MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC
Time: 3 Hours

JEE MAINS GT–4

Date: 07-07-2020
Max. Marks: 300

JEE MAIN MODEL
MATHEMATICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 01 – 20)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 21 – 25)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

PHYSICS

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 26 – 45)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 46 – 50)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

CHEMISTRY

Section	Question type	+Ve Marks	- Ve Marks	No.of Qs	Total marks
Sec – I(Q.N : 51 – 70)	Questions with Single Answer Type	4	-1	20	80
Sec – II(Q.N : 71 – 75)	Questions with Numerical Answer Type (+/ - Decimal Numbers)	4	0	5	20
Total				25	100

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) 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.

MATHEMATICS

1. **Let $\bar{a},\bar{b},\bar{c}$ be the unit vectors such that $\bar{a}$ and $\bar{b}$ are mutually perpendicular and $\bar{c}$ is equally inclined to $\bar{a}$ and $\bar{b}$ at angle θ. If $\bar{c}=x\bar{a}+y\bar{b}+z\left(\bar{a}\times\bar{b}\right)$ then**

A) $z^2=1-2x^2$ B) $z^2=1-x^2+y^2$ C) $z^2=1+2y^2$ D) $z^2=1+2x^2$

2. **Let z_1 and z_2 be two complex numbers satisfying $|z_1|=9$ and $|z_2-3-4i|=4$. Then the minimum value of $|z_1-z_2|$ is**

A) 1 B) 2 C) $\sqrt{2}$ D) 0

3. **The coefficient of x^5 in the expansion of $\left(x+\frac{1}{x}\right)^{10}\left(x-\frac{1}{x}\right)^9$ is ___**

A) $9C_3$ B) $9C_4$ C) $-9C_3$ D) $-9C_4$

4. **If a, b and c are three numbers (not necessarily different) chosen randomly and with replacement from the set $\{1,2,3,4,5\}$, then the probability that $(ab+c)$ is even, is_____**

A) $\frac{35}{125}$ B) $\frac{59}{125}$ C) $\frac{64}{125}$ D) $\frac{75}{125}$

5. **Let the matrix $A=\begin{bmatrix} x & y & -z \\ 1 & 2 & 3 \\ 1 & 1 & 2 \end{bmatrix}$ where $x,y,z\in N$. If $\left|adj\left(adj\left(adj\left(adj A\right)\right)\right)\right|=4^8.5^{16}$ then number of (x,y,z) are**

A) 28 B) 36 C) 45 D) 55

6. **The negation of $\sim s\vee(\sim r\wedge s)$ is equivalent to:**

A) $s\wedge\sim r$ B) $s\wedge(r\wedge\sim s)$

C) $s\vee(r\vee\sim s)$ D) $s\wedge r$

7. **If $A=\{1,2,3,4\}$ and $R=\{(1,1),(2,2),(3,3)\}$ then the relation R on the set A is**

A) reflexive and symmetric but not transitive B) reflexive and transitive but not symmetric

C) Symmetric and transitive but not reflexive D) an equivalence relation

8. **If variance of first 'n' natural numbers is 10 and variance of first 'm' even natural numbers is 16 then the value of m+ n is____**

A) 18 B) 22 C) 26 D) 42

9. **The six digit numbers that can be formed using 1, 3, 5, 7, 9 such that each digit is used atleast once is ____**

A) 1780 B) 1800 C) 1880 D) 1900

10. **Let α and β are the roots of $x^2-x-1=0$ such that $p_k=\alpha^k+\beta^k, k\geq 1$ then which one is correct?**

A) $p_5=p_2-p_3$ B) $p_1+p_2+p_3+p_4+p_5=26$

C) $p_3=p_5+p_4$ D) $p_4=11$

11. **AB is a chord of the circle $x^2+y^2=25$. The tangents to the circle at A and B intersect at C. If $(2,3)$ is the midpoint of AB, then the area of quadrilateral OACB (Where O is origin) is**

A) $\frac{50}{\sqrt{3}}$ B) $50\sqrt{\frac{3}{13}}$ C) $50\sqrt{3}$ D) $\frac{50}{\sqrt{13}}$

12. **If the point $A(2-x,2,2), B(2,2-y,2), C(2,2,2-z)$ and $D(1,1,1)$ are coplanar, then locus of $P(x,y,z)$ is**

A) $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=1$ B) $x+y+z+=1$

C) $\frac{1}{1-x}+\frac{1}{1-y}+\frac{1}{1-z}=1$ D) $\frac{1}{x}+\frac{1}{y}+\frac{1}{z}=2$

13. **Let $f(x)$ satisfy all the conditions of Lagrange's mean value theorem in $[0,2]$. If $f(0)=0$ and $|f'(x)|\le\frac{1}{2}$ for all x in $[0,2]$, then**

A) $f(x)<\frac{1}{2}$ B) $|f(x)|\le 1$

C) $f(x)=2x$ D) $f(x)=3$ for at least one x in $[0,2]$

14. **The equation of the lines through the point (2,3) and making intercept of length 2 units between the lines $y+2x=3$ and $y+2x=5$ is**

A) $y=3$ B) $x=3$ C) $x=2$ D) $y=2$

15. **Solution of the differential equation $\frac{dy}{dx}=\frac{2x-y+1}{x+y+2}$ is**

A) $xy-y^2=2y+C$ B) $xy+y^2+2y=3x^2+C$

C) $xy+y^2=2y+3x^2+C$ D) $xy+\frac{y^2}{2}+2y=x^2+x+C$

16. $\lim_{x\to 0}\frac{\sin\left(x^{\frac{1}{3}}\right)ln(1+3x)}{\left(\tan^{-1}\sqrt{x}\right)^2\left(e^{5x^{\frac{1}{3}}}-1\right)}=$

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

17. $\int\sqrt{x+\sqrt{(x^2+1)}}$ **dx equals (where C is integration Constant) to**

A) $\frac{1}{3}\left\{x+\sqrt{x^2+1}\right\}^{\frac{3}{2}}-\left\{x+\sqrt{x^2+1}\right\}^{\frac{1}{2}}+C$ B) $\frac{1}{2}\left\{x+\sqrt{x^2+1}\right\}^{\frac{1}{2}}-\left\{x+\sqrt{x^2+1}\right\}^{\frac{-1}{2}}+C$

C) $\frac{1}{3}\left\{x-\sqrt{x^2+1}\right\}^{\frac{3}{2}}-\left\{x+\sqrt{x^2+1}\right\}^{\frac{1}{2}}+C$ D) $\frac{1}{3}\left\{x+\sqrt{x^2+1}\right\}^{\frac{3}{2}}+\left\{x+\sqrt{x^2+1}\right\}^{\frac{-1}{2}}+C$

18. **The distance of the plane passing through the point P(1,1,1) and perpendicular to the line $\frac{x-1}{3}=\frac{y-1}{0}=\frac{z-1}{4}$ from the origin is**

A) $\frac{3}{4}$ B) $\frac{3}{4}$ C) $\frac{7}{5}$ D) 1

19. **A common tangent to the conics $x^2=6y$ and $2x^2-4y^2=9$ is**

A) $x+y=1$ B) $x-y=1$ C) $x+y=\frac{9}{2}$ D) $x-y=\frac{3}{2}$

20. **The area (in sq. units) of the region** $\{(x,y)\in R^2; x^2 \le y \le 3-2x\}$ **, is**

A) $\frac{29}{3}$ B) $\frac{34}{3}$ C) $\frac{32}{3}$ D) $\frac{31}{3}$

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. 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 in all other cases.

