JEE Main 31 January 2023 Shift 1 Memory-Based Questions

1. If $|a| = \sqrt{14}$, $|b| = \sqrt{6}$ and $|a \times b| = \sqrt{46}$, find $|a \cdot b|$.
2. $f(x) + \int_3^x [f(t)/t]\,dt = (x+1)^{1/2}$. Find $12*f(8)$.
3. From digits 0, 3, 4, 7, 9, find the total number of 5-digit numbers that can be formed if repetition is allowed.
4. If the speed of light in air is v and in another medium, it is $v_{med} = 0.2$ v. Find μ_{med}.
5. What is the electronic configuration of Nd^{2+}?
6. 2.56 g of a non-electrolyte solute is dissolved in one litre of solution. It has an osmotic pressure of 4 bar at 300K temperature. Find the molar mass of the compound. Take R = 0.083 and round off the answer to the nearest integer.
7. Compare the basic strength of the following oxides of V.
   V_2O_3, V_2O_5, V_2O_4
8. What is the hybridization of XeF_4, SF_4, and $BrCl_3$?
9. The ratio of molar specific heat capacity at constant pressure (C_p) to that of constant volume (C_v) varies with Temperature (T) as? Assume the temperature to be low.
10. If n is the number of density of charge carriers, A is the cross-sectional area of the conductor, q is the charge on each charge carrier, and I is the current through the conductor, then what will be the expression of drift velocity?
11. If R, XL, and XC denote resistance, inductive reactance and capacitve reactance, respectively, which one of the following will be a dimensionless quantity?
    i. X_LX_C/R
    ii. $R/(X_LX_C)^{1/2}$
    iii. R/X_LX_C
    iv. $R/(X_LX_C)^2$
12. A solid sphere is rolling with a kinetic energy of 7×10^{-3} J. If the mass of the sphere is 1 kg and the action is pure rolling, find the speed of the centre of mass in cm/s.
13. A lift of mass 500 kg starts moving downwards with an initial speed of 2 m/s and it accelerates at $2 m/s^2$. What will be the kinetic energy in kJ of the lift when it has moved 6 m down?
14. An electric field in a region is $4000x^2i$ N/C. The flux through a cube of side 20 cm placed in this field is $x/5$ Nm^2/C. Find x.
15. For a series LCR circuit across an AC source, current and voltage are in the same phase. If the resistance is of 20 ohms and the voltage source is 220 V. Find the current in the circuit in Amperes.

16. $\int_{\pi/6}^{\pi/3} \frac{2+3sinx}{sinx\ (1+cosx)}\,dx = ?$

17. If B = ln (1-a) and P(a) = $\left(a + \frac{a^2}{2} + \frac{a^3}{3} + \cdots + \frac{a^{50}}{50}\right)$, then $\int_0^a \frac{t^{50}}{1-t}\,dt = ?$

18. y = f(x) is a parabola with focus (-1/2, 0) and directrix y =-1/2. It is given that $tan^{-1}\sqrt{f(x)} + sin^{-1}\sqrt{f(x)+1} = \frac{\pi}{2}$. Find the number of solutions for x.

19. The direction ratios of two lines which are parallel are given by <2, 1, -1> and $< \alpha + \beta, 1 + \beta, 2 >$, then find the value of $|\ 2\alpha + 3\beta\ |$.

20. The product and sum of the first four terms of a GP is 1296 and 126 respectively. Find the sum of the possible values of the common difference.

21. If 5^{99} is divided by 11, what will be the remainder?

22. What is the oxidation state of phosphorous in Hypophosphoric acid?

23. Which of the following is the strongest artificial sweetener?
Aspartame, Saccharin, Sucralose, Alitame

24. Arrange the following in the increasing order of their ionic radii
Cl^-, K^+, S^{-2}, Ca^{+2}

25. Melting point order of: 1,2 dichlorobenzene; 1,3 dichlorobenzene; 1,4 dichlorobenzene.

26. Geometry of NH_4^+, XeF_4, SF_4, BF_3

27. Which of the following is not a method for concentrations of ore liquation?
Electrolysis, Form Flotation, Leaching, Hydraulic Washing

28. $ClO + NO_2$ gives rise to X
$X+H_2O$ gives rise to $Y + HNO_3$
Find X and Y.

