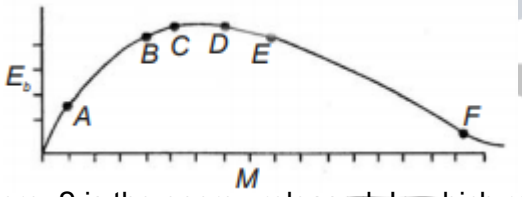
2009

PHYSICS

Direction Q. No. 1 The question contains Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

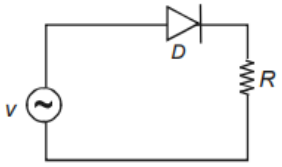
1. **Statement I** For a charged particle moving from point P to point Q, the net work done by an electrostatic field one the particle is independent of the path connecting point P to point Q.
   Statement II The net work done by a conservative force on an object moving along a closed loop is zero.
   (a) Statement I is true, Statement II is false
   (b) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
   (c) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I
   (d) Statement I is false, Statement II is true

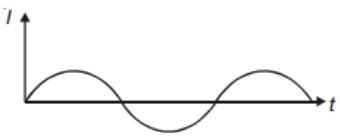
2. There is a plot of binding energy per nucleon E_b, against the nuclear mass M; A, B, C, D, F correspond to different nuclei. Consider four reactions
   (i) A + B → C + Ɛ
   (ii) C → A + B + Ɛ
   (iii) D + E → F + Ɛ
   (iv) F → D + E + Ɛ



   Where, Ɛ is the energy released. In which reactions is Ɛ positive?
   (a) (i) and (iv)
   (b) (i) and (iii)
   (c) (ii) and (iv)
   (d) (ii) and (iii)

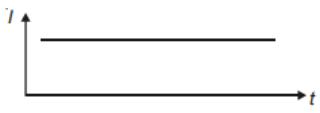
3. A p-n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit.



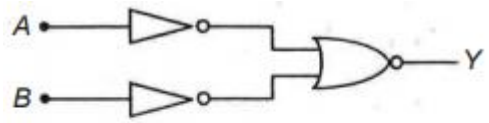
(a) 

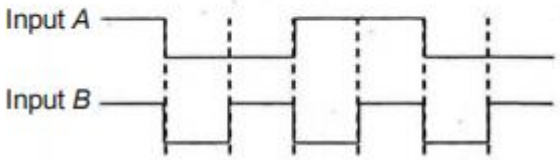
(b) 

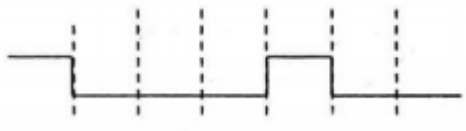
(c) 

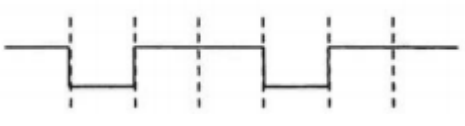
(d) 

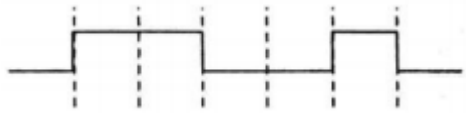
4. The logic circuit shown below has the input waveforms A and B as shown. Pick out the correct output waveform.

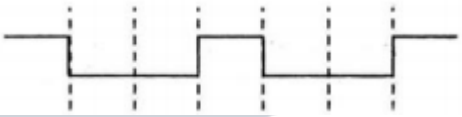




(a) 

(b) 

(c) 

(d) 

5. If x, v and a denote the displacement, the velocity and the acceleration of a particle executing simple harmonic motion of time period T, then which of the following does not change with time?

