TYBSC Sem-VI
Physical Chemistry 2016-2017

QP Code : 03293

(2½ Hours) [Total Marks : 75

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

Physical Constants
$N = 6.022 \times 10^{23}$
$F = 96500$ C
$R = 8.314$ JK^{-1} mol^{-1}
$h = 6.626 \times 10^{-34}$ J s
$c = 3 \times 10^{8}$ ms^{-1}
$k = 1.38 \times 10^{-23}$ J K^{-1}

$\pi = 3.142$
$\frac{2.303RT}{F} = 0.0592$ at 298 K
$m_e = 9.0109 \times 10^{-31}$ kg
O = 16
H = 1
Na = 23
Cl = 35.5

1. Attempt any **three** of the following :—
(A) Explain the Lindemann's theory of unimolecular reaction. 5
(B) In one dm^3 flask, 1.88×10^{19} molecules of O_2 per cubic meter are mixed with 3.0×10^{19} molecules of H_2 per cubic meter at 300K. The average molecular diameter of O_2 and H_2 gases is 2.9×10^{-10}m. Calculate the number of collisions in cm^{-3} s^{-1}. 5
(C) Explain the use of viscometer in the determination of molecular weight of polymers. 5
(D) If a polymer sample has population as :
10 molecules of molecular mass each 5,000
20 molecules of molecular mass each 7,500
25 molecules of molecular mass each 15,000.
Calcular number average and weight average molecular weights of this sample. 5
(E) Explain the principle and working of NMR spectrometer. 5
(F) Explain the terms : (i) Larmor Precession
(ii) Chemical shift.

2. Attempt any **three** of the following :—
(A) Explain the use of glass electrode determination of pH of a solution. 5
(B) Describe the experimental method for the determination of the decomposition potential of an electrolyte. 5
(C) Define overvoltage. An overvoltage of 0.64V is observed during electrolysis of INH_2SO_4 solution using lead electrodes. What will be the new value of over voltage if current density is increased five times, b = 0.12 V at 298 K. Calculate the value of 'a' also. 5
(D) Explain with the help of diagram the contruction and working of silicon solar cell. 5

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(E) Determine the solubility product and solubility of AgCl from, the following cell. 5

$$^{(-)}Ag_{(s)} \left| AgCl_{(s)},\ KCl\ (m = 0.05,\ \gamma = 0.76) \right\| AgNo_3\ (m = 0.1,\ \gamma = 0.82) \left| Ag^{(+)} \right.$$

The emf of the cell at 298 K is 0.450V

(F) (i) Derive an expression to show relation between emf of the cell and change in enthalpy of the cell reaction. 3

(ii) Under what conditions, a cell becomes hot or cold during its working. 2

3. Attempt any **three** of the following :—

(A) What are scintillation counters used for ? Describe the working of scintillation counter with reference to photo multiplier tube. 5

(B) Answer the following :—

(i) What is meant by artificial radioactivity ? 1

(ii) Give an example of artificial radioactivity induced by α–particle as projectile. 2

(iii) Distinguish between chemical equilibrium and radioactive equilibrium. 2

(C) Describe the construction and working of a nuclear power reactor. 5

(D) What is meant by tracer technique ? How is it useful to establish mechanism for hydrolysis of ester ? 5

(E) Calculate the decay constant of ^{222}Rn, if 3.0×10^{-8} g of ^{222} Rn is in equilibrium with 1.0g of ^{226} Ra. The decay constant of ^{226} Ra is $1.5 \times 10^{-11}\ s^{-1}$. 5

(F) Define Q-Value and calculate if for the following nuclear reactor. 5

$$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$$

^{235}U = 235.1175amu, ^{141}Ba = 140.9527 amu

$^{1}_{0}n = 1.0089$ amu, ^{92}Kr = 91.9264 amu

4. Attempt any **three** of the following :—

(A) State and explain the law of symmetry of crystallography. 5

(B) Determine the number of atoms contained within : (i) a simple cubic unit cell, (ii) a body centered cubic unit cell, (iii) face centred cubic unit cell. 5

(C) The second order reflection maxima from (111) plane of NaCl occurs at 10° 30′. The density of NaCl is $2.16 \times 10^3\ kgm^{-3}$. Calculate the wavelength of the X-rays used to obtain the second order reflection. 5

(D) Explain :— 5

(i) Heisenberg's Uncertainity Principle.

(ii) Hamiltonian operator.

