

Bishoftu Preparatory School

Chemistry Worksheet For Grade -Twelve In 2013 E.C.

You may refer the information given below when you work on some of the questions.

- A. Ideal gas constant, $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1} = 0.0821 \text{ L.atm/mol.k}$
- B. Avogadro's number = $6.023 \times 10^{23} \text{ mol}^{-1}$
- C. Plank's constant, $h = 6.626 \times 10^{-34} \text{ Js}$
- D. Speed of light, $C = 3.0 \times 10^8 \text{ m/s}$
- E. Rydberg constant, $R_h = 2.18 \times 10^{-18} \text{ J}$
- F. Faraday's constant, $F = 96500 \text{ c}$
- G. Natural logarithm of $\ln 2 = 0.693$
- H. Water dissociation constant, $K_w = 1.0 \times 10^{-14}$
- I. K_f of water = 1.860°C/m and K_b of water = 0.5120°C/m
- J. Henry's law constant for oxygen (KH) = $1.23 \times 10^{-3} \text{ mol/L.atm}$
- K. Mass of electron, $m_e = 9.11 \times 10^{-31} \text{ Kg}$
- L. Vapour pressure of water at $25^\circ\text{C} = 3 \text{ Kpa}$

WORKSHEET I

1. Indicate the unit that matches the description. A mass that is 1000 times greater than 1 gram.
A) kilogram B) milligram C) megagram D) gigagram
2. Which of the scientific methods does the following statement represent: "Derartu has a stain on her shirt"?
A) law B) hypothesis C) observation D) prediction
3. Which of the following numbers has five significant figures?
A) 61,530 B) 0.6153 C) 0.006154 D) 615.40
4. Which of the following sets of quantum numbers are not possible?
A) $n=3, l=2, m_l=0, s=-1/2$
B) $n=3, l=2, m_l=-2, s=-1/2$
C) $n=3, l=2, m_l=-3, s=+1/2$
D) $n=3, l=1, m_l=0, s=-1/2$
5. Which of the following orbitals are not possible?
A) 2s B) 2p C) 3f D) 4d
6. For a molecule with the formula AB_2 the molecular shape is _____.
A) linear or trigonal planar B) linear or bent
C) linear or T-shaped D) T-shaped
7. According to valence bond theory, which orbitals on bromine atoms overlap in the formation of the bond in Br_2 ?
A) 3s B) 3p C) 4s D) 4p
8. In order to produce sp^3 hybrid orbitals, _____ s atomic orbital(s) and _____ p atomic orbitals (s) must be mixed.
A) one, two B) one, three C) one, one D) two, two
9. The electron-domain geometry and the molecular geometry of a molecule of the general formula AB_n will always be the same if
A) there are no lone pairs on the central atom C) n is greater than four
B) there is more than one central atom D) the octet rule is obeyed
10. Consider the following species when answering questions following them.
(i) PCl_3 (ii) CCl_4 (iii) TeCl_4 (iv) XeF_4 (v) SF_6
In which of the molecules does the central atom utilize d orbitals to form hybrid orbitals? A) (i) and (ii)
B) (iii) only C) (i) and (v) D) (iii), (iv), and (v)
11. The hybridization of iodine in IF_3 and IF_5 are _____ and _____, respectively. A) sp^3 , sp^3d B) sp^3d , sp^3d^2 C) sp^3d , sp^3 D) sp^3d^2 , sp^3d
12. Select the SI unit you would use to measure your height.

- A) millimeters B) meters C) kilometers D) miles
13. Which group has the following electronic structures in their valence shells $ns^2(n-1)d^2$?
A) IIB B) IVB C) IIIB D) VB
14. An atom's outermost electrons are most likely to be involved in a chemical reaction. Which of the following explain why the outermost electrons are shared, lost or gained most readily ?
A) The outermost electrons are of a lower charge than the inner electron
B) The outermost electrons are crowded out of atoms by competing nucleus
C) The outermost electrons are attracted less strongly to protons in the nucleus
D) The outermost electrons are attracted less strongly to neutrons in the nucleus
15. What is the wavelength(in meters) of the photon radiated when an electron, previously excited by an input of energy moves from an orbit with $n=4$ & to the orbit with $n=2$ in hydrogen atom?
($h = 6.66 \times 10^{-34}$ j.s, $C = 3 \times 10^8$ m/s)
A). 4.86×10^7 m B) 19.97×10^{-26} m C) 4.86×10^{-7} m D) 19.97×10^{26} m
16. "No two electrons in an atom can have the same four quantum numbers" is a statement of
A. the Pauli exclusion principle. B. Bohr's equation. C. Hund's rule. D. de Broglie's relation.
17. Complete this sentence: Atoms emit visible and ultraviolet light
A. as electrons jump from lower energy levels to higher levels.
B. as the atoms condense from a gas to a liquid.
C. as electrons jump from higher energy levels to lower levels.
D. as they are heated and the solid melts to form a liquid.
18. The orbital diagram for a ground-state oxygen atom is
A. Row 1. B. Row 2. C. Row 3 .D. Row 4. E. Row 5.
19. A ground-state atom of manganese has ___ unpaired electrons and is _____.
A. 0, diamagnetic B. 2, diamagnetic C. 3, paramagnetic D. 5, paramagnetic
20. For the bond angle HCH in CH_4 , HOH in H_2O & HNH in NH_3 which of the following represent in increasing order?
A) HCH, HOH, HNH C) HOH, HCH, HNH
B) HOH, HNH, HCH D) HNH, HOH, HCH
21. Which of the following does not have a tetrahedral structure?
A) BH_4^- B) NH_4^+ C) BF_3 D) H_2O .
22. The carbon carbon link in acetylene contains:
A) One sigma & two pi bonds C) Two sigma & two pi bonds
B) Two sigma & three pi bonds D) Three sigma bonds
23. What is the correct sequence of bond order?
A) $O_2^+ > O_2^- > O_2$ B) $O_2^+ > O_2 > O_2^-$ C) $O_2 > O_2^- > O_2^+$ D) $O_2^- > O_2^+ > O_2$
24. Which of the following terms accurately describes the energy associated with the process?
 $Li(g) \rightarrow Li^+(g) + e^-$
A. electroaffinity C. ionization energy
B. bonding energy D. electronegativity
25. What is true about $SO_2 + O_2 \rightarrow SO_3$
A) Hybridized state of S changes from $sp \rightarrow sp^2$ C) SO_2 gets oxidized
B) Bent shape of SO_2 changes to trigonal planar. D) B&C

WORKSHEET II

I. Answer the following questions accordingly

- 1) What is a solution?
- 2) How does a solution form?
- 3) What is solubility?
- 4) What are the factors that affect the rate of dissolution?

5) Which intermolecular forces should be most important in each of the following solution?

A. NH_3 in water B. CH_3OH in $\text{C}_2\text{H}_5\text{OH}$ C. H_2SO_4 in H_2O D. C_6H_6 in CCl_4 E. NaNO_3 in H_2O

6) Fill in the chart below with either increases, decreases, or remains the same for changing the following

factors on the SOLUBILITY of the solute in water:

Solute	Inc.InTemp.	Dec.In Temp	Inc.In Pressure	Dec. In Pressure
CO_2				
NaCl				

7) Hydrochloric acid is actually hydrogen chloride gas dissolved in water. The solubility of hydrogen chloride

in water at 298 K and 1 atm is 12.1 moles (442 grams) per liter of solution. In what two ways can the solubility

of hydrogen chloride in water be increased to make the solution more concentrated?

a) _____

b) _____

8) you are given three bottles containing aqueous solutions of X one saturated, one unsaturated & one supersaturated. How do identify which solution is which?

