MELUHA INTERNATONAL SCHOOL
HYDERABAD

OUTGOING SR | **JEE MAINS MODEL – CT 3** | **Date: 21-06-2020**
Time: 3 Hours | **Max Marks : 300**

MATHS
SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its
answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

01. The function $f:\{-1,1\}\to R,\ f(x)=\dfrac{x+1}{x^3+1}$ can be written as the sum of an even function $g(x)$ and an odd function $h(x)$. The even function $g(x)$, is

A) $\dfrac{x^4-1}{2(x^6+1)}$ B) $\dfrac{x^4-1}{x^6+1}$ C) $\dfrac{x^4-1}{x^6-1}$ D) $\dfrac{x^4-1}{2(x^6-1)}$

02. Consider the function $f(x)=\begin{cases}\min\left(|x|,\sqrt{1-x^2}\right), & -1\le x\le 1\\ \left[|x|\right], & 1<|x|<2,\ [\ ]\ is\ GIF\end{cases}$

The number of non-differentiable points in $(-2,2)$ is

A) 1 B) 3 C) 5 D) 7

03. $\int\dfrac{(2+\sqrt{x})dx}{(x+1+\sqrt{x})^2}$ is equal to:

A) $\dfrac{x}{x+\sqrt{x}+1}+C$ B) $\dfrac{2x}{x+\sqrt{x}+1}+C$ C) $\dfrac{-2x}{x+\sqrt{x}+1}+C$ D) $\dfrac{-x}{x+\sqrt{x}+1}+C$

04. If $f(x)$ and its derivatives be differentiable everywhere and $f'(2019)=f(2019)=\dfrac{1}{2019}$ and $\int_0^{2019} f(x)dx=1$ then the value of $\int_0^{2019} x^2 f''(x)dx=$

A) 0 B) $\dfrac{1}{2019}$ C) 1 D) 2019

05. The area bounded by $y=xe^{|x|}$ and the lines $|x|=1,\ y=0$ is (in sq. units)

A) $\dfrac{1}{2}$ B) 2 C) 4 D) 6

06. Consider the differential equation $y^2dx+\left(x-\dfrac{1}{y}\right)dy=0$. If $y(1)=1$, then x is given by

A) $4-\dfrac{2}{y}-\dfrac{e^{\frac{1}{y}}}{e}$ B) $3-\dfrac{1}{y}+\dfrac{e^{\frac{1}{y}}}{e}$ C) $1+\dfrac{1}{y}-\dfrac{e^{\frac{1}{y}}}{e}$ D) $1-\dfrac{1}{y}+\dfrac{e^{\frac{1}{y}}}{e}$

07. The angle between the tangents to the curve $y = f(x) = \max\left\{x^2, (1-x)^2, 2x(1-x)\right\}$ at points having abscissa $\frac{1}{2}$ and 2 equals

A) $\frac{\pi}{4}$ B) $Tan^{-1}4$ C) $Tan^{-1}\frac{1}{2}$ D) $\frac{\pi}{3}$

08. Let $\bar{a} = 4\hat{i} + 3\hat{j}$ and $\bar{b}$ be two vectors perpendicular to each other in $xy-$plane. The vector $\bar{c}$ in the same plane having projections 1 and 2 along $\bar{a}$ and $\bar{b}$ is

A) $-\frac{2}{3}\hat{i} + \frac{11}{2}\hat{j}$ B) $2\hat{i} - \hat{j}$ C) $\frac{2}{5}\hat{i} + \frac{11}{2}\hat{j}$ D) $\frac{2}{3}\hat{i} + \frac{11}{2}\hat{j}$

09. The lines $\frac{x-1}{2} = \frac{y+1}{-1} = \frac{z-3}{\lambda}$ and $\frac{x}{1} = \frac{y}{2} = \frac{z+1}{-1}$ are

A) coplanar for all λ B) coplanar for $\lambda = \frac{19}{3}$

C) intersect at $\left(\frac{1}{5}, -\frac{2}{5}, -\frac{4}{5}\right)$ D) intersect at $\left(\frac{1}{2}, -\frac{1}{2}, -1\right)$

10. The system of equations $(a\alpha + b)x + ay + bz = 0$, $(b\alpha + c)x + by + cz = 0$ $(a\alpha + b)y + (b\alpha + c)z = 0$ has a non-trivial solution, if

A) a, b, c are in AP B) a, b, c are in GP

C) a, b, c are in HP D) α is not a root of $ax^2 + 2bx + c = 0$

11. If $a \neq p, b \neq q, c \neq r$ and $\begin{vmatrix} p & b & c \\ a & q & c \\ a & b & r \end{vmatrix} = 0$ then the value of $\frac{p}{p-a} + \frac{q}{q-b} + \frac{r}{r-c} =$

A) 0 B) 1 C) 2 D) 3

12. A variable line L is drawn through $O(0,0)$ to meet the lines $y - x - 10 = 0$ and $y - x - 20 = 0$ at A and B. A point $P(\neq O)$ is taken on L between A and B such that OA, OP, OB are in $H.P.$ then locus of P is

A) $x - y = 40$ B) $3x - 3y = 40$ C) $3y - 3x = 40$ D) $x + y = 40$

13. The equation of the circle passing through the point of intersection of the circle $x^2 + y^2 = 4$ and the line $2x + y = 1$ and having minimum possible radius is

A) $5x^2 + 5y^2 + 18x + 6y - 5 = 0$ B) $5x^2 + 5y^2 + 9x + 8y - 15 = 0$

C) $5x^2 + 5y^2 + 4x + 9y - 5 = 0$ D) $5x^2 + 5y^2 - 4x - 2y - 18 = 0$

14. 'P' is a point on the axis of the parabola $y^2 = 4ax$; Q and R are the extremities of its latus rectum. A is its vertex. If PQR is an equilateral triangle lying within the parabola and $\angle AQP = \theta$, then $\cos\theta =$

A) $\frac{2+\sqrt{3}}{2\sqrt{5}}$ B) $\frac{2-\sqrt{3}}{2\sqrt{5}}$ C) $\frac{\sqrt{5}-2}{2\sqrt{3}}$ D) $\frac{1}{\sqrt{3}}$

15. The domain of the function $f(x) = \frac{1}{\sqrt{[x]^2 - [x] - 6}}$ is $([.]$ is G.I.F.$)$

A) $(-\infty, -2) \cup [4, \infty)$ B) $(-\infty, -2] \cup [4, \infty)$

C) $(-\infty, -2) \cup (4, \infty)$ D) $(-\infty, -2] \cup (4, \infty)$

16. $\lim\limits_{x\to\infty}\sqrt[3]{x}\left(\sqrt[3]{(x+1)^2}-\sqrt[3]{(x-1)^2}\right)=$

A) $\frac{1}{3}$ B) $\frac{2}{3}$ C) 1 D) $\frac{4}{3}$

17. If $g(x)=\frac{1}{4}f\left(2x^2-1\right)+\frac{1}{2}f\left(1-x^2\right)$ where $f''(x)>0\ \forall\ x\le 0$ then $g(x)$ is increasing in

A) $\left[-\sqrt{\frac{2}{3}},0\right]$ B) $\left[-1,-\sqrt{\frac{2}{3}}\right]$ C) $(-\infty,0]$ D) $\left[-2,-\sqrt{\frac{2}{3}}\right]$

18. Let $ABCD$ be a tetrahedron such that the edges AB, AC and AD are mutually perpendicular. Let the area of the triangle ABC, ACD and ABD be $3,4,5$ sq units respectively. Then the area of the triangle BCD is

A) $5\sqrt{2}$ B) 5 C) $\frac{\sqrt{5}}{2}$ D) $\frac{5}{2}$

19. The image of the line $2x-y=1$ in the line $x+y=0$ is

A) $x+2y=-\frac{1}{3}$ B) $x-2y=1$ C) $x+3y=-\frac{2}{3}$ D) $2x+y=\frac{1}{3}$

20. The angle between a pair of tangents drawn from a point T to the circle $x^2+y^2+4x-6y+9\sin^2\theta+13\cos^2\theta=0$ is 2θ. The equation of the locus of the point T is

A) $x^2+y^2+4x-6y+4=0$ B) $x^2+y^2+4x-6y-9=0$

C) $x^2+y^2+4x-6y-4=0$ D) $x^2+y^2+4x-6y+9=0$

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical value. If the numerical value has more than two decimal places, **round-off the value** of Two decimal places. Answer to each question will be evaluated according to the following marking scheme:
Marking scheme: +4 for correct answer, 0 in all other cases.

