All India Test Series
Mock Test-5

Sankalp IIT

A Must Do Test Series for Sure Shot Success in JEE Main And Advanced

Time : 3 hrs. **VineetLoomba.com AITS - 5** **Max. Marks: 360**

Topics covered in various subjects :

Physics	:	Electrostatics and Current Electricity
Chemistry	:	Solid State, Solutions, Chemical Kinetics, Electrochemistry; Surface Chemistry
Mathematics	:	Determinants and Matrices, Vector Algebra, Three Dimensional Geometry, Mathematical Reasoning, Statistics, Probability (XI & XII)

Instructions:

(i) Duration of Test is 3 hrs.

(ii) The Test booklet consists of 90 questions. The maximum marks are 360.

(iii) There are **three** parts in the question paper. Distribution of marks subjectwise in each part is as under for each correct response.

Part A – PHYSICS (120 marks) – Questions No.1 to 30 consist **FOUR (4)** marks each for each correct response.

Part B – CHEMISTRY (120 marks) – Questions No.31 to 60 consist **FOUR (4)** marks each for each correct response.

Part C – MATHEMATICS (120 marks) – Questions No.61 to 90 consist **FOUR (4)** marks each for each correct response.

(iv) One fourth (¼) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

(v) **Pattern of the Question: Section – I : Multiple Type Objective Questions** (Straight Single Choice Multiple Type Questions); **Section – II: Assertion – Reason Type Questions; Section – III: Comprehension Type Questions :** (One Comprehension Type Question should have 3 questions - Multiple Concept Questions); **Section – IV: Straight Objective Questions:** (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

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PHYSICS

SECTION - I

Straight Single Choice Multiple Type Questions / Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 1 to 16. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Parallel plates of capacitor are given, surface charge densities σ and $-\sigma$. Pressure on one plate due to other is

   (1) $\frac{\sigma^2}{2\varepsilon_0}$ (2) $\frac{\sigma^2}{\varepsilon_0}$

   (3) $\frac{\sigma}{2\varepsilon_0}$ (4) $\frac{\sigma}{\varepsilon_0}$

2. Three charges q, $2q$ and $-3q$ are kept on the corners of an equilateral triangle such that distance of each charge from centroid is r. Then

   (1) Charges are in stable equilibrium

   (2) Electric field at centre of triangle is zero

   (3) Electric potential at the centre is zero

   (4) Electrostatic potential energy of the system is positive

3. Electric field in a region is given by $E = 2x^2\hat{i}$, where E is in V m^{-1} and x coordinate in metre. If electric potential at origin is –200 V, then what is potential at x = 3 m?

   (1) –182 V (2) –218 V

   (3) 182 V (4) 218 V

4. There are two metallic spheres of radius r_1 and r_2 having charges $+q_1$ and $+q_2$. If they are connected by a metal wire, then

   (1) Charge flows from sphere 1 to 2

   (2) Potential of 1 is more than that of 2

   (3) Electric potential energy of the system will decrease

   (4) Electric potential energy of the system remains constant

5. There is a capacitor of capacitance C and charge on the two plates q and $-q$. If separation between the plates is doubled after removing battery, then

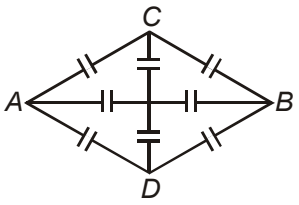
   (1) Capacitance is doubled

   (2) Charge on plates is doubled

   (3) Electric field between the plates is doubled

   (4) Electric potential difference between the plates is doubled

6. Each capacitor is of capacitance C. Then



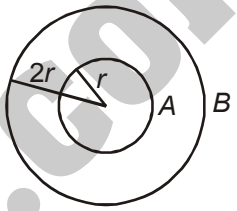
   (1) Capacitance across AB is greater than capacitance across CD

   (2) Capacitance across AB is less than capacitance across CD

   (3) Capacitance across AB is 1.5 C

   (4) Capacitance across CD is $\frac{5C}{6}$

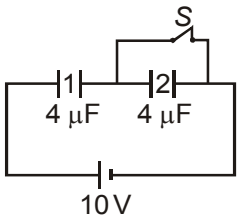
7. Figure shows two concentric thin spherical conducting shells of radius r and 2 r. Each sphere is given charge 4 q and A is earthed. Find net charge on A



