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JEE

Time: 3 Hours **M.M. 300**

ALL INDIA SKY TEST SERIES

SAARTHAK BATCH – JEE [12th]

Date : 15/10/2023

SYLLABUS

PHYSICS	CHEMISTRY	MATHEMATICS
Full syllabus (Except Semiconductor)	**Chemical Kinetics + d-f-block + Haloalakanes + Haloarene**	**Previous + Area under the Curve**

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

INSTRUCTIONS:

1. 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.
2. **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

1. Use only **blue/black pen (avoid gel pen)** for darkening the bubble.
2. Indicate the correct answer for each question by filling appropriate bubble in your **OMR** answer sheet.
3. 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**
4. 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. F_g and F_e represents gravitational and electrostatic force respectively between electrons situated at a distance 10 *cm*. The ratio of F_g / F_e is of the order of

(a) 10^{42} (b) 10 (c) 1 (d) 10^{-43}

2. The value of electric permittivity of free space is

(a) $9\times10^{9} NC^2 / m^2$

(b) $8.85\times10^{-12} Nm^2 / C^2$

(c) $8.85\times10^{-12} C^2 / Nm^2$

(d) $9\times10^{9} C^2 / Nm^2$

3. The angular momentum of electron in n^{th} orbit is given by

(a) nh (b) $\frac{h}{2\pi n}$ (c) $n\frac{h}{2\pi}$ (d) $n^2\frac{h}{2\pi}$

4. Two waves are represented by the equations $y_1 = a\sin\omega t$ and $y_2 = a\cos\omega t$. The first wave

(a) Leads the second by π

(b) Lags the second by π

(c) Leads the second by $\frac{\pi}{2}$

(d) Lags the second by $\frac{\pi}{2}$

5. The resistivity of a wire depends on its

(a) Length

(b) Area of cross-section

(c) Shape

(d) Material

6. If the binding energy of the deutrium is 2.23 *MeV*.
The mass defect given in *a.m.u*. is

(a) – 0.0024 (b) – 0.0012

(c) 0.0012 (d) 0.0024

7. The magnetic field $d\vec{B}$ due to a small current element $d\vec{l}$ at a distance $\vec{r}$ and element carrying current *i* is,

or

Vector form of Biot-savart's law is

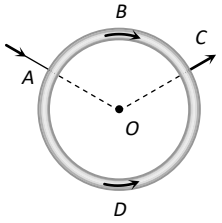
(a) $d\vec{B} = \frac{\mu_0}{4\pi} i\left(\frac{d\vec{l}\times\vec{r}}{r}\right)$ (b) $d\vec{B} = \frac{\mu_0}{4\pi} i^2\left(\frac{d\vec{l}\times\vec{r}}{r}\right)$

(c) $d\vec{B} = \frac{\mu_0}{4\pi} i^2\left(\frac{d\vec{l}\times\vec{r}}{r^2}\right)$ (d) $d\vec{B} = \frac{\mu_0}{4\pi} i\left(\frac{d\vec{l}\times\vec{r}}{r^3}\right)$

8. Ratio of amplitude of interfering waves is 3 : 4. Now ratio of their intensities will be

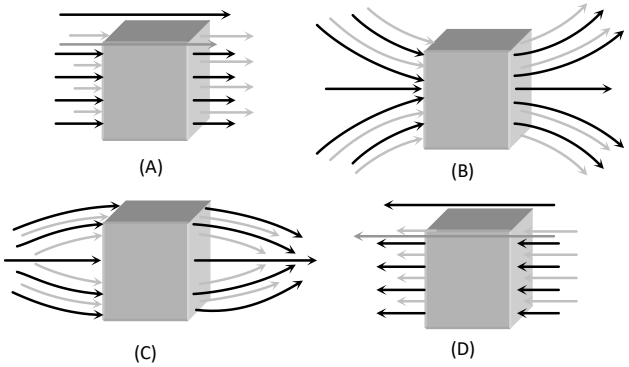
(a) $\frac{16}{9}$ (b) 49 : 1 (c) $\frac{9}{16}$ (d) N.O.T.

