

Q1. Identify the pair of physical quantities which have different dimensions:

- (1) Wave number and Rydberg's constant (2) Stress and Coefficient of elasticity
(3) Coercivity and Magnetisation (4) Specific heat capacity and Latent heat

Q2. A projectile is projected with velocity of 25 m s^{-1} at an angle θ with the horizontal. After t seconds its inclination with horizontal becomes zero. If R represents horizontal range of the projectile, the value of θ will be : [use $g = 10 \text{ m s}^{-2}$]

- (1) $\frac{1}{2} \sin^{-1} \left(\frac{5t^2}{4R} \right)$ (2) $\frac{1}{2} \sin^{-1} \left(\frac{4R}{5t^2} \right)$
(3) $\tan^{-1} \left(\frac{4t^2}{5R} \right)$ (4) $\cot^{-1} \left(\frac{R}{20t^2} \right)$

Q3. A boy ties a stone of mass 100 g to the end of a 2 m long string and whirls it around in a horizontal plane. The string can withstand the maximum tension of 80 N . If the maximum speed with which the stone can revolve is $\frac{K}{\pi} \text{ rev min}^{-1}$. The value of K is :

(Assume the string is massless and un-stretchable)

- (1) 400 (2) 300
(3) 600 (4) 800

Q4. A block of mass 10 kg starts sliding on a surface with an initial velocity of 9.8 ms^{-1} . The coefficient of friction between the surface and block is 0.5 . The distance covered by the block before coming to rest is : [use $g = 9.8 \text{ ms}^{-2}$]

- (1) 9.8 m (2) 4.9 m
(3) 12.5 m (4) 19.6 m

Q5. A particle experiences a variable force $\vec{F} = (4x\hat{i} + 3y^2\hat{j})$ in a horizontal $x - y$ plane. Assume distance in meters and force is newton. If the particle moves from point $(1, 2)$ to point $(2, 3)$ in the $x - y$ plane, then Kinetic Energy changes by :

- (1) 25 J (2) 50 J
(3) 12.5 J (4) 0 J

Q6. The approximate height from the surface of earth at which the weight of the body becomes $\frac{1}{3}$ of its weight on the surface of earth is :

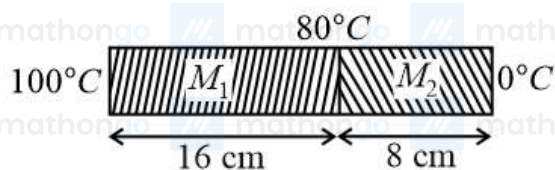
[Radius of earth $R = 6400 \text{ km}$ and $\sqrt{3} = 1.732$]

- (1) 3840 km (2) 4685 km
(3) 2133 km (4) 4267 km

Q7. The bulk modulus of a liquid is $3 \times 10^{10} \text{ Nm}^{-2}$. The pressure required to reduce the volume of liquid by 2% is :

- (1) $3 \times 10^8 \text{ N m}^{-2}$ (2) $6 \times 10^8 \text{ N m}^{-2}$
(3) $9 \times 10^8 \text{ N m}^{-2}$ (4) $12 \times 10^8 \text{ N m}^{-2}$

Q8. Two metallic blocks M_1 and M_2 of same area of cross-section are connected to each other (as shown in figure). If the thermal conductivity of M_2 is K then the thermal conductivity of M_1 will be : [Assume steady state heat conduction]



- (1) $10K$ (2) $8K$
 (3) $12.5K$ (4) $2K$

Q9. A Carnot engine whose heat sinks at 27°C , has an efficiency of 25%. By how many degrees should the temperature of the source be changed to increase the efficiency by 100% of the original efficiency ?

- (1) Increases by 18°C (2) Increases by 200°C
 (3) Increases by 120°C (4) Increases by 73°C

Q10. The equations of two waves are given by :

$$y_1 = 5 \sin 2\pi(x - vt) \text{ cm}$$

$$y_2 = 3 \sin 2\pi(x - vt + 1.5) \text{ cm}$$

These waves are simultaneously passing through a string. The amplitude of the resulting wave is :

- (1) 2 cm (2) 4 cm
 (3) 5.8 cm (4) 8 cm

Q11. A vertical electric field of magnitude $4.9 \times 10^5 \text{ N C}^{-1}$ just prevents a water droplet of a mass 0.1 g from falling. The value of charge on the droplet will be : (Given $g = 9.8 \text{ m s}^{-2}$)

- (1) $1.6 \times 10^{-9} \text{ C}$ (2) $2.0 \times 10^{-9} \text{ C}$
 (3) $3.2 \times 10^{-9} \text{ C}$ (4) $0.5 \times 10^{-9} \text{ C}$

Q12. A parallel plate capacitor is formed by two plates each of area $30\pi \text{ cm}^2$ separated by 1 mm. A material of dielectric strength $3.6 \times 10^7 \text{ V m}^{-1}$ is filled between the plates. If the maximum charge that can be stored on the capacitor without causing any dielectric breakdown is $7 \times 10^{-6} \text{ C}$, the value of dielectric constant of the material is :

$$\left[\text{Use } \frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2} \right]$$

- (1) 1.66 (2) 1.75
 (3) 2.25 (4) 2.33

Q13. Two identical cells each of emf 1.5 V are connected in parallel across a parallel combination of two resistors each of resistance 20Ω . A voltmeter connected in the circuit measures 1.2 V. The internal resistance of each cell is :

- (1) 2.5Ω (2) 4Ω
 (3) 5Ω (4) 10Ω

Q14. Given below are two statements : One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : In an uniform magnetic field, speed and energy remains the same for a moving charged particle.

Reason (R) : Moving charged particle experiences magnetic force perpendicular to its direction of motion.

(1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.

(3) Assertion is true but Reason is false.

(4) Assertion is false but Reason is true.

Q15. The magnetic field at the centre of a circular coil of radius r , due to current I flowing through it, is B . The magnetic field at a point along the axis at a distance $\frac{r}{2}$ from the centre is :

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

(2) $2B$

(3) $\left(\frac{2}{\sqrt{5}}\right)^3 B$

(4) $\left(\frac{2}{\sqrt{3}}\right)^3 B$

Q16. A resistance of 40Ω is connected to a source of alternating current rated 220 V, 50 Hz. Find the time taken by the current to change from its maximum value to the rms value :

(1) 2.5 ms

(2) 1.25 ms

(3) 2.5 s

(4) 0.25 s

Q17. A plane electromagnetic wave travels in a medium of relative permeability 1.61 and relative permittivity 6.44.

If magnitude of magnetic intensity is $4.5 \times 10^{-2} \text{ A m}^{-1}$ at a point, what will be the approximate magnitude of electric field intensity at that point ?

(Given : Permeability of free space $\mu_0 = 4\pi \times 10^{-7} \text{ N A}^{-2}$, speed of light in vacuum $c = 3 \times 10^8 \text{ m s}^{-1}$)

(1) 16.96 V m^{-1}

(2) $2.25 \times 10^{-2} \text{ V m}^{-1}$

(3) 8.48 V m^{-1}

(4) $6.75 \times 10^6 \text{ V m}^{-1}$

Q18. Choose the correct option from the following options given below :

(1) In the ground state of Rutherford's model

(2) An atom has a nearly continuous mass

electrons are in stable equilibrium. While in

distribution in a Rutherford's model but has a

Thomson's model electrons always experience a net-force.

highly non-uniform mass distribution in Thomson's model

(3) A classical atom based on Rutherford's model is doomed to collapse.

(4) The positively charged part of the atom possesses most of the mass in Rutherford's model but not in Thomson's model.

Q19. Nucleus A is having mass number 220 and its binding energy per nucleon is 5.6 MeV. It splits in two fragments B and C of mass numbers 105 and 115. The binding energy of nucleons in B and C is 6.4 MeV per nucleon. The energy Q released per fission will be:

(1) 0.8 MeV

(2) 275 MeV

(3) 220 MeV

(4) 176 MeV

Q20. A baseband signal of 3.5 MHz frequency is modulated with a carrier signal of 3.5 GHz frequency using amplitude modulation method. What should be the minimum size of antenna required to transmit the modulated signal ?

(1) 42.8 m

(2) 42.8 mm

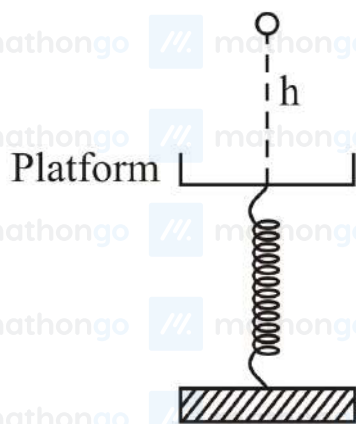
(3) 21.4 mm

(4) 21.4 m

Q21. From the top of a tower, a ball is thrown vertically upward which reaches the ground in 6 s. A second ball thrown vertically downward from the same position with the same speed reaches the ground in 1.5 s. A third

ball released, from the rest from the same location, will reach the ground in _____ s.

- Q22.** A ball of mass 100 g is dropped from a height $h = 10$ cm on a platform fixed at the top of a vertical spring (as shown in figure). The ball stays on the platform and the platform is depressed by a distance $\frac{h}{2}$. The spring constant is _____ N m^{-1}
(Use $g = 10 \text{ m s}^{-2}$)

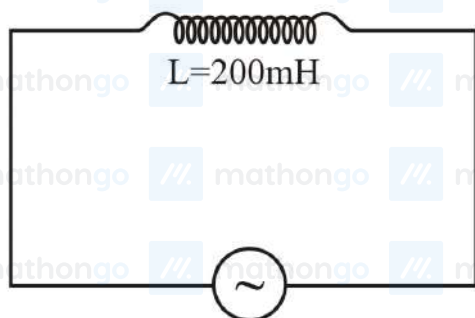


- Q23.** A metre scale is balanced on a knife edge at its centre. When two coins, each of mass 10 g are put one on the top of the other at the 10.0 cm mark the scale is found to be balanced at 40.0 cm mark. The mass of the metre scale is found to be $x \times 10^{-2}$ kg. The value of x is _____.

- Q24.** 0.056 kg of Nitrogen is enclosed in a vessel at a temperature of 127°C . The amount of heat required to double the speed of its molecules is _____ kcal.
(Take $R = 2 \text{ cal mole}^{-1} \text{ K}^{-1}$)

- Q25.** In a potentiometer arrangement, a cell gives a balancing point at 75 cm length of wire. This cell is now replaced by another cell of unknown emf. If the ratio of the emf's of two cells respectively is 3 : 2, the difference in the balancing length of the potentiometer wire in above two cases will be _____ cm.

- Q26.** As shown in the figure an inductor of inductance 200 mH is connected to an AC source of emf 220 V and frequency 50 Hz. The instantaneous voltage of the source is 0 V when the peak value of current is $\frac{\sqrt{a}}{\pi}$ A. The value of a is _____.



- Q27.** Two identical thin biconvex lenses of focal length 15 cm and refractive index 1.5 are in contact with each other. The space between the lenses is filled with a liquid of refractive index 1.25. The focal length of the

combination is _____ cm.

Q28. Sodium light of wavelengths 650 nm and 655 nm is used to study diffraction at a single slit of aperture 0.5 mm. The distance between the slit and the screen is 2.0 m. The separation between the positions of the first maxima of diffraction pattern obtained in the two cases is _____ $\times 10^{-5}$ m

Q29. When light of frequency twice the threshold frequency is incident on the metal plate, the maximum velocity of emitted electron is v_1 . When the frequency of incident radiation is increased to five times the threshold value, the maximum velocity of emitted electron becomes v_2 . If $v_2 = xv_1$, the value of x will be _____.

Q30. A transistor is used in common-emitter mode in an amplifier circuit. When a signal of 10 mV is added to the base-emitter voltage, the base current changes by $10\mu\text{A}$ and the collector current changes by 1.5 mA. The load resistance is $5\text{k}\Omega$. The voltage gain of the transistor will be _____.

Q31. If a rocket runs on a fuel ($\text{C}_{15}\text{H}_{30}$) and liquid oxygen, the weight of oxygen required and CO_2 released for every litre of fuel respectively are :

(Given : density of the fuel is 0.756 g/mL)

(1) 1188 g and 1296 g

(2) 2376 g and 2592 g

(3) 2592 g and 2376 g

(4) 3429 g and 3142 g

Q32. Consider the following pairs of electrons

(A) (a) $n = 3, l = 1, m_l = 1, m_s = +\frac{1}{2}$

(b) $n = 3, l = 2, m_l = 1, m_s = +\frac{1}{2}$

(B) (a) $n = 3, l = 2, m_l = -2, m_s = -\frac{1}{2}$

(b) $n = 3, l = 2, m_l = -1, m_s = -\frac{1}{2}$

(C) (a) $n = 4, l = 2, m_l = 2, m_s = +\frac{1}{2}$

(b) $n = 3, l = 2, m_l = 2, m_s = +\frac{1}{2}$

The pairs of electrons present in degenerate orbitals is/are

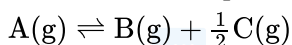
(1) Only (A)

(2) Only (B)

(3) Only (C)

(4) (B) and (C) both

Q33. For a reaction at equilibrium



the relation between dissociation constant (K), degree of dissociation (α) and equilibrium pressure (p) is given by :

(1) $K = \frac{\alpha^{\frac{3}{2}} p^{\frac{1}{2}}}{(2+\alpha)^{\frac{1}{2}} (1-\alpha)}$

(2) $K = \frac{\alpha^{\frac{1}{2}} p^{\frac{3}{2}}}{(1+\frac{3}{2}\alpha)^{\frac{1}{2}} (1-\alpha)}$

(3) $K = \frac{(\alpha p)^{\frac{3}{2}}}{(1+\frac{3}{2}\alpha)^{\frac{1}{2}} (1-\alpha)}$

(4) $K = \frac{(\alpha p)^{\frac{3}{2}}}{(1+\alpha)(1-\alpha)^{\frac{1}{2}}}$

Q34. The highest industrial consumption of molecular hydrogen is to produce compound of element :

(1) Carbon

(2) Oxygen

(3) Chlorine

(4) Nitrogen

Q35. Which of the following statements are correct ?

(A) Both LiCl and MgCl_2 are soluble in ethanol.

(B) The oxides Li_2O and MgO combine with excess of oxygen to give superoxide.

(C) LiF is less soluble in water than other alkali metal fluorides.

(D) Li_2O is more soluble in water than other alkali metal oxides.

Choose the most appropriate answer from the options given below

(1) (A) and (C) only

(2) (A), (C) and (D) only

(3) (B) and (C) only

(4) (A) and (D) only

Q36. Identify the correct statement for B_2H_6 from those given below.

(A) In B_2H_6 , all B – H bonds are equivalent.

(B) In B_2H_6 , there are four 3-centre- 2-electron bonds.

(C) B_2H_6 is a Lewis acid.

(D) B_2H_6 can be synthesized from both BF_3 and NaBH_4 .

(E) B_2H_6 is a planar molecule.

Choose the most appropriate answer from the options given below :

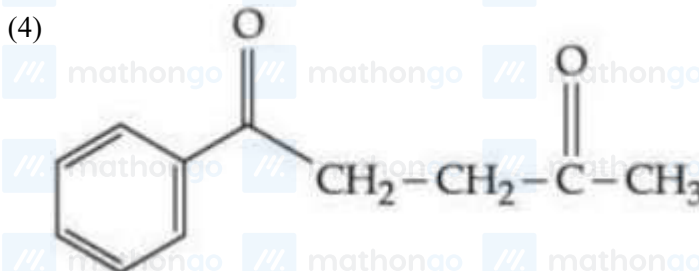
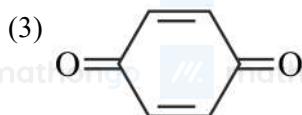
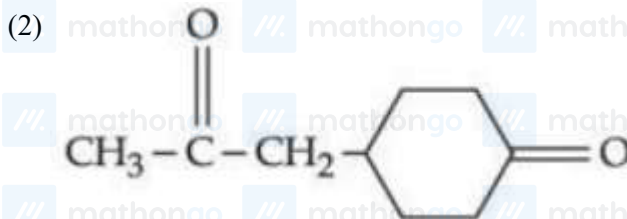
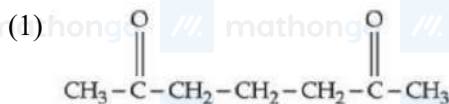
(1) (A) and (E) only

(2) (B), (C) and (E) only

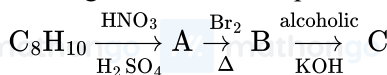
(3) (C) and (D) only

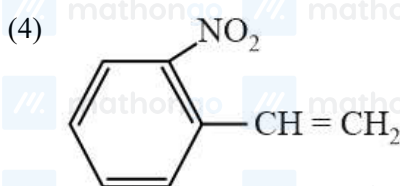
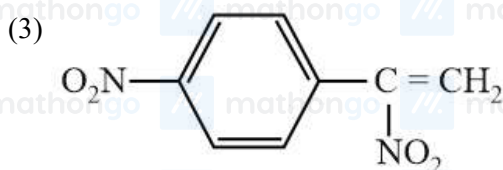
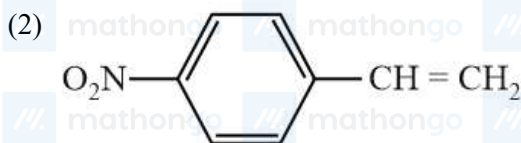
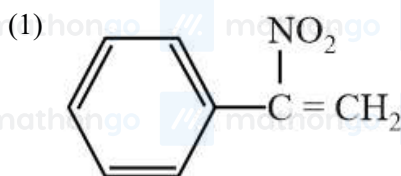
(4) (C) and (E) only

Q37. Which of the following is an example of conjugated diketone?



Q38. In the given reaction sequence, the major product 'C' is :





Q39. Given below are two statements:

Statement I : Emulsions of oil in water are unstable and sometimes they separate into two layers on standing.

Statement II : For stabilisation of an emulsion, excess of electrolyte is added.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q40. Match List - I with List - II :

List-I

- (A) Sphalerite
(B) Calamine
(C) Galena
(D) Siderite

List-II

- (I) FeCO_3
(II) PbS
(III) ZnCO_3
(IV) ZnS

Choose the most appropriate answer from the options given below :

- (1) (A) – (IV), (B) – (I), (C) – (II), (D) – (III) (2) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)
(3) (A) – (II), (B) – (II), (C) – (I), (D) – (IV) (4) (A) – (III), (B) – (IV), (C) – (II), (D) – (I)

Q41. Given below are the oxides :

Na_2O , As_2O_3 , N_2O , NO and Cl_2O_7 Number of amphoteric oxides is :

- (1) 0 (2) 1
(3) 2 (4) 3

Q42. The most stable trihalide of nitrogen is.

- (1) NF_3 (2) NCl_3
(3) NBr_3 (4) NI_3

Q43. Which one of the following elemental forms is not present in the enamel of the teeth?

- (1) Ca^{2+} (2) P^{3+}
(3) F^- (4) P^{5+}

Q44. Match List - I with List - II :

List-I

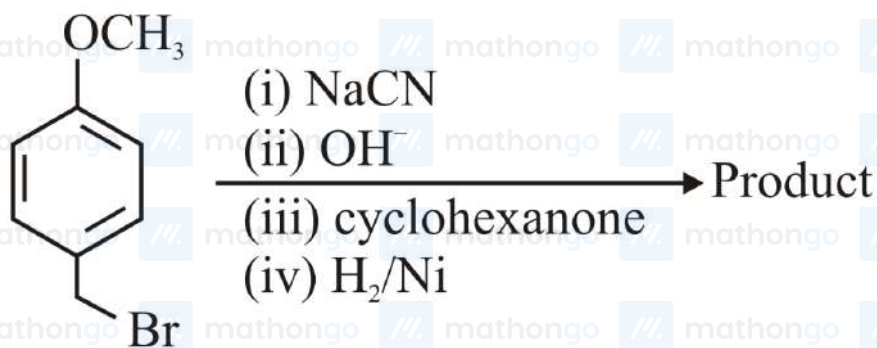
List-II

- | | |
|---------------------------------------|-------------------------------|
| (A) $[\text{PtCl}_4]^{2-}$ | (I) $\text{sp}^3 \text{d}$ |
| (B) BrF_5 | (II) $\text{d}^2 \text{sp}^3$ |
| (C) PCl_5 | (III) dsp^2 |
| (D) $[\text{Co}(\text{NH}_3)_6]^{3+}$ | (IV) $\text{sp}^3 \text{d}^2$ |

Choose the most appropriate answer from the options given below

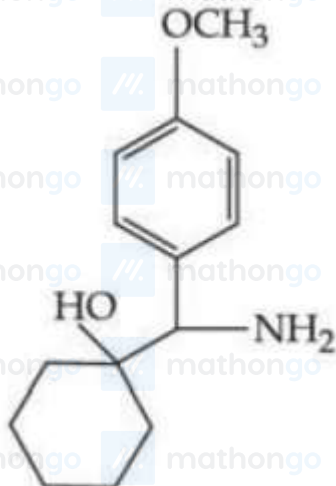
- (1) (A) – (II), (B) – (IV), (C) – (I), (D) – (III) (2) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)
- (3) (A) – (III), (B) – (I), (C) – (IV), (D) – (II) (4) (A) – (II), (B) – (I), (C) – (IV), (D) – (III)

Q45.

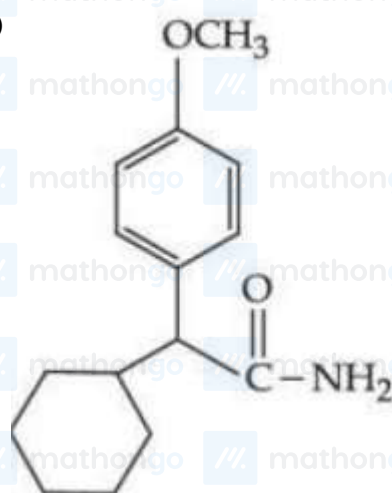


The major product of the above reactions is

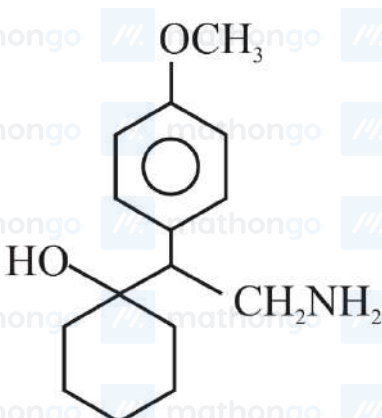
(1)



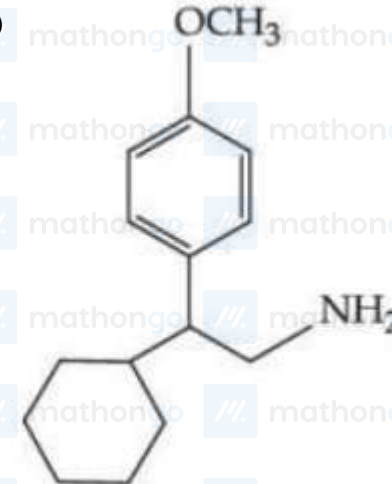
(2)



(3)



(4)



Q46. Two statements are given below :

Statement I : The melting point of monocarboxylic acid with even number of carbon atoms is higher than that of with odd number of carbon atoms acid immediately below and above it in the series.

Statement II : The solubility of monocarboxylic acids in water decreases with increase in molar mass.

Choose the most appropriate option :

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q47. Which of the following is an example of polyester?

- (1) Butadiene-styrene copolymer (2) Melamine polymer
(3) Neoprene (4) Poly- β -hydroxybutyrate-co- β -hydroxyvalerate

Q48. Which of the following is not a broad spectrum antibiotic?

- (1) Vancomycin (2) Penicillin G
(3) Ofloxacin (4) Ampicillin

Q49. During the qualitative analysis of salt with cation y^{2+} , addition of a reagent (X) to alkaline solution of the salt gives a bright red precipitate. The reagent (X) and the cation (y^{2+}) present respectively are :

- (1) Dimethylglyoxime and Ni^{2+} (2) Dimethylglyoxime and Co^{2+}
(3) Nessler's reagent and Hg^{2+} (4) Nessler's reagent and Ni^{2+}

Q50. A polysaccharide 'X' on boiling with dil H_2SO_4 at 393 K under 2 – 3 atm pressure yields 'Y'. 'Y' on treatment with bromine water gives gluconic acid. 'X' contains β -glycosidic linkages only. Compound 'X' is :

- (1) starch (2) cellulose
(3) amylose (4) amylopectin

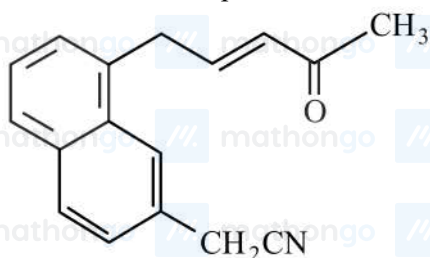
Q51. $2O_3(g) \rightleftharpoons 3O_2(g)$

At 300 K, ozone is fifty percent dissociated. The standard free energy change at this temperature and 1 atm pressure is (–)..... J mol^{-1} . (Nearest integer)

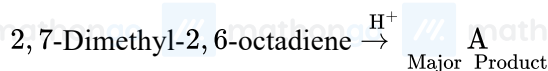
[Given: $\ln 1.35 = 0.3$ and $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

Q52. A 0.166 g sample of an organic compound was digested with conc. H_2SO_4 and then distilled with NaOH. The ammonia gas evolved was passed through 50.0 mL of 0.5 N H_2SO_4 . The used acid required 30.0 mL of 0.25 N NaOH for complete neutralization. The mass percentage of nitrogen in the organic compound is

Q53. Number of electrophilic centres in the given compound is ____



Q54. The major product 'A' of the following given reaction has sp^2 hybridized carbon atoms.



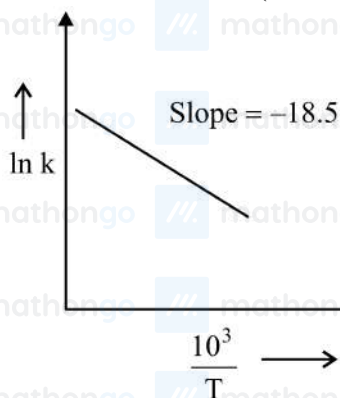
Q55. Atoms of element X form hcp lattice and those of element Y occupy $\frac{2}{3}$ of its tetrahedral voids. The percentage of element X in the lattice is (Nearest integer)

Q56. The osmotic pressure of blood is 7.47 bar at 300 K. To inject glucose to a patient intravenously, it has to be isotonic with blood. The concentration of glucose solution in g L^{-1} is (Molar mass of glucose = 180 g mol^{-1} , $R = 0.083 \text{ L bar}^{-1} \text{ mol}^{-1}$) (Nearest integer)

Q57. The cell potential for the following cell $\text{Pt}|\text{H}_2(\text{g})|\text{H}^+(\text{aq})||\text{Cu}^{2+}(0.01 \text{ M})|\text{Cu}(\text{s})$ is 0.576 V at 298 K. The pH of the solution is (Nearest integer)

(Given : $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ and $\frac{2.303RT}{F} = 0.06 \text{ V}$)

Q58. The rate constants for decomposition of acetaldehyde have been measured over the temperature range 700 – 1000 K. The data has been analysed by plotting $\ln k$ vs $\frac{10^3}{T}$ graph. The value of activation energy for the reaction is kJ mol^{-1} . (Nearest integer) (Given : $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)



Q59. The difference in oxidation state of chromium in chromate and dichromate salts is ____

Q60. In the cobalt-carbonyl complex : $[\text{Co}_2(\text{CO})_8]$, number of Co – Co bonds is "X" and terminal CO ligands is "Y". $X + Y =$ ____

Q61. If the sum of the squares of the reciprocals of the roots α and β of the equation $3x^2 + \lambda x - 1 = 0$ is 15, then $6(\alpha^3 + \beta^3)^2$ is equal to

(1) 46

(2) 36

(3) 24

(4) 18

Q62. Let $A = \{z \in \mathbb{C} : 1 \leq |z - (1 + i)| \leq 2\}$ and $B = \{z \in A : |z - (1 - i)| = 1\}$. Then, B

(1) is an empty set

(2) contains exactly two elements

(3) contains exactly three elements

(4) is an infinite set

Q63. If $\{a_i\}_{i=1}^n$, where n is an even integer, is an arithmetic progression with common difference 1, and

$\sum_{i=1}^n a_i = 192$, $\sum_{i=1}^{\frac{n}{2}} a_{2i} = 120$, then n is equal to

(1) 18

(2) 36

(3) 96

(4) 48

Q64. The remainder when 3^{2022} is divided by 5 is

- (1) 1 (2) 2
(3) 3 (4) 4

Q65. Let $S = \{\theta \in [-\pi, \pi] - \{\pm \frac{\pi}{2}\} : \sin \theta \tan \theta + \tan \theta = \sin 2\theta\}$. If $T = \sum_{\theta \in S} \cos 2\theta$, then $T + n(S)$ is equal to

- (1) $7 + \sqrt{3}$ (2) 5
(3) $8 + \sqrt{3}$ (4) 9

Q66. Let $x^2 + y^2 + Ax + By + C = 0$ be a circle passing through $(0, 6)$ and touching the parabola $y = x^2$ at $(2, 4)$.

