JEE Main 31 January 2023 Shift 2 Memory-Based Questions

1. Find the coefficient of x^{-6} in the expression $[(4x/5) - (5/2x^2)]^9$.
2. An object of mass 10 kg is moving with a velocity of 20 m/s on a rough surface. The object comes to a stop after 5 seconds. Taking g = 10 m/s^2, find the coefficient of friction.
3. An hyperbola with an eccentricity $\sqrt{2}$ has its focii at $(1+\sqrt{2}, 0)$ and $(1 - \sqrt{2}, 0)$. Find the length of the LR.
4. If a = <1, 2, -3>, b = <1, -1, 3>, and c = <1, 2, 2>. Additionally, u x a = b x c and u · a = 0. Find $25|u|^2$.
5. ${}^{2n+1}P_{n-1} : {}^{2n-1}P_n = 11:21$. Find the value of $n^2 + n + 15$.
6. Find S if $S = 1^2 + 2.3^2 + 3.5^2 + ... + 15.29^2$
7. Which one of the following is linear in shape?
   I_3^-, I_3^+, ICl_3, ICl_2^+
8. For a given hydrocarbon, 11 moles of O_2 is used to produce 4 moles of H_2O. What is the formula of the hydrocarbon then?
9. Which one of the following has an important role in neuromuscular functions?
   Ca, Mg, Li, Be
10. Arrange the following in the decreasing order of Lewis acid character.
    BF_3, BCl_3, BBr_3, BI_3
11. The pH of acid rain is 5.6. Identify the reaction involved in the acid rain.
12. Which of the following elements of f-block have half-filled f-subshell?
    i. Samarium (Sm), Atomic number - 62
    ii. Europium (Eu), Atomic number - 63
    iii. Gadolinium (Gd), Atomic number - 64
    iv. Terbium (tb), Atomic number - 65
13. Which of the following is not a disinfectant?
    Chloroxylenol, Biothionol, Terpineol, Peracetic acid
14. Which of the following compounds contain the maximum number of chlorine atoms?
    Chloropicrin, Chloral, Gammexane, Feron-12
15. A reaction follows first-order kinetics with a rate constant of 20 min^{-1}. Calculate the time required for the concentration to reach 1/32 times initial concentration.
16. If the solubility of AgCl in an aqueous solution is 1.434×10^{-3} M, then find the value of $[- \log k_{sp}]$ where k_{sp} is the solubility product of AgCl.

17. Consider the following n, l, and m values. Arrange these in the decreasing order of the energy of the corresponding orbitals for the multielectron species.
    i. n =3; l = 0; m = 0
    ii. n =4; l = 0; m = 0
    iii. n =3; l = 1; m = 0
    iv. n =3; l = 2; m = 0

18. Match the following.

UV Rays	Physiotherapy
Infrared Rays	Treatment of Cancer
X-Rays	Lasik Eye Surgery
Microwave Rays	Aircraft Navigation

19. Two balls are projected with an equal speed of 40 m/s, one at an angle of 30^0 with the horizontal and the other at an angle of 60^0 with the horizontal. Find the ratio of the maximum heights attained by the balls.

20. During an adiabatic process performed on a diatomic gas, 725 J of work is done on the gas. Find the change in the internal energy of the gas.

21. Find the ionization energy of the 2^{nd} exited state of Li^{2+} if the ionization energy of the ground state of the hydrogen atom is 13.6 eV.

22. In a series RLC circuit, R = 80 ohms, X_L = 100 ohms, X_C = 40 ohms. If the source voltage is 2500 cos(628t) volts. Find the peak current in Amperes.

23. Match the following quantities with their dimensions in MLT.
    Torque, Stress, Pressure Gradient, Angular Momentum

24. A ball of mass 1 kg is hanging from a 1 m long inextensible string which can withstand a maximum tension of 400N. Find the maximum speed that should be given to the ball.

25. Two discs of the same mass, radii r_1 & r_2 and thickness 1 mm & 0.5 mm have densities in the ratio 3:1. The ratio of their moment of inertia about the diameter is 1:x. Find x.

26. A body moving horizontally has an initial speed of 20 m/s. Due to friction, the body stops after 5 seconds. If the mass of the body is 5 kg, the coefficient of friction is x/5. Taking g = 10 m/s^2, find x.

27. A ball was dropped from a height of 20 m from the ground. Find the height in metres up to which it rises after the collision. Assume e = 1/2 and g = 10 m/s^2.

28. The equations of two simple harmonic motions are given by $y_1 = 10sin\left(\omega t + \frac{\pi}{3}\right)$ and $y_2 = 5[sin(\omega t) + \sqrt{3}cos(\omega t)]$. Find the amplitude of the resultant SHM.

29. The range of y = $\frac{x^2+2x+1}{x^2+8x+1}$ = ? if $x \in R$.

30. If a, b ∈ I and relation R_1 is defined as $a^2 - b^2 \in I$ and relation R_2 is defined as $2 + \frac{a}{b} > 0$, then:
    i. R_1 is symmetric but R_2 is not

ii. R_2 is symmetric but R_1 is not
iii. R_1 and R_2 are both symmetric
iv. R_1 and R_2 are both transitive

31. If $\int \frac{x\,dx}{\sqrt{x^2+x+2}} = Af(x) + Bg(x) + C$ where C is the constant of integration, then A + 2B = ?

32. $\lim_{x\to\infty}\left(\frac{(\sqrt{3x^2+1}+\sqrt{3x^2-1})^6}{(x+\sqrt{x^2-1})^6+(x-\sqrt{x^2-1})^6}\right)$ = ?

33. Foot of perpendicular from origin to a plane which cuts the coordinate axes at A, B, C is (2, a, 4). The area of the tetrahedron OABC is 144 m^2. Which of the following point does not lie on the plane?
(2, 2, 4), (0, 3, 4), (1, 1, 5), (5, 5, 1)

34. Find z = $\frac{i-1}{sin\frac{\pi}{6}+icos\frac{\pi}{6}}$

35. Given that $\theta \in [0, 2\pi]$, then the largest interval of values of θ which satisfy the inequation $sin^{-1}(sin\theta) + cos^{-1}(cos\theta) \geq 0$ is?