9. A uniform wire is bent in the form of a circle of radius *R*. A current *I* enters at *A* and leaves at *C* as shown in the figure : If the length *ABC* is half of the length *ADC*, the magnetic field at the centre *O* will be



(a) Zero (b) $\frac{\mu_0 I}{2R}$ (c) $\frac{\mu_0 I}{4R}$ (d) $\frac{\mu_0 I}{6R}$

10. A uniform magnetic field, parallel to the plane of the paper existed in space initially directed from left to right. When a bar of soft iron is placed in the field parallel to it, the lines of force passing through it will be represented by



(a) Figure (A) (b) Figure (B)

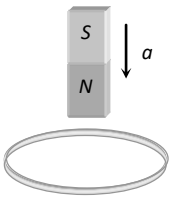
(c) Figure (C) (d) Figure (D)

11. The magnetic flux linked with a coil is given by an equation φ (in *webers*) = $8t^2 + 3t + 5$. The induced e.m.f. in the coil at the fourth second will be

(a) 16 *units* (b) 39 *units*

(c) 67 *units* (d) 145 *units*

12. A metallic ring is attached with the wall of a room. When the north pole of a magnet is brought near to it, the induced current in the ring will be



(a) First clockwise then anticlockwise
(b) In clockwise direction
(c) In anticlockwise direction
(d) First anticlockwise then clockwise

13. If E_0 represents the peak value of the voltage in an ac circuit, the *r.m.s.* value of the voltage will be

(a) $\frac{E_0}{\pi}$ (b) $\frac{E_0}{2}$ (c) $\frac{E_0}{\sqrt{\pi}}$ (d) $\frac{E_0}{\sqrt{2}}$

14. The ratio of the energies of the hydrogen atom in its first to second excited state is
(a) 1/ 4 (b) 4/9 (c) 9/ 4 (d) 4

15. The average power dissipated in a pure inductor of inductance L when an ac current is passing through it, is

(a) $\frac{1}{2}LI^2$ (b) $\frac{1}{4}LI^2$ (c) $2Li^2$ (d) Zero

16. The ratio of momenta of an electron and an $\alpha-$particle which are accelerated from rest by a potential difference of 100 V is

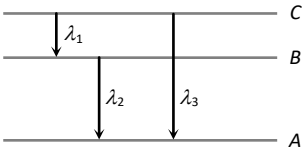
(a) 1 (b) $\sqrt{\frac{2m_e}{m_\alpha}}$ (c) $\sqrt{\frac{m_e}{m_\alpha}}$ (d) $\sqrt{\frac{m_e}{2m_\alpha}}$

17. The momentum of a photon of energy $h\nu$ will be
(a) $h\nu$ (b) $h\nu/c$ (c) $h\nu c$ (d) h/ν

18. The approximate wavelength of a photon of energy 2.48 eV is
(a) 500 $\AA$ (b)5000 $\AA$
(c) 2000 $\AA$ (d) 1000 $\AA$

19. The work function of a metallic surface is 5.01 eV. The photo-electrons are emitted when light of wavelength 2000$\AA$ falls on it. The potential difference applied to stop the fastest photo-electrons is $[h = 4.14\times10^{-15}\ eV\,\text{sec}]$
(a) 1.2 *volts* (b) 2.24 *volts*
(c) 3.6 *volts* (d) 4.8 *volts*

20. Energy levels A, B, C of a certain atom corresponding to increasing values of energy *i.e.* $E_A < E_B < E_C$. If $\lambda_1, \lambda_2, \lambda_3$ are the wavelengths of radiations corresponding to the transitions C to B, B to A and C to A respectively, which of the following statements is correct



(a) $\lambda_3 = \lambda_1 + \lambda_2$ (b) $\lambda_3 = \frac{\lambda_1\lambda_2}{\lambda_1+\lambda_2}$
(c) $\lambda_1 + \lambda_2 + \lambda_3 = 0$ (d) $\lambda_3^2 = \lambda_1^2 + \lambda_2^2$

Section - B

Integer Type Questions

21. 5 *amperes* of current is passed through a metallic conductor. The charge flowing in one minute in coulombs is $10x$ then x is

22. The frequency of ac mains in India is (in Hz)

23. The average binding energy per nucleon in the nucleus of an atom is approximately (in MeV)

24. A man runs towards mirror at a speed of $15\,m/s$. Then the speed of his image (in m/s)

25. The image formed by a convex mirror of focal length $30cm$ is a quarter of the size of the object. The distance of the object from the mirror is (in *cm*)

