Q1. If a wire is stretched to make it 0.1% longer, its resistance will :

(1) increase by 0.2% (2) decrease by 0.2%

(3) decrease by 0.05% (4) increases by 0.05%

Q2. An object, moving with a speed of $6.25\ \mathrm{m/s}$, is decelerated at a rate given by :

$$\frac{\mathrm{dv}}{\mathrm{dt}} = -2.5\sqrt{\mathrm{v}}$$

where v is the instantaneous speed. The time taken by the object, to come to rest, would be:

(1) 2 s (2) 4 s

(3) 8 s (4) 1 s

Q3. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is v, the total area around the fountain that gets wet is :

(1) $\pi\frac{v^4}{g^2}$ (2) $\frac{\pi}{2}\frac{v^4}{g^2}$

(3) $\pi\frac{v^2}{g^2}$ (4) $\pi\frac{v^4}{g}$

Q4. A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is

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

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

Q5. A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc:

(1) continuously decreases (2) continuously increases

(3) first increases and then decreases (4) remains unchanged

Q6. A pulley of radius 2 m is rotated about its axis by a force $\mathrm{F} = \left(20\mathrm{t} - 5\mathrm{t}^2\right)$ Newton (where t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation made by the pulley before its direction of motion if reversed, is :

(1) more than 3 but less than 6 (2) more than 6 but less than 9

(3) more than 9 (4) less than 3

Q7. Two bodies of masses m and 4 m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero is:

(1) $-\frac{4\mathrm{Gm}}{\mathrm{r}}$ (2) $-\frac{6\mathrm{Gm}}{\mathrm{r}}$

(3) $-\frac{9\mathrm{Gm}}{r}$ (4) zero

Q8. Work done in increasing the size of a soap bubble from a radius of 3 cm to 5 cm is nearly (Surface tension of soap solution $= 0.03\mathrm{Nm}^{-1}$):

(1) $0.2\pi\mathrm{mJ}$ (2) $2\pi\mathrm{mJ}$

(3) $0.4\pi\mathrm{mJ}$ (4) $4\pi\mathrm{mJ}$

Q9. Water is flowing continuously from a tap having an internal diameter 8×10^{-3} m. The water velocity as it leaves the tap is $0.4\ \mathrm{ms}^{-1}$. The diameter of the water stream at a distance 2×10^{-1} m below the lap is close to :

(1) 7.5×10^{-3} m (2) 9.6×10^{-3} m

(3) 3.6×10^{-3} m (4) 5.0×10^{-3} m

Q10. 100 g of water is heated from 30°C to 50°C. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is $4148\ \mathrm{J/kg/K}$):

(1) 8.4 kJ (2) 84 kJ

(3) 2.1 kJ (4) 4.2 kJ

Q11. A Carnot engine operating between temperatures T_1 and T_2 has efficiency $\frac{1}{6}$. When T_2 is lowered by 62 K, its efficiency increases to $\frac{1}{3}$. Then T_1 and T_2 are, respectively :

(1) 372 K and 330 K (2) 330 K and 268 K

(3) 310 K and 248 K (4) 372 K and 310 K

Q12. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heats γ. It is moving with speed v and is suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by :

(1) $\frac{(\gamma-1)}{2\gamma \mathrm{R}} \mathrm{Mv}^2$ K (2) $\frac{\gamma M v^2}{2\mathrm{R}}$K

(3) $\frac{(\gamma-1)}{2\mathrm{R}} \mathrm{Mv}^2$ K (4) $\frac{(\gamma-1)}{2(\gamma+1)R} \mathrm{Mv}^2$ K

Q13. Three perfect gases at absolute temperatures T_1, T_2 and T_3 are mixed. The masses of molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is :

(1) $\frac{n_1T_1+n_2T_2+n_3T_3}{n_1+n_2+n_3}$ (2) $\frac{n_1T_1+n_2T_2^2+n_3T_3^2}{n_1T_1+n_2T_2+n_3T_3}$

(3) $\frac{n_1^2T_1^2+n_2^2T_2^2+n_3^2T_3^2}{n_1T_1+n_2T_2+n_3T_3}$ (4) $\frac{(T_1+T_2+T_3)}{3}$

