



Time: 3 Hours

M.M. 300

ALL INDIA SKY TEST SERIES

TARGET BATCH - IIT - JEE

Date : 26/11 /2023

SYLLABUS

PHYSICS	CHEMISTRY	MATHEMATICS
Previous + Elasticity + SHM	Previous + Electrochemistry, Hydrocarbon	Previous + Indefinite integration & Definite integration

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose.

INSTRUCTIONS:

- This Question paper is divided in to three parts Physics, Chemistry and Mathematics each part is further divided into two sections.
Section -A Contains 20 Questions Section B contains 10 questions. Please ensure that the Questions paper you have received contains **ALL THE QUESTIONS** in each Part.
- In Section A all the 20 Questions are compulsory and Section B Contain 10 Question, out of these 10 Questions,** candidates can choose to attempt any 5 Questions. Each Question has four choices (A), (B), (C), (D) out of which **only one is correct & Carry 4 marks each 1 mark** will be deducted for each wrong answer.

GENERAL INSTRUCTION

- Use only **blue/black pen (avoid gel pen)** for darkening the bubble.
- Indicate the correct answer for each question by filling appropriate bubble in your **OMR** answer sheet.
- The answer sheet will be checked through computer hence, the answer of the question must be marked by -shading the circles against the question by dark **blue/black pen**
- Blank papers, Clipboards, Log tables, Slide Rule, Calculator, Cellular Phones Papers and Electronic Gadgets in any form are **not** allowed to be carried inside the examination hall.