26. The wavelength of light in two liquids 'x' and 'y' is 3500 Å and 7000 Å, then the critical angle of x relative to y will be (in degree)

27. A long solenoid is formed by winding 20 *turns/cm*. The current necessary to produce a magnetic field of 20 *millitesla* inside the solenoid will be approximately (in A)

$(\frac{\mu_0}{4\pi} = 10^{-7}\ tesla - metre/ampere)$

28. If two waves represented by $y_1 = 4\sin\omega t$ and $y_2 = 3\sin\left(\omega t + \frac{\pi}{3}\right)$ interfere at a point, the amplitude of the resulting wave will be about

29. The resistance of a wire is 10Ω. Its length is increased by 10% by stretching. The new resistance will now be (in Ω)

30. The power rating of an electric motor which draws a current of 3.75 *amperes* when operated at 200 *V* is about (in H.P.)

CHEMISTRY

Section - A

Single Choice Question

31. Among the following series of transition metal ions, the one where all the metal ions have $3d^2$ configuration is :
(a) $Ti^{+3}, V^{+2}, Cr^{+3}, Mn^{+4}$
(b) $Ti^{+2}, V^{+3}, Cr^{+4}, Mn^{+5}$
(c) $Ti^{+}, V^{+4}, Cr^{+6}, Mn^{+7}$
(d) $Ti^{+2}, V^{+3}, Cr^{+2}, Mn^{+3}$

32. Which of the following factor may be regarded as the main cause of Lanthanide contraction?
(a) Poor shielding of one of the 4f-electrons by another in the sub-shell.
(b) Effective shielding of one of the 4f-electrons by another in the sub-shell.
(c) Poorer shielding of 5d electron by 4f electrons.
(d) Greater shielding of 5d electron by 4f electron.

33. Spin-only magnetic moment of $[Co(NH_3)_3(H_2O)_3]Cl_3$ (in Bohr Magnetons) is
(a) Zero (b) $\sqrt{3}$ (c) $\sqrt{24}$ (d) $\sqrt{35}$

34. Which of the following statement is correct?
(a) Allotropy of sulphur arises partly because of the great variety of molecular forms that can be achieved by –S-S- catenation and partly because of the numerous ways in which the molecules to formed can be arranged within the crystal.
(b) Both rhombic and monoclinic sulphur have S_8 molecules and, therefore, possess same value of specific gravities.
(c) Ozone on reaction with Kl solution buffered with a borate buffer (pH 9.2) yields potassium iodate.
(d) The ozone layer protects the earth's surface from an excessive concentration of mainly infrared (IR) radiations.

35. Thermally most stable compound is :
(a) $HOClO_3$ (b) $HOClO_2$
(c) $HOCl$ (d) $HOClO$

36. Which is the correct sequence in the following properties. For the correct order mark (T) and for the incorrect order mark (F) :
(A) Melting point :
$NH_3 > SbH_3 > AsH_3 > PH_3$
(B) Boiling point : $NH_3 > SbH_3 > AsH_3 > PH_3$
(C) Dipole moment order :
$NH_3 > SbH_3 > AsH_3 > PH_3$
(a) TFT (b) FTF (c) FTT (d) FTF

37. The IUPAC name for the complex $[Co(NO_2)(NH_3)_5]Cl_2$ is :
(a) nitrito-N-pentaamminecobalt (III) chloride
(b) nitrito-N-pentaamminecobalt(II) chloride
(c) pentaamminenitrito-N-cobalt(II) chloride
(d) pentaamminenitrito-N-cobalt(III) chloride

38. Amongst the following, the most stable complex is
(a) $[Co(NH_3)_6]^{3+}$ (b) $[Co(C_2O_4)_3]^{3-}$
(c) $[Co(H_2O)_6]^{3+}$ (d) $[CoF_6]^{3-}$

39. $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$ are examples of which of the following types of isomerism ?
(a) Linkage (b) Geometrical
(c) Ionization (d) Optical isomerism

