# JEE Main 2023 Question Paper Solution

**Date & Shift: April 6 Shift 1** **Memory-Based Questions**

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## JEE Main 2023 Physics Question Paper

**Question 1. Find the radius of the orbit corresponding to the 4th excited state in Li++. ($a_0$ is the radius of first orbit in H-atom)**

A. $25/3a_0$
B. $16/3a_0$
C. $25a_0$
D. $12a_0$

**Answer.** A

**Question 2. If the height of the tower used for LOS communication is increased by 21%, the percentage change in range is?**

A. 5%
B. 10%
C. 15%
D. 12%

**Solution.**

For Line-of-Sight (LOS) communication, the range of communication is given by:

R = sqrt(2 * h * d)

where h is the height of the tower and d is the distance to the horizon.

Let's assume that the original height of the tower is h and the original range of communication is R. If the height of the tower is increased by 21%, the new height of the tower is 1.21h. The new range of communication is:

R' = sqrt(2 * 1.21h * d) = sqrt(1.21) * sqrt(2 * h * d) = 1.1 * R

So the percentage change in range is:

(1.1R - R) / R * 100% = 0.1R / R * 100% = 10%

Therefore, the percentage change in range when the height of the tower is increased by 21% is 10%.



Hence, the correct option is (b) 10%.

**Answer.** B

**Question 3. A block of mass 100 gm is placed on a smooth surface, moves with acceleration of a = 2x, then the change in kinetic energy can be given as ($x^n$/10), find the value of n.**

**Solution.**
The acceleration of the block is given by a = 2x, where x is the displacement of the block from its equilibrium position. Since the surface is smooth, there is no frictional force acting on the block.

The force acting on the block can be found using Newton's second law:

F = ma = m d^2x/dt^2

Since the mass of the block is 100 gm = 0.1 kg, we have:

F = 0.1 * 2x = 0.2x

The work done on the block by this force over a displacement dx is given by:

dW = F dx = 0.2x dx

The change in kinetic energy of the block is equal to the work done on the block, so we have:

dK = dW = 0.2x dx

We can integrate both sides of this equation to find the total change in kinetic energy from x = 0 to x = X:

ΔK = ∫dK = ∫0X 0.2x dx = [0.1x^2]0X = 0.1X^2

Therefore, the value of n is 2, since ΔK = 0.1X^2 = (X^2/10).

Hence, the correct value of n is 2.

**Answer.** 2

**Question 4. A car is moving with a speed of 15 m/s towards a stationary wall. A person in the car pressed the horn and experienced the change in frequency of 40 Hz due to reflection from the stationary wall. Find the frequency of the horn. (Use $v_{sound}$ = 330 m/s)**

**Answer.** 420 Hz

**Question 5. 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.**

**Solution.**
The resistance of a conductor depends on its length, cross-sectional area, and resistivity. The resistivity of a material is a constant that depends only on the material and its temperature.

The resistance of the conductor is given by:

$R = \rho * L / A$

where ρ is the resistivity of the material, L is the length of the conductor, and A is the cross-sectional area of the conductor.

If the length of the conductor is increased by 20% and the cross-sectional area is decreased by 4%, we have:

$L' = 1.2 L$ (20% increase in length)
$A' = 0.96 A$ (4% decrease in cross-sectional area)

The resistance of the conductor with the new length and cross-sectional area is:

$R' = \rho * L' / A' = \rho * (1.2 L) / (0.96 A)$

The percentage change in resistance is given by:

$(R' - R) / R * 100\%$

Substituting the expressions for R and R', we get:

(R' - R) / R * 100% = (ρ * (1.2 L) / (0.96 A) - ρ * L / A) / (ρ * L / A) * 100%

Simplifying this expression, we get:

(R' - R) / R * 100% = 25%

Therefore, the percentage change in resistance is 25%.

Hence, the correct answer is 25%.

