JEE Main 2023 Question Paper Solution

Date & Shift: April 11 Shift 1 **Memory-Based Questions**

JEE Main 2023 Physics Question Paper

Question 1. Force acting on a particle moving along the x - axis is given by F = (2 + 3x)i. The work done by this force from x = 0 to x = 4 m is

A. 16 J
B. 32 J
C. 4 J
D. 8 J

Solution. To find the work done by the force, we need to integrate the force over the displacement of the particle. The work done is given by the formula:

$W = \int F \cdot dx$

where F is the force and dx is the displacement of the particle.

In this case, the force is given by F = (2 + 3x)i, where i is the unit vector in the x-direction. The displacement of the particle is dx = dx i, where dx is the displacement along the x-axis.

Thus, the work done from x = 0 to x = 4 m is:

W = ∫ F · dx
= ∫ (2 + 3x)i · dx
= ∫ (2 + 3x) dx
= [2x + (3/2)x^2]_0^4
= 2(4) + (3/2)(4)^2 - 0
= 8 + 24
= 32 Joules

Therefore, the work done by the force from x = 0 to x = 4 m is 32 Joules.

Answer. B

Question 2. If half life of a radio-active nuclide A is equal to average life of another radio-active nuclide B. Find the ratio of decay constant of A to that of B.

A. In 2:1
B. 1: In 2
C. 2: In 2
D. In 2:2

Solution. The half-life of a radioactive nuclide is the time it takes for half of the original amount of the nuclide to decay. The average life of a radioactive nuclide is the average time it takes for the nuclide to decay.

Let the half-life of nuclide A be T_A and the average life of nuclide B be T_B. We know that:

$T_A = \ln(2)/\lambda_A$ (1)

$T_B = 1/\lambda_B$ (2)

where λ_A and λ_B are the decay constants of nuclides A and B, respectively.

Since the half-life of nuclide A is equal to the average life of nuclide B, we have:

$T_A = T_B$

Substituting equations (1) and (2) into this equation, we get:

$\ln(2)/\lambda_A = 1/\lambda_B$

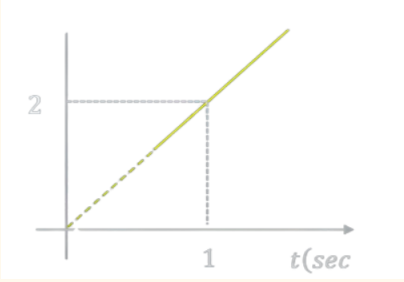
Simplifying this equation, we get:

$\lambda_B/\lambda_A = \ln(2)$

Therefore, the ratio of the decay constant of nuclide A to that of nuclide B is ln(2).

Answer. A

Question 3. Variation of magnetic field through a coil of area 4 m^2 is shown in figure. What is the EMF induced in the coil (in mV)?



A. 8
B. 16
C. 4
D. 2

Answer. A

Question 4. The characteristics of two coil is given below-
If the magnetic moment of both coil A and B are equal then choose the correct relation,

Coil A	Coil B
Radius $r_A = 10$ cm	$r_B = 20$ cm
Number of turns N_A	N_B
Current I_A	I_B

A. $2N_AI_A = N_BI_B$
B. $N_AI_A = N_BI_B$
C. $N_AI_A = 4N_BI_B$
D. $N_AI_A = 2N_BI_B$

Solution. The magnetic moment of a current loop is given by:

$\mu = I A$

where I is the current flowing through the loop and A is the area enclosed by the loop.

For the two coils A and B with radii rA and rB and number of turns NA and NB, and currents IA and IB respectively, the magnetic moments are given by:

μA = NAIAπrA^2
μB = NBIBπrB^2

Since the magnetic moments of both coils A and B are equal, we have:

μA = μB

NAIAπrA^2 = NBIBπrB^2

NAIArA^2 = NBIBrB^2

Dividing both sides by NBIB, we get:

NAIA/NBIB = rB^2/rA^2

Now, substituting the given values of rA and rB, we get:

NAIA/NBIB = (20 cm)^2/(10 cm)^2

NAIA/NBIB = 4

Therefore, the correct relation is NAIA = 4NBIB.

Answer. C

Question 5. Equation of progressive wave is y = A sin(160t — 0.5x). Let the speed of the wave be 10x then, find x.
Answer. 32

Question 6. If light is passing through a medium of critical angle 45°, then the wave speed will be

A. $3/\sqrt{2} \times 10^8$ m/s
B. $3\sqrt{2} \times 10^8$ m/s
C. $3/2 \times 10^8$ m/s

D. 3 x 10^8 m/s

Solution.

When light passes from one medium to another medium, its speed and direction of propagation may change. This phenomenon is called refraction. The angle of incidence (i) and angle of refraction (r) of the light wave are related to the refractive indices (n1 and n2) of the two media and the speed of light (c) in vacuum by Snell's law:

n1sin(i) = n2sin(r)

When the angle of incidence is greater than the critical angle, the light wave undergoes total internal reflection instead of refraction.

