

JEE Mains Mock Test – Paper 1

Physics (25 Questions)

Section A – MCQs (20 Questions)

Q1. A capacitor of capacitance C is charged to a potential V . It is then connected across an inductor of inductance L . The maximum current in the circuit is:

- (A) V/C
- (B) $V\sqrt{C/L}$
- (C) $V\sqrt{L/C}$
- (D) VC

Q2. In a parallel plate capacitor, plate separation is halved and the medium between the plates is changed to one with double the dielectric constant. Capacitance becomes:

- (A) Doubled
- (B) Halved
- (C) Quadrupled
- (D) Unchanged

Q3. The current through a resistor is $I = I_0 e^{-t/RC}$. The dimensions of RC are:

- (A) Current
- (B) Time
- (C) Resistance
- (D) Capacitance

Q4. The magnetic flux linked with a coil changes from 0.02 Wb to 0 in 10^{-3} s . The average emf induced is:

- (A) 10 V
- (B) 20 V
- (C) 2 V
- (D) 200 V

Q5. Two charges $+q$ and $-q$ are placed at a distance $2a$ apart. The electric field at a point on the perpendicular bisector at a distance x ($x \gg a$) is proportional to:

- (A) $1/x^2$
- (B) $1/x^3$
- (C) $1/x$
- (D) $1/x^4$

Q6. A solenoid has length l , area of cross-section A , and N turns. Its self-inductance is proportional to:

- (A) $N^2 A / l$
- (B) $N^2 l / A$
- (C) NAI
- (D) N/A

Q7. Drift velocity of electrons is proportional to:

- (A) Current density
- (B) Number density
- (C) Resistivity
- (D) Mobility

Q8. The capacitance of an isolated conducting sphere of radius R is:

- (A) ϵ_0 / R
- (B) $4\pi\epsilon_0 R$
- (C) $1/4\pi\epsilon_0 R$
- (D) R/ϵ_0

Q9. The energy stored in an inductor of inductance L carrying current I is:

- (A) LI
- (B) $\frac{1}{2}LI^2$
- (C) L^2I^2
- (D) $\frac{1}{2}L^2I$

Q10. A charge q is placed at the center of a cube. The flux through one face is:

- (A) q/ϵ_0
- (B) $q/6\epsilon_0$
- (C) $q/8\epsilon_0$
- (D) 0

Q11. In a series LCR circuit, the voltage across resistance, inductor, and capacitor are 20 V, 40 V, and 60 V respectively. The resultant voltage across the source is:

- (A) 20 V
- (B) 40 V
- (C) 52.9 V
- (D) 80 V

Q12. The SI unit of magnetic flux is:

- (A) Weber
- (B) Tesla
- (C) Henry
- (D) Ampere

Q13. Which of the following graphs represents Ohm's law?

- (A) $I \propto V$
- (B) $I \propto 1/V$
- (C) $V \propto R$
- (D) $I \propto R$

Q14. The time constant of an RL circuit is:

- (A) R/L
- (B) L/R
- (C) LR
- (D) $1/LR$

Q15. Two capacitors of $6\ \mu\text{F}$ and $12\ \mu\text{F}$ are connected in series. Their equivalent capacitance is:

- (A) $18\ \mu\text{F}$
- (B) $4\ \mu\text{F}$
- (C) $2\ \mu\text{F}$
- (D) $8\ \mu\text{F}$

Q16. Which quantity is conserved in an isolated LC oscillation?

- (A) Electric energy only
- (B) Magnetic energy only
- (C) Total energy
- (D) None

Q17. The potential at a point due to an electric dipole on its axial line at a distance r is proportional to:

- (A) $1/r^2$
- (B) $1/r^3$
- (C) $1/r$
- (D) $1/r^4$

Q18. If current is doubled in a conductor, drift velocity:

- (A) Halves
- (B) Doubles
- (C) Becomes four times
- (D) Remains same

Q19. A $220\ \text{V}$ AC is applied across a $50\ \text{Hz}$ inductor of $0.7\ \text{H}$. The current is:

- (A) $1\ \text{A}$
- (B) $10\ \text{A}$
- (C) $5\ \text{A}$
- (D) $220\ \text{A}$

Q20. The unit of permittivity is:

- (A) $C^2/N \cdot m^2$
 - (B) $N \cdot m^2/C^2$
 - (C) $C/N \cdot m^2$
 - (D) N/C^2
-

Section B – Numerical Answer Type (5 Questions)

Q21. A capacitor of 20 μF is charged to 200 V. Find the energy stored in Joules.

Answer: _____

Q22. A coil of inductance 0.5 H has a current of 2 A. Find its energy in Joules.