Then $A + C$ is equal to _____

- (1) 16 (2) $\frac{88}{5}$
(3) 72 (4) -8

Q67. Let $\lambda x - 2y = \mu$ be a tangent to the hyperbola $a^2 x^2 - y^2 = b^2$. Then $(\frac{\lambda}{a})^2 - (\frac{\mu}{b})^2$ is equal to

- (1) -2 (2) -4
(3) 2 (4) 4

Q68. The number of choices for $\Delta \in \{\wedge, \vee, \Rightarrow, \Leftrightarrow\}$, such that $(p\Delta q) \Rightarrow ((p\Delta \sim q) \vee ((\sim p)\Delta q))$ is a tautology, is

- (1) 1 (2) 2
(3) 3 (4) 4

Q69.

Let $S = \{\sqrt{n} : 1 \leq n \leq 50 \text{ and } n \text{ is odd}\}$. Let $a \in S$ and $A = \begin{bmatrix} 1 & 0 & a \\ -1 & 1 & 0 \\ -a & 0 & 1 \end{bmatrix}$. If $\sum_{a \in S} \det(\text{adj } A) = 100\lambda$, then λ

is equal to

- (1) 218 (2) 221
(3) 663 (4) 1717

Q70. The number of values of α for which the system of equations

$$x + y + z = \alpha$$

$$\alpha x + 2\alpha y + 3z = -1$$

$$x + 3\alpha y + 5z = 4$$

is inconsistent, is

- (1) 0 (2) 1
(3) 2 (4) 3

Q71. The set of all values of k for which $(\tan^{-1} x)^3 + (\cot^{-1} x)^3 = k\pi^3, x \in R$, is the interval

- (1) $[\frac{1}{32}, \frac{7}{8})$ (2) $(\frac{1}{24}, \frac{13}{16})$
(3) $[\frac{1}{48}, \frac{13}{16}]$ (4) $[\frac{1}{32}, \frac{9}{8})$

Q72. The domain of $f(x) = \frac{\cos^{-1}(\frac{x^2-5x+6}{x^2-9})}{\log(x^2-3x+2)}$ is

- (1) $x \in [-\frac{1}{2}, 1) \cup (2, \infty) - \{3\}$ (2) $x \in [-\frac{1}{2}, 1] \cup (2, \infty) - \{3\}$
(3) $x \in (-\frac{1}{2}, 1) \cup [2, \infty) - \{3\}$ (4) $x \in [-\frac{1}{2}, 1) \cup [2, \infty) - \{3\}$

Q73. For the function $f(x) = 4 \log_e(x-1) - 2x^2 + 4x + 5, x > 1$, which one of the following is NOT correct?

(1) $f(x)$ is increasing in $(1, 2)$ and decreasing in $(2, \infty)$

(3) $f'(e) - f''(2) < 0$

(2) $f(x) = -1$ has exactly two solutions

(4) $f(x) = 0$ has a root in the interval $(e, e + 1)$

Q74. If the tangent at the point (x_1, y_1) on the curve $y = x^3 + 3x^2 + 5$ passes through the origin, then (x_1, y_1) does NOT lie on the curve

(1) $x^2 + \frac{y^2}{81} = 2$

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

(2) $\frac{y^2}{9} - x^2 = 8$

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

Q75. The sum of absolute maximum and absolute minimum values of the function

$f(x) = |2x^2 + 3x - 2| + \sin x \cos x$ in the interval $[0, 1]$ is

(1) $3 + \frac{\sin(1) \cos^2(\frac{1}{2})}{2}$

(3) $5 + \frac{1}{2}(\sin(1) + \sin(2))$

(2) $3 + \frac{1}{2}(1 + 2 \cos(1)) \sin(1)$

(4) $2 + \sin(\frac{1}{2}) \cos(\frac{1}{2})$

Q76. The surface area of a balloon of spherical shape being inflated, increases at a constant rate. If initially, the radius of balloon is 3 units and after 5 seconds, it becomes 7 units, then its radius after 9 seconds is

(1) 9

(3) 5

(2) 7

(4) 3

Q77. If $x = x(y)$ is the solution of the differential equation $y \frac{dx}{dy} = 2x + y^3(y + 1)e^y$, $x(1) = 0$; then $x(e)$ is equal to

(1) $e^e(e^3 - 1)$

(3) $e^e - 1$

(2) $e^3(e^e - 1)$

(4) $e^e(e^2 - 1)$

Q78. Let \hat{a}, \hat{b} be unit vectors. If \vec{c} be a vector such that the angle between \hat{a} and \vec{c} is $\frac{\pi}{12}$, and $\hat{b} = \vec{c} + 2(\vec{c} \times \hat{a})$, then

$|\vec{c}|^2$ is equal to:

(1) $6(3 - \sqrt{3})$

(3) $3 + \sqrt{3}$

(2) $6(3 + \sqrt{3})$

(4) $6(\sqrt{3} + 1)$

Q79. Bag A contains 2 white, 1 black and 3 red balls and bag B contains 3 black, 2 red and n white balls. One bag is chosen at random and 2 balls drawn from it at random are found to be 1 red and 1 black. If the probability that both balls come from Bag A is $\frac{6}{11}$, then n is equal to _____

(1) 13

(3) 4

(2) 6

(4) 3

Q80. If a random variable X follows the Binomial distribution $B(33, p)$ such that $3P(X = 0) = P(X = 1)$, then the value of $\frac{P(X=15)}{P(X=18)} - \frac{P(X=16)}{P(X=17)}$ is equal to

(1) 1320

(3) $\frac{1088}{1089}$

(2) 1088

(4) $\frac{120}{1331}$

Q81. In an examination, there are 5 multiple choice questions with 3 choices, out of which exactly one is correct.

There are 3 marks for each correct answer, -2 marks for each wrong answer and 0 mark if the question is not attempted. Then, the number of ways a student appearing in the examination gets 5 marks is _____

Q82. Let $A\left(\frac{3}{\sqrt{a}}, \sqrt{a}\right)$, $a > 0$, be a fixed point in the xy -plane. The image of A in y -axis be B and the image of B in x -axis be C . If $D(3 \cos \theta, a \sin \theta)$, is a point in the fourth quadrant such that the maximum area of $\triangle ACD$ is 12 square units, then a is equal to _____

Q83. If two tangents drawn from a point (α, β) lying on the ellipse $25x^2 + 4y^2 = 1$ to the parabola $y^2 = 4x$ are such that the slope of one tangent is four times the other, then the value of $(10\alpha + 5)^2 + (16\beta^2 + 50)^2$ equals _____

Q84. The number of one-one functions $f : \{a, b, c, d\} \rightarrow \{0, 1, 2, \dots, 10\}$ such that

$$2f(a) - f(b) + 3f(c) + f(d) = 0$$
 is _____

Q85. The number of points where the function $f(x) = \begin{cases} 2x^2 - 3x - 7 & \text{if } x \leq -1 \\ [4x^2 - 1] & \text{if } -1 < x < 1, \text{ where } [t] \text{ denotes the} \\ |x + 1| + |x - 2| & \text{if } x \geq 1 \end{cases}$ greatest integer $\leq t$, is discontinuous is _____

Q86. If $f(\theta) = \sin \theta + \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} (\sin \theta + t \cos \theta) \cdot f(t) dt$, then $\left| \int_0^{\frac{\pi}{2}} f(\theta) d\theta \right|$ is _____

Q87. Let $\text{Max}_{0 \leq x \leq 2} \left\{ \frac{9-x^2}{5-x} \right\} = \alpha$ and $\text{Min}_{0 \leq x \leq 2} \left\{ \frac{9-x^2}{5-x} \right\} = \beta$. If $\int_{\beta-\frac{8}{3}}^{2\alpha-1} \text{Max} \left\{ \frac{9-x^2}{5-x}, x \right\} dx = \alpha_1 + \alpha_2 \log_e \left(\frac{8}{15} \right)$, then $\alpha_1 + \alpha_2$ is equal to _____

Q88. Let S be the region bounded by the curves $y = x^3$ and $y^2 = x$. The curve $y = 2|x|$ divides S into two regions of areas R_1 and R_2 . If $\max |R_1, R_2| = R_2$, then $\frac{R_2}{R_1}$ is equal to _____

Q89. Let a line having direction ratios 1, -4, 2 intersect the lines $\frac{x-7}{3} = \frac{y-1}{-1} = \frac{z+2}{1}$ and $\frac{x}{2} = \frac{y-7}{3} = \frac{z}{1}$ at the points A and B . Then $(AB)^2$ is equal to _____

Q90. If the shortest distance between the lines $\vec{r} = (-\hat{i} + 3\hat{k}) + \lambda(\hat{i} - a\hat{j})$ and $\vec{r} = (-\hat{j} + 2\hat{k}) + \mu(\hat{i} - \hat{j} + \hat{k})$ is $\sqrt{\frac{2}{3}}$, then the integral value of a is equal to _____

ANSWER KEYS

1. (4)	2. (4)	3. (3)	4. (1)	5. (1)	6. (2)	7. (2)	8. (2)
9. (2)	10. (1)	11. (2)	12. (4)	13. (3)	14. (1)	15. (3)	16. (1)
17. (3)	18. (3)	19. (4)	20. (3)	21. (3)	22. (120)	23. (6)	24. (12)
25. (25)	26. (242)	27. (10)	28. (3)	29. (2)	30. (750)	31. (3)	32. (2)
33. (1)	34. (4)	35. (1)	36. (3)	37. (3)	38. (2)	39. (3)	40. (2)
41. (2)	42. (1)	43. (2)	44. (2)	45. (3)	46. (4)	47. (4)	48. (2)
49. (1)	50. (2)	51. (747)	52. (63)	53. (3)	54. (2)	55. (43)	56. (54)
57. (5)	58. (154)	59. (0)	60. (7)	61. (3)	62. (4)	63. (3)	64. (4)
65. (4)	66. (1)	67. (4)	68. (2)	69. (2)	70. (2)	71. (1)	72. (1)
73. (3)	74. (4)	75. (2)	76. (1)	77. (2)	78. (2)	79. (3)	80. (1)
81. (40)	82. (8)	83. (2929)	84. (31)	85. (7)	86. (1)	87. (34)	88. (19)
89. (84)	90. (2)						

Q1. Two buses P and Q start from a point at the same time and move in a straight line and their positions are represented by $x_{Pt} = \alpha t + \beta t^2$ and $x_{Qt} = ft - t^2$. At what time, both the buses have same velocity ?

- (1) $\frac{\alpha - f}{1 + \beta}$ (2) $\frac{\alpha + f}{2\beta - 1}$
 (3) $\frac{\alpha + f}{21 + \beta}$ (4) $\frac{f - \alpha}{21 + \beta}$

Q2. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Two identical balls A and B thrown with same velocity ' u ' at two different angles with horizontal attained the same range R . If A and B reached the maximum height h_1 and h_2 respectively, then $R = 4\sqrt{h_1 h_2}$

Reason R: Product of said heights. $h_1 h_2 = \frac{u^2 \sin^2 \theta}{2g} \cdot \frac{u^2 \cos^2 \theta}{2g}$

- (1) Both A and R are true and R is the correct explanation of A. (2) Both A and R are true but R is NOT the correct explanation of A.
 (3) A is true but R is false. (4) A is false but R is true.

Q3. A disc with a flat small bottom beaker placed on it at a distance R from its center is revolving about an axis passing through the center and perpendicular to its plane with an angular velocity ω . The coefficient of static friction between the bottom of the beaker and the surface of the disc is μ . The beaker will revolve with the disc if :

- (1) $R \leq \frac{\mu g}{2\omega^2}$ (2) $R \leq \frac{\mu g}{\omega^2}$
 (3) $R \geq \frac{\mu g}{2\omega^2}$ (4) $R \geq \frac{\mu g}{\omega^2}$

Q4. For a particle in uniform circular motion, the acceleration \vec{a} at any point PR, θ on the circular path of radius R is (when θ is measured from the positive x -axis and v is uniform speed):

- (1) $-\frac{v^2}{R} \sin \theta \hat{i} + \frac{v^2}{R} \cos \theta \hat{j}$ (2) $-\frac{v^2}{R} \cos \theta \hat{i} + \frac{v^2}{R} \sin \theta \hat{j}$
 (3) $-\frac{v^2}{R} \cos \theta \hat{i} - \frac{v^2}{R} \sin \theta \hat{j}$ (4) $-\frac{v^2}{R} \hat{i} + \frac{v^2}{R} \hat{j}$

Q5. A solid metallic cube having total surface area 24 m^2 is uniformly heated. If its temperature is increased by 10°C , calculate the increase in volume of the cube. (Given $\alpha = 5.0 \times 10^{-4} \text{ }^\circ\text{C}^{-1}$).

- (1) $2.4 \times 10^6 \text{ cm}^3$ (2) $1.2 \times 10^5 \text{ cm}^3$
 (3) $6 \times 10^4 \text{ cm}^3$ (4) $4.8 \times 10^5 \text{ cm}^3$

Q6. A copper block of mass 5.0 kg is heated to a temperature of 500°C and is placed on a large ice block. What is the maximum amount of ice that can melt?

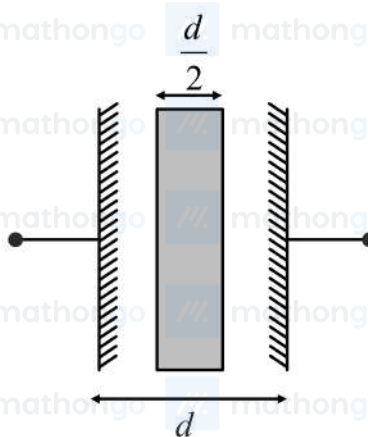
[Specific heat of copper : $0.39 \text{ Jg}^{-1} \text{ }^\circ\text{C}^{-1}$ and latent heat of fusion of water : 335 Jg^{-1}]

- (1) 1.5 kg (2) 5.8 kg
 (3) 2.9 kg (4) 3.8 kg

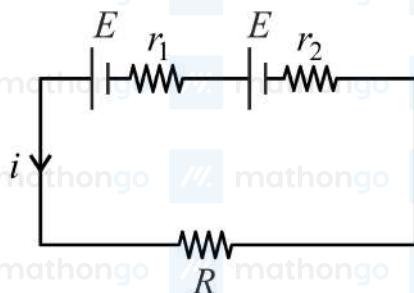
Q7. The ratio of specific heats $\frac{C_p}{C_v}$ in terms of degree of freedom f is given by :

- (1) $1 + \frac{f}{3}$ (2) $1 + \frac{2}{f}$
 (3) $1 + \frac{f}{2}$ (4) $1 + \frac{1}{f}$

Q8. Two metallic plates form a parallel plate capacitor. The distance between the plate is ' d '. A metal sheet of thickness $\frac{d}{2}$ and of area equal to area of each plate is introduced between the plates. What will be the ratio of the



(4) 4:1

$$E \quad E$$


- (4) $r_1 + r_2$

$$(4) \frac{\frac{G+S}{nKS}}{S}$$

Choose the correct answer from the options given below

- (4) Statement- I is false but Statement - II is true.

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

(2) $4B$
(4) B

Q13. A sinusoidal voltage $Vt = 210\sin 3000t$ volt is applied to a series LCR circuit in which

$L = 10 \text{ mH}$, $C = 25 \text{ } \mu\text{F}$ and $R = 100\Omega$. The phase difference ϕ between the applied voltage and resultant current will be

(1) $\tan^{-1} 0.17$
(3) $\tan^{-1} 0.30$

(2) $\tan^{-1} 9.46$
(4) $\tan^{-1} 13.33$

Q14. The electromagnetic waves travel in a medium at a speed of $2.0 \times 10^8 \text{ m s}^{-1}$. The relative permeability of the medium is 1.0. The relative permittivity of the medium will be

(1) 2.25
(3) 6.25

(2) 4.25
(4) 8.25

Q15. The interference pattern is obtained with two coherent light sources of intensity ratio 4:1. And the ratio

$\frac{I_{\max} + I_{\min}}{I_{\max} - I_{\min}}$ is $\frac{5}{x}$. Then, the value of x will be equal to :

(1) 3
(3) 2

(2) 4
(4) 1

Q16. A light whose electric field vectors are completely removed by using a good polaroid, allowed to incident on the surface of the prism at Brewster's angle. Choose the most suitable option for the phenomenon related to the prism.

(1) Reflected and refracted rays will be perpendicular to each other.

(2) Wave will propagate along the surface of prism.

(3) No refraction, and there will be total reflection of light.

(4) No reflection. and there will be total transmission of light.

Q17. A proton, a neutron, an electron and an α -particle have same energy. If $\lambda_p, \lambda_n, \lambda_e$ and λ_α are the de Broglie's wavelengths of proton, neutron, electron and α particle respectively, then choose the correct relation from the following

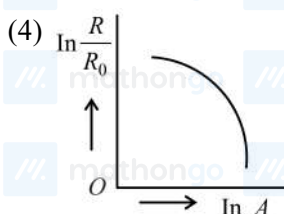
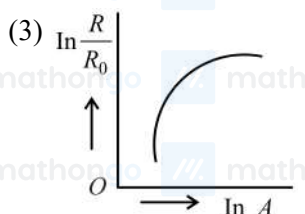
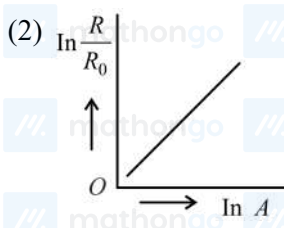
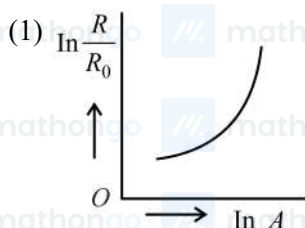
(1) $\lambda_p = \lambda_n > \lambda_e > \lambda_\alpha$

(2) $\lambda_\alpha < \lambda_n < \lambda_p < \lambda_e$

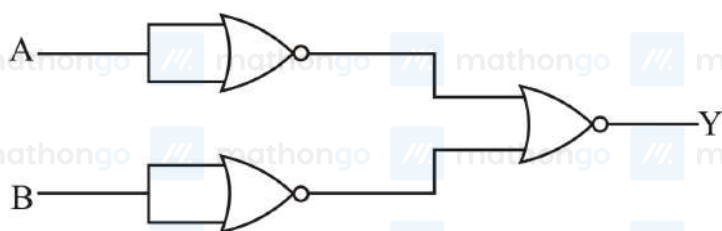
(3) $\lambda_e < \lambda_p = \lambda_n > \lambda_\alpha$

(4) $\lambda_e = \lambda_p = \lambda_n = \lambda_\alpha$

Q18. Which of the following figure represents the variation of $\ln \frac{R}{R_0}$ with $\ln A$ (if R = radius of a nucleus and A = its mass number)



Q19. Identify the logic operation performed by the given circuit



(1) AND gate

(2) OR gate

(3) NOR gate

(4) NAND gate

Q20. Match List I with List II

List I

- (A) Facsimile
- (B) Guided media Channel
- (C) Frequency Modulation
- (D) Digital Signal

List II

- (I) Static Document Image
- (II) Local Broadcast Radio
- (III) Rectangular wave
- (IV) Optical Fiber

Choose the correct answer from the following options

(1) A - IV, B - III, C - II, D - I

(2) A - I, B - IV, C - II, D - III

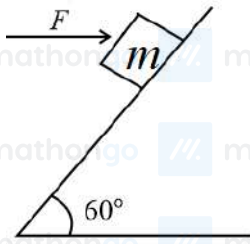
(3) A - IV, B - II, C - III, D - I

(4) A - I, B - II, C - III, D - IV

Q21. For $z = a^2 x^3 y^{\frac{1}{2}}$, where 'a' is a constant. If percentage error in measurement of 'x' and 'y' are 4% and 12%, respectively, then the percentage error for 'z' will be ____ %.

Q22. A curved in a level road has a radius 75 m. The maximum speed of a car turning this curved road can be 30 m s^{-1} without skidding. If radius of curved road is changed to 48 m and the coefficient of friction between the tyres and the road remains same, then maximum allowed speed would be ____ m s^{-1} .

Q23. A block of mass 200 g is kept stationary on a smooth inclined plane by applying a minimum horizontal force $F = \sqrt{x}$ N as shown in figure.



The value of $x =$ ____.

Q24. Moment of Inertia (M.I.) of four bodies having same mass M and radius $2R$ are as follows

$I_1 =$ M.I. of solid sphere about its diameter

$I_2 =$ M.I. of solid cylinder about its axis

$I_3 =$ M.I. of solid circular disc about its diameter

$I_4 =$ M.I. of thin circular ring about its diameter

If $2I_2 + I_3 + I_4 = xI_1$ then the value of x will be ____.

Q25. Two satellites S_1 and S_2 are revolving in circular orbits around a planet with radius $R_1 = 3200$ km and

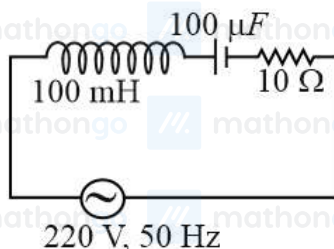
$R_2 = 800$ km respectively. The ratio of speed of satellite S_1 to the speed of satellite S_2 in their respective orbits would be $\frac{1}{x}$ where $x =$ ____.

Q26. When a gas filled in a closed vessel is heated by raising the temperature by 1°C , its pressure increases by 0.4%. The initial temperature of the gas is ____ K.

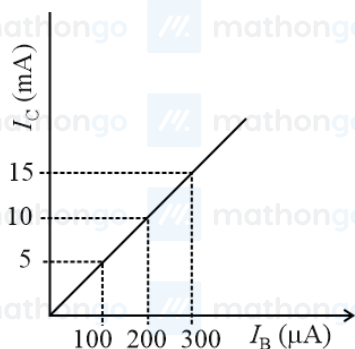
Q27. 27 identical drops are charged at 22 V each. They combine to form a bigger drop. The potential of the bigger drop will be ____ V.

Q28. The length of a given cylindrical wire is increased to double of its original length. The percentage increase in the resistance of the wire will be ____ %

Q29. In a series LCR circuit, the inductance, capacitance and resistance are $L = 100$ mH, $C = 100$ μF and $R = 10$ Ω respectively. They are connected to an AC source of voltage 220 V and frequency of 50 Hz. The approximate value of current in the circuit will be ____ A.



Q30. In an experiment of CE configuration of $n - p - n$ transistor, the transfer characteristics are observed as given in figure.



If the input resistance is 200Ω and output resistance is 60Ω , the voltage gain in this experiment will be _____.

Q31. The minimum energy that must be possessed by photons in order to produce the photoelectric effect with platinum metal is:

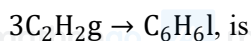
[Given: The threshold frequency of platinum is $1.3 \times 10^{15} \text{ s}^{-1}$ and $h = 6.6 \times 10^{-34} \text{ Js}$]

- (1) $8.58 \times 10^{-19} \text{ J}$ (2) $9.76 \times 10^{-20} \text{ J}$
 (3) $3.21 \times 10^{-14} \text{ J}$ (4) $6.24 \times 10^{-16} \text{ J}$

Q32. What is the correct order of electron gain enthalpy of Cl, F, Te, Po

- (1) $\text{F} > \text{Cl} > \text{Te} > \text{Po}$ (2) $\text{Cl} > \text{F} > \text{Te} > \text{Po}$
 (3) $\text{Te} > \text{Po} > \text{Cl} > \text{F}$ (4) $\text{Po} > \text{Te} > \text{F} > \text{Cl}$

Q33. At 25°C and 1 atm pressure, the enthalpy of combustion of benzene and acetylene are $-3268 \text{ kJ mol}^{-1}$ and $-1300 \text{ kJ mol}^{-1}$, respectively. The change in enthalpy for the reaction



- (1) $+324 \text{ kJ mol}^{-1}$ (2) $+632 \text{ kJ mol}^{-1}$
 (3) -632 kJ mol^{-1} (4) -732 kJ mol^{-1}

Q34. The K_{sp} for bismuth sulphide Bi_2S_3 is 1.08×10^{-73} . The solubility of Bi_2S_3 in mol L^{-1} at 298 K is

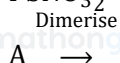
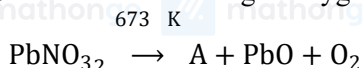
- (1) 1.0×10^{-15} (2) 2.7×10^{-12}
 (3) 3.2×10^{-10} (4) 4.2×10^{-8}

Q35. Assertion: The amphoteric behaviour of water is explained by Lewis acid base theory

Reason: water acts as acid with NH_3 and base with H_2S

- (1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
 (2) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
 (3) Assertion is true but Reason is false.
 (4) Assertion is false but Reason is true.

Q36. The number of bridged oxygen atoms present in compound B formed from the following reactions is



- (1) 0 (2) 1
 (3) 2 (4) 3

Q37. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason.

Assertion: A mixture contains benzoic acid and naphthalene. The pure benzoic acid can be separated out by the use of benzene.

Reason: Benzoic acid is soluble in hot water.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(3) Assertion is true but Reason is false.
(4) Assertion is false but Reason is true.

Q38. Given below are two statements: one is labelled as Assertion and the other is labelled as Reason.

Assertion: Polluted water may have a value of BOD of the order of 17ppm.

Reason: BOD is a measure of oxygen required to oxidise both the biodegradable and non-biodegradable organic material in water.

In the light of the above statements, choose the *most appropriate* answer from the options given below.

- (1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) Both Assertion and Reason are true but Reason is NOT the correct explanation of Assertion.
(3) Assertion is true but Reason is false.
(4) Assertion is false but Reason is true.

Q39. Solute A associates in water. When 0.7 g of solute A is dissolved in 42.0 g of water, it depresses the freezing point by 0.2 °C. The percentage association of solute A in water, is

[Given: Molar mass of A = 93 g mol⁻¹. Molal depression constant of water is 1.86 K kg mol⁻¹]

- (1) 50%
(2) 60%
(3) 70%
(4) 80%

Q40. The correct order of reduction potentials of the following pairs is

A. Cl₂ / Cl⁻

B. I₂ / I⁻

C. Ag⁺ / Ag

D. Na⁺ / Na

E. Li⁺ / Li

Choose the correct answer from the options given below.

- (1) A > B > C > E > D
(2) A > C > B > E > D
(3) A > B > C > D > E
(4) A > C > B > D > E

Q41. Given below are two statements.

Statement I: During electrolytic refining, blister copper deposits precious metals.

Statement II: In the process of obtaining pure copper by electrolysis method, copper blister is used to make the anode.

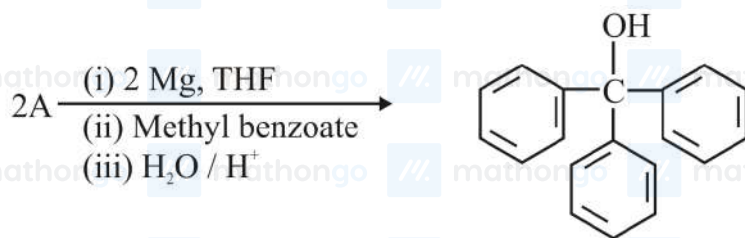
In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Statement I and Statement II are true.
(2) Both Statement I and Statement II are false.
(3) Statement I is true but Statement II is false.
(4) Statement I is false but Statement II is true.

Q42. The metal ion (in gaseous state) with lowest spin-only magnetic moment value is

- (1) V²⁺
(2) Ni²⁺
(3) Cr²⁺
(4) Fe²⁺

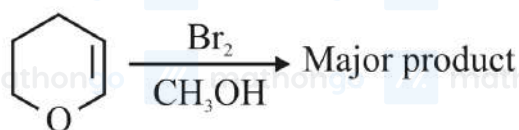
Q43. In the given reaction

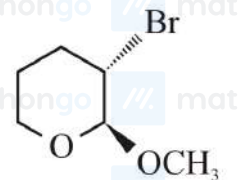
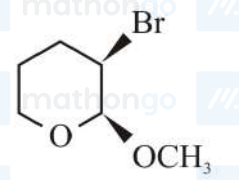
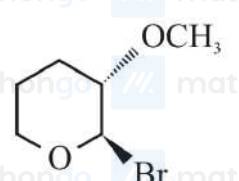
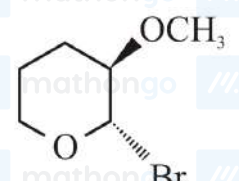


'A' can be

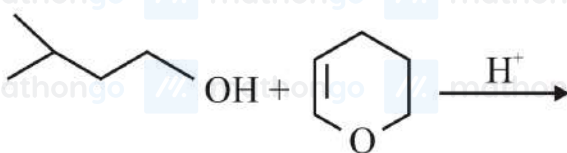
- (1) benzyl bromide (2) bromobenzene
(3) cyclohexyl bromide (4) methyl bromide

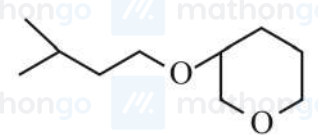
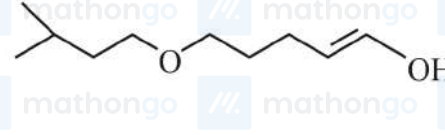
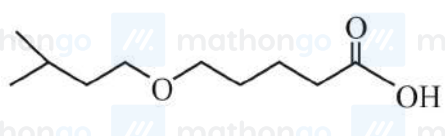
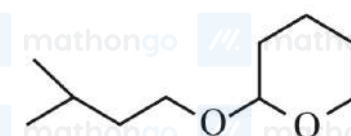
Q44. Amongst the following, the major product of the given chemical reaction is



- (1)  (2) 
(3)  (4) 

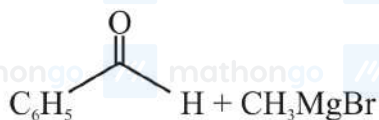
Q45. The major product formed in the following reaction, is



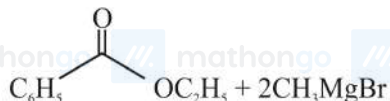
- (1)  (2) 
(3)  (4) 

Q46. Which of the following conditions or reaction sequence will NOT give acetophenone as the major product?