(a) $a^2T^2 + 4\pi^2v^2$ (b) $\frac{aT}{x}$

(c) $aT + 2\pi v$ (d) $\frac{aT}{v}$

6. In an optics experiment, with the position of the object fixed, a student varies the position of a convex lens and for each position, the screen is adjusted to get a clear image of the object. A graph between the object distance u and the image distance v from the lens, is plotted using the same scale for the two axes. A straight line passing through the origin and making an angle of 45˚ with the X-axis meets the experimental curve at P. The coordinates of P will be

(a) (2f, 2f) (b) (f/2 , f/2)

(c) (f, f) (d) (4f, 4f)

7. A thin uniform rod of length l and mass m is swinging freely about a horizontal axis passing through its end. Its maximum angular speed is ω. Its centre of mass rises to a maximum height of

(a) $\frac{1}{3}$ $l^2\omega^2/g$ (b) $\frac{1}{6}$ $l\omega/g$

(c) $\frac{1}{2}$ $l^2\omega^2/g$ (d) $\frac{1}{6}$ $l^2\omega^2/g$

8. Let $\rho(r) = Q/\pi r^4$ r be the charge density distribution for a solid sphere of radius R and total charge Q. For a point P inside the sphere at distance r_1 from the centre of the sphere, the magnitude of electric field is
   (a) zero
   (b) $Q/4\pi\varepsilon_0 r^2_1$
   (c) $Qr^2_1/4\pi\varepsilon_0 R^4$
   (d) $Qr^2_1/3\pi\varepsilon_0 R^4$

9. The transition from the state n = 4 to n = 3 in a hydrogen like atom results in ultraviolet radiation. Infrared radiation will be obtained in the transition from
   (a) 2 → 1
   (b) 3 → 2
   (c) 4 → 2
   (d) 5 → 4

10. One kg of a diatomic gas is at a pressure of 8×10^4 Nm^{-2}. The density of the gas is 4 kgm^{-3}. What is the energy of the gas due to its thermal motion?
   (a) 3×10^4 J
   (b) 5×10^4 J
   (c) 6×10^4 J
   (d) 7×10^4 J

Direction This question contains Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

11. **Statement I** The temperature dependence of resistance is usually given as $R = r_0(1 + \alpha\Delta t)$. The resistance of a wire changes from 100 Ω to 150 Ω when its temperature is increased from 27°C to 227°C. This implies that $\alpha = 2.5 \times 10^{-3}$ /°C.
   Statement II $R = R_i(1+a\Delta T)$ is valid only when the change in the temperature ΔT is small and $\Delta R = (R - R_0) << R_0$.
   (a) Statement I is true, Statement II is false
   (b) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
   (c) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I
   (d) Statement I is false, Statement II is true

Direction Q. Nos. 12 and 13 are based on the following paragraph.
A current loop ABCD is held fixed on the plane of the paper as shown in the figure. The arcs BC (radius = b) and DA (radius = a) of the loop are joined by the straight wires AB and CD. A steady current I is flowing in the loop. Angle made by AB and CD at the origin O is 30°. Another straight thin wire with steady current I_1 flowing out of the plane of the paper is kept at the origin.

12. The magnitude of the magnetic field (B) due to loop ABCD at the origin (O) is
   (a) zero
   (b) $\mu_0 I(b - a)/24ab$
   (c) $\mu_0 I/4\pi$ [b – a / ab]
   (d) $\mu_0 I/4\pi$ [2(b – a) + π/3 (a + b)]

13. Due to the presence of the current I_1 at the origin,
   (a) the forces on AB and DC are zero
   (b) the forces on AD and BC are zero
   (c) the magnitude of the net force on the loop is given by $\mu_0 I I_1/4\pi[2(b - a) + \frac{\pi}{3}(a + b)]$
   (d) the magnitude of the net force on the loop is given by $\mu_0 I I_1/24ab$ (b – a)

14. A mixture of light, consisting of wavelength 590 nm and an unknown wavelength, illuminates Young's double slit and gives rise to two overlapping interference patterns on the screen. The central maximum of both lights coincide. Further, it is observed that the third bright fringe of known light coincides with the 4th bright fringe of the unknown light. From this data, the wavelength of the unknown light is
(a) 393.4 nm (b) 885.0 nm
(c) 442.5 nm (d) 776.8 nm

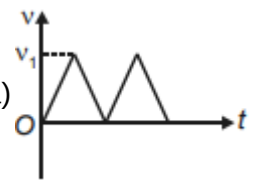
15. Two points P and Q are maintained at the potentials of 10 V and -4V, respectively. The work done in moving 100 electrons from P to Q is
(a) -19×10^{-17} J (b) 9.60×10^{-17} J
(c) -224×10^{-16} J (d) 2.24×10^{-16} J

