JEE Main 1 February 2023 Shift 1 Memory-Based Questions

1. $\lim_{n\to\infty}\left(\frac{1}{n+1}+\frac{1}{n+2}+\cdots+\frac{1}{2n}\right)$ = ?
2. For the solution of $\frac{dy}{dx}+ytanx=secx$, y(0) = 1, then $y\left(\frac{\pi}{6}\right)$ = ?
3. $\frac{1}{1+1^2+1^4}+\frac{1}{1+2^2+2^4}+\cdots\infty$ = ?
4. If $f(x)+f'(x)=\int_0^2 f(t)dt$ and $f(0)=e^{-2}$, then find $f(2)-f(0)$.
5. If Set $S=\{(\sqrt{3}+\sqrt{2})^{x^2-4}+(\sqrt{3}-\sqrt{2})^{x^2-4}=10\}$, then n(S) = ?
6. Find the number of ways by which the letters of the word ASSASSINATION can be arranged such that all vowels come together.
7. 1, 3, 5, x, y are five observations. The mean of these observations is 5 and variance is 8. What will be the sum of the cubes of x and y.
8. 1/1!50! + 1/3!48! + 1/5!46! + ...+ 1/50!0! = ?
9. Area bounded by y = x | x - 3 | and x-axis between x = -1 and x = 2 is A. Find 12A.
10. Find the remainder when $23^{200} + 19^{200}$ is divided by 49.
11. If f(x) = x2 + g'(1)x + g''(2) and g(x) = 2x + f'(1), then find f(4) - g(4).
12. Let R = {(a, b): 3a - 3b + √7 is irrational}, then:
    i. R is an equivalence relation
    ii. R is symmetric but not reflexive
    iii. R is reflexive but not symmetric
    iv. R is reflexive and symmetric but not transitive
13. Negation of the statement p V (p ∧ ~q) is:
14. Let S be solution set for values of x satisfying $\cos^{-1}(2x) + \cos^{-1}(1-x^2)^{1/2} = \pi$, then summation of $2\sin^{-1}(x^2 - 1)$ when x belongs to S is equal to?
15. A triangle be such that cos 2A + cos 2B + cos 2C is minimum. If the inradius of the triangle is 3, then what is the area and perimeter of the triangle?
16. 8, a_1, a_2, ..., a_n are terms in A.P. The sum of the first 4 terms of the series is 50 and the sum of the last 4 terms of the series is 170. Find the product of the middle terms of the series.
17. Find the total number of 3-digit numbers which are divisible by 2 or 3 but not divisible by.

18. An object of height h is kept at a distance of 20 m from a concave mirror of radius of curvature 20 m. Find the height of the image.
19. Five resistances, each with R ohm resistance, are connected in a circuit. Calculate the effective resistance. (Diagram given)
20. A uniform solid cylinder is released from the top of an inclined plane. The angle of inclination is 30^0 and the length of the incline is 600 m. Find the time taken by the cylinder to reach the bottom of the incline.
21. An object is thrown in the horizontal direction with a speed of 5 m/s from a height of 10 m. Find the speed with which it strikes the ground. Take g = 10 m/s^2.
22. An ideal gas with an adiabatic constant equal to 3/2 undergoes adiabatic expansion. The change in temperature is -T. If there are 2 moles of the gas, find the work done by the gas.
23. For a real gas, the equation of gas is given by $\left(P + \frac{an^2}{V^2}\right)(V - bn) = nRT$. If the symbols have their usual meaning, then the dimensions of $\frac{V^2}{an^2}$ are the same as:
    i. Compressibility
    ii. Bulk Modulus
    iii. Viscosity
    iv. Energy Density
24. Assertion: The value of acceleration due to gravity is the same at all the small points inside the earth assuming that it is made up of uniform density.
    Reason: The value of the gravitational field increases as we go towards the centre in a uniform spherical shell.
25. A wire carrying current i is bent in a C shape of radius R. Find the magnetic field at its centre.
26. On a rough horizontal surface, a force of 30 N is applied on a block of mass 5 kg. The block travels a distance of 50 m in 10 seconds starting from rest. Find the coefficient of friction of the surface.
27. A stone is thrown vertically up with speed v_0 from a cliff of height H. Find the average speed of the ball till the moment it reaches the ground. Given that H = 100 m, v_0 10 m/s, g= 10 m/s^2.
28. A drop of Mercury is divided into 125 drops of equal radius of 10^{-3} m each. If the surface tension of Mercury is equal to 0.45 Nm^{-1}. Find the magnitude of change in surface energy.
29. A charged particle with charge 2 x 10^{-6} C, at rest, is first accelerated through a potential difference of 100 V and then it is subjected to a transverse magnetic field of 4 mT. In the region of the magnetic field, it undergoes a circular path of radius 3 cm. Find the mass of the particle.
30. In a series LCR circuit connected across 220 V, 50 Hz AC supply. If the inductive reactance of the circuit is 79.6 ohms. If the power delivered in the circuit is maximum, the capacitance of the circuit is x μF. Find x.