Name of the candidate: _____

Signature of the candidate: _____ Signature of the invigilator: _____

PHYSICS

Section - A

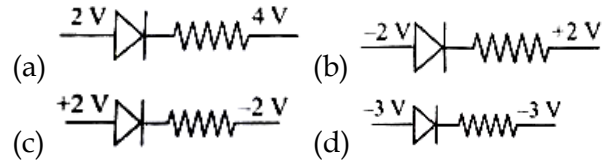
Single Choice Question

1. A longitudinal wave is represented $x = 10 \sin 2\pi \left(nt - \frac{x}{\lambda} \right)$ cm. The maximum particle velocity will be four times the wave velocity if the determined value of wavelength is equal to
(a) 2π (b) 5π (c) π (d) $\frac{5\pi}{2}$
2. A travelling wave is described by the equation $y(x,t) = [0.05 \sin(8x - 4t)]m$
The velocity of the wave is [all the quantities are in SI unit]
(a) 4 ms^{-1} (b) 8 ms^{-1} (c) 0.5 ms^{-1} (d) 2 ms^{-1}
3. A travelling harmonic wave is represented by the equation $y(x,t) = 10^{-3} \sin(50t + 2x)$, where x and y are in meter, and t is in seconds. Which of the following is a correct statement about the wave? The wave is propagating along the
(a) Negative x - axis with speed 25 ms^{-1}
(b) The wave is propagating along the positive x - axis with speed 25 ms^{-1}
(c) The wave is propagating along the positive x - axis with speed 100 ms^{-1}
(d) The wave is propagating along the negative x - axis with speed 100 ms^{-1}
4. A uniform thin rope of length 12 m and mass 6 kg hangs vertically from a rigid support and a block of mass 2 kg is attached to its free end. A transverse short - wave train of wavelength 6 cm is produced at the lower end of the rope. What is the wavelength of the wave train (in cm) when it reaches the top of the rope?
(a) 9 (b) 12 (c) 6 (d) 3
5. A tuning fork A of unknown frequency produces 5 beats/s with a fork of known frequency 340 Hz. When fork A is filed, the beat frequency decreases to 2 beats/s. What is the frequency of fork A?
(a) 342 Hz (b) 345 Hz (c) 335 Hz (d) 338 Hz
6. A stationary observer receives sound from two identical tuning forks, one of which approaches and the other one recedes with the same speed (much less than the speed of sound). The observer hears 2 beats/sec. The oscillation frequency of each tuning fork is $v_0 = 1400 \text{ Hz}$ and the velocity of sound in air is 350 m/s. The speed of each tuning fork is close to
(a) $\frac{1}{8} \text{ m/s}$ (b) $\frac{1}{2} \text{ m/s}$ (c) 1 m/s (d) $\frac{1}{4} \text{ m/s}$
7. A string of length 1 m and mass 5 g is fixed at both ends. The tension in the string is 8.0 N. The string is set into vibration using an external vibrator of frequency 100 Hz. The separation between successive nodes on the string is close to.
(a) 16.6 cm (b) 20.0 cm
(c) 10.0 cm (d) 33.3 cm
8. A string is clamped at both the ends and it is vibrating in its 4th harmonic. The equation of the stationary wave is $Y = 0.3 \sin(0.157x) \cos(200\pi t)$. The length of the string is (All quantities are in SI units)
(a) 20 m (b) 80 m (c) 60 m (d) 40 m
9. A tuning fork of frequency 480 Hz is used in an experiment for measuring speed of sound (v) in air by resonance tube method. Resonance is observed to occur at two successive length of the air column, $l_1 = 30 \text{ cm}$ and $l_2 = 70 \text{ cm}$. Then v is equal to
(a) 332 ms^{-1} (b) 379 ms^{-1}
(c) 384 ms^{-1} (d) 338 ms^{-1}
10. Two identical string X and Z made of same material have tension T_x and T_z in them. If their fundamental frequencies are 450 Hz and 300 Hz, respectively, then the ratio T_x / T_z is:
(a) 0.44 (b) 1.5 (c) 2.25 (d) 1.25
11. Radiation of wavelength λ , is incident on a photocell. The fastest emitted electron has speed v . If the wavelength is changed to $3\lambda / 4$, the speed of the fastest emitted electron will be.
(a) $> v \left(\frac{4}{3} \right)^{\frac{1}{2}}$ (b) $< v \left(\frac{4}{3} \right)^{\frac{1}{2}}$
(c) $= v \left(\frac{4}{3} \right)^{\frac{1}{2}}$ (d) $= v \left(\frac{3}{4} \right)^{\frac{1}{2}}$

12. In a photoelectric experiment, the wavelength of the light incident on a metal is changed from 300 nm to 400 nm. The decreases in the stopping potential is close to $\left(\frac{hc}{e} = 1240 \text{ nm-V}\right)$
 (a) 0.5 V (b) 1.0 V (c) 2.0 V (d) 1.5 V
13. A particle A of mass 'm' and charge 'q' is accelerated by a potential difference of 50 V. Another particle B of mass '4 m' and charge 'q' is accelerated by a potential difference of 2500 V. The ratio of de - Broglie wavelengths $\frac{\lambda_A}{\lambda_B}$ is close to.
 (a) 10.00 (b) 14.14 (c) 4.47 (d) 0.07
14. The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation
 (a) Phase (b) Intensity
 (c) Amplitude (d) Frequency
15. A particle 'P' is formed due to a completely inelastic collision of particles 'x' and 'y' having de - Broglie wavelength ' λ_x ' and ' λ_y '. If x and y were moving in opposite direction, then the de - Broglie wavelength of 'P' is
 (a) $\lambda_x + \lambda_y$ (b) $\frac{\lambda_x \lambda_y}{\lambda_x + \lambda_y}$
 (c) $\frac{\lambda_x \lambda_y}{|\lambda_x - \lambda_y|}$ (d) $\lambda_x - \lambda_y$
16. The wavelength of the photon emitted by a hydrogen atom when an electron makes a transition
 (a) 194.8 nm (b) 913.3 nm
 (c) 490.7 nm (d) 121.8 nm
17. If an electron is moving in the n^{th} orbit of the hydrogen atom, then its velocity (v_n) for the n^{th} orbit is given as
 (a) $v_n \propto n$ (b) $v_n \propto \frac{1}{n}$ (c) $v_n \propto n^2$ (d) $v_n \propto \frac{1}{n^2}$
18. **Statement I:** By doping silicon semiconductor with pentavalent material, the electron density increases.
Statement II: The n - type semiconductor has net negative charge. In the light of the above statements, choose the most appropriate answer from the options given below.
 (a) Both Statement I and Statement II are false

- (b) Statement I is true but Statement II is false
 (c) Statement I is false but Statement II is true
 (d) Both Statement I and Statement II are true

19. The forward - biased diode connection is



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

Assertion A: Diffusion current in a p - n junction is greater than the drift current in magnitude if the junction is forward biased.

