CUET PG 2025 Geophysics Question Paper

Time Allowed :1 Hour 30 Mins	**Maximum Marks :**300	**Total Questions :**75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The examination duration is 90 minutes. Manage your time effectively to attempt all questions within this period.
2. The total marks for this examination are 300. Aim to maximize your score by strategically answering each question.
3. There are 75 mandatory questions to be attempted in the Agro forestry paper. Ensure that all questions are answered.
4. Questions may appear in a shuffled order. Do not assume a fixed sequence and focus on each question as you proceed.
5. The marking of answers will be displayed as you answer. Use this feature to monitor your performance and adjust your strategy as needed.
6. You may mark questions for review and edit your answers later. Make sure to allocate time for reviewing marked questions before final submission.
7. Be aware of the detailed section and sub-section guidelines provided in the exam. Understanding these will aid in effectively navigating the exam.

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1. Which of following Maxwell's equation shows non existence of magnetic monopoles?

(A) $\nabla \cdot \vec{B} = 0$
(B) $\nabla \cdot \vec{D} = \frac{\rho}{\epsilon_0}$
(C) $\nabla \cdot \vec{E} = 0$
(D) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

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2. A long coaxial cable carries current 'I' (current flows down the surface of inner cylinder of radius 'r1' and back along the outer cylinder of radius 'r2'). The magnetic energy stored in a section of length 'L' is

(A) $\frac{\mu_0}{4\pi} I^2 L \ln\left(\frac{r_1}{r_2}\right)$
(B) $\frac{\mu_0}{4\pi} I L \ln\left(\frac{r_2}{r_1}\right)$
(C) $\frac{\mu_0}{4\pi} I^2 L \ln\left(\frac{r_2}{r_1}\right)$

(D) $\frac{\epsilon_0}{4\pi} I^2 L \ln\left(\frac{r_2}{r_1}\right)$

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3. The magnetic polarization results in a bound current Jb
(A) which is associated with magnetization of the material.
(B) which involves spin and orbital motion of electrons.
(C) which is the result of linear motion of charge when electric polarization changes.
(D) which is given by $\nabla \times \vec{M}$ (where $\vec{M}$ is magnetization).
Choose the correct answer from the options given below:

(A) (A), (B) and (C) only
(B) (A), (B) and (D) only
(C) (A), (C) and (D) only
(D) (B), (C) and (D) only

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4. Match List-I with List-II

List-I	**List-II**
(A) Displacement current (J_d)	(I) $\frac{\epsilon_0}{2}\int E^2 d\tau$
(B) Poynting vector	(II) $\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0}$
(C) Energy stored in electric field ($\vec{E}$)	(III) $\frac{1}{\mu_0}(\vec{E} \times \vec{B})$
(D) Gauss's Law	(IV) $\epsilon_0 \frac{\partial \vec{E}}{\partial t}$

Choose the correct answer from the options given below:

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

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5. At a temperature of 47°C the thermal voltage is (Given value of Boltzmann's constant = 1.38 x10^{-23} joule/°K):

(A) 27.6 mV
(B) 27.6 V
(C) 27.6 μV
(D) 2.76 V

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6. An a. c. supply of 220V is applied to a half wave rectifier through a transformer of turn ratio 20:1. In this circuit the peak inverse voltage is:

(A) 11 V
(B) 311.08 V
(C) 1.5554 V
(D) 15.554 V

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7. Match List-I with List-II

List-I	**List-II**
(A) Zener diode	(I) Negative resistance region
(B) Tunnel diode	(II) Voltage regulator
(C) Rectifier	(III) Pulsating d.c.
(D) Light emitting diode	(IV) Gallium Arsenide phosphide (GaAsP)

Choose the correct answer from the options given below:

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

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8. In common emitter connection, the collector leakage current in a transistor is 300μA. The leakage current in the transistor in common base arrangement will be (Given $\beta = 130$):

(A) 2.28 μA
(B) 2.28 mA
(C) 2.28 A
(D) 22.8 μA

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9. A power gain of 100 in decibel (db) is:

(A) 20 db
(B) 40 db
(C) 2 db
(D) 30 db

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10. A moving particle has coordinates (5t + 3, 6t, 5)m in frame S at any time 't'. The frame s' is moving with velocity $(3\hat{i}+4\hat{j})$m/s with respect to the frame S. Velocity of particle in frame s' is:

