JEE Main 2024 Question Paper with Solution Jan 31 Shift 1 (B.E./B.Tech)

JEE Main Physics Questions

Ques 1. Stopping potential is 8 V if wavelength of incident light is λ and it is 2 V for 3λ. Find threshold wavelength.

Ans. 9λ

Ques 2. Two charges Q and 3Q are kept in a line separated by a distance R. Electric field is zero at a distance x from Q. Find the value of x.

Ans. (√3-1R)/2

Ques 3. If the mass defect in a nuclear reaction is 0.4gm then find the Q value of the reaction.

Ans. 3.6 x 10^13 J

Solution: The Q-value of a nuclear reaction can be calculated using the mass-energy equivalence principle, $E = mc^2,$ where *E* is the energy, *m* is the mass defect, and *c* is the speed of light.
The mass defect (*m*) is the difference between the total mass of the reactants and the total mass of the products in the nuclear reaction.
The Q-value of the reaction is the difference in the total rest energies (or masses) of the reactants and products, multiplied by c^2.
So, if the mass defect in the nuclear reaction is 0.4gm, the Q-value can be calculated as follows:

$$Q = \text{(Mass of reactants)} - \text{(Mass of products)}$$

$$Q = m \times c^2$$

Given the mass defect (m) is 0.4gm, we need to convert it into kilograms since the speed of light c is in meters per second:

$$m = 0.4\,\text{gm} = 0.4 \times 10^{-3}\,\text{kg}$$

Now, using $c = 3 \times 10^8\,\text{m/s}$, we can calculate the Q-value:

$$Q = (0.4 \times 10^{-3}\,\text{kg}) \times (3 \times 10^8\,\text{m/s})^2$$

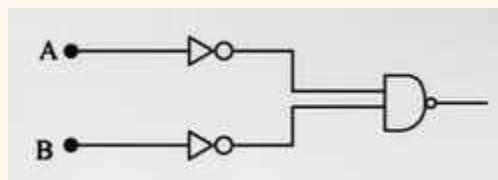$$Q = (0.4 \times 10^{-3}) \times (9 \times 10^{16})$$

$$Q = 3.6 \times 10^{13}\,\text{J}$$

So, the Q-value of the reaction is $3.6 \times 10^{13}\,\text{J}$.

Ques 4. Find minimum deviation in a thin prism if refractive index μ = cot(A/2). Here A represents the angle of the prism.

Ans. $\delta = \pi - 2A$

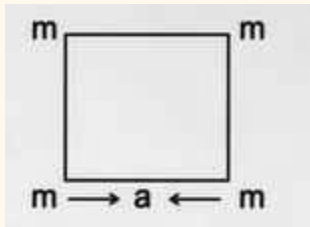**Ques 5. Output of given circuit represents which logic gate :**

A. NAND
B. NOR
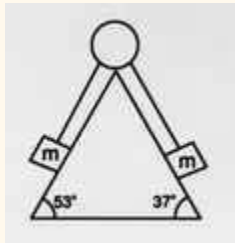C. AND

D. OR

Ans. D

Ques 6. Four equal masses m are kept at corners of a square of side

a. If net gravitational force on a mass is given by $\left(\frac{2\sqrt{2}+1}{32}\right)\frac{Gm^2}{L^2}$, **Find the value of a in the terms of L.**

Ans. a = 4L

Ques 7. Find the value of m if M = 10 kg. All the surfaces are rough.

A. 2.5kg
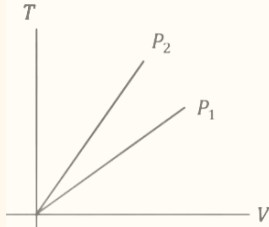B. 7.5kg
C. 12.5kg
D. 5kg

Ans. B

Ques 8. If the percentage error in measuring length and diameter of a wire is 0.1% each, then the percentage error of the resistance of the wire is :

A. 0.3%
B. 0.2%
C. 0.1%

D. 0.4%

Ans. A

Ques 9. T-V graph is given for two different pressures P₁ and P2, Then :

A. $P_2 > P_1$
B. $P_1 = P_2$
C. $P_2 < P_1$
D. $P_2 <= P_1$

Ans. A

Ques 10. For a 1-D motion, relation between position x and time t is $t = \alpha x^2 + \beta x$ Find the relation between velocity v and acceleration a.

A. $a = \alpha v$
B. $a = -2\alpha v$
C. $a = -2\alpha v^3$
D. $a = 2\alpha v^2$

Ans. C

Ques 11. Two resistances having coefficient of variation of resistivity α_1 and α_2 are having equal resistance. Equivalent temperature coefficient of resistivity in series and parallel combinations are:

A. $(\alpha_1 + \alpha_2)/2, \alpha_1 + \alpha_2$
B. $\alpha_1 + \alpha_2, \alpha_1 + \alpha_2$
C. $\alpha_1 + \alpha_2, (\alpha_1 + \alpha_2)/2$
D. $(\alpha_1 + \alpha_2)/2, (\alpha_1 + \alpha_2)/2$

Ans. D

Ques 12. An artillery of mass M₁, fires a shell of mass M2. At the time of firing the ratio of kinetic energy is.

