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CUET PG - CHEMISTRY PYQ

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SECTION – I

PHYSICAL CHEMISTRY

PHYSICAL CHEMISTRY: NUMBER OF QUESTIONS ASKED IN CUET PG EXAM (2022 to 2023)			
	Topic	**2022**	**2023**
1	**Gaseous State**	3	-
2	**Liquid State**	-	-
3	**Ionic Equilibria**	-	-
4	**Solid State**	4	2
5	**Thermodynamics**	5	2
6	**Thermochemistry**	1	-
7	**Second Law**	-	1
8	**Free Energy Functions**	-	1
9	**Partial molar quantities**	-	-
10	**Dilute solutions or Colligative Properties**	1	-
11	**Molecular Spectroscopy & Photochemistry**	3	3
12	**Chemical Kinetics**	3	2
13	**Catalysis**	-	1
14	**Surface Chemistry**	-	2
15	**Phase Equilibria**	-	1
16	**Introduction to Quantum Chemistry**	2	5
17	**Conductance**	-	1
18	**Electrochemistry**	4	3

CHAPTER-1
PHYSICAL CHEMISTRY

GASEOUS STATE

PREVIOUS YEAR EXAM QUESTIONS / PRACTICE QUESTIONS

[CUET PG]

[CUET- PG 2022]

1. Gases A, B, C and D obey the vander Waals equation with 'a' and 'b' values as given (liter-atm system of units of):

	A	B	C	D
A	6	6	6	6
B	1	2	3	4

The gas _____ has the highest critical temperature.
(1) B (2) C
(3) A (4) D

[CUET- PG 2022]

2. What is the effect of pressure in the following equilibrium reaction: $N_2 + O_2 \rightleftharpoons 2NO$
(1) Reaction moves in the forward direction with increasing pressure.
(2) Reaction moves in the backward direction with increasing pressure.
(3) Reaction remains unaltered with increasing pressure.
(4) None of the above

[CUET- PG 2022]

3. When a sample of NO_2 is placed in a container, this equilibrium is rapidly established:
$2NO_2(g) \rightleftharpoons N_2O_4(g)$
If this equilibrium mixture is a darker colour at high temperature and at low pressures, which one of these statements about the reaction is true?
(1) The reaction is endothermic and N_2O_4 is darker in colour than NO_2.
(2) The reaction is endothermic and NO_2 is darker in colour than N_2O_4.
(3) The reaction is exothermic and N_2O_4 is darker in colour than NO_2.
(4) The reaction is exothermic and NO_2 is darker in colour than N_2O_4.

Answer Key		
1	**2**	**3**
3	3	4

[PRACTICE QUESTIONS]

1. The average translational kinetic energy of Oxygen molecule at 300 K is
(1) $6.21 \times 10^{-21}\ J$
(2) $6.21 \times 10^{-23}\ J$
(3) $4.14 \times 10^{-23}\ J$
(4) $4.14 \times 10^{-21}\ J$

2. The vapour of a pure substance, when cooled under a pressure less than its triple point pressure
(1) liquefies
(2) liquefies first and then solidifies
(3) remains unchanged
(4) solidifies directly

3. The Henry's Law constants (K_H) for a few gases are given below:
$K_H(H_2) = 69.2\ kbar; K_H(N_2) = 75.4\ kbar; K_H(O_2) = 34.9\ kbar; K_H(Ar) = 40.3$ kbar at $T = 293\ K$
The mole fraction of a certain gas X in aqueous solution is 1.3×10^{-5}. The gas X exerts a partial pressure of 0.98 bar at $T = 293\ K$. The gas X is
(1) H_2 (2) N_2
(3) O_2 (4) Ar

4. The rate constant of the gas phase reaction $K + Br_2 \rightarrow KBr + Br$ follows the Arrhenius form $k = Ae^{\frac{E_a}{RT}}$. The experimental value of A is 1.0×10^{12} L mol^{-1} s^{-1}, and the value of A calculated from collision theory is $2.1 \times 10^{11}\ L\ mol^{-1}\ s^{-1}$. The value of steric factor for this reaction is
(1) 0.21 (2) 12.1×10^{11}
(3) 4.8 (4) 2.0

5. When the pressure is increased from 0.5 bar to 1.5 bar, the melting point of ice
(1) increases
(2) remains same
(3) decreases
(4) reaches critical point

