MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC | **MAINS MODEL – GT-III** | **Date: 25-05-2020**

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. If $I_1 = \int_0^{\pi} \frac{x.\sin x}{1+\cos^2 x}dx$, $I_2 = \int_0^{\pi} x\sin^4 x dx$ then $I_1 : I_2$ is equal to

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

02. $\bar{a} = \bar{i} + \bar{j}, \bar{b} = \bar{i} - \bar{j} + \bar{k}$ and $\bar{c}$ be a vector that $\bar{a} \times \bar{c} - \bar{b} = \bar{0}$ and $\bar{a}.\bar{c} = 7$, then $\left|\bar{c}\right|^2 =$

A) 26 B) 29 C) 52 D) $\frac{19}{2}$

03. The first term of a sequence of numbers is $a_1 = 5$. Succeeding terms are defined by relation $a_n = a_{n-1} + (n+1)2^n \ \forall n \geq 2$, then the value of a_{50} is

A) $52.2^{51} + 1$ B) $52.2^{51} - 4$ C) $50.2^{51} - 4$ D) $50.2^{51} + 1$

04. $\sum_{r=1}^{100} \frac{r.100C_r}{100C_{r-1}} =$

A) 100 B) 4950 C) 5050 D) 5151

05. $(p \wedge q) \vee (\sim p) \vee (p \wedge \sim q)$ is true

A) only is p & q are true
B) only is p & q all false
C) p and q can be anything
D) only is p is true & q is false

06. Let $f(x) = \begin{vmatrix} 1 & 1 & 1 \\ 3-x & 5-3x^2 & 3x^3-1 \\ 2x^2-1 & 3x^5-1 & 7x^8-1 \end{vmatrix}$. Then the equation $f(x) = 0$ has

A) No real root
B) atmost one real roots
C) atleast 2 real roots
D) equation one real root in $(0,1)$ and no other real root

07. Consider points $P(1,1,-1)$, $Q(1,-1,1)$ and a variable point R on the line $\vec{r} = \hat{j} + \lambda(\hat{k} + \hat{i})$ (λ is a real parameter) then least area of ΔPQR is

A) $\sqrt{\frac{2}{3}}$ B) $\sqrt{\frac{6}{3}}$ C) $\sqrt{\frac{8}{3}}$ D) $\frac{\sqrt{3}}{4}$

08. the sum of the rational terms in the binomial expansion of $\left(2^{\frac{1}{5}}+\sqrt{3}\right)^{20}$ is

A) 71 B) 85 C) 97 D) none of these

09. Positive value of 'a' so that the definite integral $\int_{a}^{a^2}\frac{dx}{x+\sqrt{x}}$ achieves the smallest value is

A) $\tan^2\frac{\pi}{8}$ B) $\tan^2\left(\frac{2\pi}{8}\right)$ C) $\tan^2\left(\frac{\pi}{12}\right)$ D) 0

10. $\int\frac{x\,dx}{\sqrt{1+x^2+\sqrt{\left(1+x^2\right)^3}}}$ is equal to

A) $\frac{1}{2}\ln\left(1+\sqrt{1+x^2}\right)+c$ B) $2\sqrt{1+\sqrt{1+x^2}}+c$

C) $2\left(1+\sqrt{1+x^2}\right)+c$ D) None of the above

11. If the variance of 1,2,3,4,5,....10 is $\frac{99}{12}$, then the standard deviation 3,6,9,12,.....30 is

A) $\frac{3}{2}\sqrt{33}$ B) $\sqrt{33}$ C) $\frac{\sqrt{33}}{2}$ D) none of these

12. Let A and B be two points on the hyperbola $31x^2-29y^2=1$ such that the chord AB subtends a right angle at O, the centre of hyperbola then $\frac{1}{OA^2}+\frac{1}{OB^2}=$

A) 1 B) 4 C) 10 D) 2

13. $\int\frac{(2x+1)}{\left(x^2+4x+1\right)^{3/2}}dx=$

A) $\frac{x^3}{\left(x^2+4x+1\right)^{1/2}}+C$ B) $\frac{x}{\left(x^2+4x+1\right)^{1/2}}+C$

C) $\frac{x^2}{\left(x^2+4x+1\right)^{1/2}}+C$ D) $\frac{1}{\left(x^2+4x+1\right)^{1/2}}+C$

14. Perpendicular are drawn from points on the line $\frac{x+2}{2}=\frac{y+1}{-1}=\frac{z}{3}$ to the plane $x+y+z=3$. The feet of perpendicular lies on the line

A) $\frac{x}{5}=\frac{y-1}{8}=\frac{z-2}{-13}$ B) $\frac{x}{5}=\frac{y-1}{8}=\frac{z-2}{13}$

C) $\frac{x}{4}=\frac{y-1}{3}=\frac{z-2}{-7}$ D) $\frac{x}{2}=\frac{y-1}{-7}=\frac{z-2}{5}$

15. An ellipse is inscribed in a circle such that major axis of ellipse lies along diameter of the circle and ratio of their areas 1:3 then the eccentricity of the ellipse is

A) $\frac{2\sqrt{2}}{3}$ B) $\frac{\sqrt{5}}{3}$ C) $\frac{8}{9}$ D) $\frac{2}{3}$

16. The minimum number of elements that must be added to the relation $R=\{(1,2),(2,3)\}$ on the set $A=\{1,2,3\}$ So that it is equivalence.

