

# JEE (Main) MOCK TEST

# 2024

**Time : 3 Hours**

**Total Marks : 300**

**General Instructions :**

1. There are three subjects in the question paper consisting of Physics (Q. no. 1 to 30), Chemistry (Q. no. 31 to 60) and Mathematics (Q. no. 61 to 90).
2. Each subject is divided into two sections. Section A consists of 20 multiple choice questions & Section B consists of 10 numerical value type questions. In Section B, candidates have to attempt any five questions out of 10.
3. There will be only one correct choice in the given four choices in Section A. For each question for Section A, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero mark will be awarded for not attempted question.
4. For Section B questions, 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.
5. Any textual, printed or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.
6. All calculations / written work should be done in the rough sheet is provided with Question Paper.

## Physics

### Section A

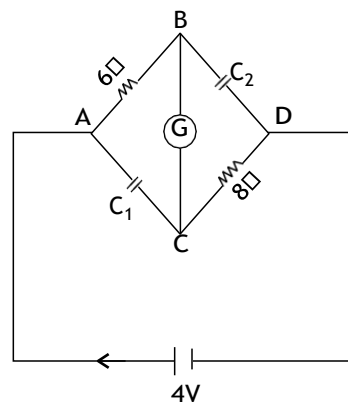
- Q. 1.** A cylindrical wire of mass  $(0.4 \pm 0.01)\text{g}$  has length  $(8 \pm 0.04)\text{ cm}$  and radius  $(6 \pm 0.03)\text{ mm}$ . The maximum error in its density will be:  
**(A)** 4%                      **(B)** 1%  
**(C)** 3.5%                    **(D)** 5%
- Q. 2.** The engine of a train moving with speed  $10\text{ ms}^{-1}$  towards a platform sounds a whistle at frequency  $400\text{ Hz}$ . The frequency heard by a passenger inside the train is : (neglect air speed. Speed of sound in air =  $330\text{ ms}^{-1}$ )  
**(A)**  $400\text{ Hz}$                 **(B)**  $388\text{ Hz}$   
**(C)**  $200\text{ Hz}$                 **(D)**  $412\text{ Hz}$
- Q. 3.** The weight of a body on the earth is  $400\text{ N}$ . Then weight of the body when taken to a depth half of the radius of the earth will be:  
**(A)**  $300\text{ N}$                 **(B)** Zero  
**(C)**  $100\text{ N}$                 **(D)**  $200\text{ N}$
- Q. 4.** A TV transmitting antenna is  $98\text{ m}$  high and the receiving antenna is at the ground level. If the radius of the earth is  $6400\text{ km}$ , the surface area covered by the transmitting antenna is approximately:  
**(A)**  $120\text{ km}^2$             **(B)**  $1549\text{ km}^2$   
**(C)**  $4868\text{ km}^2$            **(D)**  $3942\text{ km}^2$
- Q. 5.** Certain galvanometers have a fixed core made of non magnetic metallic material. The function of this metallic material is  
**(A)** To produce large deflecting torque on the coil  
**(B)** To bring the coil to rest quickly  
**(C)** To oscillate the coil in magnetic field for longer period of time  
**(D)** To make the magnetic field radial

**Q. 6.** Dimension of  $\frac{1}{\mu_0 \epsilon_0}$  should be equal to

- |                          |                              |
|--------------------------|------------------------------|
| <b>(A)</b> $\frac{T}{L}$ | <b>(B)</b> $\frac{T^2}{L^2}$ |
| <b>(C)</b> $\frac{L}{T}$ | <b>(D)</b> $\frac{L^2}{T^2}$ |

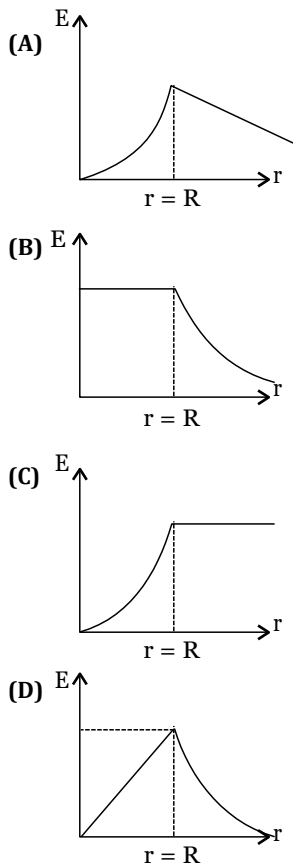
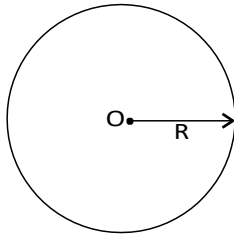
- Q. 7.** Two projectiles A and B are thrown with initial velocities of  $40\text{ m/s}$  and  $60\text{ m/s}$  at angles  $30^\circ$  and  $60^\circ$  with the horizontal respectively. The ratio of their ranges respectively is ( $g = 10\text{ m/s}^2$ )  
**(A)**  $2 : \sqrt{3}$                 **(B)**  $\sqrt{3} : 2$   
**(C)**  $4 : 9$                     **(D)**  $1 : 1$

- Q. 8.** In this figure the resistance of the coil of galvanometer G is  $2\ \Omega$ . The emf of the cell is  $4\text{ V}$ . The ratio of potential difference across  $C_1$  and  $C_2$  is:



- |                          |                          |
|--------------------------|--------------------------|
| <b>(A)</b> $\frac{5}{4}$ | <b>(B)</b> 1             |
| <b>(C)</b> $\frac{4}{5}$ | <b>(D)</b> $\frac{3}{4}$ |