Q14. Two particles are executing simple harmonic motion of the same amplitude A and frequency ω along the x-axis. Their mean position is separated by distance $X_0\ (X_0 > A)$. If the maximum separation between them is $(X_0 + A)$, the phase difference between their motion is :

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

(3) $\frac{\pi}{6}$ (4) $\frac{\pi}{2}$

Q15. A mass M, attached to a horizontal spring, executes S.H.M. with amplitude A_1. When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of $\left(\frac{A_1}{A_2}\right)$ is :

(1) $\frac{M+m}{M}$ (2) $\left(\frac{M}{M+m}\right)^{1/2}$

(3) $\left(\frac{\mathrm{M+m}}{\mathrm{M}}\right)^{1/2}$ (4) $\frac{M}{M+m}$

Q16. The transverse displacement $y(x,t)$ of a wave on a string is given by $y(x,t) = e^{-\left(ax^2+bt^2+2\sqrt{ab}xt\right)}$. This represents a

(1) wave moving in $-x$ direction with speed $\sqrt{\frac{b}{a}}$ (2) standing wave of frequency $\sqrt{b}$

(3) standing wave of frequency $\frac{1}{\sqrt{b}}$ (4) wave moving in $+x$ direction with $\sqrt{\frac{a}{b}}$

Q17. Two identical charged spheres suspended from a common point by two massless strings of length I are initially a distance $d(d << 1)$ apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result the charges approach each other with a velocity v. Then as a function of distance x between them,

(1) $v \propto x^{-1}$ (2) $v \propto x^{1/2}$

(3) $v \propto x$ (4) $v \propto x^{-1/2}$

Q18. The electrostatic potential inside a charged spherical ball is given by $\phi = \alpha\rho^2 + b$ where r is the distance from the centre; a, b are constants. Then the charge density inside ball is

(1) $-6a\varepsilon_0 r$ (2) $-24\pi a\varepsilon_0 r$

(3) $-6a\varepsilon_0$ (4) $-24\pi a\varepsilon_0 r$

Q19. A resistor 'R' and 2μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. $(\log_{10} 2.5 = 0.4)$

(1) $1.7 \times 10^5\Omega$ (2) $2.7 \times 10^6\Omega$

(3) $3.3 \times 10^7\Omega$ (4) $1.3 \times 10^4\Omega$

Q20. A current I flows in an infinitely long wire with cross section in the form of a semicircular ring of radius R. The magnitude of the magnetic induction along its axis is

(1) $\frac{\mu_0 I}{2\pi^2 R}$ (2) $\frac{\mu_0 I}{2\pi R}$

(3) $\frac{\mu_0 I}{4\pi^2 R}$ (4) $\frac{\mu_0 I}{\pi^2 R}$

Q21. A boat is moving due east in a region where the earth's magnetic field is $5.0 \times 10^{-5}\text{NA}^{-1}\text{ m}^{-1}$ due north and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is 1.50 ms^{-1}, the magnitude of the induced emf in the wire of aerial is :

(1) 0.75mV (2) 0.50mV

(3) 0.15mV (4) 1mV

Q22. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at $t = 0$. The time at which the energy is stored equally between the electric and the magnetic field is :

(1) $\frac{\pi}{4}\sqrt{LC}$ (2) $2\pi\sqrt{LC}$

(3) $\sqrt{LC}$ (4) $\pi\sqrt{LC}$

Q23. Let the $x - z$ plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with $z < 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\vec{A} = 6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on the plane of separation. The angle of refraction in medium 2 is

(1) 45° (2) 60°

(3) 75° (4) 30°

Q24. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the first car at relative speed of 15 m/s. The speed of the image of the second car as seen in the mirror of the first one is :

(1) $\frac{1}{15}$ m/s (2) 10 m/s
(3) 15 m/s (4) $\frac{1}{10}$ m/s

Q25. Direction: The question has a paragraph followed by two statements, Statement -1 and statement -2. Of the given four alternatives after the statements, choose the one that describes the statements. A thin air film is formed by putting the convex surface of a plane - convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate) surface of the film. Statement-1 : When light reflects from the air-glass plate interface, the reflected wave suffers a phase change of π. Statement-2 : The centre of the interference pattern is dark.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(3) Statement- 1 is false. Statement- 2 is true.
(4) Statement-1 is true, Statement- 2 is false.

