JEE(Main)-2026_Phase-1_(21-01-2026)_Morning

MATHEMATICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

Choose the correct answer:

1. The value of $\text{cosec}10^\circ - \sqrt{3}\sec 10^\circ$ is equal to:
   (1) 2
   (2) 6
   (3) 8
   (4) 4

2. Let (α,β,γ) be the co-ordinates of the foot of the perpendicular drawn from the point (5,4,2) on the line $\vec{r} = (-\hat{i} + 3\hat{j} + \hat{k}) + \lambda(2\hat{i} + 3\hat{j} - \hat{k})$.
Then the length of the projection of the vector $\alpha\hat{i} + \beta\hat{j} + \gamma\hat{k}$ on the vector $6\hat{i} + 2\hat{j} + 3\hat{k}$ is:
(1) 4
(2) $\frac{15}{7}$
(3) $\frac{18}{7}$
(4) 3

3. Let $\vec{c}$ and $\vec{d}$ be vectors such that $|\vec{c} + \vec{d}| = \sqrt{29}$ and $\vec{c} \times (2\hat{i} + 3\hat{j} + 4\hat{k}) = (2\hat{i} + 3\hat{j} + 4\hat{k}) \times \vec{d}$. If λ_1,λ_2
$(\lambda_1 > \lambda_2)$ are the possible values of $(\hat{c} + \vec{d}) \cdot (-7\hat{i} + 2\hat{j} + 3\hat{k})$, then the equation
$K^2x^2 + \left(K^2 - 5K + \lambda_1\right)xy + \left(3K + \frac{\lambda_2}{2}\right)y^2 - 8x + 12y$
$+ \lambda_2 = 0$ represents a circle, for K equal to:
(1) 2
(2) -1
(3) 4
(4) 1

4. Let PQ and MN be two straight lines touching the circle $x^2 + y^2 - 4x - 6y - 3 = 0$ at the points A and B respectively. Let O be the centre of the circle and $\angle AOB = \pi/3$. Then the

locus of the point of intersection of the lines PQ and MN is:
(1) $x^2 + y^2 - 18x - 12y - 25 = 0$
(2) $3\left(x^2 + y^2\right) - 12x - 18y - 25 = 0$
(3) $x^2 + y^2 - 12x - 18y - 25 = 0$
(4) $3\left(x^2 + y^2\right) - 18x - 12y + 25 = 0$

5. The number of strictly increasing functions f from the set $\{1,2,3,4,5,6\}$ to the set $\{1,2,3,....,9\}$ such that $f(i) \neq i$ for $1 \leq i \leq 6$, is equal to:
(1) 27
(2) 22
(3) 21
(4) 8

6. Let the mean and variance of 7 observations $2,4,10,x,12,14,y, x > y$, be 8 and 16 respectively. Two numbers are chosen from $\{1,2,3,x-4,y,5\}$ one after another without replacement, then the probability, that the smaller number among the two chosen numbers is less than 4 , is :
(1) $\frac{3}{5}$
(2) $\frac{4}{5}$
(3) $\frac{2}{5}$
(4) $\frac{1}{3}$

7. Let $\vec{a} = -\hat{\imath} + 2\hat{\jmath} + 2\hat{k}, \vec{b} = 8\hat{\imath} + 7\hat{\jmath} - 3\hat{k}$ and $\vec{c}$ be a vector such that $\vec{a} \times \vec{c} = \vec{b}$.

If $\vec{c} \cdot (\hat{\imath} + \hat{\jmath} + \hat{k}) = 4$, then $|\vec{a} + \vec{c}|^2$ is equal to :
(1) 35
(2) 33
(3) 27
(4) 30

8. Let $y = y(x)$ be the solution curve of the differential equation $\left(1 + x^2\right) dy + \left(y - \tan^{-1} x\right) dx = 0, y(0) = 1$.
Then the value of $y(1)$ is :
(1) $\frac{4}{e^{\pi/4}} - \frac{\pi}{2} - 1$
(2) $\frac{2}{e^{\pi/4}} - \frac{\pi}{4} - 1$
(3) $\frac{2}{e^{\pi/4}} + \frac{\pi}{4} - 1$
(4) $\frac{4}{e^{\pi/4}} + \frac{\pi}{2} - 1$

9. Let a point A lie between the parallel lines L_1 and L_2 such that its distances from L_1 and L_2 are 6 and 3 units, respectively. Then the area (in sq. units) of the equilateral triangle ABC, where the points B and C lie on the lines L_1 and L_2, respectively, is :
(1) $21\sqrt{3}$
(2) $12\sqrt{2}$

(3) $15\sqrt{6}$
(4) 27

10. Let $f:\mathbf{R} \to (0,\infty)$ be a twice differentiable function such that $f(3) = 18, f'(3) = 0$ and $f''(3) = 4$. Then $\lim_{x\to 1}\left(\log_e\left(\frac{f(2+x)}{f(3)}\right)^{\frac{18}{(x-1)^2}}\right)$ is equal to :

(1) 2
(2) 9
(3) 1
(4) 18

11.

The number of relations, defined on the set $\{a,b,c,d\}$, which are both reflexive and symmetric, is equal to:
(1) 1024
(2) 64
(3) 256
(4) 16

12. Let $a_1, a_2, a_3, \ldots$ be G.P. of increasing positive terms such that $a_2 \cdot a_3 \cdot a_4 = 64$ and $a_1 + a_3 + a_5 = \frac{813}{7}$. Then $a_3 + a_5 + a_7$ is equal to:

(1) 3252
(2) 3248
(3) 3244
(4) 3256

13. Let the foci of a hyperbola coincide with the foci of the ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$. If the eccentricity of the hyperbola is 5 , then the length of its latus rectum is:

(1) $\frac{96}{\sqrt{5}}$
(2) $24\sqrt{5}$
(3) 12
(4) 16

14. The value of $\int_{\frac{\pi}{6}}^{\frac{\pi}{6}}\left(\frac{\pi+4x^{11}}{1-\sin\left(|x|+\frac{\pi}{6}\right)}\right)dx$ is equal to:

(1) 8π
(2) 4π
(3) 6π
(4) 2π

15. If the domain of the function $f(x) = \cos^{-1}\left(\frac{2x-5}{11-3x}\right) + \sin^{-1}\left(2x^2 - 3x + 1\right)$ is the interval $[\alpha,\beta]$, then $\alpha + 2\beta$ is equal to :

(1) 3
(2) 2
(3) 1
(4) 5

16. If $x^2 + x + 1 = 0$, then the value of $\left(x + \frac{1}{x}\right)^4 + \left(x^2 + \frac{1}{x^2}\right)^4 + \left(x^3 + \frac{1}{x^3}\right)^4 + ... + \left(x^{25} + \frac{1}{x^{25}}\right)^4$ is :

(1) 175
(2) 162
(3) 128
(4) 145

17. The area of the region, inside the ellipse $x^2 + 4y^2 = 4$ and outside the region bounded by the curves $y = |x| - 1$ and $y = 1 - |x|$, is :
(1) $3(\pi - 1)$
(2) $2\pi - \frac{1}{2}$
(3) $2\pi - 1$
(4) $2(\pi - 1)$

18. The sum of all the roots of the equation $(x - 1)^2 - 5|x - 1| + 6 = 0$, is :
(1) 3
(2) 4
(3) 1
(4) 5

19. Let O be the vertex of the parabola $x^2 = 4y$ and Q be any point on it. Let the locus of the point P , which divides the line segment OQ internally in the ratio 2:3 be the conic C. Then the equation of the chord of C, which is bisected at the point (1,2), is
(1) $5x - y - 3 = 0$
(2) $4x - 5y + 6 = 0$
(3) $5x - 4y + 3 = 0$
(4) $x - 2y + 3 = 0$

20. If the coefficient of x in the expansion of $\left(ax^2 + bx + c\right)(1 - 2x)^{26}$ is -56 and the coefficients of x^2 and x^3 are both zero, then a + b + c is equal to
(1) 1500
(2) 1403
(3) 1300
(4) 1483

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. Let $f: \boldsymbol{R} \to \boldsymbol{R}$ be a twice differentiable function such that the quadratic equation $f(x)m^2 - 2f'(x)m + f''(x) = 0$ in m , has two equal roots for every $x \in \mathbf{R}$. If $f(0) = 1, f'(0) = 2$, and (α, β) is the largest interval in which the function $f\left(\log_e x - x\right)$ is increasing, then $\alpha + \beta$ is equal to

____ .

22. $6\int_0^{\pi}|(\sin 3x + \sin 2x + \sin x)|dx$ is equal to

23. Let $S = \{(m,n): m,n \in \{1,2,3,\ldots\ldots,50\}\}$. If the number of elements (m,n) in S such that $6^m + 9^n$ is a multiple of 5 is p and the number of elements (m,n) in S such that $m+n$ is a square of a prime number is q, then $p+q$ is equal to ____ .

24. For some $\alpha,\beta \in \mathbf{R}$, let $A = \begin{bmatrix}\alpha & 2\\ 1 & 2\end{bmatrix}$ and $B = \begin{bmatrix}1 & 1\\ 1 & \beta\end{bmatrix}$ be such that $A^2 - 4A + 2I = B^2 - 3B + I = 0$. Then $\left(\det\left(\text{adj}\left(A^3 - B^3\right)\right)\right)^2$ is equal to ____ .

25. Let $a_1 = 1$ and for $n \geq 1, a_{n+1} = \frac{1}{2}a_n + \frac{n^2-2n-1}{n^2(n+1)^2}$. Then $\left|\sum_{n=1}^{\infty}\left(a_n - \frac{2}{n^2}\right)\right|$ is equal to ____ .