21. If x and y are the solutions of the equation $12\sin x + 5\cos x = 2y^2 - 8y + 21$**, then the value of** $6\cot\left(\frac{xy}{2}\right) =$ _____

22. If $a_1, a_2, a_3, ..., a_{4001}$ **are terms of an A.P. such that** $\frac{1}{a_1a_2} + \frac{1}{a_2a_3} + ... + \frac{1}{a_{4000}a_{4001}} = 10$ **and** $a_1 + a_{4001} = 50$ **then** $|a_1 - a_{4001}| =$ _____

23. If $f(x) = \begin{vmatrix} x & \cos x & e^{x^6} \\ \sin^5 x & x^4 & \sec x \\ \tan^3 x & 10 & 20 \end{vmatrix}$ **, then the value of** $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} f(x)\,dx =$

24. If a tangent of slope 2 of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ **is normal to the circle** $x^2 + y^2 + 4x + 1 = 0$**, then the maximum value of** ab **is**

25. If $y(\alpha) = \sqrt{2\left(\frac{\tan\alpha + \cot\alpha}{1+\tan^2\alpha}\right) + \frac{1}{\sin^2\alpha}}$, $\alpha \in \left(\frac{3\pi}{4}, \pi\right)$ **then** $\frac{dy}{d\alpha}$ *at* $\alpha = \frac{5\pi}{6}$ **is**___

SECTION – I
(SINGLE CORRECT ANSWER TYPE)

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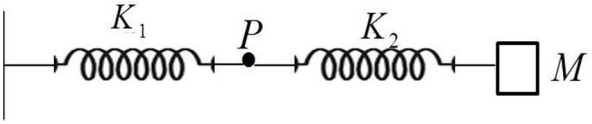
PHYSICS

26. A disc of moment of inertia I_1 **is rotating freely with an angular velocity of** ω_1**. When a second non rotating disc with moment of inertia** I_2 **is placed on the first disc, then both of them rotate with an angular velocity of**

A) $\frac{I_1\omega_1}{I_2}$ B) $\frac{I_2\omega_1}{I_2}$ C) $\frac{I_1\omega_1}{I_1+I_2}$ D) $\frac{(I_1+I_2)\omega_1}{I_2}$

27. The mass 'M' shown in the diagram oscillates in a simple harmonic motion with amplitude 'A'. The amplitude at the point 'P' is



A) $\frac{K_1A}{K_2}$ B) $\frac{K_2A}{K_1}$ C) $\frac{K_1A}{K_1+K_2}$ D) $\frac{K_2A}{K_1+K_2}$

28. 1 mole of a monoatomic gas at temperature T_0 expand slowly according to the law P^2 is proportional to T. Its final temperature is $2T_0$, then heat supplied to the gas is

A) $\frac{R}{T_0/2}$ B) RT_0 C) $\frac{3}{2}RT_0$ D) $2RT_0$

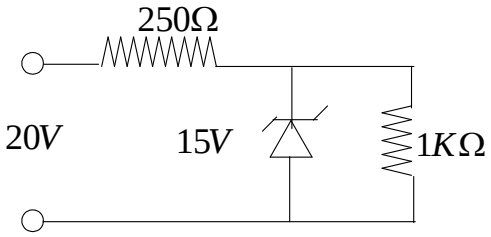
29. A charge 'q' is placed at the midpoint of the line joining two equal charges of 'Q'. The system of three charges will be in equilibrium the value of 'q' is

A) $Q/4$ B) $Q/2$ C) $-Q/4$ D) $-Q/2$

30. The activity of a sample of a radio active materials is A_1 at time t_1 and A_2 at time $t_2\ [t_2 > t_1]$ If its mean life time is T then

A) $A_1t_1 = A_2t_2$ B) $A_1 - A_2 = (t_2 - t_1)$ C) $A_1 = A_2e^{(t_2-t_1)/T}$ D) $A_2 = A_1e^{(t_2/t_1)T}$

31. A Zener diode having breakdown voltage equal to 15V is used as a voltage regulator as shown in the figure. The current through the diode is



A) 5mA B) 10mA C) 15mA D) 20mA

32. In a LCR-series circuit the voltages across R, L and C are V_R, V_L and V_C respectively, then the applied voltage is

A) $V_R + V_L + V_C$ B) $V_R + V_C - V_L$ C) $\sqrt{V_R^2 + (V_L - V_C)^2}$ D) $\sqrt{(V_R + V_L)^2 + (V_C)^2}$

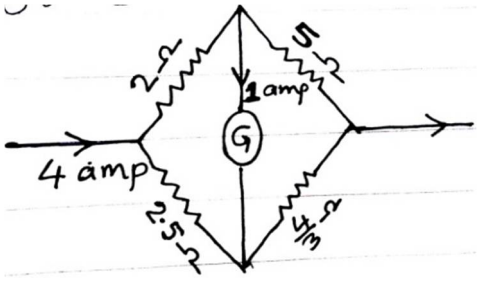
33. An electron of mass 'm' is accelerated through a potential difference of 'V' and then it enters in a magnetic field of induction 'B' normal to the lines. Then the radius of the circular path is

A) $\sqrt{\frac{2eV}{m}}$ B) $\sqrt{\frac{2Vm}{eB^2}}$ C) $\sqrt{\frac{2Vm}{eB}}$ D) $\sqrt{\frac{2Vm}{e^2B}}$

34. The critical angle of certain medium is $\sin^{-1}\left(\frac{3}{5}\right)$. The polarizing angle of the medium is

A) $\sin^{-1}\left(\frac{4}{5}\right)$ B) $\tan^{-1}\left(\frac{5}{3}\right)$ C) $\tan^{-1}\left(\frac{3}{4}\right)$ D) $\tan^{-1}\left(\frac{4}{3}\right)$

35. The resistance of the galvanometer in the Wheatstone bridge circuit shown is -----

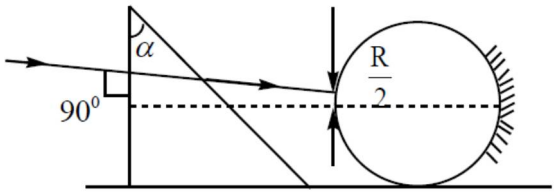


A) 2Ω B) 1Ω C) 0.5Ω D) 0.25Ω

36. A rod of length L with sides fully insulated is made of a material of thermal conductivity K that varies with temperature as $K = \frac{a}{T}$ where a is a constant. The ends of the rod are kept at temperatures T_1 and $T_2 (T_2 > T_1)$, The rate of flow of heat conduction per unit area will be -----

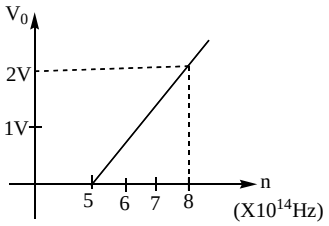
A) $\frac{a}{L}\ln\left(\frac{T_2}{T_1}\right)$ B) $\frac{a}{L^2}\ln\left(\frac{T_1}{T_2}\right)$ C) $\frac{a}{L^2}\ln\left(\frac{T_2}{2T_1}\right)$ D) $\frac{a}{L^2}\ln\left(\frac{2T_2}{3T_1}\right)$

37. A ray is incident normally on a right angle prism whose refractive index is 3 and prism angle $\alpha = 30^0$, after crossing prism ray passes through glass sphere. It strikes the glass sphere of same refractive index, at $\frac{R}{2}$ distance from principal axis, as shown in the figure, sphere is half polished. The net angle of deviation of the incident ray is



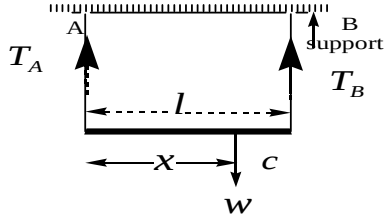
A) 180^0 B) 60^0 C) 45^0 D) 90^0

38. In an photo electric experiment, a graph drawn between stopping potential (V_0) and frequency (n) of incident radiation is shown .The threshold wavelength of photo sensitive metal used is -----



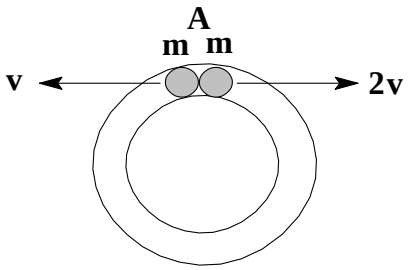
A) $4500A^0$ B) $6000A^0$ C) $5000A^0$ D) $3000A^0$

39. A light rod of length L is suspended from a support horizontally by means of two vertical wires A and B of equal length as shown in figure. The cross sectional area of A is half that of B and the young's modulus of 'A' is twice that of B. A weight W is hung as shown. The value of x so that w produces equal stress in wires A and B is



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

40. Two small particles of equal mass start moving in opposite direction from a point A in a horizontal circular orbit. Their tangential velocities are v and 2v respectively as shown in figure. Between collisions, the particles move with constant speeds along the orbit. After how many minimum elastic collisions, these two particles will again reach at point A

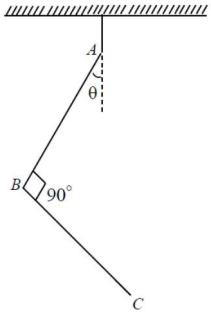


A) 4 B) 3 C) 2 D) 1

41. A loop of wire is placed in a magnetic field $\vec{B}$ = 0.02 $\hat{i}$ tesla. Then the flux through the loop is its area vector is $\vec{A}$ = 30 $\hat{i}$ + 16 $\hat{j}$ + 23 $\hat{k}$ cm², is.

