

JEE Main 2023 Question Paper Solution

Date & Shift: April 10 Shift 2

Memory-Based Questions

JEE Main 2023 Physics Question Paper

Question 1. An object moves x distance with speed v_1 and next x distance with speed v_2 . The average velocity v is related to v_1 and v_2 as

- A. $v = (v_1 + v_2)/2$
- B. $1/v = 1/v_1 + 1/v_2$
- C. $v = (2v_1 v_2) / (v_1 + v_2)$
- D. $v = (v_1 - v_2) / 2$

Answer. C

Solution. To find the average velocity of the object, we need to use the formula:

$$v = \text{total distance} / \text{total time}$$

Let's assume that the object moves the same distance x with speeds v_1 and v_2 , and let's call the time it takes to move the distance x with speed v_1 as t_1 and the time it takes to move the distance x with speed v_2 as t_2 .

Then, the total distance traveled by the object is $2x$ (since it moves x distance twice).

The total time taken by the object is:

total time = time taken to travel first x distance with speed v_1 + time taken to travel second x distance with speed v_2

$$\text{total time} = t_1 + t_2$$

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Now, we can substitute the values of distance and time in the formula for average velocity:

$$v = 2x / (t_1 + t_2)$$

To relate this average velocity v to v_1 and v_2 , we can use the formula:
average velocity = (total distance) / (total time)

Substituting the values, we get:

$$v = 2x / (t_1 + t_2)$$

We know that the time taken to travel the distance x with speed v_1 is given by:

$$t_1 = x / v_1$$

Similarly, the time taken to travel the distance x with speed v_2 is given by:

$$t_2 = x / v_2$$

Substituting these values in the expression for v , we get:

$$v = 2x / (x/v_1 + x/v_2)$$

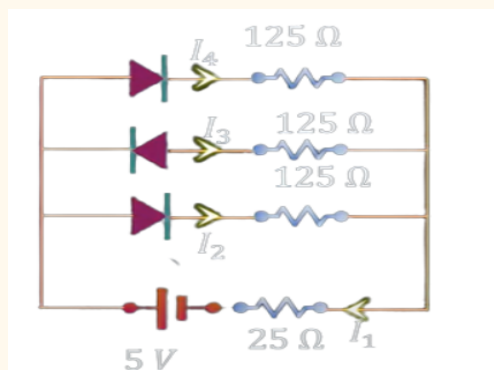
Simplifying the expression, we get:

$$v = 2v_1v_2 / (v_1 + v_2)$$

Therefore, the average velocity v is related to v_1 and v_2 by the formula:

$$v = 2v_1v_2 / (v_1 + v_2)$$

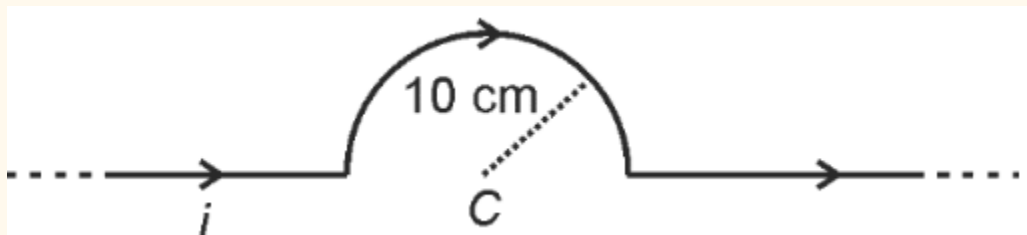
Question 2. Following circuit contains diodes with forward bias having resistance 25Ω , and reverse bias having infinite resistance. The ratio of I_1/I_2 is equal to



- A. 1
- B. 2
- C. 3
- D. 4

Answer. B

Question 3. An infinitely-long conductor has a current 14 A flowing as shown in the figure. Find the magnetic field at centre C.



- A. $88 \mu\text{T}$
- B. $44 \mu\text{T}$
- C. $10 \mu\text{T}$
- D. $120 \mu\text{T}$

Answer. B

Question 4. If half life for a radioactive decay reaction is T. Find the time after which 7/8th of initial mass decays

- A. 3T
- B. 2T
- C. T/2
- D. 4T

Answer. A

Solution. The half-life (T) of a radioactive decay reaction is the time it takes for half of the original amount of a radioactive substance to decay. We can use this information to find the time after which 7/8th of the initial mass decays.

Let's assume that the initial mass of the radioactive substance is M. After one half-life (T), the mass of the substance remaining will be $M/2$. After two half-lives (2T), the mass of the substance remaining will be $(M/2)/2 = M/4$.