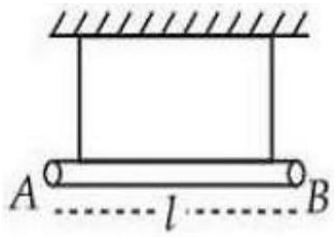
PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

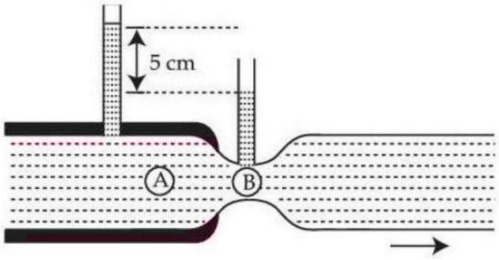
Choose the correct answer :

26. A uniform rod of mass m and length I suspended by means of two identical inextensible light strings as shown in figure. Tension in one string immediately after the other string is cut, is ____ . (g acceleration due to gravity)



(1) $mg/2$
(2) $mg/4$
(3) mg
(4) $mg/3$

27. Water flows through a horizontal tube as shown in the figure. The difference in height between the water columns in vertical tubes is 5 cm and the area of cross-sections at A and B are 6 cm^2 and 3 cm^2 respectively. The rate of flow will be ____ . cm^3/s. (take g = 10 m/s^2)



(1) $200\sqrt{3}$
(2) $100\sqrt{3}$
(3) $200\sqrt{6}$
(4) $\frac{200}{\sqrt{3}}$

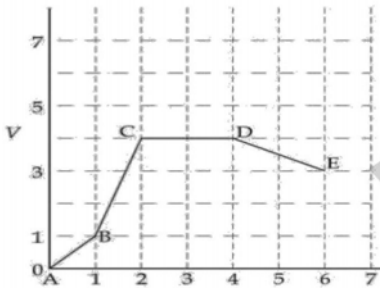
28. In an experiment the values of two spring constants were measured as $k_1 = (10 \pm 0.2)$N/m and $k_2 = (20 \pm 0.3)$N/m. If these springs are connected in parallel, then the percentage error in equivalent spring constant is:
(1) 1.33%
(2) 2.67%
(3) 2.33%
(4) 1.67%

Answer (4)

29. Two strings (A,B) having linear densities $\mu_A = 2 \times 10^{-4}$ kg/m and, $\mu_B = 4 \times 10^{-4}$ kg/m and lengths $L_A = 2.5$ m and $L_B = 1.5$ m respectively are joined. Free ends of A and B are tied to two rigid supports C and D, respectively creating a tension of 500 N in the wire. Two identical pulses, sent from C and D ends, take time t_1 and t_2, respectively, to reach the joint. The ratio t_1/t_2 is:
(1) 1.67
(2) 1.08
(3) 1.90
(4) 1.18

30. A point charge of 10^{-8}C is placed at origin. The work done in moving a point charge 2μC from point $A(4,4,2)$m to $B(2,2,1)$m is ____ J.
$\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ in SI units }\right)$
(1) 15×10^{-6}
(2) 30×10^{-6}
(3) 45×10^{-6}
(4) 0

31. Potential energy (V) versus distance (x) is given by the graph. Rank various regions as per the magnitudes of the force (F) acting on a particle from high to low.



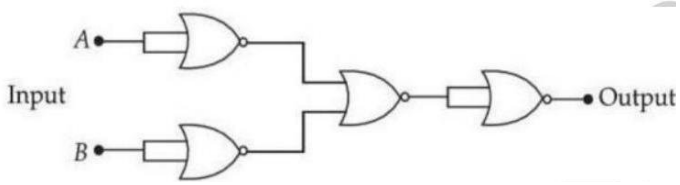
Answer (1)

(1) $F_{BC} > F_{AB} > F_{DE} > F_{CD}$
(2) $F_{CD} > F_{DE} > F_{AB} > F_{BC}$
(3) $F_{BC} > F_{CD} > F_{DE} > F_{AB}$
(4) $F_{CD} > F_{AB} > F_{BC} > F_{DE}$

32. A parallel plate capacitor has capacitance C, when there is vacuum within the parallel plates. A sheet having thickness $\left(\frac{1}{3}\right)^{rd}$ of the separation between the plates and relative permittivity K is introduced between the plates. The new capacitance of the system is
(1) $\frac{4KC}{3K-1}$
(2) $\frac{CK}{2+K}$
(3) $\frac{3KC}{2K+1}$
(4) $\frac{3CK^2}{(2K+1)^2}$

33. An aluminium and steel rods having same lengths and cross-sections are joined to make total length of 120 cm at 30°C. The coefficient of linear expansion of aluminium and steel are $24 \times 10^{-6}/\,^{\circ}C$ and $1.2 \times 10^{-5}/^{\circ}C$, respectively. The length of this composite rod when its temperature is raised to 100°C, is ____ cm .
(1) 120.20
(2) 120.15
(3) 120.03
(4) 120.06

34. The given circuit works as:



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

35. Consider a modified Bernoulli equation.
$\left(P+\frac{A}{Bt^2}\right)+\rho g(h+Bt)+\frac{1}{2}\rho V^2=$ constant
If t has the dimension of time then the dimensions of A and B are ____ , ____ respectively.
(1) $\left[ML^0T^{-1}\right]$ and $\left[M^0LT\right]$
(2) $\left[ML^0T^{-2}\right]$ and $\left[M^0LT^{-2}\right]$
(3) $\left[ML^0T^{-1}\right]$ and $\left[M^0LT^{-1}\right]$
(4) $\left[ML^0T^{-2}\right]$ and $\left[M^0LT^{-1}\right]$

36. The electric field in a plane electromagnetic wave is given by :
$E_y=69\sin\left[0.6\times10^3x-1.8\times10^{11}t\right]$ V/m
The expression for magnetic field associated with this electromagnetic wave is ____ T.
(1) $B_y=69\sin\left[0.6\times10^3x+1.8\times10^{11}t\right]$
(2) $B_z=2.3\times10^{-7}\sin\left[0.6\times10^3x+1.8\times10^{11}t\right]$
(3) $B_z=2.3\times10^{-7}\sin\left[0.6\times10^3x-1.8\times10^{11}t\right]$
(4) $B_y=2.3\times10^{-7}\sin\left[0.6\times10^3x-1.8\times10^{11}t\right]$

37. A conducting circular loop of area 1.0 m^2 is placed perpendicular to a magnetic field which varies as $B=\sin(100t)$ Tesla. If the resistance of the loop is 100Ω, then the average thermal energy dissipated in the loop in one period is ____ J.
(1) 2π
(2) $\frac{\pi}{2}$
(3) π^2
(4) π

38. A light wave described by
$E=60\left[\sin\left(3\times10^{15}\right)t+\sin\left(12\times10^{15}\right)t\right]$ (in SI units)
falls on a metal surface of work function 2.8 eV . The maximum kinetic energy of ejected photoelectron is (approximately) ____ eV .
($h=6.6\times10^{-34}$ J.s. and $e=1.6\times10^{-19}$C)
(1) 3.8
(2) 5.1
(3) 7.8
(4) 6.0

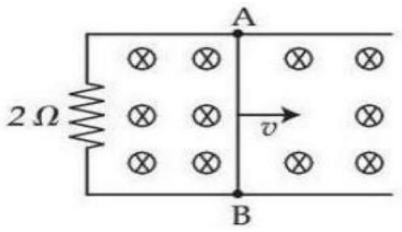
39. A current carrying solenoid is placed vertically and a particle of mass m with charge Q is released from rest. The particle moves along the axis of solenoid. If g is acceleration due to gravity then the acceleration (a) of the charged particle will satisfy
(1) $a=0$
(2) $a>g$
(3) $0<a<g$
(4) $a=g$

40. If an alpha particle with energy 7.7 MeV is bombarded on a thin gold foil, the closest

distance from nucleus it can reach is ____ m.
(Atomic number of gold = 79 and $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ in SI units)

(1) 3.85×10^{-16}
(2) 2.95×10^{-14}
(3) 3.85×10^{-14}
(4) 2.95×10^{-16}

41. A 1 m long metal rod AB completes the circuit as shown in figure. The area of circuit is perpendicular to the magnetic field of 0.10 T . If the resistance of the total circuit is 2Ω then the force needed to move the rod towards right with constant speed (v) of 1.5 m/s is ____ N.



(1) 7.5×10^{-3}
(2) 5.7×10^{-3}
(3) 5.7×10^{-2}
(4) 7.5×10^{-2}

Answer (1)

42. A gas based geyser heats water flowing at the rate of 5.0 litres per minute from 27°C to 87°C. The rate of consumption of the gas is ____ g/s.
(Take heat of combustion of gas = 5.0×10^4 J/g) specific heat capacity of water = 4200 J/ kg. °C
(1) 4.2
(2) 2.1
(3) 0.42
(4) 0.21

43. In a double slit experiment the distance between the slits is 0.1 cm and the screen is placed at 50 cm from the slits plane. When one slit is covered with a transparent sheet having thickness t and refractive index $n(= 1.5)$, the central fringe shifts by 0.2 cm . The value of t is ____ cm.
(1) 5.0×10^{-3}
(2) 5.6×10^{-4}
(3) 6.0×10^{-3}
(4) 8×10^{-4}

44. Initially a satellite of 100 kg is in a circular orbit of radius $1.5R_E$. This satellite can be moved to a circular orbit of radius $3R_E$ by supplying $\alpha \times 10^6$ J of energy. The value of α is

____ .
(Take Radius of Earth $R_E = 6 \times 10^6$ m and g = 10 m/s^2)
(1) 150
(2) 100
(3) 500
(4) 1000

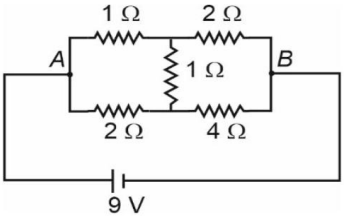
45. A 4 kg mass moves under the influence of a force $\vec{F} = \left(4t^3\hat{i} - 3t\hat{j}\right) N$ where t is the time in second. If mass starts from origin at $t = 0$, the velocity and position after $t = 2$ s will be :
(1) $\vec{v} = 4\hat{i} + \frac{5}{2}\hat{j}\ \vec{r} = \frac{8}{5}\hat{i} + 2\hat{j}$
(2) $\vec{v} = 4\hat{i} + \frac{3}{2}\hat{j}\ \vec{r} = \frac{6}{5}\hat{i} - \hat{j}$
(3) $\vec{v} = 3\hat{i} + \frac{3}{2}\hat{j}\ \vec{r} = \frac{6}{5}\hat{i} + \hat{j}$
(4) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j}\ \vec{r} = \frac{8}{5}\hat{i} - \hat{j}$

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

46. In a microscope the objective is having focal length $f_0 = 2$ cm and eye-piece is having focal length $f_e = 4$ cm. The tube length is 32 cm . The magnification produced by this microscope for normal adjustment is ____ .

47. The heat generated in 1 minute between points A and B in given circuit, when a battery of 9 V with internal resistance of 1Ω is connected across these points is ____ J.

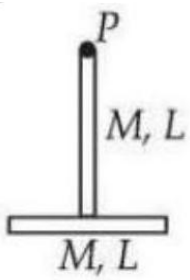


48. A collimated beam of light of diameter 2 mm is propagating along x-axis. The beam is required to be expanded in a collimated beam of diameter 14 mm using a system of two convex lenses. If first lens has focal length 40 mm , then the focal length of second lens is ____ mm .