40. Among $[Ni(CO)_4], [NiCl(PPh_3)_3]$ and $[Ni(PPh_3)_4]$
(a) $[Ni(CO_4)]$ and $[NiCl(PPh_3)_3]$ are diamagnetic and $[Ni(PPh_3)_4]$ is paramagnetic
(b) $[Ni(CO)_4]$ and $[Ni(PPh_3)_4]$ are diamagnetic and $[NiCl(PPh_3)_3]$ is paramagnetic
(c) $[NiCl(PPh_3)_3]$ and $[Ni(CO)_4]$ are paramagnetic and $[Ni(PPh_3)_4]^{4-}$ is diamagnetic

(d) $[NiCl(PPh_3)_3]$ and $[Ni(PPh_3)_4]^{4-}$ are paramagnetic and $[Ni(CO)_4]$ is diamagnetic

41. Which of the following is an oxidizing agent ?
(a) $Mn(CO)_5$ (b) $Fe(CO)_5$
(c) $Mn_2(CO)_{10}$ (d) $Fe_2(CO)_9$

42. Select the correct code about complex $[Cr(NO_2)(NH_3)_5][ZnCl_4]$:
(I) IUPAC name of compound is pentaamminenitrito-N-chromium
(III) tetrachlorozincate (II)
(II) It shows geometrical isomerism
(III) It shows linkage isomerism
(IV) It shows coordination isomerism
(a) III, IV (b) I, III and IV
(c) II, III and IV (d) I, II, III and IV

43. Maximum freezing point will be for 1 molal solution of assuming equal ionisation in each case
(a) $[Fe(H_2O)_6]Cl_3$
(b) $[Fe(H_2O)_5Cl]Cl_2.H_2O$
(c) $[Fe(H_2O)_4Cl_2]Cl.2H_2O$
(d) $[Fe(H_2O)_3Cl_3].3H_2O$

44. Osmotic pressure at 300 k when 1g glucose (P_1), 1 g urea (P_2) and 1 g sucrose (P_3) are dissolved in 500 ml of water are follows the order.
(a) $P_1 > P_2 > P_3$ (b) $P_2 > P_1 > P_3$
(c) $P_3 > P_1 > P_2$ (d) $P_2 > P_3 > P_1$

45. The freezing point of a 5 g CH_3COOH (aq) per 100 g water is -1.576^oC. The van't Hoff factor (K_f of water = 1.86 K mol^{-1} kg) :
(a) 0.996 (b) 2
(c) 0.5 (d) 1.016

46. 106.2 g 1 molal aqueous solution of ethylene glycol is cooled to -3.72^oC. Mass of ice separated during cooling is (K_f water = 1.86, freezing point of water = 0^oC)
(a) 25g (b) 50 g (c) 0.48 g (d) 40 g

47. Calculate molar conductivity of HCOOH at infinite dilution, if equivalent conductivity of $H_2SO_4 = x_1$, $Al_2(SO_4)_3 = x_2$ $(HCOO)_3Al = x_3$
(a) $6x_1 - 3x_2 + 6x_3$ (b) $\frac{x_1 - x_2 + x_3}{6}$
(c) $x_1 - x_2 + x_3$ (d) $\frac{6x_1 - 3x_2 + 6x_3}{6}$

48. Equivalent conductivity of $Fe_2(SO_4)_3$ is related to molar conductivity by the expression :
(a) $\wedge_{eq} = \wedge_m$ (b) $\wedge_{eq} = \lambda_m / 3$
(c) $\wedge_{eq} = 3 \wedge_m$ (d) $\wedge_{eq} = \wedge_m / 6$

49. Fraction of the total volume occupied by atoms in a simple cube is :
(a) $\pi / 6$ (b) $\sqrt{3\pi} / 18$
(c) $\sqrt{2\pi} / 6$ (d) $\pi / 3$

50. In a face centred cubic arrangement of A and B atoms whose A atoms are at the corner of the unit cell and B atoms at the face centres. One of the A atom is missing from one corner in unit cell. The simplest formula of the compound is
(a) A_7B_3 (b) AB_3
(c) A_7B_{24} (d) A_2B_3

Section - B

Integer Type Questions

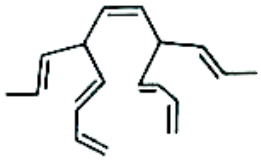
51. How many of the given chemicals liberates dinitrogen on heating
$NH_4NO_2, NaN_3, (NH_4)_2Cr_2O_7, Pb(NO_3)_2, Ba(N_3)_2$

52. $XeF_6 + H_2O(1\,mol) \rightarrow A + 2HF$, A has x sigma-bond, y pi-bond and z lone pair, then $x + y + z$ is.

