14/18

The University of Jordan
Dept. Of Chem.

General Chem.102 **First Exam**
Date: 16/4/2016 Time: 60 Min.
Name: ..... Reg. No.: .....
Instructor Name: ..... Sec.: ٩ ٢ ١١ ٥ ٦ ٨

R = 0.0821 Latm mol^{-1} K^{-1} Kw = $1x10^{-14}$ at 25° C pH + pOH = 14

$pH = pKa + log\frac{[A^-]}{[HA]}$ $kp = kc(RT)^{\Delta n}$

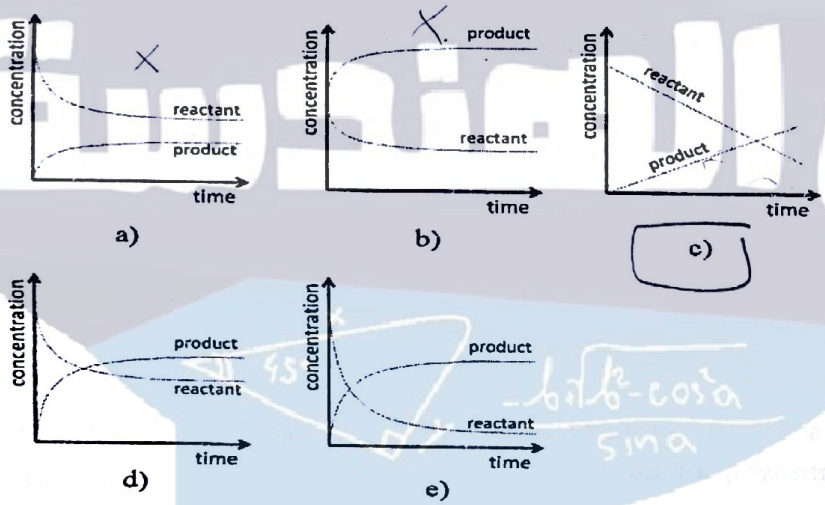
1.	a	b	c	d	e	10.	a	b	c	d	e
2.	a	b	c	d	e	11.	a	b	c	d	e
3.	a	b	c	d	e	12.	a	b	c	d	e
4.	a	b	c	d	e	13.	a	b	c	d	e
5.	a	b	c	d	e	14.	a	b	c	d	e
6.	a	b	c	d	e	15.	a	b	c	d	e
7.	a	b	c	d	e	16.	a	b	c	d	e
8.	a	b	c	d	e	17.	a	b	c	d	e
9.	a	b	c	d	e	18.	a	b	c	d	e

Circle the *correct* answer for each of the following questions and put (×) on the *corresponding choice* on the *front page*:

Q1. Consider the following reaction mechanism:
Step 1. $NO_{2(g)} + NO_{2(g)} \rightarrow N_2O_{4(g)}$
Step 2. $N_2O_{4(g)} + CO_{(g)} \rightarrow CO_{2(g)} + NO_{(g)} + NO_{2(g)}$
In the overall reaction, N_2O_4 is a
(a) reaction intermediate. (b) heterogeneous catalyst. (c) reactant.
(d) product. (e) homogeneous catalyst

Q2. Suppose the reaction: $A + 2B \longrightarrow AB_2$ occurs by the following mechanism:
Step 1 $A + B \longrightarrow AB$ slow → Rate = k [A] [B]
Step 2 $AB + B \longrightarrow AB_2$ fast
Overall $A + 2B \longrightarrow AB_2$
The rate law expression must be Rate = _____.
(a) k[A] (b) k[B] (c) $k[A][B]^2$ (d) $k[B]^2$ (e) k[A][B]

Q3. Which of the following diagrams does not represent a state of chemical equilibrium?



Q4. Consider the following equilibrium:

$4\ CuO_{(s)} \rightleftharpoons 2\ Cu_2O_{(s)} + O_{2(g)}$

When $CuO_{(s)}$ was placed in a closed container at a given temperature and reaction was allowed to reach equilibrium the pressure was found to be 0.216 atm.
The equilibrium constant K_p for the reaction is. $K_p = P_{O_2}$

(a) 0.216 (b) 0.345 (c) 0.453 (d) 0.561 (e) 0.721

Q_5. Consider the following reaction:

$H_{2(g)} + I_{2(g)} \rightleftharpoons 2\,HI_{(g)}$

The value of K_c for this equilibrium is 64. In an experiment, equal amounts of hydrogen and iodine were mixed together in 1.0 L container at 723 K, at equilibrium the reaction mixture was found to contain 1.25 moles of iodine. Calculate the concentration of hydrogen iodide in the mixture at 723K

(a) 10 (b) 12 (c) 14 (d) 16 (e) 18

$64 = \frac{(2x)^2}{1.25}$

$R - 2x = 1.25$

$x = 0.625$

Q_6. A 0.04000 mole sample of SO_3 is introduced into a 3.000 L vessel and allowed to reach equilibrium. The amount of SO_3 present at equilibrium is found to be 0.0264 mole. Calculate the value of K_c for the reaction

