



JEE MAIN-2024

DURATION: 180 MINUTES

27th Jan Shift - 1

General Instructions

1. Immediately fill in the particulars on this page of the test booklet.
2. The test is of 180 min. duration.
3. The test booklet consists of 90 questions. The maximum marks are 300.
4. There are four Section in the Question Paper, Section I, II, & III consisting of Section-1 (Physics), Section-II (Chemistry), Section-III (Mathematics) and having 30 Questions in each Subject and each subject is divided in two Section, Section A consisting 20 questions (all questions all compulsory) and Section B consisting 10 Questions (Any 05 questions are compulsory).
5. There is only one correct response for each question.
6. Each correct answer will give 4 marks while 1 Mark will be deducted for a wrong MCQ response.
7. No student is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. inside the examination room/hall.
8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator on duty in the Room/Hall. However, the candidates are allowed to take away this Test Booklet with them.

OMR - Instructions

1. Use blue/black dark ballpoint pens.
2. Darken the bubbles completely. Don't put a tick mark or a cross mark where it is specified that you fill the bubbles completely. Half-filled or over-filled bubbles will not be read by the software.
3. Never use pencils to mark your answers.
4. Never use whiteners to rectify filling errors as they may disrupt the scanning and evaluation process.
5. Writing on the OMR Sheet is permitted on the specified area only and even small marks other than the specified area may create problems during the evaluation.
6. Multiple markings will be treated as invalid responses.
7. Do not fold or make any stray mark on the Answer Sheet (OMR).

Student Details

Name of the Student (In CAPITALS)

Roll Number: _____

OMR Bar Code Number: _____

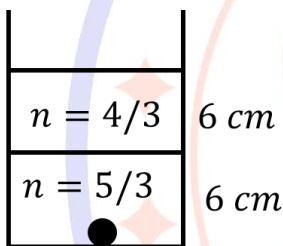
Candidate's Signature

Invigilator's Signature

Physics

- A 1000 kg block is moving with velocity 6 m/s on a smooth surface and suddenly a block of mass 200 kg is placed on it and it gets stucked. Find the velocity of the system.
(a)
(b)
(c)
(d)
- A wire of length L and resistance R_0 is divided into five segments and then joined parallelly to each other. Then find the equivalent resistance?
(a)
(b)
(c)
(d)
- $A + B \rightarrow C + D$, The binding energy of A, B, C, D were given in the question. Find the Q value of the reaction.
- Four objects of mass 1 kg are placed at the vertices of a square of side 2 m, an axis passing perpendicular to the plane of the square through one of the vertices then calculate the moment of inertia about this axis
(a) $I = 32\text{ kg m}^2$
(b) $I = 16\text{ kg m}^2$
(c) $I = 8\text{ kg m}^2$
(d) $I = 24\text{ kg m}^2$
- If the mass and specific heat of the body are 0.08 kg and 0.17 k cal/°C. The temperature difference is 5°C. Find the change in internal energy.
(a)
(b)
(c)
(d)
- Two infinite long parallel wires kept at a distance of 10 cm, carrying equal currents in opposite directions of same magnitude 10 A. Find magnetic field in between the parallel wires.
(a)
(b)
(c)
(d)
- A proton with a constant velocity passes through a region of space without any change in its velocity. If E and B represents the electric and magnetic field then the incorrect option is.
(a) $E = 0, B = 0$
(b) $E = 0, B \neq 0$
(c) $E \neq 0, B = 0$
(d) $E \neq 0, B \neq 0$
- If the mass and specific heat of the body are 0.08 kg and 0.17 k cal/°C. The temperature difference is 5°C. Find the change in internal energy.
(a)
(b)
(c)
(d)
- A charge $+Q$ is uniformly distributed on the circumference of a ring of radius R . Another charge $+q$ is now placed at the centre of the ring. Find the increase in tension after placing this charge at the centre?
(a)
(b)
(c)
(d)
- If the particle undergoing SHM is having maximum velocity 10 cm/s and the amplitude of SHM is 4 cm. Find the distance of the particle from the mean position when the velocity of the particle is 5 cm/s?
(a)
(b)
(c)
(d)
- If $\vec{E} = 200 \sin(\omega t - kx) \frac{V}{m} \hat{i}$, then find the intensity of em wave?
(a)
(b)
(c)
(d)
- If displacement of the particle is $S = 3t^2 + 4t + 5$, then velocity at $t = 5\text{ s}$ will be?
(a)
(b)
(c)
(d)
- A prism has apex angle A and refractive index $n = \cot \frac{A}{2}$. Find the minimum deviation?