(E) State and explain the postulate of quantum mechanics which is related to state function. 5

(F) What is meant by commutative property of an operator ? If $\hat{A} = d/dx$ and $\hat{B} = 3x^2$, Find out whether $\hat{A}$ and $\hat{B}$ commute with each other. 5

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5. (A) Choose the correct answer :— 4

(a) A fast reaction is the one whose half-life varies from _____ .

(i) 10^{-1} to 10^{-4}s

(ii) 10^{1} to 10^{4}s

(iii) 10^{-12} to 10^{-10}s

(b) The polydispersity index of a natural polymer is ussually _____ .

(i) zero

(ii) greater than zero

(iii) unity

(c) Bakelite is an example of _____ .

(i) natural polymer

(ii) thermoplastic polymer

(iii) thermosetting polymer

(d) The total spin of $^{1}_{1}H$, $^{16}_{6}C$ nucleus is _____ .

(i) zero

(ii) integral

(iii) half integral

OR

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

(p) Number average molar mass of a polymer is independent of molecular size.

(q) Thermo setting plastic can be reshaped and reused.

(r) Higher the electron density around a proton, higher is the shielding of the proton.

(s) The internal energy of activated complex formed durings chemical reaction, is greater than that of reactants as well as products.

(B) Choose the correct answer :— 4

(a) The emf of a cell is 0.6753V at 298K and 0.6915V at 273K. The temperature coefficient of this cell is _____ .

(i) 0.6480 VK^{-1}

(ii) -6.48×10^{-4} VK^{-1}

(iii) 6.48×10^{-4} VK^{-1}

(b) The thin glass bulb in glass electrode is filled with _____ .

(i) 0.1 MKCl saturated with AgCl

(ii) 0.1 MHCl saturated with AgCl

(iii) 0.1 MHCl saturated with Hg_2Cl_2

(c) For sponteneous cell reaction _____ .

(i) ΔG is +ve and Ecell is – ve

(ii) ΔG is – ve and Ecell is – ve

(iii) ΔG is – ve and Ecell is + ve

(d) The cell $Hg_{(l)} - Hg_2Cl_2 \,|KCl \,\|\, H_2Q, Q, H^+|Pt$ is used for titrating acid V/s base such that the pH at equivalence point is 7. The potential of quinhydrone electrode is _____ if $E^0_Q = 0.699V$.

(i) 0.2849
(ii) 0.0424
(iii) 0.0424 4

OR

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

(p) The ratio of quinone to hydroquinone is unity in quinhydrone.
(q) The quinhydrone electrode can be used in non-aqueous medium.
(r) The minimum external potential that must beapplied to an electrolytic cell to bring about continuous electrolysis is called overvoltage.
(s) Fuel cells are used in space missions. 4

(C) Choose the correct answer :—

(a) When $^{27}_{13}A1$ undergoes (α, n) reaction, the recoil nucleus formed is _____.

(i) $^{30}_{92}P$
(ii) $^{30}_{14}Si$
(iii) $^{23}_{11}Na$

(b) To sustain a fission reaction, the multiplication factor K should be _____.

(i) greater than unity
(ii) less than unity
(iii) zero

(c) The oxygen liberated during photosynthesis $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 60_2\uparrow$ comes from _____.

(i) CO_2
(ii) H_2O
(iii) both CO_2 and H_2O

(d) Anthracene acts as _____.

(i) phosphor
(ii) moderator
(iii) coolant

OR

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

(p) Radioactive equilibrium is affected by temperature and presure.
(q) ^{235}U is fissile material.
(r) Threshold energy is calculated for endoergic nuclear reactions.
(s) Boron and cadmium are used to prepare control rods.

(D) Choose the correct answer :— 3

(a) If weiss indices of a plane are $\frac{1}{2}a : \frac{2}{3}b : \alpha c$, the Miller indices of this plane will be _____ .

(i) 4 : 6 : 0
(ii) 4 : 3 : 0
(iii) 2 : 3 : 0

(b) A simple cubic crystal has _____ planes of symmetry.

(i) 9
(ii) 6
(iii) 3

(c) $8e^{4x}$ is an eigen function of the operator d/dx, the eigen value is _____ .

(i) 8
(ii) 4
(iii) 4x

OR

(D) State whether **True** or **False** :— 3

(p) There are $4Na^+$ and $4Cl^-$ per unit cell of NaCl crystal.

(q) The interplanar distance ratio $d_{100} : d_{110} : d_{111}$ for simple cubic crystal is 1 : 0.577 : 1.14.

(r) The condition $\hat{A}[f(x) + g(x)] = \hat{A} f(x) + \hat{A} g(x)$ is fulfilled by _____ .

(i) Momentum operator
(ii) Hamiltonian operator
(iii) Linear operator.

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