9) A sample of tap water is analyzed and shown to contain 0.015 grams of lead ions per 10 grams of solution.

Calculate the concentration, in ppm, of this solution.

10) Calculate the percent by mass of a solution that contains 35.8 grams of Na_2SO_4 in 136.3 grams of solution.

11) Calculate the molarities of the following solutions:

a) 2 moles of NaCl in 4 L of solution

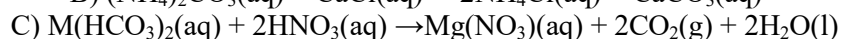
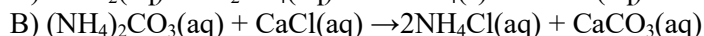
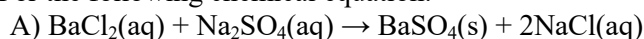
b) 34 grams of CaSO_4 in 2 L of solution

12) 50.0 mL of a NaOH solution is evaporated to dryness and the resulting residue is massed at 2.5grams.

What was the molarity of the solution

13) Equal volumes of 0.50M H_2SO_4 & 0.40M KOH are mixed. Calculate the mole fraction of the ions of the resulting solutions.

14) For the following chemical equation:



i. Write the ionic equation

ii. Identify the spectator ions.

iii. Write the net ionic equation.

15) 200ml of 2.0M $\text{HNO}_3(\text{aq})$ is prepared from a stock of 16.0M HNO_3 .

A) What volume of stock solution of 16.0M HNO_3 is used?

B) What volume of water should be added to the stock solution?

16) A solution is prepared by dissolving 1.00g of naphthalene, C_{10}H_8 in 50.0cm³ of benzene, C_6H_6 (density of benzene= 0.879g/cm³).

a) What is the percent C_{10}H_8 by mass of this solution?

b) What is the molal conc. of the solution?

c) What is the freezing point of the solution? The freezing point of pure C_6H_6 is 5.510c. K_f for C_6H_6 is 4.9 0ckg/mol

17) An aqueous solution is 0.01M CH_3OH . The conc. of this solution is also very nearly,

a) 0.01% CH_3OH by mass c) $X_{\text{CH}_3\text{OH}} = 0.01$

b) 0.01m solution d) $X_{\text{H}_2\text{O}} = 0.5$

18) A solution of glycerol in water is 90.0% $\text{C}_3\text{H}_8\text{O}_3$ & 10.0% by mass & has a density of 1.235g/cm³

- Determine: a) the molarity of the solution
b) the molality of the solution
c) the mole fraction of each component

19. What is the normality of a solution of 9.50 grams of barium hydroxide in 2000 ml solution? What is the molarity?

20. Calculate the vapour pressure of water in

a) a solution at 1000c in which the mole fraction of sucrose is 0.1

b) a solution at 1000c in which the molality the solution is 0.1m

21. A mixture of 20g of water & 80g ethanol is prepared. Assuming the solution is to be ideal, what is vapor pressure of the solution at 19 °C? At 19 °C, the vapor pressure of ethanol is 40 torr, that of water is 16.6 torr.

22) Which of the following 1 molal aqueous solutions will have the highest freezing point?

a) NaCl (aq) b) C₆H₁₂O₆ c) K₃PO₄ d) Cu(NO₃)₂

Explain

why:

23) Which of the following 1 molal aqueous solutions will have the lowest freezing point?

a) NaCl (aq) b) C₆H₁₂O₆ c) K₃PO₄ d) Cu(NO₃)₂

Explain

why:

24) Which of the following aqueous solutions will have the highest boiling point?

a) 500 g solute in 1000 g solvent b) 500 g solute in 500 g solvent

c) 1000 g solute in 500 g solvent d) 1000 g solute in 1000 g solvent

Explain

why:

25) Which of the following aqueous solutions will have the lowest boiling point?

a) 500 g solute in 1000 g solvent b) 500 g solute in 500 g solvent

c) 1000 g solute in 500 g solvent d) 1000 g solute in 1000 g solvent

Explain why:

WORKSHEET III

Which of the following reaction is not categorized under Arrhenius acid-base definition?

- A) $\text{HCl(aq)} + \text{H}_2\text{O(l)} \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
B) $\text{NH}_3(\text{aq}) + \text{H}_2\text{O(l)} \rightarrow \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$
C) $\text{NH}_3(\text{g}) + \text{HCl(g)} \rightarrow \text{NH}_4\text{Cl(s)}$
D) $\text{HF(aq)} + \text{H}_2\text{O(l)} \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{F}^-(\text{aq})$

1) For each of the following reactions, identify the acid, the base, the conjugate base & conjugate acid. A



2) Write the formula of the conjugate base of:

A) HOOH B) H₃PO₄ C) HSO₃⁻

3) Write the conjugate acid of:

A) HCO₃⁻ B) SO₄⁻ C) HSO₃⁻

4) Rank the bases in each of the following groups in order of increasing base strength.

A) H₂O, OH⁻, H⁺, Cl⁻ B) NH₂⁻, HS⁻, HTe⁻, PH₂⁻ C) BrO₂⁻, ClO₂⁻, IO₂⁻

5) Which of the following ions or molecules cannot be a Lewis base?

A) CH₃O⁻ B) H⁻ C) O²⁻ D) OH⁻ E) H⁺

6) Which of the following can be a Lewis acid but not Bronsted- Lowery acid?

A) CO₂ B) AlCl₃ C) N₂H₅⁺ D) SbCl₃

7) Which of the following cannot be considered as amphoteric species?

A) NH₄⁺ B) HCO₃⁻ C) NH₃ D) H₂PO₄⁻

8) Values of K_w as a function of temp. are as follow:

Temp. °C	K_w
0	1.14×10^{-15}
25	1.0×10^{-14}
352.09	352.09×10^{-14}
402.29	402.29×10^{-14}
505.47	505.47×10^{-14}

- A) Is ionization of water exothermic or endothermic ?
 B) Calculate the P^H of pure water at each temp.?
- 10) What type of measurements other than P^H measurements can be made to determine the extent of dissociation of acid in water?
- 11) PK_a values of three acids A,B & C are 4.5,3.5 & 6.5 respectively . What is the correct order of Acid strength?
- 12) In a 0.01M solution of HF , the percent of dissociation is 8.1% at equilibrium . What is :
 A) $[H^+]$ & P^H B) K_a values of HF C) $[OH^-]$ & P^H
- 13) A 0.10M solution of acetic acid , chlorous acid , hydrofluoric acid & nitrous acid contain the following at equilibrium.

Acid	[ACID]	[Conjugate base]	[H ₃ O ⁺]
		CH ₃ COOH	0.099M 0.0013M 0.0013M
		HClO ₂	0.072M 0.028M 0.028M
		HF	0.092M 0.0081M 0.0081M
HNO ₂	0.093M	0.0069M	0.0069M

Arrange these solutions of acids in order of increasing acid strength.