- (a)
(b)
(c)
(d)
14. Two masses $m_1 = 4 \text{ gm}$ and $m_2 = 25 \text{ gm}$ are having same kinetic energy, find the ratio of linear momentum ?
(a) 1 : 5
(b) 2 : 5
(c) 1 : 1
(d) 1 : 6
15. If the diameter of earth becomes half keeping mass to be constant, then the acceleration due to gravity at the surface of earth becomes.
(a) Half
(b) Four times
(c) Twice
(d) Three times
16. Find the apparent depth of the object placed the bottom ?



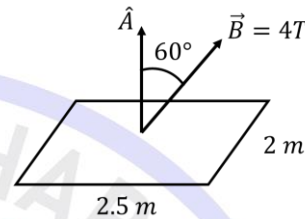
17. Find the charge on the capacitor in steady state ?

Diagram

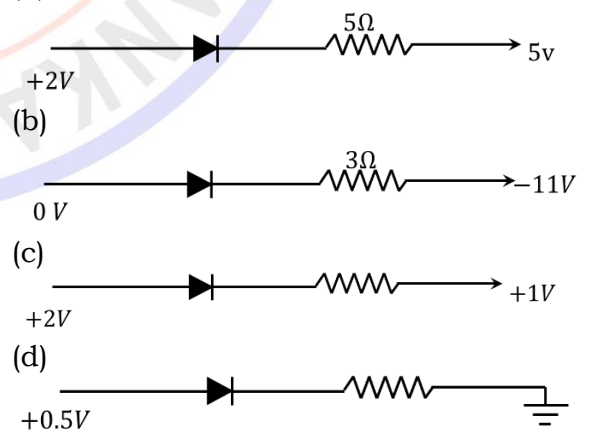
- (a)
(b)
(c)
(d)
18. **Statement 1:** In gases viscosity is higher than viscosity in liquid.
Statement 2: Surface tension decreases if a insoluble impurity is mixed in liquid.
(a) Statement I is correct and statement II is incorrect.
(b) Statement II is correct and statement I is incorrect.
(c) Both statements are correct
(d) Both statements are incorrect.
19. A train is moving on a circular track of radius 400 m with velocity 12 m/s. The distance between the rails is 1.5 m. Find the height by which outer rail should be

raised to keep it moving with the same velocity?

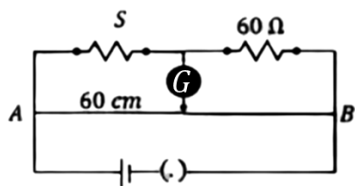
- (a)
(b)
(c)
(d)
20. A conducting loop of area $2.5 \text{ m} \times 2 \text{ m}$ is kept in a magnetic field. The conducting loop is taken out of the magnetic field in 10 sec. Find the induced emf.



- (a)
(b)
(c)
(d)
21. **Statement 1:** Linear momentum and moment of force have same dimensions.
Statement 2: Planck's constant and angular momentum have same dimensions
(a)
(b)
(c)
(d)
22. In which of the following circuits the diode is reversed biased ?



23. In the given meter bridge circuit, null point is found at 60 cm from end A. The unknown resistance S is?



24. A particle has initial ($t = 0$) velocity $\vec{v} = 5\hat{i}$ and is at origin at this instant. Its acceleration is given by $(3\hat{i} + 4\hat{j})$. When particle's x - coordinate is 16 units, then its speed is:

- (a) 13 units
 (b) $\sqrt{161}$ units
 (c) 12 units
 (d) $\sqrt{185}$ units

25. Spherometer is used to measure

- (a) Radius of curvature
 (b) Length of a rod
 (c) Density of a solid
 (d) Viscosity of a liquid

26. A particle performing simple harmonic motion according to $x = A \sin \omega t$. Then its kinetic energy (K.E), potential energy (P.E) and speed (v) at position $x = A/2$ are :

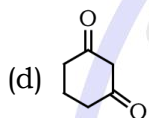
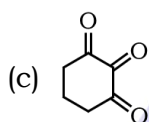
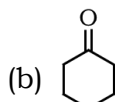
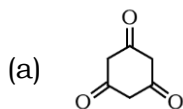
- (a) $KE = \frac{KA^2}{8}$, $PE = \frac{3KA^2}{8}$, $v = \frac{A}{3} \sqrt{\frac{K}{m}}$
 (b) $KE = \frac{3KA^2}{8}$, $PE = \frac{KA^2}{8}$, $v = \frac{A}{2} \sqrt{\frac{3K}{m}}$
 (c) $KE = \frac{3KA^2}{8}$, $PE = \frac{KA^2}{4}$, $v = A \sqrt{\frac{3K}{m}}$
 (d) $KE = \frac{KA^2}{4}$, $PE = \frac{3KA^2}{8}$, $v = \frac{A}{4} \sqrt{\frac{3K}{m}}$

27. A sphere of small size is at the bottom of a lake of depth 20 m. Due to pressure, its fractional change in volume is $\alpha \times 10^{-7}$. What is the value of α , the bulk modulus of the sphere is $5 \times 10^{12} Pa$ (use $g = 10 m/s^2$)?