21. $f(x+1)=(-1)^{x+1}x-3f(x)$ for $x\in\mathbb{N}$ and $f(1)=f(2020)$. Then the value of $\frac{f(1)+f(2)+.....+f(2019)}{2}$ is

22. $\underset{x\to 0}{Lt}\frac{9\left(\tan\frac{x}{2}-\tan\frac{x}{3}-\tan\frac{x}{6}\right)}{\sin^2 x\left(e^x-1\right)}=$

23. The value of $\int_0^3\left|x^3-3x^2+2x\right|\,dx$ is

24. If the function $f(x)=2x^3-9ax^2+12a^2x+1$, when $a>0$, attains its maximum and minimum at $x=p$ and $x=q$, respectively such that $p^2=q$, then the smallest value of $a+0.01$ is

25. Let M be a 3 x 3 matrix satisfying $M\begin{pmatrix}0\\1\\0\end{pmatrix}=\begin{pmatrix}-1\\2\\3\end{pmatrix}, M\begin{pmatrix}1\\-1\\0\end{pmatrix}=\begin{pmatrix}1\\1\\-1\end{pmatrix}$, and $M\begin{pmatrix}1\\1\\1\end{pmatrix}=\begin{pmatrix}1\\0\\12\end{pmatrix}$. Then the sum of the diagonal entries of $\frac{M}{4}$ is

PHYSICS

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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answer, out of which **ONLY ONE** option can be correct.
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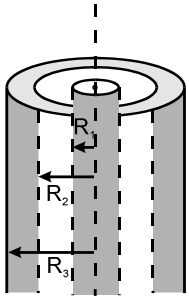
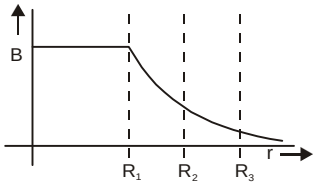
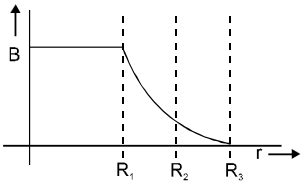
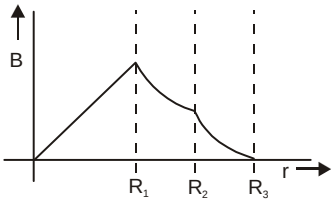
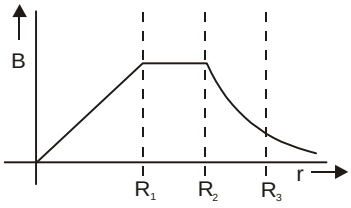
26. A coaxial cable is made up of two cylindrical conductors. The inner conductor is solid and is of radius R_1 & the outer conductor is hollow of inner radius R_2 and outer radius R_3. The space between the conductors is filled with air. The inner and outer conductors are carrying currents of equal magnitudes and in opposite directions. Then the variation of magnetic field with distance from the axis is best plotted as:



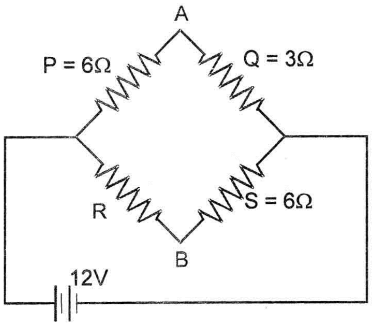
A)


B)


C)


D)


27. Consider the circuit shown in figure.



Potential difference $(V_B - V_A)$ is 4V. Assuming battery to be ideal.

Select the INCORRECT option:

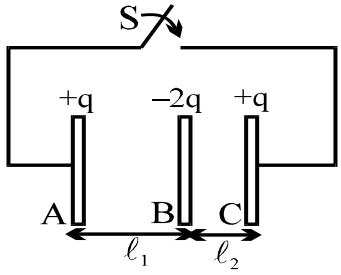
A) If points A and B are joined by a connecting wire of zero resistance then current drawn from battery is 3A.

B) If R is varied from zero to a large value then, rate of heat generated in it will be maximum when $R = 6\Omega$.

C) If R is varied from given value to a large value then, potential difference across A & B will be zero when $R = 12\Omega$

D) If R is varied from given value to a large value then, potential difference across A & B will continuously increases

28. Three long conducting plate A, B & C having charges +q, –2q & +q as shown in figure. Here plate A and C are fixed.If the switch S is closed. The middle plate (B) will start moving in



(here $\ell_1 > \ell_2$)

A) Leftward direction B) Rightward direction
C) will not move at all D) Cannot be decided

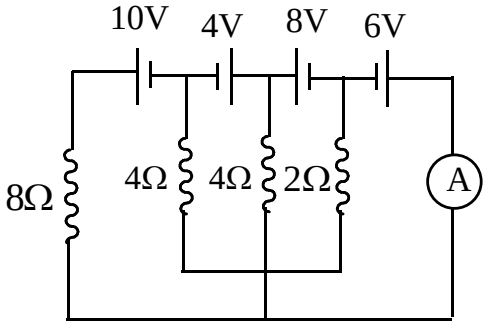
29. A variable resistance is connected across a non ideal cell of constant emf and constant internal resistance. Initial value of variable resistance is R. Now the magnitude of variable resistance has been made n times, that is, its new value is nR. Surprisingly the new value of power dissipated in variable resistance is still same as its initial value. The value of internal resistance of cell is

(A) $\frac{1+n}{2}R$ (B) $R\sqrt{n}$ (C) $\sqrt{\frac{1+n^2}{2}}R$ (D) $R+nR$

30. In a coordinate system an electric field E and a magnetic field B exist in X-direction and particle of charge *q* and mass m is projected with a velocity v from origin along Y-direction. A target is located at point (x_0, 0, 0). Find the magnitude of magnetic induction B, so that the particle will hit the target when it is crossing the X-axis third time.

A) $\pi\sqrt{\frac{2E}{qx_0}}$ B) $3\pi\sqrt{\frac{mE}{2qx_0}}$ C) $3\pi\sqrt{\frac{2mE}{qx_0}}$ D) $2\pi\sqrt{\frac{2mE}{qx_0}}$

31. Find the reading of the ideal ammeter connected in the given circuit. Assume that the cells have negligible internal resistance.

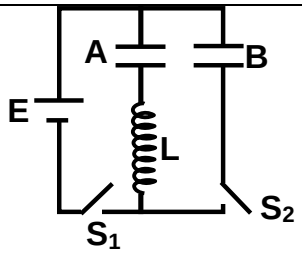


A) 2.5A B) 5 A C) 2 A D) 1 A

32. In a YDSE set up the separation between the slits is 3×10^{-3} m. The distance between the slits and the screen is 1.5 m. Light of wavelength in the visible range (4000Å – 8000Å) is allowed to fall on the slits. The wave length in the visible region that will undergo constructive interference on the screen at a distance of 1.5×10^{-3} m from central maxima is

A) 4285.7Å B) 5000 Å C) 6000 Å D) ALL THE ABOVE

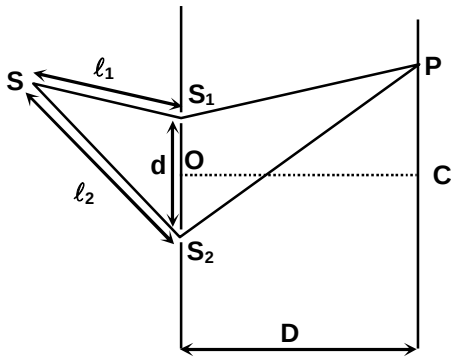
33. Two uncharged identical capacitors A and B, each of capacitance C, and an inductor of inductance L are arranged as shown in the adjacent figure. At t = 0, the switch S_1 is closed while switch S_2 remains open. At time $t = t_0 = \sqrt{LC}\frac{\pi}{2}$, switch S_2 is closed while switch S_1 is opened.



The current flowing through the inductor at t = t_0 is

A) $2CE\frac{1}{\sqrt{LC}}$ B) 0 C) $\frac{CE}{2}\times\frac{1}{\sqrt{LC}}$ D) $CE\times\frac{1}{\sqrt{LC}}$

34. In a young double slit experiment. The two slits are illuminated by a monochromatic light source S of wavelength λ = 500 nm. Distance between slits and screen is D = 2m and distance between two slits $S_1S_2 = 10$ μm. $SS_1 = \ell_1$ = 20 μm and $SS_2 = \ell_2$ = 40 μm, as shown in the figure.