Answer: _____

Q23. A 2 Ω resistor is connected across 6 V battery. Find the power dissipated in Watts.

Answer: _____

Q24. A 5 μC charge is placed in a uniform field of 1000 N/C. Find the force in Newtons.

Answer: _____

Q25. A current of 3 A flows through a wire of cross-section 1 mm^2 . If electron density is $8.5 \times 10^{28} m^{-3}$, find drift velocity (approx, in m/s).

Answer: _____

Chemistry (25 Questions)

Section A – MCQs (20 Questions)

Q26. The rate constant of a first-order reaction is 0.693 min^{-1} . The half-life of the reaction is:

- (A) 1 min
- (B) 0.693 min
- (C) 100 min
- (D) 10 min

Q27. Molar conductivity of a strong electrolyte at infinite dilution depends on:

- (A) Temperature only
- (B) Nature of electrolyte only
- (C) Both ions and temperature
- (D) Concentration

Q28. The slope of Arrhenius plot $\ln k$ vs $1/T$ gives:

- (A) Activation energy
- (B) $-E_a/R$
- (C) $\log A$
- (D) k

Q29. Which of the following shows positive deviation from Raoult's law?

- (A) Acetone + Chloroform
- (B) Acetone + Benzene
- (C) HCl + Water
- (D) NaCl + Water

Q30. In electrolysis of molten NaCl, product at cathode is:

- (A) Na metal
- (B) Cl₂ gas
- (C) H₂ gas
- (D) NaOH

Q31. The order of a reaction is determined from:

- (A) Molecularity
- (B) Experiment
- (C) Temperature
- (D) Pressure

Q32. Conductance of electrolytic solution decreases with:

- (A) Increase in concentration
- (B) Increase in dilution
- (C) Decrease in dilution
- (D) Increase in number of ions

Q33. For a zero-order reaction, rate is independent of:

- (A) Concentration
- (B) Rate constant
- (C) Time
- (D) Temperature

Q34. Osmotic pressure is directly proportional to:

- (A) Molar mass
- (B) Concentration
- (C) Pressure
- (D) Temperature

Q35. The factor $1000K_b/M$ is known as:

- (A) Cryoscopic constant
- (B) Ebullioscopic constant
- (C) Van't Hoff factor
- (D) Molal constant

Q36. The unit of rate constant for second order reaction is:

- (A) mol L⁻¹ s⁻¹

- (B) $\text{L mol}^{-1} \text{s}^{-1}$
- (C) s^{-1}
- (D) $\text{mol}^2 \text{L}^{-2} \text{s}^{-1}$

Q37. In a galvanic cell, electrons flow:

- (A) Cathode \rightarrow Anode
- (B) Anode \rightarrow Cathode
- (C) Both ways
- (D) None

Q38. The Nernst equation relates:

- (A) Cell potential and Gibbs free energy
- (B) Cell potential and reaction quotient
- (C) Current and resistance
- (D) Pressure and volume

Q39. Henry's law constant is directly proportional to:

- (A) Solubility
- (B) Partial pressure
- (C) Temperature
- (D) Mole fraction

Q40. The rate constant doubles for every 10°C rise. This is explained by:

- (A) Arrhenius equation
- (B) Raoult's law
- (C) Henry's law
- (D) Faraday's law

Q41. Which of the following solutions is isotonic with 0.1 M NaCl?

- (A) 0.1 M urea
- (B) 0.2 M glucose
- (C) 0.05 M Na_2SO_4
- (D) 0.05 M urea

Q42. In electrolysis, the amount deposited is directly proportional to:

- (A) Current only
- (B) Time only
- (C) Product of current and time
- (D) Resistance

Q43. Which of the following has highest rate constant at room temperature?

- (A) First-order reaction
- (B) Zero-order reaction

- (C) Photochemical reaction
(D) Fast reaction

Q44. Molality of a solution is defined as:

- (A) Moles of solute per litre of solution
(B) Moles of solute per kg of solvent
(C) Grams of solute per litre
(D) Grams of solute per kg of solvent

Q45. The standard electrode potential of Cu^{2+}/Cu is +0.34 V. Which is true?

- (A) Cu can reduce H^+ ions
(B) H_2 can reduce Cu^{2+} ions
(C) Cu^{2+} ions can oxidize H_2
(D) None
-

Section B – Numerical Answer Type (5 Questions)

Q46. The half-life of a first-order reaction is 20 minutes. Calculate the rate constant (s^{-1}).

Answer: _____

Q47. Calculate the freezing point of a 0.1 m solution of NaCl, assuming complete dissociation (K_f for water = $1.86 \text{ K kg mol}^{-1}$).