(A) $2\hat{i} + 2\hat{j}$
(B) $2\hat{i} - 2\hat{j}$
(C) $3\hat{i} + 4\hat{j}$
(D) $2\hat{i}$

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11. In a perfectly elastic collision if m and m be the masses and v and v be the velocities of two colliding particles. Then velocity after the collision, if particles stick together will be:

(A) $\frac{m_1v_1+m_2v_2}{v_1+v_2}$
(B) $\frac{m_1v_1+m_2v_2}{m_1+m_2}$
(C) $\frac{m_1v_2}{v_1+v_2}$
(D) $\frac{m_2v_2}{v_1-v_2}$

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12. Which of the following is/are correct about conservative and non-conservative forces?
(A) For conservative and non-conservative forces conservation of energy holds good.
(B) Friction is a conservative force.
(C) The work done by a conservative force in a closed path is zero.
(D) Friction is a non-conservative force.
Choose the correct answer from the options given below:

(A) (A), (C) and (D) only
(B) (A), (B) and (C) only
(C) (A), (B) and (D) only
(D) (B), (C) and (D) only

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13. A wave of frequency 500 Hz is travelling with a velocity 1000 m/s. How far are two points situated in wave whose displacement differ in phase by $\frac{\pi}{3}$?

(A) 0.50 cm
(B) 2.5 m
(C) 0.25 m
(D) 0.50 m

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14. Two tuning forks produce 6 beats per second when sounded together. One of the fork is in unison with 1.5 m length of wire and the other with 2.0 m length of wire. The frequencies of forks are:

(A) 18 Hz and 22 Hz
(B) 16 Hz and 22 Hz
(C) 24 Hz and 18 Hz
(D) 6 Hz and 12 Hz

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15. Match List-I with List-II

List-I	**List-II**
(A) Force	(I) Torque
(B) Distance covered	(II) Angle described
(C) Mass	(III) Moment of inertia
(D) Linear velocity	(IV) Angular velocity

Choose the correct answer from the options given below:

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

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16. If J, E and I are the angular momentum, kinetic energy of rotation and moment of inertia respectively, then which of following is incorrect?

(A) $E = \frac{1}{2} I\omega^2$
(B) $J = I\omega$
(C) $E = \frac{J^2}{2I}$
(D) $E = JI$

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17. Which of following is true in a LCR circuit?
(A) In purely inductive circuit (R = 0), Quality factor is infinite.
(B) Resistance 'R' is alone responsible for damping of oscillations.
(C) Discharge of capacitor is not oscillatory in character.
(D) Q-factor is measure of sharpness of resonance in case of a driven oscillator.
Choose the correct answer from the options given below:

(A) (A), (B) and (D) only
(B) (A), (B) and (C) only

(C) (A), (C) and (D) only
(D) (B), (C) and (D) only

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18. Two satellites A and B of mass 'M' are orbiting the earth in circular orbits at altitudes 2R and 5R respectively, where R is the radius of the earth. The ratio of kinetic energies of satellite A and B will be

(A) 1:3
(B) $\sqrt{2} : 1$
(C) 1:1
(D) 2:1

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19. The condition for bright ring in the Newton's Ring arrangement is (where 't' is thickness of film, m is order and λ is wavelength):

(A) $2t = m\lambda + \frac{\lambda}{2}$
(B) $t = m\lambda - \frac{\lambda}{2}$
(C) $2t = \frac{(2m-1)\lambda}{2}$
(D) $t = \frac{m\lambda}{2}$

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20. Which of the following is not a characteristic of a laser light?

(A) Highly coherent
(B) Highly penetrating
(C) Highly intense
(D) Highly divergent

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21. In order to produce LASER, the correct sequence of processes given below will be
(A) Pumping
(B) Population inversion
(C) Stimulated emission
(D) Light Amplification
Choose the correct answer from the options given below:

(A) (A), (B), (C), (D)
(B) (B), (A), (C), (D)
(C) (D), (C), (B), (A)

(D) (B), (A), (D), (C)

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22. Match List-I with List-II

List-I	**List-II**
(A) Circular Fringes	(I) Nicol prism
(B) Straight parallel and equidistant interference pattern	(II) Newton's Ring experiment
(C) Polarizer	(III) Interference in wedge-shaped film
(D) E-ray and O-ray travel with same speed	(IV) Optic axis

Choose the correct answer from the options given below:

