

SECOND SEMESTER B.Sc. DEGREE EXAMINATION, MAY 2010

(CCSS Programme)

Chemistry—Complementary Course

CH 2 C03—INORGANIC AND PHYSICAL CHEMISTRY

Maximum : 30 Weightage

Time : Three Hours

I. Answer *all* the questions. Each question has a weightage of $\frac{1}{4}$. Questions in this section will be multiple choice type :

- 1 Which of the following is the most energetic electromagnetic radiation ?
(a) Ultraviolet. (b) Infrared.
(c) Gamma rays. (d) X-rays.
- 2 Which of the following is not used as a unit of energy ?
(a) m^{-1} . (b) m .
(c) m^2 . (d) s^{-1} .
- 3 NMR spectroscopy is associated with nuclei having a spin value of :
(a) zero. (b) $\frac{1}{2}$.
(c) 1. (d) greater than 2.
- 4 Which of the following symmetry elements is/are there for a cubic crystal ?
(a) Axis of symmetry. (b) Plane of symmetry.
(c) Centre of symmetry. (d) All these.
- 5 X-rays are used to probe into the structure of crystals since :
(a) X-rays are of high energy.
(b) X-rays have long wavelength.
(c) Wavelength of X-rays are comparable to the diameter of crystal particles.
(d) All these.
- 6 The temperature at which a crystal will change into a liquid crystal is called :
(a) melting point. (b) boiling point.
(c) transition point. (d) freezing point.

Turn over

7. A light nucleus with n/p ratio lower than that of the stability belt is likely to emit :
- (a) alpha-particle. (b) beta particle.
(c) positron. (d) deuteron.
8. Which of the following represent a set of isotones ?
- (a) $^{23}_{11}\text{Na}$ and $^{24}_{12}\text{Mg}$. (b) $^{24}_{11}\text{Na}$ and $^{24}_{12}\text{Mg}$.
(c) $^{12}_6\text{C}$ and $^{14}_7\text{N}$. (d) $^{14}_7\text{N}$ and $^{16}_8\text{O}$.
9. Rate of a chemical reaction always increases with increase in :
- (a) Concentration. (b) Pressure.
(c) Temperature. (d) Intensity of radiation.
10. The half life of a zero order reaction is :
- (a) independent of initial concentration.
(b) inversely proportional to initial concentration.
(c) directly proportional to initial concentration.
(d) none of these.
11. Which of the following is an example of a homogeneous catalysis ?
- (a) HCl in the hydrolysis of an ester.
(b) Ni in the hydrogenation of oil.
(c) Spongy iron in the Haber process.
(d) V_2O_5 in the contact process.
12. The flash of light in the firefly is due to :
- (a) Fluorescence. (b) Phosphorescence.
(c) Chemiluminescence. (d) Reduction.

(12 × ¼ = 3 weightage)

II. Answer *all* the questions. Each question has a weightage 1 :

13. What is order of a reaction ? Write the integrated rate equation for a first order reaction.
14. Define rate constant of a reaction. What are the units of second order rate constant ?
15. The activation energy of a reaction is 40 kJ mol^{-1} and the enthalpy of the reaction is -20 kJ mol^{-1} . Calculate the activation energy of the backward reaction.
16. State and explain the Stark-Einstein law of Photochemistry.
17. What is mass defect ? Explain with an example.

- 18 Explain isotopes with examples.
- 19 State and explain the Braggs equation. $n\lambda = 2d \sin \theta$
- 20 Which of the following molecules will be microwave active ?
- (a) BF_3 . (b) NH_3 .
- (c) H_2O .
- 21 Calculate the energy of a photon of the electromagnetic radiation with a wavelength of 300 nm.

(9 × 1 = 9 weightage)

III. Answer any five questions. Each has a weightage of 2 :

- 22 Sketch the coarse NMR spectrum of ethanol and discuss. CH_3OH
- 23 The rotational energy spacing of a substance is 40 J mol^{-1} . Calculate the frequency required to effect rotational transition. $\Delta E = B[2(1+1) - 1(1+1)]$ $B = \frac{h^2}{8\pi^2 I}$
- 24 Explain Schottky and Frenkel defects.
- 25 The edge length of a body centered cubic crystal of an element is 200 pm. Calculate the radius of the atom of the element. $\frac{160}{2}$
- 26 The masses of a proton and a neutron are 1.00780 u and 1.00820 u respectively. Calculate the binding energy per nucleon of oxygen which has an atomic mass of 15.9989 u (1u = 931 MeV).
- 27 Discuss the intermediate compound formation theory of catalysis.
- 28 Differentiate between fluorescence and phosphorescence with suitable examples.

(5 × 2 = 10 weightage)

IV. Answer any two questions. Each question has a weightage of 4 :

- 29 Outline the collision theory of reaction rate. Mention its limitations.
- 30 (a) Discuss the swarm theory of liquid crystals. Give two examples of liquid crystals.
- (b) The carbon-14 activity of a freshly cut piece of wood is 16 beta particles per minute per gram carbon whereas a fossil emits 6 beta particles per minute per gram carbon. Calculate the age of the fossil if the half life of carbon-14 is 5760 years.
- 31 (a) Briefly outline the principle of infrared spectrum of a diatomic molecule.
- (b) Calculate the reduced mass of HCl molecule if the atomic mass of H and Cl atoms are 1.00 and 35.5 respectively.

(2 × 4 = 8 weightage)

$$\mu = \frac{m_1 m_2}{m_1 + m_2}$$

$$\mu = \frac{1 \times 35.5}{1 + 35.5}$$

$$\mu = \frac{35.5}{36.5} = 0.9726$$

$$\mu = 0.9726 \text{ u}$$

$$\mu = 0.9726 \times 931 = 905.7 \text{ MeV}$$

