JEE Main

MOCK TEST - 7

Instructions:

I. The JEE Main Test Paper consists of one paper containing 60 objective questions (four options with single correct answer) and 30 numerical value type questions from the syllabus of Physics, Chemistry and Mathematics.
II. The duration of paper would be 3 hours (180 minutes).
III. There will be total 90 questions : Physics - 30, Chemistry - 30, Mathematics - 30.
IV. Each question will carry 4 marks. For each correct response the applicant will be awarded four marks. For each incorrect answer there will be deduction of one mark.
V. There will be no negative marking for unattended questions. More than one answer of single question will also be considered as incorrect response and will be negatively marked.

Max. Marks : 300 **Time :** 180 minutes

PHYSICS

Section-A (Multiple Choice Questions)

1. A coil in the shape of an equilateral triangle of side l is suspended between the pole pieces of a permanent magnet, such that $\vec{B}$ is in plane of the coil. If due to a current I in the triangle, a torque $\vec{\tau}$ acts on it, the side l of the triangle is

(a) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{BI}\right)$ (b) $2\left(\frac{\tau}{\sqrt{3}BI}\right)^{1/2}$

(c) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{BI}\right)^{1/2}$ (d) $\frac{1}{\sqrt{3}}\left(\frac{\tau}{BI}\right)$

2. A long insulated copper wire is closely wound as a spiral of N turns. The spiral has inner radius a and outer radius b. The spiral lies in the X-Y plane and a steady current I flows through the wire.
The Z-component of the magnetic field at the centre of the spiral is

(a) $\frac{\mu_0 NI}{2(b-a)}\ln\left(\frac{b}{a}\right)$ (b) $\frac{\mu_0 NI}{2(b-a)}\ln\left(\frac{b+a}{b-a}\right)$

(c) $\frac{\mu_0 NI}{2b}\ln\left(\frac{b}{a}\right)$ (d) $\frac{\mu_0 NI}{2b}\ln\left(\frac{b+a}{b-a}\right)$

3. A particle moves in the x-y plane under the influence of a force such that its linear momentum is $\vec{p}(t)=A[\hat{i}\cos(kt)-\hat{j}\sin(kt)]$, where A and k are constants. The angle between the force and the momentum is

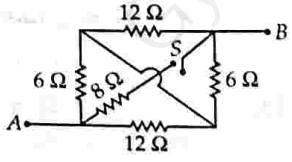
(a) 0° (b) 30° (c) 45° (d) 90°

4. A body of mass m is moving in a circular orbit of radius R about a planet of mass M. At some instant, it splits into two equal masses. The first mass moves in a circular orbit of radius $\frac{R}{2}$, and the other mass, in a circular orbit of radius $\frac{3R}{2}$. The difference between the final and initial total energies is

(a) $+\frac{GMm}{6R}$ (b) $\frac{GMm}{2R}$

(c) $-\frac{GMm}{2R}$ (d) $-\frac{GMm}{6R}$

5. The equivalent resistance between points A and B with switch S open and closed are respectively



(a) 4 Ω, 8 Ω (b) 8 Ω, 4 Ω
(c) 6 Ω, 9 Ω (d) 9 Ω, 6 Ω

6. When a dc voltage of 200 V is applied to a coil of self inductance $(2\sqrt{3}/\pi)$ H, a current of 1 A flows through it. But by replacing dc source with ac source of 200 V, the current in the coil is reduced to 0.5 A. Then the frequency of ac supply is
(a) 100 Hz (b) 75 Hz
(c) 60 Hz (d) 50 Hz

7. The magnitude of gravitational potential energy of the moon-earth system is U with zero potential energy at infinite separation. The kinetic energy of the moon with respect to the earth is K. Then
(a) $U < K$ (b) $U > K$.
(c) $U = K$ (d) $U = K/2$

8. The maximum wavelength of radiation that can produce photoelectric effect in certain metal is 200 nm. The maximum kinetic energy acquired by electron due to radiation of wavelength 100 nm will be
(a) 12.4 eV (b) 6.2 eV
(c) 100 eV (d) 200 eV