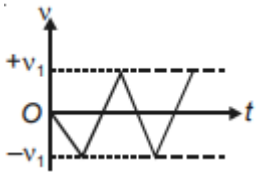
16. The surface of a metal is illuminated with the light of 400 nm. The kinetic energy of the ejected photoelectrons was found to be 1.68 eV. The work function of the metal is (hc = 1240 eV nm)
(a) 3.09 eV (b) 1.42 eV
(c) 151 eV (d) 1.68 eV

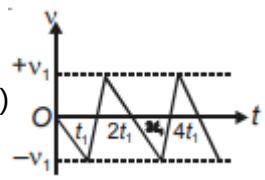
17. A particle has an initial velocity 3i + 4j and an acceleration of 0.4i + 0.3j. Its speed after 10 s is
(a) 10 units (b) $7\sqrt{2}$ units
(c) 7 units (d) 8.5 units

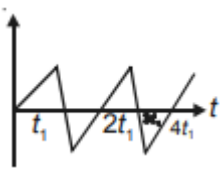
18. A motor cycle starts from rest and accelerates along a straight path at 2 ms^{-2}. At the starting point of the motor cycle, there is a stationary electric siren. How far has the motor cycle gone when the driver hears the frequency of the siren at 94% of its value when the motor cycle was at rest?
(speed of sound = 330 ms^{-1})
(a) 49 m (b) 98 m
(c) 147 m (d) 196 m

19. Consider a rubber ball freely falling from a height h = 4.9 m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then, the velocity as a function of time the height as function of time will be

(a) 

(b) 

(c) 

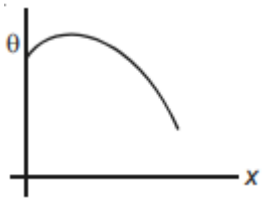
(d) 

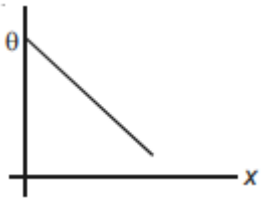
20. A charge Q is placed at two mutually opposite corners of a square. A charge q is placed at each of the other two corners. If the net electrical force on Q is zero, then the $\frac{Q}{q}$ equals

(a) $-2\sqrt{2}$ (b) -1

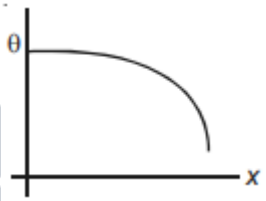
(c) 1 (d) $-\frac{1}{\sqrt{2}}$

21. A long metallic bar is carrying heat from one of its ends to the other end under steady-state. The variation of temperature θ along the length x of the bar from its hot end is best described by which of the following figure.

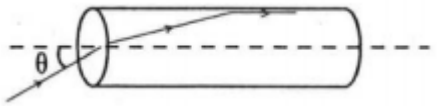
(a) 

(b) 

(c) 

(d) 

22. A transparent solid cylinder rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid-point of one end of the rod as shown in the figure



The incident angle θ for which the light ray grazes along the wall of the road is

(a) $\sin^{-1}(1/2)$ (b) $\sin^{-1}(\sqrt{3}/2)$

(c) $\sin^{-1}(2/\sqrt{3})$ (d) $\sin^{-1}(1/\sqrt{3})$

23. Three sound waves of equal amplitudes have frequencies (v – 1), v, (v + 1). They superpose to give beat. The number of beats produced per second will be

(a) 4 (b) 3

(c) 2 (d) 1

24. The height at which the acceleration due to gravity becomes $\frac{g}{9}$ (where, g is the acceleration due to gravity of R, the radius of the earth is

