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**3 SEM TDC CHMH (CBCS) C 7**

**2 0 2 5**

( Nov/Dec )

**CHEMISTRY**

( Core )

Paper : C-7

**( Physical Chemistry )**

*Full Marks : 53*

*Pass Marks : 21*

*Time : 3 hours*

*The figures in the margin indicate full marks  
for the questions*

1. Choose the correct answer : 1×5=5

(a) For a reaction,  $nA + mB \rightarrow$  products,  
the rate law is  $\frac{dP}{dt} = k[A][B]$ . The order  
of the reaction is

(i) 0

(ii) 1

(iii) 2

(iv)  $n + m$

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- (b) The half-life period of a first-order reaction is 10 minutes. The time required for the concentration of the reactant to change from 0.4 M to 0.1 M is
- (i) 10 minutes
  - (ii) 20 minutes
  - (iii) 30 minutes
  - (iv) 40 minutes
- (c) In a single-component system, if degrees of freedom are zero, the maximum number of phases that can coexist is
- (i) 1
  - (ii) 2
  - (iii) 3
  - (iv) 0
- (d) Which is correct regarding phase diagram of water?
- (i) Fusion curve of ice has positive slope and sublimation curve has a negative slope.
  - (ii) Fusion curve of ice has negative slope and sublimation curve has a positive slope.

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- (iii) Both fusion curve and sublimation curve have a positive slope.
  - (iv) Both fusion curve and sublimation curve have a negative slope.
- (e) Which of the following statements regarding catalyst is not correct?
- (i) A catalyst remains unchanged at the end of the reaction.
  - (ii) A catalyst can initiate a reaction.
  - (iii) A catalyst does not alter the equilibrium in a reversible reaction.
  - (iv) Catalysts are sometimes very specific in terms of reactions.

2. Answer any five from the following questions : 2×5=10

- (a) What is a condensed system? Write the reduced phase rule equation. 1+1=2
- (b) With suitable examples, discuss what you mean by molecularity and order of a reaction. 1+1=2
- (c) What is half-life period ( $t_{1/2}$ ) of a reaction? Write the expression of  $t_{1/2}$  for a first-order reaction. 1+1=2

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- (d) Is it possible to have a quadruple point in a phase diagram for one-component system? Explain. 2
- (e) Write the differences between adsorption and absorption. 2
- (f) A catalyst does not alter the equilibrium in a reversible reaction. Explain. 2
3. Answer any three from the following questions : 4×3=12
- (a) Draw and explain the phase diagram of water system. 4
- (b) Define phase, component and degrees of freedom. Write the relationship among phase, component and degrees of freedom. 3+1=4
- (c) Determine the number of components for the following systems : 1×4=4
- (i)  $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$   
where,  $p_{\text{NH}_3} = p_{\text{HCl}}$
- (ii)  $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$   
where,  $p_{\text{NH}_3} \neq p_{\text{HCl}}$
- (iii)  $\text{NH}_4\text{Cl}(\text{s}) \rightarrow \text{NH}_3(\text{g}) + \text{HCl}(\text{g})$   
where,  $p_{\text{NH}_3} \neq p_{\text{HCl}}$
- (iv)  $\text{Ice}(\text{s}) \rightleftharpoons \text{Water}(\text{l}) \rightleftharpoons \text{Water vapour}(\text{g})$

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- (d) What is eutectic point? Discuss it with the example of phase diagram of lead-silver system. 1+3=4
- (e) Write short notes on any two of the following : 2×2=4
- (i) Nernst distribution law
- (ii) Effect of impurity on critical solution temperature
- (iii) Incongruent melting point
4. Answer any three from the following questions : 4×3=12
- (a) Derive the expression for rate constant for a first-order reaction. 4
- (b) Show that for a first-order reaction, the time required for 99.9% of the reaction to take place is about ten times than that required for half the reaction. 4
- (c) In the light of Arrhenius equation, explain the effect of temperature on the rate of chemical reaction. How is the activation energy of a reaction determined? 3+1=4

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( Turn Over )

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- (d) (i) What do you mean by pseudo first-order reaction? Give example. 2
- (ii) Write the differential rate equations for the following elementary reactions : 2
- (1)  $A + 2B + 3C \rightarrow \text{Products}$
- (2)  $A + 3B \rightarrow 2C + D + 2E$
5. Answer any three from the following questions : 3×3=9
- (a) Discuss the mechanism of heterogeneous catalysis. 3
- (b) Discuss the working of a catalyst with the help of suitable diagram. 3
- (c) What is enzyme catalysis? Write three characteristics of enzyme catalysis. 1½+1½=3
- (d) Write a short note on any one of the following : 3
- (i) Role of nano materials in catalysis
- (ii) Catalytic promoters and catalytic poisons

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6. Answer any one from the following questions : 5
- (a) (i) Discuss the Freundlich adsorption isotherm of a gas on a solid. 3
- (ii) What are adsorbate and adsorbent? Give examples. 2
- (b) (i) Write the main points of Langmuir theory of adsorption. 3
- (ii) Discuss the effect of temperature on the adsorption of gases on solids. 2

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