

## JEE Main 8 April 2023 Shift 1 Memory-Based Questions

### PHYSICS

1. For an electron and a proton ( $m_p = 1847 m_e$ ) with the same de-Broglie wavelength, find the ratio of linear momentum.
2. If the weight of an object on the earth's surface is 400 N, then find the weight of the same particle at a depth  $R/2$  from the surface if  $R$  is the radius of the earth.
3. Two forces of magnitude  $A$  and  $A/2$  act perpendicular to each other. What will be the magnitude of the resultant force?
4. An air bubble having a volume of  $1 \text{ cm}^3$  at a depth of 40 m inside water comes to the surface. What will be the volume of the bubble at the surface?
5. The height of the antenna is 98 m. The radius of Earth is 6400 km. Find the area up to which it will transmit the signal.
6. Two mirrors A (left) and B (right) are facing each other such that they are 10 cm apart and Mirror A is at a distance of 2 cm from object O located between the two mirrors. Find the distance in cm between the 2nd and 3rd images of object O formed left of Mirror A.
7. If mass, radius of cross-section and height of a cylinder are  $(0.4 + 0.01) \text{ g}$ ,  $(6 + 0.03) \text{ m}$  and  $(8 + 0.04) \text{ m}$ . Find the maximum percentage of error in the measurement of the density of the cylinder.
8. Identify the graph showing the variation of electric field ( $E$ ) with the distance ( $r$ ) from the centre of a conducting spherical shell.
9. An atom of atomic mass 242, having binding energy per nucleon 8.4 MeV, breaks into two atoms of atomic mass 121 each (with binding energy per nucleon 7.1 MeV). Find the absolute  $Q$  value of the reaction.
10. If the velocity of charged particle has the component both in and perpendicular to the direction of the magnetic field, then what will be the shape of the path traced by the charged particle?
11. Find the moment of inertia of a semi-circular ring of mass  $m$  and radius  $R$  about an axis passing through the centre and perpendicular to the plane of the ring.
12. Find the dimensions (in MLT) of  $1/\mu_0\epsilon_0$ .
13. Find the ratio of potential difference across two capacitors  $C_1$  and  $C_2$  at steady state for the given circuit. (Diagram provided)
14. Identify the correct/incorrect statement(s).  
Statement I: If the total energy of a satellite revolving around the earth in a circular

path is E, the potential energy of the satellite is  $2E$ .  
Statement II: Kinetic energy is also twice the total energy.

15. In a long solenoid, the magnetic field intensity inside the solenoid is equal to  $1.6 \times 10^{-3}$  T. If the number of turns per unit length on the solenoid is equal to  $8/\pi$  per cm then find the current flowing in the solenoid in Amperes.
16. A particle of mass 500 gm is moving with velocity  $v = (2t)\mathbf{i} + (3t^2)\mathbf{j}$  m/s, then the force on the particle at  $t = 1$  sec is  $i + x\mathbf{j}$  N. Find  $x$ .
17. Assertion (A): A: When heat is supplied to a system, temperature increases.  
Reason (R): Positive work done increases the volume of the thermodynamic system.
18. Momentum of a particle is increased by 50% by keeping its mass constant. What will be the percentage increase in the kinetic energy of the particle?
19. Why are two different lenses used in telescopes?
20. An electric dipole with a dipole moment of  $5 \mu\text{Cm}$  is placed in a region with a uniform electric field of  $600 \text{ N/C}$  at an angle of  $90^\circ$  with the direction of the field. What will be the torque experienced by the dipole (in milli Newton-metre)?
21. A train is moving with a speed of  $10 \text{ m/s}$  towards a platform and blows a horn with a frequency of  $400 \text{ Hz}$ . Find the frequency heard by a passenger standing on the platform. Take the speed of sound  $310 \text{ m/s}$ .
22. Find the truth table for the given logic gate system.
23. In an LC oscillating circuit with  $L = 75 \text{ mH}$  and  $C = 30 \mu\text{F}$ , the maximum charge of capacitor is  $2.7 \times 10^{-4} \text{ C}$ . What will be the maximum current through the circuit?

