2024

(NEP-2020) (2nd Semester)

CHEMISTRY (MAJOR/MINOR)

(Physical Chemistry—I)

Full Marks: 75

Time: 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A-OBJECTIVE)

(Marks: 10)

Tick (✓) the correct answer in the brackets provided:

 $1 \times 10 = 10$

- 1. For an ideal gas under all conditions of temperature and pressure, the compressibility factor Z is equal to
 - (a) less than one ()
 - (b) greater than one (
 - (c) unity ()
 - (d) None of the above ()

2. For 1 mole of a gas, the kinetic energy is given by (a) E = 5/2RT(b) E = 3/2RT() (c) E = 1/2 RT(d) E = 7/2RT3. A drop of liquid appears spherical in shape due to (a) surface tension (b) evaporation (c) condensation () (d) None of the above (4. The refractive index of a liquid depends upon (a) temperature ((b) density of the liquid (c) wavelength of the light used ()

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(d) All of the above (

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5	. Th	ne charge on As ₂ S ₃ sols is due to
	(a)	the adsorption of S^{2-} ions ()
	(b)	the adsorption of O^{2-} ions ()
	(c)	the absorption of S^{2-} ions ()
	(d)	the adsorption of As ³⁺ ions ()
5.	Wh	nich method is preferred for the preparation of gold sol?
	(a)	Oxidation ()
	(b)	Double decomposition ()
	(c)	Reduction ()
	(d)	Hydrolysis ()
٠.	Fre	undlich adsorption isotherm is applicable only at
	(a)	room temperature ()
	(b)	273 K ()
	(c)	high pressure ()
	(d)	low pressure ()

8.	8. In a chemical reaction, how does t with time?	he concentration of reactant change
	(a) Decreases ()	,
	(b) Increases ()	
	(c) Remains unchanged ()	
	(d) Increases and then decreases	()
9.	9. The unit of rate constant for a second	ond-order reaction is
	(a) s^{-1} ()	
	(b) $\text{mol}^{-1} \text{ s}^{-1}$ ()	
	(c) $\text{mol}^{-1} \text{ L s}^{-1}$ ()	
	(d) $L s^{-1}$ ()	
10.	 On increasing the substrate concentrate catalyzed reaction changes from 	ration, the reaction rate of an enzyme-
	(a) zero-order to first-order ()
	(b) second-order to first-order	()
	(c) first-order to zero-order ()
	(d) first-order to second-order	()

(SECTION : B-SHORT ANSWERS)

(Marks: 15)

Answer five questions, taking at least one from each Unit:

 $3 \times 5 = 15$

UNIT-I

- 1. How does the compressibility factor vary with pressure?
- 2. State and explain the law of corresponding states.

UNIT-II

- 3. What do you mean by free volume in liquid?
- 4. Explain the terms (a) refractive index and (b) specific refraction.

UNIT-III

- 5. Differentiate between lyophilic colloid and lyophobic colloid.
- 6. Explain Freundlich adsorption isotherm.

UNIT-IV

- 7. What do you mean by order and molecularity of a reaction?
- 8. Write an equation for half-life period of a first-order reaction. Why is it independent of initial concentration?

(SECTION : C-DESCRIPTIVE)

(Marks : 50)

Answer five questions, taking at least one from each Unit:

10×5=50

UNIT-I

- 1. (a) Starting from the basic postulates, derive the kinetic gas equation.
 - (b) Calculate the pressure exerted by 88 g of CO₂ in an 8-litre vessel at 27 °C by using—
 - (i) the ideal gas equation;
 - (ii) van der Waals' equation.

(Given : a = 3.6 atm.litre mol⁻², b = 0.024 litre mol⁻¹ and R = 0.082 litre atm K⁻¹ mol⁻¹)

- 2. (a) What is excluded volume? Show that it is four times the actual volume of the gas molecules.
 - (b) Evaluate the critical constants from van der Waals' equation.

UNIT-II

- 3. (a) Describe the vacancy theory of liquids.
 - (b) Define surface tension. What are the effects of temperature on the surface tension of a liquid?

 1+4=5
- (a) Define liquid crystal. Differentiate clearly between smectic and nematic liquid crystals.
 - (b) Explain the effects of temperature on the viscosity of a liquid.

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UNIT-III

5.	(a)	Write	short	notes	on	the	following	:
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2+2=4

- (i) Tyndall effect
- (ii) Origin of charge on colloidal particle.
- (b) What are colloids? How are they classified based on (i) affinity for dispersion medium and (ii) their sizes? 2+(2+2)=6
- 6. (a) What are protective colloids? Explain how a lyophilic colloid protects lyophobic colloids.
 - (b) What is adsorption isotherm? Derive Langmuir adsorption isotherm.
 1+5=6

UNIT-IV

- 7. (a) Define zero-order reaction. Derive an expression for the rate constant and half-life period of a zero-order reaction.
 - (b) Explain activation energy. How is activation energy determined with the help of Arrhenius equation?
 2+3=5
- 8. (a) What are pseudo-unimolecular reactions? Determine the units of rate constant, k for—
 - (i) zero-order reaction;
 - (ii) first-order reaction;
 - (iii) second-order reaction;
 - (iv) third-order reaction.

