JEE MAINS GRAND TEST

DURATION: 3 Hours 0 Minutes **DATE: 2025-03-28**

IMPORTANT INSTRUCTIONS:

1. A seat marked with Reg. No. will be allotted to each student. The student should ensure that he/she occupies the correct seat only. If any student is found to have occupied the seat of another student, both the students shall be removed from the examination and shall have to accept any other penalty imposed upon them.
2. The test is of **3 hours** duration and this Test Booklet contains **90** questions. Each question carries **4** marks. For each correct response, the candidate will get **4** Marks. For each incorrect response, **one mark** will be deducted from the total scores. The maximum marks are **300**.
3. In this Test Paper, each subject will consist of two sections. **Section A** will consist of **20 questions** (all questions are mandatory) and **Section B** will have **10 questions.** Candidates can choose to attempt any **5 questions** out of these **10 questions.** In case the candidate attempts more than 5 questions, the first 5 attempted questions will be considered for marking.
4. Students cannot use log tables, calculators, or any other material in the examination hall.
5. **Mathematics Q.No.** 1 - 30
   Physics Q.No. 31 - 60
   Chemistry Q.No. 61 - 90
6. A candidate has to write his/her answer in the **OMR** sheet by darkening the appropriate bubble with the help of **Blue / Black Ball Point Pen** only as the correct answer(s) of the question attempted.

SYLLABUS

Mathematics:	Trigonometric Functions, Complex Numbers And Quadratic Equations, Determinants.
Physics:	Units And Measurement.
Chemistry:	Some Basic Concepts In Chemistry.

(Mathematics)

SECTION A

Attempt All 20 questions

1. If |z| = 1, (z ≠ −1) and z = x + iy, then $\left(\frac{z-1}{z+1}\right)$ is

A) Purely real **B)** Purely imaginary

C) Zero **D)** Undefined

2. Direction : *Each of these questions contains two statements : Statements I (Assertion) and Statement II (Reason). Each of these questions also has four alternative choices, only one of which is the correct answer you have to select one of the codes (a), (b), (c) and (d) given below.*

Statement I If $\frac{5z_2}{11z_1}$ is purely imaginary, then $\left|\frac{2z_1+3z_2}{2z_1-3z_2}\right| = 1.$

Statement II

$|z| = |\bar{z}|\ i.e.,\ |a+ib| = |a-ib|$

A) Statement I is false, Statement II is true

B) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I

C) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I

D) Statement I is true, Statement II is false

3. If $|z + 4| \le 3$, then the maximum value of $|z + 1|$ is

A) 4 **B)** 10

C) 6 **D)** 0

4. If $|z - i| \le 2$ and $z_0 = 5 + 3i$, the maximum value of $|iz + z_0|$ is

A) 7 **B)** 9

C) 13 **D)** None of these

5. If p and q are the roots of $x^2 + px + q = 0$. Then

A) $p = 1$ **B)** $p = 1$ or 0

C) $p = -2$ **D)** $p = -2$ or 0

6. If $(1 - p)$ is a root of quadratic equation $x^2 + px + (1 - p) = 0$, then its roots are

A) 0, 1 **B)** −1, 1

C) 0, −1 **D)** −1, 2

7. The number of real roots of $3^{2x^2 - 7x + 7} = 9$ is

A) 0 **B)** 2

C) 1 **D)** 4

8. If α, β be the roots of the equation $x^2 - px + q = 0$ and $\alpha > 0$, $\beta > 0$, then the value of $\alpha^{1/4} + \beta^{1/4}$ is $\left(p + 6\sqrt{q} + 4q^{1/4}\sqrt{p + 2\sqrt{q}}\right)^k$, where k is equal to

A) 1 **B)** $\frac{1}{2}$

C) $\frac{1}{3}$ **D)** $\frac{1}{4}$

9. The roots of the equation $ax^2 + bx + c = 0$, where $a \in R^+$, are two consecutive odd positive integers, then

A) $|b| \le 4a$ **B)** $|b| \ge 4a$

C) $|b| = 2a$ **D)** None of these

10. If $\begin{vmatrix} y+z & x & y \\ z+x & z & x \\ x+y & y & z \end{vmatrix} = k(x+y+z)(x-z)^2$, then k =

A) 2xyz **B)** 1

C) xyz **D)** $x^2y^2z^2$

11. If −9 is a root of the equation $\begin{vmatrix} x & 3 & 7 \\ 2 & x & 2 \\ 7 & 6 & x \end{vmatrix} = 0$, then the other two roots are