   (1) $-2q$ (2) $-4q$

   (3) $4q$ (4) Zero

8. If switch S is opened, then final charges appearing on capacitors 1 and 2 are



   (1) 40 μC, 0 (2) 20 μC, 20 μC

   (3) 40 μC, 40 μC (4) 2.5 μC, 2.5 μC

9. If charge flowing through a section in time t is $q = 4t^3$, then current flowing at time t

   (1) $12t^2$ (2) $4t^2$

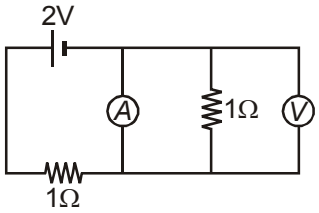
   (3) t^4 (4) $2t^3$

10. In a conductor electric field is 100 Vm^{-1} and current density is 25×10^5 Am^{-2}. The resistivity of the conductor is

    (1) 25×10^7 Ωm (2) 25×10^3 Ωm

    (3) 2.5×10^{-3} Ωm (4) 4×10^{-5} Ωm

11. Reading of ammeter and voltmeter is



(1) 0 A, 2 V (2) 0 A, 1 V

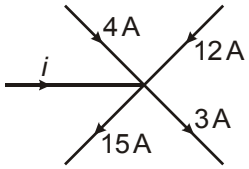
(3) 2 A, 0 V (4) 1 A, 0 V

12. An ideal battery of zero internal resistance is able to maintain a constant

(1) Current (2) Resistance

(3) Power (4) Potential difference

13. In the given current distribution the value of *i* is



(1) 1 A (2) 2 A

(3) 3 A (4) 4 A

14. An ammeter of resistance 10 Ω can read a maximum current of 50 mA. If it is to be used as voltmeter of range 100 V. Then resistance to be connected in series

(1) 2000 Ω (2) 1000 Ω

(3) 1990 Ω (4) 990 Ω

15. A potentiometer is used for the comparison of emf of two cells E_1 and E_2. For cell E_1 null point is obtained at distance 240 cm and for cell E_2 null point is obtained at distance 360 cm. Then the ratio of their emf's will be

(1) $\frac{2}{3}$ (2) $\frac{1}{3}$

(3) $\frac{1}{2}$ (4) $\frac{1}{4}$

16. The heater coil is cut in two equal parts of equal length and one of them is used in the heater for same potential difference. The power dissipated will become

(1) $\frac{1}{2}$ times

(2) $\frac{1}{3}$ times

(3) 2 times

(4) 3 times

SECTION - II

Assertion – Reason Type Questions

Directions : *Questions number 17 to 21 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.*

17. Statement-1 : If the potential difference across a segment of wire is zero the current through it must be zero.

and

Statement-2 : Ohm's law is $V = IR$.

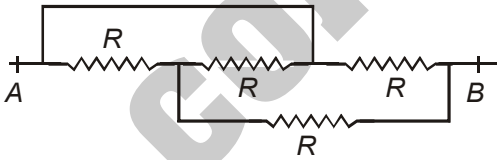
(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

18. Consider the circuit shown in figure.



Statement-1 : The equivalent resistance of the network between *AB* is $\frac{3R}{5}$.

and

Statement-2 : Potential difference across two resistance is zero.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

19. Statement-1 : Work done in moving a charge on the equipotential surface is zero.

and

Statement-2 : Electric lines cuts the equipotential surfaces perpendicularly.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

20. A parallel plate capacitor is first charged by a battery and then battery is disconnected.

Statement-1 : If the separation between the plates increases then its energy increases.

and

Statement-2 : If the separation between the plates increases then its capacitance decreases.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

21. Statement-1 : On increasing temperature resistance of metallic conductor increases.

and

Statement-2 : On increasing temperature, relaxation time decreases.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

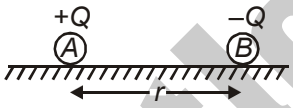
(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

SECTION - III

Comprehension Type Questions

Directions : *Question No. 22 to 24 are based on the following paragraph.*



Two very small balls A and B having charge $+Q$ and $-Q$ and masses $2m$ and m respectively are placed on a smooth suface as shown in figure. Initially the charged particles are separated by distance r. Now the particles are released in order to move freely

22. The acceleration of centre of mass of balls, when the separation between the balls becomes half of initial value, is

(1) $\frac{2KQ^2}{rm}$ (2) $\frac{KQ^2}{mr}$

(3) $\frac{KQ^2}{2mr}$ (4) Zero

23. Relative velocity of balls when the separation between the balls becomes half of initial value, is

(1) $\frac{Q}{\sqrt{4\pi\varepsilon_0 mr}}$ (2) $\frac{3Q}{\sqrt{4\pi\varepsilon_0 mr}}$

(3) $\frac{\sqrt{3}Q}{\sqrt{4\pi\varepsilon_0 mr}}$ (4) $\frac{\sqrt{2}Q}{\sqrt{3\pi\varepsilon_0 mr}}$

