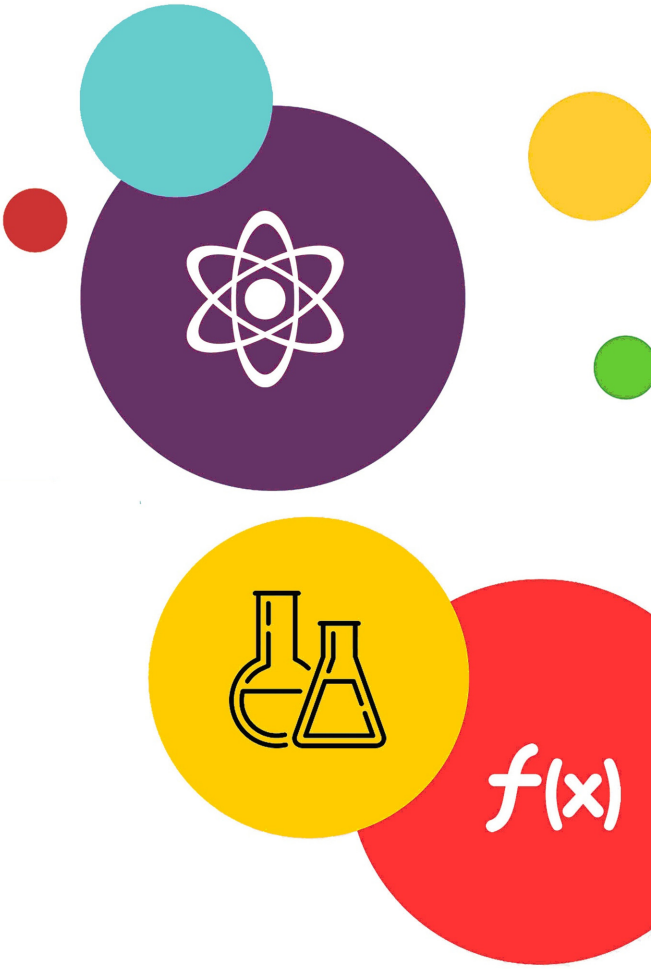
STUDY MATERIAL

JEE

FOR MAIN & ADVANCED



CHEMISTRY

Class 12

CP PUBLICATION

CHEMISTRY

Study Material for JEE Main & Advanced preparation

Prepared by Career Point Kota Experts

CAREER POINT

CONTENTS OF THE PACKAGE AT A GLANCE

CHEMISTRY

Class 12

Physical Chemistry (II)

- Chemical Kinetics
- Electro Chemistry
- Solid State
- Solutions
- Surface Chemistry

Organic Chemistry (II)

[A]

- Halogen Derivatives
- Alcohol, Ether & Phenol
- Carbonyl Compounds

[B]

- Carboxylic Acid & Its Derivatives
- Nitrogen Compounds, Amines
- Carbohydrates, Amino Acid, Protein & Polymers
- Practical Organic Chemistry
- Chemistry in Everday life

Inorganic Chemistry (II)

- p-block Elements
- Salt Analysis
- Transitional Elements
- Metallurgy
- Co-Ordination Compound

Note to the Students

Career Point offers this must have Study Package in Physics to meet the complete curriculum needs of engineering aspirants. The set comprises of 3 books. The set caters to the different requirements of students in classes XII. It offers complete and systematic coverage of **JEE Main** and **JEE Advanced** syllabi and aims to provide firm foundation in learning and develop competitive edge in preparation of the JEE and other engineering entrance examinations.

COMPONENTS OF EACH CHAPTER

These books are designed with an engaging and preparation-focused pedagogy and offer a perfect balance of conceptual learning and problem solving skills.

Theory & Concepts

Each chapter consists of high quality theory that covers all the topics, sub-topics and concepts of JEE syllabus.

Solutions

1. Concentration Terms

✦ **% Concentration :**

(i) % w/w = $\frac{\text{weight of solute (g)}}{\text{weight of solution (g)}}$

= weight of solute/100 g of solution.

(ii) It does not change on changing temperature.

Ex. 10% w/w urea solution

= 10 gm of urea is present in 100 gm of solution.

= 10 gm of urea is present in 90 gm of water.

(iii) % wt/vol (w/v)

% w/v = wt. of solute/100 ml of solution

% w/v = $\frac{\text{gram of solutes}}{\text{vol. of solution in mL}} \times 100$

(iv) It changes on changing temperature.

Ex. 10% (w/v) urea solution = 10 gm of urea is present in 100 mL of solution. But not 10 gm of urea present in 90 ml of water.

For dilute solution : vol. solution = vol. solvent.

(v) **% v/v**

If both solute & solvent are liquids = volume in (mL) of solute per 100 mL of solution.

Ex. 10% v/v alcohol ethanol aq solution = 10 ml of ethanol in 100 ml of solution.

≠ 10 ml of C_2H_5OH in 90 ml of H_2O

✦ **Strength of solution in g/L : : :**

Weight of solute (in gram) per litre (1000mL) of solution.

Ex. 10% (w/v) sucrose solution then specify its conc. in gm/L

100 mL ..... 10 gm

∴ 1000 mL ..... $\frac{10}{100} \times 1000$ = 100 gm/L

✦ **Molarity :**

No. of moles of solute per litre of solution.

Let, n = No. of moles of solute

N = No. of moles of solvent

V = volume of solution

$$M = \frac{n}{V(\text{in L})} = \left(\frac{W}{M}\right) = \frac{1000}{V\,\text{in(mL)}}$$

no. of moles of solute = molarity × volume (In L)

no. of m. moles of solute = molarity × volume (in mL)

If V_1 mL of C_1 molarity solution is mixed with V_2 mL of C_2 molarity solution (same substance or solute)

∴ $C_1(V_1 + V_2) = C_1V_1 + C_2V_2$

$$C_f = \left[\frac{C_1V_1 + C_2V_2}{V_1 + V_2}\right] = \frac{\text{Total moles}}{\text{Total volume}}$$

- It changes on changing temperature.

✦ **Molality :**

No of moles of solute per kg(1000 g) of solvent.

Let w gram of solute (Molar mass = mg/mole) is dissolved in 'W' gram of solvent.

$$\text{molality} = \left(\frac{w}{M}\right) \times \frac{1000}{W(g)}$$

$$\text{molality} = \frac{\text{moles} \times 1000}{W(g)\ \text{of solvent}}$$

- It does not change on changing temperature

✦ **Normality :**

- No. of equivalents per litre of solution

$$= \frac{\text{no. of equivalents of solute}}{\text{volume of solution (in L)}}$$

- No. of equivalents = normality × volume (L)

or (Normality = n × molarity)

- Equivalent mass = $\frac{\text{Molar mass}}{\text{n – factor}}$

- No. of equivalent = $\frac{\text{Mass of the species}}{\text{equivalent mass}}$

$$= \frac{\text{Mass of the species}}{\frac{\text{Molar mass}}{\text{n – factor}}}$$

✦ **'n' factor**

(i) For oxidizing/reducing agents :

no. of e^- involved in oxidation/reduction half reaction per mole of oxidising agent/reducing agent.

e.g. : $5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + H_2O$

n-factor = 5

(ii) For acid/base reactions :

no. of H^+ ions displaced/OH^- ions displaced per mole of acid/base.

e.g. : NaOH n - factor = 1,

H_2SO_4 n - factor = 2

Solved Examples (JEE Main/Advanced)

To understand the application of concepts, there is a solved example section. It contains large variety of all types of solved examples with explaination to ensure understanding the application of concepts.

SOLVED EXAMPLES

Ex.1 Which solution will have the highest boiling point?

(A) 1 (M) $C_6H_{12}O_6$ solution

(B) 1 (M) NaCl solution

(C) 1 (M) $BaCl_2$ solution

(D) 1 (M) $CO(NH_2)_2$ solution

Sol.(C) As the no. of particles is highest for the 1(M) $BaCl_2$ after complete ionisation, therefore, elevation of boiling pt. will be highest for this solution.

Ex.2 Which of the following colligative properties is associated with the concentration term 'molarity'?

(A) Lowering of vap. pressure

(B) Osmotic pressure

(C) Depression in freezing point

(D) Elevation in boiling point

Sol.(B) π = CRT where C is the molarity of the solution. Hence, osmotic pressure is only associated with the molarity of solution.

Ex.3 Which of the following 0.1(M) aqueous solution will have lowest boiling point ?

(A) K_2SO_4 (B) NaCl

(C) Urea (D) Glucose

Sol.(C) As the number of particles is the highest on complete dissociation of K_2SO_4. Hence boiling point is highest for K_2SO_4. As glucose and urea is not dissociated in solution hence boiling point is lower for these two solutions.

Now,

$$\frac{1}{M} = \frac{1}{\ell_s}\left(\frac{1}{m} + M' \times 10^{-3}\right)$$

For the dilute solution, we can consider

$\ell_s = 1$

$$\therefore \quad \frac{1}{M} = \left(\frac{1}{m} + M' \times 10^{-3}\right)$$

Molarity of solution = 0.1 (M)

$$\therefore \quad 10 = \frac{1}{m} + M' \times 10^{-3}$$

$$\therefore \quad 10 - M' \times 10^{-3} = \frac{1}{m}$$

$$\therefore \quad m = \frac{1}{10 - M' \times 10^{-3}}$$

For urea M = 60 and for glucose M = 180

$$\therefore \quad m_{glu} = \frac{1}{10 - 0.180}$$

$$\therefore \quad m_{urea} = \frac{1}{10 - 0.060}$$

Ans. $m_{glucose} > m_{urea}$. Hence, 0.1 (M) urea solution have lowest boiling pt.

Ex.4 Which of the following experimental methods is adopted to determine osmotic pressure ?

(A) Berkely-Hartley's method

(B) Beckmann's method

(C) Lands berger's method

(D) Differential method

Sol.(A) As it has been discussed in the theory Berkley-Hartley's method is only utilized for the determination of osmotic pressure.

Ex.5 Which one of the following pairs of solution can we expect to be isotonic at the same temperature-

(A) 0.1(M) urea and 0.1(M) NaCl

(B) 0.1(M) urea and 0.2(M) $MgCl_2$

(C) 0.1(M) NaCl and 0.1(M) Na_2SO_4

(D) 0.1(M) $Ca(NO_3)_2$ and 0.1(M) Na_2SO_4

Sol.(D) As the no. of ionic species produced after complete dissociation of 0.1(M) $Ca(NO_3)_2$ and 0.1(M) Na_2SO_4 are only same.

Ex.6 Equal volume of 0.1(M) urea and 0.1(M) glucose are mixed. The mixture will have -

(A) lower osmotic pressure

(B) same osmotic pressure

(C) higher osmotic pressure

(D) None of these

Sol.(B) The molarity of urea in the final solution = 0.05(M).

The molarity of glucose = 0.05(M)

The total molarity of solution = 0.1(M)

As osmotic pressure at given temperature is only proportional to the molarity of solution. Hence, osmotic pressure remains same.

Ex.7 When 1 mole of a solute is dissolved in 1kg of H_2O, boiling point of solution was found to be 100.5°C. K_b for H_2O is -

(A) 0.5 (B) 100

(C) 100.5 (D) 95.5

Sol.(A) $\Delta T_b = K_b \times m, \quad m = 1$

$\therefore K_b = \Delta T_b = 100.5 - 100 = 0.5$

Practice Exercises

Exercise Level - 1 : It contains objective questions with single correct choice to ensure sufficient practice to accutrately appply formule and concepts.

EXERCISE (Level-1)

Question based on Concentration Terms

Q.1 Mole fraction of $C_3H_5(OH)_3$ in a solution of 36 g of water and 46 g of glycerine is –
(A) 0.46 (B) 0.36 (C) 0.20 (D) 0.40

Q.2 The density of 3 M solution of $Na_2S_2O_3$ is 1.58 g/ml. Calculate mole fraction of $Na_2S_2O_3$–
(A) 0.96 (B) 0.046 (C) 0.74 (D) 0.25

Q.3 In the above question, calculate molality of Na^+ ions–
(A) 5.42 m (B) 7.5 m (C) 2.71 m (D) 10.84 m

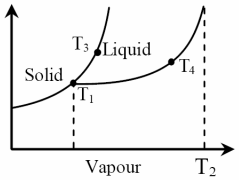
Q.4 The density of 3M solution of sodium thioslphate ($Na_2S_2O_3$) is 1.58 g/ml. Calcualte the amount of $Na_2S_2O_3$ by w/w %
(A) 30 % (B) 40 % (C) 49 % (D) 55 %

Question based on Vapour Pressure & Phase Diagram

Q.5 The pressure under which liquid and vapour can co-exist at equilibrium is called the –
(A) Limiting vapour pressure
(B) Real vapour pressure
(C) Normal vapour pressure
(D) Saturated vapour pressure

Q.6 The vapour pressure of a liquid in a closed container depends upon –
(A) Amount of liquid
(B) Surface area of the container
(C) Temperature
(D) None of the above

Q.7 Observe the P-T phase diagram for a given substance A. Then melting point of A(s), boiling point of A(l), critical point of A and triple point of A (at their respective pressures) are respectively –



(A) T_1, T_2, T_3, T_4 (B) T_4, T_3, T_1, T_2
(C) T_3, T_4, T_2, T_1 (D) T_2, T_1, T_3, T_4

Q.8 A sample of air is saturated with benzene (vapor pressure = 100 mm Hg at 298 K) at 298 K, 750 mm Hg pressure. If it is isothermally compressed to one third of its initial volume, the final pressure of the system is –
(A) 2250 torr (B) 2150 torr
(C) 2050 torr (D) 1950 torr

Question based on Raoult law & Henry law

Q.9 The vapour pressure of pure liquid solvent A is 0.80 atm. When a non-volatile substance B is added to the solvent, its vapour pressure drops to 0.60 atm. mol fraction of the component B in the solution is –
(A) 0.50 (B) 0.25 (C) 0.75 (D) 0.40

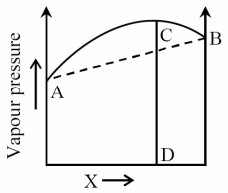
Q.10 The solubility of $N_2(g)$ in water exposed to the atmosphere, when the partial pressure is 593 mm is 5.3×10^{-4} M. Its solubility at 760 mm and at the same temperature is –
(A) 4.1×10^{-4} M (B) 6.8×10^{-4} M
(C) 1500 M (D) 2400 M

Question based on Ideal & Non ideal solution of two volatile liquids

Q.11 Which of the following plots does not represent the behaviour of an ideal binary liquid solution?
(A) plot of p_A versus x_A (mole fraction of A in liquid phase) is linear
(B) plot of p_B versus x_B is linear
(C) Plot of p_{total} versus x_A is (or x_B) is linear
(D) Plot of p_{total} versus x_A is non-linear

Q.12 Which of the following is correct for a solution showing positive deviations from Raoult's law?
(A) ΔV = + ve, ΔH = + ve
(B) ΔV = –ve, ΔH = –ve
(C) ΔV = + ve, ΔH = –ve
(D) ΔV = –ve, ΔH = + ve

Q.13 The diagram given below is a vapour pressure-composition diagram for a binary solution of A and B. In the solution, A–B interactions are –



(A) similar to A–A and B–B interactions
(B) greater than A–A and B–B interactions
(C) smaller than A–A and B–B interactions
(D) unpredictable

Exercise Level - 2 : It contains single objective type questions with moderate difficulty level to enhance the conceptual and application level of the student.