Answer: _____

Q48. A solution contains 5 g of urea ($M = 60 \text{ g mol}^{-1}$) in 100 mL of water. Calculate molarity.

Answer: _____

Q49. For a cell reaction: $\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Zn}^{2+} + \text{Cu}$, $E^\circ_{\text{cell}} = 1.1 \text{ V}$. Calculate ΔG° ($F = 96500 \text{ C/mol}$).

Answer: _____

Q50. The rate of a reaction at 600 K is double that at 590 K. Calculate activation energy ($R = 8.314 \text{ J/mol}\cdot\text{K}$).

Answer: _____

Mathematics (25 Questions)

Section A – MCQs (20 Questions)

Q51. If A is a 2×2 matrix with $\det(A) = 5$, then $\det(3A)$ is:

- (A) 15
(B) 45
(C) 9
(D) 25

Q52. The inverse of a matrix exists if:

- (A) $\det(A) = 0$
- (B) $\det(A) \neq 0$
- (C) A is square
- (D) Both B and C

Q53. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then $\det(A) =$

- (A) -2
- (B) 10
- (C) 2
- (D) -10

Q54. If $f(x) = x^2$ and $g(x) = \sqrt{x}$, then $f(g(x)) =$

- (A) x
- (B) x^2
- (C) \sqrt{x}
- (D) 1

Q55. Domain of $f(x) = \sqrt{x-1}$ is:

- (A) $(-\infty, \infty)$
- (B) $[1, \infty)$
- (C) $(0, \infty)$
- (D) $(-\infty, 1]$

Q56. The range of $\sin^{-1}(x)$ is:

- (A) $[0, \pi]$
- (B) $[-\pi/2, \pi/2]$
- (C) $(-\infty, \infty)$
- (D) $[-\pi, \pi]$

Q57. If A and B are two sets with $n(A) = 5$, $n(B) = 6$, and $n(A \cup B) = 9$, then $n(A \cap B) =$

- (A) 2
- (B) 1
- (C) 3
- (D) 4

Q58. The number of relations from a set of 3 elements to a set of 2 elements is:

- (A) 6
- (B) 8
- (C) 64
- (D) 512

Q59. The determinant of identity matrix of order 3 is:

- (A) 1

- (B) 0
- (C) 3
- (D) -1

Q60. If A is a skew-symmetric matrix of odd order, then $\det(A) =$

- (A) 0
- (B) 1
- (C) -1
- (D) Non-zero

Q61. The number of one-one functions from a set with 3 elements to a set with 5 elements is:

- (A) 10
- (B) 30
- (C) 60
- (D) 120

Q62. If $f(x) = x^3$, then $f(-x) =$

- (A) $-f(x)$
- (B) $f(x)$
- (C) $f(x)^2$
- (D) None

Q63. The adjoint of a diagonal matrix is:

- (A) Scalar multiple of identity
- (B) Transpose of itself
- (C) Same matrix
- (D) Zero matrix

Q64. If $n(A) = 4$, number of relations on A is:

- (A) 16
- (B) 64
- (C) 256
- (D) 65536

Q65. The sum of eigenvalues of a matrix is equal to:

- (A) Determinant
- (B) Trace
- (C) Rank
- (D) Dimension

Q66. The function $f(x) = \cos x$ is:

- (A) Even
- (B) Odd

- (C) Neither
- (D) Both

Q67. The determinant of $\begin{bmatrix} 2 & 3 \\ 4 & 6 \end{bmatrix}$ is:

- (A) 0
- (B) 12
- (C) -12
- (D) 24

Q68. The number of binary operations on a set of 2 elements is:

- (A) 4
- (B) 8
- (C) 16
- (D) 2

Q69. The rank of zero matrix is:

- (A) 0
- (B) 1
- (C) n
- (D) None

Q70. Which of the following is true?

- (A) Every function is a relation
- (B) Every relation is a function
- (C) No function is a relation
- (D) None

Section B – Numerical Answer Type (5 Questions)

Q71. Solve for x: $\det\left(\begin{bmatrix} x & 1 \\ 2 & 3 \end{bmatrix}\right) = 5$.

Answer: _____

Q72. If $f(x) = x^2 + 3x + 2$, find $f(-2)$.

Answer: _____

Q73. If matrix $A = \begin{bmatrix} 1 & 2 \\ 0 & 1 \end{bmatrix}$, find $\det(A^3)$.

Answer: _____

Q74. Find number of reflexive relations on a set of 2 elements.

Answer: _____

Q75. Evaluate: $\det\left(\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}\right)$.

Answer: _____

