1} \times 100 = 4.45$

$100x = 4.45$

$x = 0.0445\,M$

14] What is the solubility of BaF_2 in 0.15 M NaF. $Ksp(BaF_2)=1.7\times10^{-6}$

a) 1.7×10^{-6}

b) 2.7×10^{-5}

c) 6.8×10^{-6}

d) 1.3×10^{-3}

e) 7.56×10^{-5}

$BaF_2 \rightarrow Ba^{2+} + 2F^-$

S 0.15

↓

0 S 2S+0

$(S)(2S+0.15)^2 = 1.7$

THE DEBATE CLUB

15] A reaction mixture was prepared by mixing 0.2 mol SO_2, 0.2 mol NO_2, 0.15 mol NO and 0.15 mol SO_3 in a 5 litre reaction vessel. At 260°C, Kp=0.25 for

$$SO_2\,(g) + NO_2\,(g) \rightleftharpoons NO\,(g) + SO_3\,(g)$$

What is the equilibrium concentration of SO_2 ?

a) $[SO_2]=0.0466$

b) $[SO_2]=0.0366$

c) $[SO_2]=0.233$

d) $[SO_2]=0.175$

e) $[SO_2]=0.2$

Bonus:

Which equation correctly describes the relationship between Kp and Kc for the following reaction?

$$4\,Fe\,(s) + 3\,O_2\,(g) \rightleftharpoons 2\,Fe_2O_3\,(s),$$

a) Kp=Kc

b) $Kp=Kc \times (RT)^{-3}$

c) $Kp=Kc*(RT)^{-5}$

d) $Kp=Kc*(RT)^{3}$

e) $Kp=Kc*(RT)^{5}$

THE DEBATE CLUB

Multiple choice Questions. Choose One An

	a	b	c	d	e
1	X				
2		X			
3			X		
4	X				
5	X				
6			X		
7		X			
8			X		
9		X			
10	X				
11					
12	X		X		
13			X		
14				X	
15	X				
16		X			

THE DEBATE CLUB