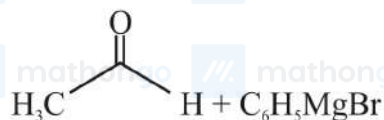
(1) (a)

(b) $\text{Na}_2\text{Cr}_2\text{O}_7, \text{H}^+$

(3)



(2) (a)



(b) PCC, DCM

(4)

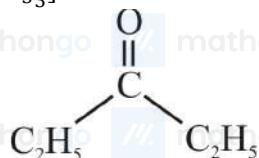


Q47. During halogen test, sodium fusion extract is boiled with concentrated HNO_3 to

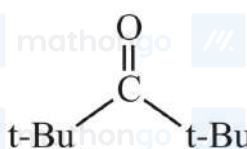
- (1) remove unreacted sodium
- (2) decompose cyanide or sulphide of sodium
- (3) extract halogen from organic compound
- (4) maintain the pH of extract.

Q48. Which of the following ketone will NOT give enamine on treatment with secondary amines? [where t - Bu is $-\text{CCH}_3$]

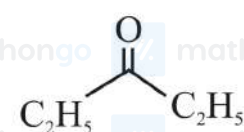
(1)



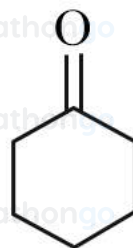
(2)



(3)



(4)



Q49. Match the following correctly

- | | |
|------------------------------------|------------------------------------|
| (i) Zymase | (a) Stomach |
| (ii) Urease | (b) Yeast |
| (iii) Diastase | (c) Malt |
| (iv) Pepsin | (d) Soyabean |
| (1) (i)-B; (ii) D(iii)-C; (iv)-A | (2) (i)-B; (ii)-A; (iii)-C; (iv)-D |
| (3) (i)-A; (ii)-B; (iii)-C; (iv)-D | (4) (i)-D; (ii)-C; (iii)-B; (iv)-A |

Q50. An antiseptic dettol is a mixture of two compounds 'A' and 'B' where A has 6π electrons and B has 2π electrons. What is B?

- (1) Bithional
- (2) Terpineol
- (3) Chlorophenol
- (4) Chloroxyenol

Q51. A protein 'A' contains 0.30% of glycine (molecular weight 75). The minimum molar mass of the protein 'A' is $____ \times 10^3 \text{ g mol}^{-1}$ [nearest integer]

Q52. How many of the following molecules are with non-zero net dipole moment,



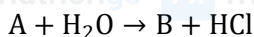
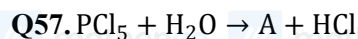
Q53. A rigid nitrogen tank stored inside a laboratory has a pressure of 30 atm at 06:00 am when the temperature is 27°C . At 03:00pm, when the temperature is 45°C , the pressure in the tank will be _____ atm. [nearest integer]

Q54. The neutralization occurs when 10 mL of 0.1 M acid 'A' is allowed to react with 30 mL of 0.05 M base MOH_2 . The basicity of the acid 'A' is [M is a metal]

Q55. A solution of Fe_2SO_4 is electrolyzed for 'x' min with a current of 1.5 A to deposit 0.3482 g of Fe. The value of x is - [nearest integer]

Given : $1 \text{ F} = 96500 \text{ C mol}^{-1}$. Atomic mass of Fe = 56 g mol^{-1}

Q56. At 345 K, the half life for the decomposition of a sample of a gaseous compound initially at 55.5 kPa was 340 s. When the pressure was 27.8 kPa, the half life was found to be 170 s. The order of the reaction is - [integer answer]



Find number of ionisable hydrogen in B

Q58. Amongst $\text{FeCl}_3 \cdot 3\text{H}_2\text{O}$, K_3FeCN_6 and CoNH_3Cl_3 , the spin-only magnetic moment value of the inner-orbital complex that absorbs light at shortest wavelength is B.M. [nearest integer]

Q59. The Novolac polymer has mass of 963 g. The number of monomer units present in it are

Q60. How many of the given compounds will give a positive Biuret test _____?

Glycine, Glycylalanine, Tripeptide, Biuret

Q61. Let $A = \{x \in \mathbb{R} : x + 1 < 2\}$ and $B = \{x \in \mathbb{R} : x - 1 \geq 2\}$. Then which one the following statements is NOT true?

(1) $A - B = -1, 1$

(2) $B - A = \mathbb{R} - 3, 1$

(3) $A \cap B = (-3, -1]$

(4) $A \cup B = \mathbb{R} - [1, 3)$

Q62. Let $a, b \in \mathbb{R}$ be such that the equation $ax^2 - 2bx + 15 = 0$ has repeated root α and if α and β are the roots of the equation $x^2 - 2bx + 21 = 0$, then $\alpha^2 + \beta^2$ is equal to:

(1) 37

(2) 58

(3) 68

(4) 92

Q63. Let z_1 and z_2 be two complex numbers such that $\bar{z}_1 = iz_2$ and $\arg \frac{z_1}{z_2} = \pi$, then the argument of z_1 is

(1) $\arg z_2 = \frac{\pi}{4}$

(2) $\arg z_2 = -\frac{3\pi}{4}$

(3) $\arg z_1 = \frac{\pi}{4}$

(4) $\arg z_1 = -\frac{3\pi}{4}$

Q64. The sum $1 + 2 \cdot 3 + 3 \cdot 3^2 + \dots + 10 \cdot 3^9$ is equal to

$$(1) \frac{2 \cdot 3^{12} + 10}{5 \cdot 3^{10} - 2}$$

$$(2) \frac{19 \cdot 3^{10} + 1}{9 \cdot 3^{10} + 1}$$

Q65. The coefficient of x^{101} in the expression

$$5 + x^{500} + x^5 + x^{499} + x^{25} + x^{498} + \dots + x^{500}, x > 0 \text{ is}$$

$$(1) {}^{501}C_{101} \times 5^{399}$$

$$(2) {}^{501}C_{101} \times 5^{400}$$

$$(3) {}^{501}C_{100} \times 5^{400}$$

$$(4) {}^{500}C_{101} \times 5^{399}$$

Q66. The value of $2\sin 12^\circ - \sin 72^\circ$ is

$$(1) \frac{\sqrt{51} - \sqrt{3}}{4}$$

$$(2) \frac{1 - \sqrt{5}}{8}$$

$$(3) \frac{\sqrt{31} - \sqrt{5}}{2}$$

$$(4) \frac{\sqrt{31} - \sqrt{5}}{4}$$

Q67. A circle touches both the y -axis and the line $x + y = 0$. Then the locus of its center

$$(1) y = \sqrt{2}x$$

$$(2) x = \sqrt{2}y..$$

$$(3) y^2 - x^2 = 2xy$$

$$(4) x^2 - y^2 = 2xy$$

Q68. The line $y = x + 1$ meets the ellipse $\frac{x^2}{4} + \frac{y^2}{2} = 1$ at two points P and Q . If r is the radius of the circle with PQ as diameter then $3r^2$ is equal to

$$(1) 20$$

$$(2) 12$$

$$(3) 11$$

$$(4) 8$$

Q69. $\lim_{x \rightarrow \frac{\pi}{2}} \tan^2 x \sin^2 x + 3 \sin x + 4^{\frac{1}{2}} - \sin^2 x + 6 \sin x + 2^{\frac{1}{2}}$ is equal to

$$(1) \frac{1}{12}$$

$$(2) -\frac{1}{18}$$

$$(3) -\frac{1}{12}$$

$$(4) \frac{1}{6}$$

Q70. The negation of the Boolean expression $\sim q \wedge p \Rightarrow \sim p \vee q$ is logically equivalent to

$$(1) p \Rightarrow q$$

$$(2) q \Rightarrow p$$

$$(3) \sim p \Rightarrow q$$

$$(4) \sim q \Rightarrow p$$

Q71. The system of equations

$$-kx + 3y - 14z = 25$$

$$-15x + 4y - kz = 3$$

$$-4x + y + 3z = 4$$

Question: is consistent for all k in the set

$$(1) R$$

$$(2) R - -11, 13$$

$$(3) R - -13$$

$$(4) R - -11, 11$$

Q72. The value of $\tan^{-1} \frac{\cos \frac{15\pi}{4} - 1}{\sin \frac{\pi}{4}}$ is equal to

$$(1) -\frac{\pi}{4}$$

$$(2) -\frac{\pi}{8}$$

$$(3) -\frac{5\pi}{12}$$

$$(4) -\frac{4\pi}{9}$$

Q73. Water is being filled at the rate of $1 \text{ cm}^3 \text{ sec}^{-1}$ in a right circular conical vessel (vertex downwards) of height 35cm and diameter 14cm. When the height of the water level is 10cm, the rate (in $\text{cm}^2 \text{ sec}^{-1}$) at which the

wet conical surface area of the vessel increases is

- (1) 5
(2) $\frac{\sqrt{21}}{5}$
(3) $\frac{\sqrt{26}}{5}$
(4) $\frac{\sqrt{26}}{10}$

Q74. If the line $y = 4 + kx$, $k > 0$, is the tangent to the parabola $y = x - x^2$ at the point P and V is the vertex of the parabola, then the slope of the line through P and V is

- (1) $\frac{3}{2}$
(2) $\frac{26}{9}$
(3) $\frac{5}{2}$
(4) $\frac{23}{6}$

Q75. If the angle made by the tangent at the point x_0, y_0 on the curve $x = 12t + \sin t \cos t$, $y = 12t + \sin^2 t$, $0 < t < \frac{\pi}{2}$, with the positive x -axis is $\frac{\pi}{3}$, then y_0 is equal to

- (1) $63 + 2\sqrt{2}$
(2) $37 + 4\sqrt{3}$
(3) 27
(4) 48

Q76. If $b_n = \int_0^{\frac{\pi}{2}} \frac{\cos^2 nx}{\sin x} dx$, $n \in \mathbb{N}$, then

- (1) $b_3 - b_2, b_4 - b_3, b_5 - b_4$ are in an A.P. with common difference -2
(2) $\frac{1}{b_3 - b_2}, \frac{1}{b_4 - b_3}, \frac{1}{b_5 - b_4}$ are in an A.P. with common difference 2
(3) $b_3 - b_2, b_4 - b_3, b_5 - b_4$ are in a G.P.
(4) $\frac{1}{b_3 - b_2}, \frac{1}{b_4 - b_3}, \frac{1}{b_5 - b_4}$ are in an A.P. with common difference -2

Q77. The area of the region enclosed between the parabolas $y^2 = 2x - 1$ and $y^2 = 4x - 3$ is.

- (1) $\frac{1}{3}$
(2) $\frac{1}{6}$
(3) $\frac{2}{3}$
(4) $\frac{3}{4}$

Q78. If $y = yx$ is the solution of the differential equation $2x^2 \frac{dy}{dx} - 2xy + 3y^2 = 0$ such that $ye = \frac{e}{3}$, then y_1 is equal to

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

Q79. Let P be the plane passing through the intersection of the planes $\vec{r} \cdot \hat{i} + 3\hat{j} - \hat{k} = 5$ and $\vec{r} \cdot 2\hat{i} - \hat{j} + \hat{k} = 3$, and the point $2, 1, -2$. Let the position vectors of the points X and Y be $\hat{i} - 2\hat{j} + 4\hat{k}$ and $5\hat{i} - \hat{j} + 2\hat{k}$ respectively.

Then the points

- (1) X and $X + Y$ are on the same side of P
(2) Y and $Y - X$ are on the opposite sides of P
(3) X and Y are on the opposite sides of P
(4) $X + Y$ and $X - Y$ are on the same side of P

Q80. A biased die is marked with numbers 2, 4, 8, 16, 32, 32 on its faces and the probability of getting a face with mark n is $\frac{1}{n}$. If the die is thrown thrice, then the probability, that the sum of the numbers obtained is 48, is

- (1) $\frac{7}{2^{11}}$
(2) $\frac{7}{2^{12}}$
(3) $\frac{3}{2^{10}}$
(4) $\frac{13}{2^{12}}$

Q81. The total number of three-digit numbers, with one digit repeated exactly two times, is _____.

- Q82.** If the sum of the co-efficients of all the positive even powers of x in the binomial expansion of $2x^3 + \frac{3^{10}}{x}$ is $5^{10} - \beta \cdot 3^9$, then β is equal to _____.
- Q83.** Let the eccentricity of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ be $\frac{5}{4}$. If the equation of the normal at the point $\frac{8}{\sqrt{5}}, \frac{12}{5}$ on the hyperbola is $8\sqrt{5}x + \beta y = \lambda$, then $\lambda - \beta$ is equal to _____.
- Q84.** If the mean deviation about the mean of the numbers $1, 2, 3, \dots, n$, where n is odd, is $\frac{5n+1}{n}$, then n is equal to _____.
- Q85.** Let $A = \begin{pmatrix} 2 & -2 \\ 1 & -1 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & 2 \\ -1 & 2 \end{pmatrix}$. Then the number of elements in the set $\{n, m: n, m \in 1, 2, \dots, 10 \text{ and } nA^n + mB^m = I\}$ is _____.
- Q86.** Let $f(x) = 2x^2 + 1$ and $g(x) = \begin{cases} 2x - 3, & x < 0 \\ 2x + 3, & x \geq 0 \end{cases}$, where t is the greatest integer $\leq t$. Then, in the open interval $-1, 1$, the number of points where fg is discontinuous is equal to _____.
- Q87.** Let $f(x) = x - 1x^2 - 2x - 3 + x - 3, x \in \mathbb{R}$. If m and M are respectively the number of points of local minimum and local maximum of f in the interval $0, 4$, then $m + M$ is equal to _____.
- Q88.** The value of $b > 3$ for which $12 \int_3^b \frac{1}{x^2 - 1x^2 - 4} dx = \log_e \frac{49}{40}$, is equal to _____.
- Q89.** Let $\vec{b} = \hat{i} + \hat{j} + \lambda \hat{k}, \lambda \in \mathbb{R}$. If \vec{a} is a vector such that $\vec{a} \times \vec{b} = 13\hat{i} - \hat{j} - 4\hat{k}$ and $\vec{a} \cdot \vec{b} + 21 = 0$, then $\vec{b} - \vec{a} \cdot \hat{k} - \hat{j} + \vec{b} + \vec{a} \cdot \hat{i} - \hat{k}$ is equal to _____.
- Q90.** Let l_1 be the line in xy -plane with x and y intercepts $\frac{1}{8}$ and $\frac{1}{4\sqrt{2}}$ respectively, and l_2 be the line in zx -plane with x and z intercepts $-\frac{1}{8}$ and $-\frac{1}{6\sqrt{3}}$ respectively. If d is the shortest distance between the line l_1 and l_2 , then d^2 is equal to _____.

ANSWER KEYS

1. (4)	2. (1)	3. (2)	4. (3)	5. (2)	6. (3)	7. (2)	8. (2)
9. (3)	10. (4)	11. (1)	12. (4)	13. (1)	14. (1)	15. (2)	16. (4)
17. (2)	18. (2)	19. (1)	20. (2)	21. (18)	22. (24)	23. (12)	24. (5)
25. (2)	26. (250)	27. (198)	28. (300)	29. (22)	30. (15)	31. (1)	32. (2)
33. (3)	34. (1)	35. (4)	36. (1)	37. (4)	38. (3)	39. (4)	40. (4)
41. (1)	42. (2)	43. (2)	44. (1)	45. (4)	46. (3)	47. (2)	48. (2)
49. (1)	50. (2)	51. (25)	52. (3)	53. (32)	54. (3)	55. (20)	56. (0)
57. (3)	58. (2)	59. (9)	60. (2)	61. (2)	62. (2)	63. (3)	64. (2)
65. (1)	66. (4)	67. (4)	68. (1)	69. (1)	70. (3)	71. (4)	72. (2)
73. (3)	74. (3)	75. (3)	76. (4)	77. (1)	78. (2)	79. (3)	80. (4)
81. (243)	82. (83)	83. (85)	84. (21)	85. (1)	86. (62)	87. (3)	88. (6)
89. (14)	90. (51)						

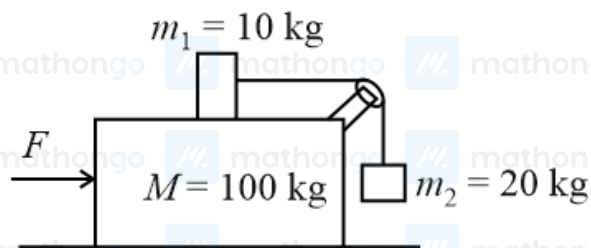
Q1. Two projectile thrown at 30° and 45° with the horizontal respectively, reach the maximum height in same time.

The ratio of their initial velocities is

- (1) $1 : \sqrt{2}$ (2) $2 : 1$
 (3) $\sqrt{2} : 1$ (4) $1 : 2$

Q2. Three masses $M = 100$ kg, $m_1 = 10$ kg and $m_2 = 20$ kg are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force F is applied on the system so that the mass m_2 moves upward with an acceleration of 2 ms^{-2} . The value of F is

(Take $g = 10 \text{ ms}^{-2}$)



- (1) 3360 N (2) 3380 N
 (3) 3120 N (4) 3240 N

Q3. A monkey of mass 50 kg climbs on a rope which can withstand the tension (T) of 350 N. If monkey initially climbs down with an acceleration of 4 m s^{-2} and then climbs up with an acceleration of 5 m s^{-2} . Choose the correct option ($g = 10 \text{ m s}^{-2}$)

- (1) $T = 700 \text{ N}$ while climbing upward (2) $T = 350 \text{ N}$ while going downward
 (3) Rope will break while climbing upward (4) Rope will break while going downward

Q4. As per the given figure, two blocks each of mass 250 g are connected to a spring of spring constant 2 N m^{-1} . If both are given velocity v in opposite directions, then maximum elongation of the spring is



- (1) $\frac{v}{2\sqrt{2}}$ (2) $\frac{v}{2}$
 (3) $\frac{v}{4}$ (4) $\frac{v}{\sqrt{2}}$

Q5. The percentage decrease in the weight of a rocket, when taken to a height of 32 km above the surface of earth will, be

(Radius of earth = 6400 km)

- (1) 1% (2) 3%
 (3) 4% (4) 0.5%

Q6. A water drop of radius 1 cm is broken into 729 equal droplets. If surface tension of water is 75 dyne cm^{-1} , then the gain in surface energy upto first decimal place will be
 [Given $\pi = 3.14$]

(1) $8.5 \times 10^{-4} \text{ J}$

(2) $8.2 \times 10^{-4} \text{ J}$

(3) $7.5 \times 10^{-4} \text{ J}$

(4) $5.3 \times 10^{-4} \text{ J}$

Q7. 7 mole of certain monoatomic ideal gas undergoes a temperature increase of 40 K at constant pressure. The increase in the internal energy of the gas in this process is

(Given $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$)

(1) 5810 J

(2) 3486 J

(3) 11620 J

(4) 6972 J

Q8. A monoatomic gas at pressure P and volume V is suddenly compressed to one eighth of its original volume. The final pressure at constant entropy will be

(1) P

(2) $8P$

(3) $32P$

(4) $64P$

Q9. When a particle executes simple Harmonic motion, the nature of graph of velocity as function of displacement will be

(1) Circular

(2) Elliptical

(3) Sinusoidal

(4) Straight line

Q10. The total charge on the system of capacitance $C_1 = 1\mu\text{F}$, $C_2 = 2\mu\text{F}$, $C_3 = 4\mu\text{F}$ and $C_4 = 3\mu\text{F}$ connected in parallel is

(Assume a battery of 20 V is connected to the combination)

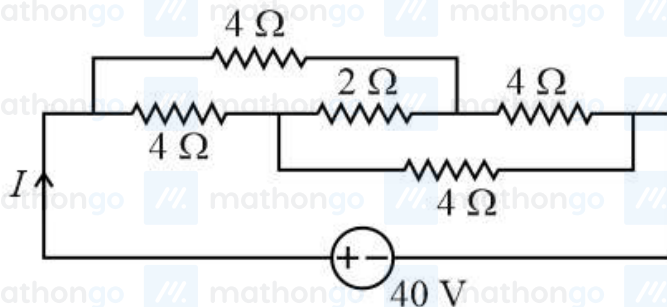
(1) $200\mu\text{C}$

(2) 200C

(3) $10\mu\text{C}$

(4) 10C

Q11. The current I in the given circuit will be



(1) 10A

(2) 20A

(3) 4A

(4) 40A

Q12. A charge particle is moving in a uniform magnetic field $(2\hat{i} + 3\hat{j})$ T. If it has an acceleration of

$(\alpha\hat{i} - 4\hat{j}) \text{ m s}^{-2}$, then the value of α will be

(1) 3

(2) 6

(3) 12

(4) 2

Q13. B_X and B_Y are the magnetic field at the centre of two coils of two coils X and Y respectively, each carrying equal current. If coil X has 200 turns and 20 cm radius and coil Y has 400 turns and 20 cm radius, the ratio of B_X and B_Y is

- (1) 1 : 1
(2) 1 : 2
(3) 2 : 1
(4) 4 : 1

Q14. In a series LR circuit $X_L = R$ and power factor of the circuit is P_1 . When capacitor with capacitance C such that $X_L = X_C$ is put in series, the power factor becomes P_2 . The ratio $\frac{P_1}{P_2}$ is

- (1) $\frac{1}{2}$
(2) $\frac{1}{\sqrt{2}}$
(3) $\frac{\sqrt{3}}{\sqrt{2}}$
(4) 2 : 1

Q15. The magnetic field of a plane electromagnetic wave is given by

$\vec{B} = 2 \times 10^{-8} \sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t) \hat{j}$ T. The amplitude of the electric field would be

- (1) 6 Vm^{-1} along x -axis
(2) 3 Vm^{-1} along z -axis
(3) 6 Vm^{-1} along z -axis
(4) $2 \times 10^{-8} \text{ Vm}^{-1}$ along z -axis

Q16. In young's double slit experiment, the fringe width is 12 mm. If the entire arrangement is placed in water of refractive index $\frac{4}{3}$, then the fringe width becomes (in mm)

- (1) 16
(2) 9
(3) 48
(4) 12

Q17. A parallel beam of light of wavelength 900 nm and intensity 100 Wm^{-2} is incident on a surface perpendicular to the beam. The number of photons crossing 1 cm^2 area perpendicular to the beam in one second is

- (1) 3×10^{16}
(2) 4.5×10^{16}
(3) 4.5×10^{17}
(4) 4.5×10^{20}

Q18. The disintegration rate of a certain radioactive sample at any instant is 4250 disintegrations per minute. 10 minutes later, the rate becomes 2250 disintegrations per minute. The approximate decay constant is

(Take $\log_e 1.88 = 0.63$)

- (1) 0.02 min^{-1}
(2) 2.7 min^{-1}
(3) 0.063 min^{-1}
(4) 6.3 min^{-1}

Q19. A radio can tune to any station in 6 MHz to 10 MHz band. The value of corresponding wavelength bandwidth will be

- (1) 4 m
(2) 20 m
(3) 30 m
(4) 50 m

Q20. A screw gauge of pitch 0.5 mm is used to measure the diameter of uniform wire of length 6.8 cm, the main scale reading is 1.5 mm and circular scale reading is 7. The calculated curved surface area of wire to appropriate significant figures is

[Screw gauge has 50 divisions on the circular scale]

- (1) 6.8 cm^2
(2) 3.4 cm^2
(3) 3.9 cm^2
(4) 2.4 cm^2

Q21. In an experiment to determine the Young's modulus of wire of a length exactly 1 m, the extension in the length of the wire is measured as 0.4 mm with an uncertainty of $\pm 0.02 \text{ mm}$ when a load of 1 kg is applied. The

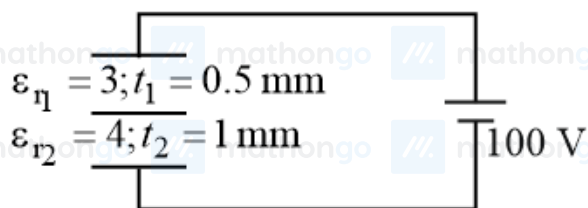
diameter of the wire is measured as 0.4 mm with an uncertainty of ± 0.01 mm. The error in the measurement of Young's modulus (ΔY) is found to be $x \times 10^{10} \text{ N m}^{-2}$. The value of x is _____.

Q22. If the initial velocity in horizontal direction of a projectile is unit vector \hat{i} and the equation of trajectory is $y = 5x(1 - x)$. The y component vector of the initial velocity is _____ \hat{j}
(Take $g = 10 \text{ m s}^{-2}$)

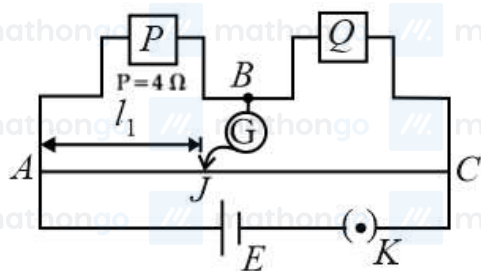
Q23. A disc of mass 1 kg and radius R is free to rotate about a horizontal axis passing through its centre and perpendicular to the plane of disc. A body of same mass as that of disc is fixed at the highest point of the disc. Now the system is released, when the body comes to the lowest position, its angular speed will be $4\sqrt{\frac{x}{3R}} \text{ rad s}^{-1}$ where $x =$ _____.

Q24. When a car is approaching the observer, the frequency of horn is 100 Hz. After passing the observer, it is 50 Hz. If the observer moves with the car, the frequency will be $\frac{x}{3} \text{ Hz}$ where $x =$ _____.

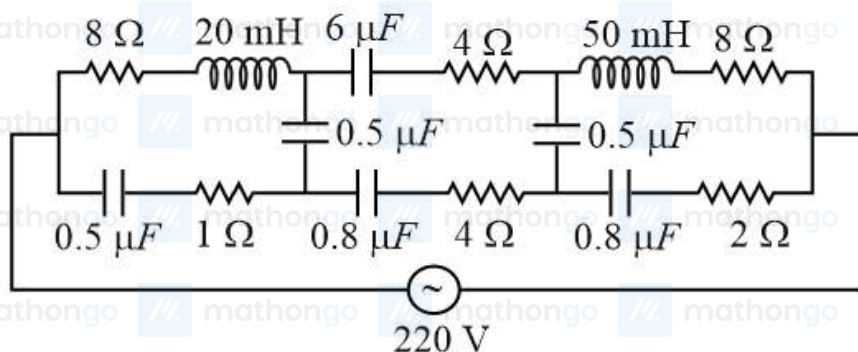
Q25. A composite parallel plate capacitor is made up of two different dielectric materials with different thickness (t_1 and t_2) as shown in figure. The two different dielectric material are separated by a conducting foil F . The voltage of the conducting foil is _____ V.



Q26. Resistance are connected in a meter bridge circuit as shown in the figure. The balancing length l_1 is 40 cm. Now an unknown resistance x is connected in series with P and new balancing length is found to be 80 cm measured from the same end. Then the value of x will be _____ Ω .

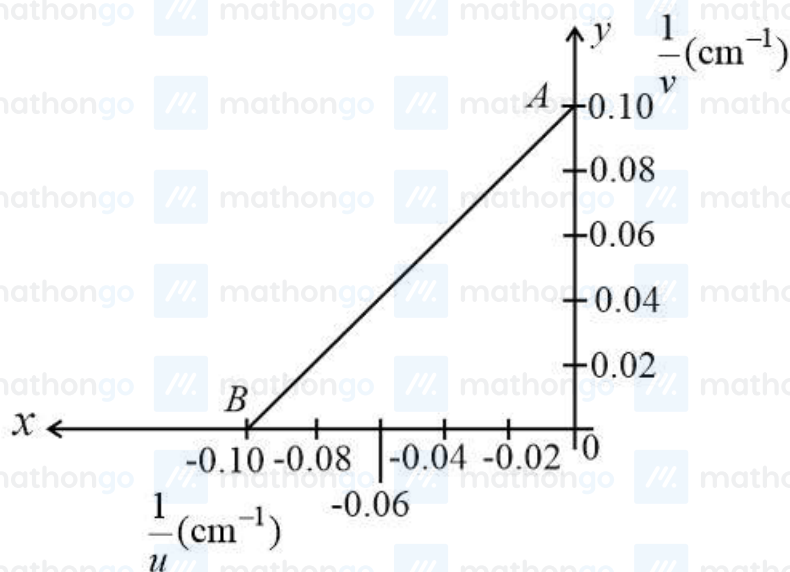


Q27. The effective current I in the given circuit at very high frequencies will be _____ A.