    A. M2/M1

    B. (M1 + M2)/M1

    C. (M1 + M2)/M2

    D. M1/(M1 + M2)

Ans. A

Ques 13. The fundamental frequency of closed organ pipe is equal to the frequency of first overtone of open organ pipe of length 60 cm. The length of closed organ pipe is

    A. 45 cm

    B. 30 cm

    C. 15 cm

    D. 60 cm

Ans. C

Ques 14. Force F depends on distance x and time t as $F = ax^2 + bt^{1/2}$. Final dimension of b^2/a is

    A. $M^{-1} L^2 T^{-3}$

    B. $M^1 L^{-3} T^3$

    C. $M^1 L^3 T^{-3}$

    D. $M^2 L^2 T^1$

Ans. C

Ques 15. Two charges q and 3q are placed at a distance r from each other. Find the distance from q where the electric field is zero.

A. r/√3+1
B. r/2
C. r/√3-1
D. 2r/3

Ans. A

Ques 16. In single electron atom/ion, first member of Lyman series is λ, then wavelength of second member of their series shall be
A. 5/27λ
B. 5/32λ
C. 27/32λ
D. 15/23λ

Ans. C

Ques 17. In YDSE, intensity at two sources are in the ratio of 1: 9. if source are incoherent then intensity at central point is I_1, and if sources are coherent (and phase differs by 60°) then intensity at central point is 12 then I1/I2 is
A. 10/13
B. 5/13
C. 8/13
D. 7/11

Ans. A

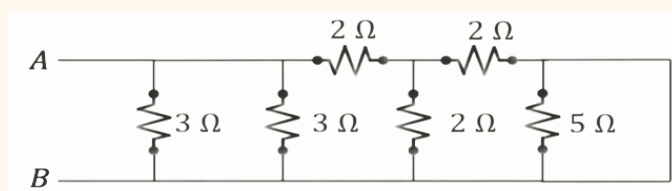**Ques 18. Calculate the average energy density of an electromagnetic wave whose electric field is oscillating with amplitude 50 V/m and frequency 5 x 10^{10} Hz :**
A. $2 * 10^{-6}$ J / (m ^ 3)
B. $1.1 * 10^{-8}$ J / (m ^ 3)
C. $3 * 10^{-7}$ J / (m ^ 3)

D. $1.6 * 10^{-7}$ J / (m ^ 3)

Ans. B

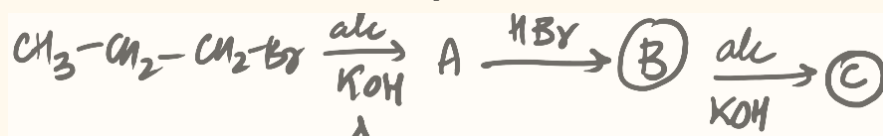## Ques 19. Find equivalent resistance between A and B for a given circuit in ___ohms.

Ans. 1

Ques 20. A uniform disk of mass 50 kg is rolling without slipping with a speed of 0.4 m/s. Find minimum energy required to bring the disk to rest (in J).

Ans. 6J

JEE Main Chemistry Questions

Ques 1. Find out the final product C.

A. Propan-1-ol
B. Propan-2-ol
C. Propene
D. Propane

Ans. B

Ques 2. Which of the following options contain amphoteric oxide(s) only?

    A. SnO2 and SiO
    B. SiO2
    C. SnO_2 and PbO_2
    D. CO and SiO

Ans. C

Ques 3. How many of the following compounds have sp³ hybridized central atoms?
H_2O, NH_3, SiO_2, SO_2, CO, CH_4 and BF_3

Ans. 4

Ques 4. Color of PbI2

Ans. Yellow

Solution: Lead(II) iodide (PbI2)typically appears as a yellow solid. The color arises from the absorption of light in the visible spectrum due to its band structure. It's worth noting that the color may vary slightly depending on factors such as the particle size, purity, and the specific crystalline form of the compound.

Ques 5. Magnetic behavior of Ni2+ with strong ligand

Ans. u = 0

Ques 6. On which factor, electrical conductivity of electrolytic cell does not depend
    A. Concentration of electrolyte

B. Amount of electrolyte added
C. Temperature
D. Nature of electrode

Ans. D

Ques 7. Decreasing order of electron gain enthalpy of the following elements (magnitude only)
Sulphur - A, Bromine - B, Fluorine - C, Argon - D

A. A>B>C>D
B. D>C>B> A
C. C>B>A>D
D. A>B>D>C

Ans. C

Ques 8. Moles of CH_4 required for formation of 22 g of CO_2 is m * 10^{-2} The value of m is:

Ans. 50

Ques 9. The total number of different alkanes formed when the following mixture is subjected to electrolysis: CH3COONa (aq) and C_2H_2COONa (aq) is (do not consider disproportionation reaction)

Ans. 3

Ques 10. If one faraday of electricity is used in the discharging of Cu2+, then find the mass (ing) of Cu deposited (nearest integer)

Ans. 32

Ques 11. The spin only magnetic moment of complex ion $[Ni(NH3)_6]^{2+}$ is

X x 10⁻¹ BM. The value of X is

Ans. 28

Ques 12. Which of the following solutions shows positive deviation from Raoult's law?