9. The speed of light (c), acceleration due to gravity (g) and pressure (P) are taken as fundamental units, the dimensions of gravitational constant (G) are
(a) $[c^0gP^{-3}]$ (b) $[c^2g^3P^{-2}]$
(c) $[c^0g^2P^{-1}]$ (d) $[c^2g^2P^{-2}]$

10. Two iron balls of radii r_1 and r_2 and masses m_1 and m_2, respectively, are allowed to fall in a liquid. The ratio of their terminal velocities v_1/v_2, will be
(a) $\frac{r_1}{r_2}$ (b) $\frac{r_2}{r_1}$ (c) $\frac{m_1r_1}{m_2r_2}$ (d) $\frac{m_1r_2}{m_2r_1}$

11. A student performs an experiment for determination of $g\left(=\frac{4\pi^2 l}{T^2}\right)$. The error in length l is Δl and in time T is ΔT and n is number of times the reading is taken. The measurement of g is most accurate for

	Δl	ΔT	n
(a)	5 mm	0.2 s	10
(b)	5 mm	0.2 s	20
(c)	5 mm	0.1 s	10
(d)	1 mm	0.1 s	50

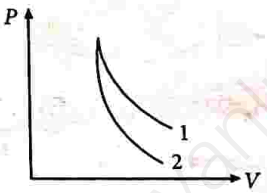
12. A wind-powered generator converts wind energy into electrical energy. Assume that the generator converts a fixed fraction of the wind energy intercepted by its blades into electrical energy. For wind speed v, the electrical power output will be proportional to
(a) v (b) v^2 (c) v^3 (d) v^4.

13. The potential at a point x (measured in μm) due to some charges situated on the x-axis is given by $V(x) = 20/(x^2 - 4)$ volt
The electric field E at $x = 4$ μm is given by
(a) (10/9) volt/μm and in the +ve x direction
(b) (5/3) volt/μm and in the –ve x direction
(c) (5/3) volt/μm and in the +ve x direction
(d) (20/9) volt/μm and in the –ve x direction

14. As shown in the figure, P and Q are two coaxial conducting loops separated by some distance. When the switch S is closed, a clockwise current I_P flows in P (as seen by E) and induced current I_{Q_1} flows in Q. The switch remains closed for a long time. When S is opened, a current I_{Q_2} flows in Q. Then the direction I_{Q_1} and I_{Q_2} (as seen by E) are
(a) respectively clockwise and anti-clockwise
(b) both clockwise
(c) both anti-clockwise
(d) respectively anti-clockwise and clockwise.

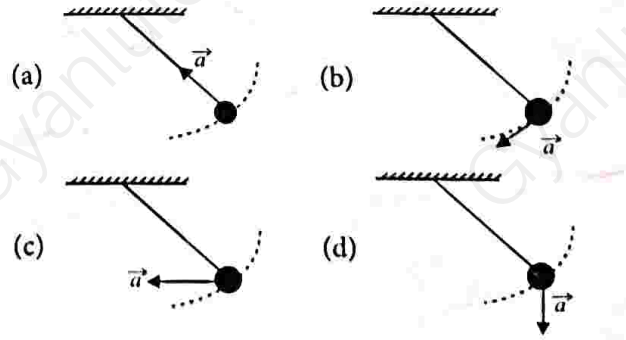
15. If a number of little droplets of water, all of the same radius r, coalesce to form a single drop of radius R, then the rise in temperature is given by(where T is the surface tension of water and J is the mechanical equivalent of heat)
(a) $\frac{T}{\rho J}\left(\frac{1}{r}-\frac{1}{R}\right)$ (b) $\frac{2J}{T\rho}\left(\frac{1}{r}-\frac{1}{R}\right)$
(c) $\frac{3T}{\rho J}\left(\frac{1}{r}-\frac{1}{R}\right)$ (d) $\frac{3J}{\rho T}\left(\frac{1}{r}-\frac{1}{R}\right)$

16. The graph, shown in the adjacent diagram, represents the variation of temperature (T) of two bodies, x and y having same surface area, with time (t) due to the emission of radiation. Find the correct relation between the emissivity and absorptivity powers of the two bodies

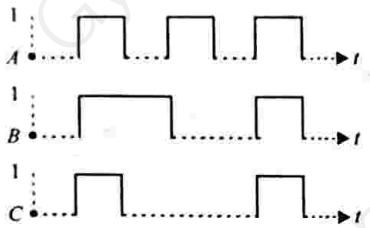


(a) $E_x > E_y$ and $a_x < a_y$ (b) $E_x < E_y$ and $a_x > a_y$
(c) $E_x > E_y$ and $a_x > a_y$ (a) $E_x < E_y$ and $a_x < a_y$.