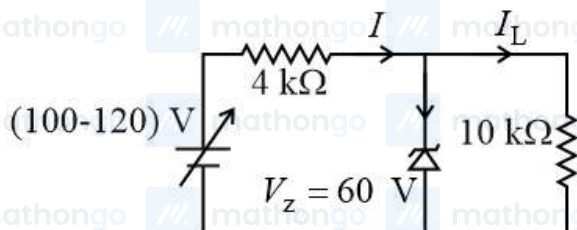
Q28. The graph between $\frac{1}{u}$ and $\frac{1}{v}$ for a thin convex lens in order to determine its focal length is plotted as shown in the figure. The refractive index of lens is 1.5 and its both the surfaces have same radius of curvatures R . The value of R will be _____ cm.

(Where u = object distance, v = image distance)



Q29. In a hydrogen spectrum λ be the wavelength of first transition line of Lyman series. The wavelength difference will be " $a\lambda$ " between the wavelength of 3rd transition line of Paschen series and that of 2nd transition line of Balmer Series where a = _____.

Q30. In the circuit shown below, maximum Zener diode current will be _____ mA.



Q31. Given two statements below :

Statement I : In Cl_2 molecule the covalent radius is double of the atomic radius of chlorine.

Statement II : Radius of anionic species is always greater than their parent atomic radius.

Choose the most appropriate answer from options given below

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
 (3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q32. Match List - I with List - II.

List-I

(Compound)

A BrF_5

B $[\text{CrF}_6]^{3-}$

C O_3

D PCl_5

List-II

(Shape)

I bent

II square pyramidal

III trigonal bipyramidal

IV octahedral

Choose the correct answer from the options given below

- (1) (A) – (I), (B) – (II), (C) – (III), (D) – (IV) (2) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)
 (3) (A) – (II), (B) – (IV), (C) – (I), (D) – (III) (4) (A) – (III), (B) – (IV), (C) – (II), (D) – (I)

Q33. Which of the given reactions is not an example of disproportionation reaction?

(1) $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

(2) $2\text{NO}_2 + \text{H}_2\text{O} \rightarrow \text{HNO}_3 + \text{HNO}_2$

(3) $\text{MnO}_4^- + 4\text{H}^+ + 3\text{e}^- \rightarrow \text{MnO}_2 + 2\text{H}_2\text{O}$

(4) $3\text{MnO}_4^{2-} + 4\text{H}^+ \rightarrow 2\text{MnO}_4^- + \text{MnO}_2 + 2\text{H}_2\text{O}$

Q34. Which of the following can be used to prevent the decomposition of H_2O_2 ?

(1) Urea

(2) Formaldehyde

(3) Formic acid

(4) Ethanol

Q35. Reaction of BeCl_2 with LiAlH_4 gives :

(A) AlCl_3

(B) BeH_2

(C) LiH

(D) LiCl

(E) BeAlH_4

Choose the correct answer from options given below

(1) (A), (D) & (E)

(2) (A), (B) & (D)

(3) (D) & (E)

(4) (B), (C) & (D)

Q36. Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are

(1) B(OH)_3 and NH_3

(2) B_2H_6 and NH_3

(3) B_2H_6 and HN_3

(4) NH_3 and B_2O_3

Q37. Which technique among the following, is most appropriate in separation of a mixture of 100 mg of p-nitrophenol and picric acid?

(1) Steam distillation

(2) 2 – 5 ft long column of silica gel

(3) Sublimation

(4) Preparative TLC (Thin Layer Chromatography)

Q38. Which of the following compounds is not aromatic?

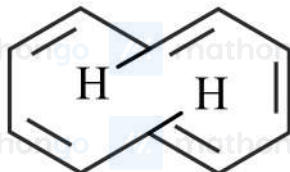
(1)



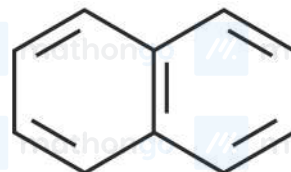
(2)



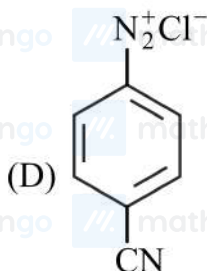
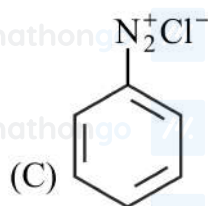
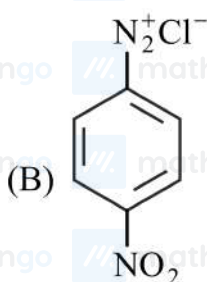
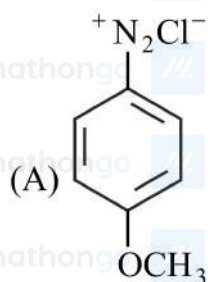
(3)



(4)



Q39. The correct stability order of the following diazonium salt is



(1) (A) > (B) > (C) > (D)

(3) (C) > (A) > (D) > (B)

(2) (A) > (C) > (D) > (B)

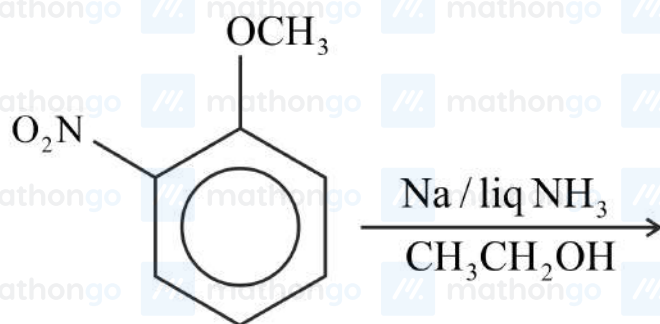
(4) (C) > (D) > (B) > (A)

Q40. $\dot{\text{Cl}} + \text{CH}_4 \rightarrow \text{A} + \text{B}$

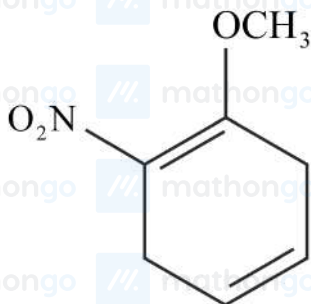
A and B in the above atmospheric reaction step are

(1) C_2H_6 and Cl_2 (3) $\dot{\text{C}}\text{H}_3$ and HCl (2) $\dot{\text{C}}\text{HCl}_2$ and H_2 (4) C_2H_6 and HCl

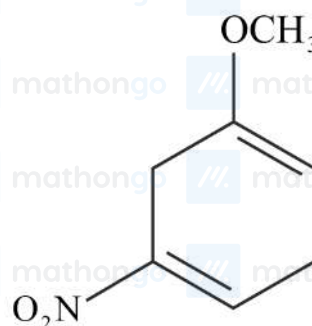
Q41. The major product formed in the given reaction is:



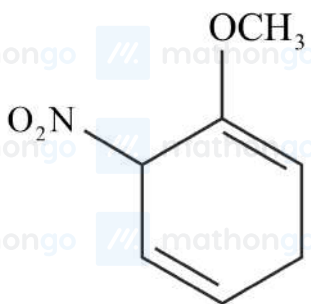
(1)



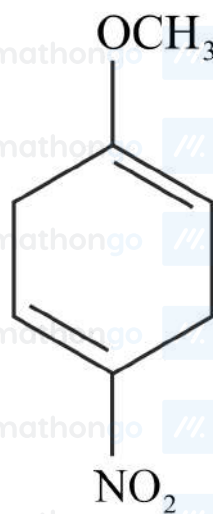
(2)



(3)



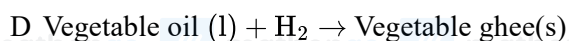
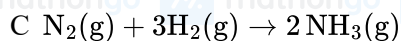
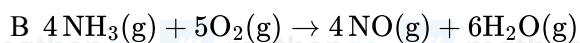
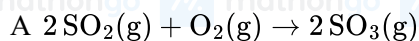
(4)



Q42. Match List - I with List - II.

List - I

(Processes/Reactions)



Choose the correct answer from the options given below

List-II

(Catalyst)

I Fe(s)

II Pt(s) – Rh(s)

III V_2O_5

IV Ni(s)

- (1) (A) – (III), (B) – (I), (C) – (II), (D) – (IV) (2) (A) – (III), (B) – (II), (C) – (I), (D) – (IV)
 (3) (A) – (IV), (B) – (III), (C) – (I), (D) – (II) (4) (A) – (IV), (B) – (II), (C) – (III), (D) – (I)

Q43. Refining using liquation method is the most suitable for metals with

- (1) Low melting point (2) High boiling point
 (3) High electrical conductivity (4) Less tendency to be soluble in melts than impurities

Q44. The dark purple colour of KMnO_4 disappears in the titration with oxalic acid in acidic medium. The overall change in the oxidation number of manganese in the reaction is

- (1) 5 (2) 1
 (3) 7 (4) 2

Q45. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Experimental reaction of CH_3Cl with aniline and anhydrous AlCl_3 does not give o and p-methylaniline.

Reason (R) : The $-\text{NH}_2$ group of aniline becomes deactivating because of salt formation with anhydrous AlCl_3 and hence yields m-methyl aniline as the product.

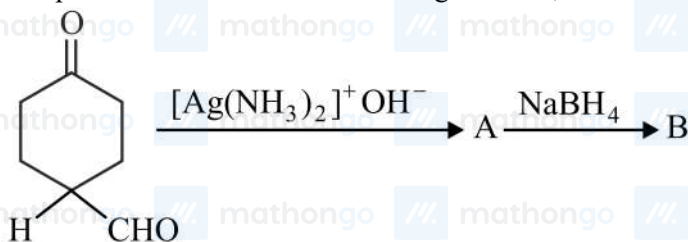
In the light of the above statements, choose the most appropriate answer from the options given below

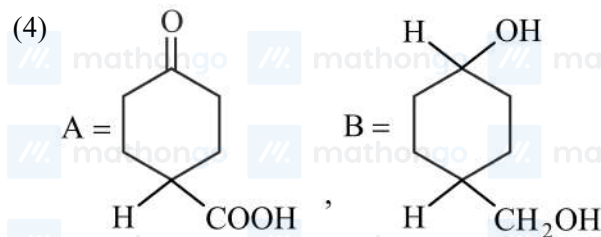
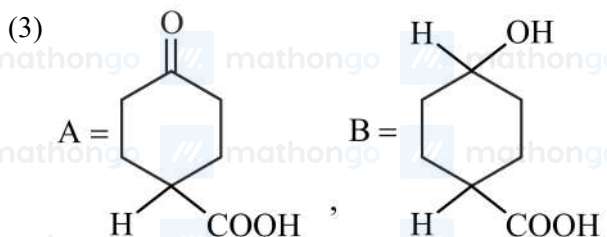
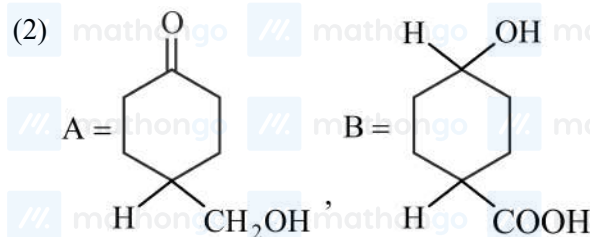
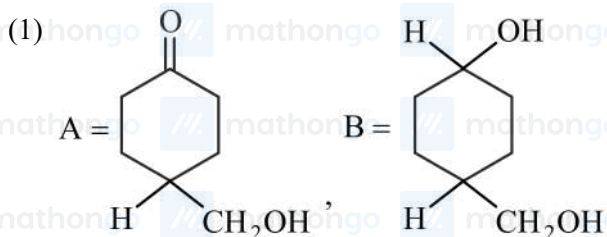
- (1) Both (A) and (R) are true and (R) is the correct explanation of (A). (2) Both (A) and (R) are true but (R) is not the correct explanation of (A).
 (3) (A) is true, but (R) is false. (4) (A) is false, but (R) is true.

Q46. The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to

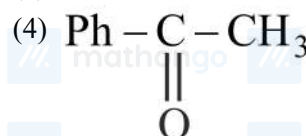
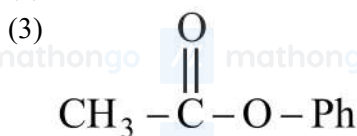
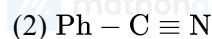
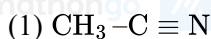
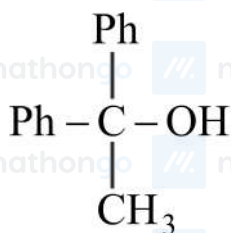
- (1) Hyperconjugation in substrate (2) Polarity of solvent
 (3) Free radical formation (4) Electromeric effect of the substrate

Q47. The products formed in the following reaction, A and B are





Q48. Which reactant will give the following alcohol on reaction with one mole of phenyl magnesium bromide (PhMgBr) followed by acidic hydrolysis?



Q49. Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents?

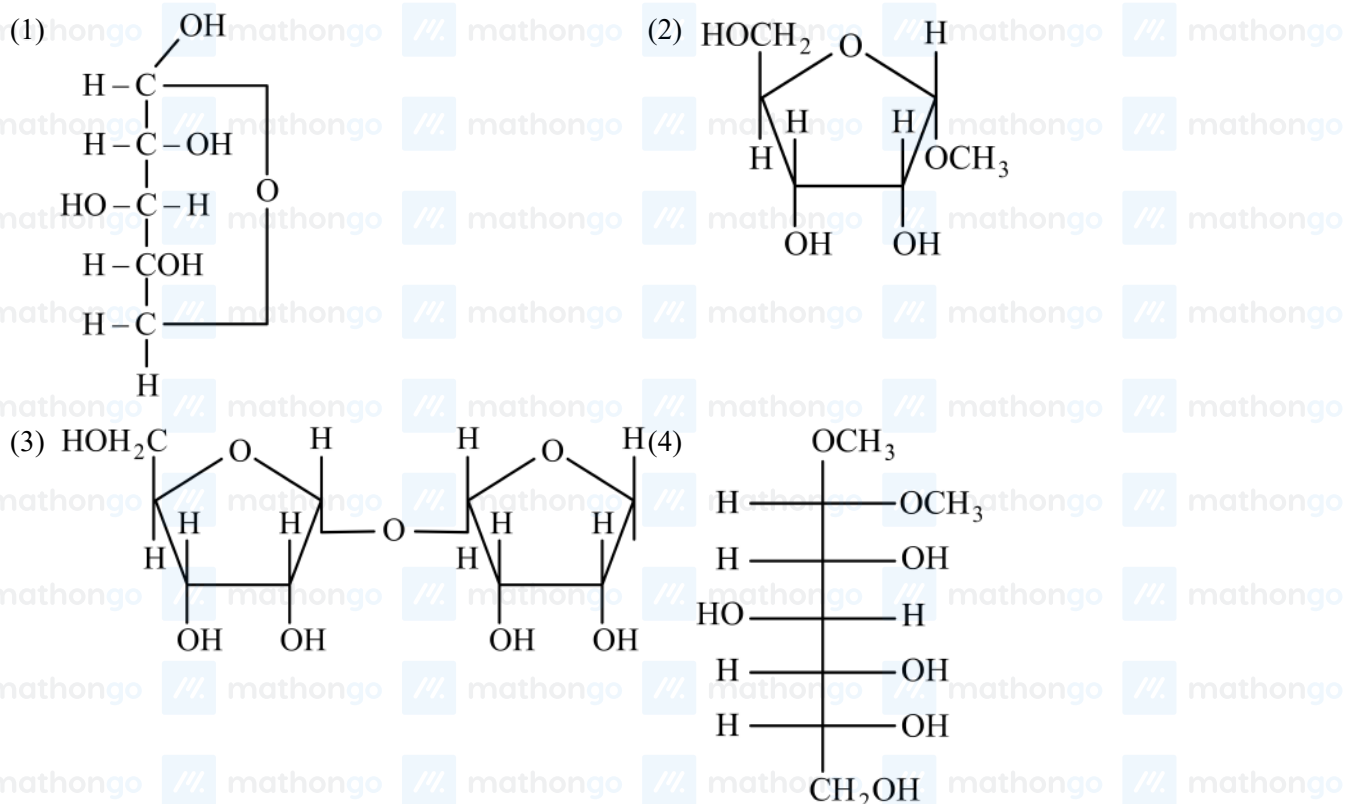
(1) Cationic detergent

(2) Soap

(3) Anionic detergent

(4) Non-ionic detergent

Q50. Which of the following is reducing sugar?



Q51. Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is (Nearest Integer) (Given : Atomic mass of Mg is 24 g mol^{-1} , $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$)

Q52. When 800 mL of 0.5M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is $x \times 10^{-2} \text{ M}$. (Molar mass of nitric acid is 63 g mol^{-1})

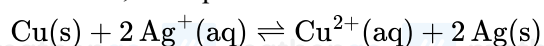
Q53. The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is _____ (the nearest integer) (Mass of electron is $9.1 \times 10^{-31} \text{ kg}$ and mass of neutron is $1.6 \times 10^{-27} \text{ kg}$)

Q54. A mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar.

Q55. 2.4 g coal is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atm pressure.

The temperature of the calorimeter rises from 298 K to 300 K. The enthalpy change during the combustion of coal is $-x \text{ kJ mol}^{-1}$. The value of x is _____ (Given : Heat capacity of bomb calorimeter 20.0 kJ K^{-1} . Assume coal to be pure carbon)

Q56. At 298 K, the equilibrium constant is 2×10^{15} for the reaction:



The equilibrium constant for the reaction

$\frac{1}{2} \text{Cu}^{2+}(\text{aq}) + \text{Ag(s)} \rightleftharpoons \frac{1}{2} \text{Cu(s)} + \text{Ag}^+(\text{aq})$ is $x \times 10^{-8}$. The value of x is _____. (Round off the answer to the nearest integer)

- Q57.** In the presence of sunlight, benzene reacts with Cl_2 to give product, X. The number of hydrogens in X is
- Q58.** The amount of charge in F (Faraday) required to obtain one mole of iron from Fe_3O_4 is _____. (Round off the answer to the nearest integer)
- Q59.** For a reaction $\text{A} \rightarrow 2\text{B} + \text{C}$ the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol L = respectively. The order of the reaction is
- Q60.** The difference between spin only magnetic moment values of $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$ and $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$ is
- Q61.** Let O be the origin and A be the point $z_1 = 1 + 2i$. If B is the point z_2 , $\text{Re}(z_2) < 0$, such that OAB is a right angled isosceles triangle with OB as hypotenuse, then which of the following is NOT true?
- (1) $\arg z_2 = \pi - \tan^{-1} 3$ (2) $\arg(z_1 - 2z_2) = -\tan^{-1} \frac{4}{3}$
 (3) $|z_2| = \sqrt{10}$ (4) $|2z_1 - z_2| = 5$
- Q62.** Consider two G.Ps. $2, 2^2, 2^3, \dots$ and $4, 4^2, 4^3, \dots$ of 60 and n terms respectively. If the geometric mean of all the $60 + n$ terms is $(2)^{\frac{225}{8}}$, then $\sum_{k=1}^n k(n-k)$ is equal to:
- (1) 560 (2) 1540
 (3) 1330 (4) 2600
- Q63.** Let $S = \left\{ \theta \in [0, 2\pi] : 8^{2\sin^2 \theta} + 8^{2\cos^2 \theta} = 16 \right\}$. Then $n(S) + \sum_{\theta \in S} \left(\sec\left(\frac{\pi}{4} + 2\theta\right) \operatorname{cosec}\left(\frac{\pi}{4} + 2\theta\right) \right)$ is equal to:
- (1) 0 (2) -2
 (3) -4 (4) 12
- Q64.** A point P moves so that the sum of squares of its distances from the points (1, 2) and (-2, 1) is 14. Let $f(x, y) = 0$ be the locus of P, which intersects the x-axis at the points A, B and the y-axis at the point C, D. Then the area of the quadrilateral ACBD is equal to
- (1) $\frac{9}{2}$ (2) $\frac{3\sqrt{17}}{2}$
 (3) $\frac{3\sqrt{17}}{4}$ (4) 9
- Q65.** Let the tangent drawn to the parabola $y^2 = 24x$ at the point (α, β) is perpendicular to the line $2x + 2y = 5$. Then the normal to the hyperbola $\frac{x^2}{\alpha^2} - \frac{y^2}{\beta^2} = 1$ at the point $(\alpha + 4, \beta + 4)$ does NOT pass through the point:
- (1) (25, 10) (2) (20, 12)
 (3) (30, 8) (4) (15, 13)
- Q66.** The statement $(\sim(p \Leftrightarrow \sim q)) \wedge q$ is:
- (1) a tautology (2) a contradiction
 (3) equivalent to $(p \Rightarrow q) \wedge q$ (4) equivalent to $(p \Rightarrow q) \wedge p$
- Q67.** Let A be a 2×2 matrix with $\det(A) = -1$ and $\det((A + I)(\operatorname{Adj}(A) + I)) = 4$. Then the sum of the diagonal elements of A can be:
- (1) -1 (2) 2
 (3) 1 (4) $-\sqrt{2}$
- Q68.** If the system of linear equations.

$$8x + y + 4z = -2$$

$$x + y + z = 0$$

$$\lambda x - 3y = \mu$$

has infinitely many solutions, then the distance of the point $(\lambda, \mu, -\frac{1}{2})$ from the plane $8x + y + 4z + 2 = 0$ is:

(1) $3\sqrt{5}$

(2) 4

(3) $\frac{26}{9}$

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

Q69. $\tan\left(2 \tan^{-1} \frac{1}{5} + \sec^{-1} \frac{\sqrt{5}}{2} + 2 \tan^{-1} \frac{1}{8}\right)$ is equal to:

(1) 1

(2) 2

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

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

Q70. Let $f: R \rightarrow R$ be a continuous function such that $f(3x) - f(x) = x$. If $f(8) = 7$, then $f(14)$ is equal to:

(1) 4

(2) 10

(3) 11

(4) 16

Q71. If the function $f(x) = \begin{cases} \frac{\log_e(1-x+x^2) + \log_e(1+x+x^2)}{\sec x - \cos x}, & x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right) - \{0\} \\ k, & x = 0 \end{cases}$ is continuous at $x = 0$, then k is equal to:

(1) 1

(2) -1

(3) e

(4) 0

Q72. If $f(x) = \begin{cases} x + a, & x \leq 0 \\ |x - 4|, & x > 0 \end{cases}$ and $g(x) = \begin{cases} x + 1, & x < 0 \\ (x - 4)^2 + b, & x \geq 0 \end{cases}$ are continuous on R , then

$(gof)(2) + (fog)(-2)$ is equal to:

(1) -10

(2) 10

(3) 8

(4) -8

Q73. Let $f(x) = \begin{cases} x^3 - x^2 + 10x - 7, & x \leq 1 \\ -2x + \log_2(b^2 - 4), & x > 1 \end{cases}$ Then the set of all values of b , for which $f(x)$ has maximum value at $x = 1$, is:

(1) $(-6, -2)$

(2) $(2, 6)$

(3) $[-6, -2) \cup (2, 6]$

(4) $[-\sqrt{6}, -2) \cup (2, \sqrt{6}]$

Q74. If $a = \lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{2n}{n^2 + k^2}$ and $f(x) = \sqrt{\frac{1 - \cos x}{1 + \cos x}}$, $x \in (0, 1)$, then:

(1) $2\sqrt{2}f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$

(2) $f\left(\frac{a}{2}\right)f'\left(\frac{a}{2}\right) = \sqrt{2}$

(3) $\sqrt{2}f\left(\frac{a}{2}\right) = f'\left(\frac{a}{2}\right)$

(4) $f\left(\frac{a}{2}\right) = \sqrt{2}f'\left(\frac{a}{2}\right)$

Q75. The odd natural number a , such that the area of the region bounded by $y = 1, y = 3, x = 0, x = y^a$ is $\frac{364}{3}$, equal to:

(1) 3

(2) 5

(3) 7

(4) 9

Q76. If $\frac{dy}{dx} + 2y \tan x = \sin x$, $0 < x < \frac{\pi}{2}$ and $y\left(\frac{\pi}{3}\right) = 0$, then the maximum value of $y(x)$ is

(1) $\frac{1}{8}$
(3) $\frac{1}{4}$

(2) $\frac{3}{4}$
(4) $\frac{3}{8}$

Q77. Let $\vec{a} = \alpha\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = 2\hat{i} + \hat{j} - \alpha\hat{k}$, $\alpha > 0$. If the projection of $\vec{a} \times \vec{b}$ on the vector $-\hat{i} + 2\hat{j} - 2\hat{k}$ is 30, then α is equal to

(1) $\frac{15}{2}$
(3) $\frac{13}{2}$

(2) 8
(4) 7

Q78. The length of the perpendicular from the point $(1, -2, 5)$ on the line passing through $(1, 2, 4)$ and parallel to the line $x + y - z = 0 = x - 2y + 3z - 5$ is:

(1) $\sqrt{\frac{21}{2}}$
(3) $\sqrt{\frac{73}{2}}$

(2) $\sqrt{\frac{9}{2}}$
(4) 1

Q79. The mean and variance of a binomial distribution are α and $\frac{\alpha}{3}$ respectively. If $P(X = 1) = \frac{4}{243}$, then $P(X = 4 \text{ or } 5)$ is equal to:

(1) $\frac{5}{9}$
(3) $\frac{16}{27}$

(2) $\frac{64}{81}$
(4) $\frac{145}{243}$

Q80. Let E_1, E_2, E_3 be three mutually exclusive events such that $P(E_1) = \frac{2+3p}{6}$, $P(E_2) = \frac{2-p}{8}$ and $P(E_3) = \frac{1-p}{2}$. If the maximum and minimum values of p are p_1 and p_2 then $(p_1 + p_2)$ is equal to:

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

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

Q81. If for some $p, q, r \in R$, all have positive sign, one of the roots of the equation

$(p^2 + q^2)x^2 - 2q(p + r)x + q^2 + r^2 = 0$ is also a root of the equation $x^2 + 2x - 8 = 0$, then $\frac{q^2 + r^2}{p^2}$ is equal to-

Q82. The number of 5-digit natural numbers, such that the product of their digits is 36, is

Q83. The series of positive multiples of 3 is divided into sets : $\{3\}, \{6, 9, 12\}, \{15, 18, 21, 24, 27\}, \dots$. Then the sum of the elements in the 11th set is equal to _____.

Q84. If the coefficients of x and x^2 in the expansion of $(1+x)^p(1-x)^q$, $p, q \leq 15$, are -3 and -5 respectively, then the coefficient of x^3 is equal to _____.

Q85. The equations of the sides AB, BC and CA of a triangle ABC are $2x + y = 0$, $x + py = 15a$ and $x - y = 3$ respectively. If its orthocentre is $(2, a)$, $-\frac{1}{2} < a < 2$, then p is equal to

Q86. The number of distinct real roots of the equation $x^5(x^3 - x^2 - x + 1) + x(3x^3 - 4x^2 - 2x + 4) - 1 = 0$ is

Q87. Let the function $f(x) = 2x^2 - \log_e x$, $x > 0$, be decreasing in $(0, a)$ and increasing in $(a, 4)$. A tangent to the parabola $y^2 = 4ax$ at a point P on it passes through the point $(8a, 8a - 1)$ but does not pass through the point $(-\frac{1}{a}, 0)$. If the equation of the normal at P is $\frac{x}{\alpha} + \frac{y}{\beta} = 1$, then $\alpha + \beta$ is equal to

Q88. If $n(2n+1) \int_0^1 (1-x^n)^{2n} dx = 1177 \int_0^1 (1-x^n)^{2n+1} dx$, then $n \in N$ is equal to _____.

Q89. Let a curve $y = y(x)$ pass through the point $(3, 3)$ and the area of the region under this curve, above the x -axis and between the abscissae 3 and $x(> 3)$ be $\left(\frac{y}{x}\right)^3$. If this curve also passes through the point $(\alpha, 6\sqrt{10})$ in the first quadrant, then α is equal to _____.

Q90. Let Q and R be two points on the line $\frac{x+1}{2} = \frac{y+2}{3} = \frac{z-1}{2}$ at a distance $\sqrt{26}$ from the point $P(4, 2, 7)$. Then the square of the area of the triangle PQR is _____.