A) 4 B) 7 C) 6 D) 5

17. For a differential function ϕ with $\phi(1)=2$, the solution of the differential equation $y'=\frac{y}{x}+\frac{\phi\left(\frac{y}{x}\right)}{\phi'\left(\frac{y}{x}\right)}, y(2)=2$ is

A) $x.\phi\left(\frac{y}{x}\right)=1$ B) $\phi\left(\frac{y}{x}\right)=x$ C) $y.\phi\left(\frac{y}{x}\right)=2$ D) $\phi\left(\frac{y}{x}\right)=y$

18. For the circle $x^2+y^2=r^2$, the value of r for which the area enclosed by the tangents drawn from the point (6,8) to the circle and the chord of contact is maximum is

A) 4 B) 5 C) 10 D) 9

19. If $x+y=k$ is a normal to the parabola $y^2=12x$, P is the length of the perpendicular from the focus of the parabola on this normal, then P is equal to

A) $6\sqrt{2}$ B) $4\sqrt{2}$ C) $3\sqrt{2}$ D) $2\sqrt{2}$

20. If it rains a dealer in rain coats can earn Rs. 500/- a day. If it is fair he will loose Rs. 40/- a day. His mean profit if the probability of a fair day is 0.6 is

A) Rs. 230 /- B) Rs. 460 /- C) Rs. 176 /- D) Rs. 88 /-

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:
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21. If OA and OB are two equal chords of the circle $x^2+y^2-2x+4y=0$ perpendicular to each other and passing through the origin O, if the slopes of OA and OB are m_1 and m_2 then $(m_1+m_2)=$ ___

22. A circle with radius unity has its centre on the positive y-axis. If this circle touches the parabola $y=2x^2$ tangentially at the point P and Q then the sum of the ordinates of P and Q is

23. The plane denoted by $\pi_1: 4x+7y+4z+81=0$ is rotated through a right angle about its line of intersection with the plane $\pi_2: 5x+3y+10z=25$. If the plane in its new position be denoted by π, and the distance of this plane from the origin is $\sqrt{k}$, where $k\in N$, then find K.

24. If the probability distribution of a random variable X is

$x=x_i$	-2	-1	0	1	2	3
$P(x=x_i)$	0.1	K	0.2	2K	0.3	K

Then the variance of X is

25. If A is the area of the figure bounded by the straight lines $x = 0$ and $x = 2$, and the curves $y = 2^x$ and $y = 2x - x^2$ then the value of $\left(A - \frac{3}{\log 2} \right) =$ _____

PHYSICS

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.
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26. The electric field of two plane electromagnetic plane waves in vacuum are given by : $\vec{E}_1 = E_0 \hat{j} \cos(\omega t - kx)$ and $\vec{E}_2 = E_0 \hat{k} \cos(\omega t - ky)$

At t = 0, a particle of charge q is at origin with a velocity $\vec{v} = 0.8c\hat{j}$ (c is the speed of light in vaccum) The instaneous force experienced by a particle is :

A) $E_0 q\left(0.4\hat{i} - 3\hat{j} + 0.8\hat{k}\right)$ B) $E_0 q\left(0.8\hat{i} - \hat{j} + 0.4\hat{k}\right)$

C) $E_0 q\left(-0.8\hat{i} + \hat{j} + \hat{k}\right)$ D) $E_0 q\left(0.8\hat{i} + \hat{j} + 0.2\hat{k}\right)$

27. Lights of two different frequencies, whose photons have energies 1 eV and 2.5 eV respectively, successively illuminate a metal whose work function is 0.5 eV. The ration of the maximum speeds of the emitted electrons will be

A) 1:5 B) 1:4 C) 1:2 D) 1:1

28. A Carnot engine having an efficiency of $\frac{1}{10}$ is being used as a refrigerator. If the work done on the refrigerator is 10 J, the amount of heat absorbed from the reservoir at lower temperature is:

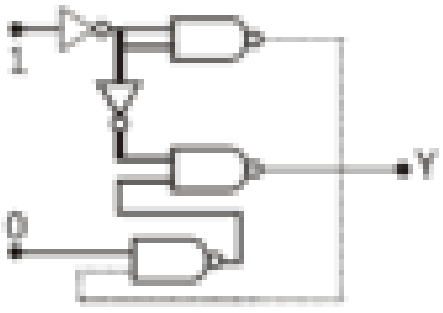
A) 1J B) 100J C) 99J D) 90J

29. What is the conductivity of a semiconductor sample having electron concentration of $5X10^{18}$ m^{-3}, hole concentration of $5X10^{19} m^{-3}$, electron mobility of 2.0 $m^2V^{-1}S^{-1}$ and hole mobility of 0.01 $m^2 V^{-1}s^{-1}$?

(take charge of electron as $1.6X10^{-19}C$)

A) $1.68(\Omega - m)^{-1}$ B) $1.83(\Omega - m)^{-1}$ C) $0.59(\Omega - m)^{-1}$ D) $1.20(\Omega - m)^{-1}$

30. In the given circuit, value of Y is:



A) 0 B) will not execute C) 1 D) toggles between 0 and 1

31. A piece of wood from a recently cut tree shows 20 decays per minute. A wooden piece of same size placed in museum (obtained from a tree cut many years back) shows 2 decays per minute. If

half life of C^{14} is 5730 years, then age of the wooden piece placed in the museum is approximately.