EXERCISE (Level-2)

Q.1 Select correct statement -
(A) b.p. of 1 molal NaCl solution is twice that of 1 molal sucrose solution
(B) b.p. elevation of 1 molal glucose solution is half of the 1 molal KCl solution
(C) b.p. is a colligative property
(D) All of the above

Q.2 At a given temperature, total vapour pressure in Torr of a mixture of volatile components A and B is given by

$$P = 120 - 75\,X_B$$

hence, vapour pressure of pure A and B respectively (in Torr) are -
(A) 120, 75 (B) 120, 195
(C) 120, 45 (D) 75, 45

Q.3 Decimolar solution of potassium ferricyanide, $K_3[Fe(CN)_6]$ has osmotic pressure of 3.94 atm at 27°C. Hence percent ionisation of the solute is -
(A) 10% (B) 20% (C) 30% (D) 40%

Q.4 An aqueous solution of urea containing 18 g urea in 1500 cm^3 of solution has a density of 1.052 g/cm^3. If the molecular weight of urea is 60, then the molality of solution is-
(A) 0.2 (B) 0.192
(C) 0.064 (D) 1.2

Q.5 If $pK_a = -\log K_a = 4$, and $K_a = C\alpha^2$ then van't Hoff factor for weak monobasic acid when C = 0.01 M is -
(A) 0.01 (B) 1.02 (C) 1.10 (D) 1.20

Q.6 pH of 1M HA (weak acid) is 2. Hence van't Hoff factor is -
(A) 1.2 (B) 1.02 (C) 1.1 (D) 1.01

Q.7 An azeotropic solution of two liquids has boiling point lower than either when it -
(A) shows a negative deviation from Raoult's law
(B) shows a positive deviation from Raoult's law
(C) shows no deviation from Raoult's law
(D) is saturated

Q.8 Cryoscopic constant of a liquid is-
(A) Decrease in freezing point when 1 gram of solute is dissolved per kg of the solvent
(B) Decrease in the freezing point when 1 mole of solute is dissolved per kg of the solvent
(C) Is the elevation for 1 molar solution
(D) Is a factor used for calculation of elevation in boiling point

Q.9 100 ml of liquid A and 25 ml of liquid B is mixed to give a solution which does not obey Raoult's law. The volume of the solution -
(A) will be 125 ml
(B) can be > or < than 125 ml
(C) can be greater than, equal to or less than 125 ml
(D) will be less than 125 ml

Q.10 H_2O and perchloric acid (b.p. 383 K) form constant boiling mixture at 71.6% of perchloric acid. The boiling point of the solution at this composition is -
(A) > 373 but < 383 K (B) < 373 K
(C) > than 383 K (D) = 373 K

Q.11 When mango is placed in dilute aqueous solution of hydrochloride acid, it-
(A) Shrinks (B) Swells
(C) Bursts (D) Nothing happens

Q.12 The hard shell of an egg is dissolved in acetic acid and then egg was subsequently placed in saturated solution of NaCl
(A) The egg will shrink
(B) The egg will become harder
(C) The egg will swell
(D) No change in the size of egg

Q.13 Which statement is incorrect about osmotic pressure (π), volume (V) and temperature (T)-
(A) $\pi \propto \frac{1}{V}$ if T is constant
(B) $\pi \propto T$ if V is constant
(C) $\pi \propto V$ if T is the constant
(D) π V is constant if T is constant

Q.14 For an ideal binary liquid solution with $P_A^0 > P_B^0$ which relation between X_A (mole fraction of A in liquid phase) & Y_A (mole fraction of A in vap. phase) is correct. X_B & Y_B are mole fraction of B in liquid & vap. phase respectively -
(A) $X_A = Y_A$
(B) $X_A > Y_A$
(C) $\frac{X_A}{X_B} < \frac{Y_A}{Y_B}$
(D) X_A, Y_A, X_B, Y_B Cannot be Corelated

Exercise Level - 3 : It contains previous years question of JEE Main from Year 2005 to 2024.

EXERCISE (Level-3)

Old Examination Questions [JEE Main]

Q.1 If α is the degree of dissociation of Na_2SO_4, the vant Hoff's factor (i) used for calculating the molecular mass is – **[AIEEE-2005]**

(A) $1 - \alpha$ (B) $1 + \alpha$

(C) $1 - 2\alpha$ (D) $1 + 2\alpha$

Q.2 Benzene and toluene form nearly ideal solutions. At 20ºC, the vapour pressure of benzene is 75 torr and that of toluene is 22 torr. The partial pressure of benzene at 20ºC for a solution containing 78 g of benzene and 46 g of toluene in torr is– **[AIEEE-2005]**

(A) 25 (B) 50 (C) 53.5 (D) 37.5

Q.3 Two solutions of a substance (non electrolyte) are mixed in the following manner. 480 ml of 1.5 M first solution + 520 mL of 1.2 M second solution. What is the molarity of the final mixture ? **[AIEEE-2005]**

(A) 1.50 M (B) 1.20 M

(C) 2.70 M (D) 1.344 M

Q.4 Which aqueous solution exhibits highest boiling point – **[AIEEE-2004]**

(A) 0.015 M glucose (B) 0.01 M KNO_3

(C) 0.015 M urea (D) 0.01M Na_2SO_4

Q.5 18 g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water. The vapour pressure of water for this aqueous solution at 100º C is - **[AIEEE 2006]**

(A) 7.60 Torr (B) 76.00 Torr

(C) 752.40 Torr (D) 759.00 Torr

Q.6 Density of a 2.05 M solution of acetic acid in water is 1.02 g/mL. The molality of the solution is - **[AIEEE 2006]**

(A) 3.28 mol kg^{-1} (B) 2.28 mol kg^{-1}

(C) 0.44 mol kg^{-1} (D) 1.14 mol kg^{-1}

Q.7 A mixture of ethyl alcohol and propyl alcohol has a vapour pressure of 290 mm at 300 K. The vapour pressure of propyl alcohol is 200 mm. If the mole fraction of ethyl alcohol is 0.6, its vapour pressure (in mm) at the same temperature will be - **[AIEEE 2007]**

(A) 350 (B) 300 (C) 700 (D) 360

Q.8 A 5.25% solution of a substance is isotonic with a 1.5% solution of urea (molar mass = 60 g mol^{-1}) in the same solvent. If the densities of both the solutions are assumed to be equal to 1.0 gcm^{-3}, molar mass of the substance will be- **[AIEEE 2007]**

(A) 90.0g mol^{-1} (B) 115.0g mol^{-1}

(C) 105.0g mol^{-1} (D) 210.0 g mol^{-1}

Q.9 The density (in g mL–1) of a 3.60 M sulphuric acid solution that is 29% H_2SO_4 (Molar mass = 98 g mol^{-1}) by mass will be - **[AIEEE 2007]**

(A) 1.64 (B) 1.88

(C) 1.22 (D) 1.45

Q.10 The vapour pressure of water at 20º C is 17.5 mm Hg. If 18g of glucose ($C_6H_{12}O_6$) is added to 178.2 g of water at 20° C, the vapour pressure of the resulting solution will be – **[AIEEE 2008]**

(A) 15.750 mm Hg (B) 16.500 mm Hg

(C) 17.325 mm Hg (D) 17.675 mm Hg

Q.11 At 80º C , the vapour pressure of pure liquid 'A' is 520 mm Hg and that of pure liquid 'B' is 1000 mm Hg. If a mixture solution of 'A' and 'B' boils at 80º C and 1 atm pressure, the amount of 'A' in the mixture is (1 atm = 760 mm Hg) **[AIEEE 2008]**

(A) 34 mol percent (B) 48 mol percent

(C) 50 mol percent (D) 52 mol percent

Q.12 A binary liquid solution is prepared by mixing n-heptane and ethanol. Which one of the following statements is correct regarding the behaviour of the solution ? **[AIEEE 2009]**

(A) The solution is non-ideal, showing +ve deviation form Raoult's Law

(B) The solution is non-ideal, showing –ve deviation from Raoult's Law

(C) n-heptane shows +ve deviation while ethanol shows – ve deviation from Raoult's Law

(D) The solution formed is an ideal solution

Q.13 Two liquids X and Y form an ideal solution At 300 K, vapour pressure of the solution containing 1 mol of X and 3 mol of Y is 550 mmHg. At the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mmHg. Vapour pressure (in mmHg) of X and Y in their pure states will be, respectively - **[AIEEE 2009]**

(A) 300 and 400 (B) 400 and 600

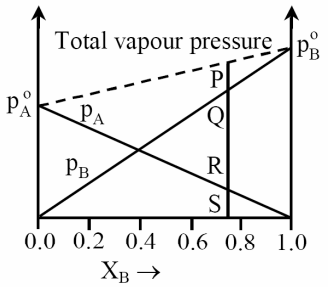
(C) 500 and 600 (D) 200 and 300

Exercise Level - 4 : It contains all variety of questions as per level of JEE Advanced such as MCQ, Column match, Passage based & Numerical type etc.

EXERCISE (Level-4)

Part-A : Multiple correct answer type questions

Q.1 Consider the following vapour-pressure composition graph SP is equal to –



(A) PQ + RS (B) PQ + QR + RS
(C) SR + SQ (D) PQ + QR

Q.2 Which of the following solutions are expected to be isotonic with respect to 6% (W/V) solution of urea ?
(A) 18% solution of glucose
(B) 1 M solution of NaCl
(C) 1 M solution of sucrose
(D) 1 M solution of CH_3COOH

Q.3 Which of the following solutions exhibit positive deviation from Raoult's law ?
(A) $H_2O + C_2H_5OH$ (B) $C_6H_6 + C_2H_5OH$
(C) $H_2O + HCl$ (D) $CHCl_3+(CH_3)_2CO$

Q.4 For which of the following solutes 'i' is greater than 1 ?
(A) Urea (B) Sucrose
(C) Sodium chloride (D) Sodium sulphate

Q.5 When a solution containing non-volatile solute is diluted with water,
(A) its vapour pressure increases
(B) its osmotic pressure increases
(C) its boiling point increases
(D) its freezing point increases

Q.6 For a solution containing non-volatile solute, the relative lowering of vapour pressure is 0.2. If the solution contains 5 moles in all, which of the following are true ?
(A) Mole fraction of solute in the solution is 0.2
(B) No. of moles of solute in the solution is 0.2
(C) No. of moles of solvent in the solution is 4
(D) Mole fraction of solvent is 0.2

Q.7 Consider following solutions :
I. 1 M aq. glucose
II. 1 M aq. sodium chloride
III. 1 M benzoic acid in benzene
IV. 1 M ammonium phosphate
(A) all are isotonic solutions
(B) III is hypotonic of I, II, IV
(C) I, II, IV are hypertonic of III
(D) IV is hypertonic of I, II, III

Q.8 5.3% (W/V) Na_2CO_3 solution and 6.3% (W/V) $H_2C_2O_4.2H_2O$ solution have same –
(A) Molality (B) Molarity
(C) Normality (D) Mole fraction

Q.9 Mole fraction of ethanol (C_2H_5OH) in ethanol-water system is 0.25. Thus, it has –
(A) 25% ethanol by weight of solution
(B) 75% water by weight of solution
(C) 46% ethanol by weight of solution
(D) 54% water by weight of solution

Q.10 Which of the following condition represent non ideal solutions ?
(A) They do not obey Raoult's law
(B) $\Delta H_{mixing} \neq 0$
(C) $\Delta V_{mixing} \neq 0$
(D) $\Delta S_{mixing} \neq 0$

Q.11 Which of the following conditions satisfies the conditions belong to minimum boiling azeotropes ?
(A) $\Delta V_{mixing} > 0$
(B) $\Delta H_{mixing} > 0$
(C) Observed vapour pressure is greater than the vapour pressure as per Raoult's law
(D) Solvent-solvent interaction forces and solute-solute interaction forces are greater than that of solvent-solute interaction forces.

Q.12 Which of the following conditions satisfies the conditions belong to maximum boiling azeotropes ?
(A) $\Delta V_{mixing} < 0$
(B) $\Delta H_{mixing} < 0$
(C) Observed vapour pressure is lesser than the vapour pressure as per Raoult's law
(D) Solvent-solvent interaction forces and solute-solute interaction forces are lesser than that of solvent-solute interaction forces.

Exercise Level - 5 : It contains previous years question of JEE Advanced from Year 2005 to 2024.

EXERCISE (Level-5)

Old Examination Questions [JEE Advanced]

Q.1 13.44 gm of $CuCl_2$ is dissolved in 1 kg of water. Determine the elevation in boiling point of the solution. K_b = 0.5 K Kg mol^{-1}. Molecular wt. of $CuCl_2$ = 134.4 **[IIT-2005]**

(A) 0.16 (B) 0.052

(C) 0.1 (D) 0.5

Q.2 75.2 g phenol is added in (1kg) of the solvent. The depression in freezing point is 7. Calculate the percentage association if phenol undergoes dimerisation (K_f = 14). **[IIT 2006]**

Q.3 When 20 g of naphthoic acid ($C_{11}H_8O_2$) is dissolved in 50g of benzene (K_f = 1.72 K kg mol^{-1}), a freezing point depression of 2K is observed. The van't Hoff factor (i) is– **[IIT-2007]**

(A) 0.5 (B) 1 (C) 2 (D) 3

Paragraph for Question No1`s. 4 to 6

Properties such as boiling point, freezing point and vapour pressure of a pure solvent changes when solute molecules are added to get homogeneous solution. These are called colligative properties. Application of colligative properties are very useful in day-to-day life. One of its example is the use of ethylene glycol and water mixture as anti-freezing liquid in the radiator of automobiles.

A solution M is prepared by mixing ethanol and water. The mole fraction of ethanol in the mixture is 0.9.

Given : Freezing point depression constant of water (K_t^{water}) = 1.86 K kg mol^{-1}

Freezing point depression constant of ethanol ($K_b^{ethanol}$) = 2.0 K kg mol^{-1}

Boiling point elevation constant of water (K_b^{water}) = 0.52 K kg mol^{-1}

Boiling point elevation constant of ethanol ($K_b^{ethanol}$) = 1.2 K kg mol^{-1}

Standard freezing point of water = 273 K

Standard freezing point of ethanol = 155.7 K

Standard boiling point of water = 373 K

Standard boiling point of ethanol = 351.5 K

Vapour pressure of pure water = 32.8 mm Hg

Vapour pressure of pure ethanol = 40 mm Hg

Molecular weight of water = 18 g mol^{-1}

Molecular weight of ethanol = 46 g mol^{-1}

In answering the following questions, consider the solution to be ideal dilute solutions and solutes to be non volatile and non-dissociative.