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

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23. Sunlight is reflected from a material. The reflected light is 100% polarized at a certain instant. Assuming refractive index of material equal to 1.732, the angle between the sun and the horizon at that instant is

(A) 30°
(B) 45°
(C) 60°
(D) 0°

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24. In Michelson Interferometer the intensity is expressed as $4A^2\cos^2\frac{\delta}{2}$, where $\delta = \frac{2\pi}{\lambda}(2d\cos\theta)$, d being the distance between Mirrors M and M. The intensity is maximum, when δ is

(A) integral multiple of 2π
(B) Integral multiple of π
(C) odd multiple of π.
(D) odd multiple of $\frac{\pi}{2}$.

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25. Which of the following orders in a double slit Fraunhofer diffraction pattern will be missing if the slit width is 0.12 mm and slits are 0.6 mm apart?

(A) 6, 12, 18, 24
(B) 4, 8, 12, 16

(C) 3, 4, 5, 6
(D) 3, 11, 15

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26. A zone plate

(A) has only one focus.
(B) can not act as convex lens.
(C) acts simultaneously as a convex lens and concave lens.
(D) has only two foci.

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27. Work done in compressing adiabatically 1g of air, initially at NTP to one fourth of its original volume is: (take density of air = 0.0001465 g/cm^3 and $\gamma = 1.5$)

(A) 1.365×10^{10} ergs
(B) 1365×10^{8} ergs
(C) 2.730×10^{10} ergs
(D) 1.365×10^{10} ergs (repeated)

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28. Change of entropy of a perfect gas for isochoric process is

(A) $C_v \log_e \frac{V_2}{V_1}$
(B) $C_v \log_e \frac{P_2}{P_1}$
(C) $C_p \log_e \frac{V_2}{V_1}$
(D) $(C_p - C_v) \log_e \left(\frac{V_2}{V_1}\right)$

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29. The ratio of adiabatic to the isobaric coefficient of expansion is

(A) $\frac{\gamma-1}{\gamma}$ (where $\gamma = \frac{C_p}{C_v}$)
(B) $\frac{1}{\gamma}$
(C) $\frac{1}{1-\gamma}$
(D) $\frac{\gamma}{\gamma-1}$

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30. Which of following is correct form of first TdS equation ?

(A) $C_v dT + T\left(\frac{\partial V}{\partial T}\right)_V dV$
(B) $C_v dT + T\left(\frac{\partial P}{\partial T}\right)_V dV$
(C) $C_v dT - T\left(\frac{\partial P}{\partial T}\right)_V dV$
(D) $C_p dT + T\left(\frac{\partial V}{\partial T}\right)_P dV$

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31. Match List-I with List-II

List-I	**List-II**
(A) Classius Clapeyron equation	(I) PV^γ = constant
(B) Gibbs Function	(II) U + PV
(C) Enthalpy	(III) U-TS + PV
(D) Adiabatic change in Perfect Gas	(IV) $\frac{dP}{dT} = \frac{L}{T(V_2 - V_1)}$

Choose the correct answer from the options given below:

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

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32. The Rayleigh Jean's Law,
(A) agrees well with experimental results at low frequencies.
(B) agrees well with experimental results at longer. wavelengths.
(C) shows ultra-violet catastrophe at higher frequencies.
(D) agrees well with experimental results at higher frequencies.
Choose the correct answer from the options given below:

(A) (A), (B) and (D) only
(B) (A), (B) and (C) only
(C) (B), (C) and (D) only
(D) (A), (C) and (D) only

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33. The energy radiated per minute from the filament of an incandescent lamp at 2000 K, surface area 4×10^{-5} m^2 and relative emittance is 0.85, will be (Given Stefan's constant $\sigma = 5.7 \times 10^{-8}$ Jm^2s^1K)

(A) 16.416 J
(B) 27.36 J
(C) 0.456 J
(D) 1641.6 J

34. X- rays of wavelength 15 pm are scattered from a target. The wavelength of the X-rays scattered through 60° is (Given compton wavelength = 2.426 pm)

(A) 13.787 pm (pm is pico metre)
(B) 16.213 pm (pm is pico metre)
(C) 15.5 pm (pm is pico metre)
(D) 1.6213 pm (pm is pico metre)