- A) Which of these acids have the strongest conjugate base?
- 14) What is the effect of adding ammonium perchlorate NH_4ClO_4 to a solution of NH_3 ?
 Explain the effect on:
 A) the dissociation of NH_3
 B) the $[OH^-]$
 C) the P^H values of the solution
- 15) Which of the following pairs cannot form a buffer system?
 A) NaH_2PO_4 / Na_2HPO_4 C) $HOCl / NaOCl$
 B) $HCl / NaCl$ D) $H_2CO_3 / NaHCO_3$
- 16) Two buffers A & B have the following conc. of their components:
- | Buffer | $[CH_3COOH]$ | $[CH_3COO^-]$ |
|--------|--------------|---------------|
| A | 0.5M | 0.5M |
| B | 0.1M | 0.1M |

- A) Which buffer system has the highest P^H ?
 B) Which buffer system resist change in P^H more than the other?
- 17) A buffer solution is made by adding 75.0g of sodium acetate to 500.00ml of a 0.64M of Acetic acid . What is the P^H of the final solution?
- 18) What meant by the buffer capacity? How do the following differ in buffer capacity?
 How do they differ in P^H ?
 A) 0.01M acetic acid & 0.01M sodium acetate solution
 B) 0.1M acetic acid & 0.1M sodium acetate solution
 C) 1.0M acetic acid & 1.0M sodium acetate solution
- 19) Calculate the ratio of $[NH_3]/[NH_4^+]$ for a buffer solution at P^H 5.0 ($K_b = 1.8 \times 10^{-5}$)
- 20) Identify the salts whose aqueous solutions are acidic, basic or neutral
 A) K_2SO_4 B) K_2CO_3 C) $(NH_4)_2SO_4$
- 21) An indicator HIn has an ionization constant $K_{In} = 1 \times 10^{-5}$ If the molecular form of the indicator

- HIn is yellow & the In⁻ form is green , what is the color of the solution containing this Indicator at P^H A) 5 B) 3 C) 7
- 22) Show that the P^H at the halfway point of the titration of a weak acid with strong base is equal to P_{Ka}
- 23) Define equivalent point & end point.
- 24) How does the titration of a strong acid with a strong base differ from the titration a weak acid with a strong base ,with respect to the following points?
- Quantity of the base required to reach the equivalent point.
 - P^H at the beginning of the titration.
 - P^H at the equivalent point.
 - P^H after addition of a slight excess of base.
- 25) If a 50.0ml of 0.100M HCN is titrated with 0.100M NaOH,calculate the P^H of the solution
- after 8.00ml of 0.100M NaOH has been added
 - at the half point in the titration
 - at the equivalent point

NOTE THE FOLLOWING POINTS

- A strong acid has a weak conjugate base.
- The P^H scale is a compact way to represent solution acidity.
- The P^H decreases as [H₃O⁺] increases & vice versa.
- In calculating the P^H of a weak acid or weak base always write the major species present in the solution.
- The more dilute the weak acid solution,the greater the percent of dissociation.
- The salt of a strong acid & a strong base gives a neutral solution.
- A basic solution is formed if anion of the salt is the conjugate base of a weak acid.
- The Lewis acid base model encompasses the Bronsted –Lowery model but the reverse is not true.
- The common ion effect is the application of Le Chatelier's principle.
- In a buffered solution the P^H is governed by the ratio of [HA]/[A⁻].
- A buffer with large capacity contains large conc. of buffering components.
- In titration of weak acid with strong base or weak base with strong acid , treat the stoichiometry and equilibrium problem separately.
- In titration of weak acid with strong base the conc. is defined for weak acid as soon as the reaction with OH⁻ has gone to completion but before any dissociation of the weak acid. The same is true for titration of weak base with strong acid
- The P^H at the equivalent point of a titration of a weak acid with strong base is always greater than 7.
- The equivalent point is defined by the stoichiometry ,not by the P^H.
- The P^H at the equivalent point is always less than 7 for titration of weak base with strong acid.
- The P^H of a solution can be stabilized by a buffer.
- The addition of a common ion ,an ion that is also a component of a weak acid to a solution suppresses the ionization of the parent weak acid.
- Every Bronsted acid has a conjugate base & every Bronsted base has a conjugate acid.

WORKSHEET IV

Multiple Choice Questions

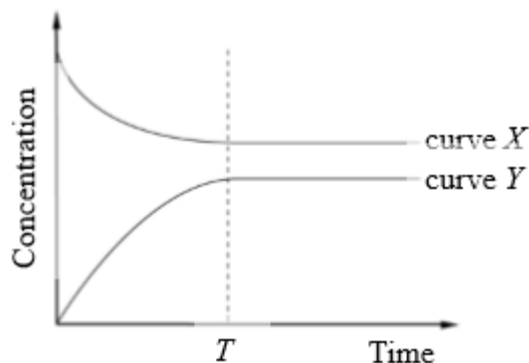
- 1.Which of the following reactions are reversible?
- $\text{HNO}_3(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaNO}_3(\text{aq}) + \text{H}_2\text{O}$
 - $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$
 - $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$
- (1) and (2) only
 - (1) and (3) only
 - (2) and (3) only
 - (1), (2) and (3)

2. Which of the following reactions is/are irreversible?
- (1) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \rightarrow \text{CuSO}_4(\text{s}) + 5\text{H}_2\text{O}(\text{l})$
 - (2) $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
 - (3) $\text{NH}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$
- A. (1) only
 B. (2) only
 C. (1) and (3) only
 D. (2) and (3) only
3. Which of the following reactions is NOT reversible?
- A. Rusting of iron
 - B. Ionization of carbonic acid
 - C. Formation of sulphur trioxide from sulphur dioxide and oxygen
 - D. Formation of thiocyanatoiron(III) ion from iron(III) ion and thiocyanate ion
4. Which of the following is an irreversible reaction?
- A. Esterification between ethanoic acid and ethanol
 - B. Ionization of sulphurous acid
 - C. Industrial preparation of ammonia
 - D. Rusting of iron
5. Which of the following reactions are irreversible?
- (1) $\text{CH}_3\text{CH}_2\text{COOH}(\text{l}) + \text{CH}_3\text{OH}(\text{l}) \rightarrow \text{CH}_3\text{CH}_2\text{COOCH}_3(\text{l}) + \text{H}_2\text{O}(\text{l})$
 - (2) $2\text{Al}(\text{s}) + 3\text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{aq}) + 3\text{H}_2(\text{g})$
 - (3) $\text{HNO}_3(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{KNO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- A. (1) and (2) only C. (2) and (3) only
 B. (1) and (3) only D. (1), (2) and (3) only
6. Which of the following processes is reversible?
- A. Dissolving carbonic acid in water
 - B. Dissolving nitric acid in water
 - C. Adding aluminum to sulphuric acid
 - D. Adding zinc to copper(II) sulphate solution
7. Which of the following statements concerning dynamic equilibrium is/are correct?
- (1) A reversible reaction stops when equilibrium is reached.
 - (2) At equilibrium, the concentrations of reactants and products are constant.
 - (3) At equilibrium, the concentrations of reactants and products are the same.
- A. (1) only C. (1) and (3) only
 B. (2) only D. (2) and (3) only
8. Which of the following statement↔s concerning the chemical equilibrium below is/are correct?
- $$\text{CaCO}_3(\text{s}) \leftrightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$$
- (1) The above chemical equilibrium can only be established in a sealed container.
 - (2) The reaction occurs spontaneously at room conditions.
 - (3) Equilibrium can be reached from the backward direction of the reaction.
- A. (1) only B. (2) only C. (1) and (3) only D. (2) and (3) only
9. Which of the following statements about chemical equilibrium is correct?
- A. Both the forward and backward reactions stop when equilibrium is reached.
 - B. The concentrations of reactants and products are still varying at equilibrium.
 - C. The rate of forward reaction is equal to the rate of backward reaction at equilibrium.
 - D. The concentrations of reactants and products are equal at equilibrium
10. Which of the following statements concerning the effect of catalysts on the reversible reactions
- A. Catalysts increase either the rate of forward reaction or the rate of backward reaction of reversible reactions.
 - B. Catalysts shorten the time for the reversible reactions to reach equilibrium by increasing the rate forward reaction and decreasing the rate of backward reaction.
 - C. Catalysts shorten the time for the reversible reactions to reach equilibrium by increasing both the rates of forward and backward reactions.