[IIT-2008]

Q.4 The freezing point of the solution **M** is –

(A) 268.7 K (B) 268.5 K

(C) 234.2 K (D) 150.9 K

Q.5 The vapour pressure of the solution M is –

(A) 39.3 mm Hg (B) 36.0 mm Hg

(C) 29.5 mm Hg (D) 28.8 mm Hg

Q.6 Water is added to the solution M such that the mole fraction of water in the solution becomes 0.9. The boiling point of this solution is –

(A) 380.4 K (B) 376.2 K

(C) 375.5 K (D) 354.7 K

Q.7 The Henry's law constant for the solubility of N_2 gas in water at 298 K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is- **[IIT-2009]**

(A) 4.0×10^{-4} (B) 4.0×10^{-5}

(C) 5.0×10^{-4} (D) 4.0×10^{-6}

Q.8 For a dilute solution containing 2.5 g of a non-volatile non-electrolye solute in 100 g of water, the elevation in boiling point at 1 atm pressure is 2°C. Assuming concentration of solute is much lower than the concentration of solvent, the vapour pressure (mm of Hg) of the solution is (take K_b = 0.76 K kg mol^{-1}) **[IIT-2012]**

(A) 724 (B) 740 (C) 736 (D) 718

Q.9 29.2% (w/w) HCl stock solution has a density of 1.25 g mL^{-1}. The molecular weight of HCl is 36.5 g mol^{-1}. The volume (mL) of stock solution required to prepare a 200 mL solution of 0.4 M HCl is. **[IIT-2012]**

Q.10 MX_2 dissociates into M^{2+} and X^- ions in an aqueous solution, with a degree of dissociation (α) of 0.5. The ratio of the observed depression of freezing point of the aqueous solution to the value of the depression of freezing point in the absence of ionic dissociation is **[JEE Advanced -2014]**

Q.11 A compound H_2X with molar weight of 80 g is dissolved in a solvent having density of 0.4 g ml^{-1}. Assuming no change in volume upon dissolution, the **molality** of a 3.2 molar solution is **[JEE Advanced - 2014]**

Q.12 If the freezing point of a 0.01 molal aqueous solution of a cobalt(III) chloride-ammonia complex (which behaves as a strong electrolyte) is – 0.0558°C, the number of chloride(s) in the coordination sphere of the complex is [K_f of water = 1.86 K kg mol^{-1}]

[JEE Advanced - 2015]

Exercise Level - 6 : Advanced level a bit complex questions for students for solid rock prepertion for Top Rankers.

EXERCISE (Level-6)

Review Exercise

Q.1 The vapour-pressure of ethanol and methanol are 44.5 and 88.7 mm Hg respectively. An ideal solution is formed at the same temperature by the mixing 60 g of ethanol with 40 g of methanol. Calculate the total vapour-pressure of the solution and the mole-fraction of methanol in the vapour. **[IIT-1986]**

Q.2 The vapour-pressure of a dilute aqueous solution of glucose ($C_6H_{12}O_6$) is 750 mm of mercury at 273 K. Calculate (i) molality and (ii) mole-fraction of the solute.

[IIT-1989]

Q.3 The vapour-pressure of pure benzene at a certain temperature is 640 mm Hg. A non-volatile, non-electrolyte solid weighing 2.175g is added to 39.0 g of benzene. The vapour-pressure of the solution is 600 mm Hg. What is the molecular weight of the solid substance ?

[IIT-1990]

Q.4 The degree of dissociation of $Ca(NO_3)_2$ in a dilute aqueous solution, containing 7.0 g of the salt per 100 g of water at 100°C is 70%. If the vapour-pressure of water at 100°C is 760 mm, calculate the vapour-pressure of the solution. **[IIT-1991]**

Q.5 Addition of 0.643 g of a compound to 50mL of benzene (density : 0.879 g/mL) lowers the freezing point from 5.51°C to 5.03°C. If k_f for benzene is 5.12, calculate the molecular weight of the compound. **[IIT-1992]**

Q.6 What weight of the non-volatile solute urea (NH_2—CO—NH_2) needs to be dissolved in 100g of water, in order to decrease the vapour-pressure of water by 25% ? What will be the molality of the solution ? **[IIT-1993]**

Q.7 What must be the concentration of an aqueous solution of common salt if it is to be isotonic with a solution of non electrolyte substance which freezes at -0.0186°C ? (Assuming NaCl is fully ionized in the first solution). $K_f = 1.86$

Q.8 An aqueous solution containing 288 gm of a non-volatile compound having the stoichiometric composition $C_xH_{2x}O_x$ in 90 gm water boils at 101.24°C at 1.00 atmospheric pressure. What is the molecular formula ?

$K_b(H_2O) = 0.512$ K mol^{-1} kg

$T_b(H_2O) = 100$°C

Q.9 1.22 g of benzoic acid is dissolved in 100 g of acetone and 100g of benzene separately. Boiling point of the solution in acetone increases by 0.17°C, while that in the benzene increases by 0.13° C; K_b for acetone and benzene is 1.7 K kg mol^{-1} & 2.6 K kg mol^{-1}. Find molecular weight of benzoic acid in two cases and justify your answer.

[IIT 2004]

Q.10 1000 g of 1 m sucrose solution in water is cooled to -3.534°C. What weight of ice would be separated out at this temperature? $K_f(H_2O) = 1.86$ K Kg mol^{-1}

Q.11 Two beaker A and B present in a closed vessel. Beaker A contains 152.4 g qeuesous solution of urea, containing 12 g of urea. Beaker B contains 196.2 g glucose solution, containing 18 g of glucose. Both solutions allowed to attain the equilibrium. Determine wt. % of glucose in it's solution at equilibrium

(A) 6.71 (B) 14.49

(C) 16.94 (D) 20

Q.12 Two component A and B form an ideal solution. The mole fractions of A and B in ideal solution are X_A and X_B, while that of in vapour phase, these components have their mole fractions as Y_A and Y_B. Then the slope and intercept of plot of $\frac{1}{Y_A}$ vs $\frac{1}{X_A}$ will be -

(A) $\frac{P_A^\circ}{P_B^\circ}, \frac{P_B^\circ - P_A^\circ}{P_B^\circ}$ (B) $\frac{P_B^\circ}{P_A^\circ}, \frac{P_A^\circ - P_B^\circ}{P_A^\circ}$

(C) $\frac{P_B^\circ}{P_A^\circ}, \frac{P_B^\circ}{P_B^\circ - P_A^\circ}$ (D) $P_A^\circ - P_B^\circ, \frac{P_A^\circ}{P_B^\circ}$

Q.13 A saturated solution of XCl_3 has a vapour pressure 17.20 mm Hg at 20°C, while pure water vapour pressure is 17.25 mm Hg. solubility product (K_{sp}) of XCl_3 at 20°C is-

(A) 9.8×10^{-2} (B) 10^{-5}

(C) 2.56×10^{-6} (D) 7×10^{-5}

Q.14 A certain non-volatile electrolyte contains 40% carbon, 6.7% hydrogen and 53.3% oxygen. An aqueous solution containing 5% by mass of the solute boils at 100.15°C. Determine the molecular formula of the compound ($K_b = 0.51$°C/m)

(A) HCHO (B) CH_3OH

(C) C_2H_5OH (D) $C_6H_{12}O_6$

Answer key

Ankswer key is provided at the end of the exercise sheets.

ANSWER KEY

EXERCISE (Level-1)

1. (C)	**2.** (B)	**3.** (A)	**4.** (A)	**5.** (D)	**6.** (C)	**7.** (C)	**8.** (C)	**9.** (B)	**10.** (B)
11. (D)	**12.** (A)	**13.** (C)	**14.** (C)	**15.** (B)	**16.** (C)	**17.** (D)	**18.** (B)	**19.** (C)	**20.** (A)
21. (B)	**22.** (B)	**23.** (B)	**24.** (A)	**25.** (B)	**26.** (A)	**27.** (D)	**28.** (A)	**29.** (B)	**30.** (B)
31. (D)	**32.** (B)	**33.** (D)	**34.** (B)	**35.** (A)	**36.** (C)	**37.** (B)			

Revision Plan

We emphasis that every student should prepare his/her own revision plan. For this purpose there is Revision Plan Section in each chapter which student should prepare while going thorugh the study material. This will be useful at the time of final revision before final exam for quick & effective revision.

Revision Plan

Prepare Your Revision plan today!

After attempting Exercise Sheet, please fill below table as per the instruction given.

A. Write Question Number (QN) which you are unable to solve at your own in **column A**.

B. After discussing the Questions written in **column A** with faculty, strike off them in the manner so that you can see at the time question number during Revision, to solve such questions again.

C. Write down the Question Number you feel are important or good in the **column B**.

EXERCISE	COLUMN A	COLUMN B
	Questions unable to solve in first attempt	Good or Important questions
Topic wise practice questions		
Level-1		
Level-2		
Level-3		
Level-4		
Level-5		
Level-6		

Revision Strategy:

Whenever you wish to revision this chapter, follow the following steps-

Step-1: Review your theory notes.

Step-2: Solve Questions of column A

Online Solutions

Self explanatory and detailed soltuion of all excercises above are available on Career Point website www.careerpoint.ac.in

SOLUTIONS

EXERCISE (Level-1)

Answer Key & Solution

Question Number	Solution
1	Click Here
2	Click Here
3	Click Here
4	Click Here
5	Click Here
6	Click Here
7	Click Here
8	Click Here
9	Click Here
10	Click Here

Question Number	Solution
11	Click Here
12	Click Here
13	Click Here
14	Click Here
15	Click Here
16	Click Here
17	Click Here
18	Click Here
19	Click Here
20	Click Here

Question Number	Solution
21	Click Here
22	Click Here
23	Click Here
24	Click Here
25	Click Here
26	Click Here
27	Click Here
28	Click Here
29	Click Here
30	Click Here

Question Number	Solution
31	Click Here
32	Click Here
33	Click Here
34	Click Here
35	Click Here
36	Click Here
37	Click Here

Sol.1 **[C]**

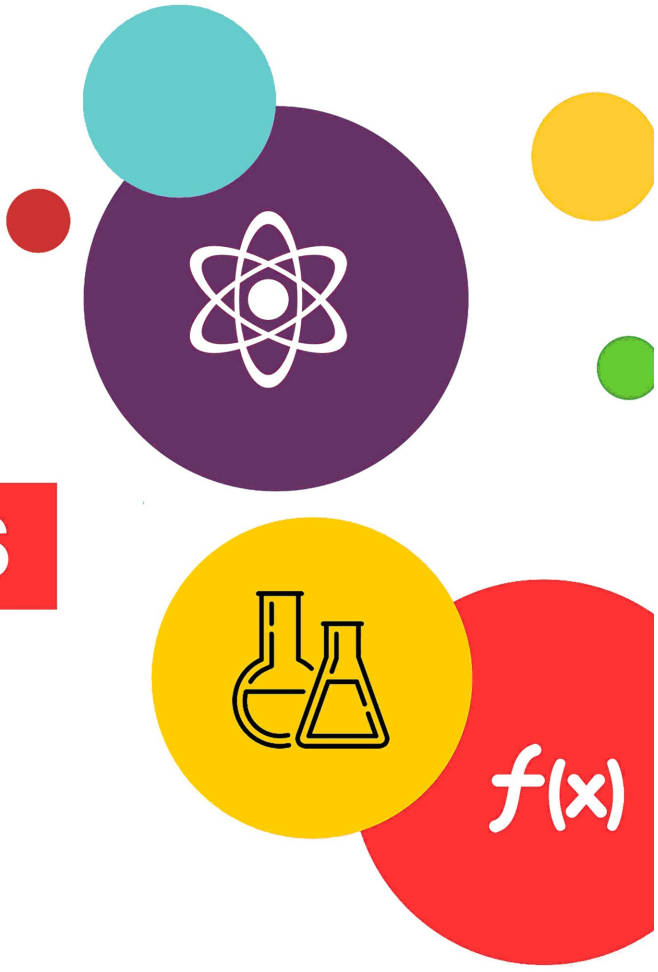
$$X_{\text{gluarine}} = \frac{46}{\frac{46}{92}+\frac{36}{18}} = \frac{0.5}{0.5+2} = 0.2$$

Top

STUDY MATERIAL

JEE

FOR MAIN & ADVANCED



MATHEMATICS

Class 12

CP PUBLICATION

MATHEMATICS

Study Material for JEE Main & Advanced preparation

Prepared by Career Point Kota Experts

CAREER POINT

CONTENTS OF THE PACKAGE AT A GLANCE

MATHEMATICS

Class 12

Differential Calculus

- Function
- Inverse Trigonometric Functions
- Limit
- Continuity
- Differentiation
- Tangent & Normal
- Monotonicity
- Maxima & Minima

Integral Calculus

- Indefinite Integration
- Definite Integration
- Area Under the Curve
- Differential Equation

Algebra (Part-II)

- Complex Number
- Probability
- Determinants
- Matrices
- Vector
- Three Dimensional Geometry

Note to the Students

Career Point offers this must have Study Package in Physics to meet the complete curriculum needs of engineering aspirants. The set comprises of 3 books. The set caters to the different requirements of students in classes XII. It offers complete and systematic coverage of **JEE Main** and **JEE Advanced** syllabi and aims to provide firm foundation in learning and develop competitive edge in preparation of the JEE and other engineering entrance examinations.

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Function

1. PRELIMINARIES

✦ Tricotomy Law

The real numbers are ordered in magnitude means. If x and y be two real numbers then there will be one and only one of the following relation will hold.

$x < y,\ x = y,\ x > y$

✦ Interval

The set of numbers between any two real numbers is called interval. The following are the types of interval.

(a) Closed Interval

$[a, b] = \{x,\ a \le x \le b\}$

(b) Open Interval

(a, b) or $]a, b[= \{x,\ a < x < b\}$

(c) Semi open or semi closed interval

$[a, b[$ or $[a, b) = \{x;\ a \le x < b\}$

$]a, b]$ or $(a, b] = \{x;\ a < x \le b\}$

2. DEFINITION OF FUNCTION

Let A and B be two non-empty sets. Then a function ' f ' from set A to set B is a rule which associates elements of set A to elements of set B such that

- All elements of set A are associated to element in set B.
- An element of set A is associated to a unique element in set B.

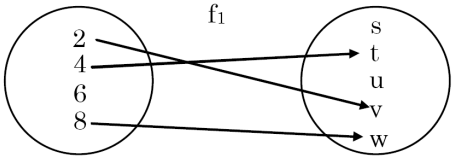
Terms such as "map" (or "mapping"), "correspondence" are used as synonyms for "function". If f is a function from a set A to set B, then we write $f : A \to B$ or $A \xrightarrow{f} B$, which is read as f is a function from A to B or f maps A to B.

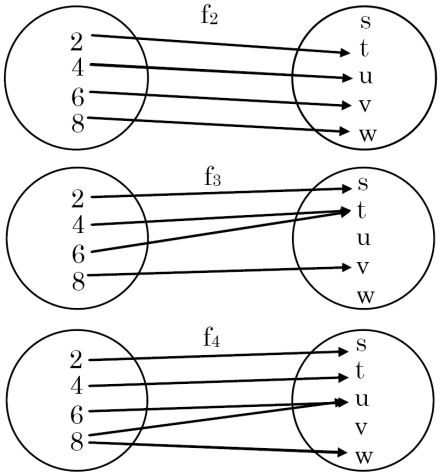
✦ Pre Image / f Image

If an element $a \in A$ is associated to an element $b \in B$, then b is called 'the f-image of a' or 'image of a under f' or 'the value of the function f at a'. Also, a is called the pre-image of b under the function f. We write it as : $b = f(a)$.

Example. 1

Let $A = \{2, 4, 6, 8\}$ and $B = \{s, t, u, v, w\}$ be two sets and let f_1, f_2, f_3 and f_4 be rules associating elements of A to elements of B as shown in the following figures.