A) 10439 years B) 13094 years C) 19039 years D) 39049 years

32. Consider a spherical shell of radius R at temperature T. The black body radiation inside it can be considered as an ideal gas of photons with internal energy per unit volume and pressure $p = \frac{1}{3}\left(\frac{U}{V}\right)$ if the shell now undergoes an adiabatic expansion the relation between T and R is:

A) $T\alpha\frac{1}{R}$ B) $T\alpha\frac{1}{R^3}$ C) $T\alpha e^{-R}$ D) $T\alpha e^{-3R}$

33. The fundamental frequency of a sonometer wire of length l is n_0. A bridge is now introduced at a distance of $\Delta l(<<l)$ from the centre of the wire. The lengths of wire on the two sides of the bridge are now vibrated in their fundamental modes. Then, the beat frequency nearly is -

A) $n_0\Delta l/l$ B) $8n_0\Delta l/l$ C) $2n_0\Delta l/l$ D) $n_0\Delta l/2l$

34. A bucket full of hot water is kept in a room and it cools from 75^0C to 70^0C in T_1 minutes, from 70^0C to 65^0C in T_2 minutes and from 65^0C to 60^0C in T_3 minutes. Then

A) $T_1 = T_2 = T_3$ B) $T_1 < T_2 < T_3$ C) $T_1 > T_2 > T_3$ D) $T_1 < T_3 < T_2$

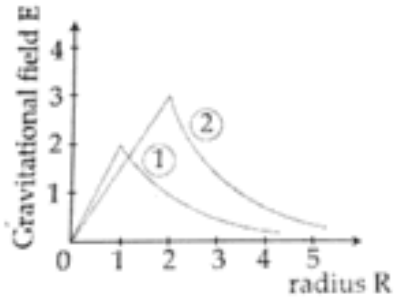
35. The magnifying power of a telescope with tube length 60cm is 5. What is the focal length of its eye piece?

A) 20cm B) 40cm C) 30cm D) 10cm

36. For good demodulation of AM signal of carrier frequency *f*, the value of RC should be

A) $RC = \frac{1}{f}$ B) $RC < \frac{1}{f}$ C) $RC = f$ D) $RC >> \frac{1}{f}$

37. Consider two solid spheres of radii $R_1 = 1m, R_2 = 2m$ and masses M_1 and M_2, respectively. The gravitational field due to sphere (1) and (2) are shown. The value of $\frac{M_1}{M_2}$ is:



A) $\frac{1}{3}$ B) $\frac{1}{2}$ C) $\frac{1}{6}$

38. Relative permittivity and permeability of a material are ε_r and μ_r, respectively. Which of the following values of these quantities are allowed for a diamagnetic material?

A) $\varepsilon_r = 0.5, \mu_r = 1.5$ B) $\varepsilon_r = 1.5, \mu_r = 0.5$ C) $\varepsilon_r = 0.5, \mu_r = 0.5$ D) $\varepsilon_r = 1.5, \mu_r = 1.5$

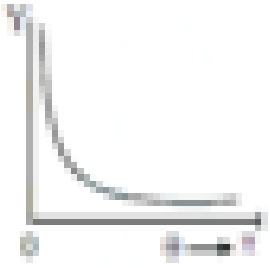
39. A compound microscope has an objective and eye-piece as thin lenses of focal lengths 1cm and 5cm respectively. The distance between the objective and the eye-piece is 20cm. The distance at which the object must be placed in front of the objective if the final image is located at 25 cm from the eye-piece, is numerically

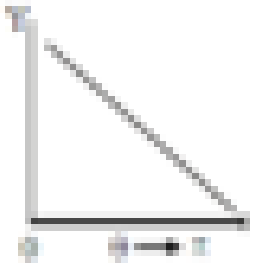
A) $\frac{95}{6}cm$ B) $\frac{95}{89}cm$ C) $\frac{5}{6}cm$ D) $\frac{25}{6}cm$

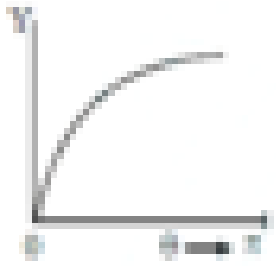
40. In an isothermal expansion of 10g of gas from volume V to 2V the work done by the gas is 575J. What is the root mean square speed of the molecules of the gas at that temperature?

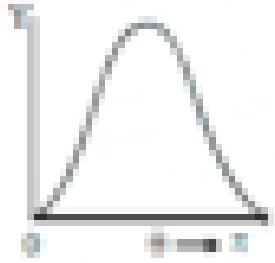
A) 398m/s B) 520m/s C) 499m/s D) 532m/s

41. The graph which depicts the results of Rutherford gold foil experiment with α -particles is:
θ : scattering angle
Y= number of scattered α -particles detected

A) 

B) 

C) 

D) 

42. The ratio of intensities of consecutive maxima in the diffraction pattern due to a single slit is

A) 1 : 4 : 9 B) 1 : 2 : 3 C) $1:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$ D) $1:\frac{1}{\pi^2}:\frac{9}{\pi^2}$

43. A polarizer – analyser set is adjusted such that the intensity of light coming out of the analyser is just 10% of the original intensity. Assuming that the polarizer – analyser set does not absorb any light the angle by which the analyser need to be rotated further to reduce the output intensity to be zero, is :