Reason R: Diffusion current in a p - n junction is from then - side to the p - side if the junction is forward biased.

In the light of the above statement choose the most appropriate answer from the option given below

- (a) Both A and R are correct and R is the correct explanation of A
 (b) Both A and R are correct but R is NOT the correct explanation of A
 (c) A is correct but R is not correct
 (d) A is not correct but R is correct

Section - B

Integer Type Questions

21. A particle executes S.H.M with amplitude 'a' and time period 'T'. The displacement of the particle when its speed is half of maximum speed is $\frac{\sqrt{x}a}{2}$. The value of x is
22. A particle executes simple harmonic motion. Its amplitude is 8 cm and time period is 6s. The time it will take to travel from its position of maximum displacement to the point corresponding to half of its amplitude is _____ s
23. The potential energy of a particle of mass 4kg in motion along the x-axis is given by $U = 4(1 - \cos 4x)$ J. The time period of the particle for small oscillation ($\sin \theta = \theta$) is $\left(\frac{\pi}{K}\right)$ s. The value of K is

24. The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is _____cm
25. At a given point of time the value of displacement of a simple harmonic oscillator is given as $y = A\cos(30^\circ)$. If amplitude is 40 cm and kinetic energy at that time is 200 J, the value of force constant is $1.0 \times 10^x \text{ Nm}^{-1}$. The value of x is _____
26. A particle performs simple harmonic motion with a period of 2 second. The time taken by the particle to cover a displacement equal to half of its amplitude from the mean position is $\frac{1}{a}$ s. The value of 'a' to the nearest integer is _____
27. Consider two identical springs each of spring constant k and negligible mass compared to the mass M as shown. Fig. 1 shows one of them and fig. 2 shows their series combination. The ratio period of oscillation of the two SHM is $\frac{T_b}{T_a} = \sqrt{x}$, where value of x is _____ (Round off to the Nearest Integer)

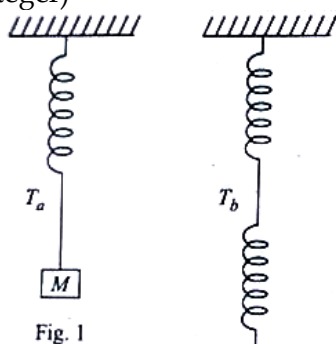
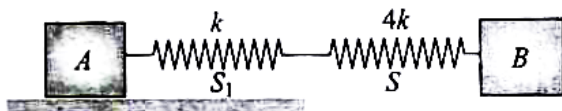


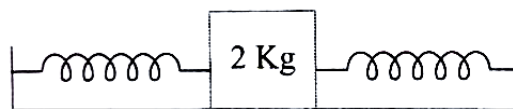
Fig. 1

Fig. 2

28. In the reported figure, two bodies A and B of masses 200 g and 800 g are attached with the system of springs. Springs are kept in a stretched position with some extension when the system is released. The horizontal surface is assumed to be frictionless. The angular frequency will be _____ rad/s when $k = 20 \text{ N/m}$



29. A particle of mass 1 kg is hanging from a spring of force constant 100 Nm^{-1} . The mass is pulled slightly downward and released so that it executes free simple harmonic motion with time period T . The time when the kinetic energy and potential energy of the system will become equal, is $\frac{T}{x}$. The value of x is _____
30. A block of a mass 2kg is attached with two identical springs of spring constant 20 N/m each. The block is placed on a frictionless surface and the ends of the springs are attached to rigid supports (see figure). When the mass is displaced from its equilibrium position, it executes a simple harmonic motion. The time period of oscillation is $\frac{\pi}{\sqrt{x}}$ in SI unit. The value of x is _____