24. The displacement of centre of mass of A and B until the separation between A and B becomes half of initial value is

(1) $\frac{r}{4}$ towards left (2) $\frac{r}{4}$ towards right

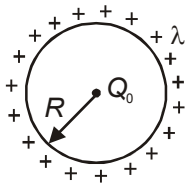
(3) $\frac{r}{3}$ towards left (4) Zero

SECTION - IV

Straight Objective Questions

Directions : *Question No. 25 to 30 are based on the following Multiple concept questions and/or difficulty/ lengthy calculations & application based questions.*

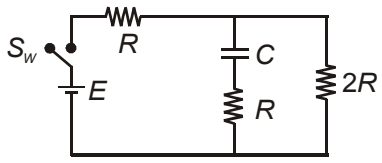
25. A ring having charge per unit length λ is located in the horizontal plane. When a point charge Q_0 is placed at the centre then the increase in tension in the ring is



(1) $\frac{Q_0\lambda}{4\pi\varepsilon_0 R^2}$ (2) $\frac{Q_0\lambda}{4\pi\varepsilon_0 R}$

(3) $\frac{Q_0\lambda}{2\pi\varepsilon_0 R^2}$ (4) $\frac{Q_0\lambda}{2\pi\varepsilon_0 R}$

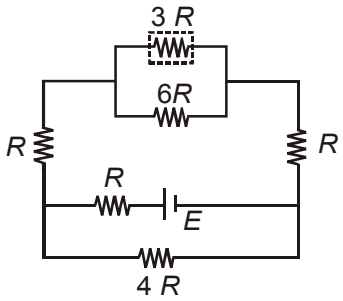
26. At $t = 0$, the switch S_w is closed. The time constant of the circuit is



(1) RC (2) $\frac{2RC}{3}$

(3) $\frac{5RC}{3}$ (4) $\frac{3RC}{5}$

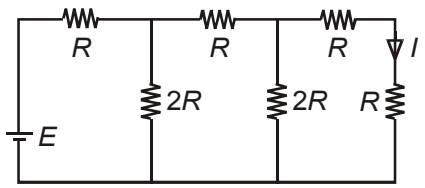
27. The electric current through resistance $3R$ shown in figure is



(1) $\frac{E}{11R}$ (2) $\frac{E}{9R}$

(3) $\frac{3E}{11R}$ (4) $\frac{4E}{11R}$

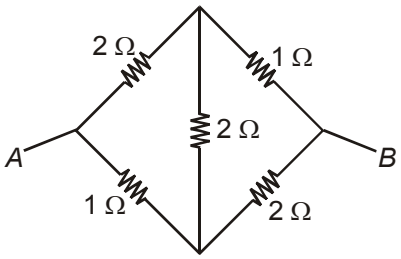
28. In the circuit shown in the figure current I through the resistance R is



(1) $\frac{E}{2R}$ (2) $\frac{E}{4R}$

(3) $\frac{E}{8R}$ (4) $\frac{E}{16R}$

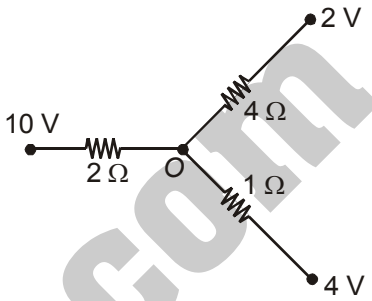
29. The equivalent resistance of the network shown in figure about AB is



(1) 1 Ω (2) 10 Ω

(3) 4 Ω (4) $\frac{10}{7}\Omega$

30. In the circuit shown in figure, the potentials of different points have been marked. The potential of point O is



(1) $\frac{18}{7}$V (2) $\frac{28}{7}$V

(3) $\frac{38}{7}$V (4) $\frac{48}{7}$V

CHEMISTRY

SECTION - I

Straight Single Choice Multiple Type Questions / Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 31 to 46. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

31. The unit cell of a binary alloy composed of A and B metals, has a ccp structure with A atom occupying the corners and B atoms occupying centers of each face of the cube. If during the crystallization of this alloy in the unit cell two A atoms are missed, the overall composition per unit cell is

(1) AB_6 (2) AB_3

(3) AB_8 (4) A_6B_{24}

32. The rate constant for a first order reaction is 6.909 min^{-1}. Therefore, the time required in minutes for the participation of 75% of the initial reaction is

(1) $\frac{2}{3}\log 2$ (2) $\frac{2}{3}\log 4$

(3) $\frac{3}{2}\log 2$ (4) $\frac{3}{2}\log 4$

33. At 300 K two pure liquids A and B have vapour pressures respectively 150 mm Hg and 100 mm Hg. In an equimolar liquid mixture of A and B, the mole fraction of B in the vapour mixture at this temperature is