A) 71.6^0 B) 45^0 C) 18.4^0 D) 90^0

44. Plane microwaves are incident on a long slit having a width of 5.0 cm. The wavelength of microwaves if the first diffraction minimum is formed at $\theta = 30^o$ is

A) 2.5 cm B) 5 cm C) 7.5 cm D) 10 cm

45. A light of wavelength λ is incident on an object of size b. If a screen is at a distance D from the object. Identify the correct condition for the observation of different phenomenon

a) If $b^2 = D\lambda$, Fresnel diffraction is observed

b) If $b^2 >> D\lambda$, Fraunhoffer diffraction is observed

c) $b^2 << D\lambda$, Fraunhoffer diffraction is observed

d) $b^2 >> D\lambda$, the approximation of geometrical optics is applicable

A) a,b and d are true B) a,c and d are true C) a and c are true D) a and d are true

SECTION-II
(Numerical Value Answer Type)

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46. Two satellites S_1 and S_2 are revolving around a planet in co-planar and concentric circular orbits of radii R_1 and R_2 in the same direction respectively. Their respective periods of revolution are 1

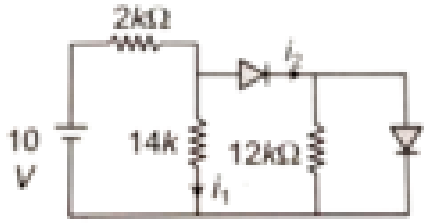
hr and 8 hr. The radius of the orbit of satellite S_1 is equal to $10^4 km$. Their relative speed when they are closest, in kmph is _____ $\times 10^4$

47. 16kg and 9 kg are separated by 25m. The velocity with which a body should be projected from the mid point of the line joining the two masses so that it just escape is $x\sqrt{G}$ then x is

48. By what percent, the energy of the satellite has to be increased to shift it from an orbit of radius 'r' to '3r' ? (rounded off to 2 decimals)

49. A 1L glass flask contains some mercury. It is found that at different temperatures the volume of air inside the flask remains the same. What is the volume (in cc) of mercury in this flask if coefficient of linear expansion of glass is $9\times10^{-6}/^0 C$ while of volume expansion of mercury is $1.8\times10^{-4}/^0 C$?

50. In the following circuit find the sum of I_1 and I_2(in mA)



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.
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51. Cassiterite is concentrated by
(A) Levigation (B) Electromagnetic separation
(C) Frothfloatation (D) Liquification

52. The purest form of commercial iron is
(A) Scrap iron and Pig iron (B) Wrought iron
(C) Cast iron (D) Pig iron

53. In the manufacture of tyre rubber, the percentage of sulphur used as a cross linking agent is
(A) 2% (B) 15% (C) 10% (D) 5%

54. Three dimensional molecular structure with cross links are formed in case of a
(A) Thermoplastic (B) Thermosetting plastic
(C) Both (a) and (b) (D) None of these

55. Which one of the amino acid can be synthesized in the body?
(A) Alanine (B) Valine (C) lysine (D) Arginine

56. Which of the following oxides shows metallic (or) insulating properties depending up on temperature?
A) VO_2 B) VO_3 C) TiO_3 D) All of these

57. Which of the following is most effective in causing the coagulation of ferric hydroxide sol?
(A) KCl (B) KNO_3 (C) K_2SO_4 (D) $K_3\left[Fe(CN)_6\right]$

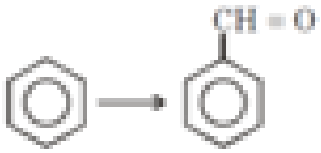
58. Which of the following complex ion is not expected to be paramagnetic?

(A) $\left[Ni(CN)_4\right]^{-2}$ (B) $\left[Cr(NH_3)_6\right]^{+3}$ (C) $\left[Fe(H_2O)_6\right]^{+2}$ (D) $\left[Ni(H_2O)_6\right]^{+2}$

59. Which of the following oxide is amphoteric oxide?

(A) CrO_3 (B) V_2O_3 (C) Cr_2O_3 (D) CrO

60.



The reagent used can be:

(A) $HCH=O+HCl+AlCl_3$ (B) $CO+HCl+AlCl_3$

(C) CrO_2Cl_2 (D) $SnCl_2+HCl$

61. Hybridization and structure of XeF_4 is

(A) sp^3d, trigonal bipyramidal (B) sp^3, tetrahedral

(C) Sp^3d^2, square planar (D) sp^3d^2, octahedral

62. Which of the following is Tranquilizer drug?

A) Furacine B) Soframicine C) Valium D) ofloxacin

63. The bleaching action of chlorine is due to

A) Reduction B) Oxidation C) Hydrogenation D) Both A and B

64. Which type of detergent is formed when stearic acid react with polyethylene glycol?

(A) cationic detergent (B) Anionic detergents

(C) Non-Ionic detergents (D) None of these

65. Which of the following is not a fibrous protein?

A) Keratin B) Myosin C) Insulin D) Both A and B

66. What is the concentration of dissolved oxygen in cold water?

(A) 15 ppm (B) 10 ppm (C) 20,000 ppm (D) 100 ppm

67. Excess nitrate in drinking water can cause

(A) Methemoglobinemia (B) Kidney damage

(C) liver damage (D) laxative effect

68. The decomposition of H_2O_2 is accelerated by

(A) Glycerine (B) Alcohol (C) Phosphoric acid (D) Pt powder

69. The pair of compound which have odd electrons in the group $NO, CO, ClO_2, N_2O_5, SO_2$ and O_3 are

(A) NO and ClO_2 (B) CO and SO_2 (C) ClO_2 and CO (D) SO_2 and O_3

70. Potassium dichromate when heated with concentrated sulphuric acid and a soluble chloride give brown-red vapours of

(A) CrO_3 (B) $CrCl_3$ (C) CrO_2Cl_2 (D) Cr_2O_3

SECTION-II
(Numerical Value Answer Type)

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71. How many of the following are negatively charged sols?