A) 60 μ Wb B) 32 μ Wb C) 46 μ Wb D) 138 μ Wb

42. An *L*-shaped object, made of thin rods of uniform mass density, is suspended with a string as shown in figure (the object is in equilibrium). If *AB = BC*, and the angle made by *AB* with downward vertical is θ, then :



A) $\tan\theta = \frac{2}{\sqrt{3}}$ B) $\tan\theta = \frac{1}{3}$ C) $\tan\theta = \frac{1}{2}$ D) $\tan\theta = \frac{1}{2\sqrt{3}}$

43. Three solid spheres each of mass *m* and radius *R* are placed at three corners of an equilateral triangle of side ' *d* ' released. The speed of any one sphere at the time of collision would be $(d > 2R)$ [Assume there is no external gravitational force acting on the system of three spheres].

A) $\sqrt{Gm\left(\frac{1}{d}-\frac{3}{R}\right)}$ B) $\sqrt{Gm\left(\frac{3}{d}-\frac{1}{R}\right)}$ C) $\sqrt{Gm\left(\frac{2}{R}-\frac{1}{d}\right)}$ D) $\sqrt{Gm\left(\frac{1}{R}-\frac{2}{d}\right)}$

44. A screw gauge has a screw having 2 threads in 1mm. The circular scale has 50 divisions. Find the diameter of wire, if the main scale shows 6th division and the circular reads 4

A) 6.46mm B) 3.46mm C) 6.54mm D) 3.04mm

45. To know the resistance G of a galvanometer by half deflection method, a battery of emf VE and resistance R is used to deflect the galvanometer by angle θ. If a shunt of resistance S is needed to get half deflection then G, R and S are related by the equation:

A) 2S(R+G)=RG B) S(R+G)=RG C) 2S=G D) 2G=S

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers.
Marking scheme: +4 for correct answer, 0 in all other cases.

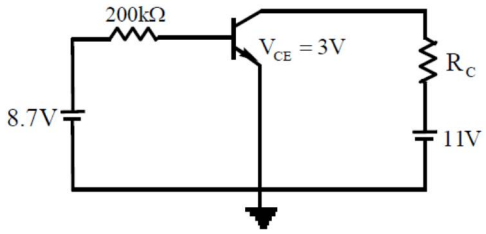
46. The electric field of plane electromagnetic wave of amplitude 2V m varies with time, propagating along *z* -axis . The average energy density of magnetic field $\left(in\ J/m^3\right)$ is equal to $x\times10^{-12}\ J/m^3$. Then 'x' value is equal to $\left(\in_0 = 8.854\times10^{-12}\ F/m\right)$.

47. A boy riding on his bike is going towards east at a speed of $4\sqrt{2}$ m/s. At a certain point, he produces a sound pulse of frequency 1650Hz that travels in air at a speed of 334m s . A second boy stands on the ground 45^0 south of east from him. The frequency of the pulse as received by the second boy is (in Hz).

48. Sun radiates thermal radiation with maximum intensity at the wavelength $\lambda = 0.5\mu m$ while its surface temperature is 6000K. If sun cools down to a temperature where it emits only 81%of its present power, the maximum intensity will then be emitted at wavelength λ' (in micro metre)is equal to $\left[\sqrt{10} = 3.1622\right]$.

49. **Water flows into a large tank with flat bottom at the rate of $10^{-4} m^3/s$. Water is also leaking out of a hole of area 1cm^2 at its bottom. If the height of the water in the tank remains steady, then this height (in cm) is : $\left(take\ g = 9.8 m/s^2\right)$.**

50. **In the shown common emitter amplifier circuit, $\beta = 80, V_{BE} = 0.7\ volt$. The value of R_C is _____ $k\Omega$ [Given $V_{CE} = 3V$]**



SECTION – I
(SINGLE CORRECT ANSWER TYPE)

This section contains 20 multiple choice questions. Each question has 4 options (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** option can be correct.
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CHEMISTRY

51. **Which of the following has highest second ionization potential?**
A) He B) Li C) Na D) Rb

52. **The hybridizations in amide bond are.**
A) sp^2, sp^2 B) sp^3, sp^3 C) sp^3, dsp^2 D) sp^2, sp^3

53. **The redox reaction among these:**
A) $CaCO_3 \xrightarrow{\Delta} X$ B) $NH_3 + HCl \rightarrow Y$
C) Formation of ionic bond D) Precipitation reaction

54. **The correct statements among these:**
I) Dipole moment of $CH_4 > CH_3Cl$

II) Intramolecular hydrogen bonding is present in ortho fluoro phenol

III) Hybridization in $\left[Ni(CN)_4\right]^{-2}$ is dSp^2

IV) CO is neutral oxide while CO_2 is a weakly acidic oxide
A) I, II B) I, III, IV C) II, III, IV D) I, II, III, IV

55. **How many sodium ions are exchanged during removal of hardness of water containing $CaCl_2$ (2 molecules)?**
A) 0 B) 4 C) 2 D) 1

56. **The correct statements about electron are:**

I) It has an antiparticle called positron
II) coulomb of charge accounts for 6.24×10^{18} electrons

III) e/m of electron is highest among fundamental particles discovered initially

IV) from Bohr's model one can easily predict the distance of electron from the nucleus.

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

57. **The gas with highest percentage in producer gas is**
A) N_2 B) O_2 C) CO D) H_2

58. Match the following:

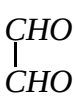
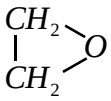
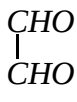
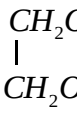
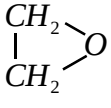
Column – I	**Column – II**
A) Orthosilicate	**P) Solid CO_2**
B) Inorganic benzene	**Q) SiC**
C) Carborundum	**R)** $B_3N_3H_6$
D) Dry ice	**S)** SiO_4^{4-}

A) A – P, B – Q, C – R, D – S B) A – S, B – P, C – R, D – Q
C) A – S, B – R, C – Q, D – P D) A – S, B – Q, C – R, D – P

59. $CaC_2 \xrightarrow{H_2O} X \xrightarrow{K_2Cr_2O_7/H_2SO_4} Y \xrightarrow[\Delta]{NaOH/CaO} Z$. What are X, Y and Z.

	X	**Y**	**Z**
A)	$Ca(OH)_2$	CH_3COOH	C_2H_6
B)	C_2H_2	$C_2H_4(OH)_2$	C_2H_6
C)	C_2H_2	CH_3COOH	C_2H_6
D)	C_2H_2	CH_3COOH	CH_4

60. $C_2H_2 + O_3 \xrightarrow{Zn/H_2O} A \xrightarrow{LiAlH_4} B \xrightarrow{H_2O} C$ **. What are A, B and C?**

	A	B	C
A)	$HCHO$	$HCOOH$	CO
B)	$HCHO$	HCOOH	CO_2
C)			
D)			

61. The electrophile that attacks benzene ring during the formation acetophenone is
A) CH_3^+ B) CO^+ C) $CH_3CO_2^+$ D) CH_3CO^+

62. Two open beakers containing a solvent and the other containing a mixture of that solvent and a non volatile solute together are sealed in a container, over time. The correct statement among these:
A) The volume of the solution and solvent does not change
B) The volume of the solution does not change but solvent changes
C) The volume of the solution decreases while that of solvent increases
D) The volume of the solution increases while that of solvent decreases.

63. The incorrect statements among I – IV are
I) Octahedral complexes with strong filed ligands have very high magnetic moments
II) When $\Delta_0 < P$ the d- electro configuration of $Co(III)$ in an octa hedral complex is $t_{2g}^4 e_g^2$
III) Wavelength of light absorbed by $\left[Co(en)_3\right]^{3+}$ is lower than that of $\left[CoF_6\right]^{3-}$.
IV) If the Δ_0 for the octahedral complex $Co(III)$ is 18000 cm^{-1}, the Δ_t for its tetrahedral complex is 16000 cm^{-1}.
A) I and IV only B) III and IV only C) II and III only D) I and II only

64. The refining method used when the metal and the impurities have low and high melting temperatures, respectively is
A) Distillation B) Liquation C) Vapor phase refining D) Zone refining

65. Given that the standard potentials (E^0) of Cu^{+2}/Cu and Cu^+/Cu are 0.34 V and 0.522 V respectively, the E^0 for Cu^{+2}/Cu^+ is _____
A) $-0.182V$ B) $+0.158V$ C) $-0.158V$ D) $+0.182V$

66. The group reagent to identify III group Cations in qualitative analysis is____

A) dilHCl B) dilHCl C) $NH_4Cl_{(s)} + NH_4OH_{(aq)}$ D) $K_2HgI_4 + KOH$

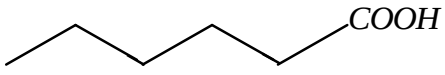
67. Which of the following compounds undergo similar type of substitution reactions (SN^1)

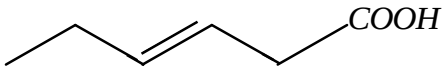
I) C_2H_5Cl **II)** $(CH_3)_3CCl$ **III)** $(C_2H_5)_3CCl$ **IV)** $(CH_3)_2CHCl$

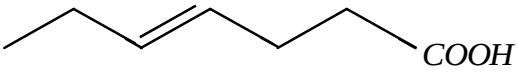
A) I,II B) II, III C) III, IV D) I, IV

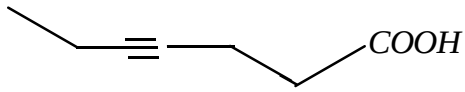
68. What is the product of the following reactions?