Similarly, after three half-lives ($3T$), the mass of the substance remaining will be $(M/4)/2 = M/8$.

Therefore, the mass remaining after n half-lives can be expressed as:

$$M(n) = M/(2^n)$$

We want to find the time after which $7/8$ th of the initial mass decays. This means that we want to find the time after which the mass remaining is $1/8$ th of the initial mass.

$$M(n) = M/(2^n) = (1/8)M$$

Solving for n , we get:

$$n = 3$$

This means that after three half-lives ($3T$), the mass remaining will be $1/8$ th of the initial mass.

Therefore, the time after which $7/8$ th of the initial mass decays is:

$$\text{time} = 3T$$

Note that this assumes that the decay follows first-order kinetics, which is the case for most radioactive decay reactions.

Question 5. Assertion (A):- fan spins even after switch is off

Reason (R) :- Fan in rotation has rotational inertia.

- A. A is correct and R is correct explanation of A
- B. A is correct and R is incorrect explanation of A
- C. A is correct and R is correct but R is not correct explanation of A
- D. Both (A) and (R) are incorrect

Answer. A

Solution. A is correct and R is correct explanation of A.

When a fan is switched off, it takes some time for it to come to a complete stop. This is because the blades of the fan have rotational inertia, which means that they resist changes in their rotational motion. As a result, the fan continues to spin for a while even after the switch is turned off.

Therefore, the reason (R) provided is a correct explanation of the assertion (A).

Question 6. When electric field is applied to the electrons in a conductor it starts

- A. Moving in straight line
- B. Drifting from higher potential to lower potential
- C. Drifting from lower potential to higher potential
- D. Moving with constant velocity

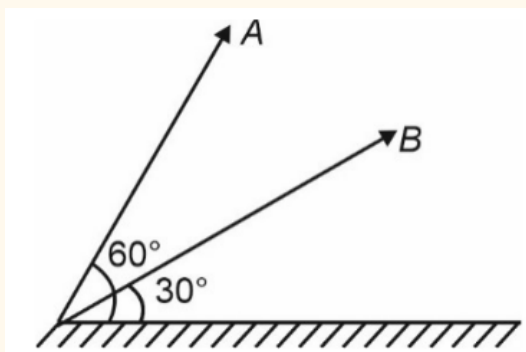
Answer. C

Question 7. Wire A and B have their Young's moduli in the ratio 1:3, area of cross section in the ratio of 1:2 and lengths in ratio of 3:4. If same force is applied on the two wires to elongate then ratio of elongation is equal to

- A. 8:1
- B. 1:12
- C. 1:8
- D. 9:2

Answer. D

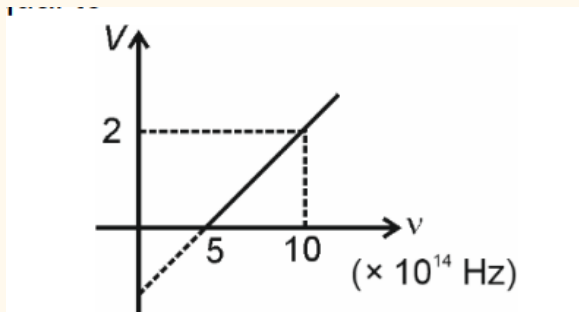
Question 8. Two projectiles A and B are projected from the same point on ground with same speed of projection as shown. Find the ratio of maximum height attained by A to that of B.



- A. 3:1
- B. 1:3
- C. $\sqrt{3}:1$
- D. $\sqrt{3}:2$

Answer. A

Question 9. Based on given graph between stopping potential and frequency of irradiation, work function of metal is equal to



- A. 1 eV
- B. 3 eV
- C. 2 eV
- D. 4 eV

Answer. C

Question 10. Assertion (A): Acceleration due to gravity is minimum at equator.

Reason (R): Rotation of earth influences acceleration.

- A. A is correct, R is correct explanation of A
- B. A is correct, R is incorrect explanation of A
- C. A is correct and R is incorrect
- D. Both A and R are incorrect

Answer. A

Solution. A is correct and R is correct explanation of A.

The assertion (A) that the acceleration due to gravity is minimum at the equator is correct. This is because the shape of the Earth is not a perfect sphere, but rather it bulges at the equator due to the centrifugal force generated by its rotation. As a result, the distance from the center of the Earth to any object at the equator is greater than the distance to the same object at the poles. Since the force of gravity decreases with distance, the acceleration due to gravity is less at the equator than at the poles.