$2\,SO_{3(g)} \rightleftharpoons 2\,SO_{2(g)} + O_{2(g)}$

$2SO_3 \rightleftharpoons 2SO_2 + O_2$

0.013 0 0

$-2x \quad +2x \quad +x$

(a) 2.1×10^{-10} (b) 5.1×10^{-8} (c) 6.0×10^{-4}

(d) 3.5×10^{-7} (e) 3.2×10^{-9}

$0.013 - 2x = 8.8 \times 10^{-3}$

$x = 2.1 \times 10^{-3}$

$K_c = \frac{2.1 \times 10^{-3}}{3.7 \times 10^{-8}}$

Q_7. What is the K_P at 1173°C for the reaction: $2\,CO_{(g)} + O_{2(g)} \rightleftharpoons 2\,CO_{2(g)}$ if K_c is 2.24×10^{22} at the same temperature

(a) 3.91×10^{18} (b) 6.89×10^{-22} (c) 1.76×10^{-20}

(d) 7.12×10^{23} (e) 1.89×10^{20}

$\Delta n = -1$

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

$= 2.24 \times 10^{22} \times (0.0821 \times 1446)^{-1}$

Q_8. Consider the following equilibrium:

$CO_{2(g)} + C_{(s)} \leftrightarrows 2CO_{(g)}$, $\Delta H = +172$ kJ/mol.

Which of the following statements is correct?

(a) Increasing the temperature of the reaction will produce more CO_2

(b) Decreasing the total pressure (increase the volume) will produce more of CO

(c) Adding more carbon monoxide to the reaction will shift the reaction to the right

(d) Adding CO_2 to the system will shift the equilibrium to the left

(e) More CO will be produced when a catalyst is added

Q_9. For the reaction

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

If $K_c = 4.3 \times 10^6$ and the following concentrations are present; $[SO_2] = 0.010$ M, $[SO_3] = 10$ M, $[O_2] = 0.01$ M. Which of the following statements is correct?

a. The system is at equilibrium

b. The system is not at equilibrium and is shifting from right to left

c. The system is not at equilibrium and is shifting from left to right

d. There is not enough information

e. The reaction will be forced in one direction

Q_{10}. Consider the following reaction

$HSO_4^- + NH_3 \rightarrow NH_4^+ + SO_4^{2-}$

Which of the following is correct?

a) HSO_4^- is Lewis base.
b) NH_3 act as acid.
c) NH_4^+ is the conjugate base of NH_3.
d) The above reaction is not acid-base reaction.
e) SO_4^{2-} is the conjugate base of HSO_4^-.

Q11. Which of the following solutions has the **LOWEST** pH value?

(a) 0.1 M HCl (b) 0.1 M NaOH (c) 0.1 M NH_3

(d) 0.1 M CH_3COOH (e) 0.1 M NaCl

Q12. Which one of these statements about strong acids is true?

a) All strong acids have H atoms bonded to electronegative oxygen atoms.
b) Strong acids are completely or nearly completely ionize in water.
c) The conjugate base of a strong acid is itself a strong bases.
d) Strong acids are very concentrated acids.
e) Strong acids produce solutions with a higher pH than weak acids.

Q13. The pH of a 0.35 M of weak base solution is 12.4. What is the K_b of this base

(a) 0.35 (b) 1.8×10^{-7} (c) 1.9×10^{-3} (d) 13.65 (e) 1.8×10^{-5}

Q14. Calculate the pH of 0.70 M aqueous solution of sodium propionate, $NaC_3H_5O_2$, $K_a(HC_3H_5O_2) = 1.3\times10^{-5}$.

(a) 9.2 (b) 9.4 (c) 8.7 (d) 8.9 (e) 4.8

Q15. Which of the following statements is **correct** concerning the strength of the acids? (part of periodic table is given):

a) HF > HCl > HBr
b) $PH_3 > H_2S > HCl$
c) $HClO > HClO_2 > HClO_3$
d) $HClO > HClO_3 > HClO_2$
e) $HF > H_2O > NH_3$

Q16 Which of the following would produce a basic aqueous solution?

(a) P_4O_{10} (b) CaO (c) KCl (d) NH_4Cl (e) CO_2

Q17. Which of the following mixtures is suitable for making buffers?

1. H_3PO_4 and NaH_2PO_4.
2. Na_2CO_3 and $NaHCO_3$.
3. NH_4Cl and NH_3.

(a) 1 only (b) 1,2, and 3 (c) 3 only
(d) 1 and 2 only (e) 2 only

$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$

$Na_2CO_3 + H_2O \rightleftharpoons NaHCO_3 + OH^-$

Q18. Given 1000 mL of a buffer that is 0.50 M in HOCl and 0.40 M in NaOCl, what is the pH after 0.20 mole of NaOH has been added?
[K_a for HOCl = 3.5×10^{-8}].

(a) 7.15 (b) 7.55 (c) 7.76 (d) 7.46 (e) 6.91

$HOCl \rightleftharpoons OCl^- + H^+$

$0.5 - 0.2 \quad 0.4 + 0.2$

$NaOCl \rightarrow Na^+ + OCl^-$

0.4

$pH = pK_a + \log \frac{0.6}{0.3}$

$-\log(3.5 \times 10^{-8})$

Q1: [a] Because it's Removed when we add two equations.