Hex – 3- ynal $\xrightarrow[(2)PBr_3(3)Mg/ether \\ (4)CO_2/H_3O^+]{(1)\,NaBH_4} ?$

A) 

B) 

C) 

D) 

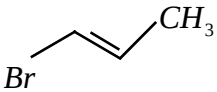
69. Match the following:

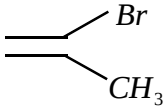
Column – I	**Column – II**
A) Riboflavin	**P) Beriberi**
B) Thiamine	**Q) Scurvy**
C) Pyridoxine	**R) Cheilosis**
D) Ascorbic acid	**S) Convulsions**

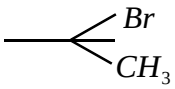
A) A – P, B – Q, C – R, D – S B) A – Q, B – P, C – R, D – S

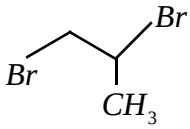
C) A – P, B – Q, C – S, D – R D) A – R, B – P, C – S, D – Q

70. 1- methyl ethylene oxide when treated with an excess of HBr produces:

A) 

B) 

C) 

D) 

SECTION-II
(Numerical Value Answer Type)

This section contains 5 questions. The answer to each question is a Numerical values comprising of positive or negative decimal numbers. .
Marking scheme: +4 for correct answer, 0 in all other cases.

71. The number of chiral carbons in chloramphenicol is_____

72. When $\Delta H = 30Kcal$ **and** ΔS **is 100 Cal. Find T =_____ K.**

73. The number of ideal solutions (1) $HCl_{(aq)} + NaOH_{(aq)}$ **(2)** $C_2H_5OH + H_2O$**. (3) n- Hexane and n-heptane (4) Chlorobenzene + Bromobenzene**

74. How many of the following have first order kinetics?

(1) $^{226}_{88}Ra \rightarrow ^{222}_{86}Rn + ^{4}_{2}He$ **(2)** $2N_2O_5 \rightarrow 2N_2O_4 + O_2$

(3) $2H_2O_2 \rightarrow 2H_2O + O_2$ **(4)** $2NH_3 \xrightarrow{Au} N_2 + 3H_2$

75. The number of resonating structures of ClO_4^- **ion is _____.**

*****

MELUHA INTERNATIONAL SCHOOL
HYDERABAD

SR MPC | **JEE MAINS GT–4** | **Date: 07-07-2020**
Time: 3 Hours | **Max. Marks: 300**

KEY SHEET

MATHEMATICS

1) **A**	2) **D**	3) **C**	4) **B**	5) **B**	6) **D**	7) **C**	8) **A**	9) **B**	10) **B**
11) **B**	12) **A**	13) **B**	14) **C**	15) **D**	16) **D**	17) **A**	18) **C**	19) **D**	20) **C**
21) **2.50**	22) **30**	23) **0**	24) **4**	25) **4**					

PHYSICS

26) **C**	27) **D**	28) **D**	29) **C**	30) **C**	31) **A**	32) **C**	33) **B**	34) **B**	35) **B**
36) **A**	37) **A**	38) **B**	39) **C**	40) **C**	41) **A**	42) **B**	43) **D**	44) **D**	45) **A**
46) **8.85**	47) **1670**	48) **0.53**	49) **5.10**	50) **2.50**					

CHEMISTRY

51) **B**	52) **D**	53) **C**	54) **C**	55) **B**	56) **D**	57) **A**	58) **C**	59) **D**	60) **D**
61) **D**	62) **B**	63) **A**	64) **A**	65) **B**	66) **C**	67) **B**	68) **D**	69) **D**	70) **D**
71) **2**	72) **300**	73) **2**	74) **3**	75) **4**					

HINTS & SOLUTIONS
MATHS

1. Given $\left|\bar{a}\right|=\left|\bar{b}\right|=\left|\bar{c}\right|=1,\left(\bar{a},\bar{b}\right)=90^0$ and

$\left(\bar{c},\bar{a}\right)=\left(\bar{c},\bar{b}\right)=\theta$

And $\bar{c}=x\bar{a}+y\bar{b}+z\left(\bar{a}\times\bar{b}\right)$

Consider dot product with $\bar{a}$

$\therefore \cos\theta = x$

Similarly we get $\cos\theta = y$

Now

$\left|\bar{c}\right|^2 = x^2a^2+y^2b^2+z^2\left(\bar{a}\times\bar{b}\right)^2+0+0+0$

$\Rightarrow 1=x^2+y^2+z^2$

$\Rightarrow 1=2\cos^2\theta+z^2$

$\Rightarrow z^2=1-2x^2$

2. $\left|z_1\right|=9$ is a circle with $c_1=(0,0);r_1=9$

$\left|z_2-3-4i\right|=4$ is a circle with

$c_2=(3,4);r_2=4$ $c_1c_2=5$ and

$\left|r_1-r_2\right|=5$ (i.e.,) the two circles touches each other internally.

$\therefore$ the minimum value of $\left|z_1-z_2\right|$ is zero

3. $\left(x+\frac{1}{x}\right)^{10}\left(x-\frac{1}{x}\right)^9=\left(x+\frac{1}{x}\right)\left(x^2-\frac{1}{x^2}\right)^9$

$=\left(x+\frac{1}{x}\right)\sum_{r=0}^{9}(-1)^r\,9c_r.\left(x^2\right)^{9-r}.\left(\frac{1}{x^2}\right)^r$

$=\left(x+\frac{1}{x}\right)\sum_{r=0}^{9}(-1)^r.9c_r.x^{18-4r}$

$\therefore$ The coeff. of x^5 is

$0+(-1)^3.9c_3=-9c_3$.

4. P (number chosen is odd) $=\frac{3}{5}$

P(number chosen is even) $=\frac{2}{5}$

$ab+c$ *is even* $\begin{cases} a,b,c \text{ are all odd} \\ c \text{ is even atleast } a \text{ or } b \text{ is even} \end{cases}$

E: $(ab+c)$ is even note that even E can be divided in two cases

E_1 : all the three numbers a, b, c are odd

$\therefore P(E_1)=\left(\frac{3}{5}\right)^3=\frac{27}{125}$

E_2 : 'c' is even and atleast one of a (or) b is even

$P(E_2)=\frac{2}{5}\left(1-\frac{9}{25}\right)=\frac{2}{5}.\frac{16}{25}=\frac{32}{125}$

$\therefore P(E)=P(E_1 \text{ or } E_2)$

$=P(E_1)+P(E_2)=\frac{59}{125}$

5. $\left|adj\left(adj\left(adj\left(adjA\right)\right)\right)\right|=$

$\left|A\right|^{16}=4^8.5^{16}=(2.5)^{16}=10^6$

$\therefore \left|A\right|=10\Rightarrow x+y+z=10$ and

$x,y,z\in n$

$\therefore$ No. of (x,y,z) are

$(10-1)c_{3-1}=9c_2=36$

6. $\sim\left(\sim s\vee\left(\sim r\wedge s\right)\right)=s\wedge\sim\left(\sim r\wedge s\right)$

$=s\wedge\left(r\vee\sim s\right)$

$=\left(s\wedge r\right)\vee\left(r\wedge\sim s\right)$

$=\left(s\wedge r\right)\vee(\text{contradiction})$

$=\left(s\wedge r\right)$

7. $4\in A$, but $(4,4)\notin R\Rightarrow$ not reflexive

8. $\frac{1^2+2^2+.....+n^2}{n}-\left(\frac{1+2+3+.....+n}{n}\right)^2$

$=10$

$\Rightarrow n=11$

$V\left(2,4,6,.....,2m\right)=16$

$\Rightarrow V\left(1,2,3,.....,m\right)=4$

$\Rightarrow \frac{m^2-1}{12}=4\Rightarrow m^2-1=48\Rightarrow m=7$

$\therefore m+n=18$

9. Forming six-digit number by given five digits.

$\therefore$ The sixth blank can be repeat digit it can be selected in $5C_1$ ways