49. 10 mole of oxygen is heated at constant volume from 30°C to 40°C. The change in the internal energy of the gas is ____ cal. (The molecular specific heat of oxygen at constant pressure, $C_p = 7$cal/mol. °C and $R = 2$ cal. /mol.°C.)

50. Two identical thin rods of mass M kg and length L m are connected as shown in figure. Moment of inertia of the combined rod system about an axis passing

through point P and perpendicular to the plane of the rods is $\frac{x}{12}ML^2$ kg m^2. The value of x is



CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which ONLY ONE is correct.

Choose the correct answer :

51. Given below are two statements :

Statement I:

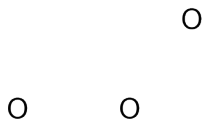
Among $[Cu(NH_3)_4]^{2+}$, $[Ni(en)_3)]^{2+}$, $[Ni(NH_3)_6]^{2+}$ and $[Mn(H_2O)_6]^{2+}$, $[Mn(H_2O)_6]^{2+}$ has the maximum number of unpaired electrons.

Statement II :

The number of pairs among $\{[NiCl_4]^{2-}, [Ni(CO)_4]\}$, $\{[NiCl_4]^{2-}, [Ni(CN)_4]^{2-}\}$ and $\{[Ni(CO)_4], [Ni(CN)_4]^{2-}\}$ that contain only diamagnetic species is two.

In the light of the above statements, choose the correct answer from the options given below :
(1) Statement I is true but Statement II is false
(2) Both Statement I and Statement II are true
(3) Both Statement I and Statement II are false
(4) Statement I is false but Statement II is true

52. An organic compound " P " of molecular formula $C_6H_{12}O_3$ gives positive lodoform test but negative Tollen's test. When "P" is treated with dilute acid, it produces "Q". "Q" gives positive Tollen's test and also iodoform test. The structure of " P " is :
(1)



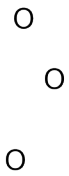
(2)



(3)



(4)



53. 14.0 g of calcium metal is allowed to react with excess HCl at 1.0 atm pressure and 273 K .

Which of the following statements is incorrect?
[Given : Molar mass in $gmol^{-1}$ of Ca – 40,Cl – 35.5, H – 1]
(1) 0.35 mol of H_2 gas is evolved.
(2) The limiting reagent is calcium metal.
(3) 7.84 L of H_2 gas is evolved.
(4) 33.3 g of $CaCl_2$ is produced.

54. Identify correct statements from the following:
A. Propanal and propanone are functional isomers.
B. Ethoxyethane and methoxypropane are metamers.
C. But-2-ene shows optical isomerism.
D. But-1-ene and but-2-ene are functional isomers.
E. Pentane and 2, 2-dimethyl propane are chain isomers.

Choose the correct answer from the options given below:
(1) A, B and C only
(2) C, D and E only
(3) B, C and D only
(4) A, B and E only

55. Given below are two statements:

Statement I: The number of pairs among [SiO_2,CO_2] , [SnO,SnO_2] , [PbO,PbO_2] and [GeO,GeO_2], which contain oxides that are both amphoteric is 2 .

Statement II: BF_3 is an electron deficient molecule, can act as a Lewis acid, forms adduct with NH_3 and has a trigonal planar geometry.

In the light of the above statements, choose the correct answer from the options given below :
(1) Statement I is true but Statement II is false
(2) Both Statement I and Statement II are true
(3) Statement I is false but Statement II is true
(4) Both Statement I and Statement II are false

56. Given below are two statements :

Statement I: When an electric discharge is passed through gaseous hydrogen, the hydrogen molecules dissociate and the energetically excited hydrogen atoms produce electromagnetic radiation of discrete frequencies.

Statement II: The frequency of second line of Balmer series obtained from $He^+$is equal to that of first line of Lyman series obtained from hydrogen atom.

In the light of the above statements, choose the correct answer from the options given below :
(1) Statement I is true but Statement II is false
(2) Both Statement I and Statement II are true

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

57. Consider the following reactions.
$PbCl_2 + K_2CrO_4 \rightarrow A + 2KCl$
(Hot solution)
$A + NaOH \rightleftharpoons B + Na_2CrO_4$
$PbSO_4 + 4CH_3COONH_4 \rightarrow (NH_4)_2SO_4 + X$
In the above reactions, *A*,*B* and *X* are respectively.
(1) $Na_2[Pb(OH)_2]$,$PbCrO_4$ and $[Pb(NH_3)_4]SO_4$
(2) $PbCrO_4$,$Na_2[Pb(OH)_4]$ and $[Pb(NH_3)_4]SO_4$
(3) $Na_2[Pb(OH)_2]$,$PbCrO_4$ and

$$(NH_4)_2[Pb(CH_3COO)_4]$$

(4) $PbCrO_4$,$Na_2[Pb(OH)_4]$ and

$$(NH_4)_2[Pb(CH_3COO)_4]$$

58. Identify the correct statements.
A. Arginine and Tryptophan are essential amino acids.
B. Histidine does not contain heterocyclic ring in its structure.
C. Proline is a six membered cyclic ring amino acid.
D. Glycine does not have chiral centre.
E. Cysteine has characteristic feature of side chain as $MeS - CH_2 - CH_2$-.

Choose the correct answer from the options given below.
(1) B and E Only
(2) C and D Only
(3) A and D Only
(4) C and E Only

59. An organic compound (P) on treatment with aqueous ammonia under hot condition forms compound (Q) which on heating with Br_2 and KOH forms compound (R) having molecular formula C_6H_7N. Names of P,Q and R respectively are
(1) Benzoic acid, 4-methylbenzamide, 4-methylaniline
(2) Benzoic acid, benzamide, aniline
(3) Toluic acid, methylbenzamide, 2-methylaniline
(4) Phenylethanoic acid, phenylethanamide, benzamine

60. Which of the following represents the correct trend for the mentioned property?

A. F > P > S > B - First Ionisation Energy

B. Cl > F > S > P - Electron Affinity

C. K > Al > Mg > B - Metallic character

D. $KO_2 > Na_2O > MgO > Al_2O_3$ – Basic character

Choose the correct answer from the options given below.
(1) A and B only
(2) A, B and D only

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

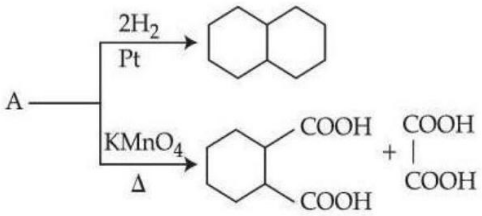
61. Elements P and Q form two types of non-volatile, non-ionizable compounds PQ and PQ_2. When 1 g of PQ is dissolved in 50 g of solvent ' A ', ΔT_b was 1.176 K while when 1 g of PQ_2 is dissolved in 50 g of solvent ' A ', ΔT_b was 0.689 K . (K_b of ' A ' = 5 K $kgmol^{-1}$). The molar masses of elements P and Q (in $gmol^{-1}$) respectively, are
(1) 70,110
(2) 25,60
(3) 65, 145
(4) 60,25

62. 80 mL of a hydrocarbon on mixing with 264 mL of oxygen in a closed U-tube undergoes complete combustion. The residual gases after cooling to 273 K occupy 224 mL . When the system is treated with KOH solution, the volume decreases to 64 mL . The formula of the hydrocarbon is
(1) C_2H_2
(2) C_4H_{10}
(3) C_2H_4
(4) C_2H_6

63. MnO_4^{2-}, in acidic medium, disproportionates to :
(1) Mn_2O_7 and MnO_2
(2) Mn_2O_7 and MnO
(3) MnO_4^- and MnO_2
(4) MnO_4^- and MnO

64. In Carius method, 0.75 g of an organic compound gave 1.2 g of barium sulphate, find percentage of sulphur (molar mass 32 g mol^{-1}). Molar mass of barium sulphate is 233 g mol^{-1}.
(1) 21.97%
(2) 10.30%
(3) 4.55%
(4) 16.48%

65. Identify A in the following reaction.



(1)

(2)

(3)

(4)

66. Given below are two statements :

Statement I :

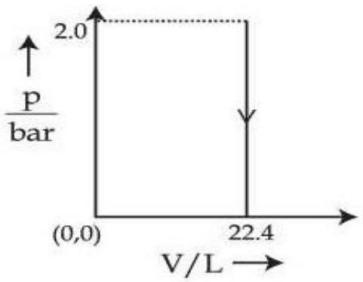
The number of species among SF_4,NH_4^+, $[NiCl_4]^{2-}$, XeF_4, $[PtCl_4]^{2-}$,SeF_4 and $[Ni(CN)_4]^{2-}$, that have tetrahedral geometry is 3 .

Statement II :

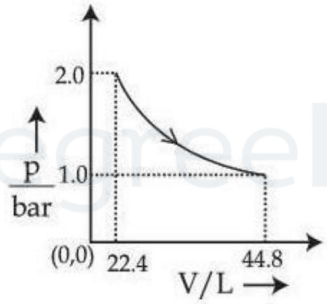
In the set [NO_2,BeH_2,BF_3,$AlCl_3$], all the molecules have incomplete octet around central atom. In the light of the above statements, choose the correct answer from the options given below :
(1) Both Statement I and Statement II are true

(2) 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

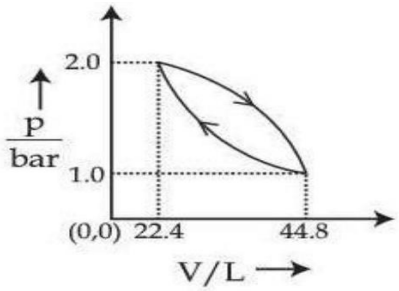
67. Which of the following graphs between pressure 'p' versus volume 'V' represents the maximum work done?
(1)



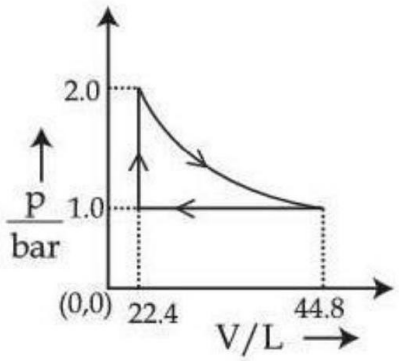
(2)



(3)



(4)



68. A hydrocarbon ' P ' (C_4H_8) on reaction with HCl gives an optically active compound ' Q ' (C_4H_9Cl) which on reaction with one mole of ammonia gives compound ' R ' ($C_4H_{11}N$). ' R ' on diazotization followed by hydrolysis gives ' S '. Identify P,Q,R and S .