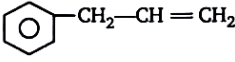
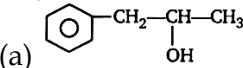
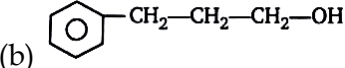
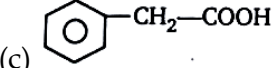
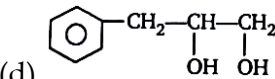


CHEMISTRY

Section - A

Single Choice Question

31. For a cell given below $\text{Ag} | \text{Ag}^+ || \text{Cu}^{2+} | \text{Cu}$
 $\text{Ag}^+ + e^- \longrightarrow \text{Ag}, E^\circ = x$
 $\text{Cu}^{2+} + 2e^- \longrightarrow \text{Cu}, E^\circ = y$
 E° cell is
 (a) $x + 2y$ (b) $2x + 2$ (c) $y - x$ (d) $y - 2x$
32. Given
 $E^\circ_{\text{Cl}_2/\text{Cl}^-} = 1.36$,
 $E^\circ_{\text{Cr}^{3+}/\text{Cr}} = -0.74 \text{ V}$
 $E^\circ_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{+3}} = 1.33 \text{ V}$
 $E^\circ_{\text{MnO}_4^-/\text{Mn}^{2+}} = 1.51 \text{ V}$
 Among the following, the strongest reducing agent is:
 (a) Cr (b) Mn^{2+} (c) Cr^{3+} (d) Cl^-
33. For the redox reaction:
 $\text{Zn}(s) + \text{Cu}^{2+}(0.1\text{M}) \longrightarrow \text{Zn}^{2+}(1\text{M}) + \text{Cu}(s)$
 Taking place in a cell, E°_{Cell} is 1.10 volt. E_{Cell} for the cell will be: $(2.303 \text{ RT/F}) = 0.0591$
 (a) 2.14 V (b) 1.80 V (c) 1.07V (d) 0.82 V