**Answer.** 25

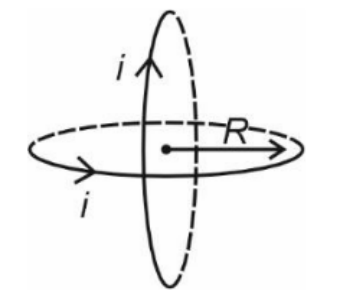
**Question 6. Assertion (A) : Earth has atmosphere and moon doesn't**
**Reason (R) : escape speed on moon is less than that Earth.**

A. (A) and (R) are correct and (R) is the correct explanation of (A)
B. (A) and (R) are correct and (R) is not the correct explanation of (A)
C. (A) is true but (R) is false
D. (A) and (R) both are false



**Answer.** A

**Question 7. Two identical current carrying coils with same centre are placed with their planes perpendicular to each other as shown.**
**If i = √2A and radius of coils is R = 1 m then magnetic field at centre C is equal to?**



A. $\mu_0$
B. $\mu_0/2$
C. $2\mu_0$
D. $\sqrt{2}\mu_0$

**Answer.** A

**Question 8. On a planet (mass density) is same as that of earth while mass of planet is twice than that of earth. Ratio of weight of a body on the surface of planet to that on earth is equal to?**

A. 1
B. $(2)^{1/3}$
C. $(2)^{-1/3}$
D. 2

**Answer.** B

**Question 9. Assertion (A): Range of a horizontal projectile is maximum when angle of projection is θ = 45°.**
**Reason (R): Range is maximum when sin(2θ) = 1.**

A. (A) and (R) both are true and (R) is correct explanation of (A)
B. (A) and (R) both are true but (R) is not correct explanation of (A)
C. (A) is true and (R) is false
D. Both (A) and (R) are false

**Solution.**
The assertion (A) is true. The range of a horizontal projectile is maximum when the angle of projection is 45 degrees. This can be shown using calculus or by using the fact that the horizontal and vertical components of the projectile's velocity are independent of each other.

The reason (R) is also true. The range of a projectile can be calculated using the formula:

R = (v^2/g) * sin(2θ)

where v is the initial velocity of the projectile, g is the acceleration due to gravity, and θ is the angle of projection. To maximize the range, we need to find the value of θ that maximizes sin(2θ). Taking the derivative of sin(2θ) with respect to θ and setting it to zero, we get:

cos(2θ) = 0

which simplifies to:

2θ = (2n + 1)π/2

where n is an integer. The value of θ that maximizes sin(2θ) is:

θ = (2n + 1)π/4



Since we are interested in the maximum range, we choose the value of θ that gives the largest value of sin(2θ), which is θ = 45 degrees.

Therefore, both (A) and (R) are true, and (R) is a correct explanation of (A). The correct answer is (A).

**Answer.** A

**Question 10. 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**

A. $\Lambda_p > \Lambda_\alpha > \Lambda_e$

B. $\Lambda_\alpha > \Lambda_p > \Lambda_e$
C. $\Lambda_e > \Lambda_p > \Lambda_\alpha$
D. $\Lambda_e > \Lambda_\alpha > \Lambda_p$

**Solution.**
The De Broglie wavelength of a particle is given by the equation:

$\lambda = h/p$

where $\lambda$ is the wavelength, h is the Planck constant, and p is the momentum of the particle.

Since the kinetic energy of the particles is given, we can use the relation:

K = p^2/2m

where K is the kinetic energy, p is the momentum, and m is the mass of the particle.

Solving for momentum, we get:

$p = \sqrt{(2mK)}$

Using this expression for each particle and substituting in the equation for De Broglie wavelength, we get:

$\lambda e = h/\sqrt{(2mK)}$

$\lambda p = h/\sqrt{(4mK)} = h/\sqrt{2m}\sqrt{(2K)}$

$\lambda \alpha = h/\sqrt{(4\alpha mK)}$

where $\alpha$ is the ratio of the mass of the alpha particle to the mass of the hydrogen atom.

Since the mass of the proton is approximately the same as the mass of the hydrogen atom, we can write:

$\alpha = m\alpha/mH = 4/1 = 4$

Therefore, we have:

$\lambda e = h/\sqrt{(2mK)}$
$\lambda p = h/\sqrt{2m}\sqrt{(2K)}$
$\lambda \alpha = h/\sqrt{(16mK)}$

Simplifying these expressions, we get:

$\lambda e = h/\sqrt{(2mK)}$
$\lambda p = h/\sqrt{(4mK)}$
$\lambda \alpha = h/(4\sqrt{mK})$

Since $\sqrt{(2mK)} > \sqrt{(4mK)} > 1/(4\sqrt{mK})$, we can conclude that:

$\Lambda e > \Lambda p > \Lambda \alpha$

Therefore, the correct option is (C).