- Q. 9.** A charge particle moving in magnetic field  $B$ , has the components of velocity along  $B$  as well as perpendicular to  $B$ . The path of the charge particle will be  
**(A)** Helical path with the axis along magnetic field  $B$   
**(B)** Straight along the direction of magnetic field  $B$   
**(C)** Helical path with the axis perpendicular to the direction of magnetic field  $B$   
**(D)** Circular path
- Q. 10.** Proton ( $P$ ) and electron ( $e$ ) will have same de-Broglie wavelength when the ratio of their momentum is (assume,  $m_p = 1849 m_e$ ):  
**(A)** 1 : 43                      **(B)** 43 : 1  
**(C)** 1 : 1849                    **(D)** 1 : 1
- Q. 11.** Graphical variation of electric field due to a uniformly charged insulating solid sphere of radius  $R$ , with distance  $r$  from the centre  $O$  is represented by:



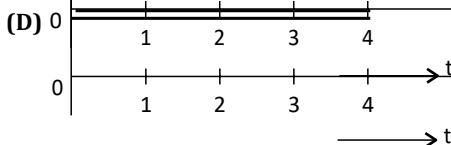
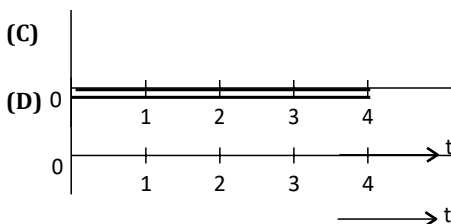
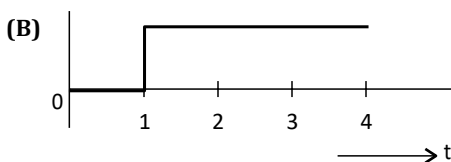
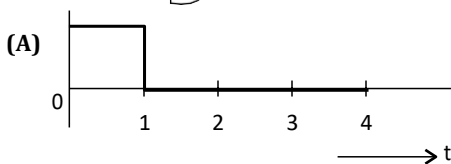
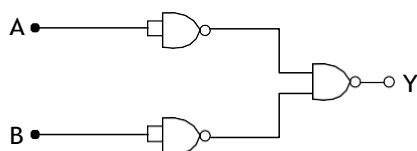
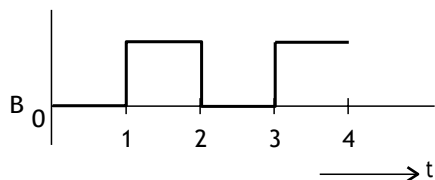
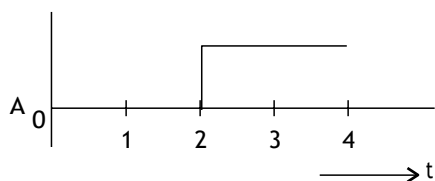
- Q. 12.** For a nucleus  ${}^A_Z X$  having mass number  $A$  and atomic number  $Z$   
**A.** The surface energy per nucleon ( $b_s$ ) =  $-a_1 A^{2/3}$ .  
**B.** The Coulomb contribution to the binding energy  $b_c = -a_2 \frac{Z(Z-1)}{A^{4/3}}$   
**C.** The volume energy  $b_v = a_3 A$   
**D.** Decrease in the binding energy is proportional to surface area.  
**E.** While estimating the surface energy, it is assumed that each nucleon interacts with 12 nucleons. ( $a_1, a_2$  and  $a_3$  are constants)  
 Choose the most appropriate answer from the options given below:  
**(A)** B, C only                      **(B)** A, B, C, D only  
**(C)** B, C, E only                    **(D)** C, D only

- Q. 13.** At any instant the velocity of a particle of mass 500 g is  $(2t\hat{i} + 3t^2\hat{j})$  ms<sup>-1</sup>. If the force acting on the particle at  $t = 1$  s is  $(\hat{i} + x\hat{j})$  N. Then the value of  $x$  will be:  
**(A)** 2                                      **(B)** 6  
**(C)** 3                                      **(D)** 4

- Q. 14.** Given below are two statements:  
**Statement I:** If  $E$  be the total energy of a satellite moving around the earth, then its potential energy will be  $\frac{E}{2}$ .  
**Statement II:** The kinetic energy of a satellite revolving in an orbit is equal to the half the magnitude of total energy  $E$ .  
 In the light of the above statements, choose the most appropriate answer from the options given below  
**(A)** Both Statement I and Statement II are incorrect  
**(B)** Statement I is incorrect but Statement II is correct  
**(C)** Statement I is correct but Statement II is incorrect  
**(D)** Both Statement I and Statement II are correct

- Q. 15.** Two forces having magnitude  $A$  and  $\frac{A}{2}$  are perpendicular to each other. The magnitude of their resultant is:  
**(A)**  $\frac{5A}{2}$                                       **(B)**  $\frac{\sqrt{5}A^2}{2}$   
**(C)**  $\frac{\sqrt{5}A}{4}$                                       **(D)**  $\frac{\sqrt{5}A}{2}$

- Q. 16.** For the logic circuit shown, the output waveform at  $Y$  is:



**Q. 17.** An aluminium rod with Young's modulus  $Y = 7.0 \times 10^{10} \text{ N/m}^2$  undergoes elastic strain of 0.04%. The energy per unit volume stored in the rod in SI unit is:

- (A) 5600 (B) 2800  
(C) 11200 (D) 8400

**Q. 18.** Given below are two statements:

**Statement I:** If heat is added to a system, its temperature must increase.

**Statement II:** If positive work is done by a system in a thermodynamic process, its volume must increase.

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

**Q. 19.** An air bubble of volume  $1 \text{ cm}^3$  rises from the bottom of a lake 40 m deep to the surface at a temperature of  $12^\circ\text{C}$ . The atmospheric pressure is  $1 \times 10^5 \text{ Pa}$ , the density of water is  $1000 \text{ kg/m}^3$  and  $g = 10 \text{ m/s}^2$ . There is no difference of the temperature of water at the depth of 40 m and on the surface. The volume of air bubble when it reaches the surface will be:

