JEE Main 6 April 2023 Shift 1 Memory-Based Questions

PHYSICS

1. Kinetic energy of electron, proton and a particle is given as K, 2K and 4K respectively, then which of the following gives the correct order of De- Broglie wavelengths of electron, proton and a particle?
2. If the height of a tower used for LOS communication is increased by 21%. Find out the percentage change in range.
3. A bock of mass 100 gm is placed on smooth surface, moves with acceleration of a 2x, then the change is kinetic energy can be given as $x^n/10$. Find the value of n.
4. Pick the correct graph between potential V at distance r from center for the uniformly charged spherical shell of radius R.
5. A car is moving with speed of 15 m/s towards a stationary wall. A person in the car press the horn and experience the change in frequency of 40 Hz due to reflection from the stationary wall. Find the frequency of horn. (Use V_{sound} = 330 m/s)
6. If the length of a conductor is increased by 20 percent and cross-sectional area is decreased by 4 percent, then calculate the percentage change in the resistance of the conductor.
7. Two identical current carrying coils with same centre are placed with their plans perpendicular to each other as shown. If i = $\sqrt{2}$ A and radius of coil is R = 1 m, then find the magnetic field at centre C.
8. Assertion (A): Earth has atmosphere and moon doesn't.
   Reason (R): escape speed on moon is less than that of Earth.
9. A ball of mass m and radius r and density ρ is dropped in a liquid of density ρ_0. After moving for some time, the speed of the ball becomes constant and equal to v_0. Find the coefficient of viscosity of the liquid.
10. The amount of heat supplied to a gas in a system is equal to 1000), the system in return does 200 J of work on the surrounding. Find change in internal energy of the gas.
11. On a planet ρ (mass density) is the same as that of Earth while the mass of the planet is twice than that of Earth. Find the ratio of the weight of a body on the surface of the planet to that on Earth.
12. A block of mass m = 100 g is connected on a horizontal surface to one end of a spring of natural length 20 cm, spring constant 7.5 N/m and kept on a smooth surface. The other end of the spring is connected to a fixed shaft rotating with H constant angular speed of 5 rad/s. Find the tension in spring.
13. Find the radius of the orbit corresponding to the 4th excited state in Li^{++} if a_0 is the radius of the first orbit in the H-atom.

14. Two solid spheres of mass m = 1/2 kg each are connected at the ends of a 2 light rod as shown in the figure. The assembly rotates about axis AA'. Then the moment of inertia of the assembly is equal to x/5 kgm^2. Find the value of x.

15. The path of an object moving with constant speed is shown in figure. The ratio of instantaneous speed to magnitude of average velocity is equal to $\sqrt{x}$. Find x.

16. The K capacitance of the capacitor can be varied by filling dielectric constant K = 4. As x varies, the capacitance changes, for x = d/3, the equivalent capacitance is C_1 and for x = 2d/3, the equivalent capacitance is 2 μF. Find the value of C_1 in μF.

17. A long cylindrical shell having current i flowing uniformly along the wall. The graph showing the variation of magnetic field (B) with the perpendicular distance (r) from the axis of the shell is?

18. In the given diagram, different types of transitions are named as A, B, C and D, then which transition emits shortest wavelength.

19. Identify the logic gate in the given circuit.

20. In an EM wave, ratio of average electric field and magnetic field energy density in an region of wave is equal to?

21. A ray undergoes refraction at boundary of a medium such that the incident angle is 45° while refraction angle is 30°. The wavelength and frequency of incident rays are λ_1 and $\boldsymbol{\nu}_1$ while that of refracted rays are λ_2 and $\boldsymbol{\nu}_2$. Find the values of λ_1 and $\boldsymbol{\nu}_1$ in terms of λ_2 and $\boldsymbol{\nu}_2$.

22. During simple harmonic motion of a pendulum, the square of time period (T^2) can be plotted against length of pendulum (l) as?

23. A rod is fixed at one end and the other end is pulled with force F = 62.8 kN, Young's modulus of rod is 2 x 10^{11} N/m^2. If the radius of cross-section of rod is 20 mm, then find the strain produced in rod.

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CHEMISTRY

1. Which of the following polymer is named Orlon?
2. If the radius of ground state hydrogen is 51 pm, find out the radius of the 5th orbit of Li2+ ions. (NAT question - round off answer to the nearest integer)
3. Which of the following have square pyramidal structure?
4. Among Neon, Fluorine, Chlorine and Argon, which elements have the highest difference of electron gain enthalpy?
5. Match deficiency with disease:
   Questions:
   i. Vitamin A, ii. Vitamin-B_2 (Riboflavin), iii. Vitamin-B_1 (Thiamine), iv. Vitamin C
   Options:
   i. Scurvy, ii. Xerophthalmia, iii. Cheilosis, iv. Beri-beri
6. The correct set of strong oxidising and reducing agent
   Ce^{4+}, Yb^{2+}, Tb^{4+} and Eu^{2+}
7. Match the compound with the type of bond.
   Questions:
   i. N_2O, ii. N_2O_4, iii. N_2O_5, iv. NO_2
   Options:
   i. N-N Bond, ii. N-O-N Bond, iii. N=N or N≡N Bond, iv. N=O bond
8. Match the reactions with their reagents.
   Questions:
   i. Etard Reaction, ii. Iodoform, iii. Gattermann, iv. HVZ
   Options:
   i. NaOCl, ii. CO/HCl, Anh. $AlCl_3$, iii. CrO_2Cl_2, CS_2, H_3O^+, iv. X_2/red P, H_2O
9. Match the compounds with their final products in the qualitative analysis.
   Questions:
   i. Nitrogen, ii. Sulphur, iii. Prosperous, iv. Halogens
   Options:
   i. AgX, ii. $(NH_4)_3PO_4.12MoO_3$, iii. $Fe(SCN)_3$, iv. $Fe_4[Fe(CN)_6]_3$
10. Photochemical smog is maximum in
    i. Himalayan Region, ii. Green Healthy Vegetation, iii. Marshy Lands, iv. Industrial Region
11. Which of the following is used for settling of cement?
    i. Gypsum, ii. Limestone, iii. Clay, iv. Silica
12. We are given with the reaction:
    R-CH_2-Br+ Nal → (in presence of Acetone) RI + NaBr
    i. This reaction can also take place in acetic acid.
    ii. This reaction is called the Swarts reaction.
    iii. This reaction shifts in a forward direction using the principle of Le - Chatelier's

principle.
iv. This reaction will take place even if Br is replaced with F.