34. For the given cell;
 $Cu(s) | Cu^{2+}(C_1M) || Cu^{2+}(C_2M) | Cu(s)$
 Change in Gibbs energy (ΔG) is negative, if
- (a) $C_1 = C_2$ (b) $C_2 = \frac{C_1}{\sqrt{2}}$
 (c) $C_1 = 2C_2$ (d) $C_2 = \sqrt{2}C_1$
35. When during electrolysis of a solution of $AgNO_3$, 9650 coulombs of charge pass through the electroplating bath, the mass of silver deposited on the cathode will be:
 (a) 1.08 g (b) 10.8 g (c) 21.6 g (d) 108 g
36. Two Faraday of electricity is passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode is:
 (at. mass of Cu = 63.5 u)
 (a) 0 g (b) 63.5 g (c) 2 g (d) 127 g
37. How much glucose (molecular weight = 180 gm/mol) should be added to 200 gm H_2O so that when solution is cooled to $-0.5^\circ C$, 14 gm of ice separates out of solution:
 [Take $K_f = 1.86 K \text{ kg/mol}$ and melting point of $H_2O = 0^\circ C$]
 (a) 9 gm (b) 18 gm (c) 0.9 gm (d) N.O.T.
38. One the basis of information given below mark the correct option, Information:
- (i) In bromoethane and chloroethane mixture intermolecular interactions of $A-A$ and $B-B$ type are nearly same as $A-B$ type interactions
- (ii) In ethanol and acetone mixture $A-A$ or $B-B$ type intermolecular interactions are stronger than $A-B$ type interactions
- (iii) In chloroform and acetone mixture $A-A$ or $B-B$ type intermolecular interactions are weaker than $A-B$ type interactions
- (a) Solution (ii) and (iii) will follow Raoult's law.
 (b) Solution (i) will follow Raoult's law
 (c) Solution (ii) will show negative deviation from Raoult's law.
 (d) Solution (iii) will show positive deviation from Raoult's law.
39. A storage battery contains a solution of H_2SO_4 38% by weight. What will be the van't Hoff factor if the $\Delta T_{f(\text{experiment})}$ is 29.08 [Given $K_f = 1.86 K \text{ mol}^{-1} \text{ kg}$]
 (a) 2 (b) 2.5 (c) 3 (d) 4
40. The Henry's law constant for the solubility of N_2 gas in water at 298 K is $1.0 \times 10^5 \text{ atm}$. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is:
 (a) 4.0×10^{-4} (b) 4.0×10^{-5}
 (c) 5.0×10^{-4} (d) 4.0×10^{-5}
41. 2 - methylbutane on reacting with bromine in the presence of sunlight gives mainly:
 (a) 2 - bromo - 2 - methylbutane
 (b) 1 - bromo - 2 - methylbutane
 (c) 1 - bromo - 3 - methylbutane
 (d) 2 - bromo - 3 - methylbutane
42. 
 on mercuration - demercuration produces the major product:
- (a) 
 (b) 
 (c) 
 (d) 
43. In the presence of peroxide, HCl and HI do not give anti - Markownikoff's addition to alkenes because:
 (a) All the steps are exothermic in HCl and HI
 (b) One of the steps is endothermic in HCl and HI
 (c) HCl is oxidizing and the HI is reducing
 (d) Both HCl and HI are strong acids
44. Which one of the following alkenes when treated with HCl yields majority an anti - Markownikoff product?
 (a) $F_3C-CH=CH_2$ (b) $Cl-CH=CH_2$
 (c) $CH_3O-CH=CH_2$ (d) $H_2N-CH=CH_2$
45. The reagent needed for converting
- $$Ph-C \equiv C-Ph \longrightarrow \begin{array}{c} Ph \\ \diagdown \\ C \\ \diagup \\ H \end{array} = \begin{array}{c} H \\ \diagup \\ C \\ \diagdown \\ Ph \end{array}$$
- is
 (a) H_2 /Lindlar cat. (b) Cat. Hydrogenation
 (c) $LiAlH_4$ (d) Li/NH_3

46. The oxidation states of Cr in $[Cr(H_2O)_6]Cl_3$, $[Cr(C_6H_6)_2]$, and $K_2[Cr(CN)_2(O)_2(O_2)(NH_3)]$ respectively are:
 (a) +3, +2 and +4 (b) +3, 0, and +6
 (c) +3, 0, and +4 (d) +3, +4, and +6

47. Which of the following name formula combination is not correct?

	Formula	Name
(a)	$K[Cr(NH_3)_2Cl_4]$	Potassium diammine tetrachlorochromate (III)
(b)	$[Co(NH_3)_4(H_2O)I]SO_4$	Tetraammine aquaiodo cobalt (III) sulphate
(c)	$[Mn(CN)_5]^{2-}$	Pentacyanomagnate (II) ion
(d)	$K_2[Pt(CN)_4]$	Potassium tetracyanoplatinate (II)

48. Given below are two statements:

Statement I: The identification of Ni^{2+} is carried out by dimethyl glyoxime in the presence of NH_4OH .

Statement II: The dimethyl glyoxime is a bidentate neutral ligand.

In the light of the above statements, choose the correct answer from the options given below.

- (a) Statement I is false but statement II is true
 (b) Both Statement I and Statement II are false
 (c) Statement I is true but Statement II is false
 (d) Both Statement I and Statement II are true

49. Match List - I with List - II

	List - I		List - II
(A)	$[Co(NH_3)_6][Cr(CN)_6]$	(i)	Linkage isomerism
(B)	$[Co(NH_3)_3(NO_2)_3]$	(ii)	Solvate isomerism
(C)	$[Cr(H_2O)_6]Cl_3$	(iii)	Co-ordination isomerism
(D)	$cis-[CrCl_2(ox)_2]^{3-}$	(iv)	Optical isomerism

Choose the correct answer from the options given below.