17. A simple pendulum is oscillating without damping. When the displacement of the bob is less than maximum, its acceleration vector is $\vec{a}$ correctly shown in



18. The following figure shows a logic gate circuit with two inputs A and B and the output C. The voltage waveforms of A, B and C are as shown below.



The logic circuit gate is

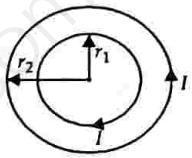
(a) OR gate (b) AND gate

(c) NAND gate (d) NOR gate.

19. Two particles are simultaneously projected in the horizontal direction from a point P at a certain height. The initial velocities of the particles are oppositely directed to each other and have magnitude v each. The separation between the particles at a time when their position vectors (drawn from the point P) are mutually perpendicular, is

(a) $\frac{v^2}{2g}$ (b) $\frac{v^2}{g}$ (c) $\frac{4v^2}{g}$ (d) $\frac{2v^2}{g}$

20. Two circular concentric loops of radii $r_1 = 20$ cm and $r_2 = 30$ cm are placed in the XY plane as shown in the figure. A current $I = 7$ amp is flowing through them. The magnetic moment of this loop system is



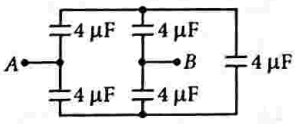
(a) $+0.4\,\hat{k}\,(\text{A m}^2)$ (b) $-1.5\,\hat{k}\,(\text{A m}^2)$

(c) $+1.1\,\hat{k}\,(\text{A m}^2)$ (d) $+1.3\,\hat{j}\,(\text{A m}^2)$

Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

21. For the arrangement of capacitors as shown in the circuit, the effective capacitance between the points A and B is (μF) ___.
(capacitance of each capacitor is 4 μF)



22. Interference fringes were produced in Young's double slit experiment using light of wavelength 5000 Å. When a film of material 2.5×10^{-3} cm thick was placed over one of the slits, the fringe pattern shifted by a distance equal to 20 fringe widths. The refractive index of the material of the film is _____.

23. Half-life of a radioactive substance is 20 minutes. The time (in minutes) between 20% and 80% decay is _____.

24. A horizontal disc rotating about a vertical axis passing through it is centre makes 180 rpm. A small piece of wax of mass 10 g falls vertically on the disc and sticks to it at a distance of 8 cm from it's axis. If the frequency is thus reduced to 150 rpm, the moment of inertia of the disc is 3.2×10^{-x} kg m^2, where the value of x is _____.

25. A reversible engine converts one fifth of heat which it absorbs from source into work. When the temperature of the sink is reduced by 70°, its efficiency is doubled. The temperature of the source is _____ K.

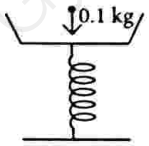
26. An electric dipole has a fixed dipole moment $\vec{p}$, which makes angle θ with respect to x-axis. When subjected to an electric field $\vec{E}_1 = E\hat{i}$, it experiences a torque $\vec{T}_1 = \tau\hat{k}$. When subjected to another electric field $\vec{E}_2 = \sqrt{3}E_1\hat{j}$ it experiences a torque $\vec{T}_2 = -\vec{T}_1$. The angle θ is _____ degree.

27. A beam of protons with a velocity of 4×10^5 m/s enters a uniform magnetic field of 0.3 T at an angle 60° to the magnetic field. Then, the pitch of the helix (in cm) is _____. ($m_p = 1.67 \times 10^{-27}$ kg)

28. A uniform thin rod AB of length L has linear mass density $\mu(x) = a + \frac{bx}{L}$, where x is measured from A. If the CM of the rod lies at a distance of $\left(\frac{7}{12}L\right)$ from A, then a and b are related as $b = na$, then the value of n is _____.