(1) 0.6 (2) 0.5

(3) 0.8 (4) 0.4

34. One Faraday of electricity is passed separately through one litre of one molar aqueous solution of (i) $AgNO_3$ (ii) $SnCl_4$ and (iii) $CuSO_4$. The number of moles of Ag, Sn and Cu deposited at cathode are respectively

(1) 1.0, 0.25, 0.5 (2) 1.0, 0.5, 0.25

(3) 0.5, 1.0, 0.25 (4) 0.25, 0.5, 0.25

35. In the Freundlich Adsorption isotherm equation, $\log\frac{x}{m} = \log k + \frac{1}{n}\log p$, the value of n is

(1) Any value from 0 to 1

(2) A negative integer

(3) A positive integer

(4) A positive or a negative fractional number

36. When Zn converts from its molten state to its solid state it has HCP structure, then fend out nearest neighbour of Zn atom

(1) 6 (2) 8

(3) 4 (4) 12

37. A solution with negative deviation among the following is

(1) Ethanol + water

(2) Chlorobenzene + Bromobenzene

(3) Chloroform + Acetone

(4) Benzene + Toluene

38. What mass of urea needs to be dissolved in 100g of water in order to decrease the vapour pressure of water by 25%?

(1) 111.1 g (2) 52 g

(3) 89 g (4) 152 g

39. The activation energy for the reaction

$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

is 209.5 kJ/mole at 581 K. The fraction of molecules of reactants having energy equal to or greater than activation energy would be

(1) 1.462×10^{24} (2) 1.462×10^{-19}

(3) 1.462×10^{28} (4) 1.462×10^{-34}

40. Smoke is a colloidal solution of a

(1) Solid in a gas (2) Liquid in a gas

(3) Gas in a solid (4) Gas in a gas

41. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monooxide is doubled, with everything else kept the same, the rate of reaction will

$CO(g) + Cl_2(g) \rightarrow COCl_2(g)$

(1) Triple

(2) Increase by factor of 4

(3) Double

(4) Remain unchanged

42. Total volume of atoms present in a face centred cubic unit cell of a metal is (r is atomic radius)

(1) $\frac{24}{3}\pi r^3$ (2) $\frac{12}{3}\pi r^3$

(3) $\frac{16}{3}\pi r^3$ (4) $\frac{20}{3}\pi r^3$

43. The chief impurity present in red bauxite is

(1) SiO_2 (2) Fe_2O_3

(3) K_2SO_4 (4) Tl_2O_3

44. Which of the following is obtained when one alpha particle is emitted from nucleus of radioactive element?

(1) Isotopes (2) Isobars

(3) Isotones (4) Isodiaphers

45. Coordiantion no. of Zn^{2+} in zinc blend is

(1) 4 (2) 5

(3) 6 (4) 8

46. A solution of w g of urea in 500 g of water is cooled to –0.5°C. 128 g of ice separate out. What is the value of w?

(k_f of water = 1.86 K kg mol^{-1})

(1) 4 g (2) 6 g

(3) 5 g (4) 8 g

SECTION - II

Assertion – Reason Type Questions

Directions : *Questions number 47 to 51 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.*

47. Statement-1 : If NaCl is doped with 10^{-5} mole% $SnCl_2$ then concentration of cation vacancies will be 1×10^{-5} mole%

and

Statement-2 : Each mole of $SnCl_2$ replaces 2 moles of NaCl

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

48. Statement-1 : E_{cell} for the half cell

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

Changes with change of concentration of MnO_4^- and Mn^{+2} but remains same with change in pH.

and

Statement-2 : E_{cell} at different concentration can be calculated by Nernst's equation.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

49. Statement-1 : Vapour pressure of a solution never can be more than vapour pressure of the pure solvent

and

Statement-2 : Vapour pressure of a solution is contributed by both the components

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

50. Statement-1 : The hexagonal close packing is more efficient than square close packing.

and

Statement-2 : In hexagonal close packing, more space is occupied by spheres.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

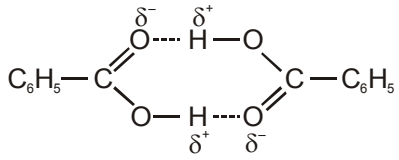
(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

51. Statement-1 : In an aqueous solution of benzoic acid, the vant Hoff factor is greater than 1.

and

Statement-2 : Benzoic acid dimerises as follows



(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

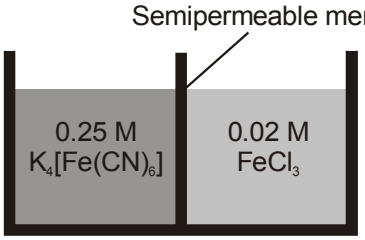
(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

SECTION - III
Comprehension Type Questions

Directions : *Question No. 52 to 54 are based on the following paragraph.*

$FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ in aqueous solution gives a blue colour. These two solutions are separated by a semipermeable membrane as shown in the figure.



