JEE Main 1 February 2023 Shift 2 Memory-Based Questions

1. $\int_{-\pi/4}^{\pi/4} \frac{x+\frac{\pi}{4}}{2-\cos 2x} dx = ?$

2. The area determined by $xy < 8$, $y < x^2$ and $y > 1$ is?

3. If $f(x) + f(1/(1 - x)) = 1 - x$, then find $f(2)$.

4. If $f(x) = x^x$ where $x > 0$, then $f''(2) + f(2) = ?$

5. If the term independent of x in the expansion $(x^{2/3} + m/x^3)^{22}$ is 7315, then find the value of m.

6. Which of the following is a tautology?
   i. $p \rightarrow (\sim p \wedge q)$
   ii. $p \rightarrow (p \vee q)$
   iii. $p \rightarrow (\sim p \vee q)$
   iv. $p \rightarrow (\sim p \wedge \sim q)$

7. For some values of λ, the following system of equations has infinitely many solutions, then find the values of α and β.
   $\alpha x + y + z = 1$
   $x + \alpha y + z = 1$
   $x + y + \alpha z = \beta$

8. Number of non-negative integral solutions of $x + y + z = 21$ if $x \geq 1, y \geq 3, z \geq 6$ are?

9. The total 6-digit numbers using the digits 4, 5, 9 which are divisible by 6 are?

10. Let the three Arithmetic Progressions be
    S1 = 2, 5, 8, 11, …, 394
    S2 = 1, 3, 5, 7, …, 397
    S3 = 2, 7, 12, …, 397
    Find the sum of the common terms of these three A.P.'s.

11. Ratio of acceleration due to gravity on the surface of planet 1 and planet 2 is x while the ratio of radii of respective planets is y. Find the ratio of respective escape velocity on the surface of planet 1 and planet 2.

12. In a hydrogen atom, an electron makes a transition from the 3rd excited state to the ground state. Find the energy of the photon emitted.

13. A uniform rod of mass 10 kg and length 6 m is hung from the ceiling. The area of the cross-section of the rod is 3 mm^2 and Young's modulus is 2 x 10^{11} N/m^2. Find the extension in the rod's length, assuming the acceleration of gravity to be 10 m/s^2.

14. Two point objects O_1 and O_2 are placed on the principle axis of a concave mirror with a radius of curvature of 40 cm. Find the distance between the two images.

15. The value of magnetic flux can be changed by changing which of the following?
    i. Area of coil
    ii. Angle
    iii. Keeping the magnitude same but changing the direction of the field
    iv. All of these

16. Assertion: To measure the potential difference across a 600 ohms resistor, a voltmeter of 1000 ohms will be favourable over a voltmeter of 4000 ohms.
    Reason: The voltmeter of a higher resistance will draw a lesser current.

17. For a heat engine based on the Carnot cycle, the source is at a temperature of 600 K. Now, if the source temperature is doubled, then its efficiency also gets doubled while keeping the sink temperature the same at x K (Kelvin). Find x.

18. If universal gravitational constant (G), Plank's constant (h), and speed of light (c) are taken as fundamental quantities then what will be the dimension of mass?

19. For a photoelectric setup, the threshold frequency is f_0. For an incident frequency of $2f_0$, the stopping potential is V_1 while for an incident frequency of $5f_0$, the stopping potential is V_2. Find the ratio of V_1 and V_2.

20. Which of the following option contains Nessler's reagent?
    $K_2[HgI_4]$, $K_2Cr_2O_7$, $K_4[Fe(CN)_6]$, $K_2[Cu(CN)_4]$

21. Find out the depression in the freezing point (ΔT_f) for CH_3COOH ($\alpha = 20\%$) dissolved in an aqueous solution having 10% (w/w) CH_3COOH in solution. IT is given that K_f of water is equal to 1.86 K.kg/mol.

22. The spin only magnetic moment of Mn^{2+} in $[Mn(H_2O)_6]^{2+}$.

23. If X is the bond length in the H_2O_2 molecule and Y is the bond length in the O_2F_2 molecule. Compare X and Y.

24. For a $\log(x/m)$ vs $\log(P)$ graph, the equation of a line is $y = 3x + 2.75$, where $\log K$ is the intercept of the line (i.e., $\log K = 2.75$). Find $\log K + 1/n$.

25. Which of the following acts as a tranquillizer?
    Aminoglycoside, Chloramphenicol, Aspirin, Valium

26. Find the number of chiral carbons in one molecule of testosterone.

27. An atom forms two lattices: FCC and BCC. The edge length of the FCC lattice is 2.5Å and the edge length of the BCC lattice is 2Å. Then find the ratio of the density of FCC to the density of BCC.

28. Which of the following order is correct regarding the magnitude of first electron gain enthalpy?
    $Cl < F$; $O < S$; $Te < O$; $S < Se$

29. Find the number of asymmetrical carbons in the structure of Vitamin C.