- (a) (A) - (iii), (B) - (i), (C) - (ii), (D) - (iv)
 (b) (A) - (iv), (B) - (ii), (C) - (iii), (D) - (i)
 (c) (A) - (ii), (B) - (i), (C) - (iii), (D) - (iv)
 (d) (A) - (i), (B) - (ii), (C) - (iii), (D) - (iv)
50. Consider the following reaction and statements:
 $[Co(NH_3)_4Br_2]^+ + Br^- \rightarrow [Co(NH_3)_3Br_3] + NH_3$
 (I) Two isomers are produced if the reactant complex ion is a *cis*-isomer.
 (II) Two isomers are produced if the reactant complex ion is a *trans*-isomer
 (III) Only one isomer is produced if the reactant complex ion is a *trans*-isomer.

- (IV) Only one isomer is produced if the reactant complex ion is a *cis*-isomer

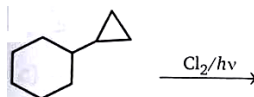
The correct statements are:

- (a) (I) and (III) (b) (III) and (IV)
 (c) (II) and (IV) (d) (I) and (II)

SECTION - B

Integer Type Questions

51. An oxidation reduction in which 3 electrons are transferred has a ΔG° of $17.37 \text{ kJ mol}^{-1}$ at 25°C . The value of E_{cell}° (in V is $____ \times 10^{-2}$) ($1F = 96500 \text{ C mol}^{-1}$)
52. For an element 'X' the process of oxidation is :
 $X_2O_4^{2-} \rightarrow \text{New compound}$
 If 965A current when passed for 100 seconds discharged 0.1 mol of $X_2O_4^{2-}$. Find the oxidation state of X in new compound.
53. If 5.79 A current for 20,000 sec, is passed in electrolysis of 0.3 molar, 1 litre $CuSO_4$ (aq). Using Pt electrode then ratio of volume of gas liberated at cathode and anode at STP is $______$.
54. When a current of 0.25 A is passed through molten MCl_x for half an hour, 0.45 g of metal M is deposited at cathode. Calculate x (Given : atomic weight of M = 193)
55. The van't Hoff factor (*i*) for a dilute solution of $K_3[Fe(CN)_6]$ is (assuming 100% ionization).
56. A complex is represented as $CoCl_3 \cdot xNH_3$. It's 0.1 molal solution in aq. Solution shows $\Delta T_f = 0.558^\circ\text{C}$, K_f for H_2O is $1.86 \text{ K mol}^{-1} \text{ kg}$. Assuming 100% ionization of complex and coordination number of Co is six, calculate number of NH_3 molecule in compound.
57. The van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. Its percentage dissociation is:



58. Number of monochlorinated products.

59. Considering that $\Delta_0 > P$, the magnetic moment (in BM) of $[Ru(H_2O)_6]^{2+}$ would be $______$.

60. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d - d transition. The octahedral splitting energy for the above complex is $\underline{\hspace{2cm}} \times 10^{-19}$ J. (Round off to the nearest integer).

$$h = 6.626 \times 10^{-34} \text{ Js}; c = 3 \times 10^8 \text{ ms}^{-1}$$

MATHEMATICS

Section - A

Single Choice Question

61. Let $f: \mathbf{R} \rightarrow \mathbf{R}$ be defined by $f(x) = \frac{4^x}{4^x + 2}$ then $f(x) + f(1-x)$ is equal to
 (a) 3 (b) 4 (c) 2 (d) 1
62. Let $f: \mathbf{R} \rightarrow \mathbf{R}$ be defined $f(x) = x^3 + x^2 + 5x + 2\sin x$
 Then
 (a) f is one-to-one but not onto
 (b) f is onto but not one-to-one
 (c) f is both one-to-one and onto
 (d) f is neither one-to-one nor onto
63. If $z \neq 0$ is a complex number such that $\arg(z) = \pi/4$, then
 (a) $\operatorname{Re}(z^2) = 0$ (b) $\operatorname{Im}(z^2) = 0$
 (c) $\operatorname{Re}(z^2) = \operatorname{Im}(z^2)$ (d) none of these
64. Let α, β be the roots of the equation $x^2 - px + r = 0$ and $\frac{\alpha}{2}, 2\beta$ be the roots of the equation $x^2 - qx + r = 0$. Then the value of r is :
 (a) $\frac{2}{9}(p-q)(2q-p)$ (b) $\frac{2}{9}(q-p)(2p-q)$
 (c) $\frac{2}{9}(q-2p)(2q-p)$ (d) $\frac{2}{9}(2p-q)(2q-p)$
65. If α, β, γ are three real numbers such that $\alpha + \beta + \gamma = 0$, then