How many maxima will appear on the screen

A) 80 B) 60

C) 40 D) 20

35. Dimensionally power of lens is equivalent to :

In the options E=Electric Field, B=Magnetic Field, L=Inductance, C=Capacitance

A) $\frac{E\sqrt{LC}}{B}$ B) $\frac{E}{B\sqrt{LC}}$ C) $\frac{B\sqrt{LC}}{E}$ D) $\frac{B}{E\sqrt{LC}}$

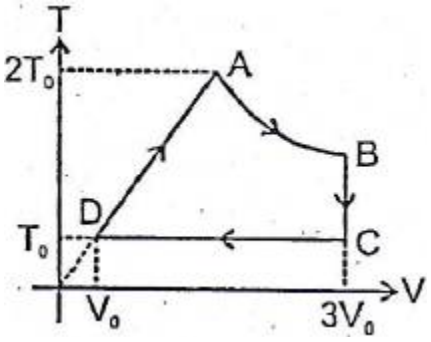
36. We have a sound source of frequency 330 Hz. The velocity of sound is 330 m/s. There is an observer recording the frequency. f & λ are frequency and wavelength observed by observer. The source is stationary, wind is blowing From source to observer and observer is moving away from the source.

The speed of wind is small compared to speed of observer.

A) $\lambda = 1m, f > 330Hz$ B) $\lambda > 1m, f < 330Hz$

3) $\lambda < 1m, f > 330Hz$ D) $\lambda > 1m, f = 330Hz$

37. Consider the cyclic process ABCDA, as shown in figure, performed on a sample of n moles of an ideal gas. Net heat supplied to the gas during the process is $4nRT_0$. Then the work done during the process AB will be :



A) $3nRT_0$ B) $nRT_0(4+ln3)$ C) $nRT_0(3+ln3)$ D) $nRT_0(2+ln3)$

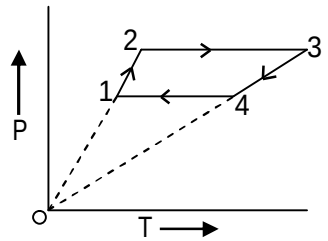
38. A vessel, having a hole of diameter d in its bottom, is hanging from a lift moving upward with acceleration a. The level of mercury in the vessel is at height "h". The surface tension of mercury is T. Mercury does not pour out from the hole. The maximum acceleration a so that mercury will not pour out, is (density of Hg is ρ, assume d << h)

A) $\frac{2T}{\rho dh}-g$ B) $\frac{2T}{\rho dh}$ C) $\frac{2T}{\rho dh}+g$ D) $\frac{4T}{\rho dh}-g$

39. A sound wave is travelling in a uniform pipe with gas of adiabatic exponent γ. If u is particle velocity at any point in medium and c is wave velocity, then relative change in pressure $\frac{dP}{P}$ while wave passes through this point is :

A) $\frac{u}{\gamma c}$ B) $\gamma\sqrt{\frac{u}{c}}$ C) $\gamma\frac{u}{c}$ D) $\frac{1}{\gamma}\frac{u^2}{c^2}$

40. Three moles of an ideal monatomic gas perform a cycle as shown in pressure-temperature graph. The gas temperatures in different states are T_1 =400 K, T_2=800 K, T_3 = 2400 K, T_4 = 1200 K. The work done by the gas during the cycle will be:

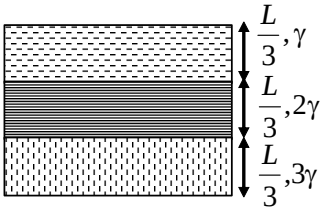


A) 20 kJ B) 30 kJ C) 40 kJ D) 80 kJ

41. In the Bohr's atomic model, electron revolves in an orbit with speed v. It produces magnetic field B at centre. The magnetic dipole moment of the electron is M. Which of the following quantity is independent of quantum number of the orbit?

A) $\frac{Mr}{Bv}$ B) $\frac{Br^2}{Mv^2}$ C) $\frac{Mr^2}{Bv^2}$ D) $\frac{Mv^2}{Br^3}$

42. Three immiscible liquids are filled in a container as shown. The base area of the container is A and coefficient of cubical expansion of the material of the container is $\frac{3\gamma}{2}$ while the coefficient of cubical expansion of the liquids are shown in the figure. The temperature of the system is increased by ΔT. The volume of the liquid flown out of the container is

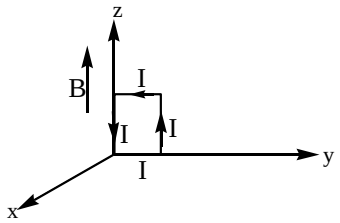


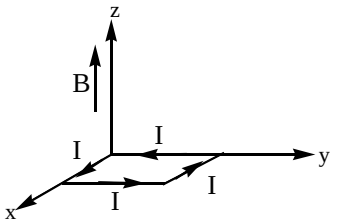
A) $\frac{Al\gamma\Delta T}{3}$ B) $Al\gamma\Delta T$ C) $\frac{2Al\gamma\Delta T}{3}$ D) $\frac{Al\gamma\Delta T}{2}$

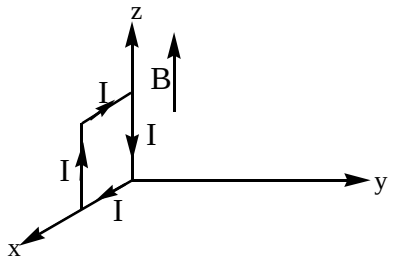
43. The vernier of a vernier scale is divided into 10 divisions which coincide with 9 divisions of the main scale, each main scale division being 0.5 mm. When the two jaws of the instrument are in contact with each other, the 4th division of the vernier scale coincides with a main scale division and the zero of the vernier lies to the right of the zero of the main scale. When a sphere is inserted between the jaws, the zero of vernier scale lies slightly to the right of 1.8 cm and the sixth vernier division coincides with a main division. The diameter of sphere will be

A) 1.85 cm B) 1.81 cm C) 1.75 cm D) 1.71 cm

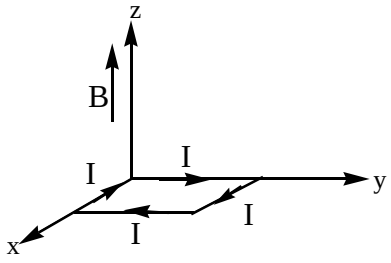
44. A rectangular loop of sides 10 cm and 5 cm carrying a current I of 12 A is placed in different orientations as shown in the figures below:

A)


B)




C)



D)

If there is a uniform magnetic field of 0.3 T in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium respectively.

A) a and b respectively B) a and c respectively

C) b and d respectively D) b and c respectively

45. Two satellites S_1 & S_2 of equal masses revolve in the same sense around a heavy planet in coplanar circular orbit of radii R & 4R. Choose the INCORRECT option

A) The ratio of period of revolution S_1 & S_2 is 1 : 8.

B) Their velocities are in the ratio 2: 1

C) Their angular momentum about the planet are in the ratio 2 : 1

D) Their energies are in the ratio 4:1

SECTION-II
(Numerical Value Answer Type)

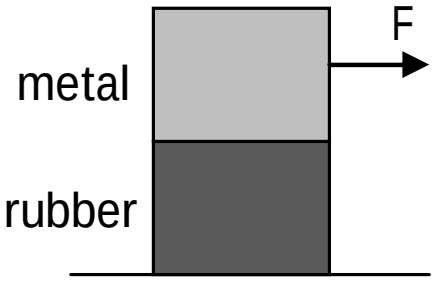
This section contains 5 questions. The answer to each question is a Numerical value. If the numerical value has more than two decimal places, **round-off the value** of Two decimal places. Answer to each question will be evaluated according to the following marking scheme:

Marking scheme: +4 for correct answer, 0 in all other cases.

46. A short dipole of moment $\vec{P} = \hat{i} + \sqrt{3}\,\hat{j}$ is kept at origin. There are three points A, B and C with co-ordinates respectively (2, 0, 0) $\left(2, 2\sqrt{3}, 0\right)$ and (0, 0, 4). Let V_A, V_B and V_C be the electric potential at these points respectively. Find $\frac{V_A - V_C}{V_A - V_B}$?

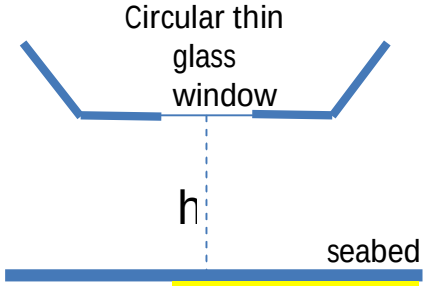
47. A radioactive sample contains a mixture of two elements *A* and *B*, which are isobars. Both the elements emit α particles. Half life of *A* is 30minutes and that of *B* is one hour. Initially the sample emits 80 particles in two seconds. One hour later 29 particles are detected in 2 seconds. Let the total weight of the sample be *58* milligram initially. Let weight of sample A be W_A (measured in milligram). Calculate $3W_A/11$.