Both the solution are sufficiently dilute and osmosis will take place as there is a difference in concentration of the solutions. Imagine the experiment is carried out at 27°C. The osmotic flow will take place in one direction and not in both.

52. Which of the following observations, may be recorded after a while?

(1) No change in colour in either of the components

(2) Blue colour appears in compartment A

(3) Blue colour appears in compartment B

(4) Blue colour appears in both A and B

53. In the given experiments, with passage of time the concentrations are expected to change as

(1) Concentration of $FeCl_3$ decreases

(2) Concentration of $K_4[Fe(CN)_6]$ increases

(3) Concentration of $FeCl_3$ increases

(4) Concentration of both remain unchanged

54. The osmotic pressure (π) of $FeCl_3$ solution can be expressed as

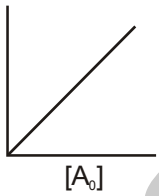
(1) 6 R (2) 18 R

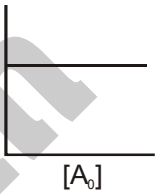
(3) 24 R (4) 75 R

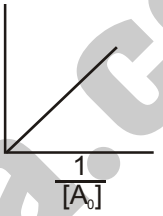
SECTION - IV
Straight Objective Question

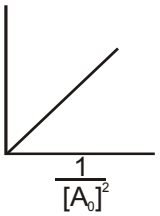
Directions : *Question No. 55 to 60 are based on* (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

55. Which of the following graph represents zero order reaction?

(1) 

(2) 

(3) 

(4) 

56. The equivalent conductance of $\frac{M}{32}$ solution of a weak monobasic acid is 8.0 mho cm^2 and at infinite dilution 400 mho cm^2. The dissociation constant of this acid is

(1) 1.25×10^{-6}

(2) 6.25×10^{-4}

(3) 1.25×10^{-4}

(4) 1.25×10^{-5}

57. $Ni/Ni^{2+}(1.0\ M) \,||\, Au^{3+}(1.0\ M)|Au$, where E^o for Ni^{2+}/Ni is –0.25 V and E^o for Au^{3+}/Au is 0.150 V. The emf of the cell is

(1) +1.25 V (2) –1.75 V

(3) +1.75 V (4) 0.4 V

58. In Na_2O having antifluorite structure

(1) Oxide ions have a cubic close packed arrangement and Na^+ occupy all the eight tetrahedral voids

(2) Oxide ions have a cubic close packed arrangement and Na^+ occupy all the octahedral voids

(3) Na^+ ions have a cubic close packed arrangement and O^{2-} occupy all the octahedral voids

(4) Na^+ ions have a cubic close arrangement and O^{2-} occupy all the tetrahedral voids

59. $A + 2B \rightarrow AB_2$

Mechanism: $A + B \rightleftharpoons AB$ (Fast)

$AB + B \rightarrow AB_2$ (Slow)

If concentration of B increases upto two times, then change in rate of reaction with respect to initial rate is

(1) Same (2) Two times

(3) Four times (4) $\frac{1}{2}$ times

60. Correct among the following

(1) In electrochemical cell cathode is positive

(2) In electrochemical cell cathode is negative

(3) Cathode is always negative

(4) Cathode is always positive

MATHEMATICS

SECTION - I

Straight Single Choice Multiple Type Questions / Application Based Single Choice Questions

This section contains 16 multiple choice questions numbered 61 to 76. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

61. The numerical value of

$$\begin{vmatrix} 5 & 5 & 5 \\ (3^x+3^{-x})^2 & (4^x+4^{-x})^2 & (5^x+5^{-x})^2 \\ (3^x-3^{-x})^2 & (4^x-4^{-x})^2 & (5^x-5^{-x})^2 \end{vmatrix}$$ is

(1) 0 (2) 1

(3) –1 (4) Dependent on x

62. If

$$f(x)=\begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & x(x+1) \\ 3x(x-1) & x(x-1)(x-2) & x(x^2-1) \end{vmatrix}, \forall\ x \in R,$$

then the value of $f(1) + f(2) + ... + f(10)$ is

(1) 55 (2) 0

(3) 10 (4) 100

63. The value of $[\vec{a}\ \vec{b}\ \vec{c} \times (\vec{a} \times \vec{b})]$, where [,] denotes scalare triple product is

(1) $\vec{a}.\vec{b}$

(2) $|\vec{a} \times \vec{b}||\vec{c}|$

(3) 1

(4) 0

64. If $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\vec{c}$ is a vector such that $|\vec{c}| = 4$, then the maximum value of $[\vec{a}\ \vec{b}\ \vec{c}]$ is