(1)

$P = CH_3 - CH = CH - CH_3$, $Q = CH_3 - CH_2 - \underset{\displaystyle Cl}{\underset{|}{CH}} - CH_3$,

$R = CH_3 - CH_2 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - CH_3$, $S = CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$

(2)

$P = CH_3$ , $Q = Cl - CH_2$ ,

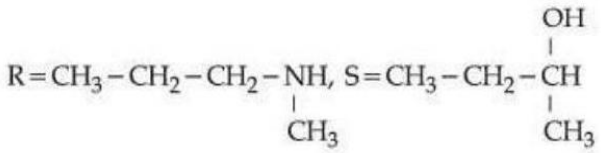
$R = H_2N - CH_2$ , $S =$ 

(3)

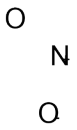
$P = CH_3 - CH = CH - CH_3$, $Q = CH_3 - CH_2 - CH_2 - CH_2 - Cl$,
$R = CH_3 - CH_2 - CH_2 - CH_2$, $S = CH_3 - CH_2 - CH_2$
NH_2

(4)

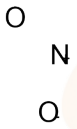
$P = CH_3 - CH_2 - CH = CH_2$, $Q = CH_3 - CH_2 - CH_2 - \underset{\displaystyle Cl}{\underset{|}{CH_2}}$,



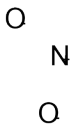
69. From the following, the least stable structure is:
(1)



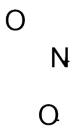
(2)



(3)

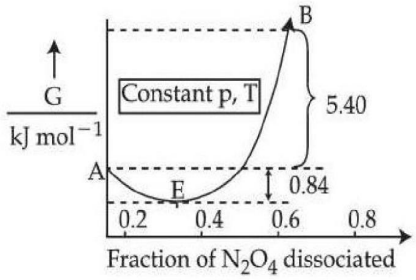


(4)



70. For the reaction, $N_2O_4 \rightleftharpoons 2NO_2$, graph is plotted as shown below. Identify correct statements.
A. Standard free energy change for the reaction is -5.40 kJ mol^{-1}.

B. As $\Delta G^{\ominus}$ in graph is positive, N_2O_4 will not dissociate into NO_2 at all.
C. Reverse reaction will go to completion.
D. When 1 mole of N_2O_4 changes into equilibrium mixture, value of $\Delta G^{\ominus} = -0.84$ kJ mol^{-1}
E. When 2 mole of NO_2 changes into equilibrium mixture, $\Delta G^{\ominus}$ for equilibrium mixture is. -6.24 $kJmol^{-1}$.



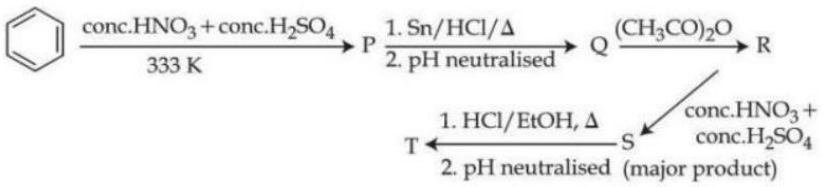
Choose the correct answer from the options given below :
(1) C and E only
(2) D and E only
(3) B and C only
(4) A and D only

SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

71. The pH and conductance of a weak acid (HX) was found to be 5 and 4×10^{-5} S, respectively. The conductance was measured under standard condition using a cell where the electrode plates having a surface area of 1 cm^2 were at a distance of 15 cm apart. The value of the limiting molar conductivity is ____ Sm^2 mol^{-1}. (nearest integer)
(Given : degree of dissociation of the weak acid (α) $\ll 1$)

72. Consider the following reaction sequence



The percentage of nitrogen in product ' T ' formed is
____ %. (Nearest integer)
(Given molar mass in $gmol^{-1}$ H:1,C:12, N:14, O : 16)

73. Consider the following reactions :
$NaCl + K_2Cr_2O_7 + H_2SO_4 \rightarrow$

$$A + KHSO_4 + NaHSO_4 + H_2O$$

$A + NaOH \rightarrow B + NaCl + H_2O$
$B + H_2SO_4 + H_2O_2 \rightarrow C + Na_2SO_4 + H_2O$
In the product ' C ', ' X ' is the number of O_2^{2-} units, ' Y ' is the total number oxygen atoms present and ' Z ' is the oxidation state of Cr . The value of X + Y + Z is
____ .

74. Use the following data :

Substance	$\frac{\Delta_f H^{\ominus}(500\ K)}{kJmol^{-1}}$	$\frac{S^{\ominus}(500\ K)}{JK^{-1}\ mol^{-1}}$
AB(g)	32	222
$A_2(g)$	6	146
$B_2(g)$	x	280

One mole each of $A_2(g)$ and $B_2(g)$ are taken in a 1 L closed flask and allowed to establish the equilibrium at 500 K .
$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$
The value of x (in $kJmol^{-1}$) is ____ . (Nearest integer)
(Given : log K = 2.2 R = 8.3 J K^{-1} mol – 1)

75. Pre-exponential factors of two different reactions of same order are identical. Let activation energy of first reaction exceeds the activation energy of second reaction by 20 kJ mol^{-1}. If k_1 and k_2 are the rate constants of first and second reaction respectively at 300 K , then $\ln \frac{k_2}{k_1}$ will be ____ . (nearest integer) $\left[R = 8.3\ J\ K^{-1}\ mol^{-1}\right]$

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MATHEMATICS

SECTION - A

1. Answer (4)

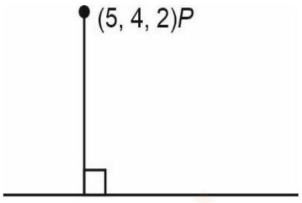
Sol. $\frac{1}{\sin 10}-\frac{\sqrt{3}}{\cos 10}$

$=\frac{1}{2}\left[\frac{\cos 10^{\circ}-\sqrt{3}\sin 10^{\circ}}{\frac{1}{2}\sin 10^{\circ}\cos 10^{\circ}}\right]$

$=2\times 2\frac{[\sin 30^{\circ}\cos 10^{\circ}-\cos 30^{\circ}\sin 10^{\circ}]}{\sin 20^{\circ}}=4$

2. Answer (3)

Sol.

3. 

$F(\alpha,\beta,\gamma)$

$\frac{x+1}{2}=\frac{y-3}{3}=\frac{z-1}{-1}=\lambda$

$(2\lambda-1,3\lambda+3,1-\lambda)$

$\overrightarrow{PF}=(2\lambda-6)\hat{i}+(3\lambda-1)\hat{j}+(-\lambda-1)\hat{k}$

$\overrightarrow{PF}\cdot(2\hat{i}+3\hat{j}-\hat{k})=0$

$4\lambda-12+9\lambda-3+\lambda+1=0\Rightarrow\lambda=1$

$\Rightarrow F\equiv(1,6,0)$

$\Rightarrow$ length of projection of $\hat{i}+6\hat{j}$ on $6\hat{i}+2\hat{j}+3\hat{k}$

$=\left|\frac{(\hat{i}+6\hat{j})\cdot(6\hat{i}+2\hat{j}+3\hat{k})}{|6\hat{i}+2\hat{j}+3\hat{k}|}\right|$

$=\frac{1}{7}(6+12)=\frac{18}{7}$

Option (3) is correct.

3. Answer (4)

Sol. $|\vec{c}+\vec{d}|=\sqrt{29}$

$$\vec{c}\times(2\hat{i}+3\hat{j}+4\hat{k})-(2\hat{i}+3\hat{j}+4\hat{k})\times\vec{d}=0$$

$$(\vec{c}+\vec{d})\times(2\hat{i}+3\hat{j}+4\hat{k})=0$$

$\Rightarrow\vec{c}+\vec{d}=\lambda(2\hat{i}+3\hat{j}+4\hat{k})$

$\Rightarrow\sqrt{29}=|\lambda|\sqrt{29}$

$\Rightarrow\lambda=\pm 1\Rightarrow\vec{c}+\vec{d}=\pm(2\hat{i}+3\hat{j}+4\hat{k})$

$\Rightarrow(\vec{c}+\vec{d})\cdot(-7\hat{i}+2\hat{j}+3\hat{k})=\pm(-14+6+12)=\pm 4$

$\Rightarrow\lambda_1=4,\lambda_2=-4$

Given equation represents a circle

$\Rightarrow K^2 = 3K + \frac{\lambda_2}{2}$ and $K^2 - 5K + \lambda_1 = 0$

$\Rightarrow K^2 = 3K - 2$ and $K^2 - 5K + 4 = 0$

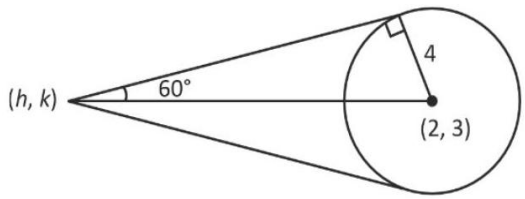
$\Rightarrow K = 1,2$ and $K = 4,1$

$\Rightarrow K = 1$

$\Rightarrow$ option (4) is correct.

4. Answer (2)

Sol.



$x^2 + y^2 - 14x - 6y - 3 = 0$

$\tan 60^\circ = \dfrac{4}{\sqrt{h^2 + k^2 - 4h - 6k - 3}}$

squaring both side

$3\left(h^2 + k^2 - 4h - 6k - 3\right) = 16$

To get locus replace h,k by x and y;

$3x^2 + 3y^2 - 12x - 18y - 9 - 16 = 0$

$3x^2 + 3y^2 - 12x - 18y - 25 = 0$

5. Answer (4)

Sol. $\begin{pmatrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{pmatrix} \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \\ 7 \\ 8 \\ 9 \end{matrix}$

Case (i) If $f(1) = 2$ then ${}^7C_5$ functions

Case (ii) $f(1) = 3$ then ${}^6C_5$

Case (iii) $f(1) = 4$ then ${}^5C_5$

$\Rightarrow 21 + 6 + 1 = 28$

Answer (2)

6. Sol. Mean $= 8$

$\dfrac{2 + 4 + 10 + x + y + 12 + 14}{7} = 8$

$\Rightarrow x + y = 14$

variance $= 16$

$$16 = \frac{2^2 + 4^2 + 10^2 + x^2 + y^2 + 12^2 + 14^2 + y^2}{7} - 8^2$$

$\Rightarrow x^2 + y^2 = 100$

$\therefore\ x = 8, y = 6$

New set : {1,2,3,4,5,6}

Required probability $= 1 - P($ both number are $\geq 4)$

$$= 1 - \frac{{}^3C_2}{{}^6C_2}$$

$$= 1 - \frac{3}{15}$$

$$= \frac{4}{5}$$

7. Answer (3)

Sol. Let $\vec{c} = x\hat{i} + y\hat{j} + z\hat{k}$

$$\vec{a} \times \vec{c} = \vec{b} \begin{vmatrix} \hat{i} & \hat{j} & k \\ -1 & 2 & 2 \\ x & y & z \end{vmatrix}$$

$$= (2z - 2y)\hat{i} + (z + 2x)\hat{j} + (-y - 2x)\hat{k}$$

$$\equiv 8\hat{i} + 7\hat{j} - 3\hat{k}$$

$$\Rightarrow 2z - 2y = 8$$
$$\left.\begin{aligned} z + 2x &= 7 \\ -y - 2x &= 3 \end{aligned}\right\} y = 3 - 2x, z = 7 - 2x$$