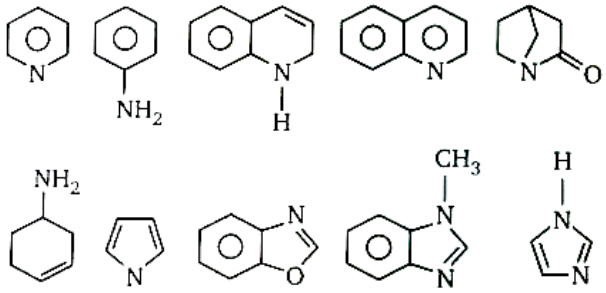
53. Consider the following complex $[Co(NH_3)_5CO_3]ClO_4$. The coordination number **(x),** oxidation number **(y)** number of d-electrons **(z)** and number of unpaired d-electrons **(w)** on the metal are respectively
x + y + z + w = ?

54. Which of the following complexes are more stable due to sidgwick rule.
(a) $Fe(CO)_5$ (b) $Co_2(CO)_8$
(c) $Fe(C_5H_5)_2$ (d) $[K_3Fe(CN)_6]$
(e) $Fe(NO)_2(CO)_2$ (d) $[CoF_6]^{4-}$

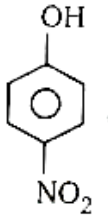
55. Number of hydrogen that can participate in hyper conjugation.



56. How many of following compounds of nitrogen have at least one nitrogen's lone pair in conjugation.



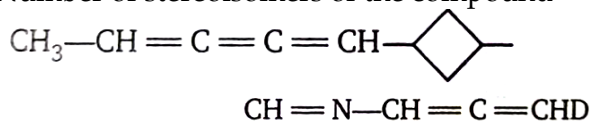
57. How many of the following compounds will lead to evolution of CO_2 gas from $NaHCO_3$ solution /



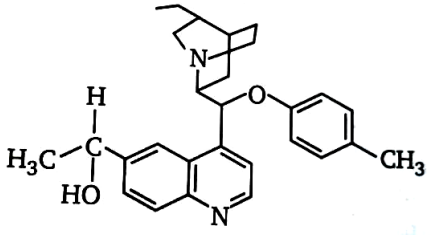
, EtOH, $R-C\equiv CH$

58. A KCl solution of conductivity of 0.14 Sm^{-1} shows a resistance of 4.19Ω in a conductivity cell. If the same cell is filled with an HCl solution, the resistance drops to 1.03Ω. The conductivity of the HCl solution is ___ $\times 10^{-2} Sm^{-1}$.

59. Number of stereoisomers of the compound



60. The number of chiral carbons present in the molecule given below is :



MATHEMATICS

Section - A

Single Choice Question

61. Let $f(n)=\left[\frac{1}{3}+\frac{3n}{100}\right]n$, where $[n]$ denotes the greatest integer less than or equal to n. Then $\sum_{n=1}^{56} f(n)$ is equal to :

(a) 56 (b) 689 (c) 1287 (d) 1399

62. The range of the function

$f(x)=\frac{x}{1+|x|}, x\in R$, is

(a) R (b) $(-1,1)$

(c) R – {0} (d) $[-1,1]$

63. The domain of the function $f(x)=\frac{1}{\sqrt{|x|-x}}$ is

(a) $(0,\infty)$ (b) $(-\infty,0)$

(c) $(-\infty,\infty)-\{0\}$ (d) $(-\infty,\infty)$

64. The domain of the function $f(x)=\frac{\sin^{-1}(x-3)}{\sqrt{9-x^2}}$ is

(a) [1, 2) (b) [2, 3) (c) [1, 2] (d) [2, 3]

65. $\tan\left(2\tan^{-1}\frac{1}{5}+\sec^{-1}\frac{\sqrt{5}}{2}+2\tan^{-1}\frac{1}{8}\right)$ is equal to :

