

JEE Main 2024 Question Paper with Solution

Jan 31 Shift 2 (B.E./B.Tech)

JEE Main Physics Questions

Ques 1. The speed of sound in oxygen in STP will be approximately?
Given that $R=8.3$ and $\gamma=1.4$

Ans. 330.05 m/s

Ques 2. If the current through an incandescent lamp decreases by 20%, how much change will be there in its illumination?

Ans. 36%

Solution: The illumination provided by an incandescent lamp is directly proportional to the square of the current passing through it (assuming the voltage remains constant), according to the formula:

$$\text{Illumination} \propto I^2$$

Where:

- Illumination is the brightness or intensity of light produced
- I is the current passing through the lamp

If the current decreases by 20%, it means the new current (I_{new}) is 80% of the original current (I_{old}) . Mathematically, we can represent this as:

$$I_{\text{new}} = 0.8 \times I_{\text{old}}$$

Now, let's calculate the change in illumination:

Change in illumination = New illumination - Old illumination

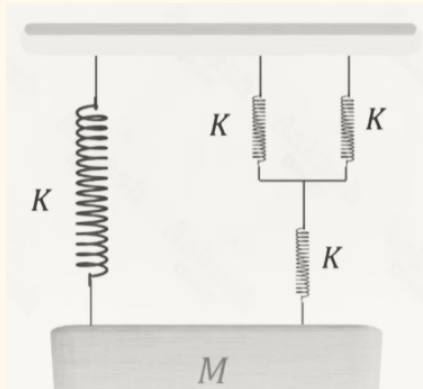
$$\begin{aligned}
 &= (I_{\text{new}})^2 - (I_{\text{old}})^2 \\
 &= (0.8 \times I_{\text{old}})^2 - (I_{\text{old}})^2 \\
 &= (0.64 \times I_{\text{old}}^2) - (I_{\text{old}})^2 \\
 &= -0.36 \times I_{\text{old}}^2
 \end{aligned}$$

So, the change in illumination will be a decrease of 36% from the original illumination.

Ques 3. Mass of the moon is 1/100 times the mass of a planet. Its diameter is 1/16 the diameter of the planet if the escape velocity of the planet is V then the escape velocity of the moon will be

Ans. $V/3$

Ques 4. The period of oscillation of system shown below is $\pi\sqrt{aM/5K}$ then a is



Ans. 12

Ques 5. For the block shown, F_1 is the minimum force required to move block upward and F_2 is the minimum force required to prevent it from slipping find $|F_1 - F_2|$

- A. $50\sqrt{3}$ N
- B. $5\sqrt{3}$ N
- C. $25\sqrt{3}$ N
- D. $(5\sqrt{3})/2$ N

Ans. B

Ques 6. Unpolarised light incident on transparent glass at incident angle 60° . If reflected ray is completely polarized, then angle of refraction is

- A. 45°
- B. 60°
- C. 30°
- D. 37°

Ans. C

Ques 7. Force on a particle moving in a straight line is given by $F = 6t^2i - 3tj$ and velocity is $v = 3t^2i + 6tj$. Find power at $t = 2$.

- A. 216 W
- B. 108 W
- C. 0 W
- D. 54 W

Ans. A

Solution: To find the power at time $t=2$, we'll use the formula for power:

$$P = \vec{F} \cdot \vec{v}$$

Where:

- \vec{F} is the force vector
- \vec{v} is the velocity vector

Given that:

$$\vec{F} = 6t^2\hat{i} - 3t\hat{j}$$

$$\vec{v} = 3t^2\hat{i} + 6t\hat{j}$$

Let's calculate the force at $t = 2$

$$\vec{F}(t = 2) = 6(2)^2\hat{i} - 3(2)\hat{j}$$

$$\vec{F}(t = 2) = 24\hat{i} - 6\hat{j}$$

Now, let's calculate the velocity at $t = 2$

$$\vec{v}(t = 2) = 3(2)^2\hat{i} + 6(2)\hat{j}$$

$$\vec{v}(t = 2) = 12\hat{i} + 12\hat{j}$$

Now, let's find the dot product of \vec{F} and \vec{v} :

