JEE Main 10 April 2023 Shift 1 Memory-Based Questions

PHYSICS

1. A conducting rod of length 1 m is moved across a magnetic field of 0.15 T, with a constant speed of 4 m/s. Find the force (in N) on the rod.

2. A monoatomic gas, initially at pressure *P* and volume *V,* is compressed to 1/8th of its volume adiabatically. What will be the final pressure of the gas?

3. A particle of mass *m* moving with a velocity *v* collides with a particle of mass *2m* at rest and sticks to it. Find out the velocity of the combined mass.

4. A particle, when projected at 15° with the horizontal, has a range of 50 m. Find the range when it is projected at 45° with the horizontal.

5. A point-sized object is placed 4 cm from the double convex lens of a focal length of 8 cm. Find the change in the position of the image when the object is moved 2 cm towards the lens.

6. A radioactive nuclei x decays simultaneously into two nuclei: y and z. If the time taken for x decaying to given y is $t_{1/2}$ = 12 minutes and that of x decaying into z is $t'_{1/2}$ = 3 minutes, then find the time in which nuclei x decays 50%.

7. A solenoid having 60 turns and a length of 15 cm produces a magnetic field of 2.4 x 10^{-3} T, find the current in the solenoid.

8. An object is placed in front of a plane mirror 12 cm away from it. If the object is kept fixed while the plane mirror is shifted towards the object by a distance of 4 cm, then what will be the length of the shift in the position of the image in cm?

9. Decay constant for a radioactive nuclide is given to be 2 x 10^3. If the molar mass of the sample is 60 gm, then find the activity of the 0.3µg sample in disintegration/seconds.

10. Find the equivalent capacitance across points A and B in the given electrical circuit. (diagram given)

11. For a given circuit (triangular in shape with 4 Ω resistances on its 2 sides and all 3 medians; the remaining side has a 16 Ω resistance), find the equivalent resistance across its ends. (diagram given)

12. For a particle performing linear SHM, its position (x) as a function of time (t) is given by x = A sin(ωt + δ). Given that, at t = 0, the particle is at at + A/2 and is moving towards x = +A. Find δ.

13. For an object radiating heat at 300K, the wavelength corresponding to the maximum intensity is λ. If the temperature of the body is further increased by 300K, what will be the new wavelength corresponding to the maximum intensity?

14. If 10 resistors, each of 10 resistance, when connected together in all possible combinations give minimum equivalent resistance R_1 and maximum equivalent resistance R_2, then find R_2/R_1.

15. If an object weighs 200 N at the surface of the earth, what will be its weight at a depth of R/2 where R is the radius of the earth?

16. If the earth shrinks to 1/64 times its initial volume, the time period of the rotation of the earth is found to be 24/x hrs. Find the value of x.

17. In an AM wave, the amplitude of modulating wave = 3 units and the amplitude of the carrier wave = 15 units. Find the ratio of maximum to minimum intensity i.e., I_{max}/I_{min}.

18. State, whether the following statement(s) is/, are correct/incorrect.
Statement I: An LCR circuit connected to an AC source has the maximum average power at resonance.
Statement II: A resistor-only circuit with zero phase difference has the maximum average power.

19. The angular momentum of an e^- in the first Bohr's orbit is *L*. What will be the change in angular momentum if it jumps into the second orbit?

20. The equation of progressive wave is y = 5 sin(6t + 0.03x). Find the speed of the wave.

21. The equivalent resistance for a given circuit is x/7. Find x. (diagram given).

22. Three concentric shells A, B and C have surface charge density σ, - σ and a respectively. The radius of A and B is 2 cm and 3 cm respectively. The electric potential at surface A is V_A and at C is Vc. If $V_A = V_C$, then find the radius of C in cm.

23. Two blocks of mass 2 kg and 1.14 kg are hung by steel and brass wires respectively as shown in the figure (diagram given). Find the change in the length of the steel wire if $Y_{steel} = 2$ x 10^{11} N/m^2 and $Y_{brass} = 1$ x 10^{10} N/m^2.

24. What is the maximum percentage error in the measurement of quantity *l*, if it is given by *l* = (a^{2}b^3)/(c√d)? Consider the percentage error in the calculation of a, b, c and d as 1%, 2%, 3% and 4% respectively.

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CHEMISTRY

1. $2CO\ (g) + O_2\ (g) \rightarrow 2CO_2\ (g)$; $\Delta H = -x$ kJ/mol
   $C\ (graphite) + O_2\ (g) \rightarrow CO_2\ (g)$; $\Delta H = -y$ kJ/mol
   Find ΔH for $C\ (graphite) + 1/2O_2\ (g) \rightarrow CO\ (g)$.

2. A radioactive element C decays into A at $t_{1/2} = 30$ minutes and into B at $t_{1/2} = 60$ minutes. Calculate the overall half-life of C in minutes.

3. At STP conditions, find out the number of molecules and moles in 2.8375 litres of O_2.

4. Enthalpy of adsorption and enthalpy of formation of micelle are respectively...
   i. Positive, Positive
   ii. Positive, Negative
   iii. Negative, Positive
   iv. Negative, Negative

5. $FeO_4^{2-} \rightarrow$ (at $E_1^0 = +2.20$ V) $\rightarrow Fe^{3+} \rightarrow$ (at $E_2^0 = +0.77$ V) $\rightarrow Fe^{2+} \rightarrow$ (at $E_3^0 = -0.44$ V) $\rightarrow Fe$
   Calculate E_4^0 if it corresponds to the transition between FeO_4^{2-} and Fe.

6. Find out I $T_1 - T_2$ l for a solution of 0.1 molal weak acid HA, if K_f of water = 1.86 K kg mol^{-1}
   T_1 = Freezing point of solution assuming no dissociation of acid
   T_2 = Freezing point of solution assuming the degree of dissociation (α) = 0.3.