(1) $4\sqrt{6}$ (2) $2\sqrt{6}$

(3) $2\sqrt{3}$ (4) $4\sqrt{3}$

65. If the plane $x + 3y + 4z = 12$ cuts the x, y and z axes at A, B and C, then the volume of the tetrahedron $OABC$ is, (where O is the origin)

(1) 12 (2) 24

(3) 6 (4) 18

66. Let $\vec{a}, \vec{b}, \vec{c}$ be three vectors such that $|\vec{b}| = 2$, $|\vec{c}| = 3$ and $\vec{a}.\vec{b} = 0$, $\vec{a}.\vec{c} = 0$ the angle between $\vec{b}$ and $\vec{c}$ is 60°, then the value of $[\vec{a}\ \vec{b}\ \vec{c}]$ is

(1) $\sqrt{3}$ (2) 3

(3) $3\sqrt{3}$ (4) 9

67. If x, y, z are three integers in A.P., lying between 1 and 9 and $x51$, $x41$, $z31$ are three digit numbers, then the value of

$$\begin{vmatrix} 5 & 4 & 3 \\ x51 & y41 & z31 \\ x & y & z \end{vmatrix}$$ is

(1) xyz (2) $x + y + z$

(3) 12 (4) 0

68. If A is the matrix of order 3 × 3 such that $|(\text{adj}(\text{adj}(\text{adj}A)))| = |A|^k$, then the value of k is

(1) 2 (2) 4

(3) 16 (4) 8

69. Let $\vec{a}, \vec{b}, \vec{c}$ be three given vectors along three concurrent edges of a parallelepiped such that $[\vec{a}\ \vec{b}\ \vec{c}] = 4$, then the volume of the parallelepiped where three concurrent edges are three concurrent diagonals of three faces of the given parallelepiped is

(1) 8 (2) 16

(3) 4 (4) 2

70. If $\lambda = abc$ and $A = \begin{pmatrix} a & b & c \\ b & c & a \\ c & a & b \end{pmatrix}$ such that $AA^T = I$, then a, b and c are the roots of the equation

(1) $x^3 + \lambda = 0$

(2) $x^3 \pm x^2 + \lambda = 0$

(3) $x^3 \pm 3x^2 + \lambda = 0$

(4) $x^3 \pm x^2 - \lambda = 0$

71. The number of different matrices which can be formed

using 12 is different real numbers is 72 × (λ)!, then the value of λ is

(1) 12 (2) 11

(3) 10 (4) 9

72. If $\vec{r} = m(\vec{a}\times\vec{b}) + n(\vec{b}\times\vec{c}) + p(\vec{c}\times\vec{a})$ and $[\vec{a}\ \vec{b}\ \vec{c}] = \frac{1}{8}$, then $(m + n + p)$ is

(1) $\vec{r}.(\vec{a}+\vec{b}+\vec{c})$

(2) $8\vec{r}.(\vec{a}+\vec{b}+\vec{c})$

(3) $4\vec{r}.(\vec{a}+\vec{b}+\vec{c})$

(4) $16\vec{r}.(\vec{a}+\vec{b}+\vec{c})$

73. The angle of inclination of any two diagonals of a cube is

(1) $\cos^{-1}\left(\frac{1}{3}\right)$ (2) $\cos^{-1}\left(\frac{2}{3}\right)$

(3) $\cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (4) $\cos^{-1}\left(\frac{3}{4}\right)$

74. The equation of the plane which meets the axes in A, B and C, given that the centroid of the triangle ABC is the point (a, b, c) is $\frac{x}{a}+\frac{y}{b}+\frac{z}{c} = \lambda$, then the value of $\lambda^3 + 1000$ is

(1) 1729 (2) 1216

(3) 1027 (4) 1064

75. Three digit number of the form xyz is randomly selected from all possible three digit numbers. Then the probability that the selected number xyz satisfy $x < y$ and $y > z$ is

(1) $\frac{4}{15}$

(2) $\frac{3}{10}$

(3) $\frac{1}{2}$

(4) $\frac{1}{3}$

76. If α, β, γ are the roots of $x^3 + bx + c = 0$, then the value of the determinant

$$\begin{vmatrix} 1+\alpha & 1 & 1 \\ 1 & 1+\beta & 1 \\ 1 & 1 & 1+\gamma \end{vmatrix}$$ is

(1) $b^2 - 2c$

(2) $3bc$

(3) $b - c$

(4) $b + c$

SECTION - II

Assertion – Reason Type Questions

Directions : *Questions number 77 to 81 are Assertion-Reason type questions. Each of these questions contains two statements. Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select the correct choice.*