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35. In Photo- electric effect
(A) There is no time interval (very small 10s) between incidence of light and emissions of photo electrons.
(B) Higher the frequency of light, more is the kinetic energy of photo electrons emitted.
(C) A bright light yields more photo-electrons than dim light.
(D) Blue light emits slower electrons than red light.
Choose the correct answer from the options given below:

(A) (A), (B) and (C) only
(B) (A), (B) and (D) only
(C) (B), (C) and (D) only
(D) (A), (C) and (D) only

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36. The roots of the equation $x^4 - 20x^3 + 140x^2 - 400x + 384 = 0$ are in

(A) Arithmetic Progression
(B) Geometric Progression
(C) Harmonic Progression
(D) Both Geometric Progression and Harmonic Progression

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37. If $1, \alpha_1, \alpha_2, \alpha_3, \ldots, \alpha_{n-1}$ are n roots of the equation, $x^n = 1$ then the value of $(1-\alpha_1)(1-\alpha_2)(1-\alpha_3)\ldots(1-\alpha_{n-1})$ is

(A) n
(B) n-1
(C) n-2
(D) n-3

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38. If the rank of matrix $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 0 & 7 & \lambda \end{pmatrix}$ is 2, then the value of λ is:

(A) 10
(B) 12
(C) 14
(D) 16

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39. If the matrix A $= \begin{pmatrix} 2 & 0 & -1 \\ 5 & 1 & 0 \\ 0 & 1 & 3 \end{pmatrix}$ satisfies the matrix equation:

(A) $A^3 - 6A^2 + 11A - I = 0$
(B) $A^3 + 6A^2 - 11A + I = 0$
(C) $A^3 + 6A^2 + 11A + I = 0$
(D) $A^3 - 6A^2 - 11A - I = 0$

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40. The system of equations
x + 2y + z = 6
x + 4y + 3z = 10
x + 4y + λz = μ
is inconsistent if

(A) $\lambda \neq 3, \mu \in \mathbb{R}$
(B) $\lambda = 3, \mu = 10$
(C) $\lambda = 3, \mu \neq 10$
(D) $\lambda + \mu = 13$

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41. Which of the following statements are correct
If $A = \begin{pmatrix} p & q \\ 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & q \\ 0 & 1 \end{pmatrix}$, then

(A) $B^n = \begin{pmatrix} 1 & nq \\ 0 & 1 \end{pmatrix}$
(B) $A^n = \begin{pmatrix} p^n & q\frac{p^n-1}{p-1} \\ 0 & 1 \end{pmatrix}$ if $p \neq 1$
(C) $AB = \begin{pmatrix} p & pq+q \\ 0 & 1 \end{pmatrix}$
(D) $B^{n-1} = \begin{pmatrix} 1 & (n+1)q \\ 0 & 1 \end{pmatrix}$

(E) $AB^n = \begin{pmatrix} p & (np+1)q \\ 0 & 1 \end{pmatrix}$

Choose the correct answer from the options given below:

(A) (A), (B), (C) and (E) only
(B) (B), (C) and (D) only
(C) (C), (D) and (E) only
(D) (A), (B), (D) and (E) only

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42. The complex number z_1, z_2 and origin, form an equilateral triangle only if:

(A) $z_1^2 - z_2^2 + z_1 z_2 = 0$
(B) $z_1^2 + z_2^2 - z_1 z_2 = 0$
(C) $z_1^2 + z_2^2 + 3z_1 z_2 = 0$
(D) $z_1^2 + z_2^2 + z_1 - z_2 = 0$

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43. Let z, z_1, z_2 be complex numbers. Then which of the following statements are True?
(A) e^z is never zero
(B) $|e^{ix}| = 1$ if x is real
(C) $e^z = 1$ if z is an integral multiple of $2\pi i$
(D) $e^{z_1} = e^{z_2}$ if and only if $z_1 - z_2 = \frac{2\pi i n}{\sqrt{3}}$, where n is an integer
(E) $|e^z| > e^z$ for $z \neq 0$

Choose the correct answer from the options given below:

(A) (A), (B) and (D) only
(B) (B), (C) and (E) only
(C) (A), (B) and (C) only
(D) (A) and (D) only

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44. Match List-I with List-II