$$\Delta = \begin{vmatrix} 1 & \cos \gamma & \cos \beta \\ \cos \gamma & 1 & \cos \alpha \\ \cos \beta & \cos \alpha & 1 \end{vmatrix} =$$

 (a) -1 (b) 0
 (c) 1 (d) $\cos \alpha \cos \beta \cos \gamma$
66. If $A^{20} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, where $A = \begin{bmatrix} 1 & 1 \\ 0 & 2 \end{bmatrix}$, then $a + b + c + d$ is equal to
 (a) 2^{19} (b) 2^{20} (c) 2^{21} (d) 2^{22}

67. If in the expansion of $\left(x^3 - \frac{1}{x^2}\right)^n$ the sum of the coefficients of x^5 and x^{10} is 0, then the coefficient of x^{20} is :
 (a) ${}^{20}C_6$ (b) $-{}^{20}C_6$ (c) ${}^{15}C_5$ (d) $-{}^{15}C_5$
68. If the ratio of sums to n terms of two A.P.'s is $(5n + 7) : (3n + 2)$, then the ratio of their 17th terms is
 (a) 172 : 99 (b) 172 : 101
 (c) 175 : 99 (d) 175 : 101
69. The values of α and β such that $\lim_{x \rightarrow \infty} \left[\frac{x^2 + 1}{x - 1} - \alpha x - 2\beta \right] = \frac{3}{2}$ are
 (a) $\alpha = -1, \beta = \frac{3}{4}$ (b) $\alpha = 1, \beta = -\frac{1}{4}$
 (c) $\alpha = -1, \beta = \frac{5}{4}$ (d) $\alpha = 1, \beta = \frac{-3}{4}$
70. The values of a and b such that the function f defined as

$$f(x) = \begin{cases} ax^2 - b, & |x| < 1 \\ -1/|x|, & |x| \geq 1 \end{cases}$$
 is differentiable are
 (a) $a = 1, b = -1$ (b) $a = 1/2, b = 1/2$
 (c) $a = 1/2, b = 3/2$ (d) none of these
71. For $f(x) = \begin{cases} x \frac{e^{1/x} - e^{-1/x}}{e^{1/x} + e^{-1/x}}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ then
 (a) f is not differentiable at $x = 0$
 (b) f is not continuous at $x = 0$
 (c) $f'(0) = 1$
 (d) $f'(0) = 0$
72. Let f be a function defined on $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ by $f(x) = 3\cos^4 x - 6\cos^3 x - 6\cos^2 x - 3$. Then the range of $f(x)$ is
 (a) $[-12, -3]$ (b) $[-6, -3]$
 (c) $[-6, 3]$ (d) $(-12, 3]$
73. The integral $\int \frac{\cos 4x - 1}{\cot x - \tan x} dx$ is equal to
 (a) $-\frac{1}{2}\cos 4x + C$ (b) $-\frac{1}{4}\cos 4x + C$
 (c) $-\frac{1}{2}\sin 2x + C$ (d) none of these