13. Consider the following reaction.
A_2B_3 (g) ⇌ 2A(g) + 3B(g)
If the initial concentration of A_2B_3 (g) is c, find the value of α.

14. Assertion: Magnetic moment of $[Fe(H_2O)_6]^{3+}$ is 5.92 BM and that of $[Fe(CN)_6]^3$ is 1.73 BM.
Reason: The oxidation state of Fe in both complexes is +3.

15. Which of the reaction is correct among the following with the appropriate enzyme?
i. Sucrose → Glucose + Fructose : Enzyme - Invertase
ii. Glucose → CO_2+ Ethanol : Enzyme - Maltase
iii. Protein → Aminoacid : Enzyme - Zymase
iv. Starch → Maltose : Enzyme - Pepsin

16. Compound 'P' with molecular formula $C_{14}H_{13}ON$ is hydrolysed to give 'Q' and 'R'. Compound 'Q' gives effervescence with $NaHCO_3$ while compound R react with Hinsberg reagent to give oily liquid which reacts with NaOH.
P → Q (Give effervescence with $NaHCO_3$) + R (React with Hinsberg reagent)
Find the products Q and R respectively.

17. Some amount of urea is added to 1000 gm of H_2O due to which the vapour pressure decreases by 25% of the original vapour pressure. Find out the mass of urea added and round off to 2 decimal places.

18. A binary compound has Y atoms forming FCC unit cell and another type of X-atoms occupying 1/3rd of tetrahedral voids. Find out the molecular formula of the compound.

19. Find log k, if ΔH° = - 54.07 kJ/mol & T = 298 K, ΔS° = 10J/mol K Also given 2.303 X 298 = 5705.

20. What is the oxidation state of Mo in Ammonium Phosphomolybdate?

21. Some amount of urea is added to 1000 gm of H_2O due to which the vapour pressure decreases by 25% of the original vapour pressure. Find out the mass of urea added and round off the answers to 2 decimal places.

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MATHEMATICS

1. Find out the coefficient of x^{18} in the expansion: $(x^4 - 1/x^3)^{15}$.
2. Find out the number of ways to distribute 20 chocolates among three students in such a way that each student gets at least one chocolate.
3. Sum of first 20 terms of the series: 5, 11, 19, 29, 41, ... is:
4. If the image of point P(1,2,3) about the plane 2x - y + 3z = 2 is Q, then find the area of triangle PQR, where coordinates of R are (4, 10, 12).
5. If $5 f(x) + 4 f(1/x) = 1/x + 3$ then, $18 \int_1^2 f(x)\, dx$ = ?
6. Find out the sum of roots of $| x^2 - 8x + 15 | - 2x + 7 = 0$.
7. Find the equivalent of (P ⇒ Q) V (R ⇒ Q).
8. Let a = 2i + 3j + 4k, b = i − 2j – 2k, c = −i + 4j + 3k and d is a vector perpendicular to both b and c. If a • d = 18, then find $| a \times d |^2$.
9. Let $a_1, a_2, a_3, \ldots, a_n$ be an arithmetic progression having a common difference as d. Then find the value of:

$$\lim_{n\to\infty} \sqrt{\frac{d}{n}} \left(\frac{1}{\sqrt{a_1} + \sqrt{a_2}} + \frac{1}{\sqrt{a_2} + \sqrt{a_3}} + \frac{1}{\sqrt{a_3} + \sqrt{a_4}} + \cdots + \frac{1}{\sqrt{a_{n-1}} + \sqrt{a_n}} \right)$$

10. $\int [x^2 (x \sec^2 x + \tan x) / (x \tan x + 1)^2] dx$ = ?
11. If ${}^{2n}C_3 : {}^{n}C_3 = 10$, then $[(n^2 + 3n) / (n^2 - 3n + 4)]$ = ?
12. Matrix A is 2 x 2 matrix and $A^2 = 1$, no elements of the matrix is zero. Let the sum of diagonal elements be a and det(A) = b, then find the value of $3a^2 + b^2$.
13. The ratio of terms of 5th term from beginning and 5th term from end is √6 : 1 in $(2^{1/4} + 1/3^{1/4})^n$. Find the value of n.
14. Mean of the first 15 numbers is 12 and the variance is 14. The mean of the next 15 numbers is 14 and the variance is *a*. If the variance of all 30 numbers is 13, then find *a*.
15. From the top of tower AB of height 30 m, the angle of depression to another tower's QP base and top is 60° and 15° respectively. Another point C lies on tower AB such that CQ is parallel to BP (where B and P are the bases of towers). Then find the area of BCQP.
16. If $2y^x + 3x^y = 20$, then find (dy/dx) at (2, 2).
17. FInd the number of words with (or) without meaning using all the letters of the word ASSASSINATION such that all the vowels come together.
18. If a cuboid has its sides along axes with lengths 3,4 and 5, find the shortest distance between body diagonal and the edge not containing the vertices of body diagonal.

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