Q1. In a typical combustion engine the workdone by a gas molecule is given by $W = \alpha^2\beta e^{\frac{-\beta x^2}{kT}}$, where x is the displacement, k is the Boltzmann constant and T is the temperature. If α and β are constants, dimensions of α will be:

(1) $\left[\mathrm{MLT}^{-2}\right]$ (2) $\left[\mathrm{M}^2\,\mathrm{LT}^{-2}\right]$

(3) $\left[\mathrm{MLT}^{-1}\right]$ (4) $\left[\mathrm{M}^0\,\mathrm{LT}^{0}\right]$

Q2. If two similar springs each of spring constant K_1 are joined in series, the new spring constant and time period would be changed by a factor:

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

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

Q3. A particle is moving with uniform speed along the circumference of a circle of radius R under the action of a central fictitious force F which is inversely proportional to R^3. Its time period of revolution will be given by :

(1) $T \propto R^{\frac{4}{3}}$ (2) $T \propto R^{\frac{5}{2}}$

(3) $T \propto R^{\frac{3}{2}}$ (4) $T \propto R^2$

Q4. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Body P having mass M moving with speed u has head-on collision elastically with another body Q having mass m initially at rest. If $m \ll M$, body Q will have a maximum speed equal to $2u$ after collision.

Reason R : During elastic collision, the momentum and kinetic energy are both conserved.

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

(1) A is correct but R is not correct.

(2) A is not correct but R is correct.

(3) Both A and R are correct and R is the correct explanation of A

(4) Both A and R are correct but R is NOT the correct explanation of A

Q5. Four identical solid spheres each of mass m and radius a are placed with their centres on the four corners of a square of side b. The moment of inertia of the system about one side of square where the axis of rotation is parallel to the plane of the square is :

(1) $\frac{8}{5}ma^2 + mb^2$ (2) $\frac{4}{5}ma^2 + 2mb^2$

(3) $\frac{8}{5}ma^2 + 2mb^2$ (4) $\frac{4}{5}ma^2$

Q6. A planet revolving in elliptical orbit has :

A. a constant velocity of revolution.

B. has the least velocity when it is nearest to the sun.

C. its areal velocity is directly proportional to its velocity.

D. areal velocity is inversely proportional to its velocity.

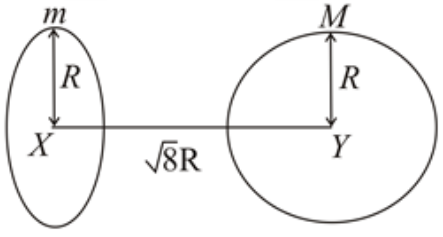
E. to follow a trajectory such that the areal velocity is constant.

Choose the correct answer from the options given below:

(1) A only (2) C only

(3) E only (4) D only

Q7. Find the gravitational force of attraction between the ring and sphere as shown in the diagram, where the plane of the ring is perpendicular to the line joining the centres. If $\sqrt{8}R$ is the distance between the centres of a ring (of mass m) and a sphere (mass M) where both have equal radius R



(1) $\frac{2\sqrt{2}}{3}\frac{GMm}{R^2}$ (2) $\frac{\sqrt{8}}{9}\frac{GmM}{R}$
(3) $\frac{1}{3\sqrt{8}}\frac{GMm}{R^2}$ (4) $\frac{\sqrt{8}}{27}\frac{GmM}{R^2}$

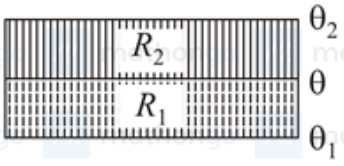
Q8. The normal density of a material is ρ and its bulk modulus of elasticity is K. The magnitude of increase in density of material, when a pressure P is applied uniformly on all sides, will be :

(1) $\frac{PK}{\rho}$ (2) $\frac{\rho P}{K}$
(3) $\frac{\rho K}{P}$ (4) $\frac{K}{\rho P}$

Q9. A large number of water drops, each of radius r, combine to have a drop of radius R. If the surface tension is T and mechanical equivalent of heat is J, the rise in heat energy per unit volume will be:

(1) $\frac{2T}{rJ}$ (2) $\frac{3T}{rJ}$
(3) $\frac{2T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$ (4) $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$

Q10. The temperature θ at the junction of two insulating sheets, having thermal resistances R_1 and R_2 as well as top and bottom temperatures θ_1 and θ_2 (as shown in figure) is given by :