$\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k}) = 4$

$x + y + z = 4$

Now $x + 3 - 2x + 7 - 2x = 4$

$$\Rightarrow\ x = 2$$
$$y = -1$$
$$z = 3$$
$$\Rightarrow\ \vec{c} = 2\hat{i} - \hat{j} + 3\hat{k}$$
$$|\vec{a} + \vec{c}|^2 = |\hat{i} + \hat{j} + 5\hat{k}|^2$$
$$= 27$$

8. Answer (3)

Sol. $\left(1 + x^2\right) dy + \left(y - \tan^{-1}\ x\right) dx = 0$

$$\frac{dy}{dx} + \frac{y}{1 + x^2} = \frac{\tan^{-1}\ x}{1 + x^2}$$

$$\text{IF} = e^{\int \frac{1}{1+x^2} dx} = e^{\tan^{-1}\ x}$$

$$ye^{\tan^{-1}\ x} = \int e^{\tan^{-1}\ x} \frac{\tan^{-1}\ x}{1 + x^2} dx$$

Let $\tan^{-1}\ x = t$

$$\frac{1}{1 + x^2} dx = dt$$

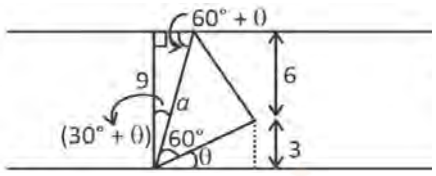
$$ye^{\tan^{-1}x} = \int e^t t \cdot dt$$
$$ye^{\tan^{-1}x} = e^t t - e^t + c$$
$$ye^{\tan^{-1}x} = e^{\tan^{-1}x}\left(\tan^{-1}x - 1\right) + c$$

Now $y(0) = 1$

$$\Rightarrow 2 = c$$
$$\therefore y = \left(\tan^{-1}x - 1\right) + 2e^{-\tan^{-1}x}$$
$$y(1) = \left(\frac{\pi}{4} - 1\right) + 2e^{-\pi/4}$$
$$= \frac{2}{e^{\frac{\pi}{4}}} + \frac{\pi}{4} - 1$$

9. Answer (1)

Sol. Let a be the side of $\triangle ABC$



$$\sin\theta = \frac{3}{a}$$
$$\sin(60^\circ + \theta) = \frac{9}{a}$$
$$\Rightarrow \frac{\sqrt{3}}{2} \times \sqrt{1 - \frac{9}{a^2}} + \frac{3}{a} \times \frac{1}{2} = \frac{9}{a}$$

$$\Rightarrow \sqrt{3}\left(\sqrt{a^2 - 9}\right) + 3 = 18$$
$$\Rightarrow 3\left(a^2 - 9\right) = 15^2 \Rightarrow a^2 - 9 = 15 \times 5$$
$$\Rightarrow a^2 = 84$$
$$\text{Area} = \frac{\sqrt{3}}{4}a^2 = 21\sqrt{3}$$

10. Answer (1)

Sol. $\ln\left(\lim_{x\to 1}\left(\frac{f(x+2)}{f(3)}\right)^{\frac{18}{(x-1)^2}}(1^\infty)\right)$

$$\ln\left(\lim_{x\to 1}\frac{18}{e^{(x-1)^2}}\left(\frac{f(x+2)}{f(3)}-1\right)\right)$$

$$\ln\left(\lim_{x\to 1}\frac{f'(x+2)}{e^{2(x-1)}}\right)$$

$$\ln\left(\lim_{x\to 1}\frac{f''(x+2)}{e^{2}}\right)$$

$$\lim_{x\to 1}\frac{f''(3)}{2}=\frac{4}{2}=2$$

11. Answer (2)

Sol. Number of such relations:

From $A \to A$ such that

$n(A) = N$ is

$\Rightarrow 2^{\left(\frac{N^2-N}{2}\right)}$

for $N = 4 \Rightarrow 2^6 = 64$

Alter :

$$\begin{bmatrix} 0 & - & - & - \\ \Theta & 0 & - & - \\ \Theta & \Theta & 0 & - \\ \Theta & \Theta & \Theta & 0 \end{bmatrix} \Rightarrow \text{each } \Theta \text{ has two choices}$$

$\Rightarrow 2^6 = 64$

12. Answer (1)

Sol. $a_2 \cdot a_3 \cdot a_4 = 64$

$\frac{a}{r} \cdot a \cdot ar = 64$

$\Rightarrow$ a $= 4$

$a_1 + a_3 + a_5 = \frac{813}{7}$

$= \frac{4}{r^2} + 4 + 4r^2 = \frac{813}{7}$

Let $r^2 = t$

$28t^2 - 785t + 28 = 0$

$(28t - 1)(t - 28) = 0$

$\Rightarrow\ t = 28, \frac{1}{28}$

$r^2 = 28$ ($\because$ G.P. is increasing)

$a_3 + a_5 + a_7$

$= a + ar^2 + ar^4 = r^2\left(a + \frac{a}{r^2} + r^2\right)$

$= 28 \times \frac{813}{7}$

$= 3252$

13. Answer (1)

Sol. $E: \frac{x^2}{A^2}+\frac{y^2}{B^2}=1$

$H: \frac{x^2}{a^2}-\frac{y^2}{b^2}=1$

For con-focal E and H

$\because\ A^2-B^2=a^2+b^2$

(Given that $A^2=36$ and $B^2=16$)

$36-16=a^2+b^2$

$$a^2+b^2=20\#(1)$$

$e_H=5$

$\Rightarrow 25=1+\frac{b^2}{a^2}$

$\Rightarrow 25a^2=20 \Rightarrow a^2=\frac{4}{5} \Rightarrow a=\frac{2}{\sqrt{5}}$

Also $a^2+b^2=20$

$b^2=20-\frac{4}{5} \Rightarrow \frac{96}{5}$

$\mathrm{L(LR)}=2\times\frac{b^2}{a}=\frac{2\times\frac{96}{5}}{\frac{2}{\sqrt{5}}}=\frac{96}{\sqrt{5}}$

14. Answer (2)

Sol. $\int_0^{\frac{\pi}{6}} \frac{\pi+4x^{11}}{1-\sin\left(|x|+\frac{\pi}{6}\right)}+\frac{\pi-4x^{11}}{1-\sin\left(|x|+\frac{\pi}{6}\right)}dx$

$=2\pi\int_0^{\frac{\pi}{6}} \frac{1}{1-\sin\left(x+\frac{\pi}{6}\right)}dx$

$=2\pi\int_0^{\frac{\pi}{6}} \frac{1+\sin\left(x+\frac{\pi}{6}\right)}{\cos^2\left(x+\frac{\pi}{6}\right)}dx$

$=2\pi\int_0^{\frac{\pi}{6}} \sec^2\left(x+\frac{\pi}{6}\right)+\tan\left(x+\frac{\pi}{6}\right)\sec\left(x+\frac{\pi}{6}\right)dx$

$\Rightarrow 2\pi\left[\tan\left(x+\frac{\pi}{6}\right)+\sec\left(x+\frac{\pi}{6}\right)\right]_0^{\frac{\pi}{6}}$

$\Rightarrow 4\pi$

15. Answer (1)

Sol. $\underbrace{-1\le\frac{2x-5}{11-3x}\le 1}_{(2)}$ and $\underbrace{-1\le 2x^2}_{(1)}-3x+1\le 1$

(1) $\frac{2x-5}{11-3x}-1\le 0$

$$\Rightarrow \frac{2x-5-11+3x}{11-3x} \leq 0$$

$$\Rightarrow \frac{5x-16}{11-3x} \leq 0$$

$$\Rightarrow x \in \left(-\infty, \frac{16}{5}\right] \cup \left(\frac{11}{3}, \infty\right) .\text{(i)}$$

(2) $\frac{2x-5}{11-3x} \geq -1$

$$\Rightarrow \frac{2x-5}{11-3x} + 1 \geq 0$$

$$\Rightarrow \frac{6-x}{11-3x} \geq 0$$

$$\Rightarrow \frac{x-6}{3x-11} \geq 0$$

$$\Rightarrow x \in \left(-\infty, \frac{11}{3}\right) \cup [6, \infty) .\text{(ii)}$$

(3) $2x^2 - 3x + 1 \leq 1$

$$\Rightarrow x(2x-3) \leq 0$$

$$x \in \left[0, \frac{3}{2}\right]$$

(4) $2x^2 - 3x + 1 \geq -1$

$$\Rightarrow 2x^2 - 3x + 2 \geq 0$$

$$x \in R$$

taking intersection of (i), (ii), (iii), (iv)

$$x \in \left[0, \frac{3}{2}\right]$$

$$\therefore \alpha + 2\beta = 3$$

16. Answer (4)

Sol.

$$x^2+x+1=0 \bigwedge_{w^2}^{w}$$

$$\left(w+\frac{1}{w}\right)^4+\left(w^2+\frac{1}{w^2}\right)^4+\left(w^3+\frac{1}{w^3}\right)^4+\ldots$$

$$\left(w^{25}+\frac{1}{w^{25}}\right)^4$$

$$\sum \left(w^k+\frac{1}{w^k}\right)^4$$

$$K=3x \Rightarrow w^{3x}+\frac{1}{w^{3x}}=2$$

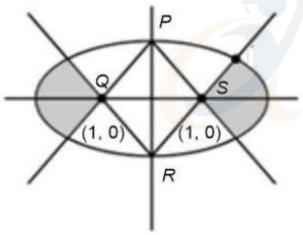
$$k\neq 3x \Rightarrow w^k+\frac{1}{w^k}=-1$$

$$\sum_{k=1}^{25}\left(w^k+\frac{1}{w^k}\right)^4 \Rightarrow 8\left(1+1+2^4\right)+1$$

$$=145$$

17. Answer (4)

Sol.