The reason (R) provided is a correct explanation of the assertion (A). The rotation of the Earth influences the acceleration due to gravity because it generates the centrifugal force that causes the bulge at the equator. This bulge reduces the gravitational force experienced by objects at the equator and thus reduces the acceleration due to gravity.

JEE Main 2023 Chemistry Question Paper

Question 1. Delicate balance of CO_2 and O_2 is not disturbed by:

- A. Deforestation
- B. Photosynthesis
- C. Burning of coal

D. Burning of petroleum

Answer. B

Solution. The delicate balance of CO₂ and O₂ is maintained by various natural processes and cycles. Out of the options given, "photosynthesis" is the natural process that helps to maintain this balance. During photosynthesis, plants take in carbon dioxide and release oxygen, which helps to balance the levels of CO₂ and O₂ in the atmosphere. The other options, such as "deforestation," "burning of coal," and "burning of petroleum," are human activities that can disturb the delicate balance of CO₂ and O₂ by releasing more CO₂ into the atmosphere than can be absorbed by natural processes. This can lead to an increase in global temperatures and climate change.

Question 2. For a metal ion magnetic moment is calculated to be 4.9BM. Find the number of unpaired.

Answer. 4

Solution. The magnetic moment of a metal ion is given by the expression: $\mu = \sqrt{n(n+2)} \times \text{BM}$.

Where μ is the magnetic moment in Bohr magnetons (BM), n is the number of unpaired electrons, and BM is the Bohr magneton. Given that the magnetic moment of the metal ion is 4.9 BM, we can write:

$$4.9 = \sqrt{n(n+2)} \times 1$$

Squaring both sides, we get:

$$24.01 = n(n+2)$$

Expanding the expression on the right-hand side, we get:

$$n^2 + 2n - 24.01 = 0$$

Using the quadratic formula, we get:

$$n = \frac{-2 \pm \sqrt{(2^2 - 4 \times 1 \times (-24.01))}}{2 \times 1}$$

$$n = \frac{-2 \pm \sqrt{(100.04)}}{2}$$

$$n = \frac{-2 \pm 10.002}{2}$$

Taking the positive root, we get:

$$n = (-2 + 10.002) / 2 = 4.001$$

Since the number of unpaired electrons cannot be fractional, we round this value to the nearest whole number to get:

$$n \approx 4$$

Therefore, the number of unpaired electrons in the metal ion is 4.

Question 3. The increasing order of metallic character

- A. Be > Ca > K
- B. K > Ca > Be
- C. Ca > K > Be
- D. K > Be > Ca

Answer. B

Solution. The metallic character of an element increases as we move down a group in the periodic table and decreases as we move across a period from left to right. Based on this trend, the correct order of increasing metallic character among the given elements is:

$$\text{Be} < \text{Ca} < \text{K}$$

So, the option which represents this order is:

$$\text{K} > \text{Ca} > \text{Be}$$

Question 4. What process is used to make soap from fat?

- A. Saponification
- B. Electrolysis
- C. Solvay process
- D. Haber process

Answer. A

Solution. The process used to make soap from fat is called saponification. In this process, a fat or oil (triglyceride) is treated with a strong base, such as sodium hydroxide (NaOH) or potassium hydroxide (KOH), in the

presence of heat. This results in the hydrolysis of the ester bond in the triglyceride molecule, which yields glycerol and three molecules of fatty acid. The fatty acid molecules then react with the base to form soap molecules and water, in a process known as saponification. So, the correct answer is "Saponification".

Question 5. An unknown organic compound is heated with fuming HNO_3 . The reaction mixture is treated with aq BaCl_2 solution which gives white precipitate. Identify the unknown organic compound.

- A. Phenylalanine
- B. Proline
- C. Cysteine
- D. Valine

Answer. C

Solution. The given test is called the Nitroprusside test, which is used to detect the presence of sulfur-containing amino acids such as cysteine and cystine in a given organic compound.

In this test, the organic compound is treated with fuming nitric acid (HNO_3) which oxidizes the sulfur-containing amino acids to sulfonic acids. Then, the reaction mixture is treated with aqueous barium chloride (BaCl_2) solution, which forms a white precipitate of barium sulfate (BaSO_4) if sulfonic acids are present.

Among the given options, the only amino acid that contains a sulfur atom is cysteine. So, the unknown organic compound is likely to be cysteine. Therefore, the correct answer is "Cysteine".