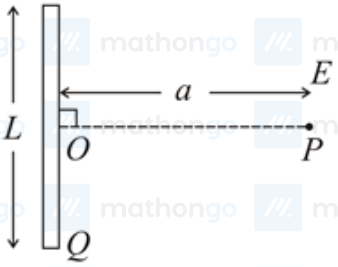


(1) $\frac{\theta_1 R_2-\theta_2 R_1}{R_2-R_1}$ (2) $\frac{\theta_2 R_2-\theta_1 R_1}{R_2-R_1}$
(3) $\frac{\theta_1 R_2+\theta_2 R_1}{R_1+R_2}$ (4) $\frac{\theta_1 R_1+\theta_2 R_2}{R_1+R_2}$

Q11. Assume that a tunnel is dug along a chord of the earth, at a perpendicular distance $\frac{R}{2}$ from the earth's centre, where R is the radius of the earth. The wall of the tunnel is frictionless. If a particle is released in this tunnel, it will execute a simple harmonic motion with a time period:

(1) $\frac{1}{2\pi}\sqrt{\frac{g}{R}}$ (2) $2\pi\sqrt{\frac{R}{g}}$
(3) $\frac{g}{2\pi R}$ (4) Image is virtual, opposite side of convex mirror.

Q12. Find the electric field at point P (as shown in figure) on the perpendicular bisector of a uniformly charged thin wire of length L carrying a charge Q. The distance of the point P from the centre of the rod is $a=\frac{\sqrt{3}}{2}L$

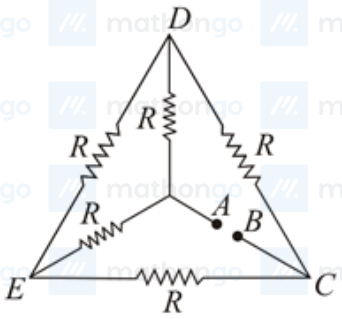


(1) $\frac{Q}{3\pi\varepsilon_0 L^2}$ (2) $\frac{Q}{2\sqrt{3}\pi\varepsilon_0 L^2}$
(3) $\frac{\sqrt{3}Q}{4\pi\varepsilon_0 L^2}$ (4) $\frac{Q}{4\pi\varepsilon_0 L^2}$

Q13. Consider the combination of two capacitors C_1 and C_2, with $C_2 > C_1$, when connected in parallel, the equivalent capacitance is 10 times the equivalent capacitance of the same connected in series. Calculate the ratio of capacitors, $\frac{C_2}{C_1}$.

(1) $4+\sqrt{15}$ (2) $2+\sqrt{15}$
(3) 9 (4) $\frac{15}{4}$

Q14. Five equal resistances are connected in a network as shown in figure. The net resistance between the points A and B is :



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

Q15. An alternating current is given by the equation $i = i_1 \sin \omega t + i_2 \cos \omega t$. The rms current will be:
(1) $\frac{1}{\sqrt{2}}(i_1 + i_2)^2$
(2) $\frac{1}{\sqrt{2}}(i_1 + i_2)$
(3) $\frac{1}{2}\left(i_1^2 + i_2^2\right)^{\frac{1}{2}}$
(4) $\frac{1}{\sqrt{2}}\left(i_1^2 + i_2^2\right)^{\frac{1}{2}}$

Q16. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**.
Assertion A : An electron microscope can achieve better resolving power than an optical microscope.
Reason R : The de Broglie's wavelength of the electrons emitted from an electron gun is much less than wavelength of visible light.
In the light of the above statements, choose the correct answer from the options given below:
(1) A is false but R is true.
(2) Both A and R are true and R is the correct explanation of A
(3) Both A and R are true but R is NOT the correct explanation of A
(4) A is true but R is false.

Q17. A short straight object of height 100 cm lies before the central axis of a spherical mirror whose focal length has absolute value $|f| = 40$ cm. The image of object produced by the mirror is of height 25 cm and has the same orientation of the object. One may conclude from the information:
(1) Image is real, same side of convex mirror.
(2) Image is virtual, opposite side of concave mirror.
(3) Image is real, same side of concave mirror.
(4) Image is virtual, opposite side of convex mirror.

Q18. In a Young's double slit experiment two slits are separated by 2 mm and the screen is placed one meter away. When a light of wavelength 500 nm is used, the fringe separation will be :
(1) 1 mm
(2) 0.50 mm
(3) 0.75 mm
(4) 0.25 mm

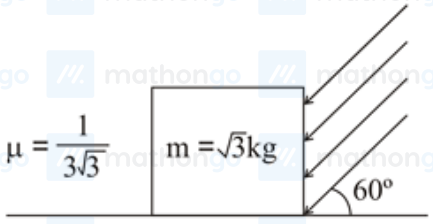
Q19. If λ_1 and λ_2 are the wavelengths of the third member of Lyman and first member of the Paschen series respectively, then the value of $\lambda_1 : \lambda_2$ is :
(1) 7 : 135
(2) 1 : 9
(3) 1 : 3
(4) 7 : 108