**Answer.** C

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## JEE Main 2023 Chemistry Question Paper

**Question 1. Polymer which is named as orlon is:**

A. Polyamide
B. Polyacrylonitrile

C. Polycarbonate
D. Polyethene

**Answer.** B

**Question 2. If the radius of ground state hydrogen is 51 pm, find out the radius of $5^{th}$ orbit of $Li^{2+}$ ions. (closest integer)**

**Answer.** 425

**Question 3. Which of the following have square pyramidal structure?**

A. $XeOF_4$
B. $BrF_3$
C. $XeF_4$
D. $XeO_3$

**Answer.** A

**Question 4. We are given some diseases in Column-II. Column-I contains name of some vitamins and their deficiencies will cause :**

| Column-I | Column-II |
|---|---|
| (A) Vitamin A | (p) Scurvy |
| (B) Vitamin B2 (Riboflavin) | (q) Xerophthalmia |
| (C) Vitamin B1 (Thiamine) | (r) Cheilosis |
| (D) Vitamin C | (s) Beri Beri |

A. A(q); B(r); C(s); D(p)
B. A(r); B(q); C(p); D(s)
C. A(q); B(r); C(p); D(s)
D. A(p); B(r); C(s); D(q)

**Solution.** Deficiencies of vitamins in Column-I are:
(A) Vitamin A - (q) Xerophthalmia
(B) Vitamin B2 (Riboflavin) - (r) Cheilosis
(C) Vitamin B1 (Thiamine) - (s) Beri Beri
(D) Vitamin C - (p) Scurvy

**Answer.** A

**Question 5. Which compound is added to cement to increase its setting time?**

A. Gypsum
B. Lime stone
C. Clay
D. Calcium carbonate

**Answer.** A



**Question 6. 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: Oxidation state of Fe in both the complexes is +3.**

A. Both Assertion and Reason are correct and Reason is the correct explanation of Assertion
B. Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion
C. Reason is correct but Assertion is not correct
D. Reason is incorrect but Reason is correct

**Solution.**
Both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.

The magnetic moment of [Fe(H2O)6]3+ is 5.92 BM because it has high-spin Fe3+ (d5, S = 5/2) and it has five unpaired electrons. On the other hand, [Fe(CN)6]3– has low-spin Fe3+ (d5, S = 1/2) and it has only one unpaired electron. Therefore, the magnetic moment of [Fe(CN)6]3– is 1.73 BM, which is much lower than that of [Fe(H2O)6]3+. The oxidation state of Fe in both the complexes is indeed +3.

**Answer.** B

**Question 7. A binary compound has Y-atoms forming FCC unit cell and another type of X-atoms occupying 1/3$^{rd}$ of tetrahedral voids. Find out the molecular formula of the compound**

A. XY
B. $X_2Y_3$
C. $X_3Y_2$
D. XY



**Solution.**
The formula of the compound can be determined as follows:

In an FCC unit cell, there are 4 atoms located at the corners and one atom at the center of each face. Thus, the total number of Y atoms in the unit cell is 4 from the corners.

In a FCC unit cell, there are tetrahedral voids and octahedral voids. Each void can accommodate one atom. The number of tetrahedral voids in a FCC unit cell is twice the number of atoms per unit cell, which is 4 in this case. Therefore, there are 8 tetrahedral voids in the unit cell. Since X atoms occupy 1/3 of the tetrahedral voids, there are 8 × 1/3 = 8/3 X atoms in the unit cell.

The ratio of X atoms to Y atoms in the unit cell is therefore (8/3)/4 = 2/3. This means that the molecular formula of the compound is X2Y3. Therefore, option B (X2Y3) is the correct answer.