D. Catalysts increase the yield of products for reversible reactions.

11. When a small amount of $\text{N}_2\text{O}_4(\text{l})$ is introduced into a sealed container at a certain temperature, the following reaction occurs

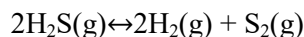
$\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ The following graph shows the changes in concentrations of $\text{N}_2\text{O}_4(\text{g})$ and $\text{NO}_2(\text{g})$ with time



Which of the following statements concerning the above graph are correct?

- (1) The reaction mixture reaches equilibrium at time T.
 - (2) Curves X and Y represent the changes in concentrations of $\text{N}_2\text{O}_4(\text{g})$ and $\text{NO}_2(\text{g})$ with time respectively.
 - (3) At time T, the rate of forward reaction is equal to the rate of backward reaction.
- A. (1) and (2) only C. (2) and (3) only
B. (1) and (3) only D. (1), (2) and (3)

12. Consider the following chemical equilibrium:



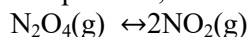
Which of the following statements concerning the above equilibrium are correct?

- (1) When 2 molecules of $\text{H}_2(\text{g})$ and 1 molecule of $\text{S}_2(\text{g})$ combine, 2 molecules of $\text{H}_2\text{S}(\text{g})$
 - (2) The concentrations of $\text{H}_2\text{S}(\text{g})$, $\text{H}_2(\text{g})$ and $\text{S}_2(\text{g})$ remain unchanged.
 - (3) The pressure of the reaction mixture remains unchanged.
- A. (1) and (2) only C. (2) and (3) only
B. (1) and (3) only D. (1), (2) and (3)

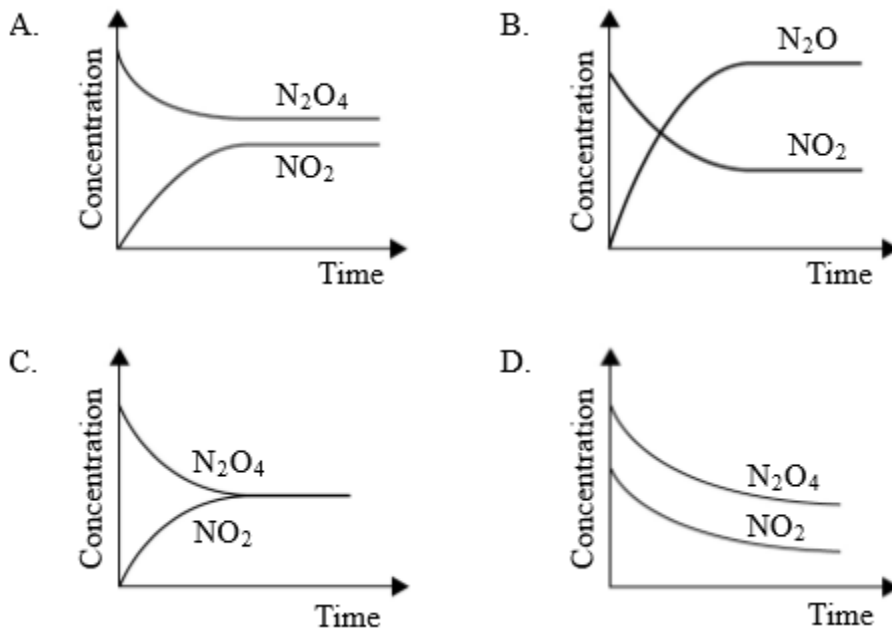
13. Which of the following statements concerning a reversible reaction is INCORRECT?

- A. Equilibrium can only be established in a closed system.
- B. Equilibrium can be reached from either the forward or the backward direction of the reversible reaction.
- C. At equilibrium, there are observable changes of the reaction mixture as the concentrations of reactants and products are still changing.
- D. At equilibrium, the rate of forward reaction is equal to the rate of backward reaction.

14. When a small amount of $\text{N}_2\text{O}_4(\text{l})$ is introduced into a sealed container at a certain temperature, the following reaction takes place:



Which of the following graphs correctly shows the changes in concentrations of N_2O_4 and NO_2 with time until the reaction reaches equilibrium?

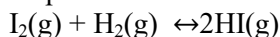


Which of the following are the characteristics of dynamic equilibrium?

- (1) The reaction system for establishing equilibrium must be an open system.
- (2) At equilibrium, the rate of forward reaction is equal to the rate of backward reaction.
- (3) At equilibrium, there are no observable changes in the reaction mixture.

- A. (1) and (2) only C. (2) and (3) only
 B. (1) and (3) only D. (1), (2) and (3)

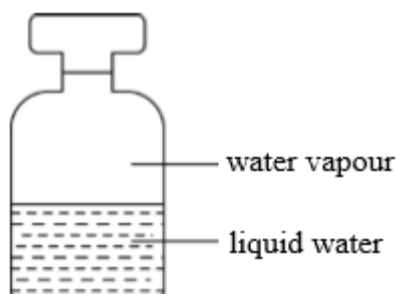
15. Equal numbers of moles of $I_2(g)$ and $H_2(g)$ are introduced in a sealed container at a certain temperature. The following reaction occurs:



The reaction mixture is allowed to reach chemical equilibrium.

Which of the following statements concerning the above chemical equilibrium is/are INCORRECT?

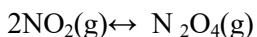
- A. The rate of combination between $I_2(g)$ molecules and $H_2(g)$ molecules is equal to the rate of decomposition of $HI(g)$ molecules.
 - B. The colour intensity of the reaction mixture remains constant.
 - C. The concentrations of $I_2(g)$ and $H_2(g)$ are always the same.
 - D. When 1 mol of $HI(g)$ decomposes, 1 mol of $I_2(g)$ and 1 mol of $H_2(g)$ combine at the same time.
16. Which of the following statements concerning chemical equilibrium is INCORRECT?
- A. There are no observable changes of the reaction mixture at chemical equilibrium.
 - B. Both forward and backward reactions are taking place at chemical equilibrium.
 - C. No reaction is taking place at chemical equilibrium.
 - D. The concentrations of both products and reactants remain unchanged at chemical equilibrium.
17. Which of the following conditions is required for a reaction to reach dynamic equilibrium?
- A. The initial concentrations of reactants must be 1.0 M.
 - B. The reaction must be carried out at room pressure.
 - C. The reaction must be carried out at room temperature.
 - D. The reaction must be carried out in a closed system.
18. The liquid water and water vapour in the bottle below are in equilibrium.



Which of the following statements are correct?