- (A)  $3 \text{ cm}^3$  (B)  $4 \text{ cm}^3$   
(C)  $2 \text{ cm}^3$  (D)  $5 \text{ cm}^3$

**Q. 20.** In a reflecting telescope, a secondary mirror is used to:

- (A) Make chromatic aberration zero  
(B) Reduce the problem of mechanical support  
(C) Move the eyepiece outside the telescopic tube  
(D) Remove spherical aberration

### Section B

**Q. 21.** The momentum of a body is increased by 50%. The percentage increase in the kinetic energy of the body is \_\_\_\_\_ %

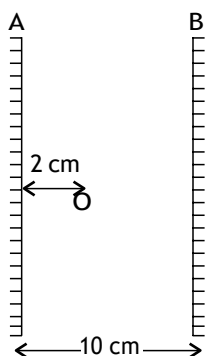
**Q. 22.** A nucleus with mass number 242 and binding energy per nucleon as 7.6 MeV breaks into two fragment each with mass number 121. If each fragment nucleus has binding energy per nucleon as 8.1 MeV, the total gain in binding energy is \_\_\_\_\_ MeV.

**Q. 23.** An electric dipole of dipole moment  $6.0 \times 10^{-6} \text{ Cm}$  placed in a uniform electric field of  $1.5 \times 10^3 \text{ NC}^{-1}$  in such a way that dipole moment is along electric field. The work done in rotating dipole by  $180^\circ$  in this field will be \_\_\_\_\_ mJ.

**Q. 24.** An organ pipe 40 cm long is open at both ends. The speed of sound in air is  $360 \text{ ms}^{-1}$ . The frequency of the second harmonic is \_\_\_\_\_ Hz.

**Q. 25.** The moment of inertia of a semicircular ring about an axis, passing through the center and perpendicular to the plane of ring, is  $\frac{1}{x} MR^2$ , where R is the radius and M is the mass of the semicircular ring. The value of x will be \_\_\_\_\_.

**Q. 26.** Two vertical parallel mirrors A and B are separated by 10 cm. A point object O is placed at a distance of 2 cm from mirror A. The distance of the second nearest image behind mirror A from the mirror A is \_\_\_\_\_ cm



- Q. 27.** The magnetic intensity at the center of a long current carrying solenoid is found to be  $1.6 \times 10^3 \text{ Am}^{-1}$ . If the number of turns is 8 per cm, then the current flowing through the solenoid is \_\_\_\_\_ A.

- Q. 28.** A current of 2 A through a wire of cross-sectional area  $25.0 \text{ mm}^2$ . The number of free electrons in a cubic meter are  $2.0 \times 10^{28}$ . The drift velocity of the electrons is \_\_\_\_\_  $\times 10^{-6} \text{ ms}^{-1}$

(given, charge on electron =  $1.6 \times 10^{-19} \text{ C}$ ).

- Q. 29.** An oscillating LC circuit consists of a 75 mH inductor and a  $1.2 \mu\text{F}$  capacitor. If the maximum charge to the capacitor is  $2.7 \mu\text{C}$ . The maximum current in the circuit will be \_\_\_\_\_ mA.

- Q. 30.** An air bubble of diameter 6 mm rises steadily through a solution of density  $1750 \text{ kg/m}^3$  at the rate of 0.35 cm/s. TGe co-efficient of viscosity of the solution (neglect density of air) is \_\_\_\_\_ poise (given,  $g = 10 \text{ ms}^{-2}$ ).

## Chemistry

### Section A

- 31.** The reaction  

$$\frac{1}{2} \text{H}_2(g) + \text{AgCl}(s) : \text{H}^+(aq) + \text{Cl}^-(aq) + \text{Ag}(s)$$

Occurs in which of the given galvanic cell.

- (1)  $\text{Pt} | \text{H}_2(g) | \text{HCl}(sol^n) | \text{AgNO}_3(sol^n) | \text{Ag}$   
 (2)  $\text{Pt} | \text{H}_2(g) | \text{HCl}(sol^n) | \text{AgCl}(s) | \text{Ag}$   
 (2)  $\text{Pt} | \text{H}_2(g) | \text{KCl}(sol^n) | \text{AgCl}(s) | \text{Ag}$   
 (4)  $\text{Ag} | \text{AgCl}(s) | \text{KCl}(sol^n) | \text{AgNO}_3 | \text{Ag}$
- 32.** Sulphur (S) containing amino acids from the following are:
- (a) isoleucine  
 (b) cysteine  
 (c) lysine  
 (d) methionine  
 (e) glutamic acid

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

- 33.** Which of the following complex is octahedral, diamagnetic and the most stable?

- (1)  $\text{K}_3[\text{Co}(\text{CN})_6]$                       (2)  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$   
 (3)  $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_2$                       (4)  $\text{Na}_3[\text{CoCl}_6]$

- 34.** Which of the following metals can be extracted through alkali leaching technique?