74. The value of $\int \frac{dx}{5+4\cos x}$ is
 (a) $\frac{1}{3}\tan^{-1}\left(\frac{1}{3}\tan x\right)+C$
 (b) $\frac{1}{3}\tan^{-1}\left(\frac{1}{3}\tan\left(\frac{x}{2}\right)\right)+C$
 (c) $\frac{2}{3}\tan^{-1}\left(\frac{1}{3}\tan x\right)+C$
 (d) $\frac{2}{3}\tan^{-1}\left(\frac{1}{3}\tan\left(\frac{x}{2}\right)\right)+C$
75. Let $f(x) = \int e^x(x-1)(x-2)dx$. Then f decreases in the interval
 (a) $(-\infty, -2)$ (b) $(-2, -1)$
 (c) $(1, 2)$ (d) $(2, \infty)$
76. The integral $\int_{-1/2}^{1/2} \left([x] + 2\log\frac{1+x}{1-x} \right) dx$ equals
 (a) $-1/2$ (b) 0
 (c) 1 (d) $2\log(1/2)$
77. If $\int_{-1}^{3/2} |x \sin \pi x| dx = k/\pi^2$, then the value of k is
 (a) $3\pi+1$ (b) $2\pi+1$
 (c) 1 (d) 4
78. The value of $\int_{e^{-1}}^{e^2} \left| \frac{\log x}{x} \right| dx$ is
 (a) $\frac{3}{2}$ (b) $\frac{5}{2}$ (c) 3 (d) 5
79. If $I_1 = \int_{1/e}^{\tan x} \frac{t}{1+t^2} dt$ and $I_2 = \int_{1/e}^{\cot x} \frac{dt}{t(1+t^2)}$ then the value of $I_1 + I_2$ is
 (a) $\frac{1}{2}$ (b) 1
 (c) $\frac{e}{2}$ (d) $\left(\frac{1}{2}\right)\left(e + \frac{1}{e}\right)$
80. The value of $\int_0^\pi [2\sin x] dx$, where $[]$ represents the greatest integer function is
 (a) π (b) 2π (c) $-\pi$ (d) $\frac{2\pi}{3}$
82. Sum of squares of modulus of all the complex numbers z satisfying $\bar{z} = iz^2 + z^2 - z$ is equal to _____
83. The least positive value of 'a' for which the equation, $2x^2 + (a-10)x + \frac{33}{2} = 2a$ has real roots is _____
84. If $B = \begin{bmatrix} 5 & 2\alpha & 1 \\ 0 & 2 & 1 \\ \alpha & 3 & -1 \end{bmatrix}$ is the inverse of a 3×3 matrix A, then the sum of all values of α for which $\det(A) + 1 = 0$, is
85. The number of real values of λ for which the system of linear equations $2x + 4y - \lambda z = 0$, $4x + \lambda y + 2z = 0$, $\lambda x + 2y + 2z = 0$ has infinitely many solutions, is
86. Let $a, b \in \mathbb{R}, b \neq 0$. Define a function

$$f(x) = \begin{cases} a \sin \frac{\pi}{2}(x-1), & \text{for } x \leq 0 \\ \frac{\tan 2x - \sin 2x}{bx^3}, & \text{for } x > 0 \end{cases}$$
 If f is continuous at $x = 0$, then $10 - ab$ is equal to
87. The surface area of a balloon of spherical shape being inflated, increases at a constant rate. If initially, the radius of balloon is 3 units and after 5 seconds, it becomes 7 units, then its radius after 9 seconds is
88. Let AD and BC be two vertical poles at A and B respectively on a horizontal ground. If AD = 8 m, BC = 11 m and AB = 10 m; then the distance (in meter) of a point M on AB from the point A such that $MD^2 + MC^2$ is minimum is _____.
89. Let the domain of the function $f(x) = \log_4(\log_5(\log_3(18x - x^2 - 77)))$ be (a, b) . Then the value of the integral $\int_a^b \frac{\sin^3 x}{(\sin^3 x + \sin^3(a+b-x))} dx$ is equal to _____.
90. The value of $\int_{-2}^2 |3x^2 - 3x - 6| dx$ is _____

Section - B

Integer Type Questions

81. Let $f(x)$ and $g(x)$ be two real polynomials of degree 2 and 1 respectively. If $f(g(x)) = 8x^2 - 2x$, and $g(f(x)) = 4x^2 + 6x + 1$, then the value of $f(2) + g(2)$ is _____.