- (1) There is no change in the total amount of water vapour and liquid water.
 - (2) The temperature of the system MUST be higher than 100°C.
 - (3) The rate of condensation is equal to the rate of vaporization.
- A. (1) and (2) only C. (2) and (3) only
 B. (1) and (3) only D. (1), (2) and (3)

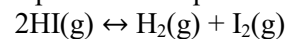
19. What is the unit of the equilibrium constant for the following equilibrium system?



- A. mol dm^{-3} C. $\text{mol}^2 \text{dm}^{-6}$
 B. $\text{mol}^{-1} \text{dm}^3$ D. $\text{mol}^{-2} \text{dm}^6$

20. Consider the following reaction: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \leftrightarrow 2\text{HI}(\text{g})$

Suppose the equilibrium constant of the given reaction at 298 K is K_c . Which is the correct expression of equilibrium constant, K_c' , for the following reaction at 298 K?



- A. $K_c' = K_c$ C. $K_c' = K_c^2$
 B. $K_c' = 1/K_c$ D. $K_c' = \sqrt{K_c}$

21. Which is the correct expression of the equilibrium constant, K_c , of the following reaction?

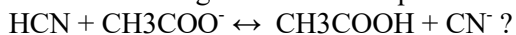


- A. $K_c = [\text{CO}_2(\text{g})]_{\text{eq}}$
 B. $K_c = [\text{CaCO}_3(\text{s})]_{\text{eq}}$
 C. $K_c = [\text{CaO}(\text{s})]_{\text{eq}}[\text{CO}_2(\text{g})]_{\text{eq}}$
 D. $K_c = [\text{CaO}(\text{s})]_{\text{eq}}[\text{CaO}(\text{g})]_{\text{eq}}/[\text{CaCO}_3(\text{s})]_{\text{eq}}$

22. The value of K_c for the reaction $\text{H}_2(\text{g}) + \text{CO}_2(\text{g}) \leftrightarrow \text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g})$ is 1.45 at 1100°C. What is the value of K_c for the reaction $\text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g}) \leftrightarrow \text{H}_2(\text{g}) + \text{CO}_2(\text{g})$ at the same temperature?

- A. 0.69 C. 1.20
 B. 0.83 D. 1.45

23. If the equilibrium constant for the reaction: $\text{CH}_3\text{COOH} + \text{CN}^- \leftrightarrow \text{HCN} + \text{CH}_3\text{COO}^-$ is denoted as K , which of the following is the correct equilibrium constant, in terms of K , for the reaction:

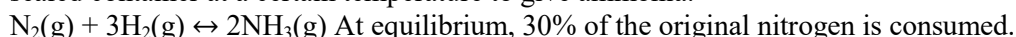


- A. K C. K^2
 B. $1/K$ D. It cannot be determined.

24. Which of the following statements concerning the magnitude of equilibrium constant, K_c , is correct?

- A. It is affected by the change in pressure.
 B. If K_c is a positive value, the forward rate is faster than the backward rate.
 C. It indicates how far the equilibrium reaches.
 D. The larger the K_c value, the faster the reaction

25. In Haber process, 0.60 mol dm^{-3} of nitrogen is mixed with 1.80 mol dm^{-3} of hydrogen in a sealed container at a certain temperature to give ammonia.



What is K_c for this reaction?

- A. $0.154 \text{ mol}^{-2} \text{ dm}^6$ C. $0.680 \text{ mol}^{-2} \text{ dm}^6$
 B. $0.265 \text{ mol}^{-2} \text{ dm}^6$ D. $1.470 \text{ mol}^{-2} \text{ dm}^6$

- Which of the following temperature scale is greater?
 A. 590F B. 150C C. 288K D. A,B, and C are equivalent
 - Hardening oils to convert to fats is called
 A. Esterification B. Hydrogenation C. Decarboxylation D. Neutralization
 - A Hospital medical technician needs to prepare 750g solution that is 5.00% glucose by mass. What mass of glucose and water must be mixed to prepare the solution?
 A. 712.5g and 37.5g B. 5g and 745g C. 25g and 725g D. 37.5g and 712.5g
- Question 4 and 5 is based on the following measurement result of copper wire by three students. The actual result of the length of the wire is 16.34cm.

Student

	Trial1	Trial 2	Trial3	Trial 4
A	15.80	15.98	16.30	17.02
B	16.30	16.41	16.33	16.35
C	15.93	15.80	15.95	15.92

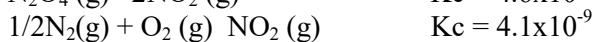
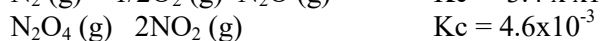
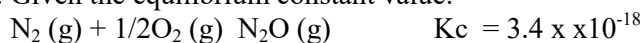
- Which student is most precise?
 A. Student C B. Student A C. Student B D. All of them
- In which student's measurement systematic error is involved ?
 A. Student C B. Student A C. Student B D. All of them
- What is the wave length of a photon emitted during transition from $n=5$ state to the $n=2$ state in hydrogen atom ?
 A. 4.5×10^{-19} B. 431 nm C. 656 nm D. $2.3 \mu\text{m}$
- Which one of the following statement is NOT CORRECT about quantum mechanical model of an atom ?
 A. The energy and position of an electron can not be determined simultaneously
 B. Lower energy orbital are filled with electron before higher energy orbital
 C. When filling orbital of equal energy, two electron will occupy the same orbital with opposite spin before entering a new orbital
 D. No two electron can have the same four quantum number
- A neutral atom X at its ground state has filled 4d orbital in the valance shell. What is the the atomic number of X ?
 A. 45 B. 33 C. 25 D. 43
- Which branch of chemistry studies about separation, identification and determination of relative amount of components of the sample ?
 A. Analytical B. physical C. biochemistry D. Inorganic
- Which of the following ionic compounds has the largest lattice energy?
 A. NaF B. LiI C. LiF D. CsI
- How many photon of red light (700 nm) would pass through a 140W lamp to generate 1.0 kJ Of energy?
 A. 3.5×10^{21} B. 6.02×10^{22} C. 3.5×10^{18} D. 3.5×10^{20}
- Which of the following transition is accompanied by emission of radiation with the longest wave length ?
 A. $n=4$ to $n=2$ B. $n=5$ to $n=2$ C. $n=1$ to $n=4$ D. $n=3$ to $n=5$
- The maximum number of electron in an orbital of an atom possessing a quantum number $n=4, l=3$, and $m_l=0$ is:
 A. 14 B. 2 C. 32 D. 8
- In the reaction : $\text{CN}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \leftrightarrow \text{HCN}(\text{aq}) + \text{OH}^-(\text{aq})$, the conjugate acid-base pairs are:
 A. CN^-/OH^- and $\text{H}_2\text{O}/\text{HCN}$ B. CN^-/HCN and $\text{H}_2\text{O}/\text{OH}^-$