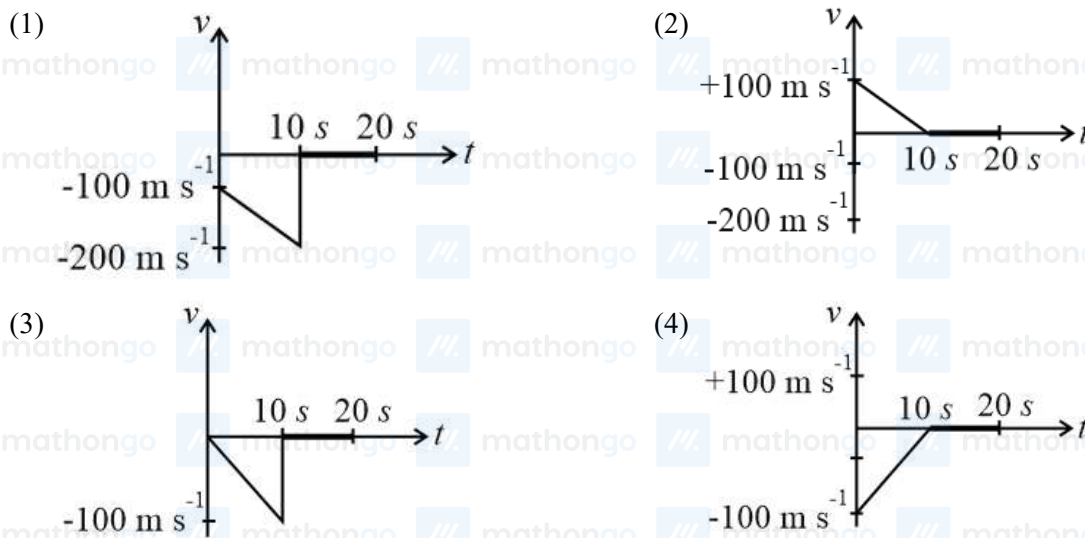
ANSWER KEYS

1. (3)	2. (1)	3. (3)	4. (2)	5. (1)	6. (3)	7. (2)	8. (3)
9. (2)	10. (1)	11. (1)	12. (2)	13. (2)	14. (2)	15. (3)	16. (2)
17. (2)	18. (3)	19. (2)	20. (2)	21. (2)	22. (5)	23. (5)	24. (200)
25. (60)	26. (20)	27. (44)	28. (10)	29. (5)	30. (9)	31. (4)	32. (3)
33. (3)	34. (1)	35. (2)	36. (2)	37. (4)	38. (3)	39. (2)	40. (3)
41. (3)	42. (2)	43. (1)	44. (1)	45. (3)	46. (2)	47. (3)	48. (4)
49. (4)	50. (1)	51. (24)	52. (54)	53. (1758)	54. (2)	55. (200)	56. (2)
57. (6)	58. (3)	59. (2)	60. (0)	61. (4)	62. (3)	63. (3)	64. (2)
65. (4)	66. (4)	67. (2)	68. (4)	69. (2)	70. (2)	71. (1)	72. (4)
73. (3)	74. (3)	75. (2)	76. (1)	77. (4)	78. (1)	79. (3)	80. (2)
81. (272)	82. (180)	83. (6993)	84. (23)	85. (3)	86. (3)	87. (45)	88. (24)
89. (6)	90. (153)						

Q1. A torque meter is calibrated to reference standards of mass, length and time each with 5% accuracy. After calibration, the measured torque with this torque meter will have net accuracy of

- (1) 15% (2) 25%
(3) 75% (4) 5%

Q2. A bullet is shot vertically downwards with an initial velocity of 100 m s^{-1} from a certain height. Within 10 s, the bullet reaches the ground and instantaneously comes to rest due to the perfectly inelastic collision. The velocity-time curve for total time $t = 20 \text{ s}$ will be : (Take $g = 10 \text{ m s}^{-2}$)



Q3. A bag is gently dropped on a conveyor belt moving at a speed of 2 m s^{-1} . The coefficient of friction between the conveyor belt and bag is 0.4. Initially, the bag slips on the belt before it stops due to friction. The distance travelled by the bag on the belt during slipping motion is : [Take $g = 10 \text{ m s}^{-2}$]

- (1) 2 m (2) 0.5 m
(3) 3.2 m (4) 0.8 m

Q4. Sand is being dropped from a stationary dropper at a rate of 0.5 kg s^{-1} on a conveyor belt moving with a velocity of 5 m s^{-1} . The power needed to keep belt moving with the same velocity will be

- (1) 1.25 W (2) 2.5 W
(3) 6.25 W (4) 12.5 W

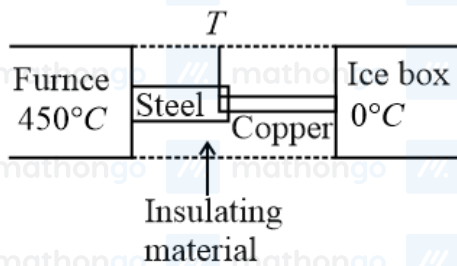
Q5. Two satellites A and B having masses in the ratio 4 : 3 are revolving in circular orbits of radii $3r$ and $4r$ respectively around the earth. The ratio of total mechanical energy of A to B is

- (1) 9 : 16 (2) 16 : 9
(3) 1 : 1 (4) 4 : 3

Q6. Two cylindrical vessels of equal cross-sectional area 16 cm^2 contain water upto heights 100 cm and 150 cm respectively. The vessels are interconnected so that the water levels in them become equal. The work done by the force of gravity during the process, is [Take density of water = 10^3 kg m^{-3} and $g = 10 \text{ ms}^{-2}$]

- (1) 0.25 J (2) 1 J
(3) 8 J (4) 12 J

Q7. If K_1 and K_2 are the thermal conductivities L_1 and L_2 are the lengths and A_1 and A_2 are the cross sectional areas of steel and copper rods respectively such that $\frac{K_2}{K_1} = 9$, $\frac{A_1}{A_2} = 2$, $\frac{L_1}{L_2} = 2$. Then, for the arrangement as shown in the figure. The value of temperature T of the steel - copper junction in the steady state will be



- (1) 18°C (2) 14°C
 (3) 45°C (4) 150°C

Q8. Read the following statements :

- A. When small temperature difference between a liquid and its surrounding is doubled the rate of loss of heat of the liquid becomes twice.
 B. Two bodies P and Q having equal surface areas are maintained at temperature 10°C and 20°C . The thermal radiation emitted in a given time by P and Q are in the ratio 1 : 1.15
 C. A carnot Engine working between 100 K and 400 K has an efficiency of 75%
 D. When small temperature difference between a liquid and its surrounding is quadrupled, the rate of loss of heat of the liquid becomes twice.

Choose the correct answer from the options given below :

- (1) A, B, C only (2) A, B only
 (3) A, C only (4) B, C, D only

Q9. Same gas is filled in two vessels of the same volume at the same temperature. If the ratio of the number of molecules is 1 : 4, then

- A. The r.m.s. velocity of gas molecules in two vessels will be the same.
 B. The ratio of pressure in these vessels will be 1 : 4.
 C. The ratio of pressure will be 1 : 1.
 D. The r.m.s. velocity of gas molecules in two vessels will be in the ratio of 1 : 4.

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

Q10. Two identical positive charges Q each are fixed at a distance of $2a$ apart from each other. Another point charge q_0 with mass m is placed at midpoint between two fixed charges. For a small displacement along the line joining the fixed charges, the charge q_0 executes SHM. The time period of oscillation of charge q_0 will be

- (1) $\sqrt{\frac{4\pi^3\epsilon_0 ma^3}{q_0 Q}}$ (2) $\sqrt{\frac{q_0 Q}{4\pi^3\epsilon_0 ma^3}}$
 (3) $\sqrt{\frac{2\pi^2\epsilon_0 ma^3}{q_0 Q}}$ (4) $\sqrt{\frac{8\pi^3\epsilon_0 ma^3}{q_0 Q}}$

Q11. Two sources of equal emfs are connected in series. This combination is connected to an external resistance R .

The internal resistances of the two sources are r_1 and r_2 ($r_1 > r_2$). If the potential difference across the source of internal resistance r_1 is zero then the value of R will be

(1) $r_1 - r_2$

(3) $\frac{r_1+r_2}{2}$

(2) $\frac{r_1 r_2}{r_1+r_2}$

(4) $r_2 - r_1$

Q12. A magnet hung at 45° with magnetic meridian makes an angle of 60° with the horizontal. The actual value of the angle of dip is

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

(2) $\tan^{-1}(\sqrt{6})$

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

(4) $\tan^{-1}\left(\sqrt{\frac{1}{2}}\right)$

Q13. Two bar magnets oscillate in a horizontal plane in earth's magnetic field with time periods of 3 s and 4 s respectively. If their moments of inertia are in the ratio of 3 : 2 then the ratio of their magnetic moments will be

(1) 2 : 1

(2) 8 : 3

(3) 1 : 3

(4) 27 : 16

Q14. A direct current of 4 A and an alternating current of peak value 4 A flow through resistance of $3\ \Omega$ and $2\ \Omega$ respectively. The ratio of heat produced in the two resistances in same interval of time will be :

(1) 3 : 2

(2) 3 : 1

(3) 3 : 4

(4) 4 : 3

Q15. A beam of light travelling along X-axis is described by the electric field $E_y = 900 \sin \omega(t - \frac{x}{c})$. The ratio of electric force to magnetic force on a charge q moving along Y-axis with a speed of $3 \times 10^7\ \text{m s}^{-1}$ will be :

[Given speed of light = $3 \times 10^8\ \text{m s}^{-1}$]

(1) 1 : 1

(2) 1 : 10

(3) 10 : 1

(4) 1 : 2

Q16. A microscope was initially placed in air (refractive index 1). It is then immersed in oil (refractive index 2). For a light whose wavelength in air is λ , calculate the change of microscope's resolving power due to oil and choose the correct option

(1) Resolving power will be $\frac{1}{4}$ in the oil than it was in the air

(2) Resolving power will be twice in the oil than it was in the air.

(3) Resolving power will be four times in the oil than it was in the air.

(4) Resolving power will be $\frac{1}{2}$ in the oil than it was in the air.

Q17. An electron (mass m) with an initial velocity $\vec{v} = v_0 \hat{i}$ ($v_0 > 0$) is moving in an electric field

$\vec{E} = -E_0 \hat{i}$ ($E_0 > 0$) where E_0 is constant. If at $t = 0$, de-Broglie wavelength is $\lambda_0 = \frac{h}{mv_0}$, then its de-Broglie wavelength after time t is given by

(1) λ_0

(2) $\lambda_0 \left(1 + \frac{eE_0 t}{mv_0}\right)$

(3) $\lambda_0 t$

(4) $\frac{\lambda_0}{\left(1 + \frac{eE_0 t}{mv_0}\right)}$

Q18. What is the half-life period of a radioactive material if its activity drops to $\frac{1}{16^{\text{th}}}$ of its initial value of 30 years ?

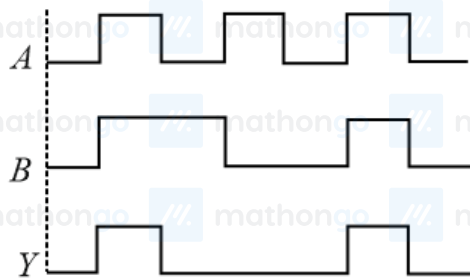
(1) 9.5 years

(2) 8.5 years

(3) 7.5 years

(4) 10.5 years

Q19. A logic gate circuit has two inputs A and B and output Y . The voltage waveforms of A , B and Y are shown below



The logic gate circuit is

- (1) AND gate (2) OR gate
(3) NOR gate (4) NAND gate

Q20. At a particular station, the TV transmission tower has a height of 100 m. To triple its coverage range, height of the tower should be increased to

- (1) 200 m (2) 300 m
(3) 600 m (4) 900 m

Q21. A ball of mass m is thrown vertically upward. Another ball of mass $2m$ is thrown at an angle θ with the vertical.

Both the balls stay in air for the same period of time. The ratio of the heights attained by the two balls respectively is $\frac{1}{x}$. The value of x is _____.

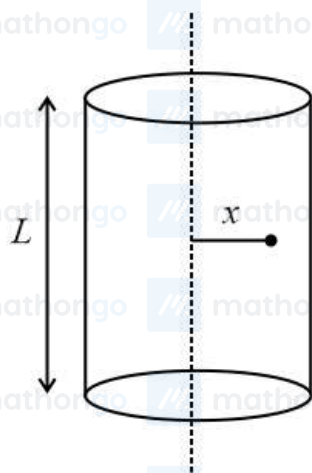
Q22. A pulley of radius 1.5 m is rotated about its axis by a force $F = (12t - 3t^2)$ N applied tangentially (while t is measured in seconds). If moment of inertia of the pulley about its axis of rotation is 4.5 kg m^2 , the number of rotations made by the pulley before its direction of motion is reversed, will be $\frac{K}{\pi}$. The value of K is _____.

Q23. A square aluminium (shear modulus is $25 \times 10^9 \text{ Nm}^{-2}$) slab of side 60 cm and thickness 15 cm is subjected to a shearing force (on its narrow face) of $18.0 \times 10^4 \text{ N}$. The lower edge is riveted to the floor. The displacement of the upper edge is _____ μm .

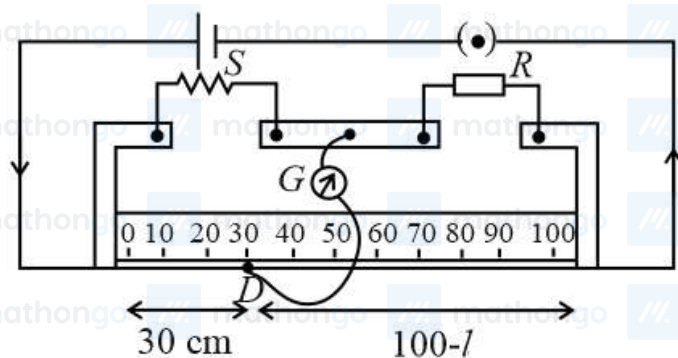
Q24. A mass 0.9 kg, attached to a horizontal spring, executes SHM with an amplitude A_1 . When this mass passes through its mean position, then a smaller mass of 124 g is placed over it and both masses move together with amplitude A_2 . If the ratio $\frac{A_1}{A_2}$ is $\frac{\alpha}{\alpha-1}$, then the value of α will be _____.

Q25. A 1 m long copper wire carries a current of 1 A. If the cross section of the wire is 2.0 mm^2 and the resistivity of copper is $1.7 \times 10^{-8} \Omega \text{ m}$. The force experienced by moving electron in the wire is _____ $\times 10^{-23} \text{ N}$ (Charge of electron = $1.6 \times 10^{-19} \text{ C}$)

Q26. A long cylindrical volume contains a uniformly distributed charge of density $\rho \text{ C m}^{-3}$. The electric field inside the cylindrical volume at a distance $x = \frac{2\epsilon_0}{\rho}$ m from its axis is _____ V m^{-1} .



Q27. In meter bridge experiment for measuring unknown resistance ' S ', the null point is obtained at a distance 30 cm from the left side as shown at point D . If R is $5.6 \text{ k}\Omega$, then the value of unknown resistance ' S ' will be _____ Ω .



Q28. To light, a 50 W, 100 V lamp is connected, in series with a capacitor of capacitance $\frac{50}{\pi\sqrt{x}} \mu\text{F}$, with 200 V, 50 Hz AC source. The value of x will be _____.

Q29. Two beams of light having intensities I and $4I$ interfere to produce a fringe pattern on a screen. The phase difference between the two beams are $\frac{\pi}{2}$ and $\frac{\pi}{3}$ at points A and B respectively. The difference between the resultant intensities at the two points is xI . The value of x will be _____.

Q30. The one division of main scale of vernier callipers reads 1 mm and 10 divisions of Vernier scale is equal to the 9 divisions on main scale. When the two jaws of the instrument touch each other the zero of the Vernier lies to the right of zero of the main scale and its fourth division coincides with a main scale division. When a spherical bob is tightly placed between the two jaws, the zero of the Vernier scale lies in between 4.1 cm and 4.2 cm and 6th Vernier division coincides with a main scale division. The diameter of the bob will be _____ 10^{-2} cm .

Q31. 250 g solution of D-glucose in water contains 10.8% of carbon by weight. The molality of the solution is nearest to (Given: Atomic Weights are $\text{H} = 1\text{u}$; $\text{C} = 12\text{u}$; $\text{O} = 16\text{u}$)

- (1) 1.03 (2) 2.06
(3) 3.09 (4) 5.40

Q32. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Energy of 2s orbital of hydrogen atom is greater than that of 2s orbital of lithium.

Reason R : Energies of the orbitals in the same subshell decrease with increase in the atomic number.

In the light of the above statements, choose the correct answer from the options given below.

- (1) Both A and R are true and R is the correct explanation of A. (2) Both A and R are true but R is NOT the correct explanation of A.
(3) A is true but R is false. (4) A is false but R is true.

Q33. The incorrect statement is

- (1) The first ionization enthalpy of K is less than that of Na and Li (2) Xe does not have the lowest first ionization enthalpy in its group
(3) The first ionization enthalpy of element with atomic number 37 is lower than that of the element with atomic number 38. (4) The first ionization enthalpy of Ga is higher than that of the d-block element with atomic number 30.

Q34. Given below are two statements.

Statement I : O_2 , Cu^{2+} and Fe^{3+} are weakly attracted by magnetic field and are magnetized in the same direction as magnetic field.

Statement II : NaCl and H_2O are weakly magnetized in opposite direction to magnetic field.

In the light of the above statements, choose the most appropriate answer from the options given below

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q35. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Activated charcoal adsorbs SO_2 more efficiently than CH_4 .

Reason R : Gases with lower critical temperatures are readily adsorbed by activated charcoal. In the light of the above statements, choose the correct answer from the options given below.

- (1) Both A and R are correct and R is the correct explanation of A. (2) Both A and R are correct but R is NOT the correct explanation of A.
(3) A is correct but R is not correct. (4) A is not correct but R is correct.

Q36. Given below are two statements:

Statement I : Hydrogen peroxide can act as an oxidizing agent in both acidic and basic conditions.

Statement II: Density of hydrogen peroxide at 298 K is lower than that of D_2O .

In the light of the above statements. Choose the correct answer from the options.

- (1) Both statement I and Statement II are true (2) Both statement I and Statement II are false
(3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

Q37. Given below are two statements:

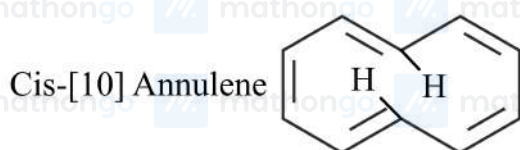
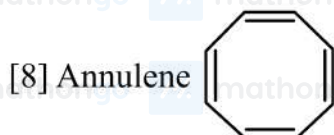
Statement I : The chlorides of Be and Al have Cl-bridged structure. Both are soluble in organic solvents and act as Lewis bases.

Statement II: Hydroxides of Be and Al dissolve in excess alkali to give beryllate and aluminate ions. In the light of the above statements. Choose the correct answer from the options given below.

- (1) Both statement I and Statement II are true (2) Both statement I and Statement II are false
 (3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true

Q38. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : [6] Annulene. [8] Annulene and cis - [10] Annulene, are respectively aromatic, not-aromatic and aromatic.



Reason R: Planarity is one of the requirements of aromatic systems.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (1) Both A and R are correct and R is the correct explanation of A. (2) Both A and R are correct but R is NOT the correct explanation of A.
 (3) A is correct but R is not correct. (4) A is not correct but R is correct.

Q39. In Carius method of estimation of halogen. 0.45 g of an organic compound gave 0.36 g of AgBr. Find out the percentage of bromine in the compound.

(Molar masses : AgBr = 188 g mol⁻¹ : Br = 80 g mol⁻¹)

- (1) 34.04% (2) 40.04%
 (3) 36.03% (4) 38.04%

Q40. Match List I with List II

List-I
Pollutant

- A Sulphate (> 500 ppm)
 B Nitrate (> 50 ppm)
 C Lead (> 50 ppb)
 D Fluoride (> 2 ppm)

List-II
Disease /sickness

- I Methemoglobinemia
 II Brown mottling of teeth
 III Laxative effect
 IV Kidney damage

Choose the correct answer from the options given below

- (1) A – IV, B – I, C – II, D – III (2) A – III, B – I, C – IV, D – II
 (3) A – II, B – IV, C – I, D – III (4) A – II, B – IV, C – III, D – I

Q41. Boiling point of a 2% aqueous solution of a nonvolatile solute A is equal to the boiling point of 8% aqueous solution of a non-volatile solute B. The relation between molecular weights of A and B is.

(1) $M_A = 4M_B$

(3) $M_A = 8M_B$

(2) $M_B = 4M_A$

(4) $M_B = 8M_A$

Q42. Which of the following methods are not used to refine any metal?

(A) Liquation

(B) Calcination

(C) Electrolysis

(D) Leaching

(E) Distillation

Choose the correct answer from the options given below

(1) B and D only

(2) A, B, D and E only

(3) B, D and E only

(4) A, C and E only

Q43. Which oxoacid of phosphorous has the highest number of oxygen atoms present in its chemical formula?

(1) Pyrophosphorous acid

(2) Hypophosphoric acid

(3) Phosphoric acid

(4) Pyrophosphoric acid

Q44. Given below are two statements:

Statement I : Iron (III) catalyst, acidified $K_2Cr_2O_7$ and neutral $KMnO_4$ have the ability to oxidise I^- to I_2 independently.

Statement II: Manganate ion is paramagnetic in nature and involves $p\pi - p\pi$ bonding.

In the light of the above statements, choose the correct answer from the options.

(1) Both statement I and Statement II are true

(2) Both statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Statement I is false but Statement II is true

Q45. The total number of $Mn = O$ bonds in Mn_2O_7 is

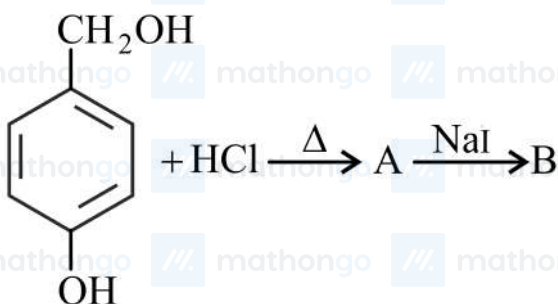
(1) 4

(2) 5

(3) 6

(4) 3

Q46. 



In the above reaction product B is

(1) (2) (3) (4) 

Q47. Match List-I with List-II

List-I

- A Benzenesulphonyl chloride
 B Hoffmann bromamide reaction
 C Carbylamine reaction
 D Hoffmann orientation

List-II

- I Test for primary amines
 II Anti Saytzeff
 III Hinsberg reagent
 IV Known reaction of Isocyanates.

Choose the correct answer from the options given below

- (1) A – IV, B – III, C – II, D – I
 (3) A – III, B – IV, C – I, D – II

- (2) A – IV, B – II, C – I, D – III
 (4) A – IV, B – III, C – I, D – II

Q48. Match List I with List II

List-I**Polymers**

- A Phenol-formaldehyde resin
 B Copolymer of 1, 3-butadiene and styrene
 C Polyester of glycol and phthalic acid
 D Polyester of glycol and terephthalic acid

List-II**Commercial names**

- I Glyptal
 II Novolac
 III Buna-s
 IV Dacron

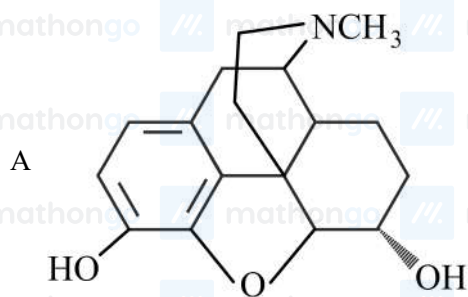
Choose the correct answer from the options given below

- (1) A – II, B – III, C – IV, D – I
 (3) A – II, B – I, C – III, D – IV

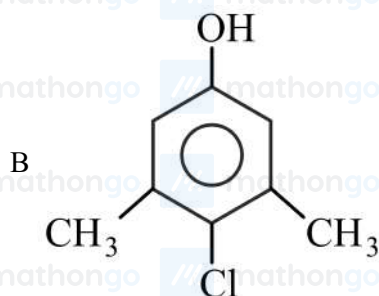
- (2) A – II, B – III, C – I, D – IV
 (4) A – III, B – II, C – IV, D – I

Q49. Match List-I with List-II

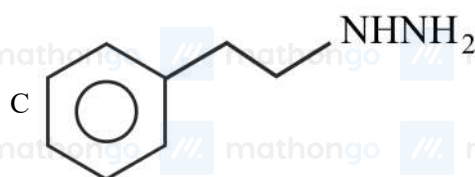
List-I**List-II**



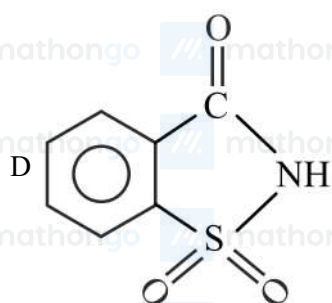
I Anti-depressant



II 550 times sweeter than cane sugar



III Narcotic analgesic



IV Antiseptic

Choose the correct answer from the options given below

- (1) A – IV, B – III, C – II, D – I
 (2) A – III, B – I, C – II, D – IV
 (3) A – III, B – IV, C – I, D – II
 (4) A – III, B – I, C – IV, D – II

Q50. A sugar 'X' dehydrates very slowly under acidic condition to give furfural which on further reaction with resorcinol gives the coloured product after sometime. Sugar 'X' is

- (1) Aldopentose
 (2) Aldotetrose
 (3) Oxalic acid
 (4) Ketotetrose

Q51. Amongst the following the number of oxide(s) which are paramagnetic in nature is

Na_2O , KO_2 , NO_2 , N_2O , ClO_2 , NO , SO_2 , Cl_2O

Q52. According to MO theory, number of species/ions from the following having identical bond order is _____

CN^- , NO^+ , O_2 , O_2^+ , O_2^{2+}

Q53. The molar heat capacity for an ideal gas at constant pressure is $20.785 \text{ J K}^{-1} \text{ mol}^{-1}$. The change in internal energy is 5000 J upon heating it from 300 K to 500 K. The number of moles of the gas at constant volume

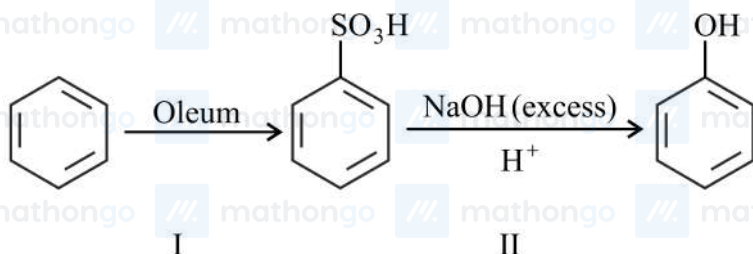
is _____

(Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

Q54. At 310 K, the solubility of CaF_2 in water is $2.34 \times 10^{-3} \text{ g/100 mL}$. The solubility product of CaF_2 is ---- $\times 10^{-8} (\text{mol/L})^3$ (nearest integer). (Given molar mass : $\text{CaF}_2 = 78 \text{ g mol}^{-1}$)

Q55. 20 mL of 0.02 $\text{MK}_2\text{Cr}_2\text{O}_7$ solution is used for the titration of 10 mL of Fe^{2+} solution in the acidic medium. The molarity of Fe^{2+} solution is _____ $\times 10^{-2} \text{ M}$

Q56. In the following reaction



The % yield for reaction I is 60% and that of reaction II is 50%. The overall yield of the complete reaction is %

Q57. $2\text{NO} + 2\text{H}_2 \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$

The above reaction has been studied at 800°C . The related data are given in the table below

Reaction serial number	Initial pressure of H_2 / kPa	Initial Pressure of NO / kPa	Initial rate $\left(\frac{-dp}{dt}\right) / (\text{kPa/s})$
1	65.6	40.0	0.135
2	65.6	20.1	0.033
3	38.6	65.6	0.214
4	19.2	65.6	0.106

The order of the reaction with respect to NO is _____

Q58. In the titration of KMnO_4 and oxalic acid in acidic medium, the change in oxidation number of carbon at the end point is

Q59. The conductivity of a solution of complex with formula $\text{CoCl}_3(\text{NH}_3)_4$ corresponds to 1 : 1 electrolyte, then the primary valency of central metal ion is

Q60. Optical activity of an enantiomeric mixture is $+12.6^\circ$ and the specific rotation of (+) isomer is $+30^\circ$. The optical purity is _____ %

Q61. Let the minimum value v_0 of $v = |z|^2 + |z - 3|^2 + |z - 6i|^2$, $z \in \mathbb{C}$ is attained at $z = z_0$. Then

$$|2z_0^2 - \bar{z}_0^3 + 3|^2 + v_0^2 \text{ is equal to}$$

(1) 1000

(2) 1024

(3) 1105

(4) 1196

Q62. Suppose $a_1, a_2, \dots, a_n, \dots$ be an arithmetic progression of natural numbers. If the ratio of the sum of the first five terms to the sum of first nine terms of the progression is 5 : 17 and $110 < a_{15} < 120$, then the sum of the

first ten terms of the progression is equal to

- (1) 290 (2) 380
(3) 460 (4) 510

Q63. The remainder when $(2021)^{2022} + (2022)^{2021}$ is divided by 7 is

- (1) 0 (2) 1
(3) 2 (4) 6

Q64. Let $A(1, 1)$, $B(-4, 3)$, $C(-2, -5)$ be vertices of a triangle ABC , P be a point on side BC , and Δ_1 and Δ_2 be the areas of triangle APB and ABC . Respectively.