48. A metal cube of mass $M = 8kg$ and side 10 cm is fixed on to the upper face of a hard rubber cube of identical dimensions. The lower face of the rubber cube is fixed to the ground. The shear modulus of rubber is $6\times10^5 Pa$. A small force *F* is applied to a vertical face of the metal cube in perpendicular direction and then released. Ignore the shearing of metal cube. The period of oscillation of the cube is given by $T = 2\pi\times10^{-2}\sqrt{\frac{n_1}{4}}$. Determine n_1.



49. Consider a spherical capacitor made of two concentric conducting shells of radii *a* and 2*a*. In the first case, when only outer shell is grounded its capacitance be *C*. Now, in the second case, Only the inner shell is grounded. The new capacitance now becomes C'. Determine the ratio $\frac{C'}{C}$.

50. A boat has a circular thin flat glass window at the bottom for observing the seabed under water of refractive index 4/3. The diameter of the window is 2 meters .The seabed is $h = 2\sqrt{7}m$ beneath the window. Estimate the radius of the area of the seabed that can be seen through the window.



CHEMISTRY

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

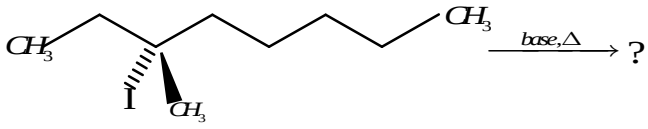
This section contains 20 multiple choice questions. Each question has 4 options (1), (2), (3) and (4) for its
answer, out of which **ONLY ONE** option can be correct.
Marking scheme: +4 for correct answer, 0 if not attempted and -1 if not correct.

51. The interplanar distance between the closest packed layers in the face-centered cubic unit cell is
A) Equal to the edge length of unit cell
B) Equal to the half the edge length of unit cell
C) Equal to the one third of body diagonal length of unit cell
D) Equal to the half of face diagonal length of unit cell

52. Arrange the following compounds in the order of increasing tendency to undergo electrophilic substitution
A) Nitrobenzene B) Benzene C) Phenol D) Toluene
E) Trimethyl phenyl ammonium ion
A) E < A < B < D < C B) C > B > A > D > E
C) A > B > E > C > D D) E < B < D < A < C

53. For a real gas PV>RT at all pressure ranges, then :
A) The gas is less compressible than ideal gas
B) The gas is highly compressible than ideal gas
C) The gas is not compressed at all
D) The gas is liquefied easily

54. How many distinct alkene products are possible when the alkyl iodide below undergoes E2 elimination?



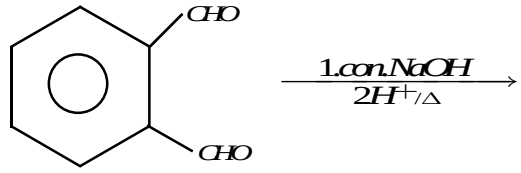
A) 1 B) 2 C) 3 D) 5

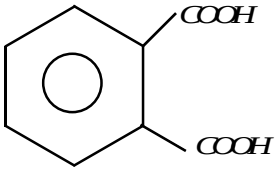
55. Equivalent conductivity of $BaCl_2, H_2SO_4$ and HCl are x_1, x_2 and x_3 $S \cdot cm^2 \cdot eq^{-1}$ at infinite dilution. If conductivity of saturated $BaSO_4$ solution is x $S \cdot cm^{-1}$, then K_{sp} of $BaSO_4$ is (in M^2) (conductivity of water neglected)

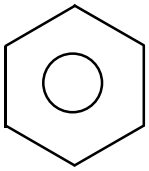
A) $\frac{500x}{(x_1 + x_2 - 2x_3)^2}$ B) $\frac{2.5 \times 10^5 x^2}{(x_1 + x_2 - x_3)^2}$ C) $\frac{10^6 x^2}{(x_1 + x_2 - 2x_3)^2}$ D) $\frac{0.25x^2}{(x_1 + x_2 - x_3)^2}$

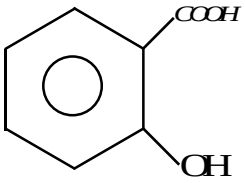
56. Bredig's arc method cannot be used for the preparation of colloidal sol of :
A) Copper B) Gold C) Silver D) Sodium

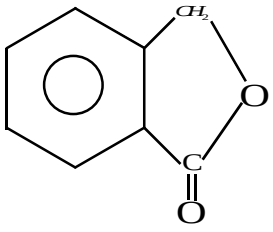
57. Identify the product in the following reaction:



A) 

B) 

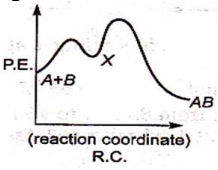
C) 

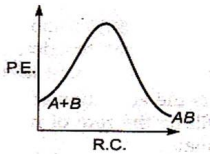
D) 

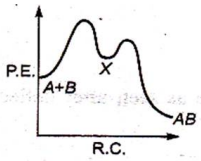
58. For an exothermic chemical process occurring in two steps as follows

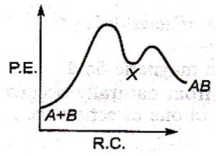
$(i)\ A + B \rightarrow X\ (slow)$ $(ii)\ X \rightarrow AB\ (fast)$

The process of reaction can be best describe by

A) 

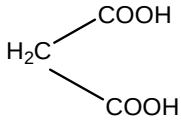
B) 

C) 

D) 

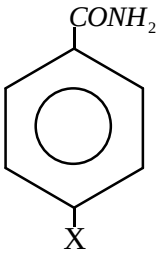
59. Which of the following is most acidic.

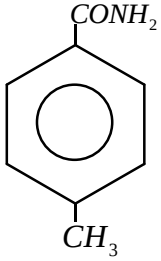
A) 

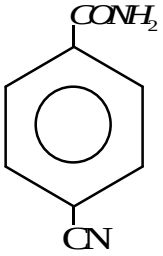
B) 

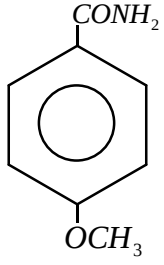
C) CH_3COOH D) HCOOH

60. Which of the following can undergo Hoffmann degradation most easily?

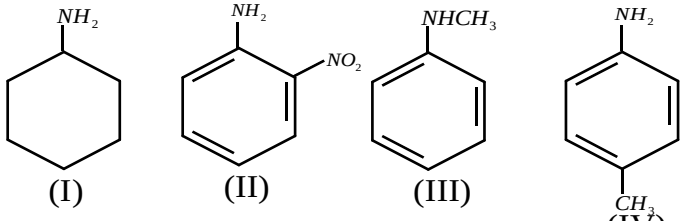
A) 

B) 

C) 

D) 

61. The correct order of decreasing base strength among the amines given is



(I) (II) (III) (IV)

A) III > I > IV > II B) IV > III > I > II C) I > IV > III > II D) I > III > IV > II

62. When 1 mole of $A_{(g)}$ is introduced in a closed vessel of one litre capacity maintained at constant temperature, the following equilibrium established

$$A_{(g)} \rightleftharpoons B_{(g)} + C_{(g)};\ K_{C_1} = ?$$

$$C_{(g)} \rightleftharpoons D_{(g)} + B_{(g)};\ K_{C_2} = ?$$

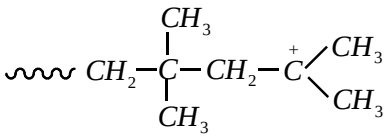
If the pressure at equilibrium is twice the initial pressure calculate $\frac{K_{C_1}}{KC_2}$ if $\frac{[C]_{eq.}}{[A]_{eq.}} = 2:1$

A) 3 : 1 B) 4 : 1 C) 2 : 1 D) 1

63. A buffer solution is made by mixing a weak acid HA $\left(K_a = 10^{-6}\right)$ with its salt NaA in equal amounts (moles). What should be amount of acid or salt that should be added to make 90 mL of buffer solution, in which if 0.1 mole of strong acid are added into 1 L of this buffer solution then change in its pH is unity?