Q20. LED is constructed from $Ga - As - P$ semiconducting material. The energy gap of this LED is 1.9 eV. Calculate the wavelength of light emitted and its colour. $h = 6.63 \times 10^{-34}$ J – s and $c = 3 \times 10^8$ m s^{-1}
(1) 654 nm and red colour
(2) 654 nm and orange colour
(3) 1046 nm and red colour
(4) 1046 nm and blue colour

Q21. A boy pushes a box of mass 2 kg with a force $\vec{F} = \left(20\hat{i} + 10\hat{j}\right)$N on a frictionless surface. If the box was initially at rest, then _____ m is displacement along the x-axis after 10 s

Q22. A person standing on a spring balance inside a stationary lift measures 60 kg. The weight of that person if the lift descends with uniform downward acceleration of $1.8\ \text{m s}^{-2}$ will be _____ N. $\left[g = 10\ \text{m s}^{-2}\right]$

Q23. As shown in the figure, a block of mass $\sqrt{3}$ kg is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle 60° with horizontal such that it does not move, will be $3x$. The value of x will
$\left[g = 10\ \text{m s}^{-2};\ \sin 60^\circ = \frac{\sqrt{3}}{2};\ \cos 60^\circ = \frac{1}{2}\right]$



Q24. A container is divided into two chambers by a partition. The volume of first chamber is 4.5 litre and second chamber is 5.5 litre. The first chamber contain 3.0 moles of gas at pressure 2.0 atm and second chamber contain 4.0 moles of gas at pressure 3.0 atm. After the partition is removed and the mixture attains equilibrium, then, the common equilibrium pressure existing in the mixture is $x \times 10^{-1}$ atm. Value of x (nearest integer) is _____

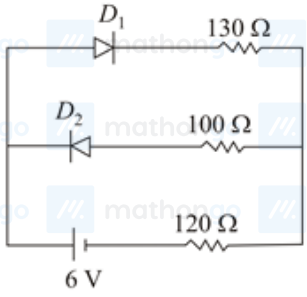
Q25. The mass per unit length of a uniform wire is $0.135\ \text{g cm}^{-1}$. A transverse wave of the form $y = -0.21\sin(x + 30t)$ is produced in it, where x is in meter and t is in second. Then, the expected value of tension in the wire is $x \times 10^{-2}$ N. Value of x is _____ (Round-off to the nearest integer)

Q26. In an electrical circuit, a battery is connected to pass 20 C of charge through it in a certain given time. The potential difference between two plates of the battery is maintained at 15 V. The workdone by the battery is _____ J

Q27. In a series LCR resonant circuit, the quality factor is measured as 100. If the inductance is increased by two fold and resistance is decreased by two fold, then the quality factor after this change will be _____

Q28. A radiation is emitted by 1000 W bulb and it generates an electric field and magnetic field at P, placed at a distance of 2 m. The efficiency of the bulb is 1.25%. The value of peak electric field at P is $x \times 10^{-1}\ \text{V m}^{-1}$. Value of x is _____ (Rounded-off to the nearest integer) [Take $\varepsilon_0 = 8.85 \times 10^{-12}\ \text{C}^2\ \text{N}^{-1}\ \text{m}^{-2},\ c = 3 \times 10^6\ \text{m s}^{-1}$]

Q29. The circuit contains two diodes each with a forward resistance of 50 Ω and with infinite reverse resistance. If the battery voltage is 6 V, the current through the 120 Ω resistance is _____ mA



Q30. The maximum and minimum amplitude of an amplitude modulated wave is 16 V and 8 V respectively. The modulation index for this amplitude modulated wave is $x \times 10^{-2}$. The value of x is _____. (Round off your answer to the nearest integer)

Q31. The orbital having two radial as well as two angular nodes is:

(1) 5d (2) 4d

(3) 4f (4) 3p

Q32. Match List-I with List-II.

List-I Electronic configuration of elements		List-II $\Delta_i H$ in kJ mol^{-1}	
(a)	$1s^2 2s^2$	(p)	801
(b)	$1s^2 2s^2 2p^4$	(q)	899
(c)	$1s^2 2s^2 2p^3$	(r)	1314
(d)	$1s^2 2s^2 2p^1$	(s)	1402

Choose the most appropriate answer from the options given below:

(1) (a) $\rightarrow$ (q), (b) $\rightarrow$ (r), (c) $\rightarrow$ (s), (d) $\rightarrow$ (p) (2) (a) $\rightarrow$ (p), (b) $\rightarrow$ (r), (c) $\rightarrow$ (s), (d) $\rightarrow$ (q)

(3) (a) $\rightarrow$ (p), (b) $\rightarrow$ (s), (c) $\rightarrow$ (r), (d) $\rightarrow$ (q) (4) (a) $\rightarrow$ (s), (b) $\rightarrow$ (p), (c) $\rightarrow$ (q), (d) $\rightarrow$ (r)

Q33. Given below are two statements:

Statement I : o-Nitrophenol is steam volatile due to intramolecular hydrogen bonding.