7. How many compounds can be easily prepared by Gabriel phthalimide synthesis, which on reaction with Hinsberg reagent produces a compound which is soluble in KOH?

8. Match the following.
   Column 1:
   A. Cotton mills, B. Paper mills, C. Fertilizer, D. Thermal power plant
   Column 2:
   i. Biodegradable waste, ii. Gypsum, iii. Non-biodegradable waste, iv. Fly ash

9. Match the following.
   Column 1:
   A. Dacron, B. Urea formaldehyde resin, C. Nylon-2, Nylon-6, D. Nylon-6,6
   Column 2:
   i. Thermosetting, ii. Biodegradable, iii. Polyester, iv. Used for making bristles of brushes

10. Mixture of A and B is added to a column containing an adsorbent for separation using a solvent. A is eluted first and B is eluted last. Then B has:
    i. High R, less adsorption
    ii. Low R, strongly adsorbed

iii. High R, strong adsorption
iv. Low R, weakly adsorbed

11. State whether the following statement(s) is/are correct/incorrect.
    Statement I: Potassium dichromate is used in volumetric analysis.
    Statement II: K_2Cr_2O, is more soluble in water than Na_2Cr_2O.

12. State whether the following statement(s) is/are correct/incorrect.
    Statement I: Reduction potential M^{3+}/M^{2+} is more for Fe than Mn.
    Statement II: V^{2+} has a magnetic moment between 4.4 - 5.2 BM.

13. The degree of dissociation of monobasic acid is 0.3. By what per cent will the observed depression in the freezing point be greater than the calculated depression in the freezing point?

14. The pair of compounds from the following pairs having both the compounds with net zero dipole moment is:
    i. CH_2Cl_2: CHCl,
    ii. 1,4-dichlorobenzene; 1,3,5-trichlorobenzene
    iii. Benzene; P-Anisidine
    iv. Cis-dichloroethene; Trans-dichloroethene

15. The pressure value of a given gas is 930.2 mm Hg. Its volume is then reduced to 40% of its initial value at a constant temperature. Find out its final pressure (in mm Hg).

16. What will be the sum of number of lone pairs in the central atom in IF_5 and IF_7.

17. Which of the following compounds do not exist?
    i. $BeCl_2$, ii. NaO_2, iii. $PbEt_4$, iv. $(NH_4)_2B$

18. Which of the following compounds is diamagnetic with low spin?
    i. $[Co(NH_3)_6]^{3+}$, ii. $[CoCl_6]^{3-}$, iii. $[CoF_6]^{3-}$, iv. $[Fe(H_2O)_6]^{3+}$

19. Which of the following does not stabilize the secondary and tertiary proteins?
    i. H-H linkage
    ii. S-S linkage
    iii. Vander Waal's forces
    iv. Hydrogen bonding

20. Which of the following molecules are bent in shape?
    i. SO_2, ii. O_3, iii. I_3^-, iv. N^{3-}

21. Which stabilizer is used for concentrating sulphuric ore?

22. Why is the prolongated heating of ferrous ammonium sulphate avoided?

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MATHEMATICS

1. $96 \cos(\pi/33) \cos(2\pi/33) \cos(4\pi/33) \ldots \cos(16\pi/33) = ?$

2. An AP series is given as 3, 8, 13, ..., 373. What will be the sum of terms which are not divisible by 3?

3. Find the number of points of non-differentiability for:
$$f(x) = \begin{cases} x|x|; & -2 < x \le 0 \\ |x - 3| + |x + 1| - 2|x - 2|; & 0 < x \le 2 \\ |x|(x^2 - x); & 2 < x \le 3 \end{cases}$$

4. Find the shortest distance between the lines:
   $25(x + 1)/7 = (y + 1)/-6 = (z + 1)/1$ and $(x - 3)/1 = (y - 1)/-2 = (z - 7)/1$

5. Find the coefficient of x^7 in $(1 - 2x + x^3)^{10}$.

6. Find the number of integral values of x which satisfy the inequality $x^2 - 10x + 19 < 6$.

7. From a square of side 30cm, the squares of side x cm are cut off to make a cuboid of maximum volume. What will be the surface area of the cuboid with an open top?

8. Identify the negation of the statement $(p \vee q) \wedge \sim r$.

9. If $a^2 + (ar)^2 + (ar^2)^2 = 33033$, $(a, r \in N)$, then find the value of $a + ar + ar^2$.

10. If the coefficient of x^7 in the expansion of $(ax - 1/bx^2)^{13}$ is equal to the coefficient of x^{-5} in the expansion of $(ax + 1/bx^2)^{13}$, then find a^4b^4.

11. If the number of ways in which a mixed double badminton can be played such that no couples played into a same game is 840. Then find the number of players.

12. If the order of matrix A is 3 x 3 and $|A| = 2$, then $| 3 \text{ adj } (|3A| A^2) | = ?$

13. If the slope of the tangent to a curve at a variable point is $(x^2 + y^2)/2xy$ and $y(2) = 0$, then find $y(8)$.

14. Let f be a differentiable function such that $x^2 f(x) - x = 4 \int_0^x t \, f(t) \, dt$. If $f(1) = 2/3$ then find $18 \, f(3)$.

15. The mean of the following data is 26. Find the variance of the data.

0 - 10	10 - 20	20 - 30	30 - 40	40 - 50
5	2	5	x	6

16. Two dice are rolled and the sum of the numbers of two dice is N then the probability that $2^N < N!$ is m/n, where m and n are coprime, then find $11m - 3n$.

17. Using the numbers 1, 2, 3, 4, 6, 6 and 7, find the total numbers of 7-digit numbers which do not contain a string of 154 or 2367. Repetition is not allowed.