The critical angle (i_c) is defined as the angle of incidence at which the angle of refraction is 90 degrees. For a given pair of media, the critical angle is given by:

i_c = sin^(-1)(n2/n1)

In the given problem, the critical angle is 45 degrees, which means that:

sin(i_c) = sin(45°) = 1/√2

Therefore, we have:

n2/n1 = sin(90°)/sin(i_c) = 1/sin(i_c) = √2

Now, the speed of light (v) in a medium is related to the refractive index (n) of the medium and the speed of light in vacuum (c) by the formula:

v = c/n

Substituting the value of n2/n1 = √2, we get:

v = c/(√2) = (c√2)/2

Substituting the value of c = 3 x 10^8 m/s, we get:

v = (3/√2) x 10^8 m/s

Therefore, the wave speed when light passes through a medium of critical angle 45 degrees is 3/√2 x 10^8 m/s.

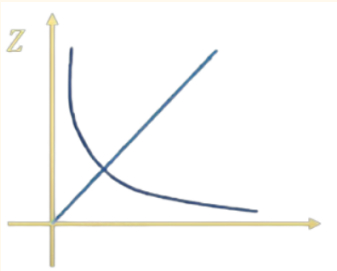
Answer. A

Question 7. In a moving coil galvanometer if the number of turns increases by 25%, then change in voltage sensitivity is?

A. 0
B. 1%
C. 25%
D. 50%

Answer. A

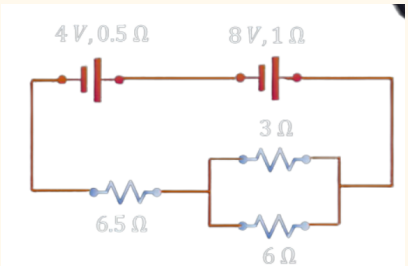
Question 8. The variation of impedance (Z) with angular frequency (w) for two electrical elements is shown in the graph given. If XL,Xc, and R are inductive reactance, capacitive reactance and resistance respectively, then



A. A is resistor B is inductor
B. A is inductor B is capacitor
C. A is inductor B is resistor
D. A is capacitor B is inductor

Answer. B

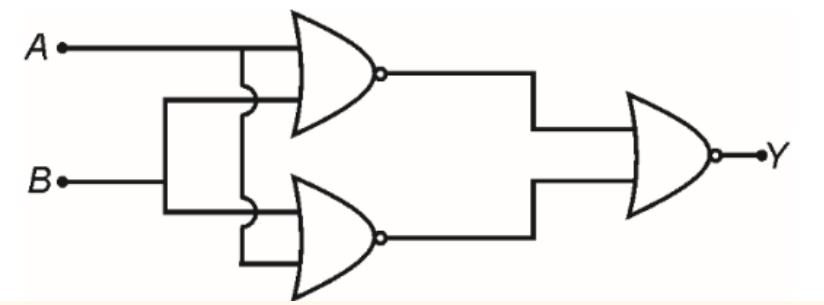
Question 9. Find the current flowing in 3Ω resistor in the given circuit



A. 0.4A
B. 0.2A
C. 0.8A
D. 0.6A

Answer. C

Question 10. Identify the logic operation of following circuit.



A. AND
B. OR
C. NOR
D. NAND

Answer. B

JEE Main 2023 Chemistry Question Paper

Question 1. Find the spin magnetic moment ratio for complexes $[Cr(Cn)_6]^{-3}$ & $[Cr(H_2O)_6]^{+3}$

Answer. 1:1

Question 2. 25% of 250g sugar solution & 40% of 500g sugar solution are mixed then find out the mass percentage in the solution.

Answer. 35 %

Question 3. In a container at a constant temperature , arrange the RMS velocity of the following: Ne, Cl_2 , UF_6

Answer. Ne > Cl_2 > UF_6

Question 4. Correct order of first ionization energy of Li, Be, C, B, N, O, F

Answer. F>N>O>C>Be>B>Li

Question 5. Match the Column

Column I	Column II
A. ClO_2^-	1. Linear
B. N_3^-	2. Tetrahedral

C. NH_4^+	3. Bent
D. SF_4	4. See-Saw

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

Question 6. Which of the following is not ambidentate ligand

A. $C_2O_4^{-2}$, H_2O
B. $EDTA^{-4}$, NO_2^-
C. NO_2^-, SCN^-
D. SCN^-, CN^-

Answer. A

Question 7. Which of the following can be represented as a meridional isomer?