$\therefore$ the no. of numbers is $\frac{5c_1.6!}{2!}=1800$

10. $\alpha+\beta=1;\quad \alpha\beta=-1$

$\alpha^2+\beta^2=3=p_2$

$\alpha^3+\beta^3=4=p_3$

$\therefore \quad \alpha^4+\beta^4=7=p_4$

$\alpha^5+\beta^5=\left(\alpha^2+\beta^2\right)\left(\alpha^3+\beta^3\right)$

$-\alpha^2\beta^2\left(\alpha+\beta\right)$

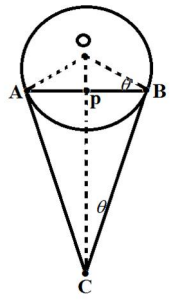
$=\left(3.4\right)-\left(-1\right)^2\left(1\right)=12-1=11$

$\therefore \quad p_5=11.$

(1) $p_2.p_3=3.4=12\neq p_5$

(2) $1+3+4+7+11=26$

11.



Here $OB=OA=5$ (radius of circle)

$OP=\sqrt{\left(2-0\right)^2+\left(3-0\right)^2}=\sqrt{3}$

$Let\angle OBP=\theta, then\angle PCB=\theta$

From $\Delta OPB, \cos\left(90-\theta\right)=\frac{OP}{OB}=\frac{\sqrt{13}}{5}$

$\Rightarrow \cot\theta=\frac{2\sqrt{3}}{\sqrt{13}}=\frac{BC}{5}$

Area of quadrilateral

$OACB=2\times\frac{1}{2}\times OB\times BC$

$=50\sqrt{\frac{3}{13}}$

Therefore, the correct answer is (2).

12. Here $\overrightarrow{AB}=\overrightarrow{OB}-\overrightarrow{OA}=x\hat{i}-y\hat{j}$

$\overrightarrow{AC}=\overrightarrow{OC}-\overrightarrow{OA}=x\hat{i}-z\hat{k}$

$\overrightarrow{AD}=\overrightarrow{OD}-\overrightarrow{OA}=\left(x-1\right)\hat{i}-\hat{j}-\hat{k}$

As these vectors are coplanar,

$$\begin{vmatrix} x & -y & 0 \\ x & 0 & -z \\ x-1 & -1 & -1 \end{vmatrix}=0$$

$\Rightarrow \frac{1}{x}+\frac{1}{y}+\frac{1}{z}=1$

Therefore, the correct answer is (1).

13. By using Lagrange's mean value theorem, $\frac{f\left(b\right)-f\left(a\right)}{b-a}=f'\left(x\right)$

$\Rightarrow \frac{f\left(2\right)-f\left(0\right)}{2-0}=f'\left(x\right)$

$\Rightarrow \frac{df\left(x\right)}{dx}=\frac{f\left(2\right)}{2}$

$\therefore f\left(x\right)=\frac{f\left(2\right)}{2}x \quad .....(1)$

Also, $\left|f'\left(x\right)\right|\leq\frac{1}{2}$

$\Rightarrow \frac{\left|f\left(2\right)\right|}{2}\leq\frac{1}{2}$

From Eq. (1),

$\left|f\left(x\right)\right|=\left|\frac{f\left(2\right)}{2}x\right|=\left|\frac{f\left(2\right)}{2}|x|\right|\leq\frac{1}{2}|x|$

In interval $\left[0,2\right]$, for maximum value of x take $x=2$

$\left|f\left(2\right)\right|\leq\frac{1}{2}.2$

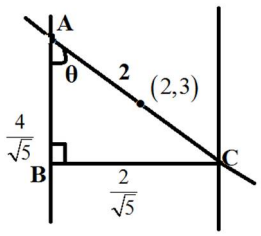
$\Rightarrow\left|f\left(2\right)\right|\leq 1$

Therefore, the correct answer is (2).

14. As the lines are parallel, distance between them $= \frac{|5-3|}{\sqrt{4}+1} = \frac{2}{\sqrt{5}} = BC$

$\therefore AB = \sqrt{4-\frac{4}{5}} = \frac{4}{\sqrt{5}}$

From $\Delta ABC, \tan\theta = \frac{\left(\frac{2}{\sqrt{5}}\right)}{\left(\frac{4}{\sqrt{5}}\right)} = \frac{1}{2}$



Slope of the given line is 2.

Let m_1 be the slope of the required line

Now $\tan\theta = \frac{1}{2} = \left|\frac{m_1+2}{1-2m_1}\right|$

$\Rightarrow \left|\frac{m_1+2}{1-2m_1}\right| = \pm\frac{1}{2}$

Consider $\frac{1}{2} = \frac{m_1+2}{1-2m_1}$

$\Rightarrow 1-2m_1 = 2m_1+4$

$\Rightarrow 4m_1 = -3$

$\Rightarrow m_1 = -\frac{3}{4}$

Similarly by taking $-\frac{1}{2}$, other value of m_1 is undefined.

The equation of the line having slope m and Passing through the point (x_1, y_1) is

$y - y_1 = m(x - x_1)$

$\Rightarrow y-3 = -\frac{3}{4}(x-2)$ *and* $y-3 = \frac{1}{0}(x-2)$

$\therefore$ Equations to the required lines are $3x+4y-18=0$ *and* $x=2$

Therefore, the correct answer is (3).

15. Given that $\frac{dy}{dx} = \frac{2x-y+1}{x+y+2}$

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

$\Rightarrow d(xy) + (y+2)\,dy = 2x\,dx + dx$

Integrating on both sides

$\Rightarrow xy + \frac{y^2}{2} + 2y = x^2 + x + C$

Therefore, the correct answer is (4).

16. $\lim_{x\to 0} \frac{\sin\left(x^{\frac{1}{3}}\right) In(1+3x)}{\left(\tan^{-1}\sqrt{x}\right)^2\left(e^{5x^{\frac{1}{3}}}-1\right)}$

$$\lim_{x\to 0}\left(\frac{3.x.x^{\frac{1}{3}}}{5.x.x^{\frac{1}{3}}}\right)\left(\frac{\left(\lim_{x\to 0}\frac{\sin\left(x^{\frac{1}{3}}\right)}{x^{\frac{1}{3}}}\right)\left(\lim_{x\to 0}\frac{In(1+3x)}{(3x)}\right)}{\left(\lim_{x\to 0}\frac{\tan^{-1}\sqrt{x}}{\sqrt{x}}\right)^2\left(\lim_{x\to 0}\frac{e^{5x^{\frac{1}{3}}}-1}{5x^{\frac{1}{3}}}\right)}\right)$$

$\left(\because \lim_{x\to 0}\frac{\sin x}{x} = 1 \text{ and } \lim_{x\to 0}\frac{In(1+x)}{x} = 1\right)$

$= \frac{3(1)(1)}{5(1)(1)}$

$= \frac{3}{5}$

Therefore, the correct answer is (1).

17. *Let* $I = \int \sqrt{x+\sqrt{x^2+1}}dx$

Let $x+\sqrt{x^2+1} = t.....(1)$

Rationalize $\Rightarrow \sqrt{x^2+1} - x = \frac{1}{t}.....(2)$

Subtract (1) & (2)

$\Rightarrow 2x = t - \frac{1}{t}$

$\Rightarrow x = \frac{1}{2}\left(t - \frac{1}{t}\right)$

Differentiating with respect to x on both sides

$dx = \frac{1}{2}\left(1+\frac{1}{t^2}\right)dt$

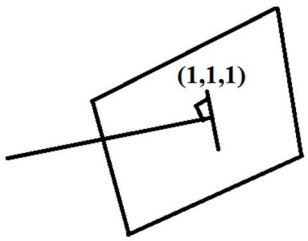
$\therefore I = \frac{1}{2}\int\left(t^{\frac{1}{2}} + t^{-\frac{3}{2}}\right)dt$

$= \frac{1}{3}t^{\frac{3}{2}} - t^{-\frac{1}{2}} + C$

$= \frac{1}{3}\left\{x+\sqrt{x^2+1}\right\}^{\frac{3}{2}} - \left\{x+\sqrt{x^2+1}\right\}^{-\frac{1}{2}} + C$

Therefore, the correct answer is (1).