29. A body is moving with velocity 30 m/s towards east. After 10 s it's velocity becomes 40 m/s towards north. The average acceleration of the body (in m s^{-2}) is _____.

30. A massless platform is kept on a light elastic spring as shown in the figure. When sand particles of mass 0.1 kg are dropped on the pan from a height of 0.24 m. The particles strikes the pan, and the spring is compressed by 0.01 m. The height (in m) from where the particle should be dropped to cause a compression of 0.04 m is _____.



CHEMISTRY

Section-A (Multiple Choice Questions)

31. Dead burnt plaster is

(a) $CaSO_4$ (b) $CaSO_4 \cdot \frac{1}{2} H_2O$

(c) $CaSO_4 \cdot H_2O$ (d) $CaSO_4 \cdot 2H_2O$

32. PMMA is the polymer of

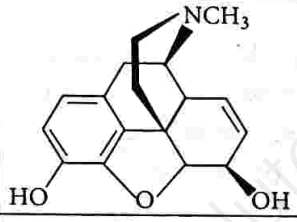
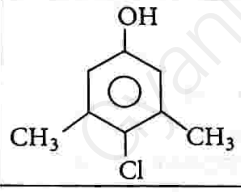
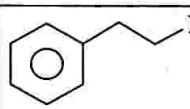
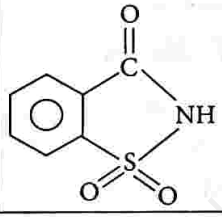
(a) methylmethacrylate (b) methacrylate

(c) methylacrylate (d) ethylacrylate.

33. When metal *M* is treated with NaOH, a white gelatinous precipitate '*X*' is obtained, which is soluble in excess of NaOH. Compound '*X*' when heated strongly gives an oxide which is used in chromatography as an adsorbent. Then metal '*M*' is

(a) Zn (b) Ca (c) Al (d) Fe.

34. Match List-I with List-II.

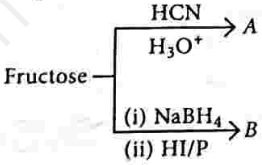
List-I		List-II	
A.		I.	Anti-depressant
B.		II.	550 times sweeter than cane sugar
C.		III.	Narcotic analgesic
D.		IV.	Antiseptic

(a) A-IV, B-I, C-II, D-III (b) A-I, B-IV, C-II, D-III
(c) A-III, B-IV, C-I, D-II (d) A-II, B-IV, C-III, D-I

35. Which of the following groups constitute basic radicals of fourth group?

(a) Pb^{2+}, Hg^{2+}, Cd^{2+} (b) Zn^{2+}, Mn^{2+}, Ni^{2+}
(c) Al^{3+}, Fe^{3+}, Cr^{3+} (d) Ca^{2+}, Sr^{2+}, Ba^{2+}

36. The formulae of *A* and *B* for the following reaction sequence

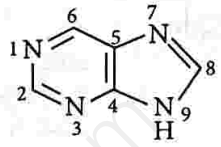


(a) $A = C_7H_{14}O_8$, $B = C_6H_{14}$
(b) $A = C_7H_{13}O_7$, $B = C_7H_{14}O$
(c) $A = C_7H_{12}O_8$, $B = C_6H_{14}$
(d) $A = C_7H_{14}O_8$, $B = C_6H_{14}O_6$

37. The reaction conditions leading to the best yields of C_2H_5Cl are

(a) C_2H_6 (excess) + $Cl_2 \xrightarrow{\text{UV light}}$
(b) $C_2H_6 + Cl_2 \xrightarrow[\text{room temperature}]{\text{dark}}$
(c) C_2H_6 (excess) + $Cl_2 \xrightarrow{\text{UV light}}$
(d) $C_2H_6 + Cl_2 \xrightarrow{\text{UV light}}$