- C. HCN and H₂O D. CN-/H₂O and HCN/OH-
15. Which of the following substances can function as Lewis acid ?
 A. LiF B. LiI C. NaF D. CsI
16. What is the difference between extensive and intensive properties?
 A. Extensive properties include color and smell, while intensive properties include enthalpy and mass
 B. Extensive properties occur outside a system, while intensive properties occur inside
 C. Extensive properties are state function while intensive properties are not
 D. Extensive properties depend on the quantity of matter, while intensive properties do not
17. For the reaction, $3\text{O}_2(\text{g}) \rightarrow 2\text{O}_3(\text{g})$. $\Delta H^\circ = +284 \text{ KJ}$. What are the signs of ΔG & ΔS respectively
 A. positive & negative B. positive & positive C. negative & negative D. negative & positive
18. Given the following equation,
 $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ $\Delta H^\circ = -571.6 \text{ KJ/mol}$.
 Which statement is incorrect?
 A. ΔH° for the reverse reaction is $+571.6 \text{ KJ/mol}$.
 B. The standard heat of formation of liquid water is -571.6 KJ/mol .
 C. ΔH° for the reaction of one-half mole of oxygen is -285 KJ/mol
 D. ΔH° for forming one mole of liquid water is -571.6 KJ/mol
19. Use the following thermo chemical equations
 $\text{C}_2\text{H}_2(\text{g}) + 5/2 \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{g})$ $\Delta H^\circ = -1300 \text{ KJ}$
 $\text{C}_2\text{H}_6(\text{g}) + 7/2 \text{O}_2(\text{g}) \rightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g})$ $\Delta H^\circ = -5660 \text{ KJ}$
 $\text{H}_2(\text{g}) + 1/2 \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$ $\Delta H^\circ = -286 \text{ KJ}$
 Calculate ΔH° for the following reaction :
 $\text{C}_2\text{H}_6(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{C}_2\text{H}_6(\text{g})$
 A. -346KJ B. -16 KJ C. -312KJ D. +1560KJ
20. Which of the following molecules do not exist?
 A. B₂ B. C₂ C. Ne₂ D. CO
21. Which one is different from the others in its arrangement of electron ?
 A. NH₃ B. PF₃ C. BCl₃ D. CH₄
22. Given the reaction below
 $\text{C}(\text{s}) + \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$, $\Delta H_f^\circ = -394 \text{ KJ}$
 $S^\circ \text{C}(\text{s}) = 5.7 \text{ J/mol.k}$
 $S^\circ \text{O}_2(\text{g}) = 205 \text{ J/mol.k}$
 $S^\circ \text{CO}_2(\text{g}) = 213.6 \text{ J/mol.k}$
 Calculate ΔG_f° for the above equation
 A. -394.86KJ B. 264.75KJ C. 432.33KJ D. 158.74KJ
23. P₂O₅ is dissolved in a non polar solvent and decomposed by the first order reaction into P₂O₄ and O₂. What time will it take for the concentration to drop from 0.01 to 0.005 if the rate constant is $0.693 \times 10^{-4} \text{ s}^{-1}$?
 A. $4.8 \times 10^{-5} \text{ s}$ B. $1.0 \times 10^4 \text{ s}$ C. 0.963s D. $1.0 \times 10^3 \text{ s}$
24. What is the activation energy of a reaction whose rate constant increased by ten times when temperature is increased from 00C to 100C ?
 A. $1.48 \times 10^7 \text{ J}$ B. $4.0 \times 10^4 \text{ J}$ C. $6.76 \times 10^{-7} \text{ J}$ D. $1.48 \times 10^5 \text{ J}$
25. The reaction between H₂ and CO is 2nd order in H₂ 1st order in CO.
 What change is occur in the rate of reaction if the concentration of each reactant is doubled?
 $2\text{H}_2(\text{g}) + \text{CO}(\text{g}) \rightarrow \text{CH}_3\text{OH}(\text{g})$
 A. 2-fold increase B. 3- fold increase C. 8- fold increase D. 4- fold increase
26. An indicator, HIn has $K_{in} = 1 \times 10^{-6}$. If the indicator, HIn is yellow & In is green. What is the color of a solution containing this indicator when its pH is 6?
 A. Yellow B. Yellowish-green C. Green D. Blue
27. Identify the correct statement ?

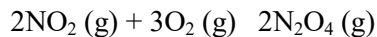
- A. An intermediate product is formed, consumed and recovered at the end of reaction
 B. The exponents in the rate law are equal to the coefficients in a single step reaction
 C. The sum of the elementary steps in a reaction mechanism is the same with the slowest reaction
 D. Termolecular reaction necessarily possesses three different types of reactant molecule
28. If the electronic configuration of an element is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2$, the four electron involved in chemical bond formation will be:
 A. $3p^6$ B. $3p^6 4s^2$ C. $3p^6 3d^2$ D. $3d^2 4s^2$
29. Which among the following is paramagnetic?
 A. N_2 B. N_2^{2-} C. C_2 D. O_2^{2-}
30. Consider the following reaction: $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
 If the rate of formation of NH_3 is 3.0 mL/min. The rate of consumption of H_2 is:
 A. 1.5 mL/min B. 4.5 mL/min C. 2.0 mL/min D. 9.0 mL/min
31. If the gaseous equilibrium: $H_2(g) + X_2(g) + Q \rightarrow 2HX(g)$, the formation of HX will be favored by:
 A. Decreasing temperature and increasing pressure
 B. Increasing temperature and decreasing pressure
 C. Increasing temperature and decreasing concentration of HX
 D. Increasing concentration of X_2 and increasing pressure
32. In the following equation what type of hybridization change, if any, occurs at the Xe atom?
 $XeCl_2(s) + Cl_2(g) \rightarrow XeCl_4(s)$
 A. sp^3d to sp^3 B. sp^2 to sp^3 C. sp^3d to sp^3d^2 D. sp^3 to sp^3d
33. Which of the following expression is correct for the rate of the reaction given below?
 $5Br^- (aq) + BrO_3^- (aq) + 6H^+ (aq) \rightarrow 3Br_2 (aq) + 3H_2O(l)$
 A. $\Delta[Br^-]/\Delta t = 5 \Delta[H^+]/\Delta t$ B. $\Delta[Br^-]/\Delta t = 5/6 \Delta[H^+]/\Delta t$
 C. $\Delta[Br^-]/\Delta t = 5/6 \Delta[H^+]/\Delta t$ D. $\Delta[Br^-]/\Delta t = 6\Delta[H^+]/\Delta t$
34. Which of the following is the unit of the rate constant of a reaction of order 3/2?
 A. $mol^{-1}.L.S^{-1}$ B. $mol^{-2}.1/L.S$ C. $mol^{-1/2}.1/L^2.S^{-1}$ D. $mol.L^2.S^{-1}$
35. Which of the following statement is true about the reaction:
 $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ for which $K_p = 1.7 \times 10^{-3}$ at 600K and K_p at 7.8×10^{-5} at 700K
 A. More nitrogen will be reacted at 700K than at 600K
 B. More ammonia will be formed at 600K than at 700K
 C. The reaction lies more farther to the right at 700K than at 600K
 D. The position of the equilibrium remains the same at 700K and at 600K
36. Which of the following statement is correctly describe a system for which Q_c is larger than K_c ?
 A. The reaction can never reach equilibrium
 B. The reaction is at equilibrium
 C. The reaction must shift to the left to reach equilibrium
 D. The reaction must shift to the right to reach equilibrium
37. Considering the following reaction,
 $C(s) + H_2O(g) + 131KJ \leftrightarrow CO(g) + H_2(g)$
 Which of the following is true about the effect on the reaction at equilibrium
 A. Adding more carbon does not affect the value of K_c
 B. Raising the temperature decrease the value of K_c
 C. Decreasing the volume of the reaction vessel favors the forward reaction
 D. Raising the reaction temperature shift the equilibrium to the right
38. The equilibrium constant for reaction (1) is k . What is the equilibrium constant for reaction (2)?
 $SO_2(g) + 1/2O_2(g) \rightleftharpoons SO_3(g)$ -----(1)
 $2SO_3(g) \rightleftharpoons SO_2(g) + O_2(g)$ -----(2)

- A. K_2 B. $2k$ C. $1/2k$ D. $1/k^2$

39. Given the equilibrium constant value:



What is the value of K_c for the following reaction ?