18. Equation of the plane is $a(x-1)+b(y-1)+c(z-1) = 0.....(1)$



Since the line is perpendicular to the plane (1)

$\therefore 3(x-1)+0(y-1)+4(z-1)=0$

$\Rightarrow 3x+0y+4z-7=0.....(2)$

Distance from origin (0, 0, 0) to equation (2) is

$$d=\frac{|ax_1+by_1+cz_1+d|}{\sqrt{a^2+b^2+c^2}}$$

$$\therefore d=\left|\frac{-7}{5}\right|=\frac{7}{5}$$

Therefore, the correct answer is (3).

19. *Let* $y=(mx+c)$ is tangent to $x^2=6y$

$\Rightarrow x^2=6(mx+c)$

So, $x^2-6mx-6c=0$

Put $D=b^2-4ac=0$

$$\Rightarrow c=\frac{-3}{2}m^2$$

$$\therefore \text{ We get } y=mx-\frac{3}{2}m^2.....(1)$$

And given by hyperbola equation is $2x^2-4y^2=9$

$$\Rightarrow \frac{x^2}{\frac{9}{2}}-\frac{y^2}{\frac{9}{4}}=1.....(2)$$

Since, equation (1) is a tangent of equation (2) then $c^2=a^2m^2-b^2$

$m=\pm 1$

$\therefore$ for $m=1$, equation of tangent is $x-y=\frac{3}{2}$

Therefore, the correct answer is (4).

20. Area $=\int_{-3}^{1}\left(3-2x-x^2\right)dx=\frac{32}{3}$ *sq.units*

21. $12\sin x+\cos x=2\left(y^2-4y+4\right)+13$

$=2(y-2)^2+13$

The max. value of L.H.S is 13

And min. value of RHS is 13

So equality holds if both are equal to 13

$\therefore y=2$ and $12\sin x+5\cos x=13$

$$\Rightarrow \frac{12}{13}\sin x+\frac{5}{13}\cos x=1$$

$\Rightarrow \cos(x-\alpha)=1,$ where

$$\alpha=\tan^{-1}\frac{12}{5}$$

$\therefore x-\alpha=2n\pi$

$\Rightarrow x=2n\pi+\alpha$

$$\therefore 6\cot\left(\frac{xy}{2}\right)=6\cot(x)=6\cot(2n\pi+\alpha)$$

$=6\cot\alpha$

$$=6\times\frac{5}{12}=\frac{5}{2}=2.50$$

22. $$\frac{1}{d}\left[\frac{a_{4001}-a_1}{a_1a_{4001}}\right]=10$$

$$\frac{4000}{a_1\ a_{4001}}=10\Rightarrow a_1.a_{4001}=400$$

$a_1+a_{4001}=50$

$\therefore (a_1+a_{4001})^2-(a_1-a_{4001})^2=4a_1a_{4001}$

$\Rightarrow |a_1-a_{4001}|=30$

23. Given that $f(x)=\begin{vmatrix} x & \cos x & e^{x^6} \\ \sin^5 x & x^4 & \sec x \\ \tan^3 x & 10 & 20 \end{vmatrix}$

$$\Rightarrow f(-x)=\begin{vmatrix} -x & \cos x & e^{x^6} \\ -\sin^5 x & x^4 & \sec x \\ -\tan^3 x & 10 & 20 \end{vmatrix}$$

$\Rightarrow -f(x)$

$\therefore f(x)$ is an odd function

$$\therefore \int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} f(x)\,dx=0$$

$$\left(\therefore \int_{-a}^{a} f(x)\,dx=0, when f(x) is odd\ function\right)$$

Therefore, the current answer is 0

24. Equation of tangent of $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with slope m is

$y=mx\pm\sqrt{a^2m^2+b^2}$

$\Rightarrow y=2x\pm\sqrt{4a^2+b^2}$

It is normal to the circle $x^2+y^2+4x+1=0$ hence, this tangent Passes through $(-2,0)$

$\Rightarrow 0=-4\pm\sqrt{4a^2+b^2}$

$\Rightarrow 4a^2+b^2=16$

Using Arithmetic mean (A.M.) ≥ Geometric mean (G.M.)

We get $\frac{4a^2+b^2}{2}\geq\sqrt{4a^2b^2}$

$\Rightarrow ab\leq 4$

$\therefore$ Minimum value of ab is 4

Therefore, the correct answer is 4.

25. $y(\alpha)=|1+\cot\alpha|$

$=-(1+\cot\alpha)\ \left(\because\alpha\in\left(\frac{3\pi}{4},\ \pi\right)\right)$

$\frac{dy}{d\alpha}=\cos ec^2\alpha$

$\therefore\left(\frac{dy}{d\alpha}\right)_{\alpha=\frac{5\pi}{6}}=4$

Therefore, the correct answer is 4.

PHYSICS

26. $I_1\omega_1+I_2\times 0=(I_1+I_2)\omega$

$\omega=\frac{I_1\omega_1}{I_1+I_2}$

27. $x_1+x_2=A$

$k_1x_1=k_2x_2$

$\frac{x_1}{x_2}=\frac{k_2}{k_1}$

$x_1=\frac{k_2}{k_1}x_2$

$x_2=\frac{k_1x_1}{k_2}$

$x_1+x_2=x_1+\frac{k_1x_1}{k_2}=A$

$\frac{(k_2+k_1)x_1}{k_2}=A$

$x_1=\frac{k_2A}{k_1+k_2}$

28. Given ,Number of moles=1 mole

Temperature $=T_0$

From Question

$P^2\propto T\Rightarrow P=c\sqrt{T}$, c is constant

$\therefore\frac{dP}{P}=\frac{1}{2}\frac{dT}{T}$ ……(1)

$PV=RT.....(2)$

$\Rightarrow PdV+VdP=RdT$

$\Rightarrow PdV=RdT-VdP$

$=RdT-RT.\frac{dP}{P}$

$=RdT-\frac{RT}{2}\frac{dT}{T}$ (By using(1))

$=\frac{RdT}{2}$

$\therefore\int_{T_0}^{2T_0}PdV=\int_{T_0}^{2T_0}\frac{RdT}{2}=\frac{RT_0}{2}$

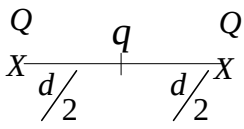
From first law of thermodynamics

$Q=\Delta U+W=nC_V\Delta T+\int PdV=\frac{3R}{2}T_0+\frac{RT_0}{2}$

$2RT_0$

Therefore, the correct answer is (D).

29.



$\frac{1}{4\pi\in_0}\frac{Q^2}{d^2}+\frac{1}{4\pi\in_0}\frac{Qq}{d^2/4}=0$

$Q^2+4Qq=0$

$4Qq=-Q^2\qquad q=\frac{-Q}{4}$

30. $A_1=A_0e^{-\lambda t_1}=A_0e^{-t_1/T}$

$A_2=A_0e^{-\lambda t_2}\Rightarrow A_0e^{-t_2/T}$

$\frac{A_1}{A_2}=e^{(t_2-t_1)/T}$

$A_1=A_2e^{(t_2-t_1)/T}$

31. $V_Z=15V$

$I_L=\frac{15}{10^3}=15mA$

$I=\frac{20-15}{250}=\frac{5}{250}=20mA$

$I_3=I-I_L=20-15=5mA$

32. Conceptual

33. $Be\vartheta = \dfrac{m\vartheta^2}{r}$

$r = \dfrac{m\vartheta}{Be}$

$m\vartheta = \sqrt{2m}\left(KE\right)$

$m\vartheta = \sqrt{2meV}\left(KE = eV\right)$

$\therefore r = \sqrt{\dfrac{2meV}{e^2B^2}} = \sqrt{\dfrac{2mV}{B^2e}}$

34. $\sin C = \dfrac{3}{5}$

$\mu = \dfrac{1}{\sin C} = \dfrac{5}{3}$

$\mu = \tan p$

$p = \tan^{-1}\left(\mu\right) = \tan^{-1}\left(\dfrac{5}{3}\right)$

35. LOOP a b c a :-

$-2I - G + \dfrac{5}{2}(4 - I) = 0$

$\Rightarrow -4.5I - G + 10 = 0$ .....(1)

Loop b d c b :-

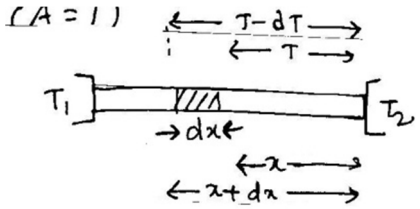
$-5(I - 1) + (5 - I)\dfrac{4}{3} + G = 0$

$\Rightarrow -5I + 5 + \dfrac{20}{3} - \dfrac{4}{3}I + G = 0$

$\Rightarrow -19I + 3G + 35 = 0$ .....(2)

Solving (1) and (2) we get G=1Ω

36. $\dfrac{d\theta}{dt} = \dfrac{K\,A\left(dt\right)}{L}$



$\dfrac{d\theta}{dt} = \dfrac{K\ dt}{dx}$ where q is rate of flow

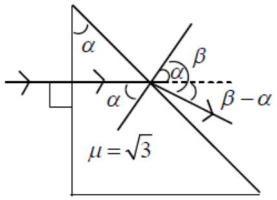
$\Rightarrow q\ dx = -\dfrac{a}{T}dT$

$\Rightarrow \int_0^L q\ dx = -a\int_{T_2}^{T_1}\dfrac{1}{T}dT$

$qL = -a\ l\,\mathrm{n}\left(\dfrac{T_1}{T_2}\right)$

$q = \dfrac{a}{L}l\,\mathrm{n}\left(\dfrac{T_2}{T_1}\right)$

37.