Now see that f_1 is not function from set A to set B, since there is an element $6 \in A$ which is not associated to any element of B. But f_2 and f_3 are the functions from A to B, because under f_2 and f_3 each element of A is associated to a unique element in B. But f_4 is not a function from A to B because an element $8 \in A$ is associated to two element u and w in B.

3. WAYS OF REPRESENTING FUNCTIONS

✦ Analytical Representation

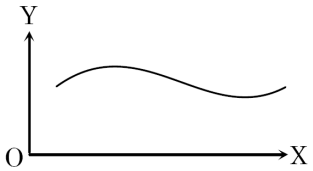
$y = \sqrt{x^2 - 1}$, $f(x) = \dfrac{\log_e x + e^x}{\sin x}$

$f(x) = \dfrac{ax^2 + bx + c}{e^{2x} \sin^{-1} x}$, ...

Representation of a function in above way is called analytical representation. i.e. when function is denoted like $y = f(x)$ or $f(x, y) = 0$, then it is called **Analytical Representation**.

✦ Graphical Representation

In 2D a set of points M(x, y) provided no two or more points lie in same straight line parallel to axis of y. Then M(x, y) represents a function, where x's denotes arguments and y denotes the value of function.



Important Points

This part contains important concepts & formulas of chapter at one place in short manner, So that student can revise all these in short time.

Points to Remember

The function whose period is 2π

1. $(\sin x)^{2n+1}, (\cos x)^{2n+1}, (\sec x)^{2n+1}, (\operatorname{cosec} x)^{2n+1}$

The function whose period is π

2. $(\sin x)^{2n}$, $(\cos x)^{2n}$, $(\sec x)^{2n}$, $(\operatorname{cosec} x)^{2n}$

3. $(\tan x)^n$, $(\cot x)^n$

4. $|\sin x|$, $|\cos x|$, $|\tan x|$, $|\cot x|$, $|\sec x|$, $|\operatorname{cosec} x|$

5. If f(x) has the period T, then f(± ax + b) will have the period $\frac{T}{|a|}$

6. If $f_1(x)$ has the period T_1

$f_2(x)$ has the period T_2

Then period of $af_1(x) + bf_2(x)$ will be

Solved Examples (JEE Main/Advanced)

To understand the application of concepts, there is a solved example section. It contains large variety of all types of solved examples with explaination to ensure understanding the application of concepts.

SOLVED EXAMPLES

Ex.1 Find the domain and range of the function $f(x) = \sqrt{2-x} + \sqrt{1+x}$

Sol. Domain of $f(x) = \{x \mid 2 - x \geq 0 \text{ and } 1 + x \geq 0\}$

$\therefore$ domain of $f(x) = [-1, 2]$

Again, $\{f(x)\}^2 = \left(\sqrt{2-x} + \sqrt{1+x}\right)^2$

$$= 3 + 2\sqrt{(2-x)(1+x)}$$

$$= 3 + 2\sqrt{2 + x - x^2}$$

$$= 3 + 2\sqrt{\frac{9}{4} - \left(x - \frac{1}{2}\right)^2}$$

$\therefore$ the greatest value of $\{f(x)\}^2$

$$= 3 + 2.\sqrt{\frac{9}{4}} = 6, \text{ when } x = \frac{1}{2}$$

the least value of $\{f(x)\}^2 = 3 + 0 = 3$,

when $x - \frac{1}{2} = \frac{3}{2}$, i.e. $x = 2$

$\therefore$ the greatest value of $f(x) = \sqrt{6}$

and the least value of $f(x) = \sqrt{3}$

$\therefore$ range of $f(x) = [\sqrt{3}, \sqrt{6}\ ]$

Ex.2 Find the range of the following function

$$f(x) = \frac{3}{2 - x^2}$$

Sol. Let $y = \frac{3}{2-x^2} = f(x)$ ....(1)

$$= \log_2\left(\sin\left(\pi - \frac{\pi}{4}\right) + 3\right) = y \text{ (let)}$$

$$\Rightarrow \quad 2^y = \sin\left(\pi - \frac{\pi}{4}\right) + 3$$

$$\Rightarrow \quad 2^y - 3 = \sin\left(\pi - \frac{\pi}{4}\right)$$

But $-1 \leq \sin\left(\pi - \frac{\pi}{4}\right) \leq 1$

$\therefore \quad -1 \leq 2^y - 3 \leq 1$

$\Rightarrow \quad 2 \leq 2^y \leq 4$

$\Rightarrow \quad 2^1 \leq 2^y \leq 2^2$

Hence $y \in [1, 2]$.

Hence Range of $f(x)$ is $[1, 2]$.

Ex.4 Find the period of the following function

$f(x) = e^{x-[x]} + |\cos \pi x| + |\cos 2\pi x| + \ldots + |\cos n\pi x|$,

[.] is greatest integer function.

Sol. $f(x) = e^{x-[x]} + |\cos \pi x| + |\cos 2\pi x| + \ldots\ldots + |\cos n\pi x|$

Period of $x - [x] = 1$

Period of $|\cos \pi x| = 1$

Period of $|\cos 2\pi x| = 1/2$

.....

.....

Period of $|\cos n\pi x| = 1/n$

So period of $f(x)$ will be

L.C.M. of all periods = 1.

Ex.5 Let a function $f : R \to R$ be defined as

Practice Exercises

Exercise Level - 1 : It contains objective questions with single correct choice to ensure sufficient practice to accutrately appply formule and concepts.

EXERCISE (Level-1)

Question based on **Domain**

Q.1 Domain of $y = \log_{10}\left(\frac{5x - x^2}{4}\right)$ is

(A) (0, 5)
(B) [1, 4]
(C) $(-\infty, 0) \cup (5, \infty)$
(D) $(-\infty, 1) \cup (4, \infty)$

Q.2 The domain of definition of

$f(x) = \frac{\sqrt{-\log_{0.3}(x-1)}}{\sqrt{x^2 + 2x + 8}}$ is:

(A) (1, 4) (B) (–2, 4)
(C) (2, 4) (D) [2, ∞)

Q.3 The function

$f(x) = \cot^{-1}\sqrt{(x+3)x} + \cos^{-1}\sqrt{x^2 + 3x + 1}$ is defined on the set S, where S is equal to:

(A) {0, 3} (B) (0, 3)
(C) {–3, 0} (D) [–3, 0]

Q.4 The domain of $\sqrt{\sec^{-1}\left(\frac{2 - |x|}{4}\right)}$ is

(A) R (B) R – (–1, 1)
(C) R – (–3, 3) (D) R – (– 6, 6)

Q.5 The domain of the function
$f(x) = {}^{24-x}C_{3x-1} + {}^{40-6x}C_{8x-10}$ is -

(A) {2, 3} (B) {1, 2, 3}
(C) {1, 2, 3, 4} (D) None of these

Q.6 Domain of the function

$f(x) = (1 - 3x)^{1/3} + 3\cos^{-1}\left(\frac{2x-1}{3}\right) + 3^{3\tan^{-1}x}$ is

(A) $\left[-\frac{1}{3}, \frac{1}{3}\right]$ (B) $\left[-\frac{1}{2}, 1\right]$
(C) [–1, 2] (D) $\left[-\frac{1}{4}, \frac{1}{2}\right]$

Q.7 The function $f(x) = \frac{\sec^{-1}x}{\sqrt{x - [x]}}$, where [x] denotes the greatest integer less than or equal to x, is defined for all x belonging to -

(A) R
(B) $R - \{(-1, 1) \cup \{n : n \in Z\}\}$
(C) $R^+ - (0, 1)$
(D) $R^+ - \{n : n \in N\}$

Q.8 The function

$f(x) = \cos^{-1}\left(\frac{|x| - 3}{2}\right) + [\log_e (4 - x)]^{-1}$ is

defined for -

(A) $[-1, 0] \cup [1, 5]$
(B) $[-5, -1] \cup [1, 4]$
(C) $[-5, -1] \cup ([1, 4) - \{3\})$
(D) $[1, 4] - \{3\}$

Q.9 The domain of function $f(x) = \log |\log x|$ is-

(A) (0, ∞) (B) (1, ∞)
(C) $(0, 1) \cup (1, \infty)$ (D) $(-\infty, 1)$

Q.10 The domain of function

$f(x) = \frac{1}{\log_{10}(3 - x)} + \sqrt{x + 2}$ is -

(A) [–2, 3) (B) [–2, 3) – {2}
(C) [–3, 2] (D) [–2, 3] – {2}

Question based on **Range**

Q.11 The range of the function $y = \frac{1}{2 - \sin 3x}$ is :

(A) $\left(\frac{1}{3}, 1\right)$ (B) $\left[\frac{1}{3}, 1\right)$
(C) $\left[\frac{1}{3}, 1\right]$ (D) None of these

Q.12 The value of the function

$f(x) = \frac{x^2 - 5x + 6}{x^2 - 4x + 3}$ lies in the interval -

(A) $(-\infty, \infty) - \left\{\frac{1}{2}, 1\right\}$ (B) $(-\infty, \infty)$
(C) $(-\infty, \infty) - \{1\}$ (D) None of these

Q.13 The range of the function,

$y = \log_{\sqrt{7}}(\sqrt{2}(\sin x - \cos x) + 5)$ is

(A) R (B) Z
(C) $[\log_7 4, \log_7 5]$ (D) $[2 \log_7 3, 2]$

Q.14 Which of the following function(s) has the range [–1, 1]

(A) $f(x) = \cos(2 \sin x)$
(B) $g(x) = \cos\left(1 - \frac{1}{1 + x^2}\right)$
(C) $h(x) = \sin(\log_2 x)$
(D) $k(x) = \tan(e^x)$

Exercise Level - 2 : It contains single objective type questions with moderate difficulty level to enhance the conceptual and application level of the student.

EXERCISE (Level-2)

Single correct answer type questions

Q.1 If fundamental period of $\frac{\cos(\sin nx)}{\tan(x/n)}$ ($n \in N$) is 6π then n is equal to
(A) 3 (B) 2 (C) 6 (D) 1

Q.2 Let $f(x) = \sin^2\left(\frac{x}{2}\right) + \cos^2\left(\frac{x}{2}\right)$ and $g(x) = \sec^2 x - \tan^2 x$. The two functions are equal over the set -
(A) ϕ
(B) R – $\left\{x : x = (2n+1)\frac{\pi}{2}, n \in Z\right\}$
(C) R
(D) None of these

Q.3 Domain and range of $\sin\left(\log\left(\frac{\sqrt{4-x^2}}{1-x}\right)\right)$ is
(A) [–2, 1), (–1, 1) (B) (–2, 1), [–1, 1]
(C) (–2, 1), R (D) None of these

Q.4 The range of $\sin^{-1}\left[x^2+\frac{1}{2}\right] + \cos^{-1}\left[x^2-\frac{1}{2}\right]$ where [ ] represent greatest integer function
(A) $\left\{\frac{\pi}{2}, \pi\right\}$ (B) $\{\pi\}$
(C) $\left\{\frac{\pi}{2}\right\}$ (D) None of these

Q.5 Let $f(x) = \frac{9^x}{9^x+3}$ and $f(x) + f(1-x) = 1$ then find value of $f\left(\frac{1}{1996}\right)+\left(\frac{2}{1996}\right)+\ldots+f\left(\frac{1995}{1996}\right)$ is-
(A) 998 (B) 997
(C) 997.5 (D) 998.5

Q.6 If $f(x)$ be a polynomial satisfying $f(x).\ f\left(\frac{1}{x}\right) = f(x) + f\left(\frac{1}{x}\right)$ and $f(4) = 65$ then $f(6) = ?$
(A) 176 (B) 217
(C) 289 (D) None of these

Q.7 Let $f : R \to R$ defined by $f(x) = \frac{\sin([x]\pi)}{x^2+2x+4}$, where [ ] represent greatest integer function, then which one is not true -
(A) f is periodic (B) f is even
(C) f is many-one (D) f is onto

Q.8 Let $f : R \to R$ be a function defined by $f(x) = x + \sqrt{x^2}$, then f is-
(A) Injective (B) Surjective
(C) Bijective (D) None of these

Q.9 Which of the following functions are equal?
(A) $f(x) = x$, $g(x) = \sqrt{x^2}$
(B) $f(x) = \log x^2$, $g(x) = 2\log x$
(C) $f(x) = 1$, $g(x) = \sin^2 x + \cos^2 x$
(D) $f(x) = \frac{x}{x}$, $g(x) = 1$

Q.10 Let $f : (4, 6) \to (6, 8)$ be a function defined by $f(x) = x + \left[\frac{x}{2}\right]$, where [ ] represent greatest integer function then $f^{-1}(i)$ is equal to -
(A) $x - 2$ (B) $x - \left[\frac{x}{2}\right]$
(C) $-x - 2$ (D) None of these

Q.11 The interval for which $\sin^{-1}\sqrt{x} + \cos^{-1}\sqrt{x} = \frac{\pi}{2}$ holds-
(A) [0, ∞) (B) [0, 3]
(C) [0, 1] (D) [0, 2]

Q.12 The function $f(x) = \sqrt{\log_{10}\cos(2\pi x)}$ exists -
(A) for any rational x
(B) only when x is a positive integer
(C) only when x is fractional
(D) for any integer value of x including zero

Q.13 The domain of the function $\sec^{-1}[x^2 - x + 1]$, is given by (where [·] is greatest integer function)-
(A) [0, 1] (B) $(-\infty, 0] \cup [1, \infty)$
(C) $\left[\frac{1-\sqrt{5}}{2}, \frac{1+\sqrt{5}}{2}\right]$ (D) None of these

Q.14 The domain of definition of the function $f(x) = \frac{\cot^{-1} x}{\sqrt{\{x^2 - [x^2]\}}}$, where $[x]$ denotes the greatest integer less than or equal to x is -
(A) R
(B) R – $\{\pm\sqrt{n} : n \in I^+ \cup \{0\}\}$
(C) R – {0}
(D) R – $\{n : n \in I\}$

Q.15 The domain of the definition of $f(x) = \log\{(\log x)^2 - 5\log x + 6\}$ is equal to-
(A) $(0, 10^2)$ (B) $(10^3, \infty)$
(C) $(10^2, 10^3)$ (D) $(0, 10^2) \cup (10^3, \infty)$

Exercise Level - 3 : It contains previous years question of JEE Main from Year 2005 to 2024.