$E: \frac{x^2}{4}+\frac{y^2}{1}=1$

Area inside $E=2\pi$

$$\text{Area } PQRS=(\sqrt{2})^2$$
$$=2$$
$$\text{Required area} \quad =2\pi-2$$
$$=2(\pi-1)$$

18. Answer (2)

Sol. $|x-1|2-5|x-1|+6=0$

Let $|x-1|=t$

$t^2-5+6=0$

$(t-3)(t-2)=0$

$t=2,3$

$|x-1|=2$ or $|x-1|=3$

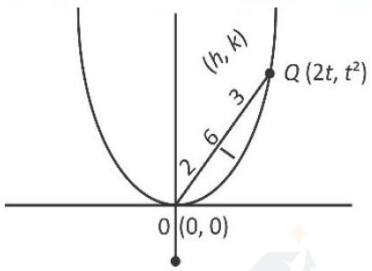
$x-1=\pm 2$ or $x-1=\pm 3$

$\Rightarrow x = 3, -1, 4, -2$
$\Rightarrow$ Sum $= 3 - 1 + 4 - 2$

$= 4$

19. Answer (3)

Sol.



$h = \frac{4t}{5}, k = \frac{2t^2}{5}$
$\Rightarrow \frac{2t^2}{5} = t, \frac{2t^2}{5} = t^2$
$\frac{5k}{2} = \left(\frac{5h}{4}\right)^2$
Replace (h,k) with (x,y)
$\frac{5y}{2} = \frac{25x^2}{16} =$
C: $8y = 5x^2$
chord with given middle point
$T = S_1$
$5xx_1 - 4(y + y_1) = 5x_1^2 - 8y_1$
$5x - 4(y + 2) = 5 - 16$
$5x - 4y - 8 = -11$
$5x - 4y + 3 = 0$

20. Answer (2)
Sol. $\left(ax^2 + bx + c\right)(1 - 2x)^{26}$
$ax^2(1 - 2x)^{26} + bx(1 - 2x)^{26} + c(1 - 2x)^{26}$
Coefficient of

$$x \Rightarrow \left[0 + b \cdot {}^{26}C_0 + c \cdot {}^{26}C_1(-2)\right] x$$
$$= b - 52c$$

Coefficient of

$$x^2 = \left(a\left({}^{26}C_0\right) + b\cdot {}^{26}C_1(-2) + c\,{}^{26}C_2(-2)^2\right)x^2$$
$$= a - 52b + {}^{26}C_2 \times 4 = a - 52b + 1300c$$

Coefficient of

$x^3 = \left[a\cdot {}^{26}C_1(-2) + b\cdot {}^{26}C_2(26)^2 + c\,{}^{26}C_3(-2)^3\right]$

$= -52a + 1300b - 20800c$

$\Rightarrow b - 52c = -56$

$\Rightarrow b - 52c = -56$

$a - 52b + 1300c = 0 \Rightarrow a = 1300$

$-a + 25b - 400c = 0$

$b = 100$

$c = 3$

$\Rightarrow a + b + c = 1403$

SECTION - B

21. Answer (1)

Sol. For equal roots, discriminant is 0 .

$4\left(f'(x)\right)^2 - 4(f(x))\left(f''(x)\right) = 0$

Let $y = f(x)$

$\left(y'\right)^2 = yy''$

$\Rightarrow \frac{y'}{y} = \frac{y''}{y'}$

$\Rightarrow \ln|y| = \ln\left|y'\right| + \ln K$

$\ln(1) = \ln|2| + \ln(K) \Rightarrow$

$\ln K = -\ln 2$

$\Rightarrow \ln|y| = \ln\left|y'\right| - \ln 2$

$\Rightarrow \ln\left|\frac{y}{y'}\right| = -\ln 2 = \ln\left(\frac{1}{2}\right)$

$\Rightarrow 2y = y'$

$\Rightarrow 2 = \left|\frac{y'}{y}\right| \Rightarrow 2x = \ln|y| + \ln\lambda$

$0 = \ln|1| + \ln\lambda$

$\Rightarrow \ln\lambda = 0$

$\Rightarrow \ln|y| = 2x$

$y = e^{2x}$

$f^{(\ln x - x)} = e^{2(\ln x - x)} = e^{2\left(\ln x^2 - 2x\right)}$

$= \frac{x^2}{e^{2x}}$

The function $\frac{x^2}{e^{2x}}$ is increasing in $(0,1)$

$$\Rightarrow \alpha+\beta=1$$

22. Answer (17)

Sol. $I=6\int_0^{\pi}|\sin x+\sin 3x+\sin 2x|dx$

$$=6\int_0^{\pi}|\sin 2x||1+2\cos x|dx$$

$$=6\int_0^{\pi}\left|(2\sin x)\left(2\cos^2 x+\cos x\right)\right|dx$$

Since $\sin x>0\forall x\in(0,\pi)$

$$\Rightarrow I=6\int_0^{\pi}(2\sin x)\cos x(2\cos x+1)dx$$

$$\Rightarrow I=6\int_0^{\pi/2}(2\sin x)\left(2\cos^2 x+\cos x\right)dx$$

$$-6\int_{\pi/2}^{2\pi/3}(2\sin x)\left(2\cos^2 x+\cos x\right)dx$$

$$+6\int_{2\pi/3}^{\pi}(2\sin x)\left(2\cos^2 x+\cos x\right)dx$$

$$6\left(\frac{7}{3}+\frac{1}{12}+\frac{5}{12}\right)=17$$

23. Answer (1333)

Sol. $5\mid 6^m+9^n$

$$\Rightarrow 5\mid 1^m+(-1)^n$$

$\Rightarrow$ m and n has to be opposite parity.

$${}^2C_1\times{}^{25}C_1\cdot{}^{25}C_1=625\times 2=1250$$

For, $m+n=K^2$ for some prime K.

$$m+n\in\{2,3,\ldots,100\}$$
$$m+n=4,9,25,49$$

$m+n=4\Rightarrow 3$ pairs
$m+n=9\Rightarrow 8$ pairs
$m+n=25\Rightarrow 24$ pairs
$m+n=49\Rightarrow 48$ pairs
$\Rightarrow 83$ pairs

$\Rightarrow$ 1333

24. Answer (225)

Sol. Using characteristic equation,

$$\begin{vmatrix} \alpha-\lambda & 2 \\ 1 & 2-\lambda \end{vmatrix} = 0$$

$$(\lambda-2)(\lambda-\alpha)-2=0$$

$$\lambda^2+\lambda(-2-\alpha)+2\alpha-2=0$$

$$\Rightarrow A^2+A(-2-\alpha)+(2\alpha-2)I=0$$

$$\Rightarrow -2-\alpha=-4 \Rightarrow \alpha=2$$

Similarly,

$$\begin{vmatrix} 1-K & 2 \\ 1 & \beta-K \end{vmatrix} = 0$$

$$\Rightarrow (K-\beta)(K-1)-1=0$$

$$K^2+K(-1-\beta)+\beta-1=0$$

$$\Rightarrow -1-\beta=-3 \Rightarrow \beta=2$$

$$\Rightarrow A=\begin{bmatrix} 2 & 2 \\ 1 & 2 \end{bmatrix}, B=\begin{bmatrix} 1 & 1 \\ 1 & 2 \end{bmatrix}$$

Let $A^3-B^3=\begin{bmatrix} 15 & 20 \\ 6 & 7 \end{bmatrix}=C, \det(C)=-15$

$$|\text{adj}C|^2=|C|^2=225$$

25. Answer (2)

Sol. $a_{n+1}=\frac{1}{2}a_n+\frac{1}{(n+1)^2}-\frac{\left((n+1)^2-n^2\right)}{n^2(n+1)^2}$

$$a_{n+1}=\frac{a_n}{2}+\frac{2}{(n+1)^2}-\frac{1}{n^2}$$

$$a_{n+1}-\frac{2}{(n+1)^2}=\frac{1}{2}\left(a_n-\frac{2}{n^2}\right)$$

Let $b_n=a_n\frac{-2}{n^2}$

then $\langle b\rangle$ is geometric progression with ratio $=\frac{1}{2}$

$$b_1=a_1-\frac{2}{1}=1-2=(-1)$$

$$\sum_{n=1}^{\infty}\left(a_n-\frac{2}{n^2}\right)=\sum_{n=1}^{\infty}b_n=\frac{(-1)}{1-\left(\frac{1}{2}\right)}=\frac{-1}{1/2}=-2$$

$$\Rightarrow\left|\sum_{n=1}^{\infty}\left(a_n-\frac{2}{n^2}\right)\right|=2$$

PHYSICS

SECTION - A

26. Answer (2)

Sol. $\tau_{\text{net}}=mg\frac{l}{2}=l\alpha$

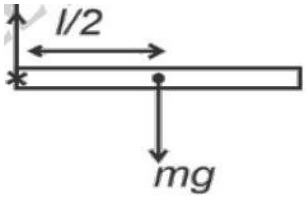
$$\Rightarrow mg\frac{l}{2}=\frac{ml^2}{3}\alpha$$

$$\Rightarrow \alpha=\frac{3g}{2l}$$

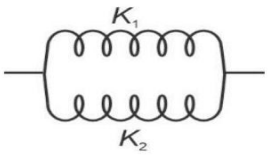
$$r_{cm} = \frac{\alpha l}{2} = \frac{3g}{4}$$
$$\therefore\ T = mg - \frac{3mg}{4} = \frac{mg}{4}$$

27. Answer (1)

Sol.



$$P_A - P_B = \rho g h = 10000 \times \frac{5}{100} = 500 \text{ Pa}$$
and $P_A + \frac{1}{2}\rho V_A^2 = P_B + \frac{1}{2}\rho V_B^2$
$$\Rightarrow P_A - P_B = \frac{1}{2}\rho\left(V_B^2 - V_A^2\right)$$
$$\Rightarrow\ 1000 = 1000\left(V_B^2 - V_A^2\right)$$
and $V_A A_A = V_B A_B$
$$\Rightarrow V_A \times 6 = V_B \times 3$$
$$\therefore\ V_A = \frac{V_B}{2}$$
Hence, $4V_A^2 - V_A^2 = 1$
$$\Rightarrow\ V_A = \frac{1}{\sqrt{3}} \text{ m/s}$$
Rate of flow $= V_A A_A = \frac{1}{\sqrt{3}} \times 6 \times 10^{-4}$ m/s
$$\Rightarrow 200\sqrt{3}$$
28. Sol.



$K_1 = 10 \pm 0.2$ N/m
$K_2 = 20 \pm 0.3$ N/m
$\because\ K_{ev} = K_1 + K_2 = 30$ N/m

$$\Delta K_{eq} = 0.5 \text{ N/m}$$

$$\%\Delta K_{eq} = \frac{\Delta K_{eq}}{K_{eq}} \times 100 = \frac{50}{30} = \frac{5}{3} = 1.67\%$$

29. Answer (4)

Sol. Since strings are joined in series, Tension in both will be same.