A) 10 m moles B) 22 m moles C) 9 m moles D) 11 m moles

64. The acid-catalysed polymerization of an alkene yields the following intermediate.



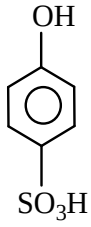
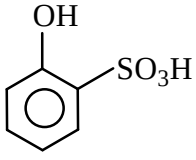
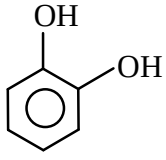
The alkene monomer is

A) $CH_3CH = CHCH_3$ B) $\left(CH_3\right)_2 C = C\left(CH_3\right)_2$

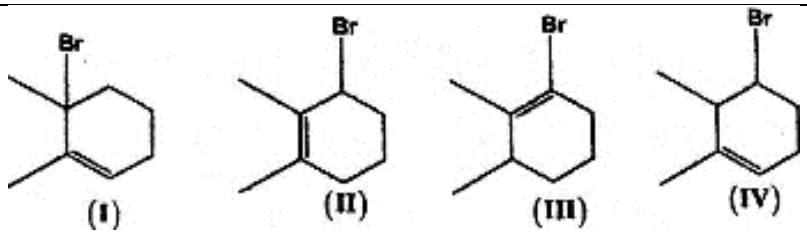
C) $CH_2 = C\left(CH_3\right)_2$ D) $CH_3CH = CH_2$

65. In the given reaction

C_6H_5–OH $\xrightarrow[100^0C]{H_2SO_4}$ [X] as major product $\xrightarrow[(ii)\,H^{\oplus}]{(i)\,NaOH\ fusion}$ [Y]. [Y] is:

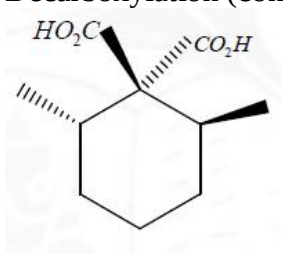
A)  B)  C)  D) 

66. What is the sum of positions assigned to bromine while numbering the parent chain in the below compounds



A) 11 B) 13 C) 15 D) 12

67. How many product(s) will be formed, when below compound undergo Decarboxylation (consider only monocarboxylic acids)

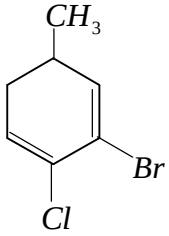


A) 0 B) 1 C) 2 D) 3

68. The major products obtained (organic) on treatment of $ArN_2^+HSO_4^{1-} \xrightarrow{EtOH} (?)$ and $ArN_2^+HSO_4^{1-} \xrightarrow{MeOH} (?)$ are respectively

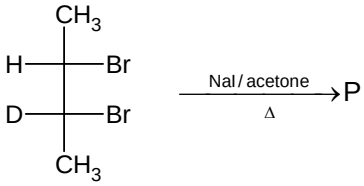
A) $ArH, ArOMe$ B) CH_3CHO, CH_3CHO C) ArH, ArH D) $ArOEt, ArOMe$

69. IUPAC name of the given compound is

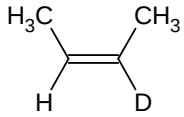


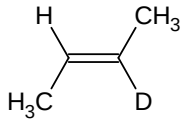
A) 1-Bromo-2-Chloro-5-methylcyclohexa-1,2-diene
B) 2-Bromo-3-chloro-6-methylcyclohexa-1,3-diene
C) 3-Bromo-2-chloro-5-methylcyclohexa-1,3-diene
D) 1-Bromo-6-chloro-3-methylcyclohexa-1,5-diene

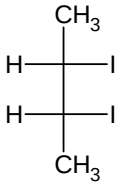
70. In the reaction

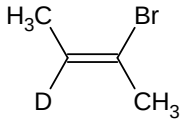


The product P is

A) 

B) 

C) 

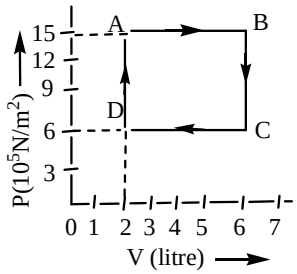
D) 

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical value. If the numerical value has more than two decimal places, **round-off the value** of Two decimal places. Answer to each question will be evaluated according to the following marking scheme:
Marking scheme: +4 for correct answer, 0 in all other cases.

71. The molal elevation constant of water is $0.52K\,kgmol^{-1}$. The boiling point of 1.0 molal aqueous KCl solution (assuming complete dissociation of KCl), should be (in ^0C)

72. The P – V graph of an ideal gas is shown below :



The net work in the cyclic process(in joul) (1 lt.atm=100j)

73. For electrolyte MCl_2 in water at 25^0C the following date is given

Conc.(M)	0.16	1
λm ($\Omega^{-1}cm^2mol^{-1}$)	282	240

$\lambda_m^0 MCl_2$ (in $ohm^{-1}cm^2mol^{-1}$) is

74. In dilute aqueous H_2SO_4, the complex diaquodioxalate ferrate(II) ion is oxidized by MnO_4^-. For this reaction, the ratio of rate of change of $[H^+]$ to the rate of change of $\left[MnO_4^-\right]$ is

75. The carbohydrate formed in the hydrolysis of DNA is subjected to acetylation with excess acetic anhydride, gram molecular weight of actylated product of that carbohydrate is how many grams more than that of the carbohydrate.

MELUHA INTERNATONAL SCHOOL
HYDERABAD

OUTGOING SR | **JEE MAINS MODEL – CT 3** | **Date: 21-06-2020**
Time: 3 Hours | **Max Marks : 300**

KEY SHEET

MATHS

1) **C**	2) **C**	3) **B**	4) **D**	5) **B**	6) **C**	7) **B**	8) **B**	9) **B**	10) **B**
11) **C**	12) **C**	13) **D**	14) **B**	15) **A**	16) **D**	17) **A**	18) **A**	19) **B**	20) **D**
21) **126.25**	22) **0.25**	23) **2.75**	24) **2.01**	25) **2.25**					

PHYSICS

26) **C**	27) **D**	28) **B**	29) **B**	30) **C**	31) **C**	32) **D**	33) **D**	34) **C**	35) **D**
36) **B**	37) **C**	38) **D**	39) **C**	40) **A**	41) **B**	42) **D**	43) **B**	44) **C**	45) **C**
46) **2**	47) **6**	48) **3**	49) **2**	50) **7**					

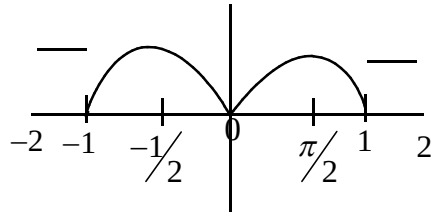
CHEMISTRY

51) **C**	52) **A**	53) **A**	54) **D**	55) **B**	56) **D**	57) **D**	58) **C**	59) **A**	60) **D**
61) **D**	62) **B**	63) **D**	64) **C**	65) **C**	66) **C**	67) **B**	68) **A**	69) **C**	70) **B**
71) **101.01**	72) **-3600**	73) **310**	74) **8**	75) **126**					

HINTS & SOLUTIONS
MATHEMATICS

01. Even function $= \frac{f(x)+f(-x)}{2} = \frac{1}{2}\left[\frac{x+1}{x^3+1}+\frac{1-x}{1-x^3}\right] = \frac{1}{2}\left[\frac{1}{x^2-x+1}+\frac{1}{1+x+x^2}\right]$
$= \frac{1}{2}\left[\frac{2(x^2+1)}{(x^2+1)^2-x^2}\right] = \frac{x^2+1}{x^4+x^2+1} = \frac{x^4-1}{x^6-1}$

02. It is non-differentiable at $x = 0,1,-1,\frac{1}{\sqrt{2}},-\frac{1}{\sqrt{2}}$



03. $\int \frac{\frac{2}{x^2}+\frac{1}{x^{3/2}}}{\left(\frac{1}{x}+\frac{1}{\sqrt{x}}+1\right)^2}dx$

$$\frac{1}{x}+\frac{1}{\sqrt{x}}+1=t\Rightarrow\left(-\frac{1}{x^2}-\frac{1}{2x^{3/2}}\right)dx=dt$$

04. $\int_0^{2019} x^2 f''(x)\,dx=\left[x^2 f'(x)-2xf(x)\right]_0^{2019}+2\int_0^{2019} f(x)\,dx=$

$(2019)^2 f'(2019)-2(2019)f(2019)+2(1)=2019$

05. $y=xe^{|x|}=\begin{cases}xe^{-x}, & -1<x<0\\ xe^{x}, & 0<x<1\end{cases}$, $\quad R.A=\left|\int_{-1}^{0} xe^{-x}dx\right|+\left|\int_{0}^{1} xe^{-x}dx\right|$