38. The "N" which contribute to the basicity for the compound is/are



(a) 1, 3, 7 (b) 3, 7, 9
(c) 1, 9, 7 (d) 9 only

39. BOD values (in ppm) for clean water (*A*) and polluted water (*B*) are expected respectively as

(a) $A < 5, B > 17$ (b) $A > 50, B < 27$
(c) $A < 15, B > 47$ (d) $A > 25, B < 17$

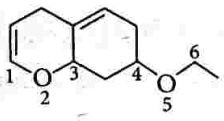
40. Benzoyl chloride is prepared from benzoic acid by

(a) Cl_2, $h\upsilon$ (b) SO_2Cl_2
(c) $SOCl_2$ (d) Cl_2, H_2O

41. Two solutions of HCl, *A* and *B*, have concentrations of 0.5 N and 0.1 M respectively. The volume of solutions *A* and *B* required to make 2 litres of 0.2 N HCl are

(a) 0.5 L of *A* + 1.5 L of *B*
(b) 1.5 L of *A* + 0.5 L of *B*
(c) 1.0 L of *A* + 1.0 L of *B*
(d) 0.75 L of *A* + 1.25 L of *B*

42. On treatment of the following compound with a strong acid, the most susceptible site for bond cleavage is



(a) $C_4 - O_5$ (b) $O_2 - C_3$
(c) $O_5 - C_6$ (d) $C_1 - O_2$

43. For '*f*'-electron, the orbital angular momentum is

(a) $\sqrt{12}\frac{h}{\pi}$ (b) $\sqrt{6}\frac{h}{\pi}$
(c) $\sqrt{3}\frac{h}{\pi}$ (d) $\sqrt{15}\frac{h}{\pi}$

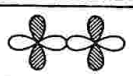
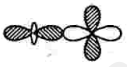
44. Which of the following statement is false in the following?

(a) Order of a reaction may be even zero.
(b) Molecularity of a reaction is always a whole number.
(c) Molecularity and order always have same values for a reaction.
(d) Order of a reaction depends upon the mechanism of the reaction.

45. Consider the following statements :
I. The radius of an anion is larger than that of parent atom.
II. The *I.E.* generally increases from left to right in a period.
III. The electronegativity of an element is the tendency of an element to lose electron.
The correct statements are
(a) I only (b) II only
(c) I and II only (d) II and III only

46. According to Henry's law, 'the partial pressure of the gas in vapour phase (p) is proportional to the mole fraction of the gas (x) in the solution'. For different gases, the correct statement about Henry's constant is
(a) higher the value of K_H at a given pressure, higher is the solubility of the gas
(b) higher the value of K_H at a given pressure, lower is the solubility of the gas
(c) K_H is not a function of nature of gas
(d) K_H value for all gases is same at a given pressure.

47. Match the Column I with Column II and mark the appropriate option.

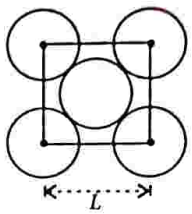
Column I		Column II	
(A)		(1)	$p - d\,\pi$ antibonding
(B)		(2)	$d - d\,\sigma$ bonding
(C)		(3)	$p - d\,\pi$ bonding
(D)		(4)	$d - d\,\sigma$ antibonding

(a) A-2, B-1, C-3, D-4 (b) A-4, B-3, C-1, D-2
(c) A-2, B-3, C-1, D-4 (d) A-4, B-1, C-3, D-2

48. Among the electrolytes Na_2SO_4, $CaCl_2$, $Al_2(SO_4)_3$ and NH_4Cl, the most effective coagulating agent for Sb_2S_3 sol is
(a) Na_2SO_4 (b) $CaCl_2$
(c) $Al_2(SO_4)_3$ (d) NH_4Cl

49. Given below are two statements :
Statement I : For KI, molar conductivity increases steeply with dilution.
Statement II : For carbonic acid, molar conductivity increases slowly with dilution.
In the light of the above statements, choose the correct answer from the options given below:
(a) Both Statement I and Statement II are true.
(b) Both Statement I and Statement II are false.
(c) Statement I is true but Statement II is false.
(d) Statement I is false but Statement II is true.