Q26. This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : A metallic surface is irradiated by a monochromatic light of frequency $v > v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are $\mathrm{K_{max}}$ and $\mathrm{V_0}$ respectively. If the frequency incident on the surface doubled, both the $\mathrm{K_{max}}$ and $\mathrm{V_0}$ are also doubled. Statement-2 : The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(3) Statement-1 is false, Statement-2 is true.
(4) Statement-1 is true, Statement-2 is false.

Q27. Energy required for the electron excitation in Li^{++} from the first to the third Bohr orbit is :

(1) 36.3eV (2) 108.8eV
(3) 122.4eV (4) 12.1eV

Q28. The half life of a radioactive substance is 20 minutes. The approximate time interval $(t_2 - t_1)$ between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 and $\frac{1}{3}$ of it had decayed is :

(1) 14 min (2) 20 min
(3) 28 min (4) 7 min

Q29. This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : Sky wave signals are used for long distance radio communication. These signals are in general, less stable than ground wave signals. Statement-2 : The state of ionosphere varies from hour to hour, day to day and season to season.

(1) Statement-1 is true, Statement-2 is true; Statement-2 is the correct explanation of Statement-1.
(2) Statement-1 is true, Statement-2 is true; Statement-2 is not the correct explanation of Statement-1.
(3) Statement- 1 is false, Statement- 2 is true.
(4) Statement-1 is true, Statement-2 is false.

Q30. A screw gauge gives the following reading when used to measure the diameter of a wire. Main scale reading : 0 mm Circular scale reading : 52 divisions Given that 1 mm on main scale corresponds to 100 divisions of the circular scale. The diameter of wire from the above date is :

(1) 0.052 cm
(2) 0.026 cm
(3) 0.005 cm
(4) 0.52 cm

Q31. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution?

(1) 0.190
(2) 0.086
(3) 0.050
(4) 0.100

Q32. The magnetic moment (spin only) of $[NiCl_4]^{2-}$ is

(1) 5.46BM
(2) 2.83BM
(3) 1.41BM
(4) 1.82BM

Q33. A gas absorbs a photon of 355 nm and emits at two wavelengths. If one of the emissions is at 680 nm, the other is at:

(1) 325 nm
(2) 743 nm
(3) 518 nm
(4) 1035 nm

Q34. Which one of the following order represents the correct sequence of the increasing basic nature of the given oxides ?

(1) $MgO < K_2O < Al_2O_3 < Na_2O$
(2) $Na_2O < K_2O < MgO < Al_2O_3$
(3) $K_2O < Na_2O < Al_2O_3 < MgO$
(4) $Al_2O_3 < MgO < Na_2O < K_2O$

Q35. Which of the following statement is wrong?

(1) Nitrogen cannot form $d\pi - p\pi$ bond.
(2) Single N − N bond is weaker than the single P − P bond,
(3) N_2O_4 has two resonance structures
(4) The stability of hydrides increases from NH_3 to BiH_3 in group 15 of the periodic table

Q36. Among the following the maximum covalent character is shown by the compound:

(1) $SnCl_2$
(2) $AlCl_3$
(3) $MgCl_2$
(4) $FeCl_2$

Q37. The hybridization of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively :

(1) sp^2, sp, sp^3
(2) sp, sp^3, sp^2
(3) sp^2, sp^3, sp
(4) sp, sp^2, sp^3

Q38. 'a' and 'b' are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because

(1) a and b for Cl_2 < a and b for C_2H_6
(2) a for Cl_2 < a for C_2H_6 but b for Cl_2 > b for C_2H_6
(3) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6
(4) a and b for Cl_2 > a and b for C_2H_6

Q39. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10dm^3 to a volume of 100dm^3 at 27°C is :

(1) $35.8\ \text{J mol}^{-1}\ \text{K}^{-1}$ (2) $32.3\ \text{J mol}^{-1}\ \text{K}^{-1}$

(3) $42.3\ \text{J mol}^{-1}\ \text{K}^{-1}$ (4) $38.3\ \text{J mol}^{-1}\ \text{K}^{-1}$

Q40. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K is

(1) 3 atm (2) 0.3 atm

(3) 0.18 atm (4) 1.8 atm

Q41. Boron cannot form which one of the following anions?