A) 2, 7 **B)** −2, 7

C) 2, −7 **D)** −2, −7

12. If A and B are square matrices of order 3 such that |A| = −1, |B| = 3, then |3 AB| =

A) −9 **B)** −81

C) −27 **D)** 81

13. If $a \ne p$, $b \ne q$, $c \ne r$ and $\begin{vmatrix} p & b & c \\ a & q & c \\ a & b & r \end{vmatrix} = 0$ then the value of $\frac{p}{p-a} + \frac{q}{q-b} + \frac{r}{r-c}$ is equal to

A) - 1 **B)** 1

C) - 2 **D)** 2

14. Let $\omega = -\frac{1}{2} + i\frac{\sqrt{3}}{2}$. Then the value of the determinate $\begin{vmatrix} 1 & 1 & 1 \\ 1 & -1-\omega^2 & \omega^2 \\ 1 & \omega^2 & \omega^4 \end{vmatrix}$ is

A) 3ω **B)** 3ω(ω − 1)

C) $3\omega^2$ **D)** 3ω(1 − ω)

15. If $B.B^T = I$ where B is non-singular 3 × 3 matrix such that $|B| = 1$, then $\det(B - I)$ is equal to

A) 1 **B)** 0

C) −1 **D)** None of these

16. If $p + q + r = a + b + c = 0$, then the determinant $\Delta = \begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix}$ equals

A) 0 **B)** 1

C) $pa + qb + rc$ **D)** None of these

17. If $f(x) = \begin{vmatrix} 1 & x & x+1 \\ 2x & x(x-1) & (x+1)x \\ 3x(x-1) & x(x-1)(x-2) & (x+1)x(x-1) \end{vmatrix}$ then $f(100)$ is equal to

A) 0 **B)** 1

C) 100 **D)** −100

18. The arbitrary constant on which the value of the determinant $\begin{vmatrix} 1 & \alpha & \alpha^2 \\ \cos(p-d)a & \cos pa & \cos(p-d)a \\ \sin(p-d)a & \sin pa & \sin(p-d)a \end{vmatrix}$ does not depend, is

A) α **B)** p

C) d **D)** a

19. If $|A|$ denotes the value of the determinant of the square matrix A of order 3, the $|-2A|$=

A) −8 | A | **B)** 8 | A |

C) −2 | A | **D)** None of these

20. If $x_1 \ne 0$, $x_2 \ne 0$, $x_3 \ne 0$, then the determinant $\begin{vmatrix} x_1 + a_1b_1 & a_1b_2 & a_1b_3 \\ a_2b_1 & x_2 + a_2b_2 & a_2b_3 \\ a_3b_1 & a_3b_2 & x_3 + a_3b_3 \end{vmatrix}$ is equal to

A) $x_1x_2x_3\left(1 + \frac{a_1b_1}{x_1} + \frac{a_2b_2}{x_2} + \frac{a_3b_3}{x_3}\right)$ **B)** $-x_1x_2x_3\left(1 + \frac{a_1b_1}{x_1} + \frac{a_2b_2}{x_2} + \frac{a_3b_3}{x_3}\right)$

C) $x_1x_2x_3\left(1 - \frac{a_1b_1}{x_1} - \frac{a_2b_2}{x_2} - \frac{a_3b_3}{x_3}\right)$ **D)** None of these

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SECTION B

This section will have 10 questions. Candidate can choose to attempt any 5 question out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be evaluated.

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21. The value of tan 9° − tan 27° − tan 63° + tan 81° is

22. If $\sin x + \sin^2 x = 1$, then the value of expression $\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + \cos^6 x - 1$ is equal to

23. $\sin^2\frac{\pi}{8} + \sin^2\frac{3\pi}{8} + \sin^2\frac{5\pi}{8} + \sin^2\frac{7\pi}{8}$ =

24. If tan α + cot α = 2, then the value of $\tan^n\alpha + \cot^n\alpha$

25. If $\sin x + \sin^2 x = 1$, then the value of $\cos^{12} x + 3\cos^{10} x + 3\cos^8 x + 3\cos^6 x - 2$ is equal to

26. If $\frac{\cos A}{3} = \frac{\cos B}{4} = \frac{1}{5}, -\frac{\pi}{2} < A < 0, -\frac{\pi}{2} < B < 0$, then value of 2 sin A + 4 sin B is