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### CHEMISTRY

1. Consider the following reaction:  $\text{XeF}_4 + \text{SbF}_5 \rightarrow [\text{XeF}_m]^{+n} + [\text{SbF}_p]^{q-}$   
Find  $m + n + p + q$ .
2. The extraction of which one of the following metals involves the concentration of the ore by leaching?  
i. Copper, ii. Magnesium, iii. Aluminium, iv. Potassium
3. Which of the following factors will contribute to a major role in the covalent character of a compound?  
i. Polarising power of cation  
ii. Polarisability of the anion  
iii. Distortion caused by cation  
iv. Polarisability of cation
4. Consider the reaction:  $\text{Cu}^{2+} + \text{X} \rightarrow \text{Cu}_2\text{X}_2 + \text{X}_2$ . Find  $\text{X}_2$ .
5. Identify the correct/incorrect statement(s).  
Statement I: Ionic radius of  $\text{Li}^+$  is greater than  $\text{Mg}^{2+}$ .  
Statement II: Lithium and magnesium can't form superoxide.
6. Which cell representation is correct for the reaction given below:  
 $\text{H}_2 + 2\text{AgCl} \rightarrow 2\text{H}^+ + 2\text{Ag} + 2\text{Cl}^-$   
i.  $\text{Pt} | \text{H}_2 | \text{HCl} | \text{AgCl} | \text{Ag}$   
ii.  $\text{Pt} | \text{H}_2 | \text{HCl} | \text{AgCl} | \text{Pt}$   
iii.  $\text{Ag} | \text{AgCl} | \text{HCl} | \text{H}_2 | \text{Pt}$   
iv.  $\text{Pt} | \text{AgCl} | \text{HCl} | \text{H}_2 | \text{Pt}$
7. Find the value of 'n' in the following redox reaction.  
 $\text{IO}_3 + \text{H}^+ + n\text{I}^- \rightarrow 6\text{I}_2 + \text{H}_2\text{O}$
8. Which of the following has the same d-electrons as chromium in chromyl chloride?  
i. Fe (III), ii. Ni (III), iii. Mn (VII), iv. Co (II)
9. How many of the following  $\alpha$ -amino acids contain sulphur?  
Lysine, Methionine, Glutamic acid, Threonine, Arginine, Cystein, Tyrosine
10. How many of the following statements are correct?  
i. If there is no relation between rate constant and temperature, then activation energy is negative.  
ii. If the activation energy is zero, rate constant is temperature independent.  
iii. If rate constant increases with increase of temperature, activation energy is positive.  
iv. If rate constant decreases with increase in temperature, activation energy is negative.
11. Which of the following is most stable, diamagnetic and octahedral shaped?  
i.  $\text{K}_3[\text{Co}(\text{CN})_6]$

- ii.  $[\text{Co}(\text{H}_2\text{O})_6]\text{Cl}_3$
  - iii.  $\text{Na}_3[\text{CoF}_6]$
  - iv. All have exactly equal stability
12. How many grams of  $\text{CO}_2$  will 0.5 g of an organic compound with 60% carbon will produce upon complete combustion?
13. Which of the following are not correctly matched?  
Metals or Ions - Maximum prescribed concentration in drinking water (ppm)
- i. Zn - 5 ppm
  - ii.  $\text{F}^-$  - 10 ppm
  - iii.  $\text{NO}_3^-$  - 50 ppm
  - iv.  $\text{SO}_4^{2-}$  - > 500 ppm
  - v. Mn - 0.05 ppm
14. Which of the following plots correctly represents Freundlich adsorption isotherm?

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### MATHEMATICS

1. Consider the word "INDEPENDENCE". What will be the number of words such that all the vowels are together?
2. Find the shortest distance between the lines:
  - i.  $(x - 5)/4 = (y - 3)/6 = (z - 2)/4$
  - ii.  $(x - 3)/7 = (y - 2)/5 = (z - 9)/6$
3. Find the number of ways such that 7 boys and 5 girls are to be seated around a circular table such that no two girls sit together.
4. Find the coefficient independent of  $x$  in the expansion of  $(3x^2 - (1/2x^5))$ .
5. If  $P = \begin{bmatrix} \sqrt{3}/2 & 1/2 \\ -1/2 & \sqrt{3}/2 \end{bmatrix}$ ,  $Q = PAP^T$ ,  $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ , then  $P^T Q^{2007} P = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ .  
Find  $2a + b + 3c - 4d$ .
6. If  $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & 2 & -1 \\ 0 & 1 & 2 \end{bmatrix}$  and  $|\text{adj}(\text{adj}(\text{adj}(A)))| = 16^n$ , then find the value of  $n$ .
7. Consider the data:  $x, y, 10, 12, 4, 6, 8, 12$ . If its mean is 9 and its variance is 9.25, then find the value of  $3x - 2y$  if  $x > y$ .
8. Dot product of two vectors is 12 and the cross product is  $4i + 6j + 8k$ , then find the product of the modulus of vectors.
9. If the coefficient of three consecutive terms in the expansion of  $(1 + x)^n$  are in the ratio 1:5:20, then find the coefficient of the fourth term of the expansion.
10. A bolt manufacturing factory has three products A, B & C. 50% and 30% of the product are A and B types respectively and the remaining is a C type. Then the probability that product A is defective is 4%, that of B is 3% and that of C is 2%. If a product is picked randomly and found to be defective, then what is the probability that it is a Type C?
11. Find the area under the curve of equations:  $x^2 \leq y$ ,  $y \leq 8 - x^2$  and  $y \leq 7$ .
12. Identify if the given function is even, odd, or neither.  
 $f(x) = (1 + 2^x)^7 / 2$
13. Let  $I(x) = \int \frac{(x+1)}{x(1+xe^x)^2} dx$ , then  $\lim_{x \rightarrow \infty} I(x) = 1$ . Find  $I(x)$ .
14. If  $\lim_{x \rightarrow 0} I(x) = \frac{1 - \cos^2 3x}{\cos^3 4x} \times \frac{\sin^3 4x}{(\log(1+2x))^5} = t$ . Then find the greatest integer fraction of  $t$ .

15. Find  $\frac{8}{\pi} \int_{\pi/6}^{5\pi/6} (8[\operatorname{cosec}x] - 5[\cot x])dx$  if  $[.]$  is the greatest integer factor.
16. Set A has 5 elements and Set B has 2 elements. Find the number of subsets of  $A \times B$  such that the number of elements is more than equal to 3 and less than 6.
17. If  $a_\alpha$  is the maximum value of  $a_n = n^3/(n^4 + 147)$ ;  $\alpha \in \mathbb{N}$ . Find  $\alpha$ .
18. Find the maximum value of  $n$  such that  $(66)!$  is divisible by  $3^n$ .