2) [e] K[A][B] Because we write the rat law expression from the slow step

3) [c] Beas ~~they are~~ ~~don't~~ it is in linear proportional and that isn't true.

4) [a] $K_p = P_{O_2}$ $\Rightarrow$ for $\frac{P_{product}}{P_{Reactin}}$ of gas

Because it's the only gas material in equation

$K_p = 0.216$

(5) (a) $\frac{x^2}{(1.25)^2} = 64$

neglicting the x of consumed amount in Reaction

$x = 10$

التاريخ / / اليوم

موضوع الدرس

(6)

$$2SO_3 \rightleftharpoons 2SO_2 + O_2$$

$(0.0133 - 2x)$ $+2x$ $+x$

(8.8×10^{-3}) $2(2.25\times10^{-3})$ (2.25×10^{-3})

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$ at equilibrium

$$K_c = \frac{(2.03\times10^{-3})^2 * (2.25\times10^{-3})}{(8.8\times10^{-3})^2} = 5.88\times10^{-4} \approx 6\times10^{-4}$$

(6)

* 0.04 mol of SO_3 at 3L

$M = 0.0133\ M$ at equilibrium

* at equilibrium. no of $SO_3 = 0.0264/3 = 8.8\times10^{-3}$

$0.0133 - 2x = 8.8\times10^{-3}$

$x = 2.25\times10^{-3}$

$T = 1173 + 273 = 1446\,K$

Q7: [e] $K_c (RT)^{\Delta n} = K_p$

$= 2.24 \times 10^{22} (0.0821 \times 1446)^{-1}$

$= 1.89 \times 10^{20}$

$\Delta n = n_{product} - n_{Reactant}$

$= 2 - 3 = -1$

Q8) $PV = nRT$, the Relation between P and V is inverse. and with n

So, when we decrease the pressure the volume will increase and the (n) amount of gas will increase

9) we must calculat the value of Q

$$= \frac{[SO_3]^2}{[SO_2]^2[O_2]} = \frac{10^2}{(0.01)^2(0.01)} = 10 \times 10^7$$

$\Rightarrow Q > K_c$, it will shift to right to

10) [e] $H_2SO_4 + NH_3 \rightarrow NH_4^+ + SO_4^{-2}$ [b]

Acid, Base, Conj Acid, Conj Base

11) [a] Least pH value that's mean the most strong acid as HCl [0.1]

12) Strong acids Always ionized completly in water as $HCl \longrightarrow H^+ + Cl^-$

$2H_2SO_4 \rightarrow 2H^+ + 2HSO_4$ [B]

التاريخ

موضوع الدرس

13) (C) $[OH^-]$ | $pH = 12.4$

$pOH = 1.6$

$-1.6 = \log [OH^-]$

$[OH^-] = 0.025$

$0.025 = \sqrt{Kb(0.25)}$

$\Rightarrow 1.9 \times 10^{-3}$

(14) (b)

$NaC_3H_5O_2$ → وسط قاعدي ← $NaOH$ قاعدة قوية
$C_3H_6O_2$ حمض ضعيف

$[NaC_3H_5O_2] = 0.7\ M$, $k_a = 1.3 \times 10^{-5}$

$k_b = \frac{1 \times 10^{-14}}{1.3 \times 10^{-5}} = 7.6 \times 10^{-10}$

$NaC_3H_5O_2 \longrightarrow Na^+ + C_3H_5O_2^-$

	0.7	0	0
−	0.7	+ 0.7	+ 0.7
	0	0.7	0.7

$C_3H_5O_2^- \xrightarrow{H_2O} C_3H_6O_2 + OH^-$

	0.7	0	0
	(0.7 − x)	+ x	+ x

$7.6 \times 10^{-10} = \frac{x^2}{(0.7 - x)}$ → negligible (−x)

$x = 2.31 \times 10^{-5} = [OH]^-$

$p[OH] = -\log(2.31 \times 10^{-5}) = 4.63$

$pH = 14 - 4.63 = 9.37 \approx \boxed{9.4}$

pH < H_2O < NH_3

(15) [e] HF > H_2O > NH_3

Refer to (pH)

(16) (b) $CaO + H_2O \longrightarrow Ca(OH)_2$ Base

(17) (b) all of them

Buffer solution =

weak acid + $\frac{1}{2}$ acid salt

weak base + base salt

التاريخ / / اليوم موضوع الدرس

0.2 NaOH (0.4) NaCl

(18) HOCl ⇌ OCl⁻ + H⁺

(0.5 − 0.2) (0.4 + 0.2)

0.3 0.6

NaCl → Na⁺ + OCl⁻

0.4

1000 ml = 1L

0.2 mol / 1L

= 0.2 M of OCl⁻

$pH = pKa + \log \frac{0.6}{0.3}$

$= -\log(3.5 \times 10^{-8}) + \log \frac{0.6}{0.3}$

[C] = 7.76

OCl^- = 0.4 from salt + addition of strong base

$\frac{b^2 + c^2 - 2bc\cos A}{\sin A}$