As_2S_3,TiO_3, Congo Red, hemoglobin, Gelatine, clay, charcoal, $Fe_2O_3.xH_2O$.

72. For the polymer
Nylon-6,6;Nylon-2-Nylon-6; Glyptal; Terylene; Melamine formaldehyude, Nylon-6
Find out number of step growth polymer which are homopolymer.

73. A metallic crystal crystallizes into a lattice containing a sequence of closed packed layers AB AB AB-------- Any packing of spheres leaves out voids in the lattice. What percentage of volume of this lattice is empty space?

74. The volume strength of 1.5N H_2O_2 solution is

75. The average formal charge on each oxygen atom in PO_4^{-3} ion is

MELUHA INTERNATIONAL SCHOOL

HYDERABAD

SR MPC | **MAINS MODEL – GT 3** | **Date: 25-05-2020**

Time: 3 Hours | **Max Marks : 300**

KEY SHEET

MATHS

1) **C**	2) **A**	3) **D**	4) **C**	5) **C**	6) **C**	7) **C**	8) **D**	9) **A**	10) **B**
11) **A**	12) **D**	13) **B**	14) **D**	15) **A**	16) **B**	17) **B**	18) **B**	19) **C**	20) **C**
21) **2.67**	22) **3.75**	23) **212**	24) **2.16**	25) **-1.33**					

PHYSICS

26) **D**	27) **C**	28) **D**	29) **A**	30) **A**	31) **C**	32) **A**	33) **B**	34) **B**	35) **D**
36) **D**	37) **C**	38) **B**	39) **B**	40) **C**	41) **B**	42) **C**	43) **C**	44) **A**	45) **B**
46) **3.14**	47) **2**	48) **66.67**	49) **150**	50) **5**					

CHEMISTRY

51) **B**	52) **B**	53) **D**	54) **B**	55) **A**	56) **D**	57) **D**	58) **A**	59) **C**	60) **B**
61) **C**	62) **C**	63) **B**	64) **C**	65) **C**	66) **B**	67) **A**	68) **D**	69) **A**	70) **C**
71) **5**	72) **1**	73) **26**	74) **8.4**	75) **0.75**					

HINTS & SOLUTIONS

MATHEMATICS

01. $I_1 = \int_0^{\pi} \frac{(\pi - x)\sin x}{1+\cos^2 x}$ $I_2 = \int_0^{\pi} (\pi - x).\sin^4 x\,dx$

$\Rightarrow 2I_1 = \pi \int_0^{\pi} \frac{\sin x}{1+\cos^2 x} dx \quad 2I_1 = \pi \int_0^{\pi} \sin^2 x$

$\Rightarrow I_1 = \frac{\pi}{2} \int_{-1}^{1} \frac{dt}{1+t^2} \qquad = \pi \times \frac{3}{4} \times \frac{1}{2} \times \frac{\pi}{2}$

$= \frac{\pi}{2} \times \frac{\pi}{2} \qquad = \frac{3\pi^2}{16}$

$I_1 : I_2 = \frac{\pi^2}{4} : \frac{3\pi}{16} = 4:3$

02. $\left|\bar{a} \times \bar{c}\right|^2 \left|\bar{b}\right|^2 \Rightarrow |a|^2 |c|^2 \sin^2\theta = |b|^2 = 3$

$\Rightarrow 2\left|\bar{c}\right|^2 \sin^2\theta = 3$

$\bar{a}.\bar{c} = 7 \Rightarrow |a|^2 |c|^2 \cos^2\theta = 49$

$\Rightarrow 2|c|^2\left(1-\sin^2\theta\right) = 49$

$\therefore |c|^2 = 26$

03. $a_n = a_{n-1} + (n+1)2^n$

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

$\therefore a_{50} - a_1 = \sum_{n=2}^{50}(n+1)2^n$

$\Rightarrow a_{50} = 50.2^{51} + 1$

04. $S = \sum_{r=1}^{100}(101-r) = 5050$

05. conceptual

06. $f(0) = 0 = f(1)$ 1 real root in $(0,1)$

since $f(x)$ is even degree $\Rightarrow$ at least 2 real roots

07. S.D b/w lines $= \dfrac{2}{\sqrt{3}}$

least area $\dfrac{1}{2}(PQ) \times \dfrac{2}{\sqrt{3}}$

$\Rightarrow A = \sqrt{\dfrac{8}{3}}$

08. $t_{r+1} = {}^{20}C_r\left(3^{\frac{1}{2}}\right)^r = {}^{20}C_r 2^{4-\frac{r}{5}}, (3)^{\frac{r}{2}}$

$\Rightarrow$ sum of rational terms is ${}^{30}C_r\left(2^{\frac{1}{5}}\right)^{20-r} + {}^{20}C_{10}.2^2.3^5 + {}^{20}C_{20}.2^0, 3^{10}$