Statement II : o-Nitrophenol has high melting due to hydrogen bonding.

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 false (2) Statement I is true but Statement II is false

(3) Statement I is false but Statement II is true (4) Both Statement I and Statement II are true

Q34. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : Dipole-dipole interactions are the only non-covalent interactions, resulting in hydrogen bond formation.

Reason R : Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.

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

(1) A is false but R is true (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) Both A and R are true and R is the correct explanation of A

Q35. Statements about heavy water are given below.

A. Heavy water is used in exchange reactions for the study of reaction mechanisms.

B. Heavy water is prepared by exhaustive electrolysis of water.

C. Heavy water has higher boiling point than ordinary water.

D. Viscosity of H_2O is greater than D_2O.

Choose the most appropriate answer from the options given below:

(1) A and C only (2) A, B and C only

(3) A and B only (4) A and D only

Q36. Find A, B and C in the following reactions:

$NH_3 + A + CO_2 \rightarrow (NH_4)_2 CO_3$

$(NH_4)_2 CO_3 + H_2O + B \rightarrow NH_4 HCO_3$

$NH_4 HCO_3 + NaCl \rightarrow NH_4 Cl + C$

(1) $A - H_2O;\ B - CO_2;\ C - NaHCO_3$ (2) $A - H_2O;\ B - O_2;\ C - Na_2 CO_3$

(3) $A - H_2O;\ B - O_2;\ C - NaHCO_3$ (4) $A - O_2;\ B - CO_2;\ C - Na_2 CO_3$

Q37. Compound A used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries.

Compound A is:

(1) PbO (2) Pb_3O_4
(3) PbO_2 (4) $PbSO_4$

Q38. Given below are two statements:

Statement I: A mixture of chloroform and aniline can be separated by simple distillation.

Statement II: When separating aniline from a mixture of aniline and water by steam distillation aniline boils below its boiling point.

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

Q39. Which of the following is a FALSE statement?

(1) Carius tube is used in the estimation of sulphur in an organic compound.
(2) Phosphoric acid produced on oxidation of phosphorus present in an organic compound is precipitated as $Mg_2P_2O_7$ by adding magnesia mixture.
(3) Carius method is used for the estimation of nitrogen in an organic compound.
(4) Kjeldahl's method is used for the estimation of nitrogen in an organic compound.

Q40. The presence of ozone in troposphere:

(1) protects us from the UV radiation (2) protects us from greenhouse effect
(3) protects us from the X-ray radiation (4) generates photochemical smog

Q41. Match List-I with List-II.

	List-I (Ore)		List-II (Element Present)
(a)	Kernite	(p)	Tin
(b)	Cassiterite	(q)	Boron
(c)	Calamine	(r)	Fluorine
(d)	Cryolite	(s)	Zinc

Choose the most appropriate answer from the options given below:

(1) $(a) \rightarrow (r), (b) \rightarrow (p), (c) \rightarrow (q), (d) \rightarrow (s)$ (2) $(a) \rightarrow (q), (b) \rightarrow (s), (c) \rightarrow (p), (d) \rightarrow (r)$
(3) $(a) \rightarrow (p), (b) \rightarrow (r), (c) \rightarrow (s), (d) \rightarrow (q)$ (4) $(a) \rightarrow (q), (b) \rightarrow (p), (c) \rightarrow (s), (d) \rightarrow (r)$

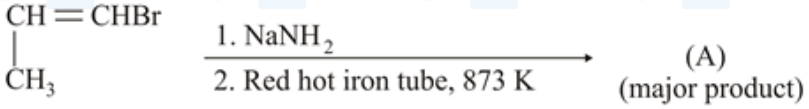
Q42. On treating a compound with warm dil. H_2SO_4, gas X is evolved which turns $K_2Cr_2O_7$ paper acidified with dil. H_2SO_4 to a green compound Y. X and Y respectively are :

(1) $X = SO_2,\ Y = Cr_2O_3$ (2) $X = SO_2,\ Y = Cr_2(SO_4)_3$
(3) $X = SO_3,\ Y = Cr_2(SO_4)_3$ (4) $X = SO_3,\ Y = Cr_2O_3$

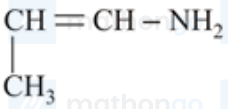
Q43. Which one of the following lanthanoids does not form MO_2? [M is lanthanoid metal]

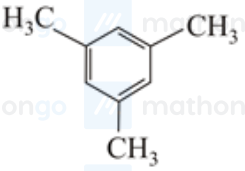
(1) Yb (2) Dy
(3) Nd (4) Pr

Q44. For the given reaction:



What is A?