(a) 2R (b) $\frac{R}{\sqrt{3}}$

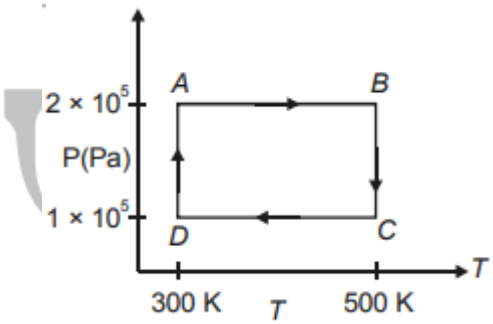
(c) $\frac{R}{2}$ (d) $\sqrt{2}$R

25. Two wires are made of the same material and have the same volume. However, wire-1 has cross-sectional area A and wire-2 has cross-sectional area 3A. If the length of wire-1 increases by Δx on applying force F, how much force is needed to stretch wire-2 by the same amount?
(a) F (b) 4F
(c) 6F (d) 9F

26. In an experiment, the angles are required to be measured using an instrument. 29 divisions of the main scale exactly coincide with the 30 divisions of the vernier scale. If the smallest division of the main scale is half a degree (= 0.5°), then the least count of the instrument is
(a) one minute (b) half minute
(c) one degree (d) half degree

27. An inductor of inductance L = 400 mH and resistors of resistances $R_1 = 4\Omega$ and $R_2 = 2\Omega$ are connected to battery of emf 12 V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at t = 0. The potential drop across L as a function of time is
(a) $6e^{-5t}$ V (b) $\frac{12}{t}e^{-3t}$ V
(c) $6(1 - e^{-t/0.2})$ V (d) $12e^{-5t}$ V

Direction Q. Nos. 28-30 are based on the following paragraph.
Two mole of helium gas are taken over the cycle ABCDA, as shown in the p-T diagram.



28. Assume the gas to be ideal, the work done on the gas in taking it from A to B is
(a) 200 R (b) 300 R
(c) 400 R (d) 500 R

29. The work done on the gas in taking it from D to A is
(a) -414 R (b) +414 R
(c) -690 R (d) +690 R

30. The net work on the gas in the cycle ABCDA is
(a) zero (b) 276 R
(c) 1076 R (d) 1904 R

CHEMISTRY

31. Knowing that the chemistry of lanthanoids (Ln) is dominated by its +3 oxidation state, which of the following statements is incorrect?
    (a) Because of the large size of the Ln (III) ions, the bonding in its compounds is predominantly ionic in character
    (b) The ionic sizes of Ln (III) decrease in general with increasing atomic number
    (c) Ln (III) compounds are generally colourless
    (d) Ln (III) hydroxide are mainly basic in character

32. A liquid was mixed with ethanol and a drop of concentrated H_2SO_4 was added. A compound with a fruity smell was formed. The liquid was
    (a) CH_3OH (b) HCHO
    (c) CH_3COCH_3 (d) CH_3COOH

33. Arrange the carbanions, $(CH_3)_3$ C', C' Cl_3, $(CH_3)_2$ C' H, C_6H_5 C' H_2, in order of their decreasing stability
    (a) C_6H_5 C'H_2 > C'Cl_3 > $(CH_3)_3$ C' > $(CH_3)_2$ C'H
    (b) $(CH_3)_2$ C' H > C'Cl_3 > C_6H_5 C'H_2 > $(CH_3)_3$ C'
    (c) C'Cl_3 > C_6H_5C'H_2 > $(CH_3)_2$C'H > $(CH_3)_3$C'
    (d) $(CH_3)_3$ C' > $(CH_3)_2$ C'H > C_6H_5 C'H_2 > C'Cl_3

34. The alkene that exhibits geometrical isomerism is
    (a) propene (b) 2-methyl propene
    (c) 2-butene (d) 2-methyl-2-butene

35. In which of the following arrangements, the sequence is not strictly according to the property written against it?
    (a) CO_2 < SiO_2 < SnO_2 < PbO_2 : increasing oxidising power
    (b) HF < HCl < HBr < HI : increasing acid strength
    (c) NH_3 > PH_3 < AsH_3 < SbH_3 : increasing basic strength
    (d) B < C < O < N : increasing first ionization enthalpy

36. The major product obtained on interaction of phenol with sodium hydroxide and carbon dioxide is
    (a) benzoic acid (b) salicylaldehyde
    (c) salicylic acid (d) phthalic acid

