QP Code : 03294

(2½ Hours) **[Total Marks : 75**

N.B. (1) **All** questions are **compulsory**.
(2) **Figures** to the **right** indicate **full** marks.
(3) Use of **logarithmic table / non-programmable** calculator is **allowed**.

Physical Constants
$N = 6.022 \times 10^{23}$
$k = 1.38 \times 10^{-23}\ JK^{-1}$
$F = 96{,}500$ coulombs
$R = 8.314\ J\ mol^{-1}\ K^{-1}$
$h = 6.625 \times 10^{-34}$ J. s.
$c = 3.1 \times 10^{8}\ ms^{-1}$

$\frac{2.303RT}{F} = 0.0592$ at 298 K

$\pi = 3.142$

1. Attempt any **three** of the following :—
   (a) State any three merits and two drawbacks of collision theory. **5**
   (b) With the help of neat labeled diagram explain the stop flow method used to study the kinetics of fast reactions. State the advantages of this method. **5**
   (c) Explain the low resolution NMR spectrum of methanol and ethanol. **5**
   (d) Discuss the viscocity method of determining molar mass of polymers. **5**
   (e) A polymer sample is composed of chains of three distinct molecular weights 2×10^4, 3×10^4 and 4×10^4 in the ratio 1 : 2 : 1. **5**
   Calculate $\overline{M}_n$ and $\overline{M}_w$
   (f) Explain the following terms with suitable diagrams in NMR spectroscopy : **5**
      (i) Flipping of a proton
      (ii) Larmor precession.

2. Attempt any **three** of the following :—
   (a) Define an expression for determination of pH using quinhydrone electrode in acidic and alkaline medium. **5**
   (b) Define decomposition potential. Describe the experimental method for determination of decomposition potential. **5**
   (c) (i) State any two objectives of electroplating. **2**
   (ii) The overvoltage of hydrogen on a certain cathode is 0.44V. Calculate the minimum voltage that must be applied to evolve hydrogen on this cathode from a solution of pH = 3.6 **3**
   (d) Describe the principle, construction and working of the silicon solar cell with the help of a neat labeled diagram. **5**
   (e) The emf of the cell **5**

   Ag | KCl (0.1m) sat- with AgCl | calomel electrode

   is 0.0390V at 298K. Calculate the solubility product and solubility of AgCl in pure water at 298K. (γ of KCl = 0.769)
   (f) (i) Name the cathode and anode used in the lithium ion cell. **2**
   (ii) State any three advantages of hydrogen as a fuel. **3**

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3. Attempt any **three** of the following :—
   (a) Describe the principle, construction and working of GM counter. **5**
   (b) (i) Explain secular radioactive equilibrium. **2**
   (ii) Calculate the weight of ^{235}U in equilibrium with 1g of ^{231}Th. The half life of ^{235}U is 6.97×10^9 years while that of ^{231}Th is 22.4 hours. **3**
   (c) Explain the basic components of a nuclear power reactor. **5**
   (d) Discuss the use of radioisotopes as tracers in Friedel-Craft's reaction and ester hydrolysis. **5**
   (e) For ^{27}Al (n, γ) reaction Q value is 6.569MeV. If the mass of ^{27}Al and the neutron is 26.990080 amu and 1.0089830 amu respectively. Calculate the mass of the product nucleus. **5**
   (f) Explain the thermonuclear reactions on earth. **5**

4. Attempt any **three** of the following :—
   (a) Explain any two limitations of classical mechanics. **5**
   (b) (i) State and explain Heisenberg's Uncertainity Principle. **2**
   (ii) A cricket ball weighing 50g is to be located within 0.2×10^{-10}m What is the uncertainity in its velocity ? **3**
   (c) The first order reflection maxima from (100), (110), (111) planes of a given crystal occur at 7.2°, 10.2° and 12.5° respectively. What type of a lattice does the crystal possess ? **5**
   (d) Derive Bragg's equation $n\lambda = 2d \sin \theta$. **5**
   (e) Explain the following with suitable examples : **5**
   (i) Linear operator
   (ii) Commutative operator.
   (f) State and explain any two laws of crystallography. **5**