- (1) Cu                                      (2) Au  
 (3) Pb                                      (4) Sn

- 35.** The correct order of spin only magnetic moments for the following complex ions is

- (1)  $[\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-} < [\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-}$   
 (2)  $[\text{Fe}(\text{CN})_6]^{3-} < [\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-} < [\text{Mn}(\text{CN})_6]^{3-}$   
 (3)  $[\text{MnBr}_4]^{2-} < [\text{CoF}_6]^{3-} < [\text{Fe}(\text{CN})_6]^{2-} < [\text{Mn}(\text{CN})_6]^{3-}$   
 (4)  $[\text{Fe}(\text{CN})_6]^{3-} < [\text{Mn}(\text{CN})_6]^{3-} < [\text{CoF}_6]^{3-} < [\text{MnBr}_4]^{2-}$

- 36.** The water gas on reacting with cobalt as a catalyst forms

- (1) Methanoic acid                      (2) Methanal  
 (3) Ethanol                              (4) Methanol

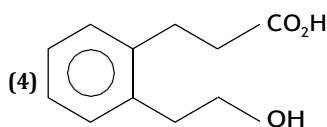
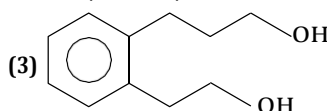
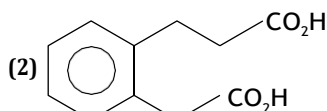
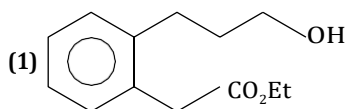
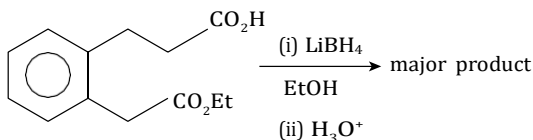
- 37.**  $2\text{IO}_3^- + x\text{I}^- + 12\text{H}^+ \rightarrow 6\text{I}_2 + 6\text{H}_2\text{O}$   
 What is the value of x?

- (1) 12                                      (2) 10  
 (3) 2                                        (4) 6

- 38.** What is the purpose of adding gypsum to cement?

- (1) To give a hard mass  
 (2) To speed up the process of setting  
 (3) To facilitate the hydration of cement  
 (4) To slow down the process of setting

- 39.** The major product formed in the following reaction is:



40. Match list I with list II:

List I (species)	List II (Maximum allowed concentration in ppm in drinking water)
A. $F^-$	I. <50 ppm
B. $SO_4^{2-}$	II. <5 ppm
C. $NO_3^-$	III. <2 ppm
D. Zn	IV. <500 ppm

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

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

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

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

41. In chromyl chloride, the number of d-electrons present on chromium is same as in (Given at no. of Ti: 22, V: 23, Cr: 24, Mn: 25, Fe: 26)

(1) Fe (III)                      (2) V (IV)

(3) Ti (III)                      (4) Mn (VII)

42. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R. Assertion A: Butan-1-ol has higher boiling point than ethoxyethane.

Reason R: Extensive hydrogen bonding leads to stronger association of molecules.

In the light of the above statements, choose the correct answer from the options given below:

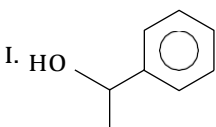
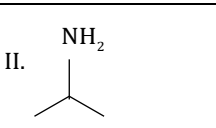
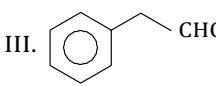
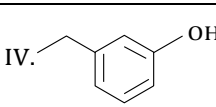
(1) Both A and R are true but R is not the correct explanation of A

(2) Both A and R are true and R is the correct explanation of A

(3) A is false but R is true

(4) A is true but R is false

43. Match List I with List II:

List I (Reagents used)	List II (Compound with Functional group detected)
A. Alkaline solution of copper sulphate and sodium citrate	I. 
B. Neutral $FeCl_3$ solution	II. 
C. Alkaline chloroform solution	III. 
D. Potassium iodide and sodium hypochloride	IV. 

Choose the correct answer from the options given below:

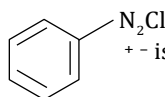
(1) A-III, B-IV, C-II, D-I

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

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

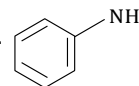
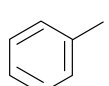
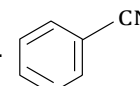
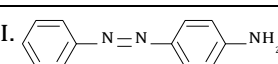
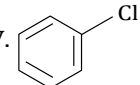
(4) A-III, B-IV, C-I, D-II

44. Match List I with List II:



+ - is reacted with reagents in List I to

form products in List II.

List I (Reagent)	List II (Product)
A. 	I. 
B. $HBF_4, \Delta$	II. 
C. Cu, HCl	III. 
D. CuCN/KCN	IV. 

Choose the correct answer from the options given below:

(1) A-I, B-III, C-IV, D-II (2) A-III, B-I, C-II, D-IV

(3) A-III, B-I, C-IV, D-II (4) A-IV, B-III, C-II, D-I

45. Match List I with List II:

List I	List II
A. Saccharin	I. High potency sweetener
B. Aspartame	II. First artificial sweetening agent
C. Alitame	III. Stable at cooking temperature
D. Sucralose	IV. Unstable at cooking temperature

Choose the correct answer from the options given below:

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

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

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

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

46. The correct order of electronegativity for given elements is:

(1)  $P > Br > C > At$       (2)  $C > P > At > Br$

(3)  $Br > P > At > C$       (4)  $Br > C > At > P$

47. Given below are two statements:

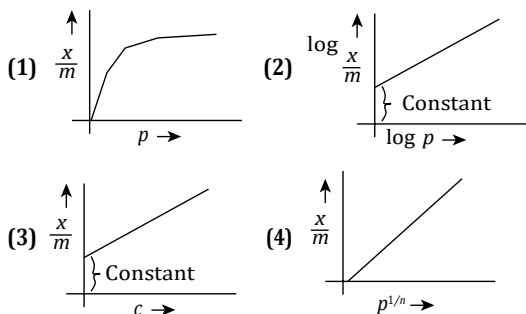
Statement I: Lithium and Magnesium do not form superoxide