Question 6. During bleeding from cut FeCl_3 is used to stop bleeding as

- A. Cl^- cause coagulation
- B. Ferric ion cause coagulation
- C. FeCl_3 dilutes blood
- D. Bleeding does not stop

Answer. B

Solution. FeCl₃ is used to stop bleeding because it causes coagulation of blood by activating the intrinsic pathway of the coagulation cascade. The ferric ions (Fe³⁺) in FeCl₃ react with the negatively charged surface of platelets and activate the clotting factors, leading to the formation of a blood clot.

The chloride ions (Cl⁻) in FeCl₃ do not directly cause coagulation, but they help in the formation of a stable clot by providing an appropriate ionic environment for the enzymatic reactions involved in the coagulation cascade.

FeCl₃ does not dilute the blood, but it helps in the formation of a stable clot, which stops bleeding.

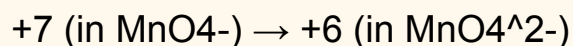
Therefore, the correct answer is "Ferric ion cause coagulation".

Question 7. How many electrons are gained by MnO₄^o in strongly alkaline medium?

Answer. 1

Solution. Manganese in permanganate ion (MnO₄⁻) has an oxidation state of +7. In a strongly alkaline medium, permanganate ion is reduced to manganate ion (MnO₄²⁻), which has an oxidation state of +6.

The reduction of permanganate ion involves the gain of electrons by manganese. To determine the number of electrons gained, we need to compare the oxidation states of manganese in permanganate and manganate ions:



The difference in oxidation states is:

$$+7 - (+6) = 1$$

This indicates that each manganese atom in permanganate ion gains one electron to form manganate ion. Therefore, the total number of electrons gained by MnO₄⁻ in strongly alkaline medium is equal to the number of manganese atoms present in the ion, which is one.

Hence, MnO_4^- gains one electron in strongly alkaline medium to form MnO_4^{2-} .

Question 8. For a first-order reaction, if the value of $t_{1/2}$ is T, then the value of $t_{7/8}$ will be _____ T.

Solution. For a first-order reaction, the half-life ($t_{1/2}$) is defined as the time required for the concentration of the reactant to decrease by half.

Mathematically, we can express the relationship between the half-life and the rate constant (k) as:

$$t_{1/2} = \ln(2) / k$$

where \ln is the natural logarithm.

To find the value of $t_{7/8}$, we need to find the time required for the concentration of the reactant to decrease by $7/8$ or 87.5%. Let's call this time $t_{7/8}$.

We can use the first-order rate law to express the relationship between the concentration of the reactant at any time (t) and its initial concentration (C_0) as:

$$C = C_0 e^{(-kt)}$$

where C is the concentration at time t.

If we substitute $C = 0.125 C_0$ (or $7/8 C_0$) into the above equation, we can solve for t to find the value of $t_{7/8}$:

$$0.125 C_0 = C_0 e^{(-kt_{7/8})}$$

$$\ln(0.125) = -kt_{7/8}$$

$$t_{7/8} = \ln(8) / k$$

Now we can express $t_{7/8}$ in terms of $t_{1/2}$ as:

$$t_{7/8} = \ln(8) / k = \ln(2^3) / k = (\ln 2)/k + (\ln 2)/k + (\ln 2)/k = t_{1/2} + t_{1/2} + t_{1/2} = 3 t_{1/2}$$

Therefore, the value of $t_{7/8}$ for a first-order reaction is 3 times the value of $t_{1/2}$.

Answer. 3

Question 9. Find out difference in oxidation state of Xe in completely Hydrolysed form of XeF_4 and XeF_6

Answer. 0

**Question 10. NH_3 , NO , N_2 , F_2 , CO , CO_2 , H_2O , and XeF_4
Fill the number of above molecules having only two lone pair of electrons.**

Answer. 3 (N_2 , CO and H_2O)

JEE Main 2023 Mathematics Question Paper

Question 1. Let a circle of $x^2 + y^2 = 16$ and line passing through (1,2) cuts the circle at A and B then the locus of the mid-point of AB is:

- A. $x^2 + y^2 + x + y = 0$
- B. $x^2 + y^2 - x + 2y = 0$
- C. $x^2 + y^2 - x - 2y = 0$
- D. $x^2 + y^2 + x + 2y = 0$

Solution. To find the locus of the midpoint of AB, we first need to find the coordinates of points A and B.

The equation of the given circle is $x^2 + y^2 = 16$.