5. (A) Choose the correct answer :— **4**
   (a) Ultracentrifuge method for determination of molecular weight requires _____ quantities of synthetic macromolecules.
   (i) large
   (ii) small
   (iii) both
   (b) _____ is a natural polymer.
   (i) cellulose
   (ii) Melamine
   (iii) Nylon.
   (c) A nucleus containing even number of protons and even number of neutrons will have _____ spin.
   (i) zero
   (ii) integral
   (iii) half integral.
   (d) The rate of the reaction is _____ to the energy of activation.
   (i) directly proportional
   (ii) inversely proportional
   (iii) not proportional.

OR **[TURN OVER**

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(A) State whether **True** or **False** :— **4**

(p) Silk is an example of an inorganic polymer.

(q) According to the activated complex theory of reactions rates, the rate constant of a reactions is given by $K = \frac{RT}{Nh} e^{-\Delta G°/RT}$

(r) The ratio of weight average molecular weight to number average molecular weight is called polydispersity index.

(s) $^{10}_{5}B$ has zero spin.

(B) Match the following :— **4**

Column M	**Column N**
(a) Glass electrode	(i) Bacon
(b) ΔS	(ii) –nFE
(c) ΔG	(iii) ion selective electrode
(d) Hydrogen oxygen fuel cell	(iv) $nF\left(\frac{\partial E}{\partial T}\right)_P$
	(v) $\left(\frac{\partial E}{\partial T}\right)_T$
	(vi) Redox electrode

OR

(B) State whether **True** or **False** :— **4**

(p) Quinhydrone electrode can function satisfactorily in highly acidic solutions.

(q) $E_G = E^0_G + 0.05916$ pH

(r) If the temperature coefficient is positive the emf of the cell decreases with rise in temperature.

(s) Calomel electrode is used in the experimental determination of overvoltage.

(C) Choose the correct answer :— **4**

(a) In a breeder reactor ^{238}U is converted into _____ .

(i) $^{238}_{92}Pu$

(ii) $^{238}_{93}Pu$

(iii) $^{238}_{92}Pu$

(b) An ideal phosphor should have _____ scintillation efficiency.

(i) low

(ii) high

(iii) medium

(c) The change $^{30}_{15}P \rightarrow {}^{30}_{40}Si$ requiress the emission of :

(i) α particle

(ii) positron

(iii) neutron

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(d) In nuclear transmulation _____ .

(i) total charge and number of nucleons is conserved.

(ii) only total charge is conserved.

(iii) neither total charge nor number of nucleons are conserved.

OR

(C) State whether **True** or **False** :— 4

(p) ^{235}U is called fissile material.

(q) Radiactive equilibrium is essentially an irrversible equilibrium.

(r) In artificial radioactivity there are no radiactive series of elements formed.

(s) $^{14}_{7}N\ ^{4}_{2}He \rightarrow\ ^{17}_{8}O + {}^{1}_{1}H$ is an example of (α, n) type of nuclear transmutation.

(D) Choose the correct answer :—

(a) The wave function _____ . 3

(i) should be finite, single valued and continuous.

(ii) should be discontinuous.

(iii) should be infinite and single valued.

(b) The expression of the de Broglie's equation is :

(i) $\lambda = h.p$

(ii) $\lambda = \frac{h}{p}$

(iii) $p = h\lambda$

(c) NaCl molecule has _____ elements of symmetry.

(i) 23

(ii) 22

(iii) 24

OR

(D) State whether True or False :— 3

(p) $\frac{1}{x}$ is not an eigen function of the operator $\frac{d^2}{dx^2}$

(q) A total of four Na^+ ions belongs to a unit cell.

(r) X-rays an produced in a Coolidge tube.

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