27. If the distance of moon from the earth is 360000 km and its diameter subtends an angle of 31' at the eye of the observer, then the diameter of the moon is _____km

28. If $\frac{\cos(x-y)}{\cos(x+y)} + \frac{\cos(z+t)}{\cos(z-t)} = 0$, then the value of tan *x* tan *y* tan *z* tan *t* is equal to

29. The value of cos 52° + cos 68° + cos 172° is

30. If $\cos A = \frac{3}{4}$, then $32 \sin\left(\frac{A}{2}\right) \sin\left(\frac{5A}{2}\right) =$

(Physics)

SECTION A

Attempt All 20 questions

31. If $x = at + bt^2$, where x is the distance travelled by the body in killometres while t is the time in seconds, then the units of b are

A) $\mathrm{km/s}$ **B)** $km - s$

C) km/S^2 **D)** $\mathrm{km} - S^2$

32. Match Column-I with Column-II

Column-I (Multiples of metre)	Column-II (Value)
a) Kilometre	P) 10^{15} nanometre
b) millimetre	Q) 10^{15} picometre
c) Mega metre	R) 10^{3} nanometre
d) micrometre	S) 10^{9} picometre

A) a - Q, b - S, c - P, d - R **B)** a - R, b - S, c - P, d - Q

C) a - S, b - R, c - Q, d - P **D)** a - Q, b - R, c - P, d - S

33. A cube has numerically equal volume and surface area. The volume of such a cube is

A) 216 units **B)** 1000 units

C) 2000 units **D)** 3000 units

34. In which of the following systems of unit, Weber is the unit of magnetic flux

A) CGS **B)** MKS

C) SI **D)** None of these

35. Match List-I with List-II and select the correct answer by using the codes given below the lists

List I	List II
(a) Distance between earth and stars	1. Microns
(b) Inter-atomic distance in a solid	2. Angstroms
(c) Size of the nucleus	3. Light years
(d) Wavelength of infrared laser	4. Fermi
	5. Kilometres

Codes

A)

a	b	c	d
5	4	2	1

B)

a	b	c	d
3	2	4	1

C)

a	b	c	d
5	2	4	3

D)

a	b	c	d
3	4	1	1

36. The pressure exerted by an object on a given surface is 2.4 Pa. The equivalent amount of pressure in CGS unit will be

A) $0.024\ \mathrm{g\ cm^{-1}\ s^{2}}$ **B)** $0.24\ \mathrm{g\ cm^{-1}\ s^{-2}}$

C) $24\ \mathrm{g\ cm^{-1}\ s^{-2}}$ **D)** $240\ \mathrm{g\ cm^{-1}\ s^{2}}$

37. The S.I. unit of force is Newton (N). It is equivalent to

A) $\mathrm{kgms^{-1}}$ **B)** $\mathrm{kgm^{2}\ s^{-2}}$

C) $\mathrm{kgms^{-2}}$ **D)** $\mathrm{kgm^{-1}\ s^{-2}}$

38. Ampere - hour is a unit of

A) Quantity of electricity **B)** Strength of electric current

C) Power **D)** Energy

39. Oersted is a unit of

A) Dip **B)** Magnetic intensity

C) Magnetic moment **D)** Pole strength

40. The velocity of a body is 10^2 mm / nano second. It is also equivalent to

A) $3.6 \times 10^{3}\ \mathrm{km\ h^{-1}}$ **B)** $3.6 \times 10^{8}\ \mathrm{km\ h^{-1}}$