50. The packing efficiency of the two-dimensional square unit cell shown below is



(a) 39.27% (b) 68.02%
(c) 74.05% (d) 78.54%

Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

51. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below :

$$1/2Cl_{2(g)} \xrightarrow{1/2\,\Delta_{diss}H^\circ} Cl_{(g)} \xrightarrow{\Delta_{eg}H^\circ} Cl^-_{(g)} \xrightarrow{\Delta_{hyd}H^\circ} Cl^-_{(aq)}$$

The magnitude of energy (in kJ mol^{-1}) involved in the conversion of $1/2Cl_{2(g)}$ to $Cl^-_{(aq)}$ (using data, $\Delta_{diss}H^\circ_{Cl_2}$ = 240 kJ mol^{-1}, $\Delta_{eg}H^\circ_{Cl}$ = −349 kJ mol^{-1}, $\Delta_{hyd}H^\circ_{Cl^-}$ = −381 kJ mol^{-1}) will be _____.

52. Electrolytic refining can be used to refine how many of the following metals?
Zn, Ti, Hg, Al

53. The pH of solution on mixing equal volume of solution having pH = 3 and pH = 4 is _____. [log 5.5 = 0.7404]

54. The difference in the oxidation number of two types of S-atoms in $Na_2S_4O_6$ is _____.

55. A given amount of Fe^{2+} is oxidized by x mol of MnO_4^- in acidic medium. The number of x moles of $Cr_2O_7^{2-}$ required to oxidize the same amount of Fe^{2+} in acidic medium is _____.

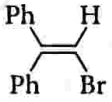
56. The number of electrons present in the 4*f*-subshell of Europium (atomic number 63) is _____.

57. The hardness of a water sample containing 10^{-3} M $MgSO_4$ expressed as $CaCO_3$ equivalents (in ppm) is _____.
(Molar mass of $MgSO_4$ is 120.37 g/mol)

58. The value of Δ_o for $[RhCl_6]^{3-}$ is 243 kJ/mol. Wavelength of light will promote an electron from the t_{2g} set to e_g set is _____ nm.

59. If 10^{-6} dm^3 of water is introduced into a 1.0 dm^3 flask at 500 K. The number of moles of water in vapour phase when equilibrium is established is _____ × 10^{-3} mol. [Given: Vapour pressure of H_2O at 300 K is 4180 Pa; R = 8.314 J K^{-1} mol^{-1}]

60. How many sp^2 C-atoms are present in product '*P*'?



+ KNH_2 ⟶ '*P*'

MATHEMATICS

Section-A (Multiple Choice Questions)

61. The foot of the perpendicular from origin to the plane $3x + 4y - 6z + 1 = 0$ is

(a) $\left(-\frac{3}{61}, \frac{4}{61}, \frac{6}{61}\right)$ (b) $\left(\frac{-3}{61}, \frac{-4}{61}, \frac{6}{61}\right)$

(c) $\left(\frac{4}{61}, \frac{-3}{61}, \frac{5}{61}\right)$ (d) None of these

62. The complex number $z = x + iy$ which satisfies the equation $\left|\frac{z-5i}{z+5i}\right| = 1$ lies on

(a) the x–axis
(b) the straight line $y = 5$
(c) the circle passing through the origin
(d) none of these

63. If all the letters of the word 'QUEST' are arranged in all possible ways and put in dictionary order, then find the rank of the given word.

(a) 41 (b) 43 (c) 42 (d) 44

64. Let $S = \left\{x \in [-6, 3] - \{-2, 2\} : \frac{|x+3|-1}{|x|-2} \geq 0\right\}$ and $T = \left\{x \in Z : x^2 - 7|x| + 9 \leq 0\right\}$. Then the number of elements in $S \cap T$ is

(a) 7 (b) 5 (c) 4 (d) 3

65. If α, β are solutions of $\sin^2 x + a \sin x + b = 0$ and $\cos^2 x + c \cos x + d = 0$, then $\sin(\alpha + \beta)$ equals

(a) $\frac{2ac}{a^2+c^2}$ (b) $\frac{a^2+c^2}{2ac}$

(c) $\frac{2bd}{b^2+d^2}$ (d) $\frac{b^2+d^2}{2bd}$

66. If $f(x) = \frac{1}{6}\left\{f(x+2) + \frac{12}{f(x+3)}\right\}$ & $f(x) > 0 \ \forall \ x \in R$ then $\lim_{x \to \infty} f(x)$ equals