If $\Delta_1 : \Delta_2 = 4 : 7$, then the area enclosed by the lines AP , AC and the x -axis is

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

Q65. If the circle $x^2 + y^2 - 2gx + 6y - 19c = 0$, $g, c \in \mathbb{R}$ passes through the point $(6, 1)$ and its centre lies on the line $x - 2cy = 8$, then the length of intercept made by the circle on x -axis is

- (1) $\sqrt{11}$ (2) 4
(3) 3 (4) $2\sqrt{23}$

Q66. Let $P(a, b)$ be a point on the parabola $y^2 = 8x$ such that the tangent at P passes through the centre of the circle $x^2 + y^2 - 10x - 14y + 65 = 0$. Let A be the product of all possible values of a and B be the product of all possible values of b . Then the value of $A + B$ is equal to

- (1) 0 (2) 25
(3) 40 (4) 65

Q67. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined as $f(x) = a \sin\left(\frac{\pi[x]}{2}\right) + [2 - x]$, $a \in \mathbb{R}$, where $[t]$ is the greatest integer

less than or equal to t . If $\lim_{x \rightarrow -1} f(x)$ exists, then the value of $\int_0^4 f(x) dx$ is equal to

- (1) -1 (2) -2
(3) 1 (4) 2

Q68. $(p \wedge r) \Leftrightarrow (p \wedge (\sim q))$ is equivalent to $(\sim p)$ when r is

- (1) p (2) $\sim p$
(3) q (4) $\sim q$

Q69. Let a vertical tower AB of height $2h$ stands on a horizontal ground. Let from a point P on the ground a man can see upto height h of the tower with an angle of elevation 2α . When from P , he moves a distance d in the direction of \overrightarrow{AP} , he can see the top B of the tower with an angle of elevation α . If $d = \sqrt{7}h$, then $\tan \alpha$ is equal to

- (1) $\sqrt{5} - 2$ (2) $\sqrt{3} - 1$
(3) $\sqrt{7} - 2$ (4) $\sqrt{7} - \sqrt{3}$

Q70. Let R_1 and R_2 be two relations defined on \mathbb{R} by $aR_1b \Leftrightarrow ab \geq 0$ and $aR_2b \Leftrightarrow a \geq b$, then

- (1) R_1 is an equivalence relation but not R_2 (2) R_2 is an equivalence relation but not R_1
 (3) both R_1 and R_2 are equivalence relations (4) neither R_1 nor R_2 is an equivalence relation

Q71. Let $A = \begin{pmatrix} 1 & 2 \\ -2 & -5 \end{pmatrix}$. Let $\alpha, \beta \in \mathbb{R}$ be such that $\alpha A^2 + \beta A = 2I$. Then $\alpha + \beta$ is equal to

- (1) -10 (2) -6
 (3) 6 (4) 10

Q72. Let $f, g : \mathbb{N} - \{1\} \rightarrow \mathbb{N}$ be functions defined by $f(a) = \alpha$, where α is the maximum of the powers of those primes p such that p^α divides a , and $g(a) = a + 1$, for all $a \in \mathbb{N} - \{1\}$. Then, the function $f + g$ is

- (1) one-one but not onto (2) onto but not one-one
 (3) both one-one and onto (4) neither one-one nor onto

Q73. Let a function $f : \mathbb{R} \rightarrow \mathbb{R}$ be defined as:

$$f(x) = \begin{cases} \int_0^x (5 - |t - 3|) dt, & x > 4 \\ x^2 + bx, & x \leq 4 \end{cases}$$

where $b \in \mathbb{R}$. If f is continuous at $x = 4$, then which of the following statements is NOT true?

- (1) f is not differentiable at $x = 4$ (2) $f'(3) + f'(5) = \frac{35}{4}$
 (3) f is increasing in $(-\infty, \frac{1}{8}) \cup (8, \infty)$ (4) f has a local minima at $x = \frac{1}{8}$

Q74. $I = \int_{\frac{\pi}{4}}^{\frac{\pi}{3}} \left(\frac{8 \sin x - \sin 2x}{x} \right) dx$. Then

- (1) $\frac{\pi}{2} < I < \frac{3\pi}{4}$ (2) $\frac{\pi}{5} < I < \frac{5\pi}{12}$
 (3) $\frac{5\pi}{12} < I < \frac{\sqrt{2}}{3}\pi$ (4) $\frac{3\pi}{4} < I < \pi$

Q75. The area of the smaller region enclosed by the curves $y^2 = 8x + 4$ and $x^2 + y^2 + 4\sqrt{3}x - 4 = 0$ is equal to

- (1) $\frac{1}{3} (2 - 12\sqrt{3} + 8\pi)$ (2) $\frac{1}{3} (2 - 12\sqrt{3} + 6\pi)$
 (3) $\frac{1}{3} (4 - 12\sqrt{3} + 8\pi)$ (4) $\frac{1}{3} (4 - 12\sqrt{3} + 6\pi)$

Q76. Let $y = y_1(x)$ and $y = y_2(x)$ be two distinct solutions of the differential equation $\frac{dy}{dx} = x + y$, with $y_1(0) = 0$ and $y_2(0) = 1$ respectively. Then, the number of points of intersection of $y = y_1(x)$ and $y = y_2(x)$ is

- (1) 0 (2) 1
 (3) 2 (4) 3

Q77. Let $\vec{a} = \alpha\hat{i} + \hat{j} + \beta\hat{k}$ and $\vec{b} = 3\hat{i} - 5\hat{j} + 4\hat{k}$ be two vectors, such that $\vec{a} \times \vec{b} = -\hat{i} + 9\hat{j} + 12\hat{k}$. Then the projection of $\vec{b} - 2\vec{a}$ on $\vec{b} + \vec{a}$ is equal to

- (1) 2 (2) $\frac{39}{5}$
 (3) 9 (4) $\frac{46}{5}$

Q78. Let $\vec{a} = 2\hat{i} - \hat{j} + 5\hat{k}$ and $\vec{b} = \alpha\hat{i} + \beta\hat{j} + 2\hat{k}$. If $\left((\vec{a} \times \vec{b}) \times \hat{i} \right) \cdot \hat{k} = \frac{23}{2}$, then $|\vec{b} \times 2\hat{j}|$ is equal to

- (1) 4 (2) 5
 (3) $\sqrt{21}$ (4) $\sqrt{17}$

Q79. If the plane P passes through the intersection of two mutually perpendicular planes $2x + ky - 5z = 1$ and $3kx - ky + z = 5$, $k < 3$ and intercepts a unit length on positive x -axis, then the intercept made by the plane

P on the y -axis is

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

(2) $\frac{5}{11}$

(3) 6

(4) 7

Q80. Let S be the sample space of all five digit numbers. If p is the probability that a randomly selected number from S , is a multiple of 7 but not divisible by 5, then $9p$ is equal to

(1) 1.0146

(2) 1.2085

(3) 1.0285

(4) 1.1521

Q81. Let $S = \{z \in \mathbb{C} : z^2 + \bar{z} = 0\}$. Then $\sum_{z \in S} (\operatorname{Re}(z) + \operatorname{Im}(z))$ is equal to _____.

Q82. Let $f(x) = 2x^2 - x - 1$ and $S = \{n \in \mathbb{Z} : |f(n)| \leq 800\}$. Then, the value of $\sum_{n \in S} f(n)$ is equal to _____.

Q83. If the length of the latus rectum of the ellipse $x^2 + 4y^2 + 2x + 8y - \lambda = 0$ is 4, and l is the length of its major axis, then $\lambda + l$ is equal to _____.

Q84. An ellipse $E : \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ passes through the vertices of the hyperbola $H : \frac{x^2}{49} - \frac{y^2}{64} = -1$. Let the major and minor axes of the ellipse E coincide with the transverse and conjugate axes of the hyperbola H . Let the product of the eccentricities of E and H be $\frac{1}{2}$. If l is the length of the latus rectum of the ellipse E , then the value of $113l$ is equal to _____.

Q85. The mean and variance of 10 observations were calculated as 15 and 15 respectively by a student who took by mistake 25 instead of 15 for one observation. Then, the correct standard deviation is _____.

Q86. Let S be the set containing all 3×3 matrices with entries from $\{-1, 0, 1\}$. The total number of matrices $A \in S$ such that the sum of all the diagonal elements of $A^T A$ is 6 is _____.

Q87. For $k \in \mathbb{R}$, let the solutions of the equation $\cos(\sin^{-1}(x \cot(\tan^{-1}(\cos(\sin^{-1} x)))) = k$, $0 < |x| < \frac{1}{\sqrt{2}}$ be α and β , where the inverse trigonometric functions take only principal values. If the solutions of the equation $x^2 - bx - 5 = 0$ are $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$ and $\frac{\alpha}{\beta}$, then $\frac{b}{k^2}$ is equal to _____.

Q88. Let M and N be the number of points on the curve $y^5 - 9xy + 2x = 0$, where the tangents to the curve are parallel to x -axis and y -axis, respectively. Then the value of $M + N$ equals _____.

Q89. Let $y = y(x)$ be the solution curve of the differential equation $\sin(2x^2) \log_e(\tan x^2) dy + \left(4xy - 4\sqrt{2}x \sin\left(x^2 - \frac{\pi}{4}\right)\right) dx = 0$, $0 < x < \sqrt{\frac{\pi}{2}}$, which passes through the point $\left(\sqrt{\frac{\pi}{6}}, 1\right)$. Then $|y(\sqrt{\frac{\pi}{3}})|$ is equal to _____.

Q90. Let the line $\frac{x-3}{7} = \frac{y-2}{-1} = \frac{z-3}{-4}$ intersect the plane containing the lines $\frac{x-4}{1} = \frac{y+1}{-2} = \frac{z}{1}$ and $4ax - y + 5z - 7a = 0 = 2x - 5y - z - 3$, $a \in \mathbb{R}$ at the point $P(\alpha, \beta, \gamma)$. Then the value of $\alpha + \beta + \gamma$ equals _____.

ANSWER KEYS

1. (2)	2. (1)	3. (2)	4. (4)	5. (2)	6. (2)	7. (3)	8. (1)
9. (3)	10. (1)	11. (1)	12. (1)	13. (2)	14. (2)	15. (3)	16. (2)
17. (4)	18. (3)	19. (1)	20. (4)	21. (1)	22. (18)	23. (48)	24. (16)
25. (136)	26. (1)	27. (2400)	28. (3)	29. (2)	30. (412)	31. (2)	32. (1)
33. (4)	34. (1)	35. (3)	36. (3)	37. (4)	38. (4)	39. (1)	40. (2)
41. (2)	42. (1)	43. (4)	44. (2)	45. (3)	46. (1)	47. (3)	48. (2)
49. (3)	50. (1)	51. (4)	52. (3)	53. (2)	54. (0)	55. (24)	56. (30)
57. (2)	58. (1)	59. (3)	60. (42)	61. (1)	62. (2)	63. (1)	64. (3)
65. (4)	66. (4)	67. (2)	68. (3)	69. (3)	70. (4)	71. (4)	72. (4)
73. (3)	74. (3)	75. (3)	76. (1)	77. (4)	78. (2)	79. (4)	80. (3)
81. (0)	82. (10620)	83. (75)	84. (1552)	85. (2)	86. (5376)	87. (12)	88. (2)
89. (1)	90. (12)						

Q1. A silver wire has a mass $(0.6 \pm 0.006)\text{g}$, radius $(0.5 \pm 0.005)\text{mm}$ and length $(4 \pm 0.04)\text{cm}$. The maximum percentage error in the measurement of its density will be

- (1) 7% (2) 3%
(3) 4% (4) 6%

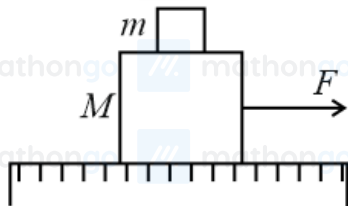
Q2. A projectile is launched at an angle α with the horizontal with a velocity 20 m s^{-1} . After 10 s, its inclination with horizontal is β . The value of $\tan \beta$ will be : ($g = 10\text{ m s}^{-2}$).

- (1) $\tan \alpha + 5 \sec \alpha$ (2) $\tan \alpha - 5 \sec \alpha$
(3) $2 \tan \alpha - 5 \sec \alpha$ (4) $2 \tan \alpha + 5 \sec \alpha$

Q3. A girl standing on road holds her umbrella at 45° with the vertical to keep the rain away. If she starts running without umbrella with a speed of $15\sqrt{2}\text{ km h}^{-1}$, the rain drops hit her head vertically. The speed of rain drops with respect to the moving girl is

- (1) 30 km h^{-1} (2) $\frac{25}{\sqrt{2}}\text{ km h}^{-1}$
(3) $\frac{30}{\sqrt{2}}\text{ km h}^{-1}$ (4) 25 km h^{-1}

Q4. A system of two blocks of masses $m = 2\text{ kg}$ and $M = 8\text{ kg}$ is placed on a smooth table as shown in figure. The coefficient of static friction between two blocks is 0.5. The maximum horizontal force F that can be applied to the block of mass M so that the blocks move together will be ($g = 9.8\text{ m s}^{-2}$)



- (1) 9.8 N (2) 39.2 N
(3) 49 N (4) 78.4 N

Q5. Two blocks of masses 10 kg and 30 kg are placed on the same straight line with coordinates $(0, 0)\text{ cm}$ and $(x, 0)\text{ cm}$ respectively. The block of 10 kg is moved on the same line through a distance of 6 cm towards the other block. The distance through which the block of 30 kg must be moved to keep the position of centre of mass of the system unchanged is

- (1) 4 cm towards the 10 kg block (2) 2 cm away from the 10 kg block
(3) 2 cm towards the 10 kg block (4) 4 cm away from the 10 kg block

Q6. What percentage of kinetic energy of a moving particle is transferred to a stationary particle when it strikes the stationary particle of 5 times its mass?

(Assume the collision to be head-on elastic collision)

- (1) 50.0% (2) 66.6%
(3) 55.6% (4) 33.3%

Q7. Statement I : The law of gravitation holds good for any pair of bodies in the universe.

Statement II : The weight of any person becomes zero when the person is at the centre of the earth.

In the light of the above statements, choose the correct answer from the options given below.

- (1) Statement 1 and statement 2 both are true. (2) Statement 1 is true and statement 2 is false.
 (3) Statement 1 and statement 2 both are false. (4) Statement 1 is false and statement 2 is true.

Q8. The velocity of a small ball of mass m and density d_1 , when dropped in a container filled with glycerine, becomes constant after some time. If the density of glycerine is d_2 , then the viscous force acting on the ball, will be

- (1) $mg\left(1 - \frac{d_1}{d_2}\right)$ (2) $mg\left(1 - \frac{d_2}{d_1}\right)$
 (3) $mg\left(\frac{d_1}{d_2} - 1\right)$ (4) $mg\left(\frac{d_2}{d_1} - 1\right)$

Q9. A mixture of hydrogen and oxygen has volume 2000 cm^3 , temperature 300 K , pressure 100 kPa and mass 0.76 g . The ratio of number of moles of hydrogen to number of moles of oxygen in the mixture will be

[Take gas constant $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$]

- (1) $\frac{1}{3}$ (2) $\frac{3}{1}$
 (3) $\frac{1}{16}$ (4) $\frac{16}{1}$

Q10. The displacement of simple harmonic oscillator after 3 seconds starting from its mean position is equal to half of its amplitude. The time period of harmonic motion is

- (1) 12 s (2) 8 s
 (3) 36 s (4) 6 s

Q11. An observer moves towards a stationary source of sound with a velocity one-fifth of the velocity of sound. The percentage change in the apparent frequency is

- (1) zero (2) 5%
 (3) 10% (4) 20%

Q12. A force of 10 N acts on a charged particle placed between two plates of a charged capacitor. If one plate of capacitor is removed, then the force acting on that particle will be.

- (1) 5 N (2) 10 N
 (3) 20 N (4) Zero

Q13. A 72Ω galvanometer is shunted by a resistance of 8Ω . The percentage of the total current which passes through the galvanometer is

- (1) 0.1% (2) 10%
 (3) 25% (4) 0.25%

Q14. The susceptibility of a paramagnetic material is 99 . The permeability of the material in Wb/A-m , is

[Permeability of free space $\mu_0 = 4\pi \times 10^{-7} \text{ Wb/A-m}$]

- (1) $4\pi \times 10^{-5}$ (2) $4\pi \times 10^{-6}$
 (3) $4\pi \times 10^{-7}$ (4) $4\pi \times 10^{-4}$

Q15. The current flowing through an ac circuit is given by $I = 5 \sin(120\pi t) \text{ A}$. How long will the current take to reach the peak value starting from zero?

- (1) $\frac{1}{60} \text{ s}$ (2) 60 s
 (3) $\frac{1}{120} \text{ s}$ (4) $\frac{1}{240} \text{ s}$

Q16. Match List - I with List - II

List-I

- (a) Ultraviolet rays
(b) Microwaves
(c) Infrared waves
(d) X-rays

List-II

- (i) Study crystal structure
(ii) Greenhouse effect
(iii) Sterilizing surgical instrument
(iv) Radar system

(1) (a) – (iii), (b)(iv), (c) – (ii), (d) – (i)

(2) (a) – (iii), (b)(i), (c) – (ii), (d) – (iv)

(3) (a) – (iv), (b)(iii), (c) – (ii), (d) – (i)

(4) (a) – (iii), (b)(iv), (c) – (i), (d) – (ii)

Q17. Consider a light ray travelling in air is incident into a medium of refractive index $\sqrt{2}n$. The incident angle is twice that of refracting angle. Then, the angle of incidence will be

(1) $\sin^{-1} \sqrt{n}$

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

(3) $\sin^{-1} (\sqrt{2n})$

(4) $2 \cos^{-1} \left(\sqrt{\frac{n}{2}} \right)$

Q18. An α particle and a carbon 12 atom has same kinetic energy K . The ratio of their de-Broglie wavelengths

($\lambda_\alpha : \lambda_{C12}$) is

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

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

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

(4) $3 : 1$

Q19. A hydrogen atom in its ground state absorbs 10.2 eV of energy. The angular momentum of electron of the hydrogen atom will increase by the value of (Given, Planck's constant = 6.6×10^{-34} Js).

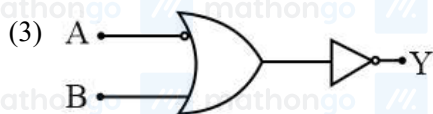
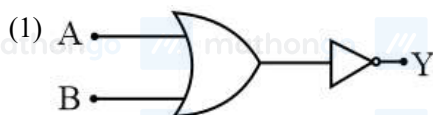
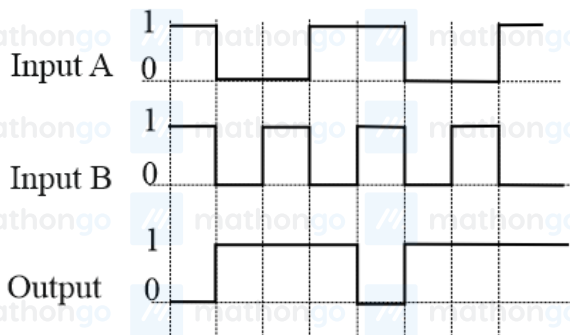
(1) 2.10×10^{-34} Js

(2) 1.05×10^{-34} Js

(3) 3.15×10^{-34} Js

(4) 4.2×10^{-34} Js

Q20. Identify the correct Logic Gate for the following output (Y) of two inputs A and B.



Q21. A pendulum of length 2 m consists of a wooden bob of mass 50 g. A bullet of mass 75 g is fired towards the stationary bob with a speed v . The bullet emerges out of the bob with a speed $\frac{v}{3}$ and the bob just completes the vertical circle. The value of v is _____ m s^{-1} (if $g = 10 \text{ m s}^{-2}$).

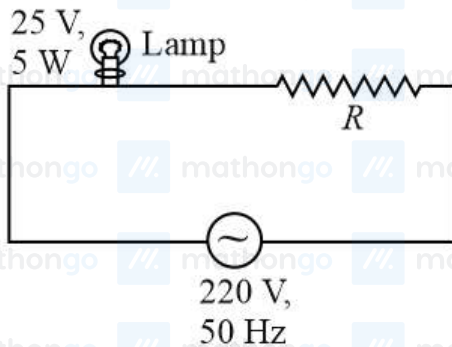
Q22. The area of cross-section of a large tank is 0.5 m^2 . It has a narrow opening near the bottom having area of cross-section 1 cm^2 . A load of 25 kg is applied on the water at the top in the tank. Neglecting the speed of water in the tank, the velocity of the water, coming out of the opening at the time when the height of water level in the tank is 40 cm above the bottom, will be _____ cm s^{-1} .

[Take $g = 10 \text{ m s}^{-2}$]

Q23. In a carnot engine, the temperature of reservoir is 527°C and that of sink is 200 K . If the workdone by the engine when it transfers heat from reservoir to sink is 12000 kJ , the quantity of heat absorbed by the engine from reservoir is _____ $\times 10^6 \text{ J}$.

Q24. A capacitor of capacitance 50 pF is charged by 100 V source. It is then connected to another uncharged identical capacitor. Electrostatic energy loss in the process is _____ nJ .

Q25. A 220 V , 50 Hz AC source is connected to a 25 V , 5 W lamp and an additional resistance R in series (as shown in figure) to run the lamp at its peak brightness, then the value of R (in ohm) will be



Q26. A cell, shunted by a 8Ω resistance, is balanced across a potentiometer wire of length 3 m . The balancing length is 2 m when the cell is shunted by 4Ω resistance. The value of internal resistance of the cell will be _____ Ω .

Q27. The current density in a cylindrical wire of radius 4 mm is $4 \times 10^6 \text{ A m}^{-2}$. The current through the outer portion of the wire between radial distances $\frac{R}{2}$ and R is _____ $\pi \text{ A}$.

Q28. In Young's double slit experiment the two slits are 0.6 mm distance apart. Interference pattern is observed on a screen at a distance 80 cm from the slits. The first dark fringe is observed on the screen directly opposite to one of the slits. The wavelength of light will be _____ nm .

Q29. A beam of monochromatic light is used to excite the electron in Li^{++} from the first orbit to the third orbit. The wavelength of monochromatic light is found to be $x \times 10^{-10} \text{ m}$. The value of x is _____.
[Given $hc = 1242 \text{ eV nm}$]

Q30. The height of a transmitting antenna at the top of a tower is 25 m and that of receiving antenna is, 49 m . The maximum distance between them, for satisfactory communication in LOS (Line-Of-Sight) is $K\sqrt{5} \times 10^2 \text{ m}$. The value of K is _____.
(Assume radius of Earth is $64 \times 10^5 \text{ m}$) [Calculate upto nearest integer value]

Q31. Given below are two statements : one is labelled as Assertion and the other is labelled as Reason.

Assertion: The ionic radii of O^{2-} and Mg^{2+} are same.

Reason: Both O^{2-} and Mg^{2+} are isoelectronic species.

In the light of the above statements, choose the correct answer from the options given below.

- (1) Both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(3) Assertion is true but Reason is false.
(4) Assertion is false but Reason is true.

Q32. Based upon VSEPR theory, match the shape (geometry) of the molecules in List-I with the molecules in List-II and select the most appropriate option.

List-I

(Shape)

- A T-shaped
B Trigonal planar
C Square planar
D See-saw

List-II

(Molecules)

- I. XeF_4
II. SF_4
III. ClF_3
IV. BF_3

- (1) (A) – (I), (B) – (II), (C) – (III), (D) – (IV)
(2) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)
(3) (A) – (III), (B) – (IV), (C) – (II), (D) – (I)
(4) (A) – (IV), (B) – (III), (C) – (I), (D) – (II)

Q33. Match List - I with List - II.

List-I

- (A) Spontaneous process
(B) Process with $\Delta P = 0, \Delta T = 0$
(C) $\Delta H_{\text{reaction}}$
(D) Exothermic Process

List-II

- (I) $\Delta H < 0$
(II) $\Delta G_{T,P} < 0$
(III) Isothermal and isobaric process

[Bond energies of molecules in reactants]

(IV) -

[Bond energies of product molecules]

Choose the correct answer from the options given below

- (1) (A) – (III), (B) – (II), (C) – (IV), (D) – (I)
(2) (A) – (II), (B) – (III), (C) – (IV), (D) – (I)
(3) (A) – (II), (B) – (III), (C) – (I), (D) – (IV)
(4) (A) – (II), (B) – (I), (C) – (III), (D) – (IV)

Q34. Addition of H_2SO_4 to BaO_2 produces

- (1) BaO, SO_2 and H_2O
(2) $BaHSO_4$ and O_2
(3) $BaSO_4, H_2$ and O_2
(4) $BaSO_4$ and H_2O_2

Q35. $BeCl_2$ reacts with $LiAlH_4$ to give

- (1) $Be + Li[AlCl_4] + H_2$
(2) $Be + AlH_3 + LiCl + HCl$
(3) $BeH_2 + LiCl + AlCl_3$
(4) $BeH_2 + Li[AlCl_4]$

Q36. Match List - I with List - II.

List-I

(Si-Compounds)

- A $(CH_3)_4Si$
B $(CH_3)_2Si(OH)_2$
C $(CH_3)_3Si(OH)_2$

List-II

(Si-Polymeric/Other Products)

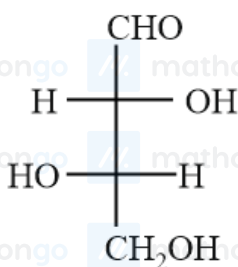
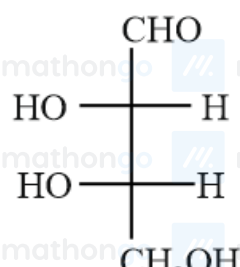
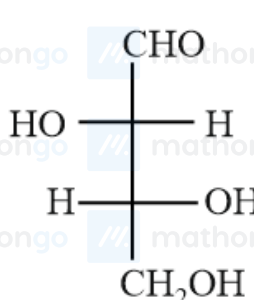
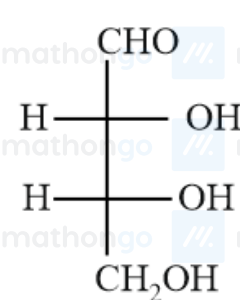
- I Chain Silicone
II Dimeric Silicone
III Silane

D $(\text{CH}_3)_3\text{Si}(\text{OH})$ IV 2 D- Silicone

Choose the correct answer from the options given below

- (1) (A) – (III), (B) – (II), (C) – (I), (D) – (IV) (2) (A) – (IV), (B) – (I), (C) – (II), (D) – (III)
 (3) (A) – (II), (B) – (I), (C) – (IV), (D) – (III) (4) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)

Q37. L-isomer of a compound 'A' ($\text{C}_4\text{H}_8\text{O}_4$) gives a positive test with $[\text{Ag}(\text{NH}_3)_2]^+$. Treatment of 'A' with acetic anhydride yields triacetate derivative. Compound 'A' produces an optically active compound (B) and an optically inactive compound (C) on treatment with bromine water and HNO_3 respectively. Compound (A) is :

- (1)  (2) 
- (3)  (4) 

Q38. Given below are two Statements :

Statement I : Classical smog occurs in cool humid climate. It is a reducing mixture of smoke, fog and sulphur dioxide.

Statement II : Photochemical smog has components, ozone, nitric oxide, acrolein, formaldehyde, PAN etc.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
 (3) Statement I is incorrect but Statement II is correct. (4) Statement I is correct but Statement II is incorrect.

Q39. Given below are two statements : one is labelled as Assertion and the other is labelled as Reason.

Assertion: At 10°C , the density of a 5 M solution of KCl [atomic masses of K & Cl are 39 & 35.5 g mol^{-1} respectively], is 'x' gml^{-1} . The solution is cooled to -21°C . The molality of the solution will remain unchanged.

Reason: The molality of a solution does not change with temperature as mass remains unaffected with temperature.

In the light of the above statements, choose the correct answer from the options given below.

- (1) Assertion is true but Reason is false. (2) Assertion is false but Reason is true.
 (3) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (4) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

Q40. Match List - I with List - II.

List-I

- A Lyophilic colloid
- B Emulsion
- C Positively charged colloid
- D Negatively charged colloid

List-II

- I Liquid-liquid colloid
- II Protective colloid
- III $\text{FeCl}_3 + \text{NaOH}$
- IV $\text{FeCl}_3 + \text{hot water}$

Choose the correct answer from the options given below

- (1) (A) – (II), (B) – (I), (C) – (IV), (D) – (III)
- (2) (A) – (III), (B) – (I), (C) – (IV), (D) – (II)
- (3) (A) – (II), (B) – (I), (C) – (III), (D) – (IV)
- (4) (A) – (III), (B) – (II), (C) – (I), (D) – (IV)

Q41. Match List - I with List - II.