28. A hollow cylindrical conductor has length of 3.14 m, while its inner and outer diameters are 4 mm and 8 mm respectively. The resistance of the conductor is $n \times 10^{-3} \Omega$. If the resistivity of the material is $2.4 \times 10^{-8} \Omega m$. The value n is.

Chemistry

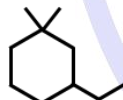
29. Which of the following has the highest enol content?



30. Which of the following can not show variable oxidation state?

- (a) Chlorine
- (b) Fluorine
- (c) Bromine
- (d) Iodine

31. IUPAC name of this compound is?



- (a) 1-ethyl-3, 3-dimethyl cyclohexane
- (b) 3-ethyl-1, 1-dimethyl cyclohexane
- (c) 1-ethyl-3, 3-dimethyl cyclohexene
- (d) 3-ethyl-1, 1-dimethyl cyclohexene

32. The compound given below is :



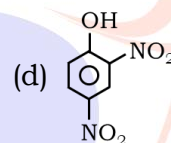
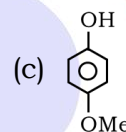
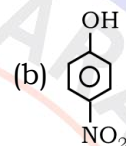
- (a) Alicyclic
- (b) Aromatic
- (c) Antiaromatic
- (d) Acyclic

33. Which of the following is polar molecule

- (a) $\text{CH}_2 = \text{CH}_2$
- (b) CHCl_3
- (c) CCl_4
- (d) CH_4

34. Which of the following is most acidic?

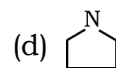
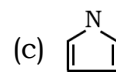
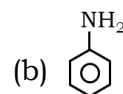
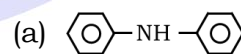
- (a) $\text{Ph} - \text{OH}$

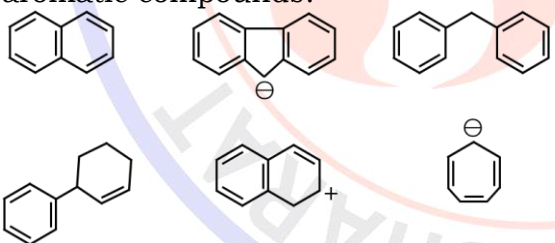


35. In which of the following compound central atom has +4 oxidation state?

- (a) SO_3
- (b) H_2SO_3
- (c) $\text{H}_2\text{S}_2\text{O}_7$
- (d) BaSO_4

36. Select the strongest Bronsted base



37. The electronic configuration of Neodymium (60) Nd is :
 (a) $[Xe]4f^46s^2$
 (b) $[Xe]5f^1$
 (c) $[Xe]4f^26s^2$
 (d) $[Xe]5f^44d^1$
38. Ethanol shows turbidity with lucas reagent (conc. HCl + anhydrous $ZnCl_2$)?
 (a) Immediately
 (b) After 5 to 7 mins
 (c) Upon heating
 (d) After 10-12 mins
39. Which type of linkage is present in nucleotide between base and sugar?
 (a) Peptide linkage
 (b) Glycosidic linkage
 (c) N-Glycosidic linkage
 (d) Amide linkage
40. During S_N1 reaction which of the following statement is correct?
 (a) Inversion occurs
 (b) Retention occurs
 (c) Almost racemization
 (d) 100% racemization
41. How many of the following are aromatic compounds?