37. Which of the following statements is incorrect regarding physisorption?
    (a) It occurs because of van der Waals' forces
    (b) More easily liquefiable gases are adsorbed readily
    (c) Under high pressure, it results into multi-molecular layer on adsorbent surface
    (d) Enthalpy of adsorption ($\Delta H_{adsorption}$) is slow and positive

38. Which of the following on heating with aqueous KOH, produces acetaldehyde?
    (a) CH_3COCl (b) CH_3CH2Cl
    (c) CH_2ClCH_2Cl (d) CH_3CHCl_2

39. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is ($h = 6.6 \times 10^{-34}$ kg m^2 s^{-1}, mass of electron, $e_m = 9.1 \times 10^{-31}$ kg)
(a) 1.52×10^{-4} m (b) 5.10×10^{-3} m
(c) 1.92×10^{-3} m (d) 3.84×10^{-3} m

40. In a fuel cell, methanol is used as fuel and oxygen gas is used as an oxidizer. The reaction is $CH_3OH(l) + \frac{3}{2} O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$. At 298 K, standard Gibb's energies of formation for $CH_3OH(l)$, $H_2O(l)$ and $CO_2(g)$ are -166.2, -237.2 and -394.4 kJ mol^{-1} respectively. If standard enthalpy of combustion of methanol is -726 $kJmol^{-1}$, efficiency of the fuel cell will be
(a) 80% (b) 87%
(c) 90% (d) 97%

41. Two liquid 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. A the same temperature, if 1 mol of Y is further added to this solution, vapour pressure of the solution increases by 10 mm Hg. Vapour pressure (in mm Hg) of X and Y in their pure states will be, respectively
(a) 200 and 300 (b) 300 and 400
(c) 400 and 600 (d) 600 and 600

42. The half-life period of a first order chemical reaction is 6.93 min. The time required for the completion of 99% of the chemical reaction will be (log 2 = 0.301)
(a) 230.3 min (b) 23.03 min
(c) 46.06 min (d) 460.6 min

43. Given $E^{o}_{Fe^{3+}/Fe}$ = -0.036 V, $E^{o}_{Fe^{2+}/Fe}$ = -0.439 V The value of standard electrode potential for the charge, $Fe^{3+}(aq) + e^{-} \rightarrow Fe^{2+}(aq)$ will be
(a) -0.072 V (b) 0.385 V
(c) 0.770 V (d) -0.270 V

44. On the basis of the following thermochemical data: [Δ, $G^{\circ}H^{+}(aq) = 0$]
$H_2O(l) \rightarrow H^{+}(aq) + OH^{-}(aq)$; $\Delta H = 57.32$ kJ
$H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(l)$; $\Delta H = -286.02$ kJ
The value of enthalpy of formation of OH^{-} ion at 25°C is
(a) -22.88 kJ (b) -228.88 kJ
(c) +228.88 kJ (d) -343.52 kJ

45. Copper crystallises in fcc with a unit cell length of 361 pm. What is the radius of copper atom?
(a) 108 pm (b) 127 pm
(c) 157 pm (d) 181 pm

46. Which of the following has an optical isomer?
(a) $[Co(NH_3)_3Cl]^{+}$ (b) $[Co(en)(NH_3)_2]^{2+}$
(c) $[Co(H_2O)_4(en)]^{3+}$ (d) $[Co(en)_2(NH_3)_2]^{3+}$

47. Solid $Ba(NO_3)_2$ is gradually dissolved in a 10 x 10^{-4} M Na_2CO_3 solution. At precipitate begin to form? (K_{sp} for $BaCO_3$ = 5.1 x 10^{-9})
    (a) 4.1 x 10^{-5} M
    (b) 5.1 x 10^{-5} M
    (c) 8.1 x 10^{-8} M
    (d) 8.1 x 10^{-7} M

48. Which one of the following reaction of xenon compounds is not feasible?
    (a) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$
    (b) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5\ O_2$
    (c) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + 2_2$
    (d) $XeF_6 + RbF \rightarrow Rb[XeF_7]$

49. Using MO theory, predict which of the following species has the shortest bond length?
    (a) O^+_2
    (b) O^{2+}_2
    (c) O^-_2
    (d) O^{2-}_2