$$\vec{F} \cdot \vec{v} = (24\hat{i} - 6\hat{j}) \cdot (12\hat{i} + 12\hat{j})$$

$$= (24 \times 12) + (-6 \times 12)$$

$$= 288 - 72$$

$$= 216$$

So, the power at $t = 2$ is 216 W

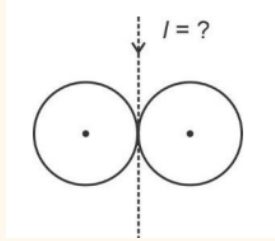
Ques 8. If $E = (A-x^2)/Bt$ where E is energy, x is displacement and t is time.

Find dimensions of AB

- A. $[M^{-1}L^2T]$
- B. $[ML^2T^{-1}]$
- C. $[M^{-1}L^2T^{-2}]$
- D. $[ML^2T^{-2}]$

Ans. A

Ques 9. Two solid spheres each of mass 2 kg and radius 75 cm are arranged as shown. Find MOI of the system about the given axis.



- A. 3.15 kg m^2
- B. 31.5 kg m^2
- C. 0.9 kg m^2
- D. 9 kg m^2

Ans. A

Ques 10. Find average power in electric circuit if source voltage (V) = $20\sin(100\omega t)$ and current in the circuit (I) = $2\sin(100\omega t + \pi/3)$

- A. 10 W
- B. 20 W
- C. 5 W
- D. 15.5 W

Ans. A

Ques 11. In a photoelectric experiment, frequency $f = 1.5f_0$ (f_0 : threshold frequency). If the frequency of light is changed to $f/2$, then photocurrent becomes (intensity of light has doubled)

- A. Zero
- B. Doubled
- C. Same
- D. Thrice

Ans. A

Solution: In the photoelectric effect, the stopping potential (and hence the photocurrent) depends on the frequency of incident light. When the

frequency of incident light is below the threshold frequency (f_0), no photoelectrons are emitted, resulting in zero photocurrent.

Given that the frequency of light in the first scenario is $1.5f_0$ and the frequency of light is changed to $f/2$ in the second scenario, let's analyze the effect on the photocurrent:

In the first scenario, the frequency of light is $1.5f_0$. Since this is above the threshold frequency, photoelectrons are emitted, resulting in a non-zero photocurrent.

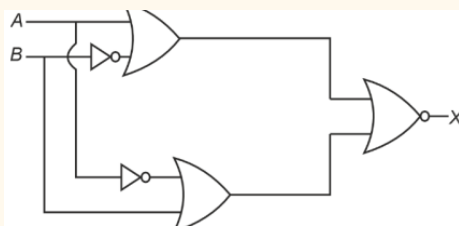
In the second scenario, the frequency of light is halved to $f/2$. This frequency is now below the threshold frequency (f_0). Therefore, no photoelectrons are emitted, resulting in zero photocurrent.

So, the correct answer is option A: Zero.

Ques 12. Radius of curvature of the equiconvex lens is 20 cm. Material of the lens has a refractive index of 1.5. Find image distance from the lens if an object is placed 10 cm away from the lens.

- A. 20 cm
- B. 10 cm
- C. 40 cm
- D. 5 cm

Ans. A



Ques 13.
Draw truth table of given gate circuit.

Draw truth table of given gate circuit

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

A	B	X
0	0	0
0	1	0
1	0	0
1	1	0

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

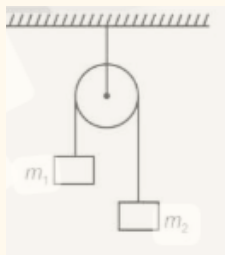
Ans. B

Ques 14. The magnetic flux through a loop varies with time as $\Phi = 5t^2 - 3t + 5$. If the resistance of loop is 8 , find the current through it at $t = 2$ s

- A. 15/8 A
- B. $\frac{5}{8}$ A
- C. 17/8 A
- D. 13/8 A

Ans. C

Ques 15. In the system shown below, the pulley & string are ideal. If the acceleration of blocks is $g/8$, find m_1/m_2



- A. 9/7
- B. 8/7
- C. 5/7
- D. 9/8

Ans. A

JEE Main Chemistry Questions

Ques 1. Which of the following is least ionic

- A. BaCl₂
- B. KCl
- C. AgCl
- D. CoCl₂

Ans. D

Solution: Ionicity generally refers to the ability of an ion or compound to form ions with a stable electronic configuration similar to that of noble gases. The closer the electronic configuration of an ion or compound is to that of a noble gas, the more ionic it is considered to be.