List-I (Equation)	**List-II (Roots)**
(A) $(z+1)^{2n} + (z-1)^{2n} = 0$	(I) $\cos(\frac{\pi}{5}) \pm i\sin(\frac{\pi}{5}), -1, \cos(\frac{3\pi}{5}) \pm i\sin(\frac{3\pi}{5})$
(B) $z^5 + z^4 + z^3 + z^2 + z + 1 = 0$	(II) purely imaginary number
(C) $(z-1)^5 + z^5 = 0$	(III) $-1, \pm\frac{1}{2} \pm i\frac{\sqrt{3}}{2}$
(D) $z^5 + 1 = 0$	(IV) $\frac{1}{2}[1 + i\cot(\frac{p\pi}{10})], p = 1, 3, 5, 7, 9$

Choose the correct answer from the options given below:

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

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

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45. For what values of n, $\tan^{-1} 3 + \tan^{-1} n = \tan^{-1}\left(\frac{3+n}{1-3n}\right)$ is valid

(A) $n \in (-\frac{1}{3}, \frac{1}{3})$
(B) $n > \frac{1}{3}$
(C) $n < \frac{1}{3}$
(D) For all real values of n

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46. The asymptotes of the curve $(x^2 - a^2)(y^2 - b^2) = a^2b^2$ are

(A) x + y = a, x + y = b
(B) xy = a, x - y = b
(C) x = ±a, y = ±b
(D) x = y

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47. The surface area of the solid generated by revolving the curve $x = e^t \cos t, y = e^t \sin t$ about y-axis for $0 \leq t \leq \pi/2$ is

(A) $2\pi e^{\pi}(2 - \sqrt{2})$ sq. unit
(B) $\frac{2\sqrt{2}}{5}\pi(e^{\pi} - 2)$ sq. unit
(C) $\frac{2\sqrt{2}}{5}\pi(e^{\pi} + \pi)$ sq unit
(D) $\frac{2\sqrt{2}}{5}\pi(e^{\pi} - \pi)$ sq unit

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48. If the radius of curvature (ρ) at (0, 1) of $y = e^x$ is $\alpha\sqrt{\beta}$, then $\alpha^2 + \beta$ is:

(A) 7
(B) 6
(C) 11
(D) 12

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49. The function $y = \tan^{-1} x$ satisfies differential equation

(A) $(1+x^2)\frac{d^{n+2}y}{dx^{n+2}} + (2n+2)x\frac{d^{n+1}y}{dx^{n+1}} + n(n+1)\frac{d^ny}{dx^n} = 0$
(B) $(1+x^2)\frac{d^{n+2}y}{dx^{n+2}} + (2n-1)x\frac{d^{n+1}y}{dx^{n+1}} + (n+1)\frac{d^ny}{dx^n} = 0$
(C) $(1+x^2)\frac{d^{n+2}y}{dx^{n+2}} + (2n^2+n+1)\frac{d^{n+1}y}{dx^{n+1}} + (n-1)\frac{d^ny}{dx^n} = 0$
(D) $(1+x^2)\frac{d^{n+2}y}{dx^{n+2}} + n(2n+1)\frac{d^{n+1}y}{dx^{n+1}} + n(n-1)\frac{d^ny}{dx^n} = 0$

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50. Which of the following statements are true?
(A) For f(x) = —x—, for all x in [-1, 2]; Lagrange's mean value theorem is satisfied
(B) For f(x) = cosx, for all x in [0, $\pi/2$]; Lagrange's mean value theorem is satisfied
(C) For f(x) = $\frac{1}{x}$, for all x in [-1, 2]; Lagrange's mean value theorem is satisfied
(D) For f(x) = x(x-1)(x-2), for all x in [0, 1/2]; Lagrange's mean value theorem is satisfied
(E) For f(x) = $x^{1/3}$, for all x in [-1, 1]; Lagrange's mean value theorem is satisfied
Choose the correct answer from the options given below:

(A) (A), (D) and (E) only
(B) (A), (B) and (D) only
(C) (B) and (D) only
(D) (B), (D) and (E) only

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51. Which of the following statements are true?
(A) The curve r = a(1 + cosθ) is symmetrical about the initial line
(B) The curve r = 2(1 - 2 sinθ) is symmetrical about the initial line
(C) The curve r = a(1 + sinθ) is symmetrical about the line $\theta = \pi/2$
(D) The curve r = a sin(3θ) is symmetrical about the initial line
(E) The curve $r^2 = a^2\cos(2\theta)$ is symmetrical about pole
Choose the correct answer from the options given below:

(A) (A), (B) and (D) only
(B) (A), (C), (D) and (E) only
(C) (A), (B), (D) and (E) only
(D) (A), (C) and (E) only