(a) 3/2 (b) $2\sqrt{3}/\sqrt{5}$
(c) 0 (d) ∞

67. In a bag there are 10 balls of either Black or White. Let A_k be the event which contains exactly k white balls and its probability is proportional to k^2. Now an another ball is drawn randomly. If $P(E)$ be the probability that the ball drawn is white and $P(E) = \frac{a}{b}$, where HCF $(a, b) = 1$, then the value of $|a - b|$ equals

(a) 14 (b) 11 (c) 8 (d) 3

68. For all $x \in (-1, 1)$, let $A(x)$ be a matrix defined by $A(x) = \sqrt{1-x^2}\begin{bmatrix} 1 & x \\ x & 1 \end{bmatrix}$, then

(a) $(A(x))^{-1} = A(-x)$
(b) $A(x)\,A(y) = A\left(\frac{x+y}{1+xy}\right)$
(c) Both (a) & (b)
(d) None of these

69. If $f(x) = (\log_{\cos x} \sin x) \times (\log_{\sin x} \cos x)^{-1} + \sin^{-1}\left(\frac{2x}{1+x^2}\right)$, then $f'\left(\frac{\pi}{4}\right) =$

(a) $\frac{8}{\ln 2} + \frac{32}{\pi^2+16}$ (b) $-\frac{8}{\ln 2} - \frac{32}{\pi^2+16}$

(c) $\frac{8}{\ln 2} - \frac{32}{\pi^2+16}$ (d) $-\frac{8}{\ln 2} + \frac{32}{\pi^2+16}$

70. Let a be a complex number such that $|a| = 1$. If the equation $az^2 + z + 1 = 0$ has a pure imaginary root, then $\tan(\arg a) =$

(a) $\frac{\sqrt{5}-1}{2}$ (b) $\frac{\sqrt{5}+1}{2}$

(c) $\sqrt{\frac{\sqrt{5}-1}{2}}$ (d) $\sqrt{\frac{\sqrt{5}+1}{2}}$

71. If $I_m = \int_0^1 x^m \cot^{-1} x\,dx$, then $(m + 1)\,I_m + (m - 1)\,I_{m-2}$ equals

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{m} + \frac{1}{2}$

(c) $\frac{\pi}{2} + \frac{1}{m}$ (d) None of these

72. If a circle $S(x, y) = 0$ has tangent $x + y = 4$ at the point $\left(\frac{3}{2}, \frac{5}{2}\right)$ and $S\left(\frac{1}{2}, \frac{3}{2}\right) = 0$, then find the radius of the circle.

(a) $\frac{1}{4}$ (b) $\frac{1}{\sqrt{3}}$ (c) $\frac{1}{2}$ (d) $\frac{1}{\sqrt{2}}$

73. A, B, C, D develop 18 items. Five items jointly by A and C, four items by A and D, four items by B and C and five items by B and D. The number of ways of selecting eight items out of 18 so that the selected ones belong equally to A, B, C, D is

(a) 5226 (b) 5626 (c) 4418 (d) 4936

74. If $\cos(x - y)$, $\cos x$, $\cos(x + y)$ are in H.P., then the value of $\cos x \sec(y/2)$ is

(a) ± 1 (b) $\pm\frac{1}{\sqrt{2}}$ (c) $\pm\sqrt{2}$ (d) $\pm\sqrt{3}$

75. The greatest term in the expansion of $(1+3x)^{54}$ when $x=\frac{1}{3}$, is

(a) 28^{th} (b) 25^{th} (c) 26^{th} (d) 24^{th}

76. A point moves in such a way that the difference of its distance from xy-plane and yz-plane remains equal to distance from zx-plane. The locus of the point is

(a) $x-y+z=2$ (b) $x-y+z=0$
(c) $x+y-z=0$ (d) $x-y-z=2$

77. If $\frac{dy}{dx}=\frac{2^x y+2^y\cdot 2^x}{2^x+2^{x+y}\log_e 2}$, $y(0)=0$, then for $y=1$, the value of x lies in the interval