- A. 1.2×10^{-6} B. 2.4×10^{-6} C. 1.2×10^6 D. 4.8×10^6

40. When the species F_2 , F_2^+ , and F_2^- are arranged in increasing order of bond energies, we will have:

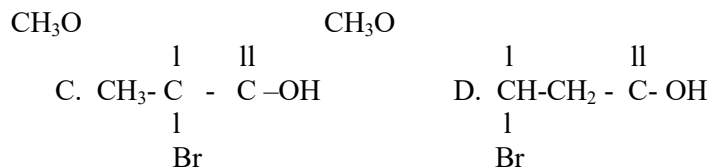
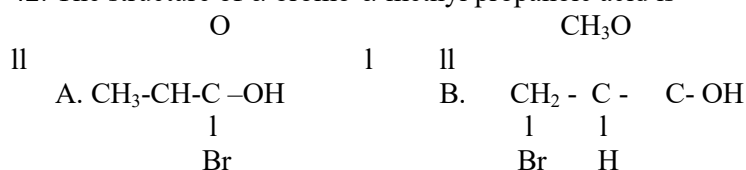
- A. $\text{F}_2^-, \text{F}_2^+, \text{F}_2$ B. $\text{F}_2^-, \text{F}_2, \text{F}_2^+$ C. $\text{F}_2^+, \text{F}_2^-, \text{F}_2$ D. $\text{F}_2^+, \text{F}_2, \text{F}_2^-$

41. 3mol of ammonia were introduced in to a 3L reaction chamber in which it is partially decomposed at high temperature in the reaction:

$2\text{NH}_3(\text{g}) \rightleftharpoons 3\text{H}_2(\text{g}) + \text{N}_2(\text{g})$. At equilibrium, at a particular temperature, 15% of the ammonia had reacted. What is the K_c for the given reaction above?

- A. $1.06 \times 10^{-4} \text{M}^2$ B. $5.6 \times 10^{-2} \text{M}^2$ C. $2.8 \times 10^{-5} \text{M}^2$ D. $9.0 \times 10^{-6} \text{M}^2$

42. The structure of α -bromo- α -methyl propanoic acid is



43. Which molecule is a fatty acid ?

- A. $(\text{CH}_3)_2\text{CH}(\text{CH}_2)_3\text{COOH}$ C. CH_2CHCOOH
 B. $\text{CH}_3(\text{CH}_2)_7\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$ D. CH_3COOH

44. An ester has the structural formula : $\text{CH}_3\text{CH}_2\text{COOCH}(\text{CH}_3)_2$, on hydrolysis, the ester would produce :

- A. Ethanoic acid and propan-1-ol. C. Ethanoic acid and propan-2-ol
 B. Propanoic acid and propan-1-ol. D. Propanoic acid and propan-2-ol

45. Given the reaction : $\text{MnO}_4^- + \text{NO}_2^- \rightarrow \text{Mn}^{2+} + \text{NO}_3^-$ (in basic medium).

When this reaction is balanced by ion electron method the coefficient of MnO_4^- , NO_2^- , Mn^{2+} and NO_3^- respectively are:

- A. 2,3,2 and 3 C. 2,5,2 and 5
 B. 3,3,2 and 2 D. 5,5,2 and 2

46. Type of solute-solvent interaction for the dissolution of NH_4F in water is:

- A. London or dispersion forces C. ion dipole force
 B. Hydrogen bonding D. dipole-dipole forces

47. The student adds 6.00g of a solid to 30.0ml of water. What is the concentration of this Solution expressed as mass/mass percent? (assume the density of water is 1gm/mL).

- A. 0.167% (m/m) B. 0.200% (m/m) C. 16.7% (m/m) D. 20.0% (m/m)

48. What is the freezing point of solution prepared by dissolving 90 gm of $\text{C}_6\text{H}_{12}\text{O}_6$ in 200 gm of water?

- A. 00C B. -2.10C C. -1.80C D. 2.10C
49. The 10.0 ml of glycerol($C_3H_8O_3$) is added to 500.0 ml of water at 500C. At this temperature, The vapor pressure of pure water is 92.5 torr and its density is 0.988 g/mol. The density of glycerol is 1.26 g/ml. What is the vapour pressure lowering ?
A. 0.125 torr B. 0.656 torr C. 0.105 torr D. 1.256
50. The electrolyte in automobile lead storage batteries is 3.7M H_2SO_4 solution that has a density of 1.230 g/ml. what is the normality of this solution ?
A. 2.92 N B. 1.45 N C. 7.50 N D. 3.68 N
51. Which of the following is NOT CORRECT about ideal solution ?
A. the volume of an ideal solution is the sum of its pure components
B. there is no expansion or contraction on mixing
C. The heat of solution is zero
D. they deviate from Raoult's law
52. If a 0.1M solution: NaCN, HCl, NH_4Cl and NaCl are given. What is the correct increase in the order of pH ?
A. $NaCN < NH_4Cl < NaCl < HCl$ B. $HCl < NH_4Cl < NaCl < NaCN$
C. $NaCl < NH_4Cl < NaCN < HCl$ D. $HCl < NaCl < NaCN < NH_4Cl$
53. Which one of the following solution resist a change in pH when small amount of an acid or base is added to it
A. 0.1M NaCl and 0.1M HCl C. 0.2M NaCl and 0.1M NaOH
B. 0.1M NH_4Cl and 0.1M NH_3 D. 0.1M NH_4Cl and 0.1M HCl
54. Which of the following is NOT CORRECT about strong acid with strong base titration ?
A. The salt formed during reaction do not undergo hydrolysis
B. The POH after equivalent point is greater is greater than 7
C. The pH is at equivalent point
D. The pH is less than 7 at the beginning of the titration
55. Given the following information :
Kb of $NH_3 = 1.8 \times 10^{-5}$, Kb of HF = 6.8×10^{-4}
Kb of $CH_3COOH = 1.8 \times 10^{-5}$ Kb of HCN = 4.9×10^{-10}
Which one of the following decrease the Ph of water?
A. CH_3COONH_4 B. NH_4F C. NH_4CN D. NaCl
56. Which of the following statement is NOT CORRECT ?
A. For a given value of K_a , the more dilute an acidic solution, the greater is the degree of ionization
B. For a given value of K_a , the more concentrated an acidic solution, the greater is the degree of ionization
C. For a given concentration, the larger the K_a , the greater is the degree of ionization
D. For a given concentration, the degree of ionization of acid decrease with a decrease in the value of K_a
57. What is the ionization constant for a weak acid HA. that is 1.60% ionized in 0.095M solution?
A. 2.69×10^{-3} B. 3.77×10^{-2} C. 2.4×10^{-5} D. 9.91×10^{-6}
58. The acid strength of $HCN < CH_3COOH < HF < HNO_2 < HCOOH$. What is the correct increasing Order in base strength of the conjugate base of the acid?
A. $CN^- < F^- < NO_2^- < HCOO^-$ C. $CN^- > CH_3COO^- > F^- > NO_2^- > HCOO^-$
B. $CN^- > F^- > CH_3COO^- > NO_2^- > HCOO^-$ D. $CN^- < F^- < CH_3COO^- < NO_2^- < HCOO^-$
59. The unknown gas X collected over water at a total pressure of 148kpa is soluble to 0.05g/L at 250C. What is the solubility of X if its partial pressure over water was 175kpa?
A. 0.0 6g/L B. 0.50 g/L C. 1.60 g/L D. 0.010 g/L
60. Which one of the following is bivariant for one component system?
A. $P=1$ B. $P=2$ C. $P=3$ D. $P=4$
61. The entropy of universe always increase and tends toward a maximum. This statement is:
A. First law of thermodynamics B. Second law of thermodynamics