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52. Match List-I with List-II

List-I	**List-II**
(A) $\lim_{x\to 0} \frac{\ln(1+x)}{\sin x}$	(I) 1
(B) $\lim_{x\to\infty} 2x\tan(1/x)$	(II) 0
(C) $\lim_{x\to\infty} \frac{x^2}{e^x}$	(III) 2
(D) $\lim_{x\to 1} x^{1/(x-1)}$	(IV) e

Choose the correct answer from the options given below:

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

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53. Match List-I with List-II

List-I (Functions)	**List-II (Concavity and Convexity)**
(A) $f(x) = e^{-x^2}$	(I) Concave downward in $(-\infty, -1)$
(B) $f(x) = (1 + x^2)e^{-x}$	(II) Concave upward in $(-\infty, 1)$
(C) $f(x) = 3x^4 + 4x^3 - 6x^2 + 12x + 12$	(III) Concave downward in $(-\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$
(D) $f(x) = (x + 1)^{1/3}$	(IV) Concave upward in $(-\infty, -1)$

Choose the correct answer from the options given below:

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

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54. A necessary and sufficient condition that the general equation of second degree $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ may represent a pair of straight lines is

(A) $abc + 2fgh - af^2 - bg^2 - ch^2 > 0$
(B) $abc + 2fgh - af^2 - bg^2 - ch^2 < 0$
(C) $abc + 2fgh - af^2 - bg^2 - ch^2 = 0$
(D) $abc + 2fgh - af^2 - bg^2 - ch^2 = a^2 + b^2 + c^2$

---

55. The plane $x + y + z = \sqrt{3}\lambda$ touches the sphere $x^2 + y^2 + z^2 - 2x - 2y - 2z - 6 = 0$ if:

(A) $\lambda = \sqrt{3} \pm 3$
(B) $\lambda = \sqrt{3} + 3 - \sqrt{2}$
(C) $\lambda = \sqrt{3} \pm \frac{1}{3}$
(D) $\lambda = \frac{1}{\sqrt{3}} \pm 3$

---

56. The equation of cone with vertex at (0, 0, 0) and passing through the circle given by $x^2 + y^2 + z^2 + x - 2z + 3y - 4 = 0, x - y + z = 2$, is

(A) $x^2 + 2y^2 + 3z^2 + xy + 2yz = 0$
(B) $x^2 + 3y^2 + 3z^2 + 2xy + yz = 0$
(C) $x^2 + 2y^2 + 3z^2 + xy - yz = 0$
(D) $x^2 + 2y^2 + 3z^2 + xy - 3yz = 0$

---

57. Which of the following statements are true?
(A) The equations of the plane passing through the point (1, -1, 2) having 2, 3, 2 as direction ratios of normal to the plane is 2x + 3y + 2z = 3
(B) Angle between the normal to the plane 2x - y + z = 6 and x + y + 2z = 7 is $\frac{\pi}{3}$
(C) The angle at which the normal vectors to the plane 4x + 8y + z = 5 is inclined to the z-axis is $\sin^{-1}(\frac{1}{9})$
(D) The equation of the plane passing through the point (3, -3, 1) and normal to the line joining the points (3, 4, -1) and (2, -1, 5) is x + 5y + 6z = -18
(E) A normal vector to the plane 2x - y + 2z = 5 is $\frac{1}{3}(2\vec{i} - \vec{j} + 2\vec{k})$
Choose the correct answer from the options given below:

(A) (A), (B), (C) and (E) only
(B) (B), (C), (D) and (E) only
(C) (A), (B), (D) and (E) only
(D) (A), (B) and (E) only

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58. Match List-I with List-II

List-I	**List-II**
(A) $9x^2 - 12xy + 4y^2 - 74x - 98y + 324 = 0$	(I) Hyperbola
(B) $12x^2 + 7xy - 12y^2 + 10x + 55y - 125 = 0$	(II) A pair of straight lines
(C) $x^2 + 3xy + 2y^2 + x + y = 0$	(III) Ellipse
(D) $5x^2 + y^2 - 30x + 1 = 0$	(IV) Parabola

Choose the correct answer from the options given below:

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

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59. Match List-I with List-II