C) $3.6 \times 10^{7}\ \mathrm{km\ h^{-1}}$ **D)** $3.6\ \mathrm{km\ h^{-1}}$

41. The equation $\left(P + \frac{a}{V^2}\right)(V - b)$ constant. The units of a are

A) $Dyne \times \mathrm{cm^{5}}$ **B)** $Dyne \times \mathrm{cm^{4}}$

C) $Dyne/cm^3$ **D)** $Dyne/cm^2$

42. Henry/ohm can be expressed in

A) Second **B)** Coulomb

C) Mho **D)** Metre

43. If the unit of length and force be increased four times, then the unit of energy is

A) Increased 4 times **B)** Increased 8 times

C) Increased 16 times **D)** Decreased 16 times

44. $1\mathrm{eV}$ is

A) Same as one joule **B)** $1.6 \times 10^{-19}\ \mathrm{J}$

C) $1V$ **D)** $1.6 \times 10^{-19}\mathrm{C}$

45. Convert 100 quintal into nanograms (ng)

A) $10^{5}\mathrm{ng}$ **B)** $10^{16}\mathrm{ng}$

C) $10^{17}\mathrm{ng}$ **D)** $10^{18}\mathrm{ng}$

46. The velocity of a particle depends upon as $v = a + bt + ct^2$; if the velocity is in m/sec, the unit of a will be

A) $m/\sec$ **B)** $m/\sec^2$

C) $m^2/\sec$ **D)** $m/\sec^3$

47. Match the following

Column-I	Column-II
a) Giga	1) 10^{4}
b) micro	2) $1/10^{12}$
c) Mega	3) 10^{9}
d) Pico	4) 10^{-6}

	5) 10^{-12}

A) a - 3; b - 1; c - 4; d - 2, 5 **B)** a - 3; b - 4; c - 1; d - 2, 5

C) a - 2, 5; b - 4; c - 1; d - 3 **D)** a - 3; b - 4; c - 2, 5; d - 1

48. $1kWh =$

A) $1000\ \mathrm{W}$ **B)** $3.6 \times 10^6\ \mathrm{J}$

C) $1000J$ **D)** $3600\ \mathrm{J}$

49. If u_1 and u_2 are the units selected in two systems of measurement and n_1 and n_2 their numerical values, then

A) $n_1u_1 = n_2u_2$ **B)** $n_1u_1 + n_2u_2 = 0$

C) $n_1n_2 = u_1u_2$ **D)** $(n_1 + u_1) = (n_2 + u_2)$

50. The value of a certain physical quantity is $\mathrm{X}\frac{\mu\mathrm{g}\times\mathrm{cm}^3}{(\text{mili second})^2}$ Its value in $\frac{\mathrm{mg}\times\mathrm{mm}^3}{\mu s^2}$ is

A) $10^{-3}X$ **B)** $10^{-6}\mathrm{X}$

C) $10^{-9}\mathrm{X}$ **D)** none of these

SECTION B

This section will have 10 questions. Candidate can choose to attempt any 5 question out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be evaluated.

51. If a distance of 4.5 km is to be converted to centimeters, what is the distance in cm ?

52. If the time taken for an event is 5 minutes, what is it in seconds?

53. A length of 3.5 meters is to be measured with an instrument that has an accuracy of 0.01 meters. What is the relative error?

54. A student measures a length as 12.3 cm with an instrument having a least count of 0.1 cm . What is the percentage uncertainty in the measurement?

55. If the density of a substance is 2 g/cm^3, what is it in kg /m^3 ?

56. Convert 9.8 × 10^3 milliliters (mL) to liters (L).

57. If a length is measured as $6.50 \pm 0.02cm$, what is the relative error?

58. The least count of a Vernier caliper is 0.01 cm . If the main scale reading is 2 cm and the Vernier scale reading is 5 divisions, what is the total length measured?

59. A velocity of 36 km/h is to be converted to meters per second (m/s). What is the velocity in m /s ?

60. A rectangular box measures 10 cm × 5 cm × 2 cm. What is its volume in cubic meters?

(Chemistry)

SECTION A

Attempt All 20 questions

61. The number of protons in an atom determines its:

A) Mass number **B)** Atomic number

C) Neutron number **D)** Valency

62. What is the limiting reactant in the reaction between 2 moles of HCl and 3 moles of $MgCO_3$?

A) HCl **B)** $MgCO_3$

C) Neither, they react **D)** None of the above

63. The Lewis structure of Ammonia (NH_3) involves:

A) Lone pair of electrons on Nitrogen **B)** Three single bonds between N and H

C) Both (A) and (B) **D)** Neither (A) nor (B)

64. Ionic bonding occurs due to _____.

A) Sharing of electrons **B)** Transfer of electrons from a metal to a non-metal

C) Attraction between polar molecules **D)** Covalent bonds between carbon atoms

65. Which of the following is a homogeneous mixture?

A) Sugar solution **B)** Air

C) Granite **D)** Milk

66. Which of the following is NOT a physical property?

A) Density **B)** Chemical reactivity

C) Boiling point **D)** Electrical conductivity

67. According to Boyle's Law, the pressure of a gas at constant temperature is _____.

A) Directly proportional to its volume **B)** Inversely proportional to its volume