09. $f'(a) = \dfrac{2a}{a+a^2} - \dfrac{1}{a+\sqrt{a}} = 0$

$\Rightarrow a = \left(\sqrt{2}-1\right)^2 = \tan^2\dfrac{\pi}{8}$

10. $\int \dfrac{x\,dx}{\sqrt{1+x^2}\left(1+\sqrt{1+x^2}\right)}$ put $1+\sqrt{1+x^2} = t^2$

11. variance $\dfrac{3}{2} = 3^2 \times \dfrac{99}{12} = 9 \times \dfrac{99}{12} \Rightarrow S.D = \dfrac{3}{2}\sqrt{33}$

12. $A(r_1\cos\alpha, r_1\sin\alpha)B\left(r_2\cos\left(\alpha+\dfrac{\pi}{2}\right)\right), r_2\sin\left(\alpha+\dfrac{\pi}{2}\right)$

$\Rightarrow 31(r_1\cos\alpha)^2 - 29(r_1\sin\alpha)^2 = 1$

$31(-r_2\sin\alpha)^2 - 29(r_2\cos\alpha)^2 = 1$

$$\frac{1}{OA^2}+\frac{1}{OB^2}=\frac{1}{r_1^2}+\frac{1}{r_2^2}=31-29=2$$

13. $$\int\frac{2x+1}{x^2\left(1+\frac{4}{x}+\frac{1}{x^2}\right)^{3/2}}dx=\int\frac{2x^{-2}+x^{-3}}{\left(1+\frac{4}{x}+\frac{1}{x^2}\right)^{3/2}}dx$$

$$put\ \frac{1}{x^2}+\frac{4}{x}+1=k^2$$

14. coordinates of any point on $\frac{x+2}{2}=\frac{y+1}{-1}=\frac{z}{3}$ is $(2r-2,-r-1,3r)$

finding foot of perpendicular on $x+y+z=3$

$$x=\frac{2}{3}r, y=\frac{-7}{3}r+1, z=\frac{5}{3}r+2$$

$$\Rightarrow\frac{x}{2}=\frac{y-1}{-7}=\frac{z-2}{5}$$

15. $$\frac{\pi a^2-\pi ab}{\pi a^2}=\frac{2}{3}=1-\frac{b}{a}$$

$$=1-\sqrt{1-e^2}$$

16. $\sin ce,\ R=\{(1,2),(2,3)\}$

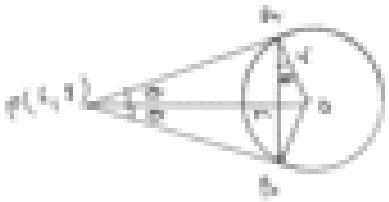
for reflective (1, 1), (2, 2), (3, 3) must be added
for symmetric (2, 1), (3, 2) must be added
for transitive (1, 3) (3, 1) must be added

17. put $\frac{y}{x}=u\Rightarrow y^1=u+xy'$

$$\Rightarrow u+xy'=u+\frac{\phi(u)}{\phi'(u)}\Rightarrow\frac{\phi'(u)}{\phi(u)}.dx=\frac{dx}{x}$$

$$\Rightarrow\phi\left(\frac{y}{x}\right)=x$$

18.



area of $\Delta OAB=2\times\frac{1}{2}\times(10-r\sin\theta)r\cos\theta$

$$=100\cos^3\theta.\sin\theta\ (\because r=10\sin\theta)$$

$$\frac{dA}{d\theta}=0\Rightarrow\theta=\frac{\pi}{6}\Rightarrow r=5$$

Normal with slope –1 is

19.

$$y=-x-2(3)(-1)-(3)(-1)^3$$

$$\Rightarrow k=9$$

$$p = \left|\frac{3-9}{\sqrt{2}}\right| = 3\sqrt{2}$$

$$mean = \sum x_i P(x_i)$$

20.

Let OA & OB the

21.

$$y - mx = 0 \ \& \ my + x = 0$$

$$\Rightarrow \frac{-2-m}{\sqrt{1+m^2}} = \frac{-2m+1}{\sqrt{1+m^2}}$$

$$\Rightarrow 3m^2 - 8m - 3 = 0 \ \Rightarrow m_1 + m_2 = \frac{8}{3}$$

22.

$$4t\left(\frac{2t^2-\alpha}{t}\right) = -1$$

$$\& \ \ t^2 + \left(2t^2-\alpha\right)^2$$

$$\Rightarrow 4t^2 = \frac{15}{4}$$

$$\left(4x+7y+4z+81\right) + \lambda\left(5x+3y+10z-25\right) = 0$$

23.

$$4\left(5\lambda+7\right) + 7\left(3\lambda+7\right) + \left(10\lambda+4\right)4 = 0$$

equation of the plane $-x+4y-6z+106=0 \Rightarrow P = \left|\frac{5.3\times 2}{\sqrt{53}}\right|$

24. Conceptual

25.

$$\int_0^2 \left(2^x - \left(24-x^2\right)\right)dx = \left[\frac{2^x}{\log 2}\right]_0^2 - \left(x^2 - \frac{x^3}{3}\right)_0$$

$$= \frac{3}{\log 2} - \frac{4}{3}$$

PHYSICS

26. $\bar{E}_1 = E_0\hat{j}\cos\left(\omega t - kx\right)$

Means travelling in +ve x-direction , $\bar{E}\times\bar{B}$ should be in x-direction