31. A string of mass per unit length equal to 7×10^{-3} kg/m is subjected to a tension equal to 70 N. Find the speed of the transverse wave on this string.

32. An alpha particle and a proton have the same de - Broglie wavelengths. Find the ratio of kinetic energies of proton and alpha particle.

33. If the mass of a planet is 9 times that of the earth and its radius is 2 times that of the earth, then the escape speed from this planet is $xv_e/\sqrt{2}$. Find x if v_e is escape speed from the earth.

34. There are n number of polarizers arranged one after the other. Each polarizer pass axis is inclined at 45° with respect to the previous polarizer. Unpolarized light of intensity l_o is incident on this setup. The final transmitted light has an intensity of $l_o/64$. Find n.

35. Two thin insulating sheets (each having charge density $+\sigma$) are arranged in front of each other. Find the net electric field magnitude in the 3 regions created by the two sheets.

36. Identify the compound with the fastest rate of dehydration. (Compounds in options were represented diagrammatically.)

37. Which of the following compounds have maximum splitting?
$[Fe(CN)]^{4-}$, $[Fe(NH3)_6]^{2+}$, $[Fe(Cl)_6]^{4-}$, $[Fe(OX)_3]^{4-}$

38. The average kinetic energy of a gas depends on:
    i. Nature of the gas
    ii. Pressure of the gas
    iii. Volume of the gas
    iv. Temperature of the gas

39. Consider the structure of Mn_2O_7. If X is the number of Mn-Mn bonds and Y is the number of Mn-O-Mn bonds, calculate X + Y.

40. Assertion: Hydrogen is an environment-friendly fuel.
    Reason: Hydrogen is the lightest element.

41. Identify the pyranose form from the given compound.

42. $X(g) \rightarrow 2y(g)$; Kp_1 - (i)
    $A(g) \rightarrow B(g) + C(g)$; Kp_2 - (ii)
    If degree of dissociation is same for both the reactions, find out ratio of total pressure P_1 & P_2 respectively.

43. Which of the following is not correctly matched
    i. Antibiotic - Penicillin
    ii. Antiseptic - Chloroxylenol
    iii. Tranquilizer - Erythromycin
    iv. Analgesic - Aspirin

44. When $K[Fe(CN)_6]$ is added to $FeCl_3$, the Prussian blue complex compound formed is:
    i. $Fe_3[Fe(CN)_6]_4$
    ii. $K_2Fe[Fe(CN)_6]$
    iii. $Fe_4[Fe(CN)_6]_3$
    iv. $K_2Fe_3[Fe(CN)_6]_2$

45. How photochemical smog can be controlled in automobiles?
    i. Using catalytic converters which will increase the emission of nitrogen oxides

ii. Using catalytic converters which will decrease the emission of nitrogen oxides
iii. By increasing sulphur content in fuel
iv. By decreasing sulphur content in fuel

46. If X is the oxidation number of Bromine in Bromic acid and Y is the oxidation number of Bromine in perbromic acid. Find X + Y.

47. Electrons are emitted in a cathode ray tube with a velocity of 1000m/s. Select the correct statement:
The de-Broglie wavelength of e is 666.67 nm
Cathode rays travel from the cathode to the anode.
The characteristics of the electron depend on the metal used in the cathode
The characteristics of the electron depend on the gas filled inside the cathode tube

48. Match the pairs

Schiff's Test	Carbohydrate
Carbylamine test	Peptide
Molish Test	Aldehyde
Biuret test	1° amine

49. Choose the correct statements from the following:
i. Beryllium oxide is an acidic oxide
ii. Beryllium sulphate is soluble in an aqueous medium
iii. Beryllium carbonate is thermally stable
iv. Beryllium shows anomalous behaviour in comparison to other Group 2 elements

50. The density of a 3 M NaCl solution is 1 g/mol. The molality of the solution is 'X'. Then find 2X. (Round off the answer to the nearest integer.)

51. H-atom in ground state absorbs 12.75 eV of energy. When the orbital angular momentum of the electron becomes nh/2π,, find the value of n.

52. Consider the following first order reaction:
$A \rightarrow C$; $t_{1/2}$ =15 min, $B \rightarrow D$; $t_{1/2}$ = 5min
The initial concentrations of A and B are 1 molar and 8 molar respectively. The time when the concentration of A and B becomes equal is 'X' minutes. Find 2X. (Round off the answer to the nearest integer.)

53. Find out the difference in temperature of a KCI solution (i = 2) if 25 mL of this KCI solution requires 20 mL of 1 M $AgNO_3$ solution for complete precipitation of KCI solution. K = 1.86 K.kg/mol. Assume molarity = molality. (Round off the answer to the nearest integer.)

54. Assertion: Chlorine easily forms oxides and the compounds are explosive.
Reason: The higher oxidation states of chlorine, bromine and iodine are released when halogens form oxides and fluorides.

55. For the given reaction in acidic medium:
MnO_4 (0.001 M) + $8H^+$ + $5e^-$ → Mn_2+ (0.1 M) + $4H_2O$
E^o_{cell} = 1.54 V

E_{cell} = 1.2832 V
Find out the pH of the solution.