42. Find out number of stereoisomers obtained when 3-methylhex-2-ene reacts with HBr in presence of peroxide.
43. Among the following number of meta directing groups are :
 $-CN$, $-NO_2$, $-COOH$, $-CH_3$,
 $-SO_3H$, NH_3^+ , $-F$
44. **ASSERTION** : Boron is Hard Element.
REASON : Boron has unusually high melting point due to its crystalline structure.
 (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion
 (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion
 (c) A is true, R is not
 (d) R is true, A is not
45. $PbCrO_4 \rightarrow$ complex
 Complex is :
 (a) Dianionic with CN = 6
 (b) Dianionic with CN = 4
 (c) Neutral with CN = 4
 (d) Trianionic with CN = 6
46. Which of the following configuration has strongest metallic bonding?
 (a) $[Ar]3d^74s^2$
 (b) $[Ar]3d^54s^1$
 (c) $[Ar]3d^54s^1$
 (d) $[Ar]3d^34s^2$
47. **Assertion** : All s-block elements are found in Nature.
Reason : 4f and 5f Series Periodic table are kept below.
 (a) Assertion and Reason, both are true and Reason is correct explanation of Reason
 (b) Assertion and Reason, both are true and Reason is not correct explanation of Assertion
 (c) Assertion is True, but Reason is False
 (d) Assertion is False but Reason is True
48. Find out the sum of bond orders of CO & NO^+
49. Calculate mass of CH_4 consumed for the formation of 22g CO_2 .

50. It is given that radius of 3rd stationary Orbit is r , find radius of 4th stationary Orbit.
 (a) $16r/9$
 (b) $6r/16$
 (c) $4r/3$
 (d) $3r/4$
51. We are given information of reactant of reaction with following about concentration with initial rate
 Initial Concentration, Initial rate
- | | |
|--------|----------------------|
| 0.005 | 7.5×10^{-4} |
| 0.02 M | 3×10^{-3} |
- Find out order respect to that of reaction w.r.t that reactant
52. Calculate the temperature (in K) at which kinetic energy of mono atomic gaseous molecule is equal to 0.414 eV
 (a) 3198 K
 (b) 319.8 K
 (c) 2500 K
 (d) 2900 K
53. A complex with maximum spin angular momentum?
 (a) $[FeF_6]^{3-}$
 (b) $[Fe(CN)_6]^{3-}$
 (c) $[Fe(H_2O)_6]^{2+}$
 (d) $[Fe(H_2O)_6]^{2+}$
54. A solution of two volatile components showing negative deviation from Raoult's law shows :
 (a) Decrease in vapour pressure, boiling point increases
 (b) Increase in vapour pressure, boiling point decreases
 (c) Decrease in vapour pressure, boiling point decreases
 (d) Increase in vapour pressure, boiling point increases
55. Calculate the number of electron for which $n = 4$ and $s = +1/2$
56. **Statement 1** : pH of solution of salt of weak acid & weak base depends on K_a & K_b
Statement 2 : pH of this type of salt is always 7
- (a) If both statements are correct and statement-2 is correct explanation of statement-1
 (b) If both statements are correct but statement-2 is not correct explanation of statement-1
 (c) If statement-1 is correct but statement-2 is wrong
 (d) If both statements are wrong

Mathematics

57. $\frac{x^2}{25} + \frac{y^2}{16} = 1$. Find the chord length given its mid point is $(1, \frac{2}{5})$
[Jee_Main_2024]

58. If $8 = 3 + \frac{3+P}{4} + \frac{3+2P}{4^2} + \dots \dots \infty$. Find the value of p is:

- (a) 9
(b) 5/4
(c) 3
(d) 1

59. Four points $(2k, 3k), (1,0), (0,0), (0,1)$ lie on a circle. Find the value of k .
[Jee_Main_2024]

60. A line $4x + 5y = 20$ is trisected by two lines L_1 and L_2 , both passing through origin. Find tangent made by L_1 and L_2

- (a.) $\frac{8}{5}$ & $\frac{2}{5}$
(b) $\frac{8}{5}$ & 1
(c) $\frac{2}{5}$ & $\frac{1}{2}$
(d) $\frac{5}{2}$ & $\frac{1}{2}$

61. $\cos 2x + \sin x = 2a - 7, a \in [p, q]$. $r = (\tan 9^\circ + \tan 81^\circ) - (\tan 27^\circ + \tan 63^\circ)$. Find the value of pqr .
[Jee_Main_2024]

62. $a = \lim_{x \rightarrow 0} \frac{\sqrt{1+\sqrt{1+x^4}} - \sqrt{2}}{x^4}$ and $b = \lim_{x \rightarrow 0} \frac{\sin^2 x}{\sqrt{2} - \sqrt{1+\cos(x)}}$. Then the value of ab^3 is:
[Jee_Main_2024]

63. ${}^{n-1}C_r = (k^2 - 8) \cdot {}^n C_{r+1}$. Find range of k .
[Jee_Main_2024]

64. If $\int_0^1 \frac{dx}{\sqrt{3+x}\sqrt{1+x}} = A + B\sqrt{2} + C\sqrt{3}$, then the value of $A + B + C$ is:
[Jee_Main_2024]

65. $|z - i| = |z + i| = |z - 1|$. Find the number of z satisfying this.
[Jee_Main_2024]