$=\left|-xe^{-x}-e^{-x}]_{-1}^{0}\right|+\left|xe^{x}-e^{x}]_{0}^{1}\right| \quad =\left|-1-e+e\right|+\left|e-e-0+1\right|=2$

06. $\frac{dx}{dy}+\frac{1}{y^2}x=\frac{1}{y^3}$

I. F $e^{\int\frac{1}{y^2}dx}=e^{-\frac{1}{y}}$

$\Rightarrow x.e^{\int-\frac{1}{y}dx}=\int-\frac{1}{y}.e^{-\frac{1}{y}dy}=I$

Put $-\frac{1}{y}=t$

$\Rightarrow I=\int(-t)e^{t}dt$

$=e^{t}(1-t)$

$\Rightarrow x.e^{-\frac{1}{y}}=e^{\frac{1}{y}}\left(1+\frac{1}{y}\right)+c$

$\Rightarrow x=1+\frac{1}{y}+c.e^{\frac{1}{y}}$

Where $x=1,\ y=1$

$\Rightarrow C=-\frac{1}{e}$

07. $A\left(\frac{1}{2},\frac{1}{2}\right)\Rightarrow\frac{dy}{dx}=(2-4x)=2-4\left(\frac{1}{2}\right)=0$

$B(2,4)\Rightarrow\frac{dy}{dx}=2x=2(2)=4 \qquad \theta=\tan^{-1}(4)$

08. Let $\bar{b}=x\bar{i}+y\bar{j}$ Since a is perpendicular to b so $4x+3y=0$. Thus $\bar{b}=x\left(\bar{i}-\frac{4}{3}\bar{j}\right)$.

Let $c=id+vj$ be the required vector. According to the given condition

$1=\frac{c.a}{|a|}\Rightarrow 4u+3v=5.$ Also

$2=\frac{c.b}{|b|}\Rightarrow\frac{ux-(4/3)vx}{\sqrt{x^2\left(1+(16/9)\right)}}=2\Rightarrow 3u-4v=\pm 10$

Solving these equations we have $u=2$ and $v=-1$ *or* $u=-2/5,\ v=11/5.$

09. Use the condition for coplanarity $\begin{vmatrix} 1 & -1 & 4 \\ 2 & -1 & \lambda \\ 1 & 2 & -1 \end{vmatrix} = 0 \Rightarrow \lambda = \frac{19}{3}$

10. The given system of equations will have a non-trivial solution, if

$$\Delta = \begin{vmatrix} a\alpha + b & a & b \\ b\alpha + c & b & c \\ 0 & a\alpha + b & b\alpha + c \end{vmatrix} = 0$$

$$\Rightarrow \quad -\left(a\alpha^2 + 2b\alpha + c\right)\left(ac - b^2\right) = 0$$

11. Applying $R_1 - R_2$ *and* $R_2 - R_3$, we have kept p – a, q – b and r – c as desired

$$\begin{vmatrix} p-a & -(q-b) & 0 \\ 0 & q-b & -(r-c) \\ a & b & r \end{vmatrix} = 0$$

Expand w.r.t. C_1

$\therefore (p-a)\{(q-b)r + b(r-c)\} + a\{(q-b)(r-c)\} = 0$ or

$(p-a)(q-b)r + (p-a)(r-c)b + a(q-b)(r-c) = 0$

Dividing throughout by $(p-a)(q-b)(r-c)$

Since $a \neq p, b \neq q, c \neq r$ is given $\frac{r}{r-c} + \frac{b}{q-b} + \frac{a}{p-a} = 0$

Add 1 + 1 on both sides to get the desired form $\frac{r}{r-c} + \left(\frac{b}{q-b} + 1\right) + \left(\frac{a}{p-a} + 1\right) = 1 + 1$ or

$\frac{r}{r-c} + \frac{q}{q-b} + \frac{p}{p-a} = 2$

$\therefore \sum \frac{p}{p-a} = 2$

12. $S = (y - x - 10)(y - x - 20) = 0$ and $O(0,0) = (x_1, y_1)$

Locus of P is $S_1 = 0$, $3y - 3x = 40$

13. Equation of the circle is $x^2+y^2-4+K(2x+y-1)=0$ radius$=\sqrt{\frac{5k^2}{4} + 4 + k}$ radius is minimum when

$K = -\frac{2}{5}$

14. Let P(h,0) be the point on axis

$\therefore$ Slope of $PQ = \frac{1}{\sqrt{3}}$

15. (1) F(x) is defined for

$[x]^2 - [x] - 6 > 0 \Rightarrow ([x] - 3)([x] + 2) > 0$

$\Rightarrow [x] < -2$ or $[x] > 3$

But $[x] < -2 \Rightarrow [x] = -3, -4, -5, ...$

$\therefore x < -2$

$\therefore$ Domain of $f = (-\infty, -2) \cup [4, \infty)$

16. $\lim\limits_{x\to\infty} x^{1/3}\left\{(x+1)^{1/3}+(x-1)^{1/3}\right\}\left\{(x+1)^{1/3}-(x-1)^{1/3}\right\}$

Rationalise $\lim\limits_{x\to\infty}\dfrac{x^{1/3}\left\{(x+1)^{1/3}+(x-1)^{1/3}\right\}2}{\left\{(x+1)^{2/3}+(x^2-1)^{1/3}+(x-1)^{2/3}\right\}}$

$$\lim_{x\to\infty}\frac{2.x^{2/3}\left\{\left(1+\frac{1}{x}\right)^{1/3}+\left(1-\frac{1}{x}\right)^{1/3}\right\}2}{x^{2/3}\left\{\left(1+\frac{1}{x}\right)^{2/3}+\left(1-\frac{1}{x}\right)^{1/3}+\left(1-\frac{1}{x}\right)^{2/3}\right\}}=\frac{2x2}{3}=\frac{4}{3}$$

17. $g'(x)=x\left\{f'\left(2x^2-1\right)-f'\left(1-x^2\right)\right\}>0$

Now $f'(x)$ is increasing and $x<0$

$\Rightarrow 2x^2-1<1-x^2$

$3x^2<2$

$\Rightarrow x^2<2/3$

$|x|<\sqrt{\frac{2}{3}}$

$-\sqrt{\frac{2}{3}}<x<0$

19. $2x-y=1\Rightarrow x=\alpha, y=2\alpha-1$

The image of the point $(\alpha,2\alpha-1)$ in the line $x+y=0$ is given by

$$\frac{x-\alpha}{1}=\frac{y-(2\alpha-1)}{1}=-2\frac{(\alpha+2\alpha-1)}{1+1}=1-3\alpha$$

$\therefore\ x=1-2\alpha,\ y=2\alpha-1+1-3\alpha=-\alpha$

Elimination of α gives the image $x-2y=1$

20. Radius=$2|\sin\alpha|$

21. $\sum\limits_{x=1}^{2019} f(x+1)=\sum\limits_{x=1}^{2019}(-1)^{x+1}x-3\sum\limits_{x=1}^{2019} f(x)$

Since $f(1)=f(2020)$

$4\sum\limits_{x=1}^{2019} f(x)=1-2+3-4+5.....+2019=1010$

22. $\underset{x\to0}{lt}\dfrac{\tan\frac{x}{2}-\tan\frac{x}{3}-\tan\frac{x}{6}}{x^3}=\dfrac{1}{36}$

23 $\int\limits_0^1\left(x^3-3x^2+2x\right)dx-\int\limits_1^2\left(x^3-3x^2+2x\right)dx+\int\limits_2^3\left(x^3-3x^2+2x\right)dx$

$=\dfrac{11}{4}$

24. $f^1(x)=0$

$\Rightarrow x=a, x=2a$

$f^{11}(a)<0,\ f^{11}(2a)>0$

F(x) ma. At x = a, min. at x = 2a.

p = a, q = 2a.

