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F - 1401

C.B.S.(Fourth Semester)
EXAMINATION, May-June, 2022
CHEMISTRY
(Properties of Matter)
(C-401)

Time : Three Hours] *[Maximum Marks: 40*

Note-Attempt all sections as directed.

Section - A
(Objective/Multiple Choice Questions)
(0.5 marks each)

Note-Attempt all questions.

Choose the correct answer :

1. An LPG(liquified petroleum gas) cylinder weighs 14.8 kg when empty. When full it weighs 29.0 kg and shows a pressure of 2.5 atm. In the course of use at 27ºC, the weight of the full cylinder reduces to 23.2 kg. Find out the volume of the gas in cubic meters used up at the normal usage conditions, and the final pressure inside the cyllinder. Assume LPG to the n-butane with normal boiling point of 0ºC.

   (A) 2.46

   (B) 1.52

   (C) 3.91

   (D) 4.25

2. Calculate the pressure exerted by one mole of carbon dioxide gas in a 1.32 dm^3 vessel at 48^0 C using van der Waals equation. The van der Waals constants are:

   $a=3.59\ dm^6\ atm\ mol^{-2}$ and $b= 0.0427 dm^3\ mol^{-1}$.

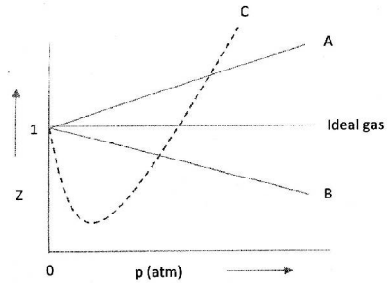
   (A) 15.23atm

   (B) 18.56atm

   (C) 17.23atm

   (D) 20.49atm

3. The given graph represent the variation of (compressibility factor(z)= pV/nRT) versus p, for three real gases, A,B and C. Identify the only incorrect statement.



   (A) For the gas A, a=0 and its dependence on p is linear at all pressure

   (B) For the gas B, b=0 and its dependence on p is linear at all pressure

   (C) For the gas C, which is typical real gas for which neither a nor b=0. By knowing the minima and the point of intersection, with Z=1, a and b can be calculated

   (D) At high pressure, the slope is positive for all real gases.

4. At 27^0C, hydrogen is leaked through a tiny hole into a vessel for 20 min. Another unknown gas at the same temperature and pressure as that of hydrogen is leaked through same hole for 20 min. After the effusion of the gases the mixture exerts a pressure of 6 atm. The hydrogen content of the mixture is 0.7 mole. If the volume of the container is 3L What is the molecular weight of the unknown gas?

   (A) 1000 g mol^{-1}

   (B) 1200 g mol^{-1}

   (C) 1020 g mol^{-1}

   (D) 1002 g mol^{-1}

5. Consider two liquits A and B such that A has half the surface tension and twice the density of B. If liquid A rises to a height of 2.0 cm in a capillary, what will be the height to which liquid B will rise in the same capillary?

   (A) 0.80m

   (B) 0.08m

   (C) 0.04m

   (D) 0.40m

6. The refractive index of CCl_4 at 20^0C is 1.4573. If its density at the given temperature is 1.595g cm^{-3}, calculate the molar refraction.

   (A) 20.95

   (B) 25.85

   (C) 45.97

   (D) 26.51

7. Acetic acid has a normal boiling point of 118^0C and a ΔH_{vap} of 23.4 kJ/mol. What is the vapour pressure (in mmHg) of acetic acid at 25^0C?

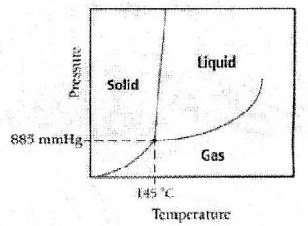
   (A) 2.92×10^{-39}mmHg

   (B) 7.16×10^{3}mmHg

   (C) 758mmHg

   (D) 80.6mmHg

8. Consider the phase diagram shown here. A sample of the substance in the phase diagram is initially at 175 ^{0}C and 925 mmHg. What phase transition occurs when the pressure is decreased to 760 mmHg at constant temperature?