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

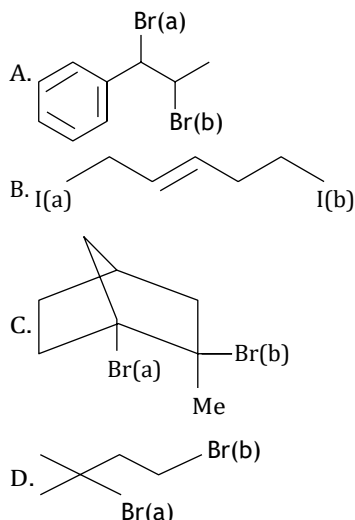
In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is correct but Statement II is incorrect

- (2) Statement I is incorrect but Statement II is correct  
 (3) Both statement I and Statement II are correct  
 (4) Both statement I and Statement II are incorrect
48. Which of the following represent the Freundlich adsorption isotherms?



49. Which halogen is known to cause the reaction given below:  
 $2\text{Cu}^{2+} + 4\text{X}^- \rightarrow \text{Cu}_2\text{X}_2(\text{s}) + \text{X}_2$   
 (1) All halogens (2) Only chlorine  
 (3) Only Bromine (4) Only Iodine
50. Choose the halogen which is most reactive towards  $\text{S}_{\text{N}}1$  reaction in the given compounds (A, B, C, & D)

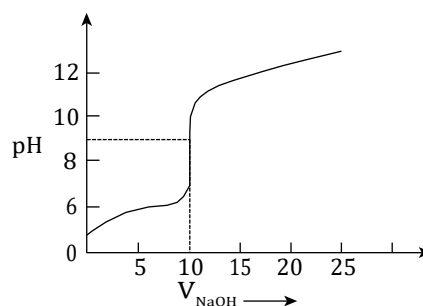


- (1) A-Br(a) ; B-I(a) ; C-Br(b) ; D-Br(a)  
 (2) A-Br(b) ; B-I(a) ; C-Br(a) ; D-Br(a)  
 (3) A-Br(b) ; B-I(b) ; C-Br(b) ; D-Br(b)  
 (4) A-Br(a) ; B-I(a) ; C-Br(a) ; D-Br(a)

### Section B

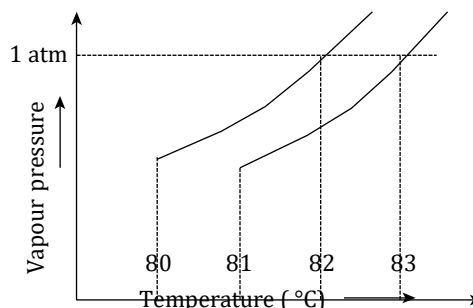
51. Molar mass of the hydrocarbon (X) which on ozonolysis consumes one mole of  $\text{O}_3$  per mole of (X) and gives one mole each of ethanal and propanone is \_\_\_\_\_  $\text{g mol}^{-1}$  (Molar mass of C :  $12 \text{ g mol}^{-1}$ , H :  $1 \text{ gmol}^{-1}$ )
52.  $\text{XeF}_4$  reacts with  $\text{SbF}_5$  to form  $[\text{XeF}_m]^{n+}[\text{SbF}_y]^{z-}$   
 $m + n + y + z =$  \_\_\_\_\_

53. The number of following statements which is/are incorrect is \_\_\_\_\_  
 (1) Line emission spectra are used to study the electronic structure.  
 (2) The emission spectra of atoms in the gas phase show a continuous spread of wavelength from red to violet.  
 (3) An absorption spectrum is like the photographic negative of an emission spectrum.  
 (4) The element helium was discovered in the sun by spectroscopic method.
54. The titration curve of a weak acid vs. strong base with phenolphthalein as indicator is shown below. The  $K_{\text{phenolphthalein}} = 4 \times 10^{-10}$   
 Given:  $\log 2 = 0.3$



The number of following statement/s which is/are correct about phenolphthalein is \_\_\_\_\_

- (1) It can be used as an indicator for the titration of weak acid with weak base.  
 (2) It begins to change colour at  $\text{pH} = 8.4$   
 (3) It is a weak organic base  
 (4) It is colourless in acidic medium
55. When a 60 W electric heater is immersed in a gas for 100s in a constant volume container with adiabatic walls, the temperature of the gas rises by  $5^\circ\text{C}$ . The heat capacity of the given gas is \_\_\_\_\_  $\text{K}^{-1}$  (Nearest integer).
56. The vapour pressure vs. temperature curve for a solution solvent system is shown below:

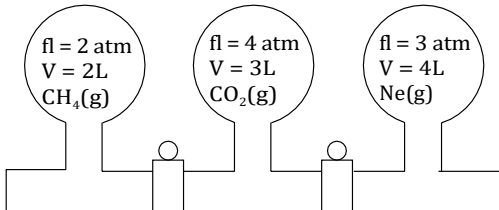


The boiling point of the solvent is \_\_\_\_\_  $^\circ\text{C}$

57. 0.5 g of an organic compound (X) with 60% carbon will produce \_\_\_\_\_  $\times 10^{-1} \text{ g}$  of  $\text{CO}_2$  on complete combustion.

58. The number of following factors which affect the percent covalent character of the ionic bond is \_\_\_\_\_
- (1) Polarising power of cation
  - (2) Extent of distortion of anion
  - (3) Polarisability of the anion
  - (4) Polarising power of anion

59.