77. Statement-1 : If the value of the determinant $\begin{vmatrix} a & 1 & 1 \\ 1 & b & 1 \\ 1 & 1 & c \end{vmatrix}$ is positive, then $abc > -8$.

and

Statement-2 : A.M. > G.M.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

78. Statement-1 : If $\{(\vec{a}-\vec{b})\times(\vec{a}-\vec{b}-\vec{c})\}.(\vec{a}+2\vec{b}+\vec{c}) = k[\vec{a}\ \vec{b}\ \vec{c}]$, then $k = 3$.

and

Statement-2 : $[\lambda\vec{a}\ \mu\vec{b}\ \gamma\vec{c}] = \lambda\mu\gamma[\vec{a}\ \vec{b}\ \vec{c}]$, where λ, μ and γ are real constants.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for

Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

79. Statement-1 : If $\vec{A} = (\tan\alpha)\hat{i} + \hat{j} + \hat{k}$, $\vec{B} = \hat{i} + (\tan\beta)\hat{j} + \hat{k}$, $\vec{C} = \hat{i} + \hat{j} + (\tan\gamma)\hat{k}$ and $\alpha + \beta + \gamma = 180°$, then the value of $(\vec{A}\times\vec{B}).\vec{C}$ is 2.

and

Statement-2 : If $\vec{A} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$, $\vec{B} = b_1\hat{i} + b_2\hat{j} + b_3\hat{k}$, $\vec{C} = c_1\hat{i} + c_2\hat{j} + c_3\hat{k}$, then $(\vec{A}\times\vec{B}).\vec{C} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

80. Statement-1 : If $\vec{a}, \vec{b}, \vec{c}$ are three non-coplanar, non-zero vectors, then and $(\vec{a}.\vec{a})\vec{b}\times\vec{c} + (\vec{a}.\vec{b})\vec{c}\times\vec{a} + (\vec{a}.\vec{c})\vec{a}\times\vec{b} = [\vec{b}\ \vec{c}\ \vec{a}]\vec{a}$.

and

Statement-2 : If the vectors $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar s.t. $[\vec{a}\ \vec{b}\ \vec{c}] = 5$, then the value of $[\vec{a}\times\vec{b}\ \vec{b}\times\vec{c}\ \vec{c}\times\vec{a}]$ is 20.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

81. Statement-1 : $-(p \Leftrightarrow q) \Leftrightarrow -p \Leftrightarrow q$ is a tautology.

and

Statement-2 : $(p \to q) \vee r \Leftrightarrow (p \vee r) = (p \vee -r)$ is a tautology.

(1) Statement-1 is True, Statement-2 is True; Statement-2 **is** a correct explanation for Statement-1

(2) Statement-1 is True, Statement-2 is True; Statement-2 **is NOT** a correct explanation for Statement-1

(3) Statement-1 is True, Statement-2 is False

(4) Statement-1 is False, Statement-2 is True

SECTION - III

Comprehension Type Questions

Directions : *Question No. 82 to 84 are based on the following paragraph.*

In a determinant, if by putting $x = a$ its r-rows become identical, then $(x - a)^{r-1}$ is a factor of the determinant.

82. $\begin{vmatrix} 1 & a & a^2 \\ 1 & b & b^2 \\ 1 & c & c^2 \end{vmatrix}$ is equal to

(1) $(a - b)(b - c)(c - a)$ (2) $(a - b)(b - c)(a - c)$

(3) $(a + b)(b + c)(c + a)$ (4) $(a + b + c)abc$

83. $\begin{vmatrix} 1 & a & a^3 \\ 1 & b & b^3 \\ 1 & c & c^3 \end{vmatrix}$ is equal to

(1) $(a - b)(b - c)(c - a)(a + b + c)$

(2) $(a - b)(b - c)(a - c)$

(3) $(a + b)(b + c)(c + a)$

(4) $(ab + bc + ca)(a + b + c)$

84. $\begin{vmatrix} 1 & 1 & 1 \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$ is equal to

(1) $(a - b)(b - c)(c - a)(a^2 + b^2 + c^2)$

(2) $(a - b)(b - c)(c - a)(a + b + c)^2$

(3) $(a - b)(b - c)(c - a).abc$

(4) $(a - b)(b - c)(c - a)(ab + bc + ca)$

SECTION - IV

Straight Objective Question

Directions : *Question No. 85 to 90 are based on* (Straight Single Choice - Multiple Concept Questions and/or Difficulty/Lengthy calculations & Application based questions)