29. The following values of K (rate constants) are given at different temperatures. Find out the activation energy E_a for:
T = 200 K; K_1 = 0.03
T = 200 K; K_2 = 0.05

30. $Cu^{+2} + KI \rightarrow X + Cu_2I_2$
$X + Na_2S_2O_3 \rightarrow Y$
Find X and Y.

31. Calculate the partial pressure of X, given that X = 0.6 g and Y = 0.4 g. The molar masses of X and Y are 20 g/mol and 45 g/mol respectively and the pressure of the solution is 740 mm Hg.

32. $Cu^{2+} + I^- \rightarrow A \rightarrow B + C$. Identify B and C.

33. Phenol reacts with Br_2 in a low-potential solvent. Identify the major product. (Diagrammatic representations of the product were given in the options.)

34. Which of the following statements is correct regarding the products obtained on electrolysis of brine solution?

i. Cl_2 at cathode
ii. O_2 at cathode
iii. H_2 at cathode
iv. OH^- at anode

35. SO_2 (g) + 0.5 O_2 (g) → SO_3 (g)
If $K_p = 2 \times 10^{12}$ and Kc = *m* x 1013, then the value of *m* in terms of RT will be?

36. In which of the following reactions H_2O_2 acts as a reducing agent?
i. $H_2O_2 + Mn^{2+} \rightarrow MnO_2 + H_2O$
ii. $NaOCl + H_2O_2 \rightarrow NaCl + O_2$
iii. $Fe2+ + H_2O_2 \rightarrow Fe^{3+} + H_2O$
iv. $PbS + H_2O_2 \rightarrow PbSO_4 + H_2O$

37. A drop of water of 1 mm radius is divided into 1000 droplets. If the surface tension of the water surface is 0.072 J/m^2, then the increment in surface energy while breaking down the bigger drop into small droplets as mentioned is?

38. A force of 200 N is exerted on a disc of mass 70 kg at its centre, forming an angle of 30^0 with the horizontal. Find the normal reaction given by the ground on the disc.

39. At a depth d from the surface of the earth, the acceleration due to gravity is the same as its value at height d above the surface of the earth. If the earth is a sphere of radius 6400 km, find the value of d.

40. Choose the graph depicting the variation of electric potential with respect to the radial distance from the centre of a conducting sphere charged with a positive charge.

41. In a sample of Hydrogen atoms, one atom goes through a transition n = 3 to ground state with an emitted wavelength of λ_1. Another atom goes through a transition n = 2 to ground state with an emitted wavelength of λ_2. Find λ_1/λ_2.

42. For a particle performing SHM, the maximum potential energy is 25 J. The kinetic energy in J at half the amplitude is x/4. Find x.

43. The current through a 5 ohms resistance remains the same irrespective of its connection in series or in a parallel combination of two identical cells. Find the internal resistance of the cell in ohms.

44. A block of mass m is connected to two identical springs of force constant K on a smooth horizontal surface. Find the total number of oscillations of the block per unit time.

45. Assertion: The beam of electrons shows wave nature and exhibits interference and diffraction.
Reason: The Davission-Germer experiment verified the wave nature of electrons.

46. A projectile is launched on a horizontal surface that if thrown with an initial velocity of u, it has a velocity of $\sqrt{3}u/2$ at maximum height. Calculate the time of flight of the projectile.

47. A diatomic gas is taken from point A (50, 50) to point B (200, 20) isothermally. Find the change in internal energy.

48. An unpolarized light of intensity I_0 is incident on a polarizer A and subsequently on polarizer B whose pass axis is perpendicular to that of A. Now a polarizer C is

introduced between A and B such that the pass axis of C is at 45^0 with the pass axis of A. Find the new intensity that comes out of B.

49. A conductor of length l and cross-sectional area A has a thrift velocity v_d when used across a potential difference V. When another conductor of the same material and length but double the cross-sectional area is used across the same potential difference, then what will be the new thrift velocity?

50. The weight of an organic compound is 0.492 g. When the hydrocarbon undergoes composition, it produces 0.792 g of CO_2. Find the percentage of carbon in the given hydrocarbon.