Three bulbs are filled with  $\text{CH}_4$ ,  $\text{CO}_2$  and Ne as shown the picture. The bulbs are connected

through pipes of zero volume. When the stopcocks are opened and the temperature is kept constant throughout, the pressure of the system is found to be \_\_\_\_\_ atm. (Nearest integer)

60. The number of given statement/s which is/are correct is \_\_\_\_\_
- (1) The stronger the temperature dependence of the rate constant, the higher is the activation energy.
  - (2) If a reaction has zero activation energy, its rate is independent of temperature.
  - (3) The stronger the temperature dependence of the rate constant, the smaller is the activation energy
  - (4) If there is no correlation between the temperature and the rate constant then it means that the reaction has negative activation energy.

## Mathematics

### Section A

61. The area of the region  $\{(x, y): x^2 \leq y \leq 8 - x^2, y \leq 7\}$  is
- |        |        |
|--------|--------|
| (A) 24 | (B) 21 |
| (C) 20 | (D) 18 |

62. Let  $\begin{bmatrix} \sqrt{3} & 1 \\ 2 & 2 \\ -1 & \sqrt{3} \\ 2 & 2 \end{bmatrix}, A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$  and  $Q = PAP^T$ , If

$P^T Q^{2007} P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ , then  $2a + b - 3c - 4d$  equal to

- |          |          |
|----------|----------|
| (A) 2004 | (B) 2007 |
| (C) 2005 | (D) 2006 |
63. Negation of  $(p \rightarrow q) \rightarrow (q \rightarrow p)$  is
- |                         |                         |
|-------------------------|-------------------------|
| (A) $(\sim q) \wedge p$ | (B) $p \vee (\sim q)$   |
| (C) $(\sim p) \vee q$   | (D) $q \wedge (\sim p)$ |
64. Let  $C(\alpha, \beta)$  be the circumcenter of the triangle formed by the lines
- $$4x + 3y = 69,$$
- $$4y - 3x = 17 \text{ and}$$
- $$x + 7y = 61.$$
- Then  $(\alpha - \beta)^2 + \alpha + \beta$  is equal to
- |        |        |
|--------|--------|
| (A) 18 | (B) 15 |
| (C) 16 | (D) 17 |

65. Let  $\alpha, \beta, \gamma$ , be the three roots of the equation  $x^3 + bx + c = 0$ . If  $\beta\gamma = 1 = -\alpha$ , then  $b^3 + 2c^3 - 3\alpha^3 - 6\beta^3 - 8\gamma^3$  is equal to

- |                     |                     |
|---------------------|---------------------|
| (A) $\frac{155}{8}$ | (B) 21              |
| (C) 19              | (D) $\frac{169}{8}$ |

66. Let the number of elements in sets A and B be five and two respectively. Then the number of subsets of  $A \times B$  each having at least 3 and at most 6 elements is:

- |         |         |
|---------|---------|
| (A) 752 | (B) 772 |
| (C) 782 | (D) 792 |

67. If the coefficients of three consecutive terms in the expansion of  $(1 + x)^n$  are in the ratio 1 : 5 : 20, then the coefficient of the fourth term is

- |          |          |
|----------|----------|
| (A) 5481 | (B) 3654 |
| (C) 2436 | (D) 1817 |

68. Let R be the focus of the parabola  $y^2 = 20x$  and the line  $y = mx + c$  intersect the parabola at two points P and Q.

Let the point  $G(10, 10)$  be the centroid of the triangle PQR. If  $c - m = 6$ , then  $(PQ)^2$  is

- |         |         |
|---------|---------|
| (A) 325 | (B) 346 |
| (C) 296 | (D) 317 |

69. Let  $S = \frac{1+2+\dots+K}{K}$  and  $\sum_{j=1}^n S_j = A$

+ D), where  $A, B, C, D \in \mathbb{N}$  and A has least value. Then

- |                                       |                                   |
|---------------------------------------|-----------------------------------|
| (A) $A + B$ is divisible by D         | (B) $A + B = 5(D - C)$            |
| (C) $A + C + D$ is not divisible by B | (D) $A + B + D$ is divisible by 5 |

70. The shortest distance between the lines

$$\frac{x-4}{4} = \frac{y+2}{5} = \frac{z+3}{3} \text{ and } \frac{x-1}{3} = \frac{y-3}{4} = \frac{z-4}{2} \text{ is}$$

- |                 |                 |
|-----------------|-----------------|
| (A) $2\sqrt{6}$ | (B) $3\sqrt{6}$ |
| (C) $6\sqrt{3}$ | (D) 6           |

71. The number of arrangements of the letters of the word "INDEPENDENCE" in which all the vowels always occur together is.  
 (A) 16800 (B) 14800  
 (C) 18000 (D) 33600

72. If the points with position vectors  $\alpha\hat{i} + 10\hat{j} + 13\hat{k}$ ,  $6\hat{i} + 11\hat{j} + 11\hat{k}$ ,  $\frac{9}{2}\hat{i} + \beta\hat{j} - 8\hat{k}$  are collinear, then  $(19\alpha - 6\beta)^2$  is equal to  
 (A) 49 (B) 36  
 (C) 25 (D) 16

73. In a bolt factory, machines A, B and C manufacture respectively 20%, 30% and 50% of the total bolts. Of their output 3, 4 and 2 percent are respectively defective bolts. A bolt is drawn at random from the product. If the bolt drawn is found the defective, then the probability that it is manufactured by the machine C is.  
 (A)  $\frac{5}{14}$  (B)  $\frac{3}{7}$   
 (C)  $\frac{9}{28}$  (D)  $\frac{2}{7}$

74. If for  $z = \alpha + i\beta$ ,  $|z + 2| = z + 4(1 + i)$ , then  $\alpha + \beta$  and  $\alpha\beta$  are the roots of the equation  
 (A)  $x^2 + 3x - 4 = 0$  (B)  $x^2 + 7x + 12 = 0$   
 (C)  $x^2 + x - 12 = 0$  (D)  $x^2 + 2x - 3 = 0$