(1) BH_4^- (2) $B(OH)_4^-$

(3) BO_2^- (4) BF_6^{3-}

Q42. The strongest acid amongst the following compounds is :

(1) $HCOOH$ (2) $CH_3CH_2CH(Cl)CO_2H$

(3) $ClCH_2CH_2CH_2COOH$ (4) CH_3COOH

Q43. Which of the following reagents may be used to distinguish between phenol and benzoic acid ?

(1) Tollen's reagent (2) Molisch reagent

(3) Neutral $FeCl_3$ (4) Aqueous NaOH

Q44. Identify the compound that exhibits tautomerism.

(1) Lactic acid (2) 2- Butene

(3) Phenol (4) None of these

Q45. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of :

(1) a vinyl group (2) an isopropyl group

(3) an acetylenic triple bond (4) two ethylenic double bonds

Q46. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre positions. If one atom of B is missing from one of the face centred points, the formula of the compound is

(1) AB_2 (2) A_2B_3

(3) $A_2\ B_5$ (4) A_2B

Q47. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression:

(1) $\alpha = \frac{i-1}{x+y+1}$ (2) $\alpha = \frac{x+y-1}{i-1}$

(3) $\alpha = \frac{x+y+1}{i-1}$ (4) $\alpha = \frac{i-1}{(x+y-1)}$

Q48. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at -6°C will be : [K_t for water $= 1.86\ \text{K kg mol}^{-1}$, and molar mass of ethylene glycol $= 62\ \text{g mol}^{-1}$)

(1) 204.30 g (2) 400.00 g

(3) 304.60 g (4) 804.32 g

Q49. The reduction potential of hydrogen half cell will be negative if :

(1) $\mathrm{p}\,(\mathrm{H_2}) = 1$ atm and $[\mathrm{H^+}] = 1.0\mathrm{M}$

(2) $\mathrm{p}\,(\mathrm{H_2}) = 2$ atm and $[\mathrm{H^+}] = 1.0\mathrm{M}$

(3) $\mathrm{p}\,(\mathrm{H_2}) = 2$ atm and $[\mathrm{H^+}] = 2.0\mathrm{M}$

(4) $\mathrm{p}\,(\mathrm{H_2}) = 1$ atm and $[\mathrm{H^+}] = 2.0\mathrm{M}$

Q50. The rate of a chemical reaction doubles for every $10^{\circ}\mathrm{C}$ rise of temperature. If the temperature is raised by $50^{\circ}\mathrm{C}$, the rate of the reaction increases by about :

(1) 24 times

(2) 32 times

(3) 64 times

(4) 10 times

Q51. Which of the following statements regarding sulphur is incorrect?

(1) The vapour at $200^{\circ}\mathrm{C}$ consists mostly of $\mathrm{S_8}$ rings

(2) At $600^{\circ}\mathrm{C}$ the gas mainly consists of $\mathrm{S_2}$ molecules

(3) The oxidation state of sulphur is never less than $+4$ in its compounds

(4) $\mathrm{S_2}$ molecule is paramagnetic.

Q52. The structure of $\mathrm{IF_7}$ is :

(1) trigonal bipyramid

(2) octahedral

(3) pentagonal bipyramid

(4) square pyramid

Q53. In context of the lanthanoids, which of the following statements is not correct ?

(1) All the members exhibit $+3$ oxidation state

(2) Because of similar properties the separation of lanthanoids is not easy.

(3) Availability of 4f electrons results in the formation of compounds in $+4$ state for all the members of the series.

(4) There is a gradual decrease in the radii of the members with increasing atomic number in the series.

Q54. The outer electron configuration of Gd (Atomic No : 64 is :

(1) $4f^8 5d^0 6s^2$

(2) $4f^4 5d^4 6s^2$

(3) $4f^7 5d^1 6s^2$

(4) $4f^3 4d^5 6s^2$

Q55. Which of the following facts about the complex $[\mathrm{Cr(NH_3)_6}]\mathrm{Cl_3}$ s wrong ?

(1) The complex is paramagnetic

(2) The complex is an outer orbital complex

(3) The complex gives white precipitate with silver nitrate solution

(4) The complex involves d^2sp^3 hybridization and is octahedral in shape.