The equation of the line passing through (1,2) can be found by using the point-slope form:

$$(y - 2) = m(x - 1)$$

where m is the slope of the line. To find the slope, we need another point on the line. Let's take (0, k) as a general point on the line, where k is a constant.

$$\text{So, } (k - 2) = m(0 - 1)$$

$$\Rightarrow m = 2 - k$$

The equation of the line becomes:

$$(y - 2) = (2 - k)(x - 1)$$

$$\Rightarrow y = (2 - k)x + (k - 2)$$

Now, we can find the coordinates of A and B by solving the system of equations formed by the circle and the line:

$$x^2 + y^2 = 16$$

$$y = (2 - k)x + (k - 2)$$

Substituting the second equation into the first equation, we get a quadratic equation in x:

$$x^2 + ((2 - k)x + (k - 2))^2 = 16$$

Expanding and simplifying, we get:

$$(x^2 + (2 - k)^2x^2) + 2x(k - 2)(2 - k) + (k - 2)^2 - 16 = 0$$

Simplifying further, we get:

$$(k^2 + 4)x^2 - 4kx - 4k + 4 = 0$$

Using the quadratic formula, we get:

$$x = \frac{4k \pm \sqrt{16k^2 - 4(k^2 + 4)(-4)}}{2(k^2 + 4)}$$

$$\Rightarrow x = \frac{2k \pm 2\sqrt{k^2 + 4}}{k^2 + 4}$$

Substituting this value of x into the equation of the line, we get the corresponding values of y:

$$y = (2 - k)x + (k - 2)$$

Now, the midpoint of AB can be found by using the midpoint formula:

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

where (x_1, y_1) and (x_2, y_2) are the coordinates of A and B.

After some algebraic simplification, we obtain:

$$(\text{midpoint}) = (x, y) = \left(\frac{(1-k)}{(k^2+4)}, \frac{(2k^2+2)}{(k^2+4)} \right)$$

Now, to find the locus of the midpoint, we need to eliminate k from the equations for x and y .

We can do this by first finding k in terms of x and y . From the equation for y above, we can solve for k :

$$k = \frac{(2x - y + 2)}{(x - 1)}$$

Substituting this expression for k into the equation for x , we get:

$$x = \frac{(2x - y + 2)}{(x - 1)} \pm \frac{\sqrt{(2x - y + 2)^2 + 16}}{(x^2 - 2x + 1)}$$

Simplifying, we obtain:

$$2x^3 + 3xy^2 - 5x^2 - 5y^2 - 8x + 4y = 0$$

Therefore, the locus of the midpoint of AB is:

$$x^2 + y^2 - x - 2y = 0$$

So, the correct option is (C)

Answer. C

Question 2. The sum of all 4 digit numbers using the digits 1,2,2,3 is?

Answer. 26464

Question 3. 4,11,21,34..... Find the value of $(S_{29} - S_9) / 60$?

Answer. 223

Question 4. The coefficient of x and x^2 in $(1 + x)^p (1 - x)^q$ are 4 and -5 , then $2p + 3q$ is?

Answer. 63

Question 5. If a dice is thrown n -times and probability of getting 7 times odd is equal to 9 times even. Then $P(2 \text{ even})$ is $K/2^{15}$ then K is

- A. 58
- B. 60
- C. 48
- D. 65

Answer. B

Question 6. If area bounded by region $\{x, y\} | |x^2 - 2| \leq y \leq x\}$ is **A**, then $6A + 16\sqrt{2}$ is?

Answer. 27

Question 7. $y = f(x)$ is a quadratic function passing through $(-1, 0)$ and tangent to it at $(1, 1)$ is $y = x$. Find x intercept by normal at point $(\alpha, \alpha + 1)$, $(\alpha > 0)$

- A. 7
- B. -7
- C. 5
- D. -5



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Answer. A

Question 8. The equation of conic is $19x^2 + 15y^2 = 285$. A concentric circle with radius 4 units is given then angle of common tangent made by minor axis of ellipse is?

- A. $\pi/3$
- B. $\pi/2$
- C. $\pi/6$
- D. $\pi/4$

Answer. A

Question 9. 8 persons has to travel from A to B in 3 allotted cars. If a car can carry maximum 3 persons. Then find the number of ways they can travel.

- A. 1880
- B. 1800
- C. 1680
- D. 1600

Answer. C

Question 10. Let α be the remainder $(22)^{2022} + (2022)^{22}$ is divided by 3 and β be the remainder when the same is divided by 7 then $\alpha^2 + \beta^2$ is?

Answer. 5



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