Given refractive index $\mu = \sqrt{3}$

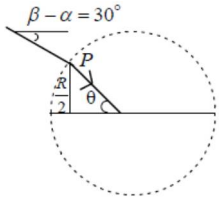
Angle of prism $\alpha = 30^0$

According to Snell's law,

$\mu \sin\alpha = 1.\sin\beta$

$\sqrt{3}\sin 30^0 = \sin\beta$

$\Rightarrow \beta = 60^0 \Rightarrow \beta - \alpha = 30^0$



$\sin\theta = \dfrac{\left(\dfrac{R}{2}\right)}{R} = \dfrac{1}{2} \Rightarrow \theta = 30^0 = \beta - \alpha$

$\therefore$ The incident ray on the sphere is directed radially.

$\therefore$ It will be reflected back and will retrace the path

$\therefore$ Angle of deviation is 180^0

Therefore, the correct answer is (A).

38. $V_0 = \left(\dfrac{h}{e}\right)v - \dfrac{hv_0}{e}$

$X-$ intercept gives threshold frequency

So from graph $v_0 = 5\times10^{14}\,Hz$

$\lambda_0 = \dfrac{C}{v_0} = \dfrac{3\times10^8}{5\times10^{14}}$

$= 0.6\times10^{-6}m = 6000\,\overset{0}{A}.$

39. $Y_A = 2Y_B; \dfrac{T_A}{A_A} = \dfrac{T_B}{A_B};$

$T_A x = T_B\left(l - x\right)$

$\dfrac{T_A}{T_B} = \dfrac{l-x}{x} = \dfrac{l}{x} - 1 \quad \left[A_A = \dfrac{A_B}{2}\right]$

$\dfrac{T_A}{T_B} = \dfrac{l}{x} - 1 \quad \left[Y_A = 2Y_B\right]$

$\dfrac{T_A}{A_A} = \dfrac{T_B}{A_B}$

$\dfrac{T_A}{T_B} = \dfrac{A_A}{A_B} = \dfrac{A_B}{2A_B} \Rightarrow \dfrac{T_A}{T_B} = \dfrac{1}{2}$

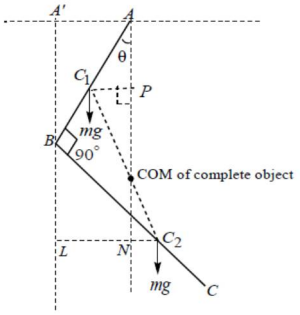
$\dfrac{l}{x} - 1 = \dfrac{1}{2} \Rightarrow x = \dfrac{2l}{3}$

Torque same at equilibrium

40. After every elastic collision velocities will be exchanged.
From starting point '2v' velocity ball covers 240^o and 'v' velocity ball covers 120^o. After collision velocity are exchanged and again they covered same angles so before meet 'A' point two collisions will be occur.

41. $\phi = \vec{B} \cdot \vec{A} = (0.02\ \hat{i}) \cdot (30\ \hat{i} + 16\ \hat{j} + 23\ \hat{k}) \times 10^{-4} = 60\ \mu$ Wb

42.



Let mass of one rod is 'm'.
Balancing torque about hinge point.

$mg(C_1P) = mg(C_2N)....(1)$

$C_1P = \frac{L}{2}\sin\theta \; and \; C_2N = C_2L - LN$

$C_2L = \frac{L}{2}\cos\theta$

$LN = AA' = L\sin\theta$

From

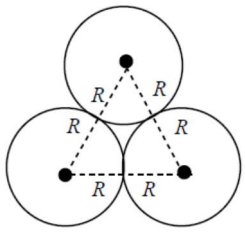
$(1) \Rightarrow mg\left(\frac{L}{2}\sin\theta\right) = mg\left(\frac{L}{2}\cos\theta - L\sin\theta\right)$

$\Rightarrow \frac{3}{2}mgL\sin\theta = \frac{1}{2}mgL\cos\theta$

$\Rightarrow \tan\theta = \frac{1}{3}$

Therefore, the correct answer is (B).

43. From conservation of mechanical energy



Energy of system at the instance of release = Energy of system at the instance of Collision

$\therefore \left[-\frac{Gm^2}{d}\right] = 3\left[-\frac{Gm^2}{2R}\right] + 3\left[\frac{1}{2}mv^2\right]$

And $v = \sqrt{Gm\left(\frac{1}{R} - \frac{2}{d}\right)}$

Therefore, the correct answer is (D).

44. Least count

$= \frac{pitch}{Number\ of\ divisions} = \frac{0.5}{50} = 0.01\ mm$

Diameter of wire

$= 6 \times 0.5 + 4 \times 0.01 = 3.04\ mm$

Therefore, the correct answer is (D).

45. Conceptual

46. 1. Given Electric Field E =2V m

$\varepsilon_0 = 8.854 \times 10^{-12}\ F/m$

Equating the average energy density of electric and magnetic field

$\langle u_B \rangle = \langle u_E \rangle$

$= \frac{1}{4}\varepsilon_0 E_0^2 = \frac{1}{4} \times 8.854 \times 10^{-12} \times (2)^2$

$= 8.85 \times 10^{-12}\ J/m^2$

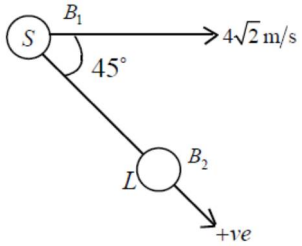
Therefore, the correct answer is 8.85.

47. 1. Speed of boy $v = 4\sqrt{2}\ m/s$

Frequency of sound pulse $v_0 = 1650 Hz$

B_1 or the first boy is the source of the sound and B_2 is the listener. v_s is the component of the velocity of the source along the source – listener axis (SL axis). Here,

$v_s = 4\sqrt{2}\cos 45^0 = 4m/s$



Using Doppler's effect formula

$v = \left(\frac{v - v_L}{v - v_A}\right)v_0$

Speed of sound in air

$v = 334 m/s, v_s = 4m/s, v_L = 0$

$v = \left(\frac{334}{334-4}\right) \times 1650 Hz = \frac{334}{330} \times 1650 Hz = 1670 Hz$

Therefore, the correct answer is 1670.

48. 1. When sun cools to the temperature T where it emits only 81%of its present radiating power, then

$\sigma T^4 = \left(\frac{81}{100}\right)\sigma(6000)^4 \left(\because E = \sigma T^4\right)$

$\Rightarrow T = \sqrt{0.9}(6000)$

$= 0.95 \times 6000 = 5700K$

2. By Wien's displacement law,

$\lambda_m T = \text{constant}$

Hence if λ_m is the required wavelength $\lambda_m(5700) = 0.5 \times 6000$

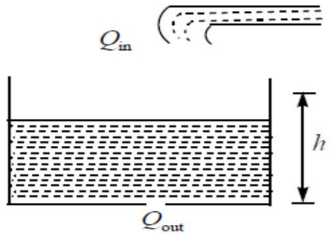
$\lambda_m = \frac{6000}{5700} \times 0.5 = \frac{10}{19} = 0.53\mu m$

Therefore, the correct answer is 0.53.