For string A

$$t_1 = \frac{L_A}{V_A} = L_A\sqrt{\frac{M_A}{T}}$$

And For string B

$t_2 = \frac{L_B}{V_B} = L_B\sqrt{\frac{M_B}{T}}$

$\Rightarrow \frac{t_1}{t_2} = \frac{L_A}{L_B}\sqrt{\frac{M_A}{M_B}}$

$\Rightarrow \frac{t_1}{t_2} = \frac{2.5}{1.5}\sqrt{\frac{2\times10^{-4}}{4\times10^{-4}}}$

$\Rightarrow \frac{t_1}{t_2} = 1.178 \approx 1.18$

30. Answer (2)

Sol. $W = \frac{Kq_1q_2}{r_2} - \frac{Kq_1q_2}{r_1}$

$\Rightarrow W = 9\times10^9\times10^{-8}\times2\times10^{-6}$

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

$\Rightarrow W = \frac{180\times10^{-6}}{6} = 30\times10^{-6}$ J

31. Sol. In Potential energy v/s distance (x) graph, magnitude of Force is the slope of the graph.

$\therefore$ greater the slope, more the force.

$\therefore\ F_{BC} > F_{AB} > F_{DE} > F_{CD}$

32. Answer (3)

Sol. $C_{\text{new}} = \frac{\varepsilon_0 A}{d - t + \frac{t}{K}}$

$$\Rightarrow \frac{\varepsilon_0 A}{d\left(1 - \frac{t}{d} + \frac{t}{dK}\right)}$$

$$\Rightarrow \frac{C}{1 - \frac{1}{3} + \frac{1}{3K}}$$

$$C_{\text{new}} = \frac{3CK}{2K+1}$$

33. Answer (2)

Sol. Since the rods are joined in series,

$\Delta l_{\text{eq}} = \Delta l_1 + \Delta l_2$

$\Rightarrow\ I\alpha_1\Delta T + I\alpha_2\Delta T$

$\Rightarrow\ I\Delta T(\alpha_1 + \alpha_2)$

$\Rightarrow 60\times(100-30)\left(24\times10^{-6} + 1.2\times10^{-5}\right)$

$\Rightarrow\ 0.1512$ cm

$\therefore$ New length $= 120 + 0.1512 = 120.1512$ cm

34. Answer (4)

Sol. $O/P = A + B = \overline{A \cdot B}$

$\therefore$ It is Nand gate

35. Answer (3)

Sol. $P + \frac{A}{Bt^2} + \rho g(h + Bt) + \frac{1}{2}\rho V^2 = \text{constant}$

dimensions of quantities being added should be equal.

$\therefore\ [h] = [Bt]$

$\therefore\ [B] = LT^{-1}$

And $[P] = \left[\frac{A}{Bt^2}\right]$

$$\therefore [A] = [P][B]\left[t^2\right]$$
$$[A] = ML^{-1}T^{-2}LT^{-1}T^2$$
$$[A] = M^1L^0T^{-1}$$

36. Answer (3)

Sol. Magnitudes of $\vec{E}$ and $\vec{B}$ vary synchronously.

and $\frac{E_0}{C} = B_0$

$\therefore\ B_0 = \frac{69}{3\times10^8} = 23 \times 10^{-8}$ or 2.3×10^{-7}SI

$\therefore\ \beta = 2.3 \times 10^{-7}\sin\ \left(0.6 \times 10^3 x - 1.8 \times 10^{11} t\right)$

37. Answer (4)

Sol. According to Faradys law,

$$|\varepsilon| = \frac{d\phi}{dt}$$
$$\Rightarrow\ |\varepsilon| = A\frac{dB}{dt} = 100\cos\ (100t)$$
$$\text{and Power } = \frac{\varepsilon^2}{R} = \frac{100 \times 100\cos^2\ (100t)}{100}$$
$$P = 100\cos^2\ (100t) = \frac{dC}{dt}$$
$$Q = \int_0^T 100\cos^2\ (100t)dt$$
$$Q = 50 \times \frac{\pi}{50} = \pi\text{J}$$

38. Answer (2)

Sol. $E = 60\left[\sin\ \left(3 \times 10^{15} t\right) + \sin\ \left(12 \times 10^{15} t\right)\right]$

highest frear $= \frac{12\times10^{15}}{2\pi} = \frac{6}{\pi} \times 10^{15}$

$\therefore KE_{\max} = h\upsilon - \phi_0$

$\Rightarrow \frac{6.6 \times 10^{-34} \times 6 \times 10^{15}}{1.6 \times 10^{-19}\pi} - 2.8$

$\Rightarrow 7.87 - 2.8 \approx 5.1\text{eV}$

39. Answer (4)

Sol. Since charge moves along magnetic field, magnetic force on it will be zero.
$\therefore a = g$

40. Answer (2)

Sol. Kinetic energy would convert into electrostatic P.E.

$$\text{K.E.} = \frac{Kze \cdot 2e}{r}$$
$$\Rightarrow 7.7 \times 10^6 \times 1.6 \times 10^{-19} = \frac{9 \times 10^9 \times 79 \times \left(1.6 \times 10^{-19}\right)^2 \times 2}{r}$$
$$r = 2.95 \times 10^{-14}\ \text{m}$$

41. Sol. Force on rod directly will be :

$$F = \frac{B^2 v l^2}{r} = \frac{(0.1)^2 \times 1.5 \times 1^2}{2}$$
$$\Rightarrow F = 7.5 \times 10^{-3}\ \text{N}$$

42. Answer (3)

Sol. Heat given by gas is equal to heat taken by water

$$\Rightarrow \text{m} \times 5 \times 10^4 = \frac{5}{60} \times 4200 \times 60$$
$$\Rightarrow m = 0.42g$$

43. Answer (4)

Sol. $d = 0.1\ \text{cm} = 0.1 \times 10^{-2}\ \text{m}$
$D = 0.5\ \text{mm}$
$n = 1.5$
Thickness

$$t = \frac{xd}{D(m-1)}$$

Or $8 \times 10^{-4}\ \text{cm}$

44. **Answer (4)**

Sol. To send satellite from r_1 radius orbit to r_2 radius orbit, energy needed to be supplied will be

$$E = -\frac{GM_m}{2r_2} + \frac{GM_m}{2r_1}$$
$$\therefore E = \frac{GMm}{2}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$
$$\Rightarrow E = \frac{gR^2 m}{2}\left(\frac{2}{3R} - \frac{1}{3R}\right)$$
$$E = 10^9 = 1000 \times 10^6\ \text{J}$$

45. Sol. $\vec{F} = m\vec{a}$

$$\vec{a} = \frac{1}{4}\left(4t^3\hat{i} - 3t\hat{j}\right)$$

$$\frac{d\vec{v}}{dt} = \frac{1}{4}\left(4t^3\hat{i} - 3t\hat{j}\right)$$

$$\vec{v} = \frac{1}{4}\left(t^4\hat{i} - \frac{3}{2}t^2\hat{j}\right) = \frac{t^4}{4}\hat{i} - \frac{3}{8}t^2\hat{j}$$

At $= t = 2$

$$\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j}$$

$$\vec{v} = \frac{d\vec{r}}{dt} = \frac{t^4}{4}\hat{i} - \frac{3}{8}t^2\hat{j}$$

$$\vec{r} = \frac{t^5}{20}\hat{i} - \frac{t^3}{8}\hat{j}$$

At $t = 2$

$$\vec{r} = \frac{8}{5}\hat{i} - \hat{j}$$

46. Answer (100)

Sol. Magnification $(M) = \frac{L}{f_0} \cdot \frac{D}{f_e}$

$$= \frac{32}{2} \cdot \frac{25}{4}$$
$$= 100$$

47. Answer (1080)

Sol. It is a balanced wheatstone bridge

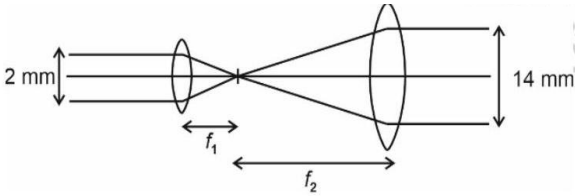
$$R = \frac{3 \times 6}{3 + 6} = 2\Omega$$

$$P = \left(\frac{9}{2+1}\right)^2 \times 2 = 18$$

$$H = 18 \times 60 = 1080\ \text{J}$$

48. Answer (280)

Sol.



$$\frac{f_1}{1} = \frac{f_2}{7}$$

$$f_2 = 7 \times 40$$

$$f_2 = 280\ \text{mm}$$

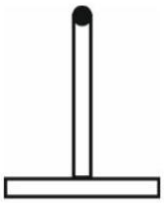
49. Answer (500)

Sol. $\Delta U = nC_v\Delta T$

$$\Delta U = 10 \times \frac{5}{2} \times 2 \times 10$$
$$= 500\text{cal}$$

50. Answer (17)

Sol.



$$I = \frac{ml^2}{3} + \frac{ml^2}{12} + ml^2$$
$$I = \frac{17}{12}ml^2$$

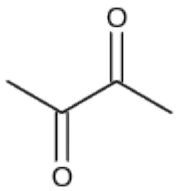
CHEMISTRY

SECTION - A

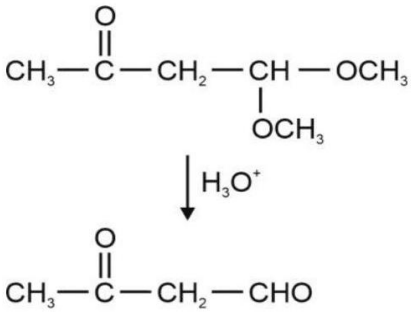
51. Answer (1)
Sol. $[Cu(NH_3)_4]^{2+} \Rightarrow Cu^{2+} \Rightarrow 3\,d^9(n = 1)$
$[Ni(en)3)]^{2+} \Rightarrow Ni^{2+} \Rightarrow 3\,d^8(n = 2)$
$[Ni(NH_3)_6]^{2+} \Rightarrow Ni^{2+} \Rightarrow 3\,d^8(n = 2)$
$[Mn(H_2O)_6]^{2+} \Rightarrow Mn^{2+} \Rightarrow 3\,d^5(n = 5)$
$[NiCl_4]^{2-} \Rightarrow Ni^{2+} \Rightarrow sp^3(n = 2) \Rightarrow$ paramagnetic
$[Ni(CO)_4] \Rightarrow sp^3 \Rightarrow$ diamagnetic
$[Ni(CN)_4]^{2-} \Rightarrow dsp^2 \Rightarrow$ diamagnetic

52. **Answer (1)**

Sol.



gives positive iodoform test



(gives positive Tollen's test and iodoform test)

53. Answer (4)

Sol. $\underset{\text{(LR)}}{Ca} + \underset{\text{(excess)}}{2HCl} \longrightarrow CaCl_2 + H_2 \uparrow$

$n_{Ca} = \frac{14}{40} = 0.35$

$n_{Ca} = n_{H_2} = 0.35 = n_{CaCl_2}$

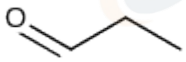
$V_{H_2} = 0.35 \times 22.4\ L = 7.84\ L$

Mass of $CaCl_2 = 0.35 \times 111\ g$

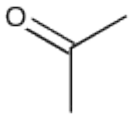
$= 38.85\ g$

54. Answer (4)

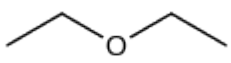
Sol.