List-I

- A Concentration of gold ore
- B Leaching of alumina
- C Froth stabiliser
- D Blister copper

List-II

- I Aniline
- II NaOH
- III SO_2
- IV NaCN

Choose the correct answer from the options given below.

- (1) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)
- (2) (A) – (IV), (B) – (II), (C) – (I), (D) – (III)
- (3) (A) – (III), (B) – (II), (C) – (I), (D) – (IV)
- (4) (A) – (II), (B) – (IV), (C) – (III), (D) – (I)

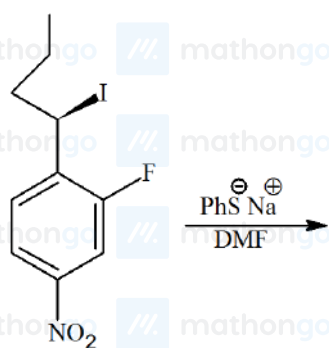
Q42. Heating white phosphorus with conc. NaOH solution gives mainly

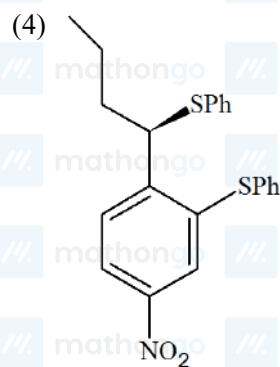
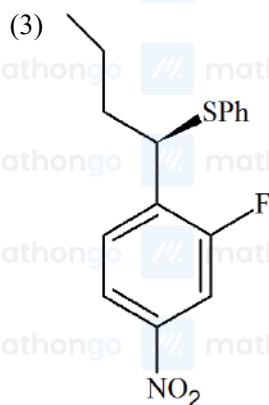
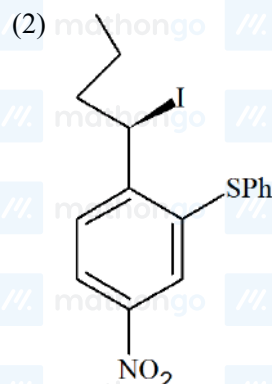
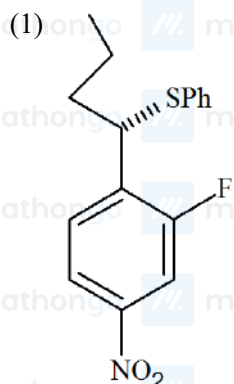
- (1) Na_3P and H_2O
- (2) H_3PO and NaH
- (3) P(OH)_3 and NaH_2PO_4
- (4) PH_3 and NaH_2PO_2

Q43. Which of the following will have maximum stabilization due to crystal field?

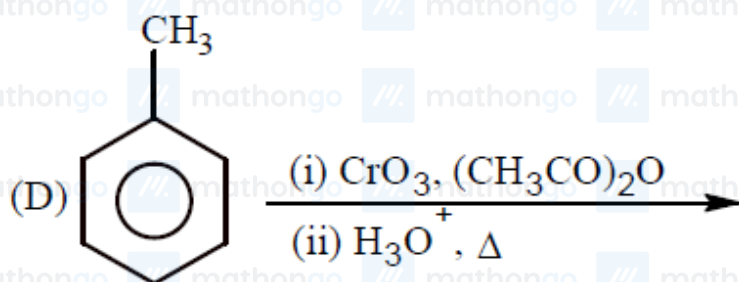
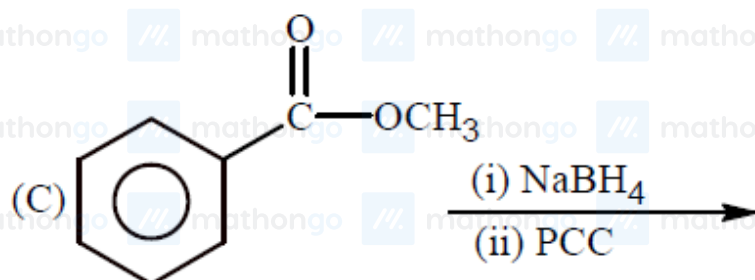
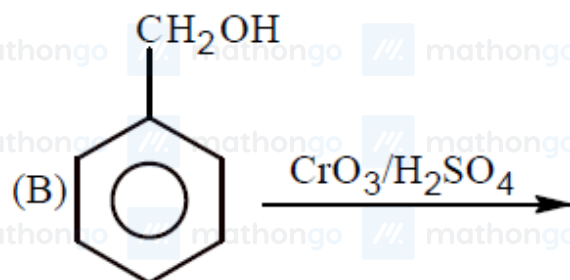
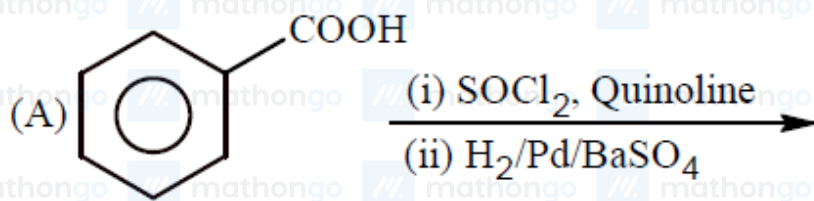
- (1) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
- (2) $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- (3) $[\text{Co}(\text{CN})_6]^{3-}$
- (4) $[\text{Cu}(\text{NH}_3)_4]^{2+}$

Q44. The major product of the following reaction is





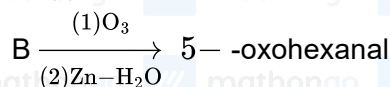
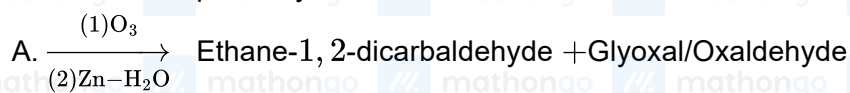
Q45. Which of the following reactions will yield benzaldehyde as a product?



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

- (2) C & D
(4) A & C

Q46. 'A' and 'B' respectively are



- (1) 1-methylcyclohex-1, 3-diene & cyclopentene. (2) Cyclohex-1, 3-diene & cyclopentene
(3) Cyclohex-1, 3-diene & 1-methylcyclopent-1-ene (4) 1-methylcyclohex-1, 4-diene & 1-methylcyclopent-1-ene

Q47. Given below are two statements :

Statement - I : In Hofmann degradation reaction, the migration of only an alkyl group takes place from carbonyl carbon of the amide to the nitrogen atom.

Statement - II : The group is migrated in Hofmann degradation reaction to electron deficient atom.

In the light of the above statements, choose the most appropriate answer from the options given below

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
 (3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q48. Match List - I with List - II.

List-I**(Polymer)**

- A Bakelite
 B Glyptal
 C PVC
 D Polystyrene

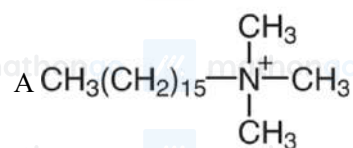
List-II**(Used in)**

- I Radio and television cabinets
 II Electrical switches
 III Paints and Lacquers
 IV Water pipes

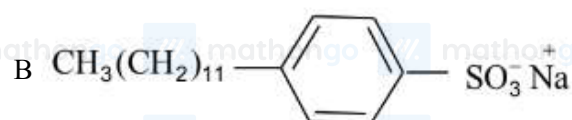
Choose the correct answer from the options given below

- (1) (A) – (II), (B) – (III), (C) – (I), (D) – (IV) (2) (A) – (II), (B) – (III), (C) – (IV), (D) – (I)
 (3) (A) – (I), (B) – (II), (C) – (III), (D) – (IV) (4) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)

Q49. Match List - I with List - II.

List-I**List-II**

- I Dishwashing powder



- II Toothpaste



- III Laundry soap



- IV Hair conditioner

Choose the correct answer from the options given below

- (1) (A) – (IV), (B) – (II), (C) – (III), (D) – (I) (2) (A) – (III), (B) – (II), (C) – (IV), (D) – (I)
 (3) (A) – (IV), (B) – (III), (C) – (II), (D) – (I) (4) (A) – (II), (B) – (IV), (C) – (I), (D) – (II)

Q50. Which of the following is structure of a separating funnel?



Q51. If the uncertainty in velocity and position of a minute particle in space are, $2.4 \times 10^{-26} (\text{ms}^{-1})$ and $10^{-7} (\text{m})$ respectively. The mass of the particle in g is ____ (Nearest integer)
(Given : $h = 6.626 \times 10^{-34} \text{ Js}$)

Q52. $2 \text{NOCl(g)} \rightleftharpoons 2 \text{NO(g)} + \text{Cl}_2(\text{g})$

In an experiment, 2.0 moles of NOCl was placed in a one-litre flask and the concentration of NO after equilibrium established, was found to be 0.4 mol /L. The equilibrium constant at 30°C is ____ $\times 10^{-4}$.

Q53. Total number of possible stereoisomers of dimethyl cyclopentane is

Q54. Metal deficiency defect is shown by $\text{Fe}_{0.93} \text{O}$. In the crystal, some Fe^{2+} cations are missing and loss of positive charge is compensated by the presence of Fe^{3+} ions. The percentage of Fe^{2+} ions in the $\text{Fe}_{0.93} \text{O}$ crystals is ____ (Nearest integer)

Q55. Two elements A and B which form 0.15 moles of A_2B and AB_3 type compounds. If both A_2B and AB_3 weigh equally, then the atomic weight of A is ____ times of atomic weight of B.

Q56. 2 g of a non-volatile non-electrolyte solute is dissolved in 200 g of two different solvents A and B whose ebullioscopic constants are in the ratio of 1 : 8. The elevation in boiling points of A and B are in the ratio $\frac{x}{y}$ (x : y). The value of y is ____ (Nearest Integer)

Q57. The limiting molar conductivities of NaI, NaNO_3 and AgNO_3 are 12.7, 12.0 and 13.3 $\text{mSm}^2 \text{mol}^{-1}$, respectively (all at 25°C). The limiting molar conductivity of AgI at this temperature is ____ $\text{mSm}^2 \text{mol}^{-1}$.

Q58. The rate constant for a first order reaction is given by the following equation :

$$\ln k = 33.24 - \frac{2.0 \times 10^4 \text{ K}}{T}$$

The Activation energy for the reaction is given by kJmol^{-1} . (In Nearest integer) (Given :

$$R = 8.3 \text{ J K}^{-1} \text{mol}^{-1})$$

Q59. The number of statement(s) correct from the following for Copper is/are

- (A) Cu(II) complexes are always paramagnetic
 (B) Cu(I) complexes are generally colourless
 (C) Cu(I) is easily oxidized
 (D) In Fehling solution, the active reagent has Cu(I)

Q60. Acidified potassium permanganate solution oxidises oxalic acid. The spin-only magnetic moment of the manganese product formed from the above reaction is B.M. ____ (Nearest Integer)

Q61. The area of the polygon, whose vertices are the non-real roots of the equation $\bar{z} = iz^2$ is

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

Q62. If $x = \sum_{n=0}^{\infty} a^n$, $y = \sum_{n=0}^{\infty} b^n$, $z = \sum_{n=0}^{\infty} c^n$, where a, b, c are in A.P. and $|a| < 1, |b| < 1, |c| < 1, abc \neq 0$, then

- (1) x, y, z are in A.P. (2) x, y, z are in G.P.
 (3) $\frac{1}{x}, \frac{1}{y}, \frac{1}{z}$ are in A.P. (4) $\frac{1}{x} + \frac{1}{y} + \frac{1}{z} = 1 - (a + b + c)$

Q63. The value of $\cos\left(\frac{2\pi}{7}\right) + \cos\left(\frac{4\pi}{7}\right) + \cos\left(\frac{6\pi}{7}\right)$ is equal to

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

Q64. In an isosceles triangle ABC , the vertex A is $(6, 1)$ and the equation of the base BC is $2x + y = 4$. Let the point B lie on the line $x + 3y = 7$. If (α, β) is the centroid ΔABC , then $15(\alpha + \beta)$ is equal to

- (1) 51 (2) 39
 (3) 41 (4) 49

Q65. Let the eccentricity of an ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1, a > b$, be $\frac{1}{4}$. If this ellipse passes through the point

$\left(-4\sqrt{\frac{2}{5}}, 3\right)$, then $a^2 + b^2$ is equal to

- (1) 29 (2) 31
 (3) 32 (4) 34

Q66. Let a be an integer such that $\lim_{x \rightarrow 7} \frac{18 - [1-x]}{[x-3a]}$ exists, where $[t]$ is greatest integer $\leq t$. Then a is equal to

- (1) -2 (2) 6
 (3) -6 (4) -7

Q67. The boolean expression $(\sim(p \wedge q)) \vee q$ is equivalent to

- (1) $q \rightarrow (p \wedge q)$ (2) $p \rightarrow q$
 (3) $p \rightarrow (p \rightarrow q)$ (4) $p \rightarrow (p \vee q)$

Q68. Let the system of linear equations $x + 2y + z = 2, \alpha x + 3y - z = \alpha, -\alpha x + y + 2z = -\alpha$ be inconsistent. Then α is equal to

- (1) $\frac{5}{2}$ (2) $-\frac{5}{2}$
 (3) $\frac{7}{2}$ (4) $-\frac{7}{2}$

Q69. $\sin^{-1}\left(\sin \frac{2\pi}{3}\right) + \cos^{-1}\left(\cos \frac{7\pi}{6}\right) + \tan^{-1}\left(\tan \frac{3\pi}{4}\right)$ is equal to

(1) $\frac{11\pi}{12}$
 (3) $\frac{31\pi}{12}$

(2) $\frac{17\pi}{12}$
 (4) $-\frac{3\pi}{4}$

Q70. If $\cos^{-1}\left(\frac{y}{2}\right) = \log_e\left(\frac{x}{5}\right)^5$, $|y| < 2$, then

(1) $x^2 y'' + xy' - 25y = 0$
 (3) $x^2 y'' - xy' + 25y = 0$

(2) $x^2 y'' - xy' - 25y = 0$
 (4) $x^2 y'' + xy' + 25y = 0$

Q71. The number of distinct real roots of $x^4 - 4x + 1 = 0$ is

(1) 0
 (3) 2

(2) 1
 (4) 4

Q72. The lengths of the sides of a triangle are $10 + x^2$, $10 + x^2$ and $20 - 2x^2$. If for $x = k$, the area of the triangle is maximum, then $3k^2$ is equal to

(1) 5
 (3) 10

(2) 12
 (4) 20

Q73. $\int \frac{(x^2+1)e^x}{(x+1)^2} dx = f(x)e^x + C$, where C is a constant, then $\frac{d^3 f}{dx^3}$ at $x = 1$ is equal to

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

(2) $\frac{3}{8}$
 (4) $\frac{7}{8}$

Q74. The value of the integral $\int_{-2}^2 \frac{|x^3+x|}{(e^{|x|}+1)} dx$ is equal to

(1) $5e^2$
 (3) 4

(2) $3e^{-2}$
 (4) 6

Q75. Let $\frac{dy}{dx} = \frac{ax-by+a}{bx+cy+a}$, where a, b, c are constants. represent a circle passing through the point $(2, 5)$. Then the shortest distance of the point $(11, 6)$ from this circle is

(1) 10
 (3) 7

(2) 8
 (4) 5

Q76. If $\frac{dy}{dx} + \frac{2^{x-y}(2^y-1)}{2^x-1} = 0$, $x, y > 0$, $y(1) = 1$, then $y(2)$ is equal to

(1) $2 + \log_2 3$
 (3) $2 - \log_{-2} 3$

(2) $2 + \log_2 2$
 (4) $2 - \log_2 3$

Q77. Let $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{c} = 2\hat{i} - 3\hat{j} + 2\hat{k}$. Then the number of vectors \vec{b} such that $\vec{b} \times \vec{c} = \vec{a}$ and

$|\vec{b}| \in \{1, 2, \dots, 10\}$ is

(1) 0
 (3) 2

(2) 1
 (4) 3

Q78. If two straight lines whose direction cosines are given by the relations $l + m - n = 0$, $3l^2 + m^2 + cnl = 0$ are parallel, then the positive value of c is

(1) 6
 (3) 3

(2) 4
 (4) 2

Q79. Five numbers x_1, x_2, x_3, x_4, x_5 are randomly selected from the numbers $1, 2, 3, \dots, 18$ and are arranged in the increasing order ($x_1 < x_2 < x_3 < x_4 < x_5$). The probability that $x_2 = 7$ and $x_4 = 11$ is

(1) $\frac{1}{136}$
 (3) $\frac{7}{68}$

(2) $\frac{1}{68}$
 (4) $\frac{5}{68}$

Q80. Let X be a random variable having binomial distribution $B(7, p)$. If $P(X = 3) = 5P(X = 4)$, then the sum of the mean and the variance of X is

(1) $\frac{105}{16}$
 (3) $\frac{31}{36}$

(2) $\frac{77}{36}$
 (4) $\frac{35}{36}$

Q81. The number of ways, 16 identical cubes, of which 11 are blue and rest are red, can be placed in a row so that between any two red cubes there should be at least 2 blue cubes, is _____.

Q82. If the sum of the first ten terms of the series $\frac{1}{5} + \frac{2}{65} + \frac{3}{325} + \frac{4}{1025} + \frac{5}{2501} + \dots$ is $\frac{m}{n}$, where m and n are co-prime numbers, then $m + n$ is equal to _____.

Q83. If the coefficient of x^{10} in the binomial expansion of $\left(\frac{\sqrt{x}}{5^{\frac{1}{4}}} + \frac{\sqrt{5}}{x^{\frac{1}{3}}}\right)^{60}$ is $5^k l$, where $l, k \in N$ and l is coprime to 5, then k is equal to _____.

Q84. A rectangle R with end points of the one of its sides as $(1, 2)$ and $(3, 6)$ is inscribed in a circle. If the equation of a diameter of the circle is $2x - y + 4 = 0$, then the area of R is _____.

Q85. A circle of radius 2 unit passes through the vertex and the focus of the parabola $y^2 = 2x$ and touches the parabola $y = \left(x - \frac{1}{4}\right)^2 + \alpha$, where $\alpha > 0$. Then $(4\alpha - 8)^2$ is equal to _____.

Q86. The positive value of the determinant of the matrix A , whose $Adj(Adj(A)) = \begin{bmatrix} 14 & 28 & -14 \\ -14 & 14 & 28 \\ 28 & -14 & 14 \end{bmatrix}$, is _____.

Q87. Let $f : R \rightarrow R$ be a function defined $f(x) = \frac{2e^{2x}}{e^{2x} + e}$. Then $f\left(\frac{1}{100}\right) + f\left(\frac{2}{100}\right) + f\left(\frac{3}{100}\right) + \dots + f\left(\frac{99}{100}\right)$ is equal to _____.

Q88. If the sum of all the roots of the equation $e^{2x} - 11e^x - 45e^{-x} + \frac{81}{2} = 0$ is $\log_e P$, then P is equal to _____.

Q89. Let $A_1 = \{(x, y) : |x| \leq y^2, |x| + 2y \leq 8\}$ and $A_2 = \{(x, y) : |x| + |y| \leq k\}$. If $27(\text{Area } A_1) = 5(\text{Area } A_2)$, then k is equal to _____.

Q90. Let the mirror image of the point (a, b, c) with respect to the plane $3x - 4y + 12z + 19 = 0$ be $(a - 6, \beta, \gamma)$.

If $a + b + c = 5$, then $7\beta - 9\gamma$ is equal to _____.

ANSWER KEYS

1. (3)	2. (2)	3. (3)	4. (3)	5. (3)	6. (3)	7. (1)	8. (2)
9. (2)	10. (3)	11. (4)	12. (1)	13. (2)	14. (1)	15. (4)	16. (1)
17. (4)	18. (1)	19. (2)	20. (2)	21. (10)	22. (300)	23. (16)	24. (125)
25. (975)	26. (8)	27. (48)	28. (450)	29. (114)	30. (192)	31. (4)	32. (2)
33. (2)	34. (4)	35. (3)	36. (4)	37. (2)	38. (1)	39. (3)	40. (1)
41. (2)	42. (4)	43. (3)	44. (1)	45. (3)	46. (3)	47. (1)	48. (2)
49. (1)	50. (1)	51. (22)	52. (125)	53. (6)	54. (85)	55. (2)	56. (8)
57. (14)	58. (166)	59. (3)	60. (6)	61. (2)	62. (3)	63. (2)	64. (1)
65. (2)	66. (3)	67. (4)	68. (4)	69. (1)	70. (4)	71. (3)	72. (3)
73. (1)	74. (4)	75. (2)	76. (4)	77. (1)	78. (1)	79. (2)	80. (2)
81. (56)	82. (276)	83. (5)	84. (16)	85. (63)	86. (14)	87. (99)	88. (45)
89. (6)	90. (137)						

Q1. A small toy starts moving from the position of rest under a constant acceleration. If it travels a distance of 10 m in t s, the distance travelled by the toy in the next t s will be:

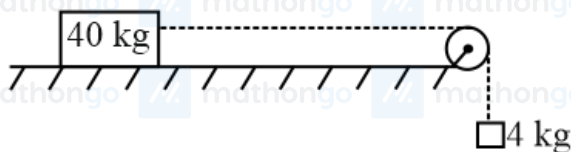
- (1) 10 m (2) 20 m
(3) 30 m (4) 40 m

Q2. A person can throw a ball upto a maximum range of 100 m. How high above the ground he can throw the same ball?

- (1) 25 m (2) 50 m
(3) 100 m (4) 200 m

Q3. A block of mass 40 kg slides over a surface, when a mass of 4 kg is suspended through an inextensible massless string passing over frictionless pulley as shown below.

The coefficient of kinetic friction between the surface and block is 0.02. The acceleration of block is: (Given $g = 10 \text{ m s}^{-2}$.)

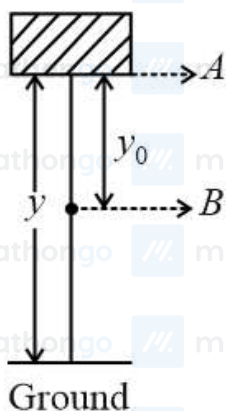


- (1) $\frac{8}{11} \text{ m s}^{-2}$ (2) 1 m s^{-2}
(3) $\frac{1}{5} \text{ m s}^{-2}$ (4) $\frac{4}{5} \text{ m s}^{-2}$

Q4. A block of mass M placed inside a box descends vertically with acceleration a . The block exerts a force equal to one-fourth of its weight on the floor of the box. The value of $|a|$ will be

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

Q5. In the given figure, the block of mass m is dropped from the point A . The expression for kinetic energy of block when it reaches point B is



- (1) mgy_0 (2) $\frac{1}{2}mgy_0^2$
(3) $\frac{1}{2}mgy^2$ (4) $mg(y - y_0)$

Q6. The time period of a satellite revolving around earth in a given orbit is 7 hours. If the radius of orbit is increased to three times its previous value, then approximate new time period of the satellite will be

- (1) 36 hours (2) 40 hours
(3) 30 hours (4) 25 hours

Q7. At what temperature a gold ring of diameter 6.230 cm be heated so that it can be fitted on a wooden bangle of diameter 6.241 cm? Both the diameters have been measured at room temperature (27°C).

(Given: coefficient of linear thermal expansion of gold $\alpha_L = 1.4 \times 10^{-5} \text{ K}^{-1}$)

- (1) 125.7°C (2) 91.7°C
(3) 425.7°C (4) 152.7°C

Q8. Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways.

The work done by the gas is W_1 if the process is purely isothermal, W_2 , if the process is purely adiabatic and W_3 if the process is purely isobaric. Then, choose the correct option

- (1) $W_2 < W_1 < W_3$ (2) $W_1 < W_2 < W_3$
(3) $W_2 < W_3 < W_1$ (4) $W_3 < W_1 < W_2$

Q9. A vessel contains 16 g of hydrogen and 128 g of oxygen at standard temperature and pressure. The volume of the vessel in cm^3 is :

- (1) 72×10^5 (2) 32×10^5
(3) 27×10^4 (4) 54×10^4

Q10. The motion of a simple pendulum executing S.H.M. is represented by the following equation

$y = A \sin(\pi t + \phi)$, where time is measured in second. The length of pendulum is

- (1) 97.23 cm (2) 25.3 cm
(3) 99.4 cm (4) 406.1 cm

Q11. Two point charges Q each are placed at a distance d apart. A third point charge q is placed at a distance x from mid-point on the perpendicular bisector. The value of x at which charge q will experience the maximum Coulomb's force is:

- (1) d (2) $\frac{d}{2}$
(3) $\frac{d}{\sqrt{2}}$ (4) $\frac{d}{2\sqrt{2}}$

Q12. If the electric potential at any point (x, y, z) m in space is given by $V = 3x^2$ volt. The electric field at the point $(1, 0, 3)$ m will be :

- (1) 3 Vm^{-1} , directed along positive x -axis. (2) 3 Vm^{-1} , directed along negative x -axis.
(3) 6 Vm^{-1} , directed along negative x -axis. (4) 6 Vm^{-1} , directed along positive x -axis.

Q13. A capacitor is discharging through a resistor R . Consider in time t_1 , the energy stored in the capacitor reduces to half of its initial value and in time t_2 , the charge stored reduces to one eighth of its initial value. The ratio $\frac{t_1}{t_2}$ will be

- (1) $\frac{1}{2}$ (2) $\frac{1}{3}$
(3) $\frac{1}{4}$ (4) $\frac{1}{6}$

Q14. The combination of two identical cells, whether connected in series or parallel combination provides the same current through an external resistance of 2Ω . The value of internal resistance of each cell is

- (1) 2Ω (2) 4Ω
(3) 6Ω (4) 8Ω

Q15. Two long current carrying conductors are placed parallel to each other at a distance of 8 cm between them. The magnitude of magnetic field produced at mid-point between the two conductors due to current flowing in

them is $300 \mu\text{T}$. The equal current flowing in the two conductors is :

- (1) 30 A in the same direction. (2) 60 A in the opposite direction.
(3) 30 A in the opposite direction. (4) 300 A in the opposite direction.

Q16. Given below are two statements :

Statement I: The electric force changes the speed of the charged particle and hence changes its kinetic energy; whereas the magnetic force does not change the kinetic energy of the charged particle.

Statement II: The electric force accelerates the positively charged particle perpendicular to the direction of electric field. The magnetic force accelerates the moving charged particle along the direction of magnetic field.

In the light of the above statements, choose the most appropriate answer from the options given below :

- (1) Both Statement I and Statement II are correct. (2) Both Statement I and Statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect. (4) Statement I is incorrect but Statement II is correct.

Q17. The speed of light in media A and B are $2.0 \times 10^{10} \text{ cm s}^{-1}$ and $1.5 \times 10^{10} \text{ cm s}^{-1}$ respectively. A ray of light enters from the medium B to A at an incident angle θ . If the ray suffers total internal reflection, then

- (1) $\theta = \sin^{-1}\left(\frac{4}{3}\right)$ (2) $\theta > \sin^{-1}\left(\frac{2}{3}\right)$
(3) $\theta > \sin^{-1}\left(\frac{3}{4}\right)$ (4) $\theta < \sin^{-1}\left(\frac{3}{4}\right)$

Q18. The electric field at a point associated with a light wave is given by

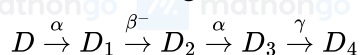
$$E = 200 [\sin(6 \times 10^{15})t + \sin(9 \times 10^{15})t] \text{ Vm}^{-1}$$

$$\text{Given: } h = 4.14 \times 10^{-15} \text{ eVs}$$

If this light falls on a metal surface having a work function of 2.50 eV, the maximum kinetic energy of the photoelectrons will be

- (1) 1.90 eV (2) 3.27 eV
(3) 3.60 eV (4) 3.42 eV

Q19. In the following nuclear reaction,



Mass number of D is 182 and atomic number is 74. Mass number and atomic number of D_4 respectively will be

- (1) 174 and 71 (2) 174 and 69
(3) 172 and 69 (4) 172 and 71

Q20. The TV transmission tower at a particular station has a height of 125 m. For doubling the coverage of its range, the height of the tower should be increased by

- (1) 500 m (2) 375 m
(3) 250 m (4) 125 m

Q21. The moment of inertia of a uniform thin rod about a perpendicular axis passing through one end is I_1 . The same rod is bent into a ring and its moment of inertia about a diameter is I_2 . If $\frac{I_1}{I_2}$ is $\frac{x\pi^2}{3}$, then the value of x will be _____.

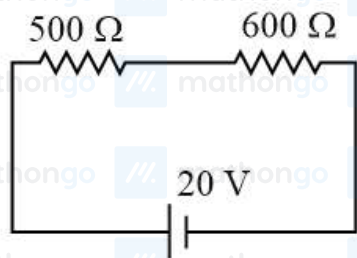
Q22. A small spherical ball of radius 0.1 mm and density 10^4 kg m^{-3} falls freely under gravity through a distance h before entering a tank of water. If, after entering the water the velocity of ball does not change and it

continue to fall with same constant velocity inside water, then the value of h will be ____ m. (Given $g = 10 \text{ m s}^{-2}$, viscosity of water $= 1.0 \times 10^{-5} \text{ N-s m}^{-2}$).