    A. $CHCl_3 + C_6H_6$

    B. $CH_3COCH_3 + CS_2$

    C. $CH_3COCH_3 + CHCl_3$

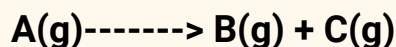   D. $CH_3COCH_3 + C_6H_5NH_2$

Ans. B

Ques 13. Species having carbon with sextet of valence electron and acts as an electrophile is:

    A. Carbanion

    B. Carbocation

    C. Free Radical

    D. Nitrene

Ans. B

Ques 14. Find the rate constant for first order gaseous reaction:
A(g)-------> B(g) + C(g)

A. $$k = \frac{2.303}{t} \log \frac{p_i}{2p_i - p_t}$$

B. $$k = \frac{2.303}{t} \log \frac{2p_i}{p_i - p_t}$$

C. $$k = \frac{2.303}{t} \log \frac{p_i - p_t}{2p_i}$$

D. $$k = \frac{2.303}{t} \log \frac{2p_t}{2p_i - p_t}$$

Ans. A

JEE Main Mathematics Questions

Ques 1. In the expansion of $(1 + x)(1 - x^2)(1 + 3/x + 3/x^2 + 1/x^3)^5$ the sum of coefficients of x^3 and x^{-13} is

Ans. 118

Ques 2. If $$f(x) = \begin{vmatrix} x^3 & 2x^2 + 1 & 1 + 3x \\ 3x^2 + 2 & 2x & x^3 + 6 \\ x^3 - x & 4 & x^2 - 2 \end{vmatrix}$$ **for all x $\in$ R, then 2f(0) + f'(0) is equal to**

Ans. 42

Ques 3. let 's' be the set of positive integral values of a for which $$\frac{ax^2 + 2(a+1)x + 9a + 4}{x^2 + 8x + 32} < 0, \forall x \in R.$$ **Then, the number of elements in 's' is**

Ans. 0

Ques 4. If $f(x) = \frac{4x+3}{6x-4}, x \neq \frac{2}{3}$ and $(f \circ f)(x) = g(x)$, where

$g: R - \left[\frac{2}{3} \to R \to \left\{\frac{2}{3}\right\}\right.$ then $(g \circ g \circ g)(4)$ is equal to

Ans. 4

Ques 5. If the system of linear equations x - 2y + z = -4; 2x + αy + 3z = 5 and 3x - y + βz = 3 has infinitely many solutions then 12α + 13β is equal to

Ans. 104.28

Ques 6. Sum of the series

$\frac{1}{1-3 \cdot 1^2 + 1^4} + \frac{2}{1-3 \cdot 2^2 + 2^4} + \frac{3}{1-3 \cdot 3^2 + 3^4} + \cdots$ upto 10 terms is____.

A. -55/109
B. 55/109
C. 45/109
D. - 45/109

Ans. A

Ques 7. If one of the diameters of the circle $x^2 + y^2 - 10x + 4y + 13 = 0$ is a chord of another circle and whose center is the point of intersection of the lines 2x + 3y = 12 and 3x - 2y = 5 then the radius of the circle is

A. 6
B. 3√2
C. √20
D. 4

Ans. A

Ques 8. An urn contains 15 red, 10 white, 60 orange balls, 15 green balls. 2 balls are taken with replacement. Find the probability 1 ball is red and the other ball is white.

    A. 2/27

    B. 3/22

    C. 1/33

    D. 1/29

Ans. C

Ques 9. $\lim\limits_{x \to 0} \dfrac{e^{|2 \sin x|} - 2|\sin x| - 1}{x^2}$ is

    A. Doesn't exist

    B. 2

    C. 1

    D. -1

Ans. B

Ques 10. Let $\vec{a} = 3\hat{i} + \hat{j} - 2\hat{k}$, $\vec{b} = 4\hat{i} + \hat{j} + 7\hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} + 4\hat{k}$ be 3 vectors. If a vector $\vec{p}$ satisfies $\vec{p} \times \vec{b} = \vec{c} \times \vec{b}$ and $\vec{p} \times \vec{a} = 0$ then $\vec{p}.(\hat{i} - \hat{j} - \hat{k})$ is equal to

    A. 32

    B. 23

    C. 16

    D. 61

Ans. A

Ques 11. The solution of differential equation $y\dfrac{dx}{dy} = x(\log_e x - \log_e y + 1)$ x > 0, y > 0 and passing through (e, 1) is

A. $| \log_e(y/x) | = y^2$

B. $2| \log_e(x/y) | = y$

C. $| \log_e(y/x) | = x$

D. $| \log_e(x/y) | = y$

Ans. D

Ques 12. A = {1, 2, 3, 4} , R = {(1, 2), (2, 3), (2, 4)} R ⊆ S and S is an equivalence relation then the minimum number of elements to be added to R is n, then the value of n is?

Ans. 13