49. Given Rate of flow $Q = 10^{-4} m^3/s$

Acceleration due to gravity

$g = 9.8\ m/s^2$



Since height of water column is constant therefore, water inflow rate (Q_{in}) = water outflow rate

$Q_{in} = 10^{-4} m^3/s$

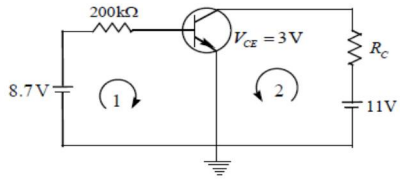
$Q_{out} = Au = 10^{-4} \times \sqrt{2gh}$

$10^{-4} = 10^{-4}\sqrt{19.6 \times h}$

$h = \frac{1}{19.6} m = 5.1cm$

Therefore, the correct answer is 5.10.

50.



Given $\beta = \frac{I_C}{I_B} = 80$

$V_{BE} = 0.7V$

Applying KVL in loop (1)

$V_{BE} = 0.7V = 8.7 - I_B(200 \times 10^3)$

$\Rightarrow I_B = \frac{8}{200 \times 10^3} = 4 \times 10^{-5} A$

$\Rightarrow \beta = 80 = \frac{I_C}{I_B} \Rightarrow I_C = 32 \times 10^{-4} A$

Applying KVL in loop (2)

$V_{CE} = 3V = 11 - I_C R_C$

$3 = 11 - 32 \times 10^{-4} R_C$

$\Rightarrow R_C = \frac{8}{32 \times 10^{-4}} \qquad \therefore R_C = 2.5k\Omega$

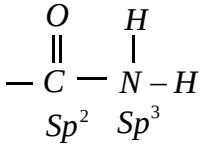
Therefore, the correct answer is 2.50.

CHEMISTRY

51. $Li^+ \xrightarrow{I_2} Li^{2+} + e^-$ highest among all the elements as it has to lose $1s^2$ electrons (due to He configuration).

$He \quad IP_1 = +2373kJ \qquad IP_2 = +5251KJ$

$Li \quad IP_1 = +520kJ \qquad IP_2 = +7300\ kJ$



52. Amide bond

53. Formation of ionic bond

$\overset{\text{Red}}{Na} + \overset{0}{Cl} \rightarrow \overset{+}{Na}\overset{}{Cl}^-$

$\overset{0}{\quad} \quad \overset{\text{OX}}{\quad}$

. Redox reaction

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$ Non- Redox (No- change in oxidation number)

$NH_3 + HCl \rightarrow NH_4Cl$ Non- Redox (No – change in oxidation number)

$AgNO_3 + NaCl \rightarrow AgCl \downarrow + NaNO_3$ Non-redox (Precipitation reaction) (No- change in oxidation number)

54. I is a wrong statement

$^{\mu}CH_4 < ^{\mu} CH_3Cl$ but given is

$^{\mu}CH_4 > ^{\mu} CH_3Cl$

55. Calgon $Na_2\ [Na_4(PO_3)_6] + 2CaCl_2$

$\rightarrow Na_2[Ca_2(PO_3)_6] + 4NaCl$

56. a) $^0_{-1}\beta$ or $^0_{-1}e$ for electron an opposite particle $^0_{+1}\beta$ or $^0_{+1}e$ positron

b) Charge of electron is 1.602×10^{-19}

Coulombs $\frac{1}{1.62 \times 10^{-19}} = 6.24 \times 10^{18}$ electrons

c) e/m among the first discovered fundamental particles electron has lightest mass hence has highest e/m

$\frac{1.602 \times 10^{-19}}{9.11 \times 10^{-28}} = 1.758 \times 10^8$ c/g

$= 1.758 \times 10^{11} c/kg$

d) $r_n = \frac{0.529}{z} \times n^2\ A^0$

57. Produce gas composition: Co-33% N_2 - 64% $CO_2 and\ H_2 = 3\%$

58.

Orthosilicate - SiO_4^{4-}	A –s
Inorganic benzene - $B_3N_3H_6$	B – r
Carborundum - SiC	C –q
Dry ice – solid CO_2	D - p

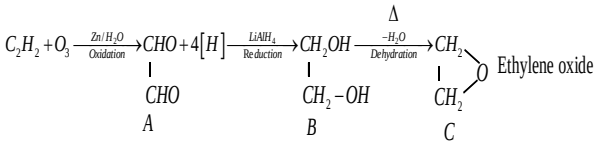
59. $CaC_2 + H_2O \rightarrow Ca(OH)_2 + C_2H_2(X).$

$C_2H_2 + [O] + H_2O \xrightarrow{K_2Cr_2O_7 + H_2SO_4} CH_3COOH(Y)$

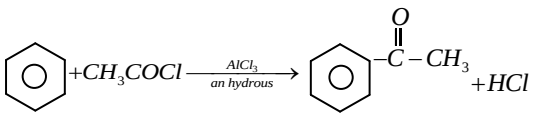
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$CH_3COONa \rightarrow NaOH \xrightarrow[\Delta]{CaO} CH_4(Z) + Na_2CO_3$

60.



61.



Acetophenone

$CH_3COCl + AlCl_3 \rightarrow CH_3CO^+ + [AlCl_4]^-$

Electrophile (acyliumion)

62. Solvent evaporates more than solution condensation of solvent into solution takes place. Hence volume of solution increases while solvent decreases.

63. a) Strong field ligand pairs up electrons hence it has zero magnetic moment but given high magnetic moment hence incorrect.

b) $\Delta_f = \frac{4}{9}\Delta_0 = \frac{4}{9} \times 18,000 = 8,000\ cm^{-1}$ but given 16000 cm^{-1} hence (incorrect)

64. Difference in melting temperatures reflects liquation technique for refining process.

65. Apply $\Delta G^0 = -nFE^0$

$-n_3FE_3^0 = -n_1FE_1 - (n_2FE_2^0)$

$-1 \times FE_3^0 = (-2 \times F \times 0.34)V - (-1 \times F \times 0.522)V$

$-FE_3^0 = -0.68FV + 0.522FV$

$-FE_3^0 = -0.158FV$

$E_3^0 = \frac{-0.158FV}{-F} = +0.158V$

66. III group reagent is $NH_4Cl_{(s)} + NH_4OH_{(aq)}$

67. B, C are 3^0 – alkyl halides undergo SN^1 – mechanism

68. $CH_3 - CH_2 - C \equiv C - CH_2 - CHO \xrightarrow{(1)NaBH_4}$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2OH$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2OH \xrightarrow{PBr_3}$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2Br + H_3PO_3$

$CH_3 - CH_2 - C \equiv C - CH_2CH_2Br + Mg \xrightarrow{ether}$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2 - Mg - Br$

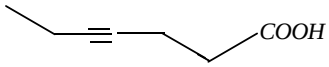
$CH_3 - CH_2 - C \equiv C - CH_2CH_2Mg - Br \xrightarrow{CO_2}$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2 - COOMgBr$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2 - COOMgBr + H_2O \xrightarrow{H^+}$

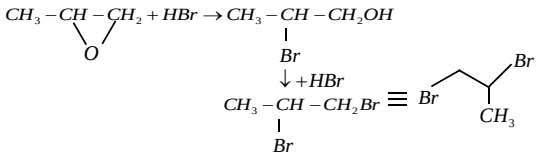
$CH_3CH_2 - C \equiv C - CH_2 - CH_2 - COOH + Mg(OH)Br$

$CH_3 - CH_2 - C \equiv C - CH_2 - CH_2 - COOH$

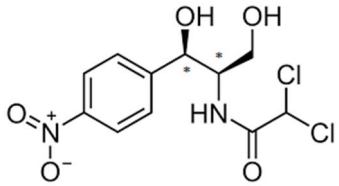
$\equiv$ 

69. Riboflavin – Cheilosis
Thiamine - Beriberi
Pyridoxine - Convulsions
Ascorbic acid - Scurvy

70. 1- methyl ethylene oxide is



71. Chloramphenicol



72. $T = \frac{\Delta H}{\Delta S} = \frac{30000}{100} = 300K = 300.00$

73. Ideal solutions are (3) n- Hexane + n – Heptane (4) chlorobenzene + bromobenzene

74. $^{226}_{86}Ra \rightarrow ^{222}_{86}Ra + ^4_2He$ radioactive decay ;

rate $= K[Ra]^1$

$2N_2O_5 \rightarrow 2N_2O_4 + O_2 \quad rate = K[N_2O_5]^1$

$2H_2O_2 \rightarrow 2H_2O + O_2 \quad rate = K[H_2O_2]^1$

$2NH_3 \xrightarrow{Au} N_2 + 3H_2$ rate $= K[NH_3]^0$

75. $I \equiv V$ are identical.

$\therefore$ I, II,III and IV are resonating structures

*****

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