Q23. In an experiment to determine the velocity of sound in air at room temperature using a resonance tube, the first resonance is observed when the air column has a length of 20.0 cm for a tuning fork of frequency 400 Hz is used. The velocity of the sound at room temperature is 336 m s^{-1} . The third resonance is observed when the air column has a length of ____ cm

Q24. The displacement current of $4.425 \mu\text{A}$ is developed in the space between the plates of parallel plate capacitor when voltage is changing at a rate of 10^6 V s^{-1} . The area of each plate of the capacitor is 40 cm^2 . The distance between each plate of the capacitor is $x \times 10^{-3} \text{ m}$. The value of x is ,
(Permittivity of free space, $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$) _____

Q25. Two resistors are connected in series across a battery as shown in figure. If a voltmeter of resistance 2000Ω is used to measure the potential difference across 500Ω resistor, the reading of the voltmeter will be ____ V



Q26. An inductor of 0.5 mH, a capacitor of $200 \mu\text{F}$ and a resistor of 2Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the frequency of ac source will be ____ $\times 10^2 \text{ Hz}$.

Q27. In a double slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the plane of slits. If the screen is moved by $5 \times 10^{-2} \text{ m}$ towards the slits, the change in fringe width is $3 \times 10^{-3} \text{ cm}$. If the distance between the slits is 1 mm, then the wavelength of the light will be ____ nm.

Q28. The half life of a radioactive substance is 5 years. After x years a given sample of the radioactive substance gets reduced to 6.25% of its initial value. The value of x is ____

Q29. A potential barrier of 0.4 V exists across a p-n junction. An electron enters the junction from the n -side with a speed of $6.0 \times 10^5 \text{ m s}^{-1}$. The speed with which electron enters the p side will be $\frac{x}{3} \times 10^5 \text{ m s}^{-1}$, then the value of x is ____.: (Given mass of electron $= 9 \times 10^{-31} \text{ kg}$, charge on electron $= 1.6 \times 10^{-19} \text{ C}$.)

Q30. The Vernier constant of Vernier callipers is 0.1 mm and it has zero error of (-0.05 cm) . While measuring diameter of a sphere, the main scale reading is 1.7 cm and coinciding vernier division is 5. The corrected diameter will be ____ $\times 10^{-2} \text{ cm}$.

Q31. Using the rules for significant figures, the correct answer for the expression $\frac{0.02858 \times 0.112}{0.5702}$ will be:

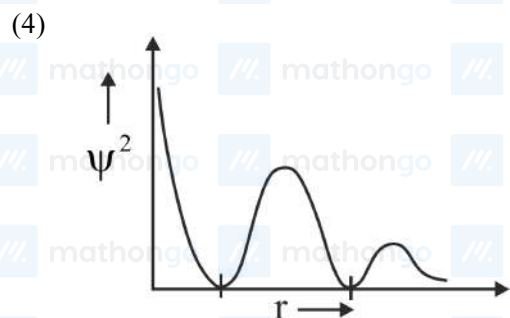
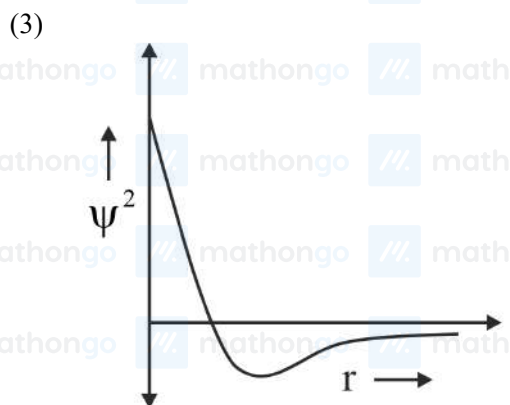
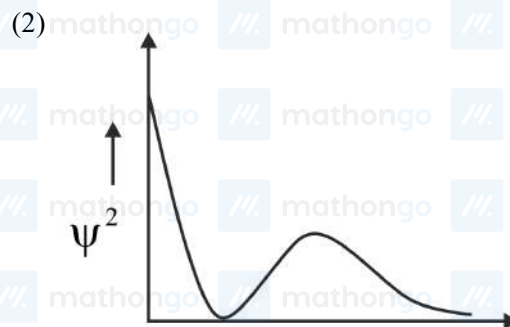
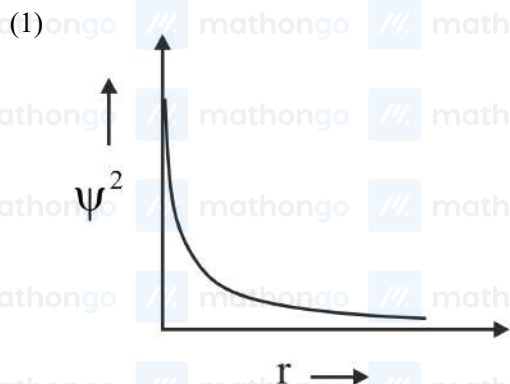
(1) 0.005613

(2) 0.00561

(3) 0.0056

(4) 0.006

Q32. Which of the following is the correct plot for the probability density $\psi^2(r)$ as a function of distance r of the electron from the nucleus for 2s orbital?



Q33. Given below are two statements. One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : The first ionization enthalpy for oxygen is lower than that of nitrogen.

Reason R : The four electrons in 2p orbitals of oxygen experience more electron-electron repulsion.

In the light of the above statements, choose the correct answer from the options given below.

- (1) Both A and R are correct and R is the correct explanation of A. (2) Both A and R are correct but R is NOT the correct explanation of A.
(3) A is correct but R is not correct. (4) A is not correct but R is correct

Q34. Consider the species CH_4 , NH_4^+ and BH_4^- . Choose the correct option with respect to the there species:

- (1) They are isoelectronic and only two have tetrahedral structures (2) They are isoelectronic and all have tetrahedral structures
(3) Only two are isoelectronic and all have tetrahedral structures (4) Only two are isoelectronic and only two have tetrahedral structures

Q35. Number of lone pair (s) of electrons on central atom and the shape of BrF_3 molecule respectively, are :

- (1) 0 , triangular planar. (2) 1 , pyramidal.
(3) 2 , bent T-shape. (4) 1, bent T-shape

Q36. 4.0 moles of argon and 5.0 moles of PCl_5 are introduced into an evacuated flask of 100 litre capacity at 610 K. The system is allowed to equilibrate. At equilibrium, the total pressure of mixture was found to be 6.0 atm. The K_p for the reaction is [Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

(1) 2. 25

(3) 12. 13

(2) 6. 24

(4) 15. 24

Q37. Amongst baking soda, caustic soda and washing soda carbonate anion is present in :

(1) Washing Soda only

(2) washing soda and caustic soda only.

(3) washing soda and baking soda only.

(4) baking soda, caustic soda and washing soda.

Q38. Aqueous solution of which of the following boron compounds will be strongly basic in nature?

(1) NaBH_4

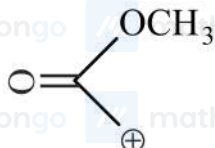
(2) LiBH_4

(3) B_2H_6

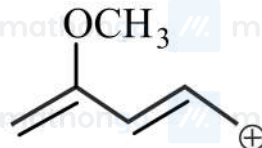
(4) $\text{Na}_2\text{B}_4\text{O}_7$

Q39. Which of the following carbocations is most stable:

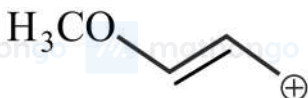
(1)



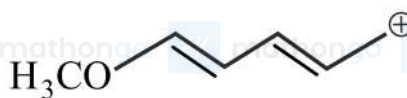
(2)



(3)



(4)



Q40. Sulphur dioxide is one of the components of polluted air. SO_2 is also a major contributor to acid rain. The correct and complete reaction to represent acid rain caused by SO_2 is :

(1) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$

(2) $\text{SO}_2 + \text{O}_3 \rightarrow \text{SO}_3 + \text{O}_2$

(3) $\text{SO}_2 + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4$

(4) $2\text{SO}_2 + \text{O}_2 + 2\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SO}_4$

Q41. 42. 12% (w/v) solution of NaCl causes precipitation of a certain sol in 10 hours. The coagulating value of NaCl for the sol is

[Given : Molar mass : Na = 23.0 g mol^{-1} ; Cl = 35.5 g mol^{-1}]

(1) 36 mmol L^{-1}

(2) 36 mol L^{-1}

(3) 1440 mol L^{-1}

(4) 1440 m mol L^{-1}

Q42. Match List I with List II.

List I With Ore

List II Composition

A. Siderite

I. FeCO_3

B. Malachite

II. $\text{CuCO}_3 \cdot \text{Cu(OH)}_2$

C. Sphalerite

III. ZnS

D. Calamine

IV. ZnCO_3

Choose the correct answer from the options given below:

(1) A-I, B-II, C-III, D-IV

(2) A-III, B-IV, C-E, D-I

(3) A-IV, B-III, C-I, D-II

(4) A-I, B-II, C-IV, D-III

Q43. Given below are two statements .

Statement I : In $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, Cu – O bonds are present.

Statement II : In $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, ligands coordinating with Cu (II) ion are O- and S-based ligands.

In the light of the above statements, choose the correct answer from the options given below

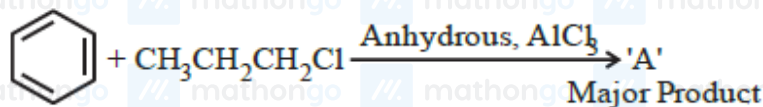
(1) Both Statement I and Statement II are correct

(2) Both Statement I and Statement II are incorrect

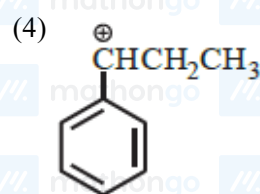
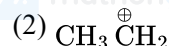
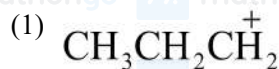
(3) Statement I is correct but Statement II is incorrect

(4) Statement I is incorrect but Statement II is correct

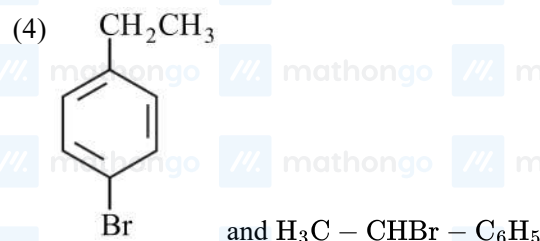
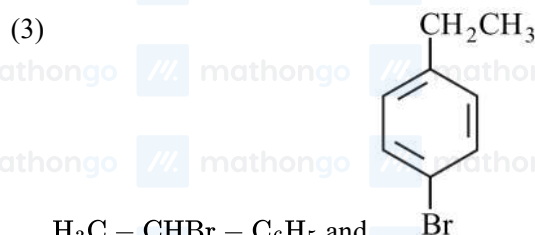
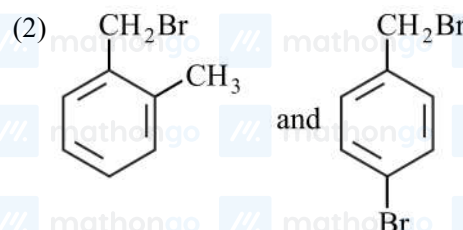
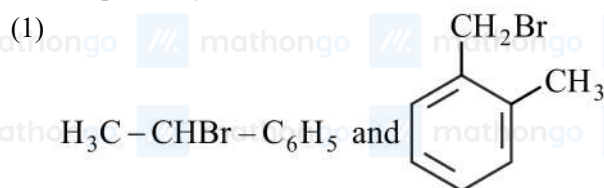
Q44.



The stable carbocation formed in the above reaction is :



Q45. Two isomers (A) and (B) with Molar mass 184 g/mol and elemental composition C, 52.2%; H, 49% and Br 42.9% gave benzoic acid and p-bromobenzoic acid, respectively on oxidation with KMnO_4 . Isomer (A) is optically active and gives a pale yellow precipitate when warmed with alcoholic AgNO_3 . Isomer (A) and (B) are, respectively :



Q46. In Friedel-Crafts alkylation of aniline, one gets:

(1) alkylated product with ortho and para substitution.

(2) secondary amine after acidic treatment.

(3) an amide product.

(4) positively charged nitrogen at benzene ring.

Q47. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Dacron is an example of polyester polymer.

Reason R: Dacron is made up of ethylene glycol and terephthalic acid monomers.

In the light of the above statements, choose the most appropriate answer from the options given below.

- (1) Both A and R are correct and R is the correct explanation of A
- (2) Both A and R are correct but R is NOT the correct explanation of A.
- (3) A is correct but R is not correct.
- (4) A is not correct but R is correct.

Q48. The mixture of chloroxylenol and terpineol is an example of :

- (1) Antiseptic
- (2) Pesticide
- (3) Disinfectant
- (4) narcotic analgesic

Q49. A white precipitate was formed when BaCl_2 was added to water extract of an inorganic salt. Further, a gas with characteristic odour was released when the formed white precipitate was dissolved in dilute HCl. The anion present in the inorganic salt is:

- (1) I^-
- (2) SO_3^{2-}
- (3) S^{2-}
- (4) NO_2^-

Q50. The structure of protein that is unaffected by heating is :

- (1) secondary structure
- (2) tertiary structure
- (3) primary structure
- (4) Quaternary structure

Q51. A box contains 0.90 g of liquid water in equilibrium with water vapour at 27°C . The equilibrium vapour pressure of water at 27°C 32.0 Torr. When the volume of the box is increased, some of the liquid water evaporates to maintain the equilibrium pressure. If all the liquid water evaporates, then the volume of the box must be _____ litre. [nearest integer]

(Given: $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$)

(Ignore the volume of the liquid water and assume water vapours behave as an ideal gas.)

Q52. 2.2 g of nitrous oxide (N_2O) gas is cooled at a constant pressure of 1 atm from 310 K to 270 K causing the compression of the gas from 217.1 mL to 167.75 mL. The change in internal energy of the process, ΔU is $-x \text{ J}$. The value of x is _____.

[nearest integer]

(Given: atomic mass of N = 14 g mol^{-1} and of O = 16 g mol^{-1} . Molar heat capacity of N_2O is $100 \text{ JK}^{-1} \text{ mol}^{-1}$)

Q53. For the reaction given below:



If two equivalents of AgCl precipitate out, then the value of x will be _____

Q54. The number of chiral alcohol(s) with molecular formula $\text{C}_4\text{H}_{10}\text{O}$ is _____ (Assume stereoisomers as different chiral alcohols)

Q55. Elevation in boiling point for 1.5 molal solution of glucose in water is 4 K. The depression in freezing point for 4.5 molal solution of glucose in water is 4 K. The ratio of molal elevation constant to molal depression constant (K_b/K_f) is _____

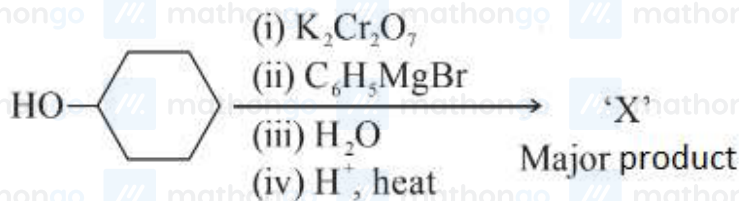
Q56. The cell potential for the given cell at 298 K $\text{Pt}|\text{H}_2(\text{g}, 1 \text{ bar})||\text{H}^+(\text{aq})||\text{Cu}^{2+}(\text{aq})|\text{Cu}(\text{s})$ is 0.31 V. The pH of the acidic solution is found to be 3, whereas the concentration of Cu^{2+} is 10^x M . The value of x is _____.

(Given: $E^\ominus_{\text{Cu}^{2+}/\text{Cu}} = 0.34 \text{ V}$ and $\frac{2.303RT}{F} = 0.06 \text{ V}$)

Q57. The equation $k = (6.5 \times 10^{12} \text{ s}^{-1})e^{-26000 \text{ K}/T}$ is followed for the decomposition of compound A. The activation energy for the reaction is ____ KJ mol^{-1} . [nearest integer]
(Given: $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

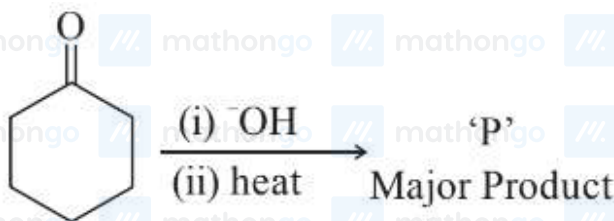
Q58. Spin only magnetic moment of $[\text{MnBr}_6]^{4-}$ is ____ B.M. (round off to the closest integer)

Q59. In the given reaction



the number of sp^2 hybridised carbon (s) in compound 'X' is ____.

Q60. In the given reaction,



The number of π electrons present in the product 'P' is ____.

Q61. Let α be a root of the equation $1 + x^2 + x^4 = 0$. Then the value of $\alpha^{1011} + \alpha^{2022} - \alpha^{3033}$ is equal to:

- (1) 1 (2) α
(3) $1 + \alpha$ (4) $1 + 2\alpha$

Q62. Let (z) represent the principal argument of the complex number z . The, $|z| = 3$ and

$\arg(z - 1) - \arg(z + 1) = \frac{\pi}{4}$ intersect:

- (1) Exactly at one point (2) Exactly at two points
(3) Nowhere (4) At infinitely many points.

Q63. The sum of the infinite series $1 + \frac{5}{6} + \frac{12}{6^2} + \frac{22}{6^3} + \frac{35}{6^4} + \frac{51}{6^5} + \frac{70}{6^6} + \dots$ is equal to:

- (1) $\frac{425}{216}$ (2) $\frac{429}{216}$
(3) $\frac{288}{125}$ (4) $\frac{280}{125}$

Q64. Let $n \geq 5$ be an integer. If $9^n - 8n - 1 = 64\alpha$ and $6^n - 5n - 1 = 25\beta$, then $\alpha - \beta$ is equal to:

- (1) $1 + {}^nC_2(8 - 5) + {}^nC_3(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$
(2) $1 + {}^nC_2(8 - 5) + {}^nC_3(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$
(3) ${}^nC_3(8 - 5) + {}^nC_4(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$
(4) ${}^nC_3(8 - 5) + {}^nC_4(8^2 - 5^2) + \dots + {}^nC_n(8^{n-2} - 5^{n-2})$

Q65. The distance of the origin from the centroid of the triangle whose two sides have the equations $x - 2y + 1 = 0$

and $2x - y - 1 = 0$ and whose orthocenter is $(\frac{7}{3}, \frac{7}{3})$ is:

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

Q66. Let a triangle ABC be inscribed in the circle $x^2 - \sqrt{2}(x + y) + y^2 = 0$ such that $\angle BAC = \frac{\pi}{2}$. If the length of side AB is $\sqrt{2}$, then the area of the $\triangle ABC$ is equal to:

- (1) 1 (2) $\frac{(\sqrt{6}+\sqrt{3})}{2}$
 (3) $\frac{(\sqrt{3}+\sqrt{3})}{2}$ (4) $\frac{(\sqrt{6}+2\sqrt{3})}{4}$

Q67. Let $P : y^2 = 4ax$, $a > 0$ be a parabola with focus S . Let the tangents to the parabola P make an angle of $\frac{\pi}{4}$ with the line $y = 3x + 5$ touch the parabola P at A and B . Then the value of a for which A , B and S are collinear is:

- (1) 8 only (2) 2 only
 (3) $\frac{1}{4}$ only (4) any $a > 0$

Q68. The value of $\lim_{x \rightarrow 1} \frac{(x^2-1) \sin^2(\pi x)}{x^4-2x^3+2x-1}$ is equal to:

- (1) $\frac{\pi^2}{6}$ (2) $\frac{\pi^2}{3}$
 (3) $\frac{\pi^2}{2}$ (4) π^2

Q69. Negation of the Boolean statement $(p \vee q) \Rightarrow ((\sim r) \vee p)$ is equivalent to:

- (1) $p \wedge (\sim q) \wedge r$ (2) $(\sim p) \wedge (\sim q) \wedge r$
 (3) $(\sim p) \wedge q \wedge r$ (4) $p \wedge q \wedge (\sim r)$

Q70. The number of values of $a \in N$ such that the variance of 3, 7, 12, a , $43 - a$ is a natural number is:

- (1) 0 (2) 2
 (3) 5 (4) infinite

Q71. From the base of a pole of height 20 meter, the angle of elevation of the top of a tower is 60° . The pole subtends an angle 30° at the top of the tower. Then the height of the tower is:

- (1) $15\sqrt{3}$ (2) $20\sqrt{3}$
 (3) $20 + 10\sqrt{3}$ (4) 30

Q72. Let $A = \begin{pmatrix} 2 & -1 \\ 0 & 2 \end{pmatrix}$. If $B = I - {}^5C_1(\text{adj } A) + {}^5C_2(\text{adj } A)^2 - \dots - {}^5C_5(\text{adj } A)^5$, then the sum of all elements of the matrix B is:

- (1) -5 (2) -6
 (3) -7 (4) -8

Q73. Let $f : R \rightarrow R$ be a function defined by $f(x) = (x - 3)^{n_1}(x - 5)^{n_2}$, $n_1, n_2 \in N$. The, which of the following is NOT true?

- (1) For $n_1 = 3$, $n_2 = 4$, there exists $\alpha \in (3, 5)$ where f attains local maxima. (2) For $n_1 = 4$, $n_2 = 3$, there exists $\alpha \in (3, 5)$ where f attains local maxima.
 (3) For $n_1 = 3$, $n_2 = 5$, there exists $\alpha \in (3, 5)$ where f attains local maxima. (4) For $n_1 = 4$, $n_2 = 6$, there exists $\alpha \in (3, 5)$ where f attains local maxima.

Q74. Let f be a real valued continuous function on $[0, 1]$ and $f(x) = x + \int_0^1 (x - t)f(t)dt$. Then which of the following points (x, y) lies on the curve $y = f(x)$?

- (1) (2, 4) (2) (1, 2)
 (3) (4, 17) (4) (6, 8)

Q75. If $\int_0^2 (\sqrt{2x} - \sqrt{2x - x^2}) dx = \int_0^1 \left(1 - \sqrt{1 - y^2} - \frac{y^2}{2}\right) dy + \int_1^2 \left(2 - \frac{y^2}{2}\right) dy + I$, then I equal to

(1) $\int_0^1 \left(1 + \sqrt{1 - y^2}\right) dy$ (2) $\int_0^1 \left(\frac{y^2}{2} - \sqrt{1 - y^2} + 1\right) dy$
 (3) $\int_0^1 \left(1 - \sqrt{1 - y^2}\right) dy$ (4) $\int_0^1 \left(\frac{y^2}{2} + \sqrt{1 - y^2} + 1\right) dy$

Q76. If $y = y(x)$ is the solution of the differential equation $(1 + e^{2x}) \frac{dy}{dx} + 2(1 + y^2)e^x = 0$ and $y(0) = 0$, then $6\left(y'(0) + \left(y(\log_e \sqrt{3})\right)^2\right)$ is equal to:

(1) 2 (2) -2
 (3) -4 (4) -1

Q77. Let A, B, C be three points whose position vectors respectively are:

$$\begin{aligned}\vec{a} &= \hat{i} + 4\hat{j} + 3\hat{k} \\ \vec{b} &= 2\hat{i} + \alpha\hat{j} + 4\hat{k}, \alpha \in R \\ \vec{c} &= 3\hat{i} - 2\hat{j} + 5\hat{k}\end{aligned}$$

If α is the smallest positive integer for which $\vec{a}, \vec{b}, \vec{c}$ are non-collinear, then the length of the median, $\triangle ABC$, through A is:

(1) $\frac{\sqrt{82}}{2}$ (2) $\frac{\sqrt{62}}{2}$
 (3) $\frac{\sqrt{69}}{2}$ (4) $\frac{\sqrt{66}}{2}$

Q78. Let $\frac{x-2}{3} = \frac{y+1}{-2} = \frac{z+3}{-1}$ lie on the plane $px - qy + z = 5$, for some $p, q \in R$. The shortest distance of the plane from the origin is:

(1) $\sqrt{\frac{3}{109}}$ (2) $\sqrt{\frac{5}{142}}$
 (3) $\sqrt{\frac{5}{71}}$ (4) $\sqrt{\frac{1}{142}}$

Q79. Let Q be the mirror image of the point $P(1, 2, 1)$ with respect to the plane $x + 2y + 2z = 16$. Let T be a plane passing through the point Q and contains the line $\vec{r} = -\hat{k} + \lambda(\hat{i} + \hat{j} + 2\hat{k})$, $\lambda \in R$. Then, which of the following points lies on T ?

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

Q80. The probability that a relation R from $\{x, y\}$ to $\{x, y\}$ is both symmetric and transitive, is equal to:

(1) $\frac{5}{16}$ (2) $\frac{9}{16}$
 (3) $\frac{11}{16}$ (4) $\frac{13}{16}$

Q81. The total number of four digit numbers such that each of the first three digits is divisible by the last digit, is equal to _____.

Q82. Let 3, 6, 9, 12, ... upto 78 terms and 5, 9, 13, 17, ... upto 59 terms be two series. Then, the sum of the terms common to both the series is equal to _____.

Q83. Let the coefficients of x^{-1} and x^{-3} in the expansion of $\left(2x^{\frac{1}{5}} - \frac{1}{x^{\frac{1}{5}}}\right)^{15}$, $x > 0$, be m and n respectively. If r is a positive integer such $mn^2 = {}^{15}C_r \cdot 2^r$, then the value of r is equal to _____.

Q84. The number of solutions of the equation $\sin x = \cos^2 x$ in the interval $(0, 10)$ is _____.

Q85. Let $M = \begin{bmatrix} 0 & -\alpha \\ \alpha & 0 \end{bmatrix}$, where α is a non-zero real number and $N = \sum_{k=1}^{49} M^{2k}$. If $(I - M^2)N = -2I$, then the positive integral value of α is _____.

Q86. Let $f(x)$ and $g(x)$ be two real polynomials of degree 2 and 1 respectively. If $f(g(x)) = 8x^2 - 2x$, and $g(f(x)) = 4x^2 + 6x + 1$, then the value of $f(2) + g(2)$ is _____.

Q87. Let f and g be twice differentiable even functions on $(-2, 2)$ such that $f(\frac{1}{4}) = 0$, $f(\frac{1}{2}) = 0$, $f(1) = 1$ and $g(\frac{3}{4}) = 0$, $g(1) = 2$. Then, the minimum number of solutions of $f(x)g''(x) + f'(x)g'(x) = 0$ in $(-2, 2)$ is equal to _____.

Q88. For real numbers $a, b (a > b > 0)$, let

$$\text{Area} \left\{ (x, y) : x^2 + y^2 \leq a^2 \text{ and } \frac{x^2}{a^2} + \frac{y^2}{b^2} \geq 1 \right\} = 30\pi$$

and

$$\text{Area} \left\{ (x, y) : x^2 + y^2 \geq b^2 \text{ and } \frac{x^2}{a^2} + \frac{y^2}{b^2} \leq 1 \right\} = 18\pi$$

Then the value of $(a - b)^2$ is equal to _____.

Q89. Let $y = y(x)$, $x > 1$, be the solution of the differential equation $(x - 1)\frac{dy}{dx} + 2xy = \frac{1}{x-1}$, with $y(2) = \frac{1+e^4}{2e^4}$.

If $y(3) = \frac{e^\alpha + 1}{\beta e^\alpha}$, then the value of $\alpha + \beta$ is equal to _____.

Q90. Let $\vec{a} = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b} = \hat{i} + \hat{j} + \hat{k}$ and \vec{c} be a vector such that $\vec{a} \times (\vec{b} + \vec{c}) = \vec{0}$, then the value of $3(\vec{c} \cdot \vec{a})$ is equal to _____.

ANSWER KEYS

1. (3)	2. (2)	3. (1)	4. (2)	5. (1)	6. (1)	7. (4)	8. (1)
9. (3)	10. (3)	11. (4)	12. (3)	13. (4)	14. (1)	15. (3)	16. (3)
17. (3)	18. (4)	19. (1)	20. (2)	21. (8)	22. (20)	23. (104)	24. (8)
25. (8)	26. (5)	27. (600)	28. (20)	29. (14)	30. (180)	31. (2)	32. (2)
33. (1)	34. (2)	35. (3)	36. (1)	37. (1)	38. (4)	39. (4)	40. (4)
41. (4)	42. (1)	43. (3)	44. (3)	45. (3)	46. (4)	47. (1)	48. (1)
49. (2)	50. (3)	51. (29)	52. (72)	53. (5)	54. (2)	55. (3)	56. (7)
57. (216)	58. (6)	59. (8)	60. (4)	61. (1)	62. (3)	63. (3)	64. (3)
65. (3)	66. (1)	67. (4)	68. (4)	69. (3)	70. (1)	71. (4)	72. (3)
73. (3)	74. (4)	75. (3)	76. (3)	77. (1)	78. (2)	79. (2)	80. (1)
81. (1086)	82. (2223)	83. (5)	84. (4)	85. (1)	86. (18)	87. (4)	88. (12)
89. (14)	90. (29)						