List-I	List-II
(A) $\frac{y^2}{36} - \frac{x^2}{16} = 1$	(I) Eccentricity is $2\sqrt{2}$
(B) $7x^2 + 12xy - 2y^2 - 2x + 4y - 7 = 0$	(II) Eccentricity is $\frac{3}{2}$
(C) $7x^2 - y^2 = 224$	(III) Eccentricity is $\sqrt{13}/3$
(D) $\frac{x^2}{16} - \frac{y^2}{20} = \frac{1}{9}$	(IV) Asymptotes are $y = \pm\frac{3}{2}x$

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60. If two stones are thrown vertically upwards with their velocities in the ratio 2:5, then the ratio of the maximum heights attained by the stones is

(A) 4:25
(B) 1:5/2
(C) 6:15
(D) 8:20

---

61. If three forces of magnitudes 8 newtons, 5 newtons and 4 newtons acting a point are in equilibrium, then the angle between the two smaller forces is

(A) $\cos^{-1}\left(-\frac{13}{40}\right)$
(B) $\cos^{-1}\left(-\frac{23}{40}\right)$
(C) $\cos^{-1}\left(-\frac{33}{40}\right)$
(D) $\cos^{-1}\left(-\frac{21}{40}\right)$

---

62. Two forces acting at a point of a body are equilibrium if and only if they
(A) are equal in magnitude
(B) have same direction
(C) have opposite direction
(D) act along the same straight line
(E) are not equal in magnitude but have same direction
Choose the correct answer from the options given below:

(A) (A), (C) and (D) only
(B) (A), (B), (D) and (E) only
(C) (B), (C) and (D) only
(D) (A), (C), (D) and (E) only

---

63. Match List-I with List-II

List-I	List-II
(A) P and Q are two perpendicular forces, acting at a point	(I) Resultant R = —P-Q—
(B) P and Q are equal, forces acting at a point at an angle α	(II) Resultant R = P + Q
(C) P and Q are acting at a point in same direction.	(III) Resultant R = 2P $\cos(\alpha/2)$
(D) P and Q are acting at a point in opposite direction	(IV) Resultant R = $\sqrt{P^2+Q^2}$

Choose the correct answer from the options given below:

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

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64. The value of $\int_2^3 \vec{A} \cdot \frac{d\vec{A}}{dt} dt$ if $\vec{A}(2) = 2\hat{i} - \hat{j} + 2\hat{k}$ and $\vec{A}(3) = 4\hat{i} - 2\hat{j} + 3\hat{k}$ is

(A) 8
(B) 9
(C) 10
(D) 11

---

65. If R is a closed region in the xy-plane bounded by a simple closed curve C and if M(x, y) and N(x, y) are continuous functions of x and y having continuous derivative in R, then

(A) $\oint_C M dx + N dy = \iint_R \left(\frac{\partial M}{\partial x} - \frac{\partial N}{\partial y}\right) dxdy$
(B) $\oint_C M dx + N dy = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dxdy$
(C) $\oint_C M dx + N dy = \iint_R \left(\frac{\partial M}{\partial y} - \frac{\partial N}{\partial x}\right) dxdy$
(D) $\oint_C M dx + N dy = \iint_R \left(\frac{\partial M}{\partial x} + \frac{\partial N}{\partial y}\right) dxdy$

---

66. The surface area of the plane $x + 2y + 2z = 12$ cut off by $x = 0, y = 0$ and $x^2 + y^2 = 16$ is

(A) 2π
(B) 3π
(C) 5π
(D) 6π

---

67. The value of $\oint_S \vec{F} \cdot d\vec{s}$ where $\vec{F} = 4x\hat{i} - 2y^2\hat{j} + z^2\hat{k}$ taken over the cylinder $x^2 + y^2 = 4, z = 0$ and $z = 3$ is:

(A) 126π
(B) 168π
(C) 42π
(D) 84π

---

68. The directional derivative of $\nabla \cdot (\nabla f)$ at the point (1, -2, 1) in the direction of the normal to the surface $xy^2z = 3x + z^2$ where $f = 2x^3y^2z^4$ and $\nabla = \hat{i}\frac{\partial}{\partial x} + \hat{j}\frac{\partial}{\partial y} + \hat{k}\frac{\partial}{\partial z}$ is

(A) $\frac{1724}{\sqrt{21}}$
(B) $\frac{1724}{\sqrt{23}}$
(C) $\frac{1724}{\sqrt{19}}$
(D) $\frac{1724}{\sqrt{29}}$