50. In context with the transition elements, which of the following statements is incorrect?
    (a) In addition to the normal oxidation state, the zero oxidation state is also shown by these elements in complexes
    (b) In the highest oxidation state, the transition metal shows basic character and form cationic complexes
    (c) In the highest oxidation states of the first five transition elements (Sc to Mn), all the 4s and 3d electrons are used for bonding
    (d) Once the d^5 configuration is exceeded, the tendency to involve all the 3d electrons in bonding decreases

51. Calculate the wavelength (in nanometer) associated with a proton moving at 1.0 x 10^3 ms^{-1} (Mass of proton = 1.67 x 10^{-27} kg and h = 6.63 x 10^{-3} Js)
    (a) 0.032 nm
    (b) 0.40 nm
    (c) 2.5 nm
    (d) 14.0 nm

52. 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?
    (a) The solution formed is an ideal solution
    (b) The solution is non-ideal, showing positive deviation from Raoult's law
    (c) The solution is non-ideal, showing negative deviation from Raoult's law
    (d) n-heptane shows positive deviation while ethanol show negative deviation from Raoult's law

53. The number of stereoisomers possible for a compound of the molecular formula CH_3 – CH ═ CH – CH(OH) – Me is
    (a) 3
    (b) 2
    (c) 4
    (d) 6

54. The IUPAC name of neopentane is
    (a) 2-methyl butane
    (b) 2,2-dimethyl propane
    (c) 2-methyl propane
    (d) 2,2-dimethyl butane

55. The set representing the correct order of ionic radius is
(a) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$ (b) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$
(c) $Li^{2+} > Na^+ > Mg^{2+} > Be^{2+}$ (d) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

56. The two functional groups present in a typical carbohydrate are
(a) –OH and – COOH (b) –CHO and –COOH
(c) > C ═ O and –OH (d) –OH and –CHO

57. The bond dissociation energy of B—F in BF_3 is 646 kJ mol^{-1} whereas that of C—F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B—F bond dissociation energy as compared to that of C—F is
(a) smaller size of B-atom as compared to that of C-atom.
(b) stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4
(c) Significant pπ – pπ interaction between B and F in BF_3 whereas there is no possibility of such interaction between C and F in CF_4
(d) Lower degree of pπ-pπ interaction between B and F in BF_3 than that between C and F in CF_4

58. In Cannizaro reaction given below $2PhCHO \xrightarrow{OH^{\ominus}} PhCH_2OH + PhCO^{\ominus}_2$ the slowest step is
(a) the attack of : : $OH^{\ominus}$ at the carboxyl group
(b) The transfer of hydride to the carbonyl group
(c) the abstraction of proton from the carboxylic group
(d) the deprotonation of $PhCH_2OH$

59. Which of the following pairs represents linkage isomers?
(a) $[Cu(NH_3)_4][PtCl_4]$ and $[Pt(NH_3)_4][CuCl_4]$
(b) $[Pd(PPh_3)_2(NCS)_2]$ and $[Pd(PPh_3)_2(SCN)_2]$
(c) $[CO(NH_3)_5]NO_3SO_4$ and$[CO(NH_3)_5SO_4]NO_3$
(d) $[PtCl_2(NH_3)_4]Br_2$ and $[PtBr_2(NH_3)_4]Cl_2$

60. Buna-N synthetic rubber is a copolymer of

(a) $H_2C = CH - \underset{\displaystyle Cl}{\underset{|}{C}} = CH_2$ and $H_2C = CH - CH = CH_2$

(b) $H_2C = CH - CH = CH_2$ and $H_5C_6 - CH = CH_2$

(c) $H_2C = CH - CN$ and $H_2C = CH - CH = CH_2$

(d) $H_2C = CH - CN$ and $H_2C = CH - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2$

MATHEMATICS

61. Let a, b, c be such that (b + c) ≠ 0.

If $\begin{vmatrix} a & a+1 & a-1 \\ -b & b+1 & b-1 \\ c & c-1 & c+1 \end{vmatrix} + \begin{vmatrix} a+1 & b+1 & c-1 \\ a-1 & b-1 & c+1 \\ (-1)^{n+2}a & (-1)^{n+1}b & (-1)^n c \end{vmatrix} = 0$