EXERCISE (Level-3)

Old Examination Questions [JEE Main]

Q.1 Let $f : (-1, 1) \to B$, be a function defined by $f(x) = \tan^{-1}\frac{2x}{1-x^2}$, then f is both one-one and onto when B is the interval **[AIEEE-2005]**

(A) $\left(0, \frac{\pi}{2}\right)$ (B) $\left[0, \frac{\pi}{2}\right)$

(C) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ (D) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

Q.2 A real valued function $f(x)$ satisfies the functional equation $f(x-y) = f(x)\,f(y) - f(a-x)\,f(a+y)$ where a is a given constant and $f(0) = 1$, then $f(2a-x)$ is equal to - **[AIEEE-2005]**

(A) $-f(x)$ (B) $f(x)$

(C) $f(a) + f(a-x)$ (D) $f(-x)$

Q.3 The largest interval lying in $\left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$ for which the function

$f(x) = 4^{-x^2} + \cos^{-1}\left(\frac{x}{2} - 1\right) + \log(\cos x)$ defined, is- **[AIEEE 2007]**

(A) $[0, \pi]$ (B) $\left(\frac{-\pi}{2}, \frac{\pi}{2}\right)$

(C) $\left[-\frac{\pi}{4}, \frac{\pi}{2}\right)$ (D) $\left[0, \frac{\pi}{2}\right)$

Q.4 Let $f : N \to Y$ be a function defined as $f(x) = 4x + 3$ where $Y = \{y \in N : y = 4x + 3 \text{ for some } x \in N\}$. Inverse of f is - **[AIEEE 2008]**

(A) $g(y) = 4 + \frac{y+3}{4}$ (B) $g(y) = \frac{y+3}{4}$

(C) $g(y) = \frac{y-3}{4}$ (D) $g(y) = \frac{3y+4}{3}$

Q.5 For real x, let $f(x) = x^3 + 5x + 1$, then - **[AIEEE 2009]**

(A) f is one - one but not onto on R

(B) f is onto on R but not one - one

(C) f is one - one and onto on R

(D) f is neither one - one nor onto on R

Q.6 Let $f(x) = (x+1)^2 - 1$, $x \geq -1$

Statement - 1 :

The set $\{x : f(x) = f^{-1}(x)\} = \{0, -1\}$.

Statement - 2 :

f is a bijection. **[AIEEE 2009]**

(A) Statement -1 is true, Statement-2 is true; Statement-2 is a correct explanation for Statement -1

(B) Statement-1 is true, Statement-2 is true; Statement-2 is ***not*** a correct explanation for Statement -1.

(C) Statement -1 is true, Statement-2 is false.

(D) Statement -1 is false, Statement-2 is true

Q.7 The domain of the function

$f(x) = \frac{1}{\sqrt{|x| - x}}$ is : **[AIEEE 2011]**

(A) $(-\infty, \infty)$ (B) $(0, \infty)$

(C) $(-\infty, 0)$ (D) $(-\infty, \infty) - \{0\}$

Q.8 Let A and B be nonempty set in R and $f : A \to B$ be a bijective function.

Statement-1: f is an onto function

Statement-2 : There exists a function $g : B \to A$ such that $fog = I_B$. **[AIEEE Online- 2012]**

(A) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of Statement-1

(B) Statement-1 is true, Statement-2 is true and Statement-2 is not the correct explanation of statement-1

(C) Statement-1 is true, Statement-2 is false

(D) Statement-1 is false, Statement-2 is true

Q.9 The range of the function $f(x) = \frac{x}{1+|x|}$, $x \in R$ is : **[AIEEE Online- 2012]**

(A) $[-1, 1]$ (B) R (C) $R - \{0\}$ (D) $(-1, 1)$

Q.10 If P(S) denotes the set of al subsets of a given set S, then the number of one to one functions from the set $S = \{1, 2, 3\}$ to the set P(S) is : **[AIEEE Online- 2012]**

(A) 24 (B) 8 (C) 336 (D) 320

Q.11 Let $A = \{1, 2, 3, 4\}$ and $R : A \to A$ be the relation defined by $R = \{(1, 1), (2, 3), (3, 4), (4, 2)\}$. The correct statements is : **[JEE Main Online -2013]**

(A) R does not have an inverse

(B) R is not a one to one function

(C) R is an onto function

(D) R is not a function

Q.12 If $a \in R$ and the equation $-3(x-[x])^2 + 2(x-[x]) + a^2 = 0$ (where $[x]$ denotes the greatest integer $\leq x$) has no integral solution, then all possible values of a lie in the interval : **[JEE Main -2014]**

(A) $(-\infty, -2) \cup (2, \infty)$ (B) $(-1, 0) \cup (0, 1)$

(C) (1, 2) (D) $(-2, -1)$

Exercise Level - 4 : It contains all variety of questions as per level of JEE Advanced such as MCQ, Column match, Passage based & Numerical type etc.

EXERCISE (Level-4)

Part-A : Multiple correct answer type questions

Q.1 If $f(x) = \sqrt{x^2 - |x|}$, $g(x) = \frac{1}{\sqrt{9 - x^2}}$ then D_{f+g} contains

(A) $(-3, -1)$ (B) $[1, 3)$

(C) $[-3, 3]$ (D) $\{0\} \cup [1, 3)$

Q.2 If $f(x) = \frac{3x - 1}{3x^3 + 2x^2 - x}$ and $S = \{x \mid f(x) > 0\}$ then S contains

(A) $(-\infty, -2)$ (B) $\left(\frac{1}{3}, 5\right)$

(C) $(-\infty, -1)$ (D) $(0, \infty) - \left\{\frac{1}{3}\right\}$

Q.3 If D is the domain of the function $f(x) = \sqrt{1 - 2x} + 3\sin^{-1}\left(\frac{3x - 1}{2}\right)$ then D contains-

(A) $\left[-\frac{1}{3}, \frac{1}{2}\right]$ (B) $\left[-\frac{1}{3}, 0\right]$

(C) $\left[-\frac{1}{3}, 1\right]$ (D) $\left[\frac{1}{2}, 1\right]$

Q.4 Let $A = R - \{2\}$ and $B = R - \{1\}$.

Let $f : A \to B$ be defined by $f(x) = \frac{x - 3}{x - 2}$ then–

(A) f is one-one (B) f is onto

(C) f is bijective (D) None of these

Q.5 If $F(x) = \frac{\sin \pi[x]}{\{x\}}$, then $F(x)$ is:

(A) Periodic with fundamental period 1

(B) Even

(C) Range is singleton

(D) Identical to $\operatorname{sgn}\left(\operatorname{sgn}\frac{\{x\}}{\sqrt{\{x\}}}\right) - 1$, where $\{x\}$ denotes fractional part function and [.] denotes greatest integer function and sgn (x) is a signum function.

Q.6 Let $f : [-1, 1] \to [0, 2]$ be a linear function which is onto then $f(x)$ is/are

(A) $1 - x$ (B) $1 + x$ (C) $x - 1$ (D) $x + 2$

Q.7 In the following functions defined from $[-1, 1]$ to $[-1, 1]$ the functions which are not bijective are:

(A) $\sin(\sin^{-1}x)$ (B) $\frac{2}{\pi}\sin^{-1}(\sin x)$

(C) (sgn x) $\ell n\, e^x$ (D) x^3 sgn x

Q.8 Which of the following function is periodic ?

(A) sgn (e^{-x})

(B) $\sin x + |\sin x|$

(C) $\min(\sin x, |x|)$

(D) $\left[x + \frac{1}{2}\right] + \left[x - \frac{1}{2}\right] + 2[-x]$

Where $[x]$ denotes greatest integer function.

Q.9 If $f(x) = \begin{cases} 2x + 3 & x \le 1 \\ a^2x + 1 & x > 1 \end{cases}$ then values of 'a' for which $f(x)$ is injective is

(A) -3 (B) 3 (C) 0 (D) 1

Q.10 Consider the function $y = f(x)$ satisfying the condition $f\left(x + \frac{1}{x}\right) = x^2 + \frac{1}{x^2}$ $(x \neq 0)$, then

(A) domain of $f(x)$ is R

(B) domain of $f(x)$ is $R - (-2, 2)$

(C) range of $f(x)$ is $[-2, \infty)$

(D) range of $f(x)$ is $[2, \infty)$

Q.11 Consider the real-valued function satisfying $2f(\sin x) + f(\cos x) = x$. Then

(A) domain of $f(x)$ is R

(B) domain of $f(x)$ is $[-1, 1]$

(C) range of $f(x)$ is $\left[-\frac{2\pi}{3}, \frac{\pi}{3}\right]$

(D) range of $f(x)$ is R

Q.12 Let $f(x) = x^2 - 2ax + a(a + 1)$, $f : [a, \infty) \to [a, \infty)$. If one of the solutions of the equation $f(x) = f^{-1}(x)$ is 5049, then the other may be

(A) 5051 (B) 5048 (C) 5052 (D) 5050

Q.13 If $f : R^+ \to R^+$ is a polynomial function satisfying the functional equation $f(f(x)) = 6x - f(x)$, then $f(17)$ is equal to -

(A) 17 (B) -51 (C) 34 (D) -34

Q.14 $f : R \to [-1, \infty)$ and $f(x) = \ell n([|\sin 2x| + |\cos 2x|])$ (where [.] is the greatest integer function)

(A) $f(x)$ has range Z

(B) $f(x)$ is periodic with fundamental period $\pi/4$

(C) $f(x)$ is invertible in $\left[0, \frac{\pi}{4}\right]$

(D) $f(x)$ is into function

Q.15 Let $f(x) = \operatorname{sgn}(\cot^{-1}x) + \tan\left(\frac{\pi}{2}[x]\right)$, where $[x]$ is the greatest integer function less than or equal x. Then which of the following alternatives is/are true ?

(A) $f(x)$ is many one but not even function

(B) $f(x)$ is periodic function

(C) $f(x)$ is bounded function

(D) Graph of $f(x)$ remains above the x-axis

Exercise Level - 5 : It contains previous years question of JEE Advanced from Year 2005 to 2024.

EXERCISE (Level-5)

Old Examination Questions [JEE Advanced]

Q.1 $f(x)=\begin{cases}x, & x\in Q\\ 0, & x\notin Q\end{cases}$; $g(x)=\begin{cases}0 & x\in Q\\ x & x\notin Q\end{cases}$

then $(f-g)$ is **[IIT Scr. 2005]**

(A) one-one, onto

(B) neither one-one, nor onto

(C) one-one but not onto

(D) onto but not one-one

Q.2 If X and Y are two non-empty sets where $f: X \to Y$ is function is defined such that $f(C) = \{f(x): x \in C\}$ for $C \subseteq X$ and $f^{-1}(D) = \{x : f(x) \in D\}$ for $D \subseteq Y$ for any $A \subseteq X$ and $B \subseteq Y$ then- **[IIT 2005]**

(A) $f^{-1}(f(A)) = A$

(B) $f^{-1}(f(A)) = A$ only if $f(X) = Y$

(C) $f(f^{-1}(B)) = B$ only if $B \subseteq f(x)$

(D) $f(f^{-1}(B)) = B$

Q.3 Find the range of values of t for which $2\sin t = \dfrac{1-2x+5x^2}{3x^2-2x-1}$; $t \in \left[-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right]$

[IIT 2005]

Q.4 Let $f(x) = \dfrac{x^2-6x+5}{x^2-5x+6}$ **[IIT 2007]**.

Column-I	**Column-II**
(A) If $-1 < x < 1$, then $f(x)$ satisfies	(P) $0 < f(x) < 1$
(B) If $1 < x < 2$, then $f(x)$ satisfies	(Q) $f(x) < 0$
(C) If $3 < x < 5$, then $f(x)$ satisfies	(R) $f(x) > 0$
(D) If $x > 5$, then $f(x)$ satisfies	(S) $f(x) < 1$

Q.5 Let $f(x) = x^2$ and $g(x) = \sin x$ for all $x \in R$. Then the set of all x satisfying $(f \circ g \circ g \circ f)(x) = (g \circ g \circ f)(x)$, where $(f \circ g)(x) = f(g(x))$, is **[IIT 2011]**

(A) $\pm\sqrt{n\pi}$, $n \in \{0, 1, 2...\}$

(B) $\pm\sqrt{n\pi}$, $n \in \{1, 2...\}$

(C) $\dfrac{\pi}{2} + 2n\pi, n \in \{...., -2, -1, 0, 1, 2, ...\}$

(D) $2n\pi$, $n \in \{...., -2, -1, 0, 1, 2, ...\}$

Q.6 The function $f : [0, 3] \to [1, 29]$, defined by $f(x) = 2x^3 - 15x^2 + 36x + 1$, is **[IIT 2012]**

(A) one-one and onto.

(B) onto but not one-one.

(C) one-one but not onto.

(D) neither one-one nor onto.

Q.7 Let $f : (-1, 1) \to IR$ be such that $f(\cos 4\theta) = \dfrac{2}{2-\sec^2\theta}$ for $\theta \in \left(0, \dfrac{\pi}{4}\right) \cup \left(\dfrac{\pi}{4}, \dfrac{\pi}{2}\right)$.

Then the value(s) of $f\left(\dfrac{1}{3}\right)$ is (are)

MCQ **[IIT 2012]**

(A) $1-\sqrt{\dfrac{3}{2}}$ (B) $1+\sqrt{\dfrac{3}{2}}$

(C) $1-\sqrt{\dfrac{2}{3}}$ (D) $1+\sqrt{\dfrac{2}{3}}$

Q.8 Let $f : \left(-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right) \to R$ be given by $f(x) = (\log(\sec x + \tan x))^3$. Then

MCQ **[IIT-Advance 2014]**

(A) $f(x)$ is an odd function

(B) $f(x)$ is a one-one function

(C) $f(x)$ is an onto function

(D) $f(x)$ is an even function

Q.9 Let $f(x) = \sin\left(\dfrac{\pi}{6}\sin\left(\dfrac{\pi}{2}\sin x\right)\right)$ for all $x \in R$ and $g(x) = \dfrac{\pi}{2}\sin x$ for all $x \in R$. Let $(f \circ g)(x)$ denote $f(g(x))$ and $(g \circ f)(x)$ denote $g(f(x))$. Then which of the following is (are) true ?

MCQ **[IIT-Advance 2015]**

(A) Range of f is $\left[-\dfrac{1}{2}, \dfrac{1}{2}\right]$

(B) Range of $f \circ g$ is $\left[-\dfrac{1}{2}, \dfrac{1}{2}\right]$

(C) $\lim\limits_{x\to 0}\dfrac{f(x)}{g(x)} = \dfrac{\pi}{6}$

(D) There is an $x \in R$ such that $(g \circ f)(x) = 1$

Q.10 Let X be a set with exactly 5 elements and Y be a set with exactly 7 elements. If α is the number of one-one functions from X to Y and β is the number of onto functions from Y to X, then the value of $\dfrac{1}{5!}(\beta - \alpha)$ is ____. **[JEE - Advance 2018]**

Exercise Level - 6 : Advanced level a bit complex questions for students for solid rock prepertion for Top Rankers.

EXERCISE (Level-6)

Review Exercise

Q.1 Find the natural number 'a' for which $\sum_{k=1}^{n} f(a+k) = 16(2^n - 1)$, where the function '$f$' satisfies the relation $f(x + y) = f(x)\ f(y)$ for all natural numbers x, y and further $f(1) = 2$.

[IIT-1992]

Q.2 A function $f : R \to R$, where R, is the set of real numbers, is defined by $f(x) = \dfrac{\alpha x^2 + 6x - 8}{\alpha + 6x - 8x^2}$

Find the interval of values of α for which $f(x)$ is onto. Is the functions one-to-one for $\alpha = 3$? Justify your answer. **[IIT 1996]**

Q.3 Let $f(x) = [x] \sin\left(\dfrac{\pi}{[x+1]}\right)$, where [.] denotes the greatest integer function. Then find the domain of f. **[IIT 1996]**

Q.4 If f is an even function defined on the interval (–5, 5), then four real values of x satisfying the equation $f(x) = f\left(\dfrac{x+1}{x+2}\right)$ are ....., ... and. ..... **[IIT-1996]**

Q.5 If the function $f : [1, \infty) \to [1, \infty)$ is defined by $f(x) = 2^{x(x-1)}$, then find the value of $f^{-1}(x)$.