(a) 1 (b) 2 (c) $\frac{1}{4}$ (d) $\frac{5}{4}$

66. If $\cos^{-1}x-\cos^{-1}\frac{y}{2}=\alpha$, where

$-1\le x\le 1, -2\le y\le 2, x\le\frac{y}{2}$, then for all x, y, $4x^2-4xy\cos\alpha+y^2$ is equal to :

(a) $4\sin^2\alpha$ (b) $2\sin^2\alpha$

(c) $4\sin^2\alpha-2x^2y^2$ (d) $4\cos^2\alpha+2x^2y^2$

67. If the system of equations

$x+y+z=6$

$2x+5y+\alpha z=\beta$

$x+2y+3z=14$

has infinitely many solutions, then $\alpha+\beta$ is equal to :

(a) 8 (b) 36 (c) 44 (d) 48

68. The number of values of k for which the linear equations $4x+ky+2z=0, kx+4y+z=0$ and $2x+2y+z=0$ possess a non-zero solution is
(a) 2 (b) 1 (c) zero (d) 3

69. Let A and B be any two 3×3 symmetric and skew symmetric matrices respectively. Then which of the following is **not** true?
(a) $A^4 - B^4$ is a symmetric matrix
(b) AB – BA is a symmetric matrix
(c) $B^5 - A^5$ is a skew-symmetric matrix
(d) AB + BA is a skew-symmetric matrix

70. If A is a symmetric matrix and B is a skew-symmetric matrix such that $A+B=\begin{bmatrix}2 & 3\\ 5 & -1\end{bmatrix}$, then AB is equal to :
(a) $\begin{bmatrix}-4 & -1\\ -1 & 4\end{bmatrix}$ (b) $\begin{bmatrix}4 & -2\\ -1 & -4\end{bmatrix}$
(c) $\begin{bmatrix}4 & -2\\ 1 & -4\end{bmatrix}$ (d) $\begin{bmatrix}-4 & 2\\ 1 & 4\end{bmatrix}$

71. The value of k for which the function $f(x)=\begin{cases}\left(\frac{4}{5}\right)^{\frac{\tan 4x}{\tan 5x}}, & 0<x<\frac{\pi}{2}\\ k+\frac{2}{5}, & x=\frac{\pi}{2}\end{cases}$ is continuous at $x=\frac{\pi}{2}$, is :
(a) $\frac{17}{20}$ (b) $\frac{2}{5}$ (c) $\frac{3}{5}$ (d) $-\frac{2}{5}$

72. Let k be a non-zero real number.
If $f(x)=\begin{cases}\frac{(e^x-1)^2}{\sin\left(\frac{x}{k}\right)\log\left(1+\frac{x}{4}\right)}, & x\neq 0\\ 12, & x=0\end{cases}$
is a continuous function then the value of k is :
(a) 4 (b) 1 (c) 3 (d) 2

73. Let f be a composite function of x defined by $f(u)=\frac{1}{u^2+u-2}, u(x)=\frac{1}{x-1}$. Then the number of points x where f is discontinuous is :
(a) 4 (b) 3 (c) 2 (d) 1

74. If $x=\sqrt{2^{\operatorname{cosec}^{-1}t}}$ and $y=\sqrt{2^{\sec^{-1}t}}$ $(|t|\geq 1)$, then $\frac{dy}{dx}$ is equal to.
(a) $\frac{y}{x}$ (b) $-\frac{y}{x}$ (c) $-\frac{x}{y}$ (d) $\frac{x}{y}$

75. For $a>0, t\in\left(0,\frac{\pi}{2}\right)$, let $x=\sqrt{a^{\sin^{-1}t}}$ and $y=\sqrt{a^{\cos^{-1}t}}$, Then $1+\left(\frac{dy}{dx}\right)^2$ equals :
(a) $\frac{x^2}{y^2}$ (b) $\frac{y^2}{x^2}$
(c) $\frac{x^2+y^2}{y^2}$ (d) $\frac{x^2+y^2}{x^2}$

76. A spherical balloon is being inflated at the rate of 35 cc/min. The rate of increase in the surface area (in cm^2/min.) of the balloon when its diameter is 14 cm, is :
(a) 10 (b) $\sqrt{10}$ (c) 100 (d) $10\sqrt{10}$