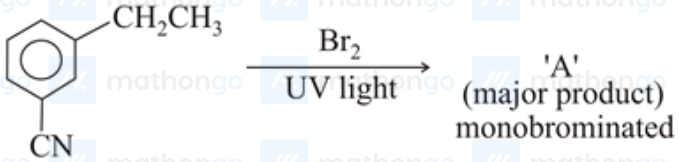
(1) 

(2) 

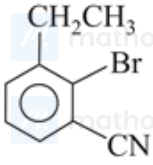
(3) 

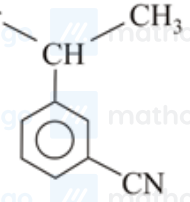
(4) $CH_3\,CH_2\,CH_2\,NH_2$

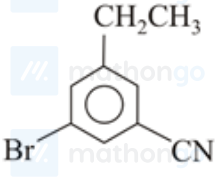
Q45. For the given reaction:

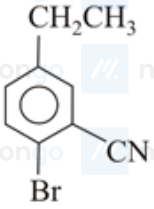


What is A?

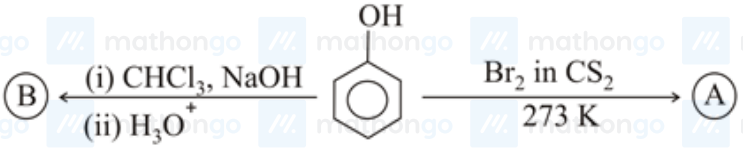
(1) 

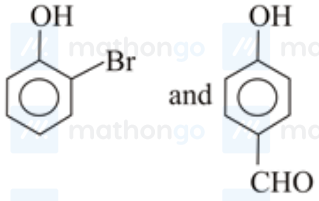
(2) 

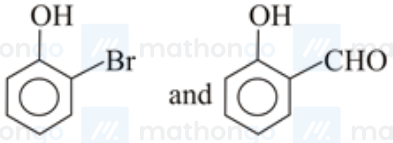
(3) 

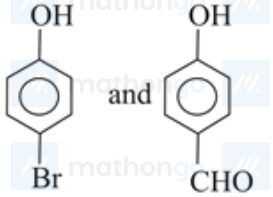
(4) 

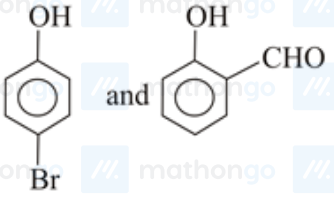
Q46. Identify the major products A and B respectively in the following reactions of phenol



(1) 

(2) 

(3) 

(4) 

Q47. $\underset{(C_4H_8Cl_2)}{A} \xrightarrow[373\ K]{\text{Hydrolysis}} \underset{(C_4H_8O)}{B}$

B reacts with Hydroxyl amine but does not give Tollen's test. Identify A and B.

(1) 2, 2-Dichlorobutane and Butanal

(2) 2, 2-Dichlorobutane and Butan-2-one

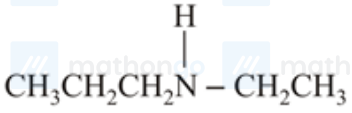
(3) 1, 1-Dichlorobutane and 2-Butanone

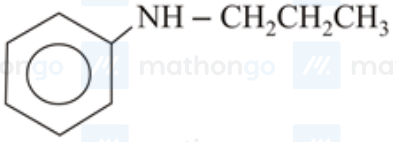
(4) 1, 1-Dichlorobutane and Butanal

Q48. An amine on reaction with benzenesulphonyl chloride produces a compound insoluble in alkaline solution. This amine can be prepared by ammonolysis of ethyl chloride. The correct structure of amine is:

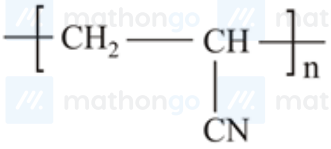
(1) $CH_3CH_2NH_2$

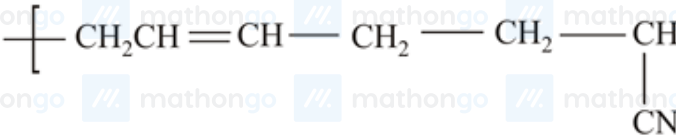
(2) $CH_3CH_2CH_2NHCH_3$

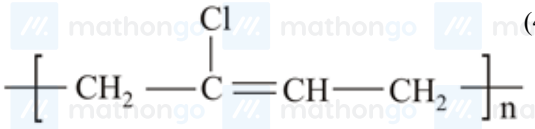
(3) 

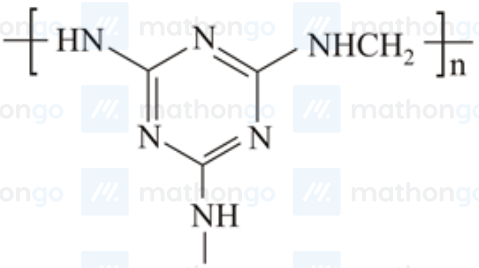
(4) 

Q49. The structure of Neoprene is :

(1) 

(2) 

(3) 

(4) 

Q50. Which of the following vitamin is helpful in the blood clotting?

