JEE Main 29 January 2023 Shift 1 Memory-Based Questions

1. Two trains moving in the same direction with velocity and u_1 and u_2 and the frequency of the sound of these trains is f_1 and f_2. If an observer is standing between the two trains, what frequency of the sound will the observer hear?
2. If points A (4, -11) and B (8, -5) lie on a circle $x^2 + y^2 - 3x + 10y - 15 = 0$. The tangents drawn at these points A and B intersect at C. What will be the radius of the circle drawn with centre C and with the line passing through A and B as its tangent?
3. If f(x) is such that $f(x + y) = f(x) + f(y) - 1$ and $f'(0) = 2$, then $f(-2) = ?$
4. Write the decreasing order of hydration energy of the following ions.
   Mg^{+2}, Cs^{+}, K^{+}, Ca^{+2}, Rb^{+}
5. The ratio of the coefficient of three consecutive terms in $(1 + 2x)^n$ is 2:5:8. Then what is the middle term of the three?
6. A body is projected with an internal velocity 'u' with an angle of 30 degrees with the horizontal. Find the ratio of kinetic energy at the highest point to the point of projection.
7. Point O and 2 long wires are being kept in the same plane such that point O lies at the middle of the line. Then the magnetic field at point O due to the current i flowing in both wires is equal to?
8. A block sliding down an inclined plane of inclination of 30 degrees with an acceleration of g/4. Find the coefficient of friction between the block and the inclined plane.
9. A ball of mass 0.4 kg fell from a height h. The ball reaches the ground in 8 seconds. Calculate the loss of potential energy.
10. A car is moving on a circular track of radius 50 m with the coefficient of friction being 0.34. Find the maximum speed of turning considering that $g = 10\ m/s^2$.
11. Find the ratio of the maximum wavelength of the Lyman series of the Hydrogen atom to the maximum wavelength of the Balmer series of the Helium atom.
12. If $Re(z_1z_2) = 0$ and $Re(z_1 + z_2) = 0$, then find $Im(z_1)$ and $Im(z_2)$.
13. Consider y = f(x) such that (1,1) satisfying the following differential equation y(x +1)dx + x2dy = 0, then y =f(x) is given by?
14. If $a_1, a_2, a_3, ..., a_n$ are positive numbers form a geometric progression such that $a_5 + a_7 = 12$ and $a_4 - a_6 = 9$. Find $a_7 + a_9$.
15. Find the product in the given reaction. (Organic chemistry)
16. Which of the following compounds are paramagnetic?
    NO_2, NO, K_2O, Na_2O_2

17. Arrange the following in increasing the order of PKa.
    Phenol, 2-4 Dinitrophenol, 2,4,5-trimethyl phenol, 4 nitrophenol, 4- chlorophenol
18. Which of the following has the highest bond dissociation energy?
    I_2, F_2, Cl_2, Br_2
19. Select the correct statement among the following.
    i. Photochemical smog has a high concentration of the oxidizing agent.
    ii. Classical smog has a high concentration of the oxidizing agent.
    iii. Classical smog contains NO_2.
    iv. None of these.
20. How many of the following compounds are odd electron species?
    NO_2, NO_2^+, ICl_4^-, BrF_3, NO
21. Find out the magnetic character of Li_2O, K_2O, and MgO.
22. If X is the number of bridge bonds present in $Mn_2(CO)_{10}$ and Y is the number of bridge bonds present in $W(CO)_6$. Then, find X + Y.
23. At low pressure, Vanderwaal's equation will be?
24. Which compound will give both the lassaigne test of nitrogen and halogen?
25. Conductivity Graph - Which of the following statement is incorrect about the following graph? (image given)
26.

Reaction	**Reagents**
Hofmaan Degradation	Conc KOH
Clemmensen Reaction	NaOhH, Br2
Cannizzaro Reaction	Zinc-Hg, HCI
Reimer - Tiemaan Reaction	CHCL3, NaOH

27. Find the number of millimoles of $Ca(OH)_2$ in 100 ml solution, given pH = 12
28. For a hypothetical reaction, $K_{eq} = 10^2$. Use $T = 27^0C$ and $R = 8.3\ JK^{-1}mol^{-1}$. If the value of delta G^0 for the above reaction is x kJ. Find the value of 2x (rounded off to the nearest integer).
29. If the dimensional formula for pressure gradient is X, electric field is Y, energy dentisy is W, and latent heat is Z. Find the dimensional formula of {[X][Y]/[Z][W]}.
30. $K_f = 10^3$, $K_b = 10^2$. Find delta G^0 at delta $T = 27^0C$.
31. There was a question related to the "Mond Process'.
32. A small circular loop of radius r is placed in the plane of a square loop of side length L (r<<L). Circular loop is at the centre of the square. Find mutual inductance.
33. A solid sphere is released from point O at the top of an inclineof height 7 m. Find the value of velocity of centre of mass of sphere at the bottomost point of the incline after it reaches there in a free pure rolling. Assume g to be 10 m/s^2.

34. Two resistances R and 3R are joined in parallel. What is the ratio of the heat produced in resistance R to that in resistance 3R.

35. A ball of mass 2 kg is dropped from a height of 9.8 m and it rebounds to a height of 4.9 m. It remains in contact for 0.2 seconds and the average force exerted by the ground on the ball is $x(2^{1/2} + 1)$ N. Find the value of x. Assume $g = 9.8\ m/s^2$.

36. A disc of radius R is rolling with a uniform angular velocity when it is placed on a rough horizontal surface. What will be the velocity at the centre of the disc when pure rolling starts?

37. In a standard YDSE, the first minima obtained in front of the slit is for a wavelength of 800 nm. If the distance between the slit and the screen is 5 m, find the distance between the slits.

38. Two charges $4q_0$ and $-q_0$ are separated by a distance r. Find the distance from $4q_0$ charge where the net electrif field is zero.

39. If $f(x) = [\log_x(x-1)/\log_{x-1}(x-4)]$ is a function, what is its domain?

40. If [A] is 3x3 matrix and $A^2 = 3A + aI$ and $A^4 = 21\ A + bI$, find the value of a + b.

41. Find the area common to the regions:
    $x^2 + y^2$ is less than or equal to 21
    x greater than or equal to 1
    y^2 is less than or equal to 4x

42. In a football club, there are 15 players with each player having a T-Shirt of their own name. Find the number of ways such that at least 13 players pick the correct T-Shirt of their own name.