75.  $\lim_{x \rightarrow 0} \left| \frac{(1 - \cos^2(3x)) \left( \frac{\sin^3(4x)}{\cos^3(4x)} \right)}{(\log_e(2x+1))^5} \right|$  is equal to \_\_\_\_\_.  
 (A) 24 (B) 9  
 (C) 18 (D) 15

76. The number of ways, in which 5 girls and 7 boys can be seated at a round table so that no two girls sit together, is  
 (A)  $7(720)^2$  (B) 720  
 (C)  $7(360)^2$  (D)  $126(5!)^2$

77. Let  $f(x) = \frac{\sin x + \cos x - \sqrt{2}}{\sin x - \cos x}$ ,  $x \in [0, \pi] - \left\{ \frac{\pi}{4} \right\}$ . Then  $f\left(\frac{7\pi}{12}\right) f\left(\frac{7\pi}{12}\right)$  is equal to  
 (A)  $\frac{-2}{3}$  (B)  $\frac{2}{9}$   
 (C)  $\frac{-1}{3\sqrt{3}}$  (D)  $\frac{2}{3\sqrt{3}}$

78. If the equation of the plane containing the line  $x + 2y + 3z - 4 = 0 = 2x + y - z + 5$  and perpendicular to the plane  $\vec{r} = (\hat{i} - \hat{j}) + \lambda(\hat{i} + \hat{j} + \hat{k}) + \mu(\hat{i} - 2\hat{j} + 3\hat{k})$  is  $ax + by + cz = 4$ , then  $(a - b + c)$  is equal to  
 (A) 22 (B) 24

(C) 20 (D) 18

79. Let  $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$ . If  $|\text{adj}(\text{adj}(\text{adj}(2A)))| = (16)^n$ , then  $n$  is equal to  
 (A) 8 (B) 9  
 (C) 12 (D) 10

80. Let  $I(x) = \int \frac{(x+1)}{x(1+xe^x)^2} dx, x > 0$ .  $\lim_{x \rightarrow \infty} I(x) = 0$ , then  $I(1)$  is equal to  
 (A)  $\frac{e+1}{e+2} - \log_e(e+1)$  (B)  $\frac{e+2}{e+1} + \log_e(e+1)$   
 (C)  $\frac{e+2}{e+1} - \log_e(e+1)$  (D)  $\frac{e+1}{e+2} + \log_e(e+1)$

**Section B**

81. Let  $A = \{0, 3, 4, 6, 7, 8, 9, 10\}$  and  $R$  be the relation defined on  $A$  such that  $R = \{(x, y) \in A \times A : x - y \text{ is odd positive integer or } x - y = 2\}$ . The minimum number of elements that must be added to the relation  $R$ , so that it is a symmetric relation, is equal to \_\_\_\_\_.

82. Let  $[t]$  denote the greatest integer  $\left( \leq t, \text{ If the constant term in the expansion of } \left( 3x^2 - \frac{1}{2x^5} \right)^t \right)$  is  $\alpha$ , then  $[\alpha]$  is equal to \_\_\_\_\_.

83. Let  $\lambda_1, \lambda_2$  be the values of  $\lambda$  for which the points  $\left( \frac{\lambda}{2}, 1, \lambda \right)$  and  $(-2, 0, 1)$  are at equal distance from the plane  $2x + 3y - 6z + 7 = 0$ . If  $\lambda_1 > \lambda_2$ , then the distance of the point  $(\lambda_1 - \lambda_2, \lambda_2, \lambda_1)$  from the line  $\frac{x-5}{1} = \frac{y-1}{2} = \frac{z+7}{2}$  is \_\_\_\_\_.

84. If the solution curve of the differential equation  $(y - 2 \log_e x) dx + (x \log_e x^2) dy = 0, x > 1$  passes through the points  $\left( e, \frac{4}{3} \right)$  and  $(e^4, \alpha)$ , then  $\alpha$  is equal to \_\_\_\_\_.

85. Let  $\vec{a} = 6\hat{i} + 9\hat{j} + 12\hat{k}$ ,  $\vec{b} = \alpha\hat{i} + 11\hat{j} - 2\hat{k}$  and  $\vec{c}$  be vectors such that  $\vec{a} \times \vec{c} = \vec{a} \times \vec{b}$ . If  $\vec{a} \cdot \vec{c} = -12$ ,  $\vec{c} \cdot (\hat{i} - 2\hat{j} + \hat{k}) = 5$ , then  $\vec{c} \cdot (\hat{i} + \hat{j} + \hat{k})$  is equal to \_\_\_\_\_.

86. The largest natural number  $n$  such that  $3n$  divides  $66!$  is \_\_\_\_\_.



87. If  $a_0$  is the greatest term in the sequence

$$a_n = \frac{n^3}{n^4 + 147}, n = 1, 2, 3, \dots, \text{ then } a \text{ is equal to}$$

\_\_\_\_\_.

88. Let the mean and variance of 8 numbers  $x, y, 10, 12, 6, 12, 4, 8$  be 9 and 9.25 respectively. If  $x > y$ , then  $3x - 2y$  is equal to \_\_\_\_\_.

89. Consider a circle  $C_1: x^2 + y^2 - 4x - 2y = \alpha - 5$ . Let its mirror image in the line  $y = 2x + 1$  be another circle  $C_2: 5x^2 + 5y^2 - 10fx - 10gy + 36 = 0$ . Let  $r$  be the radius of  $C_2$ . Then  $\alpha + r$  is equal to \_\_\_\_\_.