(a) $(1,2)$ (b) $\left(\frac{1}{2},1\right]$ (c) $(2,3)$ (d) $\left(0,\frac{1}{2}\right]$

78. OA is perpendicular drawn from the centre 'O' of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, to the tangent at any point M on the ellipse. If the normal to the ellipse at the point M meets x-axis at N, then $(OA)\cdot(MN)$ is

(a) $a\sqrt{a^2-b^2}$ (b) $b\sqrt{a^2-b^2}$
(c) a^2 (d) b^2

79. Let $f: R\to R$ be differentiable at $x=0$. If $f(0)=0$ and $f'(0)=2$, then the value of

$\lim\limits_{x\to 0}\frac{1}{x}[f(x)+f(2x)+f(3x)+...+f(2025x)]$ is

(a) 2025 (b) 0
(c) 2025×2026 (d) 2025×2024

80. The hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ and the circle $x^2+y^2=a^2$ intersect at an angle

(a) $\theta=\frac{\pi}{2}$ (b) $\theta=\tan^{-1}\left(\frac{a+b}{\sqrt{ab}}\right)$

(c) $\theta=\tan^{-1}\left(\frac{1}{\sqrt{ab}}\right)$ (d) $\theta=\tan^{-1}\left(\frac{a-b}{ab}\right)$

Section-B (Numerical Value Type)

Attempt any 5 questions out of 10

81. Let $f(x+y)=f(x)\,f(y)$, $\forall\ x, y\in N$ and $f(1)=2$. If $\sum\limits_{m=1}^{n} f(k+m)=16(2^n-1)$, then $k=$ _____.

82. If the mean deviation about the mean of the numbers $1, 2, 3, ... n$, when n is odd, is $\frac{5(n+1)}{n}$, then n is equal to _____.

83. If the integers a, b, c are in A.P., lying between 1 and 9 and $a13$, $b43$, and $c73$ are three-digit numbers, then the value of the determinant $\begin{vmatrix} 1 & 4 & 7 \\ a13 & b43 & c73 \\ a & b & c \end{vmatrix}$ is _____.

84. If m is the smallest natural number such that $m>120$ for which $n=\underbrace{111.....1}_{m \text{ times}}$ is not a prime number. Then the value of $m-87$ is _____.

85. If the equation $12x^2-10xy+2y^2+11x-5y+c=0$ represents a pair of straight lines, then c is _____.

86. In a triangle PQR, let $\vec{a}=\overrightarrow{QR}$, $\vec{b}=\overrightarrow{RP}$ and $\vec{c}=\overrightarrow{PQ}$. If $|\vec{a}|=4$, $|\vec{b}|=5$ and $\frac{\vec{a}\cdot(\vec{c}-\vec{b})}{\vec{c}\cdot(\vec{a}-\vec{b})}=\frac{|\vec{a}|}{|\vec{a}|+|\vec{b}|}$, then value of $|\vec{a}\times\vec{b}|^2$ is _____.

87. If family of curves satisfy $(9-x^2)\left(\frac{dy}{dx}\right)^2=9-y^2$ and infinite members of the family touch the line $ax+by=1$, form m ordered pairs of a and b, then m is equal to _____.

88. The vertices of a triangle are $(1, 0, 0)$, $\left(0,\frac{1}{\sqrt{2}},0\right)$, $\left(0,0,\frac{1}{\sqrt{3}}\right)$. If its orthocentre is (α, β, γ), then $(\alpha\beta\gamma)^{-2/5}$ is _____.

89. If $\int\frac{2e^x+3e^{-x}}{4e^x+7e^{-x}}dx=\frac{1}{14}(ux+v\log_e(4e^x+7e^{-x}))+C$, where C is a constant of integration, then $u+v$ is equal to _____.

90. The value of k, if $f(x)=\begin{cases}\left(\frac{4}{5}\right)^{\frac{\tan 4x}{\tan 5x}}, & 0<x<\frac{\pi}{2}\\ k+\frac{2}{5}, & x=\frac{\pi}{2}\end{cases}$ is continuous at $x=\pi/2$ is _____.

SPACE FOR ROUGH WORK