Then, the value of 'n' is

(a) zero (b) any even integer
(c) any odd integer (d) any integer

62. If the mean deviation of number 1, 1 + d, 1 + 2d, …, 1 + 100d from their mean is 255, then d is equal to

(a) 10.0 (b) 20.0
(c) 10.1 (d) 20.2

63. If the roots of the equation $bx^2 + cx + a = 0$ are imaginary, then for all real values of x, the expression $3b^2x^2 + 6bcx + 2c^2$ is

(a) greater than 4ab (b) less than 4ab
(c) greater than -4ab (d) less than -4ab

64. Let A and B denote the statements

A : cosα + cosβ + cosγ = 0
B : sinα + sinβ + sinγ = 0

If cos (β – γ) + cos (γ – α) + cos (α – β) = $\frac{3}{2}$, then

(a) A is true and B is false (b) A is false and B is true
(c) Both A and B are true (d) Both A and B are false

65. The lines $p(p^2 + 1)x – y + q = 0$ and $(p^2 + 1)^2 x + (p^2 + 1) y + 2q = 0$ are perpendicular to a common line for

(a) exactly one value of p (b) exactly two values of p
(c) more than two value of p (d) no value of p

66. If A, B and C are three sets such that A ∩ B = A ∩ C and A ∪ B = A ∪ C, then

(a) A = C (b) B = C
(c) A ∩B = Φ (d) A = B

67. If u, v, w are non-coplanar vectors and p, q are real numbers, then the equality [3upvpw]-[pv w qv] – [2w qv qu] = 0 holds for

(a) exactly two values of (p, q) (b) more than two but not all values of (p, q)
(c) all values of (p, q) (d) exactly one value of (p, q)

68. Let the line $\frac{x-2}{3} = \frac{y-1}{-5} = \frac{z+2}{2}$ lies in the plane x + 3y – αz + β = 0. Then (α,β) equals

(a) (6, -17) (b) (-6, 7)
(c) (5, -15) (d) (-5, 15)

69. From 6 different novels of 3 different dictionaries, 4 novels and 1 dictionary are to be selected and arranged in a row on the shelf so that the dictionary is always in the middle. Then, the number of such arrangements is
(a) atleast 500 but less than 750 (b) atleast 750 but less than 1000
(c) atleast 1000 (d) less than 500

70. $\int_0^{\pi}[\cot x]\,dx$,[] denotes the greatest integer function, is equal to
(a) $\frac{\pi}{2}$ (b) 1
(c) -1 (d) $-\frac{\pi}{2}$

71. For real x, let $f(x) = x^3 + 5x + 1$, then
(a) f is one-one but not onto R (b) f is onto R but not one-one
(c) f is one-one and onto R (d) f is neither one-one nor onto R

72. In a binomial distribution B(n, p = ¼), if the probability of atleast one success is greater than or equal to 9/10, then n is greater than
(a) $1/\log_{10} 4 - \log_{10} 3$ (b) $1/\log_{10} 4 + \log_{10} 3$
(c) $9/\log_{10} 4 - \log_{10} 3$ (d) $4/\log_{10} 4 - \log_{10} 3$

73. If P and Q are the points of intersection of the circles $x^2 + y^2 + 3x + 7y + 2p - 5 = 0$ and $x^2 + y^2 + 2x + 2y - p^2 = 0$, then there is a circle passing through P, Q and (1, 1) and
(a) all values of p (b) all except one value of p
(c) all except two values of p (d) exactly one value of p

74. The projections of a vector on the three coordinate axes are 6, -3, 2, respectively. The direction cosines of the vector are
(a) 6, -3, 2 (b) $\frac{6}{5}, -\frac{3}{5}, \frac{2}{5}$
(c) $\frac{6}{7}, -\frac{3}{7}, \frac{2}{7}$ (d) $-\frac{6}{7}, -\frac{3}{7}, \frac{2}{7}$

75. If $\left|Z - \frac{4}{Z}\right| = 2$, then the maximum value of |z| is equal to
(a) $\sqrt{3} + 1$ (b) $\sqrt{5} + 1$
(c) 2 (d) $2 + \sqrt{2}$