Q56. Phenol is heated with a solution of mixture of KBr and $\mathrm{KBrO_3}$. The major product obtained in the above reaction is

(1) 3-Bromophenol

(2) 4-Bromophenol

(3) 2, 4, 6- Tribromophenol

(4) 2-Bromophenol

Q57. Sodium ethoxide has reacted with ethanoyl chloride. The compound that is produced in the above reaction is :

(1) 2-Butanone

(2) Ethyl chloride

(3) Ethyl ethanoate

(4) Diethyl ether

Q58. Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloroacetate and another compound. The other compound is :

(1) Trichloromethanol
(2) 2, 2, 2-Trichloropropanol
(3) Chloroform
(4) 2, 2, 2-Trichloroethanol

Q59. Silver Mirror test is given by which one of the following compounds ?
(1) Acetone
(2) Formaldehyde
(3) Benzophenone
(4) None of these

Q60. The presence or absence of hydroxyl group on which carbon atom of sugar differentiates RNA and DNA ?
(1) 2^{nd}
(2) 3^{rd}
(3) 4^{th}
(4) 1^{st}

Q61. Let α, β be real and z be a complex number. If $z^2 + \alpha z + \beta = 0$ has two distinct roots on the line $\text{Re}\, z = 1$, then it is necessary that
(1) $\beta \in (-1, 0)$
(2) $|\beta| = 1$
(3) $\beta \in (1, \infty)$
(4) $\beta \in (0, 1)$

Q62. If $\omega(\neq 1)$ is a cube root of unity, and $(1 + \omega)^7 = A + B\omega$. Then (A, B) equals
(1) $(1, 1)$
(2) $(1, 0)$
(3) $(-1, 1)$
(4) $(0, 1)$

Q63. This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement - 1 : The number of ways of distributing 10 identical balls in 4 distinct boxes such that no box is empty is ${}^9C_3$ Statement-2: The number of ways of choosing any 3 places from 9 different places is ${}^9C_3$.
(1) Statement -1 is true, Statement -2 is true; Statement -2 is not a correct explanation for Statement -1
(2) Statement -1 is true, Statement -2 is false.
(3) Statement -1 is false, Statement- 2 is true.
(4) Statement -1 is true, Statement -2 is true; Statement -2 is a correct explanation for Statement -1

Q64. A man saves Rs. 200 in each of the first three months of his service. In each of the subsequent months his saving increases by Rs. 40 more than the saving of immediately previous month. His total saving from the start of service will be Rs. 11040 after
(1) 19 months
(2) 20 months
(3) 21 months
(4) 18 months

Q65. The coefficient of x^7 in the expansion of $\left(1 - x - x^2 + x^3\right)^6$ is
(1) -132
(2) -144
(3) 132
(4) 144

Q66. If $A = \sin^2 x + \cos^4 x$, then for all real x
(1) $\frac{13}{16} \leq \text{A} \leq 1$
(2) $1 \leq \text{A} \leq 2$
(3) $\frac{3}{4} \leq \text{A} \leq \frac{13}{16}$
(4) $\frac{3}{4} \leq \text{A} \leq 1$

Q67. The lines $L_1 : y - x = 0$ and $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q respectively. The bisector of the acute angle between L_1 and L_2 intersect L_3 at R. This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : The ratio $PR : RQ$ equals $2\sqrt{2} : \sqrt{5}$. Statement-2 : In any triangle, bisector of an angle divides the triangle into two similar triangles.

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

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

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

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

Q68. The two circles $x^2 + y^2 = ax$ and $x^2 + y^2 = c^2 (c > 0)$ touch each other if

(1) $|a| = c$

(2) $a = 2c$

(3) $|a| = 2c$

(4) $2|a| = c$

Q69. Equation of the ellipse whose axes are the axes of coordinates and which passes through the point $(-3, 1)$ and has eccentricity $\sqrt{\frac{2}{5}}$ is

(1) $5x^2 + 3y^2 - 48 = 0$

(2) $3x^2 + 5y^2 - 15 = 0$

(3) $5x^2 + 3y^2 - 32 = 0$

(4) $3x^2 + 5y^2 - 32 = 0$

Q70. $$ \lim _{x \rightarrow 2}\left(\frac{\sqrt{1-\cos \{2(x-2)\}}}{x-2}\right)