$p^2 = q \Rightarrow a = 2$

25. Let $M = \begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}$

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}\begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \\ 3 \end{bmatrix}$$

$b_1 = -1, b_2 = 2, b_3 = 3$

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}\begin{bmatrix} 1 \\ -1 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ -1 \end{bmatrix}$$

$a_1 - b_1 = 1, a_2 - b_2 = 1, a_3 - b_3 = -1$

$a_1 = 0, a_2 = 3, a_3 = 2$

$$\begin{bmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 12 \end{bmatrix}$$

$a_1 + b_1 + c_1 = 1, a_2 + b_2 + c_2 = 0, a_3 + b_3 + c_3 = 12$

$c_1 = 2, c_2 = -5, c_3 = 7$

$$M = \begin{bmatrix} 0 & -1 & 2 \\ 3 & 2 & -5 \\ 2 & 3 & 7 \end{bmatrix}$$

PHYSICS

26. For radius R_1 $B.2\pi r / 1 = \dfrac{2}{\pi R_1^2} x\pi R_1^2$

$$b = \frac{2}{2\pi R_1^2} r_1$$

$for\ R_1\ to\ R_2$

$B.2\pi r_2 = \mu_o i$

$B = \dfrac{\mu_o i}{2\pi r_2} \qquad (R_1 < r_2 < R_2)$

$for\ R_2\ to\ R_3$

$B.2\pi r_3 = \mu_o[i - \dfrac{ix\pi\left(r_3^2 - R_2^2\right)}{\pi\left(R_3^2 - R_2^2\right)}$

$= \dfrac{\mu_0 i\left(R_3^2 - r_3^2\right)}{R_3^2 - R_2^2}$

$B\alpha - \perp$

$From\ R_3\ to \infty$

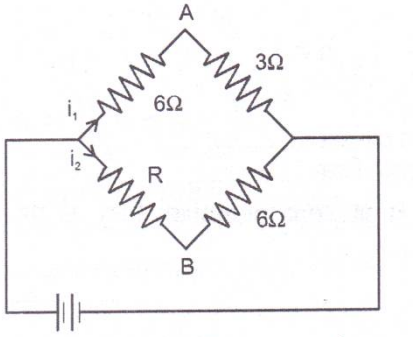
$B2\pi r_4 = \mu(i - i) = 0$

$B = 0$

$R_3 \le r_4 < \infty$

27. $i_1 = \dfrac{12}{9}A = \dfrac{4}{3}A$

$i_2 = \dfrac{12}{6+R}A$



$V_B - V_A = -R\ \dfrac{12}{6+R} + 6 \times \dfrac{4}{3}$

$V_B - V_A = -R\dfrac{12}{6+R} + 6 \times \dfrac{4}{3}$

$4 = \dfrac{12R}{6+R} - 8 \Rightarrow \dfrac{12R}{6+R} = 4$

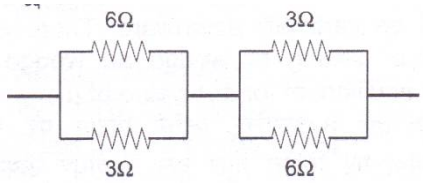
$3R = 6 + R$

$R = 3\Omega$

Vaccros R = 4V

If A and B are joined by connecting wire then equivalent circuit will be:

$R_{eq} = 4\Omega$

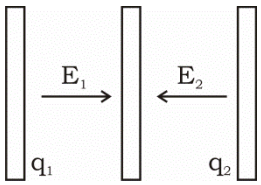


i = 3A

Power of $R = \left(\frac{12}{6+R}\right)^2 R$

And this will be maximum when $R = 6\Omega$

28.



$E_1\ell_1 = E_2\ell_2 \Rightarrow q_1\ell_1 = q_2\ell_2 \quad q_2 > q_1$

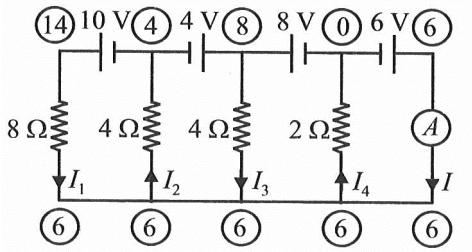
29.

$$P = \frac{\varepsilon^2 R}{(r+R)^2} = \frac{\varepsilon^2 n}{(r+nR)^2} R$$

$$\Rightarrow \quad r = R\sqrt{n}$$

30. $\frac{1}{2}\left(\frac{qE}{m}\right)t^2 = x_0 \quad t = 3\left(\frac{2\pi m}{qB}\right)$

31.



The current through ammeter

$$I = I_4 - I_3 + I_2 - I_1$$

$$= \left(\frac{6-0}{2}\right) - \left(\frac{8-6}{4}\right) + \frac{(6-4)}{4} - \frac{(14-6)}{8}$$

$$= 3 - \frac{1}{2} + \frac{1}{2} - 1 = 3 - 1 = 2\,A$$

32. Here the position y on the screen will correspond to maxima.

$y = \frac{n\lambda D}{d}$

$\lambda = \frac{30,000}{n}$ when n = 1, 2, 3, 4, ……..

34. Optical path difference between the beans arriving at P

$\Delta x = (\ell_2 - \ell_1) + d\sin\theta$

for maxima

$(\ell_2 - \ell_1) + d\sin\theta = n\lambda$

$$\sin\theta = \frac{1}{d}\left[n\lambda - (\ell_2 - \ell_1)\right]$$

$$\theta = \sin^{-1}\left[2\left(\frac{n}{40} - 1\right)\right]$$

$$|\sin\theta| \le 1$$

$$-1 \le 2\left[\frac{n}{40} - 1\right] \le 1$$

or $20 \le n \le 60$

Hence number of maxima = 60 – 20 = 40

35. The dimension of $\frac{B}{E\sqrt{LC}}$ *is* $\frac{1}{meter}$

$$\left(\frac{B}{E} = \frac{1}{V} \& \frac{1}{\sqrt{LC}} = \omega = \frac{1}{T}\right)$$

37. $W_{AB} + W_{BC} + W_{CD} + W_{DA} = \Delta Q$ $\{\because \Delta U = 0$ in cyclic process$\}$

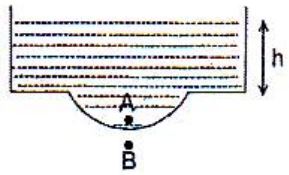
$$\Rightarrow W_{AB} + 0 + nRT_0 \ln\left(\frac{V_0}{3V_0} + nR\right)\left(2T_0 - T_0\right) = 4nRT_0 \ \{\because DA \text{ is isobaric process}\}$$

Get $W_{AB} = nRT_0 \ln 3 + 3nRT_0$

38. $P_A = P_0 + \rho\left(g + a\right)h$

$P_B = P_0$

$$P_0 + \rho\left(g + a\right)h = P_0 + \frac{2T}{\frac{d}{2}}$$



39. $\frac{P}{\rho^\gamma} = c \Rightarrow \frac{dp}{p} = \gamma\frac{d\rho}{\rho}$

and $\frac{d\rho}{\rho} = -\frac{dV}{V}$

$$= -\frac{\partial y}{\partial x}$$

$$y = A\sin(\omega t - kx)$$

$\Rightarrow u = \frac{\partial y}{\partial t} = -\frac{\partial y}{\partial x}c$; when $c = \frac{\omega}{k}$

$\Rightarrow \frac{dp}{p} = \gamma\frac{u}{c}$.

40. Figure shows that on segments, 1-2 and 3-4, pressure is directly proportional to the temperature. It follows from ideal gas equation that gas volume remains unchanged in this case and the gas does no work. So, we must find the work done only in isobaric processes 2-3 and 4-1.

The work $W_{23} = P_2(V_3 - V_2)$ *and* $W_{41} = P_1(V_1 - V_4)$

Total work done by the gas during the cycle is, $W = P_2(V_3 - V_2) + P_1(V_1 - V_4)$

The equation of state for three moles of ideal gas, $P_1V_1 = 3RT_1,\ P_1V_4 = 3RT_4$

$$P_2V_2 = 3RT_2,\ P_2V_3 = 3RT_3$$

Putting these values, we get: $W = 3R(T_3 + T_1 - T_2 - T_4) = 20kJ$.

41. $r = (K_1)n^2$

$T \propto r^{3/2} \Rightarrow T \propto n^3 \Rightarrow T = K_2 n^3$

$B = \frac{\mu_0 I}{2r} = \frac{\mu_0}{2r}.\frac{e}{T} \Rightarrow B \propto \frac{1}{n^5}$

$M = IA = \frac{e}{T}\pi r^2 \Rightarrow M \propto n$

$r \propto n^2, v \propto \frac{1}{n}$

$\therefore \frac{Br^2}{Mv^2}$ will be independent of n.