---

69. Let $\vec{F}$ be the vector valued function and f be a scalar function. Let $\nabla = \hat{i}\frac{\partial}{\partial x} + \hat{j}\frac{\partial}{\partial y} + \hat{k}\frac{\partial}{\partial z}$ then,
(A) div (grad f) = $\nabla^2 f$
(B) curl curl $\vec{F}$ = grad curl $\vec{F}$ - $\nabla^2\vec{F}$
(C) div curl $\vec{F} = \vec{0}$
(D) curl grad f = $\vec{0}$
(E) div $(f\vec{F})$ = f div $\vec{F}$ + (grad f) $\times\vec{F}$
Choose the correct answer from the options given below:

(A) (A), (B) and (C) only
(B) (A) and (D) only
(C) (A), (B) and (D) only
(D) (B), (D) and (E) only

---

70. Which one of the following statement is not correct?

(A) The functions $x^2 - 1, 3x^2$ and $2 - 5x^2$ are linear dependent.
(B) The functions x, x^2 and x^3 are linearly independent.
(C) The functions 1, sinx and cosx are linearly dependent.
(D) The functions x and $\frac{1}{x}$ are linearly independent.

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71. The Laplace transform of $\cos\sqrt{t}$ is:

(A) $\sum_{n=0}^{\infty} \frac{(-1)^{n-1}n!}{(2n)!s^n}$, s is the parameter of Laplace transform.
(B) $\sum_{n=0}^{\infty} \frac{(-1)^{n}n!}{(2n)!s^{n+1}}$, s is the parameter of Laplace transform.
(C) $\sum_{n=0}^{\infty} \frac{(-1)^{n+1}n!}{(2n)!s^{n}}$, s is the parameter of Laplace transform.
(D) $\sum_{n=0}^{\infty} \frac{(-1)^{n}n!}{(2n)!(s+1)^{n+1}}$, s is the parameter of Laplace transform.

---

72. The general solution of differential equation $\frac{d^2y}{dx^2} + 9y = \cos(3x)$ is:

(A) $C_1\cos(3x) + C_2\sin(3x) + \frac{x}{3}\sin(3x)$
(B) $C_1\cos(3x) + C_2\sin(3x) + \frac{x}{6}\sin(3x)$
(C) $C_1\cos(3x) + C_2\sin(3x) - \frac{x}{6}\sin(3x)$
(D) $C_1\cos(3x) + C_2\sin(3x) + \frac{x}{3}\cos(3x)$

---

73. The integral equation corresponding to the boundary value problem $\frac{d^2y}{dx^2} + \lambda y(x) = 0; y(0) = 0; y(1) = 0$ is

where $k(x,t) = \begin{cases} t(1-x) & \text{where } t < x \\ x(1-t) & \text{where } t > x \end{cases}$

(A) $y(x) = \lambda\int_0^1 k(x,t)y(t)dt$
(B) $y(x) = 1 + \lambda\int_0^1 k(x,t)y(t)dt$
(C) $y(x) = 1 + \lambda^2\int_0^1 k(x,t)y(t)dt$
(D) $y(x) = 1 + 3\lambda\int_0^1 k(x,t)y(t)dt$

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74. Match List-I with List-II

List-I (Curve)	**List-II (Orthogonal trajectory)**
(A) $xy = c$	(I) $\frac{y^2}{2} + x^2 = c$
(B) $e^x + e^{-y} = c$	(II) $y(y^2 + 3x^2) = c$
(C) $y^2 = cx$	(III) $y^2 - x^2 = 2c$
(D) $x^2 - y^2 = cx$	(IV) $e^y - e^{-x} = c$

Choose the correct answer from the options given below:

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

75. The particular integral of differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = e^{-x}\log x$ is:

(A) $\frac{x^2}{2}\left(\frac{1}{2} - \log_e x\right)e^{-x} + e^{-2x}(x\log_e x - x)$
(B) $\frac{x^2e^{-x}}{2}\left(\frac{1}{2} - \log_e x\right) + x^2e^{-x}(\log_e x - 1)$
(C) $\frac{x^2}{2}\left(\frac{1}{3} - \log_e x\right)e^{-x} + e^{-x}(x\log_e x - x)$
(D) $\frac{x^2}{2}\left(\frac{1}{3} - \log_e x\right)e^{-x} + x^2e^{-x}(\log_e x - 1)$