[IIT 99]

Q.6 Let $[x]$ = the greatest integer less than or equal to x. If all the values of x such that the product $\left[x - \dfrac{1}{2}\right]\left[x + \dfrac{1}{2}\right]$ is prime, belongs to the set $[x_1, x_2) \cup [x_3, x_4)$, find the value of $x_1^2 + x_2^2 + x_3^2 + x_4^2$.

Q.7 The set of real values of 'x' satisfying the equality $\left[\dfrac{3}{x}\right] + \left[\dfrac{4}{x}\right] = 5$ (where [ ] denotes the greatest integer function) belongs to the interval $\left(a, \dfrac{b}{c}\right]$ where $a, b, c \in N$ and $\dfrac{b}{c}$ is in its lowest form. Find the value of $a + b + c + abc$.

Q.8 Let $f : R \to R - \{3\}$ be a function with the property that there exist $T > 0$ such that $f(x + T) = \dfrac{f(x) - 5}{f(x) - 3}$ for every $x \in R$. Prove that $f(x)$ is periodic.

Q.9 In a function

$$2f(x) + xf\left(\frac{1}{x}\right) - 2f\left(\left|\sqrt{2}\sin\left(\pi\left(x + \frac{1}{4}\right)\right)\right|\right)$$

$= 4\cos^2\dfrac{\pi x}{2} + x\cos\dfrac{\pi}{x}$. Prove that

(i) $f(2) + f\left(\dfrac{1}{2}\right) = 1$

(ii) $f(2) + f(1) = 0$

Q.10 Verify if $f(x) = \dfrac{x^2 - 8x + 18}{x^2 + 4x + 30}$ is an one-one function.

Q.11 Find the domain of the function,

$$f(x) = \frac{1}{[|x-1|] + [|7-x|] - 6}$$

Where[·] is greatest integer function.

Q.12 Let n be a positive integer and define $f(n) = 1! + 2! + 3! + ... + n!$, where $n! = n(n-1)(n-2) .... 3.2.1$. Find the polynomial $P(x)$ and $Q(x)$ such that $f(n+2) = P(n)\,f(n+1) + Q(n)\,f(n)$, for all $n \geq 1$.

Q.13 Find the domain of

$$y = \sqrt{-\log_{\frac{x+4}{2}}\left(\log_2\frac{2x-1}{3+x}\right)}$$

Answer key

Ankswer key is provided at the end of the exercise sheets.

ANSWER KEY

EXERCISE (Level-1)

1. (A)	**2.** (D)	**3.** (C)	**4.** (D)	**5.** (A)	**6.** (C)	**7.** (B)
8. (C)	**9.** (C)	**10.** (B)	**11.** (C)	**12.** (A)	**13.** (D)	**14.** (C)
15. (A)	**16.** (D)	**17.** (B)	**18.** (D)	**19.** (B)	**20.** (A)	**21.** (B)
22. (C)	**23.** (B)	**24.** (C)	**25.** (A)	**26.** (A)	**27.** (A)	**28.** (B)
29. (B)	**30.** (B)	**31.** (A)	**32.** (D)	**33.** (B)	**34.** (D)	**35.** (A)
36. (A)	**37.** (A)	**38.** (D)	**39.** (C)	**40.** (A)	**41.** (A)	

Revision Plan

We emphasis that every student should prepare his/her own revision plan. For this purpose there is Revision Plan Section in each chapter which student should prepare while going thorugh the study material. This will be useful at the time of final revision before final exam for quick & effective revision.

Revision Plan

Prepare Your Revision plan today!

After attempting Exercise Sheet, please fill below table as per the instruction given.

A. Write Question Number (QN) which you are unable to solve at your own in **column A**.

B. After discussing the Questions written in **column A** with faculty, strike off them in the manner so that you can see at the time question number during Revision, to solve such questions again.

C. Write down the Question Number you feel are important or good in the **column B**.

EXERCISE	COLUMN A	COLUMN B
	Questions unable to solve in first attempt	Good or Important questions
Topic wise practice questions		
Level-1		
Level-2		
Level-3		
Level-4		
Level-5		
Level-6		

Revision Strategy:

Whenever you wish to revision this chapter, follow the following steps-

Step-1: Review your theory notes.

Step-2: Solve Questions of column A

Online Solutions

Self explanatory and detailed soltuion of all excercises above are available on Career Point website **www.careerpoint.ac.in**

FUNCTION

EXERCISE (Level-1)

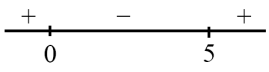
Answer Key & Solution

Question Number	Solution
1	Click Here
2	Click Here
3	Click Here
4	Click Here
5	Click Here
6	Click Here
7	Click Here
8	Click Here
9	Click Here
10	Click Here
11	Click Here
12	Click Here
13	Click Here
14	Click Here
15	Click Here
16	Click Here
17	Click Here
18	Click Here
19	Click Here
20	Click Here
21	Click Here

Question Number	Solution
22	Click Here
23	Click Here
24	Click Here
25	Click Here
26	Click Here
27	Click Here
28	Click Here
29	Click Here
30	Click Here
31	Click Here
32	Click Here
33	Click Here
34	Click Here
35	Click Here
36	Click Here
37	Click Here
38	Click Here
39	Click Here
40	Click Here
41	Click Here

Sol.1 **[A]**

$$\frac{5x - x^2}{4} > 0 \Rightarrow x^2 - 5x < 0 \Rightarrow x(x-5) < 0$$



Hence $x \in (0, 5)$

Top

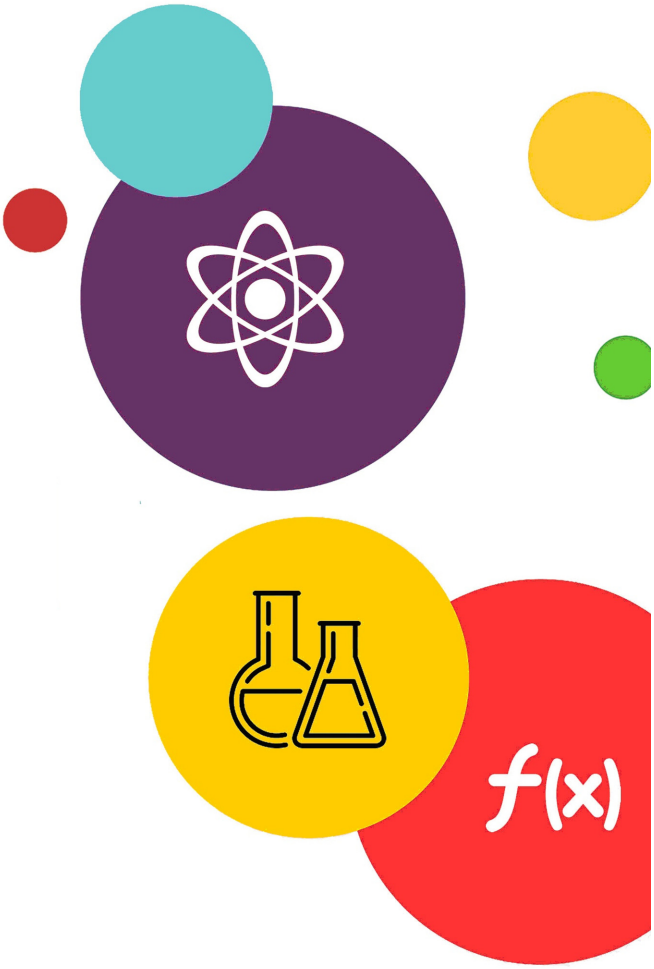
STUDY MATERIAL

JEE

FOR MAIN & ADVANCED

PHYSICS

Class 12



CP PUBLICATION

PHYSICS

Study Material for JEE Main & Advanced preparation

Prepared by Career Point Kota Experts

CAREER POINT

CONTENTS OF THE PACKAGE AT A GLANCE

PHYSICS

Class 12

Electrodynamics

[A]

- Electrostatics
- Gauss's Law
- Capacitance
- Current Electricity

[B]

- Magnetic Effect of Current
- Magnetism and Matter
- E.M.I.
- Alternating Current
- Electromagnetic wave

Optics

- Reflection at Plane & Curved surface
- Refraction at Plane surface
- Prism (Dispersion & Deviaton)
- Refraction at Curved surface
- Wave nature of Light : Interference
- Diffraction
- Polarization
- Optical Instrument

Modern Physics

- Atomic Structure & Matter Waves
- Nuclear Physics & Radioactivity
- Photoelectric Effect & x-Rays
- Semiconductor & Electronic Devices
- Practical Physics

Note to the Students

Career Point offers this must have Study Package in Physics to meet the complete curriculum needs of engineering aspirants. The set comprises of 3 books. The set caters to the different requirements of students in classes XII. It offers complete and systematic coverage of **JEE Main** and **JEE Advanced** syllabi and aims to provide firm foundation in learning and develop competitive edge in preparation of the JEE and other engineering entrance examinations.

COMPONENTS OF EACH CHAPTER

These books are designed with an engaging and preparation-focused pedagogy and offer a perfect balance of conceptual learning and problem solving skills.

Current Electricity

1. ELECTRIC CURRENT

(a) It is the time rate of flow of charge through a conductor when there is net transfer of charge (say Δq) across a cross section during a time interval (say Δt), we define average electric current as

$$I_{av} = \frac{\Delta q}{\Delta t}$$

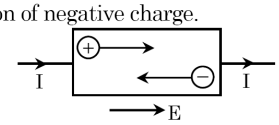
(b) We can also define instantaneous current at any instant 't' as $I_{in} = \frac{dq}{dt}$

(c) If magnitude and direction of I_{in} does not change with time then 't' is said to be **steady state current** or **direct current**.

(d) Current is one of the seven fundamental quantities. The S.I. unit of current is ampere.

$$1 \text{ Ampere} = \frac{1 \text{ Coulomb}}{1 \text{ Second}}$$

(e) The conventional direction of current is along the direction of flow of positive charge and opposite to motion of negative charge.



(f) When charge flow a cross section, the principle of conservation of charge is not violated. Hence a current carrying conductor always remains uncharged. This is also why current does not change with change in cross-section.

(g) Though current has direction. It is a scalar quantity because -

(i) It does not obey laws of vector addition.

(ii) Its direction merely represents the sense of flow of charge.

(h) To generate electric current one must have a source of charge carriers and source of energy (or emf).

Type of Material	Charge Carries
Metal	Free electrons
Semiconductors	Free electrons & holes
Gas / Electrolyte	+ve and –ve ions

NOTE Electric field inside an electrostatically charge conductor is zero. However in a current carrying conductor internal electric field is created by the source of emf. This is why in electrostatics the dielectric constant of conductor is infinite but not in current electricity.

Example Based on

Circulatory motion of charge

Example. 1

In hydrogen atom, the electron moves in an orbit of radius 0.5 Å with a speed of 2.2×10^6 m/s. The equivalent current will be.

(A) 1.12 m A (B) 4.32 m A

(C) 3.32 m A (D) 7.12 m A

Solution.(A)

$I = \frac{\text{charge}}{\text{time}}$ = charge on electron × frequency of oscillation = e.f. = $e.\frac{\omega}{2\pi} = \frac{ev}{2\pi r}$

Example. 2

A non-conducting ring of radius R carries linear charge density λ. The ring rotates with constant angular velocity ω(about its central axis). What will be the equivalent current ?

(A) $\lambda R \omega$ (B) $2\pi R\omega / \lambda$

(C) $\frac{\lambda\omega}{2\pi}$ (D) None

Solution.(A)

Total charge on the ring = $2\pi R\lambda$. Take any point A on the ring. As the ring rotates about the given axis, total charge crossing the point A in every rotation will be $Q = 2\pi R\lambda$.

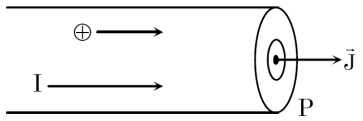
Therefore by definition of current.

$$I = \frac{Q}{T} = Q\,f = Q\,\frac{\omega}{2\pi} = 2\pi R\lambda.\ \frac{\omega}{2\pi} = \lambda R\omega$$

2. CURRENT DENSITY

(a) The current density at a point is defined as a vector having magnitude equal to current per unit area surrounding that point and normal to the direction of charge flow. It is represented by $\vec{J}$.

(b) At a point P if current I passes normally through area dA (see figure), then $\vec{J} = \frac{d\vec{I}}{dA}$



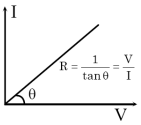
(c) The direction of current density is the direction of motion of positive charge at the point P.

Important Points

This part contains important concepts & formulas of chapter at one place in short manner, So that student can revise all these in short time.

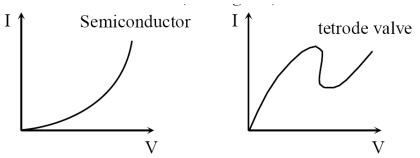
✦ Important Points

(a) A conducting device obeys ohm's law only if its physical state remains unchanged. In this case the graph between I and V is a straight line passing through origin ($\because V \propto I$). Such a conductor (e.g. metals, alloys etc) is called ohmic-conductor having resistance (R) equal to reciprocal of slope of I-V. curve (see figure)



(b) Resistance of ohmic conductor is independent of applied voltage hence it is also called **static resistance**.

(c) For other substances such as gases, semiconductors, electrolytes etc, the I-V curve is not a straight line. Hence they are called nonohmic conductors. (see figure)



(d) For non ohmic conductors it is not possible to determine static resistance (R) as the curve has different slopes at different voltage.

(e) Therefore for these we define **dynamic resistance** (r) as ratio of change in voltage to change in current at a given voltage. It is also measured in ohm.

$$r = \frac{\Delta V}{\Delta I}$$

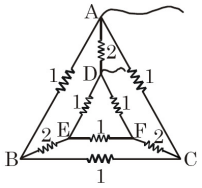
(f) Remember that static resistance R can never be negative, but dynamic resistance r may have negative value (as in case of tetrode valve)

Solved Examples (JEE Main/Advanced)

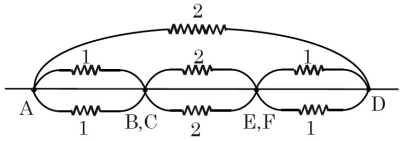
To understand the application of concepts, there is a solved example section. It contains large variety of all types of solved examples with explaination to ensure understanding the application of concepts.

SOLVED EXAMPLES

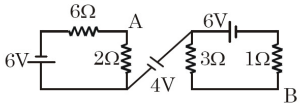
Ex.1 A network of nine conductors connects six points A, B, C, D, E and F as shown. The figures denote resistances in ohms. The equivalent resistance between A and D is



Sol. B and c are equipotential points and so are E and F. Here the circuit can be redrawn as shown in Figure. 1Ω and 1Ω in parallel sum up to 1/2W ; 2W and 2W in parallel sum up to 1 W ; 1/2W, 1 W, 1/2W in series sum up to 1/2 + 1 + 1/2 = 2Ω ; 2Ω and 2Ω in parallel sum up to = 1Ω .

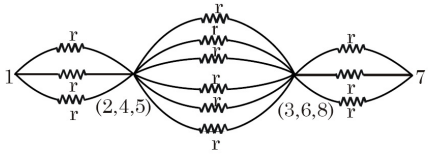


Ex.2 In the network shown in the figure below, calculate the potential difference between A and B.