(1) Vitamin C

(2) Vitamin E

(3) Vitamin K

(4) Vitamin B

Q51. The number of significant figures in 50000.020×10^{-3} is _____

Q52. A certain gas obeys $P(V_m - b) = RT$. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$. The value of x is _____(Integer answer) (Z : compressibility factor)

Q53. For a chemical reaction $A + B = C + D$ $\left(\Delta_r H^\Theta = 80\ kJ\ mol^{-1}\right)$ the entropy change $\Delta_r S^\Theta$ depends on the temperature T (in K) as $\Delta_r S^\Theta = 2T\left(JK^{-1}\,mol^{-1}\right)$. Minimum temperature at which it will become spontaneous is _____ K. (Integer)

Q54. A homogeneous ideal gaseous reaction $AB_{2(g)} \rightleftharpoons A_{(g)} + 2\,B_{(g)}$ is carried out in a 25 litre flask at $27^\circ C$. The initial amount of AB_2 was 1 mole and the equilibrium pressure was 1.9 atm. The value of K_p is $x \times 10^{-2}$. The value of x is _____ (Integer answer) $\left[R = 0.08206\ dm^3\ atm\ K^{-1}\ mol^{-1}\right]$

Q55. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is _____

Q56. 224 mL of $SO_{2(g)}$ at 298 K and 1 atm is passed through 100 mL of 0.1 M NaOH solution. The non-volatile solute produced is dissolved in 36 g of water. The lowering of vapour pressure of solution (assuming the solution is dilute) ($P^\circ_{(H_2O)} = 24$ mm of Hg) is $x \times 10^{-2}$ mm of Hg the value of x is _____ (Integer answer)

Q57. Consider the following reaction

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O\ ,\ E^\circ = 1.51\ V$

The quantity of electricity required in Faraday to reduce five moles of MnO_4^- is _____

Q58. An exothermic reaction $X \rightarrow Y$ has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is -20 kJ, then the activation energy for the reverse reaction in kJ is _____ (Integer answer)

Q59. 3.12 g of oxygen is adsorbed on 1.2 g of platinum metal. The volume of oxygen adsorbed per gram of the adsorbent at 1 atm and 300 K in L is _____
$[R = 0.0821\ \text{L atm K}^{-1}\ \text{mol}^{-1}]$

Q60. Number of bridging CO ligands in $[Mn_2(CO)_{10}]$ is _____

Q61. The number of seven digit integers with sum of the digits equal to 10 and formed by using the digits 1, 2 and 3 only is:
(1) 77 (2) 82
(3) 42 (4) 35

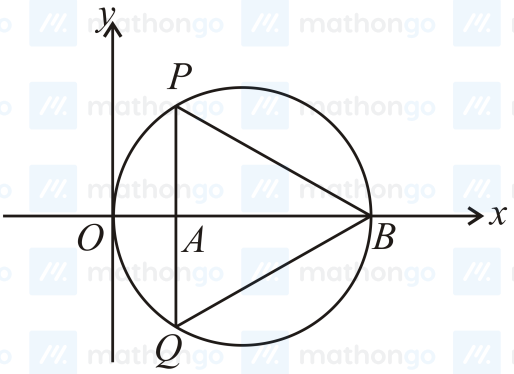
Q62. The sum of the infinite series $1 + \frac{2}{3} + \frac{7}{3^2} + \frac{12}{3^3} + \frac{17}{3^4} + \frac{22}{3^5} + \ldots\ldots$ is equal to:
(1) $\frac{9}{4}$ (2) $\frac{15}{4}$
(3) $\frac{11}{4}$ (4) $\frac{13}{4}$

Q63. In an increasing geometric series, the sum of the second and the sixth term is $\frac{25}{2}$ and the product of the third and fifth term is 25. Then, the sum of 4^{th}, 6^{th} and 8^{th} terms is equal to:
(1) 35 (2) 32
(3) 26 (4) 30

Q64. The maximum value of the term independent of t in the expansion of $\left(tx^{\frac{1}{5}} + \frac{(1-x)^{\frac{1}{10}}}{t}\right)^{10}$ where $x \in (0,1)$ is:
(1) $\frac{10!}{\sqrt{3}(5!)^2}$ (2) $\frac{10!}{3(5!)^2}$
(3) $\frac{2.10!}{3\sqrt{3}(5!)^2}$ (4) $\frac{2.10!}{3(5!)^2}$