- B. Zeroth law of thermodynamics D. Third law of thermodynamics
62. The reaction : $\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$, when both ΔH and ΔS are negative, the reaction will be:
- Spontaneous at all temperature
 - Non spontaneous at any temperature
 - Non spontaneous at low temperature but spontaneous at high temperature
 - Spontaneous at low temperature but non spontaneous at high temperature
63. Values that depend on state of a system and not on how that state is reached are:
- State function
 - path function
 - closed system
 - adiabatic process
64. Which of the following cases lead to an increase in the internal energy of a system ?
- 14J of heat are released by the system and 7J of work are done on the system
 - 18J of heat released by the system and 7J of work are done on the system
 - 14J of heat are gained by the system and 7J of work are done by the system
 - 7J of heat are gained by the system and 7J of work are done by the system
65. At constant temperature and pressure, which one of the following statement about enthalpy change (ΔH) and internal energy (ΔE) change is correct for the reaction:
- $$\text{NO}(\text{g}) + 1/2\text{O}_2(\text{g}) \rightarrow \text{NO}_2(\text{g})$$
- $\Delta H < \Delta E$
 - $\Delta H = \Delta E$
 - $\Delta H > \Delta E$
 - $\Delta H > 0$
66. What can be said for a particular reaction, $\Delta H = 58.5 \text{ kJ}$ and $\Delta S = 135 \text{ J/K}$ - ?
- Spontaneous at temperature below 1600°C
 - Spontaneous at all temperature
 - Spontaneous at temperature above 1600°C
 - Non-spontaneous at all temperature
68. During electrolysis of brine solution using inert electrodes
- The overall reaction is : $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
 - The remaining solution would have pH less than 7
 - At the cathode the reaction takes place is: $2\text{Na}^+ + 2\text{e}^- \rightarrow 2\text{Na}$
 - At the anode the reaction takes place is: $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
60. Which of the following is not a condensation polymer ?
- Nylon
 - polyester
 - Teflon
 - Bakelite
61. Which of the following is not true regarding carboxylic acid s?
- The higher acids have sharp irritating odour due to their high volatility
 - Solubility of carboxylic acids decrease with increasing molecular mass
 - Carboxylic acids have higher boiling points than alcohols of similar size
 - The higher member carboxylic acids are waxy solids
62. A type of protein which promote the breakdown of starch to simple sugar glucose is:
- Keratin
 - ferrite
 - Amylase
 - insulin
63. Which of the following ores contains CO_3^{2-} ?
- Bauxite
 - Dolomite
 - Epsomite
 - Cassiterite
64. Which of the following statements is NOT CORRECT ?
- For a given value of K_a , the more dilute an acidic solution, the greater is the degree of Ionization
 - For a given value of K_a , the more concentrated an acidic solution, the greater is the degree of ionization
 - For a given concentration , the larger the K_a , the greater is the degree of ionization
 - For a given concentration, the degree of ionization of acid decrease with a decrease in The value of K_a
65. Given the standard reduction potential of the following hypothetical ions:
- $$E^0_{\text{red}} \text{T}^{3+} = -1.66\text{V}, \quad E^0_{\text{red}} \text{X}^+ = -2.71\text{V}, \quad E^0_{\text{red}} \text{Y}^+ = -3.05\text{V}, \quad E^0_{\text{red}} \text{Z}^{+2} = -2.37$$
- Y
 - X
 - T
 - Z
66. Which of the following is false about polymer?
- They are macromolecule made from small unit
 - They can be prepared by either condensation or addition polymerization

- C. Most condensation polymers are homopolymers
 D. disposing synthetic polymers can pollute the environment
67. Which one of the following is copolymer?
 A. Dacron B. Teflon C. Perspex D. polyvinylchloride
68. Consider the polymer made from tetrachloro ethylene. What is the molecular mass (in g/mol) of the polymer if it contains 3.2×10^3 tetrachloro ethylene ?
 A. 5.31×10^5 B. 5.31×10^{-5} C. 3.51×10^5 D. 3.51×10^{-5}
69. which of the following conversion require reducing agent?
 A. $\text{Br}_2(\text{g}) \rightarrow 2\text{Br}^-(\text{aq})$ C. $\text{NO}_3^-(\text{aq}) \rightarrow \text{NO}_2(\text{g})$
 B. $\text{Mn}^{2+}(\text{aq}) \rightarrow \text{MnO}_4^-$ D. $\text{Fe}^{3+}(\text{aq}) \rightarrow \text{Fe}^{2+}$
70. Which one of the following is INCORRECTLY matched?
 A. Natural rubber - Neoprene C. Isoprene - 2-methylpropene
 B. Teflon - Tetrafluoroethylene D. Bakelite - phenol & formaldehyde
71. Which of the following metal is manufactured by electrolytic reduction?
 A. Zn B. Al C. Cr D. Pb
72. Which of the following process is used to separate gangue by concentrating sulphide ores?
 A. Froth floatation B. Gravity separation C. Amalgamation D. leaching
73. What type of bond is formed when Lewis acid reacts with Lewis base?
 A. Hydrogen bond B. Ionic Bond C. Coordinate covalent bond D. Covalent bond
74. A 25.00 mL sample of 0.105 M H_2SO_4 is titrated with a NaOH solution of unknown Concentration. The phenolphthalein endpoint was reached when 17.23 mL of the NaOH solution had been added. What is the concentration of the NaOH?
 A. 0.076 M B. 0.144 M C. 0.152 M D. 0.307 M
75. During the electrolysis of an aqueous solution of AgNO_3 , what would happen to the mass of silver metal deposited if the current is doubled and the electrolysis is decreased to 1/2 of its initial value?
 A. It would increase to twice its initial value C. It would stay the same
 B. It would decrease to 1/4 of its initial value D. It would decrease to 1/2 its initial value
76. Which of the following statement is true?
 A. A battery is rechargeable
 B. A battery produces electricity spontaneously
 C. A battery has generally no liquid components
 D. A battery produces the same amount of electricity, regardless of composition
77. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of this reaction?
 A. 0 B. 1 C. 2 D. 3
78. Which of the following form of synthetic rubber can be vulcanized to greatly enhance its Mechanical strength?
 A. Neoprene B. Isoprene C. Styrene butadiene rubber D. Butyl rubber
79. Which of the following statement is INCORRECT about chromium?
 A. Ferrochrome chromium and cobalt
 B. It is positive toward oxidizing acids like conc. H_2SO_4
 C. It is produced by reducing chromium (III) oxide with aluminum metal
 D. It is used for electroplating
80. What structural feature is usually needed to present in order for condensation polymer to be Produced?
 A. monomer molecules with the same functional group
 B. monomer molecules with a carbon-carbon sigma bond
 C. One dihydroxy alcohol molecule and one dicarboxylic acid molecule
 D. monomer molecules with two or more functional group