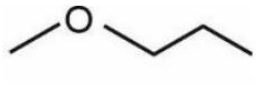
and



$\Rightarrow$ functional isomer



and


⇒ Metamers

$CH_3 - CH = CH - CH_3$ ⇒ doesn't show optical isomer



and



⇒ position isomer



and


⇒ chain isomer

A, B and E are correct

55. Answer (2)

Sol. GeO_2, SiO_2, CO_2 ⇒ acidic oxides
SnO, SnO_2, PbO, PbO_2 ⇒ amphoteric oxide
GeO ⇒ distinctly acidic
BF_3 ⇒ Lewis acid

$$\underset{\substack{(sp^2)\\ \text{trigonal}\\ \text{planar}}}{BF_3} + NH_3 \longrightarrow \underset{\substack{\text{Both B and N are}\\ sp^3 \text{ hybridised}}}{B\overset{-}{F_3} - \overset{+}{N}H_3}$$

56. Answer (2)

Sol. Frequency $\propto \frac{Z^2}{n^3}$
∴ Frequency of second line of Balmer series of

$He + \propto \frac{2^2}{2^3}(Z = 2, n = 2)$

$\therefore$ Frequency of first line of Lyman series of $H \propto \frac{1^2}{1^3}$

$(Z = 1, n = 1)$

57. Answer (4)

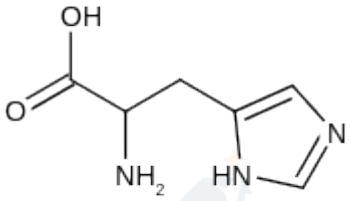
Sol. $\underset{\text{(Hot solution)}}{PbCl_2} + K_2CrO_4 \rightarrow \underset{(A)}{PbCrO_4} + 2KCl$

$$PbCrO_4 + NaOH \rightleftharpoons Na_2[Pb(OH)_4] + Na_2CrO_4$$

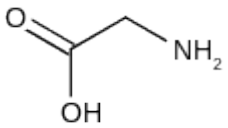
(B)

$$PbSO_4 + 4CH_3COONH_4 \rightarrow (NH_4)_2SO_4 + (NH_4)_2\underset{(X)}{[Pb(CH_3COO)_4]}$$

58. Answer (3)

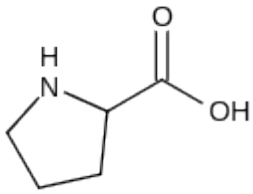


(Histidine)

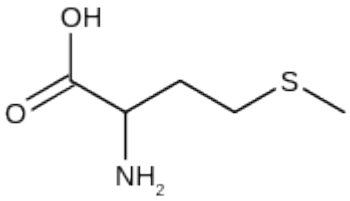


(Glycine)

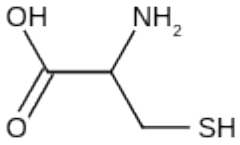
Sol. Arginine and Tryptophan are essential amino acids.



(Proline)



(Methionine)

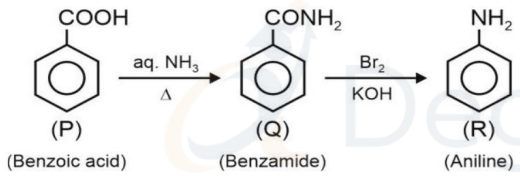


(Cysteine)

59. Answer (2)

Sol. $C_6H_7N \Rightarrow DU = 4$

C_6H_7N is aniline.



60. Answer (2)

Sol. Statements A, B and D are correct.

Metallic character order : $K > Mg > Al > B$

Statement C is incorrect.

	F	P	S	B
I.E. (kJ/mol)	1680	1012	1000	800

61. Answer (2)

Sol. $1.176 = (5)\left(\frac{1\times1000}{(MW)(50)}\right)$

$MW_{PQ} = 85.03$

$P + Q = 85$

$0.689 = (5)\left(\frac{1000}{(MW)50}\right)$

$MW_{PQ_2} = 145.1$

$P + 2Q = 145$

$Q = 60$

P = 25

62. Answer (1)

Sol. $V_{CO_2} = 224 - 64 = 160\ mL$

V_{O_2} remaining $= 64\ mL$

C_xH_y : Hydrocarbon

$x = \frac{160}{80} = 2$

V_{O_2} used $= 264 - 64 = 200$

$x + \frac{y}{4} = \frac{200}{80} = 2.5$

$2 + \frac{y}{4} = 2.5$

$\frac{y}{4} = 0.5$

$y = 2 \Rightarrow C_2H_2$

63. Answer (3)

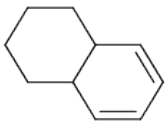
Sol. $4H^+ + 3MnO_4^{2-} \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

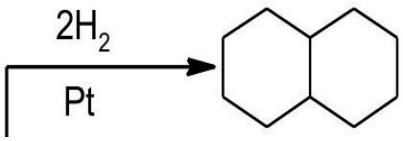
64. Answer (1)

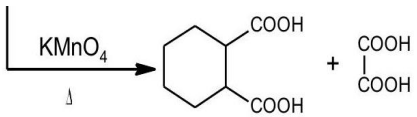
Sol. % of $S = \frac{1.2\times32}{233\times(0.75)} \times 100 = 21.97$

65. Answer (3)

Sol.







66. Answer (3)

Sol. Statement I is incorrect as only NH_4^+ and $[NiCl_4]^{2-}$ are tetrahedral

Statement II is correct

67. Answer (2)

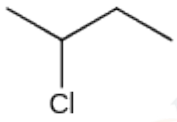
Sol. $W_1 = 0$

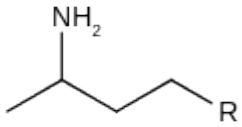
$$W_2 = (44.8) \times \ln 2 = 31.04$$
$$W_3 < 31.04$$
$$W_4 < 31.04$$
W_2 is max

68. Answer (1)

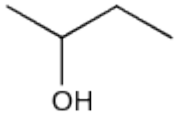
Sol. P : $CH_3 - CH = CH - CH_3$

Q :





S :



69. Answer (2)

Sol. Structure in option (2) is least stable as two +ve charges are present on adjacent atoms.

70. Answer (2)

Sol. D is correct.
E is correct.

$$\Delta G^{\circ}_{\text{reaction}} = G_B - G_A = 5.40 \text{ kJ mol}^{-1}$$

71. Answer (6)

Sol. Resistance $= \frac{10^5}{4}$Ohm

$$R = \frac{\rho l}{A}$$

$$\frac{10^5}{4} = (\rho)\left(\frac{15 \text{ cm}}{1 \text{ cm}^2}\right)$$

$$\rho = \frac{10^5}{4 \times 15} \text{ Ohm.cm}$$

$$\text{Conductivity} = 60 \times 10^{-5} \text{ S cm}^{-1}$$
$$= 6 \times 10^{-4} \text{ S cm}^{-1}$$

$$\alpha = \frac{\lambda_m}{\lambda^{\circ}_m}$$

$$C\alpha = 10^{-5}$$

$$\lambda_m = \frac{k}{H^+_{\text{total}}}$$

In m^3(1000 L)

$$H^+ = 0.01 \text{ mol m}^{-3}$$

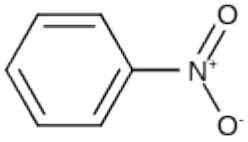
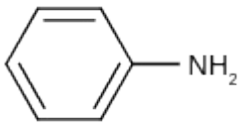
$$\lambda_m = \frac{0.06}{0.01} = 6 \text{Sm}^2 \text{ mol}^{-1}$$

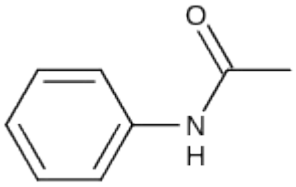
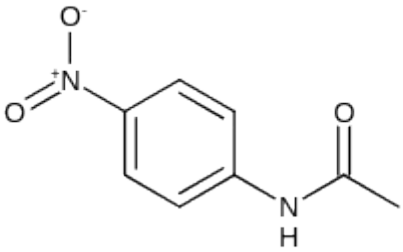
As $\lambda_m \approx \lambda^{\circ}_m$

$$\lambda^{\circ}_m = 6 \text{Sm}^2 \text{ mol}^{-1}$$

72. Answer (20)

Sol.

A :	
B :	

R :	
S :	

T :



$T = C_6H_4(NH_2)(NO_2)$

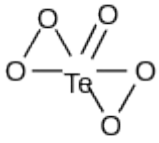
$\%$ of $N = \frac{2\times14}{138} \times 100$

= 20.28%

≈ 20

73. Answer (13)

Sol. C is CrO_5



$X = 2$

$Y = 5$

$Z = +6$

$X + Y + Z = 13$

74. Answer (70)

Sol. $\Delta G^\circ = -2.303 \times R \times T \times \log K$

$$= -2.303 \times 8.3 \times 500 \times 2.2$$
$$= -21.026 \frac{kJ}{mole}$$

$A_2 + B_2 \rightleftharpoons 2AB$

$\Delta H^\circ = 64 - 6 - x$

$= (58 - x) kJ\ mol^{-1}$

$\Delta S^\circ = 444 - 146 - 280$

$= 18$

$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$

$-21.026 = (58 - x) - (0.5)(18)$

$= (58 - x) - 9 = 49 - x$

$-21.026 = 49 - x$

$x = 49 + 21.026$

$= 70.026$

≈ 70

75. Answer (8)

Sol. $\ln \frac{k_2}{k_1} = \frac{\Delta E}{RT}$

$$= \frac{20 \times 1000}{8.3 \times 300} = 8.03$$
$$\approx 8$$