42. Let V be the volume of liquid flown out of container

$$V = \frac{AL}{3}[\gamma\Delta T + 2\gamma\Delta T + 3\gamma\Delta T] - \left[A(1+\gamma\Delta T)L\left(1+\frac{\gamma}{2}\Delta T\right) - AL\right]$$

$$= 2AL\gamma\Delta T - AL\left(1+\frac{3\gamma}{2}\Delta T\right) + AL = \frac{AL\gamma\Delta T}{2}$$

43. Least court (LC) =1 MSD – 1VSD = $0.05\text{mm} - \frac{9}{10}$ (0.05) mm = 0.005 cm

Reading of scale = Diameter = MSR + n (Least count) – zero error
= [1.8 + 6 × (0.005) – 4×(0.005)] cm
D = 1.81 cm

44. Potential energy, $U = -\bar{M}.\bar{B}$

$$U = -MB\cos\theta$$

When $\theta = 0^0$, U is minimum and equilibrium is stable

In option (b), $\bar{M}$ is parallel to $\bar{B}$, stable

In option (d), $\bar{M}$ is anti parallel to $\bar{B}$, unstable

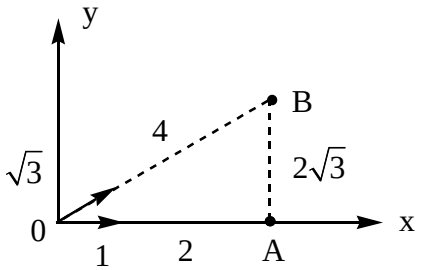
45. $T^2 \propto R^3 \Rightarrow \frac{T_1}{T_2} = 1:8$

$V \propto \sqrt{\frac{1}{R}} \Rightarrow \frac{V_1}{V_2} = 2:1$

Angular momentum = MVR

Energy $E \propto \frac{1}{R}$

46.



net dipole moment is 2 units and is aligned to line OB.

$$V_B = -\frac{k(2)}{(4)^2}$$

$$V_A = -\frac{k(1)}{(2)^2}$$

$$V_C = 0$$

$$\frac{V_A - V_C}{V_A - V_B} = 2$$

47. We have $N_1\lambda_1 + N_2\lambda_2 = 40$ and

$N_1\lambda_1 e^{-\lambda_1 t_0} + N_2\lambda_2 e^{-\lambda_2 t_0} = 29/2$,

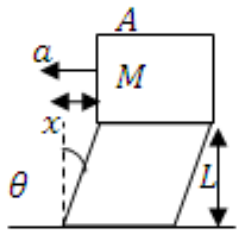
where $\lambda_1 = \ln 2/0.5$ and $\lambda_2 = \ln 2/1$.

Solving gives $N_1\lambda_1 = 18$ and $N_2\lambda_2 = 22$.

So $\frac{N_2}{N_1} = \frac{18}{11}$.

Now $M(N_1 + N_2) = 58$, where M is molecular weight. Hence we get $MN_1 = 22$

48.



We have $a = \ddot{x} = \frac{\eta\theta A}{M} = -\frac{\eta x A}{LM}$

49. With grounding, let charge Q be supplied to the capacitor. Out of this, only $\frac{Q}{2}$ remains on the inner shell. Hence the electric field between the plates is half the field without grounding. So P.D. falls to half the original value. So capacitance becomes twice

50. Consider a ray of light entering from water into glass at the edge of the window. This ray must enter the cabin (air) from glass. Hence the angle at the interface between the glass and air must be greater than the critical angle.

CHEMISTRY

55. $\lambda^0_{BaSO_4} = (x_1 + x_2 - x_3)\,ohm^{-1}cm^2eq^{-1}$

$\mu^0_{BaSO_4} = 2(x_1 + x_2 - x_3)\,ohm^{-1}cm^2mol^{-1}$

$$2(x_1 + x_2 - x_3) = x \times \frac{1000}{s(in\,M)}$$

$$S = \frac{500x}{x_1 + x_2 - x_3}$$

$$K_{SP} = S^2 = \frac{2.5\times10^5 x^2}{(x_1 + x_2 - x_3)^2}$$

57. This is an example of intermolecular cannizzaro reaction.

60. In RDS migration is easy when donating groups present

62.

$$\underset{1-x}{A_{(g)}} \rightleftharpoons \underset{x+y}{B_{(g)}} + \underset{x-y}{C_{(g)}}$$

$$\underset{x-y}{C_{(g)}} \rightleftharpoons \underset{y}{D_{(g)}} + \underset{x+y}{B_{(g)}}$$

$1-x+x+y+x-y+y=2$

$1+x+y=2 \Rightarrow x+y=1$ -- (1)

$\frac{x-y}{1-x}=\frac{2}{1} \Rightarrow x-y=2-2x \Rightarrow 3x-y=2$ -- (2)

From (1) and (2), $4x=3 \Rightarrow x=0.75, y=0.25$

$\frac{K_{C_1}}{K_{C_2}}=\frac{1\times 0.5}{0.25}\times\frac{0.5}{0.25}=\frac{4}{1}$

63.

$$\underset{x}{A^-} + \underset{0.1}{H^+} \rightleftharpoons \underset{x}{HA}$$

$x-0.1$ $\quad$ $x+0.1$

$pH = PKa + \log\frac{x}{x} = PKa$

$pH-1 = PKa + \log\frac{x-0.1}{x+0.1}$

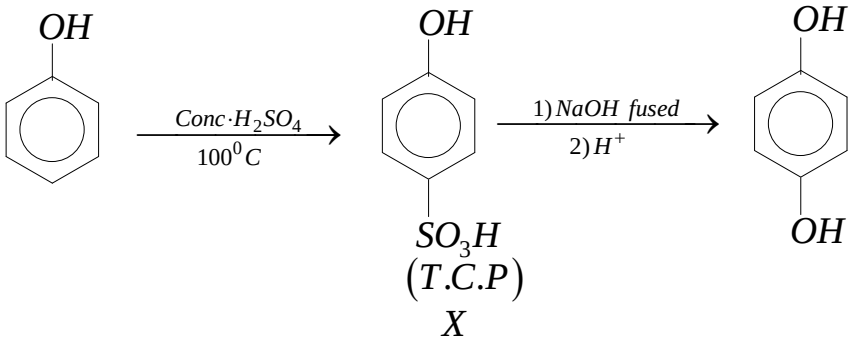
$\frac{1}{10}=\frac{x-0.1}{x+0.1} \Rightarrow 10x-1=x+0.1 \Rightarrow 9x=1.1 \Rightarrow x=\frac{1.1}{9} mole$

$1000 ml \rightarrow 1.1/9 mole$

$90 ml \rightarrow ?$

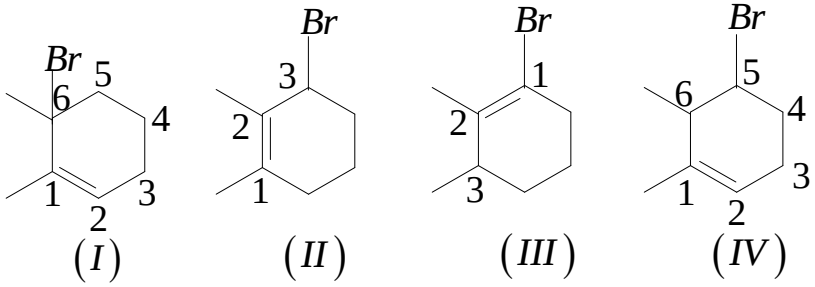
$\frac{1.1}{9}\times\frac{90}{1000}=0.011 mole = 11 m mole.$

65.



At 25^0C, K.C.P product, O-substitution product is major.

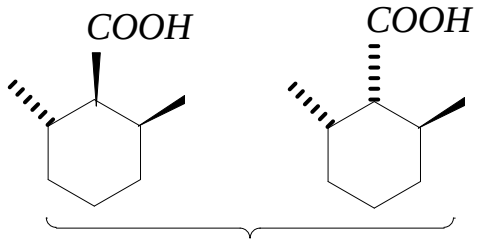
66. Follow the lowest locant rule



(I) (II) (III) (IV)

$6+3+1+5=15.$

67.



Both are identical

70. Anti elimination.

71. $\Delta T_b = K_b \cdot m \cdot i = 0.52 \times 1 \times 2 = 1.04$

$T_b = 100 + 1.04 = 101.04^0 C$

72. $W = area = -4 \times 10^{-3} \times 9 \times 10^5$

$W = -3600\,J$

73. $\lambda_C = \lambda_0 - b\sqrt{c}$

$282 = \lambda_0 - b \times 0.4$ -- (1)

$240 = \lambda_0 - b$ -- (2)

From (1) and (2), $282 = 240 + b - 0.4b$

$\Rightarrow 0.6b = 42 \Rightarrow b = 70.$

$\lambda_0 = 310$

74. $MnO_4^- + \left[Fe\left(C_2O_4\right)_2\left(H_2O\right)_2 \right]^{2+} + 8H^+ \rightarrow Mn^{2+} + Fe^{3+} + 4CO_2 + 6H_2O$

75. In D-Dexoxyribose, three OH groups present but not four.
3 x 42 = 126.