(1) equals $\sqrt{2}$

(2) equals $-\sqrt{2}$

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

(4) does not exist

Q71. Consider the following statements P : Suman is brilliant Q : Suman is rich R : Suman is honest The negation of the statement "Suman is brilliant and dishonest if and only if Suman is rich" can be expressed as

(1) $\sim (\mathrm{Q} \leftrightarrow (\mathrm{P} \wedge \sim \mathrm{R}))$

(2) $\sim Q \leftrightarrow \sim P \wedge R$

(3) $\sim (P \wedge \sim R) \leftrightarrow Q$

(4) $\sim P \wedge (Q \leftrightarrow \sim R)$

Q72. If the mean deviation about the median of the numbers a, 2a, . . . , 50a is 50 , then |a| equals

(1) 3

(2) 4

(3) 5

(4) 2

Q73. Let R be the set of real numbers This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : $A = \{(x, y) \in R \times R : y - x$ is an integer $\}$ is an equivalence relation on R. Statement-2 : $B = \{(x, y) \in R \times R : x = \alpha y$ for some rational number $\alpha\}$ is an equivalence relation on R.

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

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

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

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

Q74. Let A and B be two symmetric matrices of order 3 . This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement -1 : A(BA) and (AB)A are symmetric matrices. Statement - 2 : AB is symmetric matrix if matrix multiplication of A and B is commutative.

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

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

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

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

Q75. The number of values of k for which the linear equations $4x+ky+2z=0; kx+4y+z=0; 2x+2y+z=0$ possess a non-zero solution is

(1) 2

(2) 1

(3) zero

(4) 3

Q76. The domain of the function $f(x)=\frac{1}{\sqrt{|x|-x}}$ is

(1) $(0,\infty)$

(2) $(-\infty,0)$

(3) $(-\infty,\infty)-\{0\}$

(4) $(-\infty,\infty)$

Q77. The value of p and q for which the function $f(x)=\begin{cases}\frac{\sin(p+1)x+\sin x}{x} & x<0\\ q & ,x=0\\ \frac{\sqrt{x+x^2}-\sqrt{x}}{x^{3/2}} & ,x>0\end{cases}$ is continuous for all x in R, is

(1) $p=\frac{5}{2}, q=\frac{1}{2}$

(2) $p=-\frac{3}{2}, q=\frac{1}{2}$

(3) $p=\frac{1}{2}, q=\frac{3}{2}$

(4) $p=\frac{1}{2}, q=-\frac{3}{2}$

Q78. $\frac{d^2x}{dy^2}$ equals

(1) $-\left(\frac{d^2y}{dx^2}\right)^{-1}\left(\frac{dy}{dx}\right)^{-3}$

(2) $\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-2}$

(3) $-\left(\frac{d^2y}{dx^2}\right)\left(\frac{dy}{dx}\right)^{-3}$

(4) $\left(\frac{d^2y}{dx^2}\right)^{-1}$

Q79. The shortest distance between line $y-x=1$ and curve $x=y^2$ is

(1) $\frac{3\sqrt{2}}{8}$

(2) $\frac{8}{3\sqrt{2}}$

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

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

Q80. The value of $\int_0^1 \frac{8\log(1+x)}{1+x^2}dx$ is

(1) $\frac{\pi}{8}\log 2$

(2) $\frac{\pi}{2}\log 2$

(3) $\log 2$

(4) $\pi\log 2$

Q81. For $x\in\left(0,\frac{5\pi}{2}\right)$, define $f(x)=\int_0^x \sqrt{t}\sin t dt$. Then f has

(1) local minimum at π and 2π

(2) local minimum at π and local maximum at 2π

(3) local maximum at π and local minimum at 2π

(4) local maximum at π and 2π

Q82. The area of the region enclosed by the curves $y=x, x=e, y=\frac{1}{x}$ and the positive x-axis is

(1) 1 square units (2) $\frac{3}{2}$ square units
(3) $\frac{5}{2}$ square units (4) $\frac{1}{2}$ square units

Q83. If $\frac{dy}{dx} = y + 3 > 0$ and $y(0) = 2$, then $y(\ln 2)$ is equal to
(1) 5 (2) 13
(3) -2 (4) 7