85. If $\begin{vmatrix} \text{cosec}\alpha & 1 & 0 \\ 1 & 2\text{cosec}\alpha & 1 \\ 0 & 1 & 2\text{cosec}\alpha \end{vmatrix} = \frac{1}{2}(\lambda^3 + \mu^3)$,

then the minimum value of $\lambda + \mu$ is

(1) 1 (2) –1

(3) 2 (4) 4

86. If $\begin{vmatrix} a^2 & bc & ac+c^2 \\ a^2+ab & b^2 & ac \\ ab & b^2+bc & c^2 \end{vmatrix} = \lambda^2 a^2 b^2 c^2, \lambda \in R^+$,

then the value of $\lambda^5 + 18$ is

(1) 40 (2) 50

(3) 80 (4) 34

87. If $\vec{a}, \vec{b}, \vec{c}$ are non-coplanar unit vectors such that $\vec{a} \times (\vec{b} \times \vec{c}) = \frac{1}{\sqrt{2}}(\vec{b} + \vec{c})$, then the angle between $\vec{a}$ and $\vec{b}$ is

(1) $\frac{3\pi}{4}$ (2) $\frac{\pi}{4}$

(3) $\frac{\pi}{2}$ (4) π

88. A variable plane is at a constant distance p from the origin meets the axes in A, B, C. The locus of the centroid of the tetrahedron $OABC$ is $\frac{1}{x^2} + \frac{1}{y^2} + \frac{1}{z^2} = \frac{\lambda}{p^2}$, then the value of λ^2 is

(1) 2^7 (2) 2^8

(3) 2^9 (4) 2^{10}

89. A number n from first hundred natural number is selected randomly. The probability that n^n is a perfect square is

(1) $\frac{11}{20}$ (2) $\frac{1}{2}$

(3) $\frac{51}{100}$ (4) $\frac{1}{10}$

90. Let $\vec{u}, \vec{v}$ and $\vec{w}$ be vectors such that $\vec{u} + \vec{v} + \vec{w} = \vec{0}$. If $|\vec{u}| = 3$, $|\vec{v}| = 4$ and $|\vec{w}| = 5$, then the value of $\vec{u}.\vec{v} + \vec{v}.\vec{w} + \vec{w}.u + 100$ is

(1) 100 (2) 75

(3) 125 (4) 50

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2. This sheet should not be folded or crushed.
3. Use only blue/black ball point pen to fill the circles.
4. Use of pencil is strictly prohibited.
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WRONG METHODS ⊗ ◉ ◉ ✓ CORRECT METHOD ○ ○ ○ ●

	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
1.	○	○	○	○	16.	○	○	○	○	31.	○	○	○	○	46.	○	○	○	○	61.	○	○	○	○	76.	○	○	○	○
2.	○	○	○	○	17.	○	○	○	○	32.	○	○	○	○	47.	○	○	○	○	62.	○	○	○	○	77.	○	○	○	○
3.	○	○	○	○	18.	○	○	○	○	33.	○	○	○	○	48.	○	○	○	○	63.	○	○	○	○	78.	○	○	○	○
4.	○	○	○	○	19.	○	○	○	○	34.	○	○	○	○	49.	○	○	○	○	64.	○	○	○	○	79.	○	○	○	○
5.	○	○	○	○	20.	○	○	○	○	35.	○	○	○	○	50.	○	○	○	○	65.	○	○	○	○	80.	○	○	○	○
6.	○	○	○	○	21.	○	○	○	○	36.	○	○	○	○	51.	○	○	○	○	66.	○	○	○	○	81.	○	○	○	○
7.	○	○	○	○	22.	○	○	○	○	37.	○	○	○	○	52.	○	○	○	○	67.	○	○	○	○	82.	○	○	○	○
8.	○	○	○	○	23.	○	○	○	○	38.	○	○	○	○	53.	○	○	○	○	68.	○	○	○	○	83.	○	○	○	○
9.	○	○	○	○	24.	○	○	○	○	39.	○	○	○	○	54.	○	○	○	○	69.	○	○	○	○	84.	○	○	○	○
10.	○	○	○	○	25.	○	○	○	○	40.	○	○	○	○	55.	○	○	○	○	70.	○	○	○	○	85.	○	○	○	○
11.	○	○	○	○	26.	○	○	○	○	41.	○	○	○	○	56.	○	○	○	○	71.	○	○	○	○	86.	○	○	○	○
12.	○	○	○	○	27.	○	○	○	○	42.	○	○	○	○	57.	○	○	○	○	72.	○	○	○	○	87.	○	○	○	○
13.	○	○	○	○	28.	○	○	○	○	43.	○	○	○	○	58.	○	○	○	○	73.	○	○	○	○	88.	○	○	○	○
14.	○	○	○	○	29.	○	○	○	○	44.	○	○	○	○	59.	○	○	○	○	74.	○	○	○	○	89.	○	○	○	○
15.	○	○	○	○	30.	○	○	○	○	45.	○	○	○	○	60.	○	○	○	○	75.	○	○	○	○	90.	○	○	○	○