$\therefore \vec{B}$ is in $\hat{k}$

$$\therefore \vec{B}_1 = \frac{E_0}{C}\cos\left(\omega t - kx\right)\hat{k}$$

$$\vec{E}_2 = E\hat{k}\cos\left(\omega t - ky\right)$$

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

$\vec{E}_2 = \frac{E_0}{c}\hat{i}\cos(\omega t - ky)$

$\therefore$ travelling in +ve y –axis

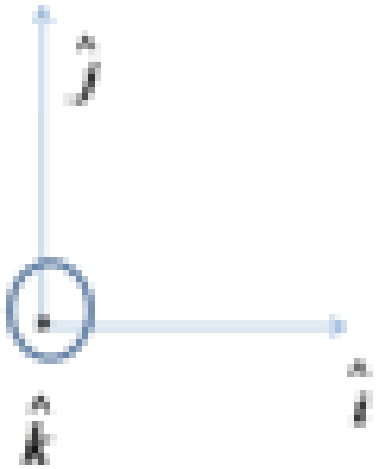
$\vec{E} \times \vec{B}$ should be in y-axis

$\therefore$ net force , $\vec{F}_{net} = \vec{F}_e + \vec{F}_m$

$= q\left(\vec{E}_1 + \vec{E}_2\right) + q\left(0.8c\,\hat{j}\right) \times \left(\vec{B}_1 + \vec{B}_2\right)$

$t = 0$

$x = 0$



$\vec{E}_1 = E_0\hat{j} \quad \vec{E}_2 = E_0\hat{j}$

$\vec{B}_1 = \frac{\vec{E}_0}{c}\hat{k} \quad \vec{B}_2 = \frac{\vec{E}_0}{c}\hat{i}$

$\therefore \vec{F}_{net} = qE_0\left(\hat{j} + \hat{k}\right) + q \times 0.8c \times \frac{E_0}{C}\hat{j}\left(\hat{k} + \hat{i}\right)$

$= qE_0\left(\hat{j} + \hat{k}\right) + 0.8qE_0\left(\hat{i} - \hat{k}\right)$

$= qE_0\left(0.8\hat{i} + \hat{j} + 0.2\hat{k}\right)$

27. Einstein equation KE_{max}=E-Work function;

$\frac{1}{2}mv^2 = E - W$

Using this concept,

$\frac{\frac{1}{2}mV_1^2 \max}{\frac{1}{2}mV_2^2 \max} = \frac{1-.5}{2.5-.5} = \frac{1}{4} or \frac{V_1 \max}{V_2 \max} = \frac{1}{2}$

28. $e = \frac{1}{10}$ (given)

$e = 1 - \frac{T_2}{T_1} = \frac{1}{10}$

$$\frac{T_2}{T_1}=\frac{9}{10}$$

$$\beta=\frac{1}{1-\frac{T_2}{T_1}}$$

$$\beta=\frac{Q_1}{W}$$

$$Q_1=W\times\beta$$

29. The conductivity of semiconductor

$$\sigma=e\left(\eta_e\mu_e+\eta_h\mu_h\right)$$

$$=1.6\times10^{-19}(5\times10^{18}\times2+5\times10^{19}\times0.01)$$

$$=1.6\times1.05=1.68$$

30. Conceptual

31. Given: $\frac{dN_o}{dt}=20\,decays/\min$

$$\frac{dN}{dt}=2decays/\min$$

$$T_{1/2}=5730\,years$$

As we know,

$$N=N_0e^{-\lambda t}$$

$$\log\frac{N_o}{N}=\lambda t$$

$$\therefore t=\frac{1}{\lambda}\log\frac{N_0}{N}$$

$$=\frac{2.303\times T_{1/2}}{0.693}\times\log_{10}\frac{N_0}{N}$$

$$But\ \frac{\frac{dN_0}{dt}}{\frac{dN}{dt}}=\frac{N_0}{N}=\frac{20}{2}=10$$

$$\therefore t=\frac{2.303\times5730}{0.693}\times1$$

32. $$As, P=\frac{1}{3}\left(\frac{U}{V}\right)$$

$$But\frac{U}{V}=KT^4$$

$$So, P=\frac{1}{3}KT^4$$

$$or\frac{uRT}{V}=\frac{1}{3}KT^4$$

$$\frac{4}{3}\pi R^3T^3=\text{constant}$$

Therefore, $T\alpha\frac{1}{R}$

33. $$n_o=\frac{v}{2l}$$

$$n_1 = \frac{v}{2(l/2-\Delta l)}, \frac{v}{2(l/2+\Delta l)}$$

$$Beatfrequency = n_1 - n_2$$

$$\Rightarrow v\left[\frac{1}{l-2\Delta l} - \frac{1}{l+2\Delta l}\right]$$

$$\Rightarrow v\left[\frac{(l+2\Delta l)-(l-2\Delta l)}{l^2-4\Delta l^2}\right]$$

$$= v\frac{4\Delta l}{l^2-4\Delta l^2} = \frac{8}{l}\frac{\Delta l v}{2l} = \frac{8\Delta \ln_0}{l}$$

34. more the initial temperature more is the rate of cooling. Hence $T_3>T_2>T_1$
Or the rate of cooling decreases with decrease in temperature difference between body and surrounding.