Q84. Let I be the purchase value of an equipment and $\mathrm{V(t)}$ be the value after it has been used for t years. The value $\mathrm{V(t)}$ depreciates at a rate given by differential equation $\frac{\mathrm{dV(t)}}{\mathrm{dt}} = -\mathrm{k(T - t)}$, where $\mathrm{k} > 0$ is a constant and T is the total life in years of the equipment. Then the scrap value $\mathrm{V(T)}$ of the equipment is
(1) $\mathrm{I} - \frac{\mathrm{kT}}{2}$ (2) $1 - \frac{k(T-t)^2}{2}$
(3) e^{-kT} (4) $\mathrm{T}^2 - \frac{1}{\mathrm{k}}$

Q85. If $\overrightarrow{\mathrm{a}} = \frac{1}{\sqrt{10}}(3\hat{\mathrm{i}} + \hat{\mathrm{k}})$ and $\overrightarrow{\mathrm{b}} = \frac{1}{7}(2\hat{\mathrm{i}} + 3\hat{\mathrm{j}} - 6\hat{\mathrm{k}})$, then the value of $(2\overrightarrow{\mathrm{a}} - \overrightarrow{\mathrm{b}}) \cdot [(\overrightarrow{\mathrm{a}} \times \overrightarrow{\mathrm{b}}) \times (\overrightarrow{\mathrm{a}} + 2\overrightarrow{\mathrm{b}})]$ is
(1) -3 (2) 5
(3) 3 (4) -5

Q86. The vector $\vec{a}$ and $\vec{b}$ are not perpendicular and $\vec{c}$ and $\vec{d}$ are two vectors satisfying: $\vec{b} \times \vec{c} = \vec{b} \times \vec{d}$ and $\vec{a} \cdot \vec{d} = 0$. Then the vector $\vec{d}$ is equal to
(1) $\vec{c} + \left(\frac{\vec{a} \cdot \vec{c}}{\vec{a} \cdot \vec{b}}\right)\vec{b}$ (2) $\vec{b} + \left(\frac{\vec{b} \cdot \vec{c}}{\vec{a} \cdot \vec{b}}\right)\vec{c}$
(3) $\vec{c} - \left(\frac{\vec{a} \cdot \vec{c}}{\vec{a} \cdot \vec{b}}\right)\vec{b}$ (4) $\vec{b} - \left(\frac{\vec{b} \cdot \vec{c}}{\vec{a} \cdot \vec{b}}\right)\vec{c}$

Q87. If the angle between the line $x = \frac{y-1}{2} = \frac{z-3}{\lambda}$ and the plane $x + 2y + 3z = 4$ is $\cos^{-1}\left(\sqrt{\frac{5}{14}}\right)$, then λ equals
(1) $\frac{3}{2}$ (2) $\frac{2}{5}$
(3) $\frac{5}{3}$ (4) $\frac{2}{3}$

Q88. This question has Statement -1 and Statement -2. Of the four choices given after the statements, choose the one that best describes the two statements. Statement-1 : The point $A(1, 0, 7)$ is the mirror image of the point $B(1, 6, 3)$ in the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$. Statement-2 : The line: $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ bisects the line segment joining $A(1, 0, 7)$ and $B(1, 6, 3)$.
(1) Statement -1 is true, Statement-2 is true; Statement -2 is not a correct explanation for Statement -1
(2) Statement -1 is true, Statement -2 is false.
(3) Statement -1 is false, Statement -2 is true.
(4) Statement -1 is true, Statement -2 is true; Statement -2 is a correct explanation for Statement -1

Q89. Consider 5 independent Bernoulli's trials each with probability of success p. If the probability of at least one failure is greater than or equal to $\frac{31}{32}$, then p lies in the interval
(1) $\left(\frac{3}{4}, \frac{11}{12}\right]$ (2) $\left[0, \frac{1}{2}\right]$
(3) $\left(\frac{11}{12}, 1\right]$ (4) $\left(\frac{1}{2}, \frac{3}{4}\right]$

Q90. If C and D are two events such that $C \subset D$ and $P(D) \neq 0$, then the correct statement among the following is

(1) $P(C \mid D) \geq P(C)$
(2) $P(C \mid D) < P(C)$
(3) $P(C \mid D) = \frac{P(D)}{P(C)}$
(4) $P(C \mid D) = P(C)$

ANSWER KEYS

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