6. The ratio of the mean speed of an oxygen molecule to the r.m.s. speed of a nitrogen molecule at the same temperature is (Molecular wt of $O_2 = 32\ gmol$; Molecular wt of $N_2 = 28\ gmol^{-1}$)
(1) $\left(\frac{3\pi}{7}\right)^{\frac{1}{2}}$ (2) $\left(\frac{7}{3\pi}\right)^{\frac{1}{2}}$
(3) $\left(\frac{3}{7\pi}\right)^{\frac{1}{2}}$ (4) $\left(\frac{7\pi}{3}\right)^{\frac{1}{3}}$

7. The density of SO_3 gas at $35°C$ and 715 torr is
(1) $0.03\ g\ L^{-1}$ (2) $1.43\ g\ L^{-1}$
(3) $2.15\ g\ L^{-1}$ (4) $2.98\ g\ L^{-1}$

8. Velocity of He molecule at a given temperature is 40 miles s' What will be the velocity of O_2 at the same temperature?
(1) $7.07\ mile\ s^{-1}$ (2) $14.14\ mile\ s^{-1}$
(3) $28.28\ mile\ s^{-1}$ (4) $42.42\ mile\ s^{-1}$

9. The number of vibrational (regular) degrees of freedom in a non-linear activated complex containing N atoms is
(1) $3N-5$ (2) $3N-6$
(3) $3N-7$ (4) $3N-8$

10. Which of the following gas will have the lowest rate of diffusion?
(1) H_2 (2) N_2
(3) F_2 (4) O_2

11. The compressibility factor (z) for an ideal gas is
(1) Zero (2) > 1
(3) < 1 (4) 1

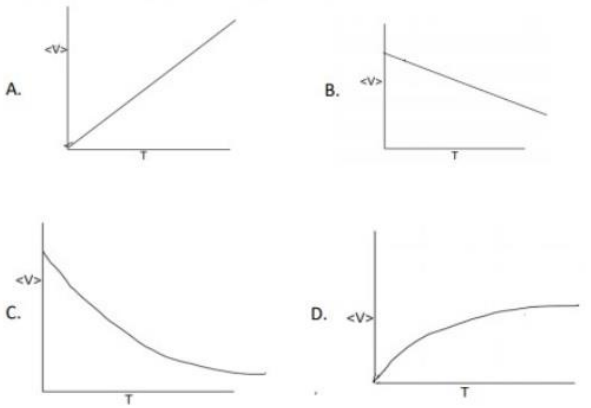
12. The root mean square velocity of a certain gas at 27°C is x m sec^{-1}. Its root mean square velocity at 927°C is:
(1) x/2 m sec^{-1} (2) 2x m sec^{-1}
(3) 3x m sec^{-1} (4) 4x m sec^{-1}

13. The Maxwell's relationship derived from the equation, $dE = TdS - PdV$ is:
(1) $\left(\frac{\partial T}{\partial V}\right)_S - \left(\frac{\partial P}{\partial S}\right)_V$ (2) $\left(\frac{\partial P}{\partial V}\right)_T = -\left(\frac{\partial T}{\partial S}\right)_P$
(3) $\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$ (4) None of these

14. According to the kinetic theory of gasses, the ratio of the root mean square velocity of molecular oxygen and molecular hydrogen at 300 K is
(1) 1 :1 (2) 1 :2√2
(3) 1 :4 (4) 1 :16

15. If drops do not collapse under the effect of gravity, it indicates that
(1) the pressure inside the drop is greater than outside of the drop
(2) viscosity of the liquid is large
(3) the surface tension is low
(4) the pressure outside the drop is greater than inside of the drop

16. Considering the Maxwe ll's distribution of molecules of a gas, which one of the following graphs is a qualitative representation of average speed of molecules with change in absolute temperature?



(1) Figure A (2) Figure B
(3) Figure C (4) Figure D

17. The value of van der Waals constants $'a'$ for some gases given as

Gas	a(L.atm.mol^{-2})
N_2	1.390
O_2	1.360
NH_3	4.170
CH_4	2.253

The order of liquefaction of these gases is
(1) $N_2 > O_2 > NH_3 > CH_4$
(2) $NH_3 > CH_3 > N_2 > O_2$
(3) $NH_3 < CH_4 < N_2 < O_2$
(4) $N_2 < O_2 < NH_3 < CH_4$

Answer Key									
1	2	3	4	5	6	7	8	9	10
3	4	2	3	3	2	3	2	3	3
11	12	13	14	15	16	17			
4	2	1	3	1	4	2			

EXPLANATIONS

[CUET PG]

1. Correct Answer is 3:-

$T_c = \frac{8a}{27Rb}$

If a increase and b decreases T_c increase.