Sol. The distribution of current is shown in Fig., keeping in view that the inflow and outflow of current in a cell must be the same. Applying the loop rule to the left and right loops.

Sol. Symmetry about entrance point 1 and exit point 7 shows that 2, 4, 5 are equipotential points and 5,6, and 8 are equipotential points. Hence the circuit can be redrawn as shown in Figure. The resistance r, r and r in parallel sum up to r/3.



r, r, r, r, r, r in parallel sum up to r/6 and r, r, r in parallel sum up to r/3. Next r/3. r/6, r/3 in series sum up to 5r/6.

Ex.4 Two resistors with temperature coefficients of resistance α_1 and α_2 have resistances R_{01} and R_{02} at 0°C .Find the temperature coefficient of the compound resistor consisting of the two resistors connected in parallel.

Sol. $R_1 = R_{01}(1+\alpha_1 t)$

and $R_2 = R_{02}(1+\alpha_2 t)$

Also $R = \dfrac{R_1 R_2}{R_1 + R_2} = R_0(1+\alpha t)$

and $R_o = \dfrac{R_{01}R_{02}}{R_{01}+R_{02}}$

$\therefore \quad \dfrac{R_{01}R_{02}}{R_{01}+R_{02}}(1+\alpha t)$

Practice Exercises

Exercise Level - 1 : It contains objective questions with single correct choice to ensure sufficient practice to accutrately appply formule and concepts.

EXERCISE (Level-1)

Questions based on **Current & Resistance definitio**

Q.1 In copper, each copper atom releases one electron. If a current of 1.1 A is flowing in the copper wire of uniform cross-sectional area of diameter 1 mm, then drift velocity of electrons will approximately be-
(Density of copper = 9×10^3 kg /m^3, Atomic weight of copper = 63)
(A) 10.3 mm/s (B) 0.1 mm/s
(C) 0.2 mm/s (D) 0.2 cm/s

Q.2 A current of 5A exists in a 10 Ω resistance for 4 minutes. The number of electrons and charge in coulombs passing through any section of the resistor in this time are -
(A) 75×10^{20}, 600C (B) 75×10^{21}, 600C
(C) 75×10^{20}, 1200C (D) 75×10^{19}, 1200C

Q.3 A potential difference V exists between the ends of a metal wire of length ℓ. The drift velocity will be doubled if -
(A) V is doubled
(B) ℓ is doubled
(C) The diameter of the wire is doubled
(D) The temperature of the wire is doubled

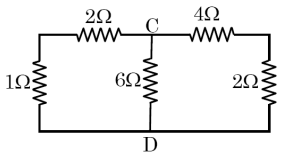
Q.4 The current in a conductor varies with time t is $I = 2t + 3t^2$ where I is in ampere and t in seconds. Electric charge flowing through a section of conductor during t = 2 sec to t = 3 sec. is -
(A) 10 C (B) 24 C (C) 33 C (D) 44 C

Q.5 The current in a copper wire is increased by increasing the potential difference between its end. Which one of the following statements regarding n, the number of charge carriers per unit volume in the wire and v the drift velocity of the charge carriers is correct -
(A) n is unaltered but v is decreased
(B) n is unaltered but v is increased
(C) n is increased but v is decreased
(D) n is increased but v is unaltered

Q.6 Consider two conducting wires of same length and material, one wire is solid with radius r. The other is a hollow tube of outer radius 2r while inner r. The ratio of resistance of the two wires will be -
(A) 1 : 1 (B) 1 : 2 (C) 3 : 1 (D) 1 : 4

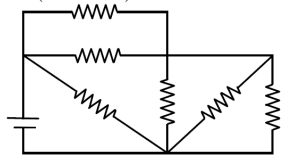
Questions based on **Series & parallel combination of Resistance**

Q.7 Equivalent resistance between point C and D in the combination of resistance shown is –



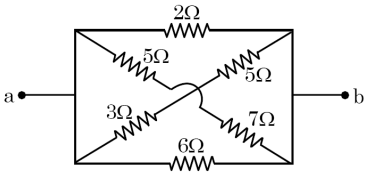
(A) 3 Ω (B) 1 Ω (C) 1.5 Ω (D) 0.5 Ω

Q.8 In the figure shown each resistor is of 20 Ω and the cell has emf 10 volt with negligible internal resistance. Then rate of joule heating in the circuit is (in watts) -



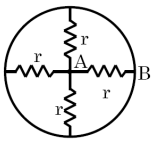
(A) 100/11 (B) 10000/11
(C) 11 (D) None of these

Q.9 Find the equivalent resistance between a & b



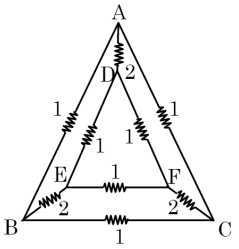
(A) $\frac{7}{8}\Omega$ (B) $\frac{8}{7}\Omega$
(C) $\frac{6}{7}\Omega$ (D) $\frac{7}{6}\Omega$

Q.10 The equivalent resistance between point A and B is -



(A) 4 r (B) 2r (C) r (D) $\frac{r}{4}$

Q.11 A network of nine conductors connects six points A, B, C, D, E and F as shown below. The digits denote resistances in Ω. Find the equivalent resistance between B and C-



(A) $\frac{2}{15}\Omega$ (B) $\frac{7}{12}\Omega$
(C) $\frac{5}{12}\Omega$ (D) $\frac{11}{12}\Omega$

Exercise Level - 2 : It contains single objective type questions with moderate difficulty level to enhance the conceptual and application level of the student.

EXERCISE (Level-2)

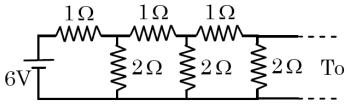
Single correct answer type questions

Q.1 A carbon and an aluminium wire connected in series. If the combination has resistance of 30 ohm at 0°C, what is the resistance of carbon and aluminium wire at 0°C so that the resistance of the combination does not change with temperature - [$\alpha_c = -0.5 \times 10^{-3}$ (C°)$^{-1}$ and $\alpha_{Al} = 4 \times 10^{-3}$ (C°)$^{-1}$]

(A) $\frac{10}{3}\Omega, \frac{80}{3}\Omega$ (B) $\frac{80}{3}\Omega, \frac{10}{3}\Omega$

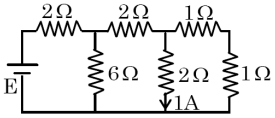
(C) 10 Ω, 80 Ω (D) 80 Ω, 10 Ω

Q.2 An infinite ladder network of resistance is constructed with 1 Ω and 2 Ω resistance. The 6V battery between A and B has negligible internal resistance. The current that passes through 2 Ω resistance nearest to the battery is -



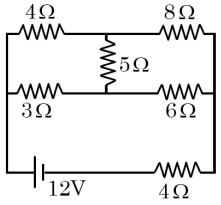
(A) 1A (B) 1.5 A (C) 2 A (D) 2.5 A

Q.3 The emf of the battery shown in the figure is given by -



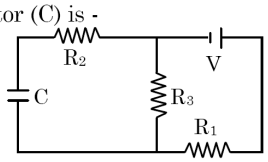
(A) 6 V (B) 12 V (C) 18 V (D) 8 V

Q.4 In the given figure the ratio of current in 8Ω and 3Ω will be -



(A) $\frac{8}{3}$ (B) $\frac{3}{8}$ (C) $\frac{4}{3}$ (D) $\frac{3}{4}$

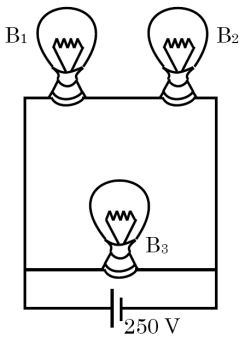
Q.5 In figure the steady state voltage drop across capacitor (C) is -



(A) V (B) $\frac{VR_1}{\left[R_3\left(\frac{R_1.R_3}{R_1+R_3}\right)\right]}$

(C) $\frac{VR_3}{R_1+R_3}$ (D) $\frac{VR_1}{R_1+R_3}$

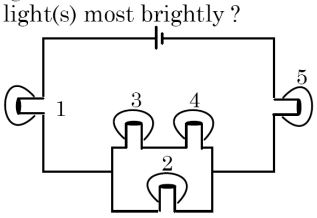
Q.6 A 100 W bulb B_1, and two 60 W bulbs B_2 and B_3, are connected to a 250 V source, as shown in the figure. Now W_1, W_2 and W_3 are the output powers of the bulbs B_1, B_2 and B_3, respectively. (Rated potential of each bulb is 250 V) select correct alternative -



(A) $W_1 > W_2 = W_3$ (B) $W_1 > W_2 > W_3$

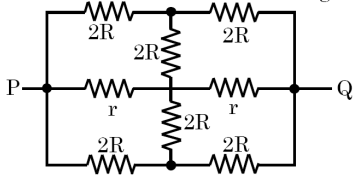
(C) $W_1 < W_2 = W_3$ (D) $W_1 < W_2 < W_3$

Q.7 In the fig below the bulbs are identical, which bulb(s), light(s) most brightly ?



(A) 1 only (B) 4 only (C) 2 and 3 (D) 1 and 5

Q.8 The effective resistance between points P and Q of the electrical circuit shown in the figure is -



(A) 2Rr / (R + r) (B) 8R (R + r) / (3 R + r)

(C) 2r + 4R (D) 5R / 2 + 2r

Q.9 A long resistance wire is divided into 2n parts. Then n parts are connected in series and the other n parts in parallel separately. Both combinations are connected to identical supplies. Then the ratio of heat produced in series to parallel combinations will be -

(A) 1 : 1 (B) 1 : n^2 (C) 1 : n^4 (D) n^2 : 1

Q.10 In a potentiometer experiment it is found that no current pass through the galvanometer when the terminals of the cell are connected across 125 cm of potentiometer wire. On shunting the cell by a 2Ω resistance the balancing length reduces to half. The internal resistance of the cell is –

(A) 4 Ω (B) 2Ω (C) 1Ω (D) 0.5Ω

Exercise Level - 3 : It contains previous years question of JEE Main from Year 2005 to 2024.

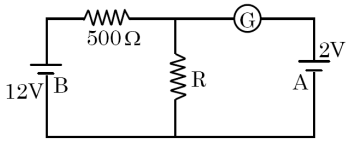
EXERCISE (Level-3)

Old Examination Questions [JEE Main]

Q.1 A moving coil galvanometer has 150 equal divisions. Its current sensitivity is 10 divisions per milliampere and voltage sensitivity is 2 divisions per millivolt. In order that each division reads 1 volt, the resistance in ohms needed to be connected in series with the coil will be - **[AIEEE-2005]**

(A) 10^3 (B) 10^5 (C) 99995 (D) 9995

Q.2 In the circuit, the galvanometer G shows zero deflection. If the batteries A and B have negligible internal resistance, the value of the resistor R will be- **[AIEEE-2005]**



(A) 200 Ω (B) 100 Ω (C) 500 Ω (D) 1000 Ω

Q.3 Two sources of equal emf are connected to an external resistance R. The internal resistances of the two sources are R_1 and $R_2 (R_2 > R_1)$. If the potential difference across the source having internal resistance R_2 is zero, then - **[AIEEE-2005]**

(A) $R = R_2 \times (R_1 + R_2)/(R_2 - R_1)$
(B) $R = R_2 - R_1$
(C) $R = R_1R_2/(R_1 + R_2)$
(D) $R = R_1R_2/(R_2 - R_1)$

Q.4 An energy source will supply a constant current into the load if its internal resistance is - **[AIEEE-2005]**

(A) equal to the resistance of the load
(B) very large as compared to the load resistance
(C) zero
(D) non-zero but less than the resistance of the load

Q.5 In a potentiometer experiment the balancing with a cell is at length 240 cm. On shunting the cell with a resistance of 2 Ω, the balancing length becomes 120 cm. The internal resistance of the cell is - **[AIEEE-2005]**

(A) 1 Ω (B) 0.5 Ω (C) 4 Ω (D) 2 Ω

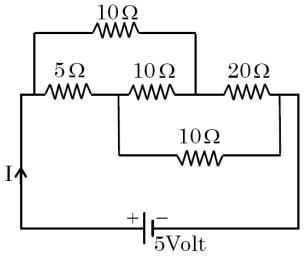
Q.6 A material 'B' has twice the specific resistance of 'A'. A circular wire made of 'B' has twice the diameter of a wire made of 'A'. Then for the two wires to have the same resistance, the ratio ℓ_B/ℓ_A of their respective lengths must be - **[AIEEE-2006]**

(A) $\frac{1}{4}$ (B) 2 (C) 1 (D) $\frac{1}{2}$

Q.7 The Kirchhoff's first law ($\Sigma i = 0$) and second law ($\Sigma iR = \Sigma E$), where the symbols have usual meanings, are respectively based on - **[AIEEE-2006]**

(A) conservation of momentum, conservation of charge
(B) conservation of charge, conservation of energy
(C) conservation of charge, conservation of momentum
(D) conservation of energy, conservation of charge

Q.8 The current I drawn from the 5 volt source will be – **[AIEEE-2006]**



(A) 0.67 A (B) 0.17 A (C) 0.33 A (D) 0.5 A

Q.9 In a Wheatstone's bridge, three resistances P, Q and R are connected in the three arms and the fourth arm is formed by two resistances S_1 and S_2 connected in parallel. The condition for the bridge to be balance will be - **[AIEEE-2006]**

(A) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{2S_1S_2}$ (B) $\frac{P}{Q} = \frac{R}{S_1 + S_2}$

(C) $\frac{P}{Q} = \frac{2R}{S_1 + S_2}$ (D) $\frac{P}{Q} = \frac{R(S_1 + S_2)}{S_1S_2}$

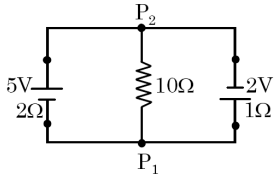
Q.10 An electric bulb is rated 220 volt – 100 watt. The power consumed by it when operated on 110 volt will be- **[AIEEE-2006]**

(A) 25 watt (B) 50 watt
(C) 75 watt (D) 40 watt

Q.11 The resistance of wire is 5 ohm at 50°C and 6 ohm at 100°C. The resistance of the wire at 0°C will be – **[AIEEE-2007]**

(A) 2 ohm (B) 1 ohm (C) 4 ohm (D) 3 ohm

Q.12 A 5 V battery with internal resistance 2 Ω and a 2V battery with internal resistance 1Ω are connected to a 10Ω resistor as shown in the figure. **[AIEEE-2008]**



The current in the 10 Ω resistor is -

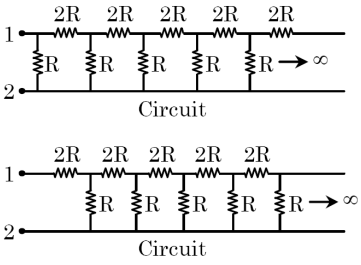
(A) 0.03 A P_1 to P_2 (B) 0.03 A P_2 to P_1
(C) 0.27 A P_1 to P_2 (D) 0.27 A P_2 to P_1

Exercise Level - 4 : It contains all variety of questions as per level of JEE Advanced such as MCQ, Column match, Passage based & Numerical type etc.