77. Let $f(x) = 3\sin^4 x + 10\sin^3 x + 6\sin^2 x - 3$, $x\in\left[-\frac{\pi}{6},\frac{\pi}{2}\right]$. Then, f is
(a) increasing in $\left(-\frac{\pi}{6},\frac{\pi}{2}\right)$
(b) decreasing in $\left(0,\frac{\pi}{2}\right)$
(c) increasing in $\left(-\frac{\pi}{6},0\right)$
(d) decreasing in $\left(-\frac{\pi}{6},0\right)$

78. The tangent to the curve $y=x^2-5x+5$, parallel to the line $2y=4x+1$, also passes through the point :
(a) $\left(\frac{7}{2},\frac{1}{4}\right)$ (b) $\left(\frac{1}{8},-7\right)$
(c) $\left(-\frac{1}{8},7\right)$ (d) $\left(\frac{1}{4},\frac{7}{2}\right)$

79. Let $f(x)=4x^3-11x^2+8x-5, x\in R$. Then f :
(a) has a local minima at $x=\frac{1}{2}$
(b) has a local minima at $x=\frac{3}{4}$
(c) is increasing in $\left(\frac{1}{2},\frac{3}{4}\right)$
(d) is decreasing in $\left(\frac{1}{2},\frac{4}{3}\right)$

80. The minimum value of $2^{\sin x}+2^{\cos x}$ is :

(a) $2^{-1+\frac{1}{\sqrt{2}}}$ (b) $2^{-1+\sqrt{2}}$

(c) $2^{1-\sqrt{2}}$ (d) $2^{1-\frac{1}{\sqrt{2}}}$

SECTION - B

Integer Type Questions

81. $50\tan\left(3\tan^{-1}\left(\frac{1}{2}\right)+2\cos^{-1}\left(\frac{1}{\sqrt{5}}\right)\right)+$ $4\sqrt{2}\tan\left(\frac{1}{2}\tan^{-1}(2\sqrt{2})\right)$ is equal to _____.

82. If $P=\begin{bmatrix}1 & \alpha & 3\\ 1 & 3 & 3\\ 2 & 4 & 4\end{bmatrix}$ is the adjoint of a 3×3 matrix A and $|A| = 4$, then α is equal to :

83. If the function

$$f(x)=\begin{cases}(1+|\cos x|)\dfrac{\lambda}{|\cos x|} & , \quad 0<x<\dfrac{\pi}{2}\\ \mu & , \quad x=\dfrac{\pi}{2}\\ e^{\frac{\cot 6x}{\cot 4x}} & , \quad \dfrac{\pi}{2}<x<\pi\end{cases}$$ is

continuous at $x=\frac{\pi}{2}$, then

$9\lambda+6\log_e\mu+\mu^6-e^{6\lambda}$ is equal to

84. Let $a, b \in R, b \neq 0$, Define a function

$$f(x)=\begin{cases}a\sin\dfrac{\pi}{2}(x-1), & \text{for } x\le 0\\ \dfrac{\tan 2x-\sin 2x}{bx^3}, & \text{for } x>0\end{cases}$$

If f is continuous at $x = 0$, then 10 – ab is equal to _____

85. Let a function $f : \mathbf{R} \to \mathbf{R}$ be defined as

$$f(x)=\begin{cases}\sin x-e^x & \text{if} \quad x\le 0\\ a+[-x] & \text{if} \quad 0<x<1\\ 2x-b & \text{if} \quad x\ge 1\end{cases}$$

where $[x]$ is the greater integer less than or equal to x. If f is continuous on **R**, then (a + b) is equal to :

86. If $y = y(x)$ is an implicit function of x such that $\log_e(x + y) = 4xy$, then $\frac{d^2y}{dx^2}$ at $x = 0$ is equal to _____.

87. The number of real solutions of $x^7+5x^3+3x+1=0$ is equal to _____.

88. The number of distinct real roots of the equation $x^7 – 7x – 2 = 0$ is

89. Let $f(x)$ be a cubic polynomial with $f(1) = –10$, $f(–1) = 6$, and has a local minima at $x = 1$, and $f'(x)$ has a local minima at $x = –1$. Then $f(3)$ is equal to _____

90. Let M and m be respectively the absolute maximum and the absolute minimum values of the function, $f(x) = 2x^3 – 9x^2 + 12x + 5$ in the interval [0, 3]. Then M – m is equal to