76. Three distinct points A, B and C given in the 2-dimensional coordinate plane such that the ratio of the distance of any one of them from the point (1,0) to the distance from the point (-1,0) is equal to $\frac{1}{3}$. Then, the circumcentre of the ΔABC is at the point
(a) (5/4, 0) (b) (5/2, 0)
(c) (5/3, 0) (d) (0, 0)

77. The remainder left out when $8^{2n} - (62)^{2n+1}$ is divided by 9 is
(a) 0 (b) 2
(c) 7 (d) 8

78. The ellipse $x^2 + 4y^2 = 4$ is inscribed in a rectangle aligned with the coordinate axes, which is turn is inscribed in another ellipse that passes through the point (4, 0). Then, the equation of the ellipse is
(a) $x^2 + 12y^2 = 16$ (b) $4x^2 + 48y^2 = 48$
(c) $4x^2 + 64y^2 = 48$ (d) $x^2 + 16y^2 = 16$

79. The sum to the infinity of the series
$1 + \frac{2}{3} + 6/3^2 + 10/3^3 + 14/3^4 + \ldots$ is
(a) 3 (b) 4
(c) 6 (d) 2

80. The differential equation which represents the family of curves $y = c_1e^{c2x}$, where c_1 and c_2 are arbitrary constants, is
(a) $y' = y^2$ (b) $y'=y'y$
(c) $yy' = y'$ (d) $yy' = (y')^2$

81. One ticket is selected at random from 50 tickets numbered 00, 01, 02, …, 49. Then, the probability that the sum of the digits on the selected ticket is 8, given that the product of these digits is zero equals
(a) $\frac{1}{14}$ (b) $\frac{1}{7}$
(c) $\frac{5}{14}$ (d) $\frac{1}{50}$

82. Let y be an implicit function of x defined by $x^{2x} - 2x^2 \cot y - 1 = 0$. Then, $y'(1)$ equals
(a) -1 (b) 1
(c) log 2 (d) –log 2

83. The area of the region bounded by the parabola $(y - 2)^2 = x - 1$, the tangent to the parabola at the point (2, 3) and the X-axis is
(a) 6 sq units (b) 9 sq units
(c) 12 sq units (d) 3 sq units

84. Given, $P(x) = x^4 + ax^3 + bx^2 + cx + d$ such that x = 0 is the only real root of $P'(x) = 0$. If $P(-1) < P(1)$, then in the interval [-1, 1],
(a) P(-1) is the minimum and P(1) is the maximum of P
(b) P(-1) is not minimum but P(1) is the maximum of P
(c) P(-1) is the minimum and P(1) is not the maximum of P
(d) P(-1) is the minimum nor P(1) is the maximum of P

85. The shortest distance between the line $y - x = 1$ and the curve $x = y^2$ is
(a) $\frac{3\sqrt{2}}{8}$ (b) $\frac{2\sqrt{3}}{8}$
(c) $\frac{3\sqrt{2}}{5}$ (d) $\frac{\sqrt{3}}{4}$

Directions Q. Nos. 86 to 90 are Assertion-Reason type questions. Each of these questions contains two statements: Statement I (Assertion) and Statement II (Reason). Each of these questions also have four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I

(b) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I

(c) Statement I is true, Statement II is false

(d) Statement I is false, Statement II is true

86. Let $f(x) = (x + 1)^2 - 1, x \geq -1$
Statement I The set $\{x : f(x) = f^{-1}(x)\} = \{0, -1\}$
Statement II f is a bijection.

87. Let $f(x) = x|x|$ and $g(x) = \sin x$
Statement I gof is differentiable at x = 0 and its derivative is continuous at that point.
Statement II gof is twice differentiable at x = 0.

88. **Statement I** The variance of first n even natural numbers is $n^2 - 1/4$.
Statement II The sum of first n natural numbers is $\frac{n(n+1)}{2}$ and the sum of squares of first n natural numbers is $\frac{n(n+1)(2n+1)}{6}$.

89. **Statement I** ~ (p ↔ ~ q) is equivalent to p ↔ q.
Statement II ~ (p ↔ ! q) is a tautology.

90. Let A be 2 x 2 matrix.
Statement I adj (adj A) = A
Statement II |adj A| = A