66. If $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3)$, then find $f'(10)$.
[Jee_Main_2024]

67. Consider two arithmetic progressions
4, 9, 14, 19, ... upto 25 terms
3, 6, 9, 12, ... upto 36 terms
Find the number of common terms in two series.
[Jee_Main_2024]

68. $f(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$
Statement 1: $f(-x)$ = inverse of $f(x)$
Statement 2: $f(x)f(y) = f(x + y)$
[Jee_Main_2024]
(a) Statement 1 correct Statement 2

- is incorrect
 (b) Statement 2 correct Statement 1 is incorrect
 (c) Both are correct
 (d) Both are incorrect

69. $a_1, a_2, a_3, \dots, a_{10} \cdot \sum_{k=1}^{10} a_k = 50$.
 $\sum_{k>j} a_k \cdot a_j = 1100$. Find standard deviation.

[Jee_Main_2024]

70. If sum of coefficients of $(10x^2 - 3x + 1)^n$ is A & sum of coefficients of $(1 + x^2)^n$ is B , then relation between A & B is?

[Jee_Main_2024]

71.
$$f(x) = \begin{cases} \frac{a(7x-12-x^2)}{b|x^2-7x+12|} & x < 3 \\ \frac{\sin(x-3)}{2^{x-[x]}} & x > 3 \\ b & x = 3 \end{cases}$$

For $f(x)$ to be continued at $x = 3$, what are ordered pair (a, b) are in a set S . The number of elements in S is

[Jee_Main_2024]

- (a) 0
 (b) Infinity
 (c) 1
 (d) 2
72. If $f(x) - f(y) = \ln\left(\frac{x}{y}\right) + x - y$, then find $\sum_{k=1}^{20} f'\left(\frac{1}{k^2}\right)$

[Jee_Main_2024]

- (a) 2890
 (b) 2390
 (c) 1245
 (d) None of these
73. $I_1 = \int_a^b x \sin(4x - x^2)$
 $I_2 = \int_a^b \sin(4x - x^2)$

(a, b) is orthocentre of triangle whose vertices have coordinates $(1, 2)$, $(2, 3)$ and $(3, 1)$. Find $\frac{I_1}{I_2}$

[Jee_Main_2024]

74. If $\vec{a} = \hat{i} + 2\hat{j} + \hat{k}$, $\vec{b} = 3(\hat{i} - \hat{j} + \hat{k})$, $\vec{a} \cdot \vec{c} = 3$ and $\vec{a} \times \vec{c} = \vec{b}$, then $\vec{a} \cdot ((\vec{c} \times \vec{b}) - \vec{b} - \vec{c}) =$

[Jee_Main_2024]

- (a) 24
 (b) 38
 (c) 10
 (d) None of these

75. If ${}^{n-1}C_r = (k^2 - 8)^n C_{r+1}$. Find k .

[Jee_Main_2024]

- (a) $k \in [-3, -2\sqrt{2}] \cup (2\sqrt{2}, 3]$
 (b) $k \in [-4 - 2\sqrt{3}] \cup (2\sqrt{2}, 4]$
 (c) $k \in [2\sqrt{3}, 4)$
 (d) $k \in [3, 2\sqrt{3}]$

76. Find the shortest distance between the lines

$$L_1: \frac{x-1}{2} = \frac{y+1}{4} = \frac{z-1}{3} \text{ and}$$

$$L_2: \frac{2x-1}{5} = \frac{y-2}{3} = \frac{z}{8}$$

[Jee_Main_2024]

77. If the shortest distance between $y^2 = 4x$ and centre of circle $x^2 + y^2 - 4x - 16y - 64 = 0$ is d , then find value of d^2

[Jee_Main_2024]

78. $f: N - \{1\} \rightarrow N$
 $f(n)$ is largest prime factor of n .
 $\therefore f$ is

[Jee_Main_2024]

- (a) One - One, Onto
 (b) Onto, Many One
 (c) One - One, onto
 (d) Neither One - One nor onto

79. If α is a root of $x^2 + x + 1 = 0$ satisfying $(1 + \alpha)^7 = a + b\alpha + c\alpha^2$, then ordered triplet (a, b, c) is:

[Jee_Main_2024]

- (a) (2, 3, 4)
- (b) (1, 3, 5)
- (c) (3, 3, 2)
- (d) (-1, 5, 4)

80. The vertices of a triangle ABC are $A(1, 2)$, $B(-3, 4)$ and $C(5, 8)$ then orthocentre of $\triangle ABC$ is _____.

[Jee_Main_2024]