1+(1×4)=5

(b) Write the characteristics of catalysis. Explain enzyme catalysis. 2+3=5

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(a)
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(b)
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(c)
$$E=1/2RT$$
 ()

(d)
$$E = 7/2RT$$
 (m)

ω A drop of liquid appears spherical in shape due to

(a)

surface tension

(d) None of the above

4. The refractive index of a liquid depends upon

6

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-	(c)	(4)	(a)	7. F.	(d)	(c)	<i>(a)</i>	(a)		(d)	(c)	<i>(b)</i>	(a)	The charge on As ₂ S ₃ sols is due
d) 1				reun					nich	the	the	the	the	cha
I wo	igh	273 K	mom	dlic	ydro	Reduction	oubl	Oxidation	met	ads	abs	ads	ads	urge
(d) low pressure	pres	^	tem	n ad	Hydrolysis	tion	de	ion	hod	dros	orpt	orpt	orpt	on /
sure	high pressure	_	pera	gorp	•		com		is p	tion	ion	ion	ion	4s ₂ S
		_	room temperature	tion	_		Double decomposition	_	refe	of A	the absorption of S ^{2–}	adsorption of O ^{2–}	the adsorption of S^{2-}	3 80
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(d)	(c)	<i>(b)</i>	(a)		(d)	(c)	<i>(b)</i>	(a)		(d)	(0)	<i>(b)</i>	(a)	ik H
first-order to second-order ()	first-order to zero-order ()	second-order to first-order ()	zero-order to first-order ()	On increasing the substrate concentration, the reaction rate of an enzymecatalyzed reaction changes from	$L s^{-1}$ ()	$mol^{-1} L s^{-1}$ ()	$mol^{-1} s^{-1}$ ()	s ⁻¹ ()	The unit of rate constant for a second-order reaction is	Increases and then decreases ()	Remains unchanged ()	Increases ()	Decreases ()	a chemical reaction, how does the concentration of reactant change th time?

(SECTION : B—SHORT ANSWERS)

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4. Explain the terms (a) refractive index and (b) specific refraction.

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(Marks: 50)

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UNIT-I

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- (ii) van der Waals' equation.
- mol^{-1} litre b = 0.024 mol^{-2} , $R = 0.082 \text{ litre atm } \text{K}^{-1} \text{ mol}^{-1}$ atm.litre $\alpha = 3.6$.. (Given

S

and

- 5 What is excluded volume? Show that it is four times the actual volume of the gas molecules. (a) Ŕ
- 2 Evaluate the critical constants from van der Waals' equation. (g)

UNIT-II

Define surface tension. What are the effects of temperature on the Describe the vacancy theory of liquids. (a) *(a)* e,

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1+4=5

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- 1+4=5 Define liquid crystal. Differentiate clearly between smectic and nematic liquid crystals. (a 4
- Explain the effects of temperature on the viscosity of a liquid. *(a)*

S

SECTION: C-DESCRIPTIVE

(Marks: 50

Answer five questions, taking at least one from each Unit:

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g of CO_2 in an 8-litre vessel Starting from the basic postulates, derive the kinetic gas equation. Calculate the pressure exerted by 88 at 27 °C by using-(a) (g) H

5

- gas equation; van der Waals' the ideal Ξ
- b = 0.024 mol^{-2} , $R = 0.082 \text{ litre atm } \text{K}^{-1} \text{ mol}^{-1}$ atm.litre a = 3.6.. (Given

equation.

5

and

 mol^{-1}

litre

- S What is excluded volume? Show that it is four times the actual volume (a) 'n
 - Evaluate the critical constants from van der Waals' equation. of the gas molecules. (*q*)

5

UNIT-II

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UNIT-III

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- Tyndall effect Œ
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- 2+(2+2)=6 colloids? How are they classified based on (i) affinity for dispersion medium and (ii) their sizes? What are (q)
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- 1+5=6What is adsorption isotherm? Derive Langmuir adsorption isotherm. (p)

UNIT-IV

- 1+4=5Define zero-order reaction. Derive an expression for the rate constant and half-life period of a zero-order reaction. 7. (a)
- 2+3=5 Explain activation energy. How is activation energy determined with the help of Arrhenius equation? (q)
- What are pseudo-unimolecular reactions? Determine the units of rate constant, k for-8. (a)
- zero-order reaction;
- first-order reaction;
- Ξ
- third-order reaction. (iv)

second-order reaction;

(iii)

 $1+(1\times4)=5$

2+3=5Write the characteristics of catalysis. Explain enzyme catalysis. (q)

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