Q65. The intersection of three lines $x - y = 0$, $x + 2y = 3$ and $2x + y = 6$ is a/an
(1) Isosceles triangle (2) Equilateral triangle
(3) Right angled triangle (4) None of the above

Q66. In the circle given below, let $OA = 1$ unit, $OB = 13$ unit and $PQ \perp OB$. Then, the area of the triangle PQB



(in square units) is :
(1) $24\sqrt{3}$ (2) $26\sqrt{3}$
(3) $24\sqrt{2}$ (4) $26\sqrt{2}$

Q67. The value of $\lim\limits_{h\to 0}\left\{\frac{\sqrt{3}\sin\left(\frac{\pi}{6}+h\right)-\cos\left(\frac{\pi}{6}+h\right)}{\sqrt{3}h\left(\sqrt{3}\cos h-\sin h\right)}\right\}$ is :
(1) $\frac{4}{3}$ (2) $\frac{2}{\sqrt{3}}$
(3) $\frac{2}{3}$ (4) $\frac{3}{4}$

Q68. Let $R = \{(P,Q) | P \text{ and } Q \text{ are at the same distance from the origin}\}$ be a relation, then the equivalence class of $(1,-1)$ is the set

(1) $S=\left\{(x, y) \middle| x^2+y^2=1\right\}$ (2) $S=\left\{(x, y) \middle| x^2+y^2=2\right\}$
(3) $S=\left\{(x, y) \middle| x^2+y^2=\sqrt{2}\right\}$ (4) $S=\left\{(x, y) \middle| x^2+y^2=4\right\}$

Q69. Let A be a symmetric matrix of order 2 with integer entries. If the sum of the diagonal elements of A^2 is 1, then the possible number of such matrices is:
(1) 12 (2) 4
(3) 1 (4) 6

Q70. The value of $\begin{vmatrix}(a+1)(a+2) & a+2 & 1\\(a+2)(a+3) & a+3 & 1\\(a+3)(a+4) & a+4 & 1\end{vmatrix}$ is
(1) 0 (2) $(a+2)(a+3)(a+4)$
(3) -2 (4) $(a+1)(a+2)(a+3)$

Q71. If $\frac{\sin^{-1} x}{a}=\frac{\cos^{-1} x}{b}=\frac{\tan^{-1} y}{c} ; 0<x<1$, then the value of $\cos\left(\frac{\pi c}{a+b}\right)$ is:
(1) $\frac{1-y^2}{1+y^2}$ (2) $1-y^2$
(3) $\frac{1-y^2}{y\sqrt{y}}$ (4) $\frac{1-y^2}{2y}$

Q72. Let f be any function defined on R and let it satisfy the condition: $|f(x)-f(y)| \leq \left|(x-y)^2\right|, \forall(x, y) \in R$. If $f(0)=1$, then :
(1) $f(x)=0, \forall x \in R$ (2) $f(x)$ can take any value in R
(3) $f(x)<0, \forall x \in R$ (4) $f(x)>0, \forall x \in R$

Q73. The maximum slope of the curve $y=\frac{1}{2} x^4-5 x^3+18 x^2-19 x$ occurs at the point
(1) $\left(3, \frac{21}{2}\right)$ (2) $(2,2)$
(3) $(2,9)$ (4) $(0,0)$

Q74. The value of $\sum_{n=1}^{100} \int_{n-1}^{n} e^{x-[x]} dx$, where $[x]$ is the greatest integer $\leq x$, is:
(1) $100(e-1)$ (2) $100e$
(3) $100(1-e)$ (4) $100(1+e)$

Q75. The value of $\int_{-\pi/2}^{\pi/2} \frac{\cos^2 x}{1+3^x} dx$ is:
(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$
(3) 2π (4) 4π

Q76. The rate of growth of bacteria in a culture is proportional to the number of bacteria present and the bacteria count is 1000 at initial time $t=0$. The number of bacteria is increased by 20% in 2 hours. If the population of bacteria is 2000 after $\frac{k}{\log_e\left(\frac{6}{5}\right)}$ hours, then $\left(\frac{k}{\log_e 2}\right)^2$ is equal to:
(1) 8 (2) 4
(3) 16 (4) 2

Q77. If $\vec{a}$ and $\vec{b}$ are perpendicular, then $\vec{a} \times\left(\vec{a} \times\left(\vec{a} \times\left(\vec{a} \times \vec{b}\right)\right)\right)$ is equal to:
(1) $\left|\vec{a}\right|^4 \vec{b}$ (2) $\vec{0}$
(3) $\vec{a} \times \vec{b}$ (4) $\frac{1}{2}\left|\vec{a}\right|^4 \vec{b}$

Q78. If $(1,5,35),(7,5,5),(1, \lambda, 7)$ and $(2 \lambda, 1,2)$ are coplanar, then the sum of all possible values of λ is:
(1) $\frac{44}{5}$ (2) $-\frac{44}{5}$
(3) $\frac{39}{5}$ (4) $-\frac{39}{5}$

Q79. Consider the three planes
$P_1 : 3x + 15y + 21z = 9$
$P_2 : x - 3y - z = 5$, and
$P_3 : 2x + 10y + 14z = 5$
Then, which one of the following is true?
(1) P_2 and P_3 are parallel.
(2) P_1, P_2 and P_3 all are parallel.
(3) P_1 and P_2 are parallel.
(4) P_1 and P_3 are parallel.