2. Correct Answer is 3:-

If $\Delta n_g = 0; independent\ on\ P\ and\ V$

Here, $\Delta n_g = 2 - 1 = 0$

3. Correct Answer is 4:-

$\Delta n_g = 1 - 2 = -1$

$\Delta n_g < 0; at\ high\ pressure\ low\ volume$

At low pressure reaction goes to backward direction. More NO_2 formed.

[PRACTICE QUESTIONS]

1. Correct Answer is 1:-

$K.E = \frac{3}{2}\ KT$

$= \frac{3}{2} \times 1.38 \times 10^{-23}$

$= 6.21 \times 10^{-21} J$

2. Correct Answer is 4:-

3. Correct Answer is 2:-

$P_A = X_A . P_0$

$0.98 = 1.3 \times 10^{-5} \times P_0$

$P_0 = 75.4\ Kbar$

4. Correct Answer is 3:-

$steric\ factor = \frac{A_{exp.}}{A_{Collision}}$

$= \frac{1 \times 10^{12}}{2.1 \times 10^{11}}$

$= 4.8$

5. Correct Answer is 3:-

if pressure increases, melting point decrease.

6. Correct Answer is 2:-

$V_{rms} = \sqrt{\frac{3RT}{M\pi}}$

$V_{rms} \propto \frac{1}{\sqrt{M\pi}}$

$\frac{V_{O_2}}{V_{N_2}} = \frac{\sqrt{\frac{8RT}{32\pi}}}{\sqrt{3RT/28}} = \sqrt{\frac{7}{3\pi}}$

$= \left(\frac{7}{3\pi}\right)^{\frac{1}{2}}$

7. Correct Answer is 3:-

$P_m = dRT$

$\frac{715}{760} = d \times 0.082 \times 308k$

$d = \frac{715}{760 \times 0.082 \times 308k} = 2.15 g/L$

8. Correct Answer is 2:-

$V = \sqrt{\frac{3RT}{m}}$

$\frac{V_{He}}{V_{O_2}} = \sqrt{\frac{m_{O_2}}{m_{He}}}$

$\frac{40}{V_{O_2}} = \sqrt{\frac{32}{4}}$

$\frac{40}{V_{O_2}} = \sqrt{8}$

$V_{O_2} = 14.14 miles\ s^{-}$

9. Correct Answer is 3:-

10. Correct Answer is 3:- The rate of diffusion of a gas is inversely proportional to the square root of its molar mass. This means, heavier gases diffuse slower than lighter gases.

Among the listed options, F2 has the highest molar mass (38 g/mol) compared to H2 (2 g/mol), N2 (28 g/mol), and O2 (32 g/mol).

Therefore, according to Graham's Law of Diffusion, F2 will have the lowest rate of diffusion.

11. Correct Answer is 4:-

The compressibility factor (z) is defined as the ratio of the actual volume of a gas to the volume it would occupy as an ideal gas at the same temperature and pressure.

For an ideal gas, the gas particles are assumed to be point-sized with no intermolecular forces. Therefore, there's no attraction or repulsion between particles, and they effectively have zero volume themselves.

Consequently, the actual volume of an ideal gas will be directly proportional to the number of moles (n), temperature (T), and inversely proportional to the pressure (P), as represented by the ideal gas law: PV = nRT.

Since the ideal gas law holds true for ideal gases, dividing both sides by nRT gives us: z = PV / nRT = 1.

Hence, the compressibility factor for an ideal gas is always equal to 1.

12. Correct Answer is 2:-

$V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{rms} \propto \sqrt{T}$

$\frac{(V_r)_2}{(V_{rms})_1} = \sqrt{\frac{1200}{300}} = 2$

$(V_{rms})_2 = 2x$

13. Correct Answer is 1:-

According to Euler theorem;

$dE = \left(\frac{dT}{dv}\right)_S - \left(\frac{dP}{dS}\right)_V$

14. Correct Answer is 3:-

$v_{rms} = \sqrt{\frac{1}{m}}$

$v_{\frac{O_2}{H_2}} = \sqrt{\frac{m_{H_2}}{m_{O_2}}}$

$= \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = 1:4$

15. Correct Answer is 1:- when a drop remains stable despite gravity's pull, it signifies that the internal pressure, primarily due to surface tension, is sufficiently higher than the external pressure, maintaining the droplet's integrity.

16. Correct Answer is 4:-

$average\ speed(v) = \sqrt{\frac{8RT}{\pi m}}$

$v_{avg} \propto T^{1/2}$

17. Correct Answer is 2:- A is used molecular attraction. More is the attraction, gas easily liquefy.

$a \propto \frac{1}{L.P}$