A. $[Pt(NH_3)_3Cl_3]^+$
B. $[Pt(en)_3]^{4+}$
C. $[Pt(en)_2Cl_2]^{2+}$
D. $[Pt(en)_2(NH_3)_2]^{4+}$

Answer. A

Question 8. Find the number of atoms per unit cell if edge length is 300pm, density = 3 g/cm^3 , molecular mass = 40 g(nearest integer)

Answer. 3

Question 9. Identify the correct statement about the compound GaAlC14

A. Chlorine atom is bonded to both Ga and Al

B. Ga is cationic part and less electronegative than Al
C. Chlorine atom forms co — ordinate bond with Ga
D. Chlorine atom is bonded to Al

Answer. D

Question 10. Which type of copper is formed by the following reactions?
$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

A. Blister copper
B. Copper crisp
C. Reduced copper
D. Copper slag

Solution.
The type of copper formed by the given reactions is:

Blister copper

Blister copper is an impure form of copper that is typically produced by smelting copper ore or concentrate with the presence of impurities such as sulfur, iron, and other metals. The given reactions involve the reduction of copper sulfide (Cu2S) and copper oxide (Cu2O) to copper metal (Cu) with the release of sulfur dioxide (SO2). The first reaction produces copper(I) oxide (Cu2O) and sulfur dioxide (SO2) from copper(I) sulfide (Cu2S) and oxygen (O2), while the second reaction produces copper metal (Cu) and sulfur dioxide (SO2) from copper(I) oxide (Cu2O) and copper(I) sulfide (Cu2S). The resulting product is a mixture of copper metal and impurities, which is known as blister copper.

Answer. A

JEE Main 2023 Mathematics Question Paper

Question 1. If x + y + z = 17 and x, y, z are non-negative integers, then find the number of integral solutions is

A. 136
B. 171
C. 90
D. 130

Answer. B

Question 2. 5 boys with allotted roll numbers and seat numbers are seated in such a way that no one sits on the allotted seat. The number of such seating arrangements is?

Solution.
This problem can be solved using the principle of derangements, which states that the number of ways to arrange n objects such that no object is in its original position is given by the subfactorial of n, denoted !n.

In this case, we have 5 boys and 5 seats, and we want to find the number of ways to seat them such that no one sits in their allotted seat. We can think of this as a derangement problem, where each boy's allotted seat is their "original position."

The subfactorial of 5, denoted !5, is given by:

!5 = 5! * (1/0! - 1/1! + 1/2! - 1/3! + 1/4! - 1/5!)
= 120 * (1 - 1 + 1/2 - 1/6 + 1/24 - 1/120)

= 44

Therefore, the number of ways to seat the boys such that no one sits in their allotted seat is 44.

Answer. 44

Question 3. Let M = $[a_{ij}]_{2*2}$, 0 ≤ i, j ≤ 2, where $[a_{ij}]$ Ɛ {0,1,2} and A be the event such that M is invertible then P(A) is?

A. 49/81
B. 16/27
C. 47/81
D. 46/81

Answer. B

Question 4. The number of solutions of $\cos^4\theta - 2\cos 2\theta + 3\sin^6\theta + 1 = 0$ in [0, 2π] is

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

Answer. C

Question 5. Let awards in event A is 48 and awards in event B is 25 and awards in event C is 18 and also n(A ∪ B ∪ C) = 60, n(A ∩ B ∩ C) = 5, then how many got exactly two awards is?

A. 21
B. 25
C. 24
D. 23

Answer. A

Question 6. Consider the plane 2x + y – 3z = 6. If (α, β, γ) is the image of point (2, 3, 5) in the given plane, then α + β + γ = _____

Solution.
We can find the image of the point (2, 3, 5) in the plane 2x + y - 3z = 6 as follows:

The normal vector to the plane is given by (2, 1, -3). The distance from the point (2, 3, 5) to the plane is given by:

d = |2(2) + 1(3) - 3(5) - 6| / sqrt(2^2 + 1^2 + (-3)^2) = 8 / sqrt(14)

The image of the point in the plane can be found by moving a distance of d along the normal vector in the opposite direction from the plane. Therefore, we get:

α = 2 - 2d = 2 - 16 / sqrt(14)
β = 3 - d = 3 - 8 / sqrt(14)
γ = 5 + 3d = 5 + 24 / sqrt(14)

Adding these values, we get:

α + β + γ = 2 - 16 / sqrt(14) + 3 - 8 / sqrt(14) + 5 + 24 / sqrt(14)
= 10

Therefore, α + β + γ = 10.

Answer. 10

Question 7. Consider two sets A and B. Set A has 5 elements whose mean & variance are 5 and 8 respectively. Set B has also 5 elements whose mean & variance are 12 & 20 respectively. A new set C is

formed by subtracting 3 from each element of set A and by adding 2 to each element of set B. The sum of mean & variance of the set C is _____.

Answer. 58

Question 8. The number of rational terms in the expansion of $(3^{3/4} + 5^{3/2})^{60}$?

Answer. 16

Question 9. Let a and b are roots of $x^2 - 7x - 1 = 0$. The value of $(a^{21} + b^{21} + a^{17} + b^{17}) / (a^{19} + b^{19})$ is?

A. 29
B. 49
C. 53
D. 51

Answer. D

Question 10. The mean of coefficients of $x, x^2, ..., x^7$ in the binomial expansion of $(2 + x)^9$ is?

Answer. 2736