35. M = 5

$M = \frac{-f_0}{f_e}$ (Normal adjustment)

$f_0 + f_e = L$ (L = 60 cm)

36. For good demodulation,

$$\frac{1}{f} << RC or, RC >> \frac{1}{f}$$

37. $E = \frac{GM}{r^2}$

(gravitational field due to solid sphere)
From graph

$\frac{GM_1}{(1)^2}$ = 2 units

$\frac{GM_2}{(2)^2}$ = 3 units

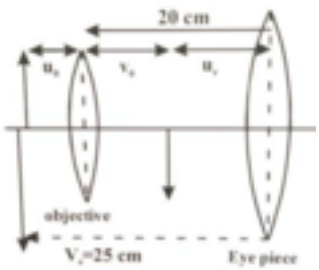
$$\frac{M_1}{M_2/4} = \frac{2}{3}$$

$$\frac{M_1}{M_2} = \frac{2}{12} = \frac{1}{6}$$

$$\frac{M_1}{M_2} = \frac{1}{6}$$

38. for a diamagnetic material, the value of μ_r is less than one. For any material, the value of $\in_r$ is always greater than 1

39.



Final image distance $L=V_0+u_e=20$

For objective $\frac{1}{f_0} = \frac{1}{v_0} + \frac{1}{u_0}$

For eye piece $\frac{1}{f_e}=-\frac{1}{25}+\frac{1}{u_e}$

$or\frac{1}{5}+\frac{1}{25}=\frac{1}{u_e}$

$\therefore u_e=\frac{25}{6}cm$

$\therefore v_0=20-u_e$

$v_0=20-\frac{25}{6}=\frac{95}{6}$

$\therefore \frac{1}{u_0}=1-\frac{1}{v_0}==1-\frac{95}{6}=-\frac{89}{95}$

$\therefore u_0=\frac{95}{89}$

40. $v_{rms}=\sqrt{\frac{3pv}{mass\,of\,the\,gas}}$

41. Conceptual

42. $I=I_0\left[\frac{\sin\alpha}{\alpha}\right]^2$, where $\alpha=\frac{\phi}{2}$

For n[th] secondary maxima $d\sin\theta=\left(\frac{2n+1}{2}\right)\lambda$

$\Rightarrow\alpha=\frac{\phi}{2}=\frac{\pi}{\lambda}\left[d\sin\theta\right]=\left(\frac{2n+1}{2}\right)\pi$

$I=I_0\left(\frac{\sin\left(\frac{2n+1}{2}\right)\pi}{\left(\frac{2n+1}{n}\right)\pi}\right)=\frac{I_0}{\left\{\frac{(2n+1)}{2}\right\}^2}$

So $I_0:I_1:I_2=I_0:\frac{4}{9\pi^2}I_0:\frac{4}{25\pi^2}I_0$

$=I:\frac{4}{9\pi^2}:\frac{4}{25\pi^2}$

43. $I=I_0\cos^2\phi$

44. $a\sin\theta=n\lambda$

45. Conceptual

46. $T^2\alpha R^3, V_0=\frac{2\pi R}{T}$, Rel. velocity = $V_{01}-V_{02}$

47. $v=\sqrt{\frac{4G\left(M_1+M_2\right)}{d}}$

48. $TE=\frac{-GMm}{2r};\frac{\Delta E}{E}\times100=\frac{2}{3}(100)$

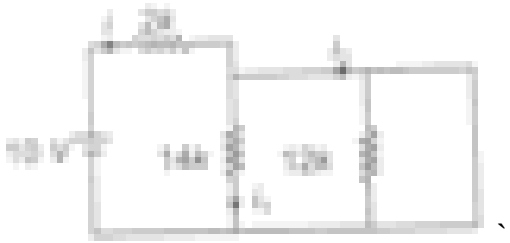
49. It is given that the volume of air in the flask remains the same. This means that the expansion in volume of the vessel is exactly equal to the volume expansion of mercury.

$\Delta V_G = \Delta V_L$

$or\, V_G \gamma_G \Delta\theta = V_L \gamma_L \Delta\theta$

$\therefore V_L = \dfrac{V_G \gamma_G}{\gamma_L} = \dfrac{1000 \times \left(3 \times 9 \times 10^{-6}\right)}{1.8 \times 10^{-4}} = 150cc$

50. The equivalent circuit can be redrawn as follows



From figure it is clear that current drawn from the battery

$i = i_2 = \dfrac{10}{2} = 5mA\, and\, i_1 = 0$

CHEMISTRY

51. Cassiterite contains the magnetic impurities

57. $Fe(OH)_3$ is positive sol. For coagulation highest magnitude of –ve charge ion is required.

58. $\left[Ni(CN)_4\right]^{-2}$

No. of unpaired electrons=0

68. Decomposition of H_2O_2 can be acceleration by finally divided metals such as Ag,Au,Pt,Fe,…..,etc.

70. Chromyl chloride test

$K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \rightarrow 2KHSO_4 + 4NaHSO_4 + 2CrO_2Cl_2$

71. Negatively charged solutions are

As_2S_3, congo red, gelatin, clay, charcoal

73. In AB AB packing spheres occupy 74%, 26% empty

74. Volume strength = $N \times 5.6$

75. Formal charge on oxygen $= \dfrac{-3}{4} = -0.75$