C) Independent of its volume **D)** Directly proportional to its temperature

68. Which of the following molecules has a VSEPR geometry of trigonal planar?

A) CH_4 **B)** NH_3

C) BF_3 **D)** H_2O

69. Which of the following gases has the highest rate of diffusion at room temperature?

A) CO_2 **B)** O_2

C) N_2 **D)** He

70. Balancing a chemical equation is important for:

A) Predicting the products of the reaction **B)** Determining the relative amounts of reactants and products

C) Both (A) and (B) **D)** Neither (A) nor (B)

71. Given below are two statements :

Statement I : Lithium and Magnesium do not form superoxide

Statement II : The ionic radius of Li^+ is larger than ionic radius of Mg^{2+}

In the light of the above statements, choose the most appropriate answer from the questions given below :

A) Statement I is incorrect but Statement II is correct **B)** Statement I is correct but Statement II is incorrect

C) Both statement I and Statement II are incorrect

D) Both Statement I and Statement II are correct

72. In the combustion of Methane(CH_2), what is the coefficient of Oxygen (O_2)?

A) 1 **B)** 2

C) 4 **D)** 5

73. What is the SI unit of density?

A) g/mL **B)** kg/L

C) kg/m^3 **D)** J/kg°C

74. Which of the following states has a definite shape and volume?

A) Solid **B)** Liquid

C) Gas **D)** Plasma

75. In the reaction $2H_2 + O_2 \rightarrow 2H_2O$, how many moles of H_2O are produced when 3 moles of H_2 are reacted?

A) 1 mol **B)** 1.5 mol

C) 2 mol **D)** 3 mol

76. The average kinetic energy of molecules in a substance increases with _____.

A) Volume **B)** Pressure

C) Temperature **D)** Density

77. What is the difference between ionic and covalent bonding?

A) Sharing of electrons in both cases **B)** Transfer of electrons in ionic bonding only

C) No difference, both are the same **D)** Both involve attraction between oppositely charged ions

78. The property of a substance to resist change in temperature is called:

A) Specific heat capacity **B)** Thermal conductivity

C) Melting point **D)** Heat of fusion

79. Entropy (S) is a measure of _____.

A) Disorder or randomness **B)** Energy content

C) Chemical reactivity **D)** Temperature

80. Which of the following elements has the highest electron affinity?

A) Fluorine **B)** Chlorine

C) Bromine **D)** Iodine

SECTION B

This section will have 10 questions. Candidate can choose to attempt any 5 question out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be evaluated.

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81. In the reaction, $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$, the amount of oxygen needed to completely burn 4.0 g of CH_4 is _____ g

82. When burnt in air, a 12.0 g mixture of carbon and sulphur yields a mixture of CO_2 and SO_2, in which the number of moles of SO_2 is half that of CO_2. The mass of the carbon (in gram) the mixture contains is
(At. wt. of S = 32)

83. 12 litre of H_2 and 11.2 litre of Cl_2 are mixed and exploded. The volume of H_2 in the mixture is

84. One litre of milk weighs 1.035 kg. The butter fat is 4% in volume of milk has density of 875 kg/m^3. Find the density of fat free skimed milk

85. Calculate the mass percent (w/w) of sulphuric acid in a solution prepared by dissolving 4 g of sulphur trioxide in a 100 mL sulphuric acid solution containing 80 mass percent (w/w) of H_2SO_4 and having a density of 1.96 g/mL (Molecular weight of H_2SO_4 = 98 g)
Take reaction $SO_3 + H_2O \rightarrow H_2SO_4$

86. A mixture contains 18 g water and 414 g ethanol. The mole fraction of water is _____ .

87. A particular 100-octane aviation gasoline used 1 cc of $(C_2H_5)_4$ Pb, of density 1.66 gm/cc per litre of gasoline. $(C_2H_5)_4$ Pb is made as follows :
$4C_2H_5Cl + 4NaPb \rightarrow (C_2H_5)_4 Pb + 4NaCl$
How many gram of C_2H_5Cl is needed to make enough $(C_2H_5)_4$ Pb for 10 litre of gasoline
(atomic mass of Pb = 206)

88. A 400 mg of iron capsule contains 100 mg of ferrous fumarate ($C_4H_2FeO_4$). The percentage of iron present on it, is approximately _____%

89. If law of conservation of mass was to hold true, then 18.80 g of $BaCl_2$ on reaction with 11.80 g of H_2SO_4 will produce 7.30 g of HCl and $BaSO_4$ equal to _____ g.

90. The standard molar volume of He, if its density is 0.1784 g/L at STP is _____ L

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