Q80. A fair coin is tossed a fixed number of times. If the probability of getting 7 heads is equal to probability of getting 9 heads, then the probability of getting 2 heads is
(1) $\frac{15}{2^{13}}$
(2) $\frac{15}{2^{14}}$
(3) $\frac{15}{2^{12}}$
(4) $\frac{15}{2^{8}}$

Q81. The number of solutions of the equation $\log_4(x-1) = \log_2(x-3)$ is _____.

Q82. The sum of 162^{th} power of the roots of the equation $x^3 - 2x^2 + 2x - 1 = 0$ is _____.

Q83. Let $m, n \in N$ and $\gcd(2,\ n) = 1$. If $30\binom{30}{0} + 29\binom{30}{1} + \ldots\ldots + 2\binom{30}{28} + 1\binom{30}{29} = n.\,2^m$, then $n + m$ is equal to _____. (Here $\binom{n}{k} = {}^nC_k$)

Q84. The number of integral values of k for which the equation $3\sin x + 4\cos x = k + 1$ has a solution, $k \in R$ is _____.

Q85. If $\sqrt{3}(\cos^2 x) = \left(\sqrt{3} - 1\right)\cos x + 1$, then number of solutions of the given equation when $x \in \left[0,\ \frac{\pi}{2}\right]$ is _____.

Q86. The value of the integral $\int_0^{\pi} |\sin 2x| dx$ is _____.

Q87. The area bounded by the lines $y = ||x-1| - 2|$ and $y = 2$ is _____.

Q88. The difference between degree and order of a differential equation that represents the family of curves given by $y^2 = a\left(x + \frac{\sqrt{a}}{2}\right), a > 0$ is _____.

Q89. If $y = y(x)$ is the solution of the equation $e^{\sin y}\cos y\frac{dy}{dx} + e^{\sin y}\cos x = \cos x, y(0) = 0$; then $1 + y\left(\frac{\pi}{6}\right) + \frac{\sqrt{3}}{2}y\left(\frac{\pi}{3}\right) + \frac{1}{\sqrt{2}}y\left(\frac{\pi}{4}\right)$ is equal to _____.

Q90. Let $(\lambda, 2, 1)$ be a point on the plane which passes through the point $(4, -2, 2)$. If the plane is perpendicular to the line joining the points $(-2, -21, 29)$ and $(-1, -16, 23)$, then $\left(\frac{\lambda}{11}\right)^2 - \frac{4\lambda}{11} - 4$ is equal to _____.

ANSWER KEYS

1. (4)	**2.** (4)	**3.** (4)	**4.** (3)	**5.** (3)	**6.** (3)	**7.** (4)	**8.** (2)
9. (4)	**10.** (3)	**11.** (2)	**12.** (2)	**13.** (1)	**14.** (1)	**15.** (4)	**16.** (2)
17. (4)	**18.** (4)	**19.** (1)	**20.** (1)	**21.** (500)	**22.** (492)	**23.** (3.33)	**24.** (26)
25. (1215)	**26.** (300)	**27.** (282.84)	**28.** (137)	**29.** (20)	**30.** (33)	**31.** (1)	**32.** (1)
33. (1)	**34.** (1)	**35.** (2)	**36.** (1)	**37.** (3)	**38.** (1)	**39.** (3)	**40.** (4)
41. (4)	**42.** (3)	**43.** (1)	**44.** (2)	**45.** (2)	**46.** (4)	**47.** (2)	**48.** (3)
49. (3)	**50.** (3)	**51.** (8)	**52.** (1)	**53.** (200)	**54.** (73)	**55.** (6)	**56.** (18)
57. (25)	**58.** (50)	**59.** (2)	**60.** (0)	**61.** (1)	**62.** (4)	**63.** (1)	**64.** (3)
65. (1)	**66.** (1)	**67.** (3)	**68.** (2)	**69.** (2)	**70.** (3)	**71.** (1)	**72.** (4)
73. (2)	**74.** (1)	**75.** (2)	**76.** (2)	**77.** (1)	**78.** (1)	**79.** (4)	**80.** (1)
81. (1)	**82.** (3)	**83.** (45)	**84.** (11)	**85.** (1)	**86.** (2)	**87.** (8)	**88.** (2)
89. (1)	**90.** (8)						