EXERCISE (Level-4)

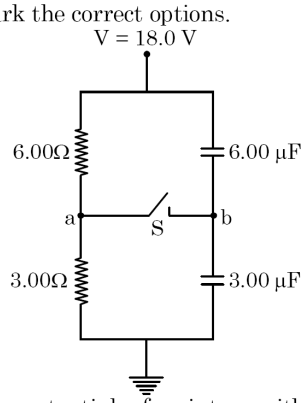
Part-A : Multiple correct answer type questions

Q.1 Two circuits (as shown in figure) are called circuit A and circuit B. The equivalent resistance of circuit A is x and that of circuit B is y between 1 and 2.



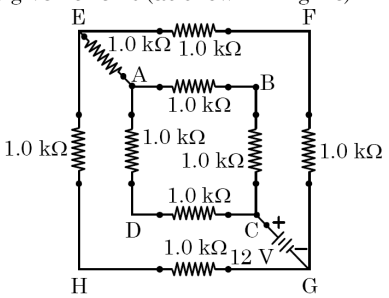
(A) $y > x$ (B) $y = (\sqrt{3} + 1)\,R$
(C) $xy = 2R^2$ (D) $y - x = 2R$

Q.2 Study the following circuit diagram in figure and mark the correct options.



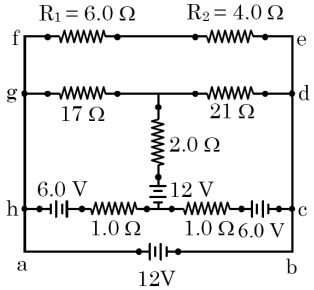
(A) The potential of point a with respect to point b in the figure when switch S is open is –6V.
(B) The points a and b are at the same potential, when S is opened.
(C) The charge flowing though switch S when it is closed is 54 μC.
(D) The final potential of b with respect to ground when switch S is closed is 8 V.

Q.3 In the given circuit (as shown in figure)



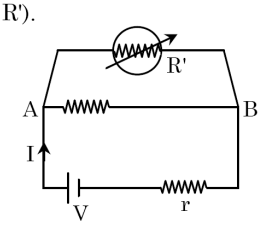
(A) the equivalent resistance between C and G is 3 kΩ.
(B) the current provided by the source is 4 mA
(C) the current provided by the source is 8 mA
(D) voltage across points G and E is 4 V

Q.4 In the circuit shown in figure, mark the correct option.



(A) potential drop across R_1 is 3.2 V
(B) Potential drop across R_2 is 5.4 V
(C) Potential drop across R_1 is 7.2 V
(D) Potential drop across R_2 is 4.8 V

Q.5 Consider a simple circuit shown in figure stands for a variable resistance R'. R' can vary from R_0 to infinity, r is internal resistance of the battery ($r << R << R'$).



(A) Potential drop across, AB is nearly constant as R' is varied
(B) Current through R' is nearly a constant as R' is varied
(C) Current I depends sensitively on R'
(D) $I \geq \dfrac{V}{r + R}$ always

Q.6 When no current is passed through a conductor–
(A) the free electrons do not move
(B) the average speed of free electrons over a large period of time is zero
(C) the average velocity of free electrons over a large period of time is zero
(D) the average of the velocities of all the free electrons at an instant is zero

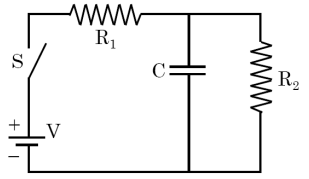
Q.7 A current passes through a wire of non-uniform cross-section. Which of the following quantities are independent of the cross-section –
(A) the charge crossing in a given time interval
(B) drift velocity
(C) current density
(D) free-electron density

Exercise Level - 5 : It contains previous years question of JEE Advanced from Year 2005 to 2024.

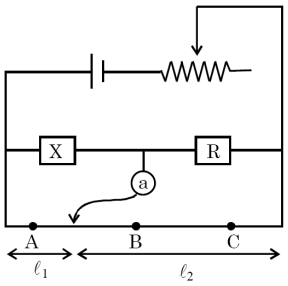
EXERCISE (Level-5)

Old Examination Questions [JEE Advanced]

Q.1 In the given circuit the switch S is closed at time t = 0. The charge Q on the capacitor at any instant t is given by $Q(t) = Q_0(1 - e^{-\alpha t})$. Find the value of Q_0 and α in terms of given parameters as shown in the circuit. **[IIT-JEE 2005]**



Q.2 An unknown resistance is to be determined using resistance R_1, R_2, and R_3. If their corresponding null points are A, B and C. Which of the following will give most accurate reading ? **[IIT-JEE 2005]**



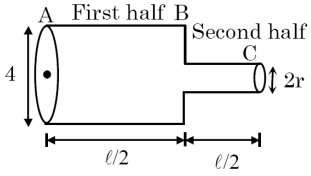
Q.3 A galvanometer having Resistance 100 Ω is used to form an ammeter with the help of resistance 0.1Ω. The maximum deflection of galvanometer is at 100 μA. Find the smallest current when Galvanometer shows maximum deflection- **[IIT-JEE 2005]**

(A) 100.1 mA (B) 1000.1 mA
(C) 10.01 mA (D) 1.001 mA

Q.4 A 4 μF capacitor, a resistance of 2.5 MΩ is in series with 12 V battery. Find the time after which the potential difference across the capacitor is 3 times the potential difference across the resistor
[Given ℓn (2) = 0.693] **[IIT-JEE 2005]**
(A) 13.86 s (B) 6.93 s (C) 7 s (D) 14 s

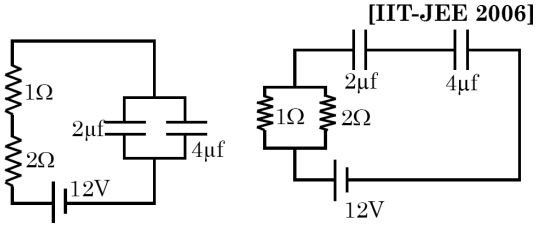
Q.5 An ideal gas is filled in a closed rigid and thermally insulated container. A coil of 100 Ω resistor carrying current 1A for 5 minutes supplies heat to the gas. The change in internal energy of the gas is - **[IIT-JEE 2005]**
(A) 10 kJ (B) 30 kJ (C) 20 kJ (D) 0 kJ

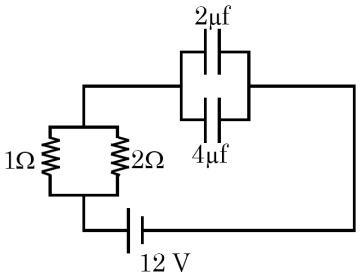
Q.6 Consider a cylindrical element as shown in the figure. Current flowing the through element is I and resistivity of material of the cylinder is ρ. Choose the correct option out the following - **[IIT-JEE 2006]**



(A) Power loss in second half is four times the power loss in first half
(B) Voltage drop in first half is twice of voltage drop in second half
(C) Current density in both halves are equal
(D) Electric field in both halves is equal

Q.7 Time constant for the given circuits are – **[IIT-JEE 2006]**





(A) 18 μs, $\frac{8}{9}$ μs, 4μs (B) 18 μs, 4 μs, $\frac{8}{9}$ μs
(C) 4μs, $\frac{8}{9}$ μs, 18 μs (D) $\frac{8}{9}$ μs, 18μs, 4μs

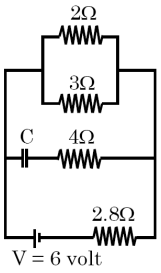
Q.8 A parallel plate capacitor C with plates of unit area and separation d is filled with a liquid of dielectric constant K = 2. The level of liquid is d/3 initially. Suppose the liquid level decreases at a constant speed V, the time constant as a function of time t is - **[IIT-JEE 2008]**

Exercise Level - 6 : Advanced level a bit complex questions for students for solid rock prepertion for Top Rankers.

EXERCISE (Level-6)

Review Exercise

Q.1 Calculate the steady state current in the 2Ω resistor shown in the circuit (see figure). The internal resistance of the battery is negligible and the capacitance of the condenser C is 0.2 μF. **[IIT-JEE 1982]**

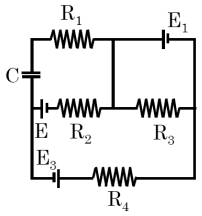


Q.2 Two resistors, 400 Ω, and 800 Ω are connected in series with a 6 V battery. It is desired to measure the current in the circuit. An ammeter of 10 Ω resistance is used for this purpose. What will be the reading in the ammeter ? Similarly, if a voltmeter of 1000 Ω resistance is used to measure the potential difference across the 400 Ω resistor, what will be the reading in the voltmeter ? **[IIT-JEE 1982]**

Q.3 A wire of length L and 3 identical cells of negligible internal resistances are connected in series Due to the current the temperature of the wire is raised by ΔT in a time t. A number N of similar cells is now connected in series with a wire of the same material and cross-section but of length 2L. The temperature of the wire is raised by the same amount ΔT in the same time t. The value of N is - **[IIT-JEE 2001]**
(A) 4 (B) 6 (C) 8 (D) 9

Q.4 A piece of copper and another of germanium are cooled from room temperature to 80K. The resistance of - **[IIT-JEE 1988]**
(A) Each of them increases
(B) Each of them decreases
(C) Copper increases and germanium decreases
(D) Copper decreases and germanium increases

Q.5 In the given circuit –
$E_1 = 3$, $E_2 = 2$, $E_3 = 6$ volt,
$R_1 = 2\Omega$, $R_4 = 6$ ohm, $R_3 = 2\Omega$,
$R_2 = 4$ ohm, $C = 5\mu F$.
Find the current in R_3 and the energy stored in the capacitor. **[IIT-JEE 1998]**



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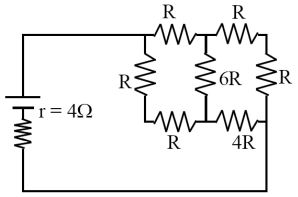
Q.6 A micro ammeter has a resistance of 100 Ω and full scale range of 50 μA. It can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combinations - **MCQ** **[IIT-JEE 1991]**
(A) 50 V range with 10 KΩ resistance in series
(B) 10 V range with 200 KΩ resistance in series
(C) 5 mA range with 1 Ω resistance in parallel
(D) 10 mA range with 1 Ω resistance in parallel

Q.7 Read the following statements carefully -
Y : The resistivity of semiconductor decreases with increases of temperature.
Z : In a conducting solid, the rate of collisions between free electrons and ions increases with increase of temperature.
Select the correct statement (s) from the following **[IIT-JEE 1993]**
(A) Y is true but Z is false
(B) Y is false but Z is true
(C) Both Y and Z are true
(D) Y is true and Z is the correct reason for Y

Q.8 A battery of internal resistance 4 Ω is connected to the network of resistance as shown. In order that maximum power can be delivered to the network, the value of R in ohm should be - **[IIT-JEE 1995]**



(A) $\frac{4}{9}$ (B) 2 (C) $\frac{8}{3}$ (D) 18

Q.9 A uniform copper wire of mass 2.23×10^{-3} kg carries a current of 1 A when 1.7 V is applied across it. Calculate its length and area of cross-section. If the wire is uniformly stretched to double its length, calculate the new resistance. Density of copper is 8.92×10^3 kg m^{-3} and resistivity is 1.7×10^{-8} Ωm. **[Roorkee 95]**

Q.10 An electrical circuit is shown in figure. Calculate the potential difference across the resistor of 400 ohm, as will be measured by the voltmeter V of resistance 400 ohm, either by applying Kirchhoff's rules or otherwise. **[IIT-JEE 1996]**

Q.11 In the circuit shown in Fig., the battery is an ideal one, with emf V. The capacitor is initially uncharged. The switch S is closed at time t = 0.
(a) Find the charge Q on the capacitor at time t.
(b) Find the current in AB at time t. What is its limiting value at $t \to \infty$?
[IIT-JEE 1997]

Answer key

Ankswer key is provided at the end of the exercise sheets.

ANSWER KEY

EXERCISE (Level-1)

1. (B)	**2.** (C)	**3.** (A)	**4.** (B)	**5.** (B)	**6.** (C)	**7.** (C)	**8.** (C)	**9.** (B)	**10.** (D)
11. (B)	**12.** (B)	**13.** (C)	**14.** (A)	**15.** (A)	**16.** (C)	**17.** (C)	**18.** (D)	**19.** (B)	**20.** (A)
21. (A)	**22.** (B)	**23.** (C)	**24.** (A)	**25.** (B)	**26.** (B)	**27.** (B)	**28.** (B)	**29.** (B)	**30.** (B)
31. (C)	**32.** (D)	**33.** (B)	**34.** (A)	**35.** (C)	**36.** (B)	**37.** (B)	**38.** (C)	**39.** (B)	**40.** (D)
41. (C)	**42.** (C)								

Revision Plan

We emphasis that every student should prepare his/her own revision plan. For this purpose there is Revision Plan Section in each chapter which student should prepare while going thorugh the study material. This will be useful at the time of final revision before final exam for quick & effective revision.

Revision Plan

Prepare Your Revision plan today!

After attempting Exercise Sheet, please fill below table as per the instruction given.

A. Write Question Number (QN) which you are unable to solve at your own in **column A**.

B. After discussing the Questions written in **column A** with faculty, strike off them in the manner so that you can see at the time question number during Revision, to solve such questions again.

C. Write down the Question Number you feel are important or good in the **column B**.

EXERCISE	COLUMN A	COLUMN B
	Questions unable to solve in first attempt	Good or Important questions
Topic wise practice questions		
Level-1		
Level-2		
Level-3		
Level-4		
Level-5		
Level-6		

Revision Strategy:

Whenever you wish to revision this chapter, follow the following steps-

Step-1: Review your theory notes.

Step-2: Solve Questions of column A

Online Solutions

Self explanatory and detailed soltuion of all excercises above are available on Career Point website **www.careerpoint.ac.in**

CURRENT ELECTRICITY

EXERCISE (Level-1)

Answer Key & Solution

Question Number	Solution
1	Click Here
2	Click Here
3	Click Here
4	Click Here
5	Click Here
6	Click Here
7	Click Here
8	Click Here
9	Click Here
10	Click Here
11	Click Here

Question Number	Solution
12	Click Here
13	Click Here
14	Click Here
15	Click Here
16	Click Here
17	Click Here
18	Click Here
19	Click Here
20	Click Here
21	Click Here
22	Click Here

Question Number	Solution
23	Click Here
24	Click Here
25	Click Here
26	Click Here
27	Click Here
28	Click Here
29	Click Here
30	Click Here
31	Click Here
32	Click Here
33	Click Here

Question Number	Solution
34	Click Here
35	Click Here
36	Click Here
37	Click Here
38	Click Here
39	Click Here
40	Click Here
41	Click Here
42	Click Here

Sol.1 **[B]**

Given

$I = 1.1\ A$

$e = 1.6 \times 10^{-19}\ C$

$A = \pi r^2 = p \times (0.05)^2$

$= 78.5 \times 10^{-4}\ cm^2$

$$v_d = \frac{I}{neA}$$

$$n = \frac{6\times10^{23}}{7cm^3} = 0.86 \times 10^{23}\ /\ m^3$$

$$v_d = \frac{1.1}{0.86\times1.6\times10^{-19}\times78.5\times10^{-4}}$$

(volume of 63g Cu)

$v_d = 0.01$ cm/s.

$= 0.1$ mm/s

Top