90. Let  $[t]$  denote the greatest integer  $\leq t$ . Then

$$\frac{2}{\pi} \int_{\pi/6}^{5\pi/6} (8 [\operatorname{cosec} x] - 5 [\cot x]) dx \text{ is equal to}$$

\_\_\_\_\_.

## Answer Key

### Physics

Q. No.	Answer	Topic Name	Chapter Name
1	A	Error	Unit and dimension
2	A	Doppler's effect	Sound wave
3	D	Variation of $g$	Gravitation
4	D	Range	Communication system
5	B	Galvanometer	Magnetism
6	D	Dimensional equation	Units & Dimension
7	C	Range of projectile	Motion in 2D
8	C	RC circuit	Electric current
9	A	Force on moving charge in magnetic field	Moving charge and magnetism
10	D	Debroglie wavelength	Dual nature of matter
11	D	electric field due to charged sphere	Electrostatics
12	D	Binding energy	Nuclear physics
13	C	Momentum	Newton's second law
14	A	Energy of satellite	Gravitation
15	D	Resultant vector	Vectors
16	B	Logic gates	Semiconductors
17	A	Energy stored in stretched rod	Elasticity
18	D	Thermodynamic process	Thermodynamics
19	D	Isothermal process	Thermodynamics
20	C	Telescope	Ray optics
21	[125]	Kinetic energy	Work, Energy and Power
22	[121]	Binding energy	Nuclear physics
23	[18]	Dipole in uniform electric field	Electric dipole
24	[900]	Organ pipe	Sound wave
25	[1]	MI of semicircular ring	Rotational motion
26	[18]	Plane mirror	Ray optics
27	[2]	Solenoid	Electromagnetism
28	[25]	Drift velocity	Electric current
29	[9]	LC circuit	Electromagnetic induction
30	[10]	Terminal velocity	Fluid mechanics

## Answer Key

<b>Chemistry</b>			
<b>Q No</b>	<b>Answer</b>	<b>Topic's Name</b>	<b>Chapter's Name</b>
31	(2)	Electrochemical Cell	Electrochemistry
32	(4)	Proteins and Polysaccharide	Biomolecules
33	(1)	Crystal Field Theory	Coordination Compounds
34	(4)	Concentration of Ores	General Principles and Processes of Isolation of Elements
35	(4)	Crystal Field Theory	Coordination Compounds
36	(4)	Catalysis	Surface Chemistry
37	(2)	Applications of Oxidation Number	Redox Reaction
38	(4)	Some Important Compounds of Calcium	S-Block Elements
39	(4)	Reactions of Carboxylic Acid	Aldehydes, Ketones & Carboxylic Acids
40	(1)	Water Pollution	Environmental Chemistry
41	(4)	Some Transition Elements	d & f Block Elements
42	(2)	Physical Properties	Alcohols, Phenols & Ethers
43	(1)	Detection of Functional Group	Salt Analysis
44	(3)	Naming Reaction	Nitrogen Containing Compounds
45	(2)	Chemicals in Food	Chemistry In Everyday Life
46	(4)	Trends in Physical Properties	Classification of Elements and Periodicity in Properties
47	(3)	Trends in Physical Properties	Classification of Elements and Periodicity in Properties
48	(BONUS)	Freundlich Isothermal	Surface Chemistry
49	(4)	Some Transition Elements	d & f Block Elements
50	(1)	Fundamental Concepts in Organic Reaction Mechanism	Organic Chemistry - Some Basic Principles and Techniques
51	[70]	Law of Chemical Combinations	Some Basic Concepts of Chemistry
52	[11]	Some Transition Elements	d & f Block Elements
53	[1]	Evidence for Quantized Electronic Energy Levels	Atomic Structure
54	[2]	Hydrolysis of Salts and the pH of their Solutions	Ionic Equilibrium
55	[1200]	Adiabatic	Thermodynamics
56	[82]	Vapour Pressure of Solutions of Liquids in Liquids	Solutions
57	[11]	Stoichiometry	Some Basic Concepts of Chemistry
58	[3]	Ionic And Electrovalent Bond	Chemical Bonding & Molecular Structure
59	[3]	Ideal Gas Equation	States of Matter
60	[2]	Effect of Temperature and Catalyst on Rate of a Reaction	Chemical Kinetics

## Answer Key

### Mathematics

Q. No.	Answer	Topic Name	Chapter Name
61	C	Area between the curves	Integral Calculus
62	C	Algebra of matrices	Matrices
63	D	Negation of a statement	Mathematical Reasoning
64	D	Circumcentre	Straight line
65	C	Cube root of unity	Cubic Equation
66	D	$r$ things out of $n$ things	Permutation and Combination
67	B	Coefficient of a term	Binomial theorem
68	A	Parabola	Conic Section
69	A	Sum of $n$ terms	Sequences and series
70	B	Shortest distance	Three dimensional geometry
71	A	Number of ways	Permutation and Combination
72	B	Collinearity	Vector algebra
73	A	Conditional probability	Probability
74	B	Roots of equation	Complex numbers
75	C	Limits of trigonometry	Limits
76	D	Number of ways	Permutation and Combination
77	B	Higher order derivatives	Differentiability
78	A	Equation of plane	Three dimensional geometry
79	D	Adjoint	Matrices and Determinants
80	C	Indefinite Integral	Integral Calculus
81	[19]	Symmetric relation	Relation and Function
82	[1275]	General term	Binomial theorem
83	[9]	Plane	Three dimensional geometry
84	[3]	Linear Differential Equation	Differential equation
85	[11]	Algebra of vectors	Vector algebra
86	[31]	Remainder theorem	Binomial theorem
87	[5]	Maxima/Minima	Application of derivatives
88	[25]	Mean, Variance	Statistics
89	[2]	Circle	Conic Section
90	[14]	Definite Integral	Integral Calculus