**Answer.** B

**Question 8. Some amount of urea is added to 1000 gm of $H_2O$ due to which vapour pressure decreases by 25% of the original vapour pressure. Find out mass of urea added (Round off to two decimal places)**

**Answer.** 18.52

**Question 9. Strong reducing & oxidizing agent among the following respectively.**

A. $Ce^{+3}$ & $Ce^{+4}$
B. $Eu^{+2}$ & $Ce^{+4}$
C. $Ce^{+4}$ & $Tb^{+4}$
D. $Ce^{+4}$ & $Eu^{+2}$



**Answer.** B

**Question 10. Photochemical smog is most likely to be found in which of the following industrial areas?**

A. Marshy areas
B. Himalayan valley in winters
C. Warm moist climates
D. Sunny dessert areas

**Solution.**
Photochemical smog is most likely to be found in sunny desert areas. This is because photochemical smog is formed due to the reaction of nitrogen

oxides and volatile organic compounds in the presence of sunlight. Sunny and warm climates with high levels of automobile traffic and industrial activity tend to have higher levels of nitrogen oxides and volatile organic compounds, which can contribute to the formation of photochemical smog. Desert areas with high levels of traffic and industrial activity are particularly susceptible to photochemical smog because they receive high levels of sunlight and have stagnant air conditions that trap pollutants.
**Answer.** D

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## JEE Main 2023 Mathematics Question Paper

**Question 1. Sum of first 20 terms**
5, 11, 19, 29, 41

**Answer.** 3520

**Question 2. Coefficient of $x^{18}$ in $(x^4 - 1/x^3)^{15}$**

**Answer.** 6

**Question 3. If the image of point P(1, 2, 3) about the plane 2x — y + 3z = 2 is Q, then the area of triangle PQR, where coordinates of R is (4, 10, 12)**

A. √1531 / 2
B. √1675 / 2
C. √2443 / 2
D. √1784 / 2

**Answer.** A

**Question 4. If 5 f(x) + 4f (1/x) = 1/x + 3, then 18 $\int_1^2$ f (x)dx is:**

A. 10log 2 + 6
B. 10log 2 - 6
C. 5log 2 + 6
D. 5log 2 - 6

**Answer.** B

**Question 5. The sum of roots of $|x^2 - 8x + 15| - 2x + 7 = 0$ is:**

A. 11 + √3
B. 11 - √3
C. 9 + √3
D. 9 - √3

**Answer.** C

**Question 6. Mean of first 15 numbers is 12 and variance is 14. Mean of next 15 numbers is 14 and variance is a. If variance of all 30 numbers is 13, then a is equal to**



A. 12
B. 14
C. 10
D. 3

**Answer.** C

**Question 7. From the top of 30 m tower AB the angle of depression to another tower's QP base and top is 60º and 30º respectively. Another point C lies on tower AB such that CQ is parallel to BP (where B and P are the base of towers). Then the area of BCQP is?**

A. 600 (√3 - 1)
B. 600 (√3 + 1)

C. 600
D. 300 (√3 - 1)

**Answer.** A

**Question 8. Number of words with (or) without meaning using all the letters of the word ASSASSINATION such that all the vowels come together is?**

A. 38004
B. 38042
C. 50400
D. 60200

**Answer.** C

**Question 9. Matrix A is 2 × 2 matrix and $A^2 = I$, no elements of the matrix is zero, let sum of diagonal elements is a and det(A) = b, then the value of $3a^2 + b^2$ is?**



**Solution.**
As A is a 2x2 matrix, its determinant can be written as:
det(A) = ad - bc

Also, since A^2 = I, we have:
A × A = I
which implies:
A^2 - I = 0

Expanding this, we get:
A^2 - I^2 = 0
(A + I) × (A - I) = 0

Since no elements of A are zero, the above equation implies that either A + I = 0 or A - I = 0. Thus, A can have one of the following two forms:

A = [1 0; 0 -1] or A = [-1 0; 0 1]

In the first case, the diagonal elements of A add up to a = 0, and det(A) = -1. In the second case, the diagonal elements add up to a = 0 again, but det(A) = 1.

Therefore, in both cases, we have 3a^2 + b^2 = 1.

**Answer.**1

**Question 10. The number of points of non-differentiability of the function f(x) = [4 + 13sinx] in (0, 2$\pi$) is ____.**

**Answer.** 50