(A) Solid to liquid

(B) Liquid to gas

(C) Solid to gas

(D) Liquid to solid

9. A power pattern of MgO, known to crystallize in the cubic system, shows diffraction lines at $\sin\theta$ values of 0.1461, 0.1690, 0.2801, 0.2801, 0.2935 and 0.3697. Determine the lattice type of MgO.

(A) s.c.c.

(B) b.c.c.

(C) f.c.c.

(D) none

10. In the ccp packing, the number of lattice points per unit area in the planes is in the order:

(A) (100)>(110)>(111)

(B) (100)>(111)>(110)

(C) (111)>(100)>(110)

(D) (111)>(110)>(110)

11. Polonium is the only metal known to exist in a simple cubic lattice form. The density of polonium at 0 ^{0}C is measured to be 10.00 g/cm^3. The atomic radius of polonium would then be (assume the mass of a polonium atom=2.7×10^{-22}g)

(A) $1.1\mathring{A}$

(B) $1.9\mathring{A}$

(C) $1.5\mathring{A}$

(D) $2.3\mathring{A}$

12. When Si is doped with a Group V element:-

(A) Donor levels are created close to the valence band

(B) Donor levels are created close to the conduction band

(C) Aceptor levels are created close to the valence band

(D) Acceptor levels are created close to the conduction band

13. When river water containing colloidal clay flows into the sea, the major cause of silting is:-

(A) Accumulation of sand at the bottom

(B) Flocculation and coagulation

(C) Decreased salinity of sea water

(D) Micellization

14. Stability of lyophobic dispersions is determined by

(A) Inter-particle electric double layer repulsion and intra-particle Van der Walls attraction

(B) Inter-particle electric double layer attraction and intra-particle Van der Waals repulsion

(C) Inter-particle excluded volume repulsion and intra-particle Van der Waals attraction

(D) Inter-particle excluded volume attraction and intra-particle Van der Waals repulsion

15. Michael Farady observed that the colour of colloidal suspensions of gold nanoparticles changes with the size of the nanoparticles. This is because:-

(A) gold forms complex with the solvent

(B) band gap of gold changes with size of the nanoparticle

(C) gold in nanocrystalline form undergoes transmutation to other elements

(D) Colloidal suspensions diffract light

16. The potential difference between the fixed charged layer and the diffused layer having opposite charge is called:-

(A) Zeta potential

(B) Streaming potential

(C) Dorn potential

(D) Colloidal potential

17. During purification of colloidal sol by ultracentrifugation which of the following is observed:-

(A) Impurities are settled at the bottom of the ultracentri fuge tube

(B) Impurities are removed through ultrafilters

(C) It's rate can be increased by applying pressure

(D) Colloidal particles are settled at the bottom of the ul tracentrifuge tube

18. The volume of a gas adsorbed on a solid surface is 10.0mL, 11.0mL,11.2mL,14.5mL and 22.5mL at 1.0,2.0,3.0,4.0 and 5.0 atm. pressure, respectively. These data are best represented by:-

(A) Gibbs's isotherm

(B) Langmuir isotherm

(C) Freundlich isotherm

(D) BET isotherm

19. A 5 g/L polymer solution is prepared with a polymer whose molar mass is 25 kg. the osmotic pressure(in atm) of this solution at 25^0C is (consider RT=2500 $Jmol^{-1}$):-

(A) 0.002

(B) 0.05

(C) 0.005

(D) 0.008

20. There are several types of mean molar masses for polymer and they are dependent on experimental methods like:

1. Osmometry
2. Light scattering
3. Sedimentation

Correct relation between mean molar masses and experimental method is:

(A) $\overline{M}n \Rightarrow (3), \overline{M}w \Rightarrow (2), \overline{M}z \Rightarrow (1)$

(B) $\overline{M}n \Rightarrow (2), \overline{M}w \Rightarrow (3), \overline{M}z \Rightarrow (1)$

(C) $\overline{M}n \Rightarrow (1), \overline{M}w \Rightarrow (2), \overline{M}z \Rightarrow (3)$

(D) $\overline{M}n \Rightarrow (1), \overline{M}w \Rightarrow (3), \overline{M}z \Rightarrow (2)$

Section - B

(Very Short Answer Type Question)

(0.75 marks each)

Note: -Attempt all questions.

1. Explain mean free path of gaseous molecules increases and number of collisions per unit time decreases with lowering of temperature.
2. Write the significance of Dieterici equation and Berthelot's equation.
3. Explain an ideal gas is not expected to show any cooling on free expansion.
4. Briefly define addition of detergents decreases the surface tension of water.
5. Why are the X-rays suitable for determining the crystal structure?
6. List and describe the symmetry elements of C_6H_6.
7. Why are lyophilic sols more stable than lyophobic sols?
8. Discuss the origin of charge on colloidal particles. What is meant by electrical double layer?
9. What is depression in freezing point? How is molecular weight of a dissolved substance determined with this method?

10. Kismis swells in water but grape shrinks in a concentrated sugar solution. Why?

Section-C

(Short Answer Type Questions)

(1.25 marks each)

Note- Attempt all questions.

1. Derive the expression for kinetic theory of gases pv= $\frac{1}{3}mNc^2$. Why is this theory is called kinetic theory?
2. What is the mean free path λ for oxygen molecules at temperature T= 300K and P=1.00 atm? Assume that the molecular diameter d=290 pm and the gas is ideal.
3. Define the term vapour pressure of liquid. Explain why the vapour pressure of liquid increases with increase in temperature and why a liquid cool down on evaporation.
4. The radius of a given capillary is 1.05×10^{-4}m. A liquid whose density is 0.80g/cm^3 rises up to a height of 6.25×10^{-2}m, calculate the Surface tension of liquid assuming the contact angle to be zero.
5. Describe different planes in primitive, face centered and body centered cubic crystals.
6. Explain how metallic conductors and semiconductors are identified. Discuss their properties in terms of Band theory.

7. Most of the medicines are prepared in colloidal state. Why? Write the name of any two such medicines.
8. Discuss the optical and electrical properties of colloidal system.
9. Explain Brownian movement. What is its effect on viscocity?
10. On adding mercuric iodide in aqueous Potassium iodide solution, its vapour pressure sure increases. Why?

Section-D

(Long Answer Type Questions)

(2 marks each)

Note-Attempt all questions.

1. Write the mathematical expression for the Maxwell distribution of molecular speeds for a gas and explain briefly the terms involved. Derive the mathematical expression for the most probable speed of a gas molecule.

OR

Starting from the Van der Waals equation, derive the relations

$a=27R^2T_c^2/64P_c$ and $b=RT_c/8P_c$ Where T_c and P_c are critical temperature and critical pressure of the gas and 'a' and 'b' are Van der Waals constants.

2. Derive the formula for the coefficient of viscosity of liquid. What will happen to the viscosity of a liquid if the radius of the capillary of the viscometer used for its measurement is doubled?

OR

Establish the structure of benzene based on parachor values.

Atomic Parachors		Structual Parachors	
Atom	Parachor	Structure	Parachor
C	4.8	Double bond	23.2
H	17.1	6-membered ring	6.1

3. What are Millar indices? Why are these preferred over the Weise indices for the designation of planes in a crystal? Write the Millar indices of the planes with intercepts:

1. 0a,2b,2c
2. a, 1/3b,1/4c
3. -2a,3b,4c
4. 1a,3b,-1c

OR

(a) Derive Bragg's equation $n\lambda = 2d\sin\theta$ and explain its importance.

(b) The (002) plane of an elemental FCC crystal diffracts X-rays(λ =0.154nm) at Bragg angle 90^0. The density of the crystal is $4\times10^4 kgm^{-3}$. Find the atomic weight of the elemental solid.

4. Describe Zeta potential. How to determine Zeta potential by electrophoresis and electroosmotic methods.

OR

(a) Describe chemical method for the preparation of colloidal solution giving example.

(b) What are protective colloids? Explain how a lyophilic colloid can stabilize a lyophobic colloid? Write a note on 'Gold Number'.

5. What are the basic difference between Macromolecules and Polymers. Determine the molar mass of macromolecules by sedimentation method.

OR

Considering complete dissociation in 0.1M aqueous sugar solution, 0.1 M NaCl and 0.1 M $BaCl_2$solution. Given the answers of the following with reason:

(a) At constant temperature, whose vapour pressure in minimum?

(b) At one atmospheric pressure, whose boiling point will be minimum?

[15]

(c) At one atmospheric pressure, whose freezing point will be the highest?

(d) What will be the decreasing order of their Osmotic pressure?