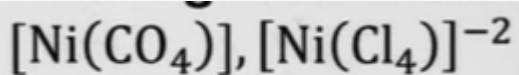
Let's analyze the given compounds:

CoCl₂: Cobalt (Co) typically forms Co²⁺ ions, which do not have a noble gas configuration. Chlorine (Cl) typically forms Cl⁻ ions, achieving the electronic configuration of argon. So, CoCl₂ is less ionic compared to the others.

Therefore, the least ionic compound among the given options is:

D. CoCl₂

Ques 2. Select the option of the correct property Paramagnetic &



Diamagnetic

Ans. Diamagnetic, Paramagnetic

Ques 3. Number of isomeric products formed by monochlorination Of 2-methyl butane in presence of sunlight is

Ans. 6

Ques 4. From the vitamins A, B-1, B-6, B-12, C, D, and K, the number of vitamins that can be stored in our body is

Ans. 3

Ques 5. If 5 moles of an ideal gas expands from 10 L to a volume of 100 L at 300k under isothermal and reversible condition then work, W, is - x J. The value of x is (even $n = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

Ans. 2.303

Ques 6. Statement I: $\text{S}_2\text{O}_3^{2-}$ disproportionates into $\text{H}_2\text{S}_2\text{O}_3$ and S_2^{2-} in alkaline medium

Statement II: ClO_4^- undergoes disproportionation in acidic medium

- A. Statement I is correct but Statement II is incorrect**
- B. Statement I is incorrect but Statement II is correct**
- C. Both Statement I and Statement II are correct**
- D. Both Statement I and Statement II are incorrect**

Ans. A

Ques 7. A compound (x) with molar mass 108 g mol^{-1} undergoes acetylation to give product with molar mass 192 g mol^{-1}

Ans. 2

Ques 8. Half life of a first order reaction is 36hr. Find out time (in hour) required for concentration of reactant to get reduced by 90%.

Ans. 120

Ques 9. Statement-I : Among 15th group hydrides reducing character decreases from NH_3 to BiH_3 .

Statement-II : E_2O_3 and E_2O_5 are always basic. [Where E is group 15 element]

- A. Both statement-I and Statement-II are correct
- B. Statement-I is correct and Statement-II is false
- C. Statement-I is false and Statement-II is correct
- D. Both Statement-I and Statement-II are false

Ans. B

Ques 10. Which of the following has maximum ionic character?

- A. KCl
- B. AgCl
- C. CoCl_2
- D. BaCl_2

Ans. A

Ques 11. Match the following :

- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{+3}$ (i) $t_{2g}^2 e_g^0$
- (b) $[\text{Fe}(\text{H}_2\text{O})_6]^{+3}$ (ii) $t_{2g}^3 e_g^0$
- (c) $[\text{Ni}(\text{H}_2\text{O})_6]^{+2}$ (iii) $t_{2g}^3 e_g^2$
- (d) $[\text{V}(\text{H}_2\text{O})_6]^{+3}$ (iv) $t_{2g}^6 e_g^2$

- A. (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)
- B. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
- C. (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)
- D. (a)-(ii), (b) - (iv) (c) - (i) (d)-(iii)

Ans. A

Ques 12. Quantum number for outermost electron of K-atom are given by

- A. $n = 4, l = 0, m = 0, s = 1/2$
- B. $n = 4, l = 1, m = 0, s = 1/2$
- C. $n = 3, l = 0, m = 0, s = 1/2$
- D. $n = 4, l = 0, m = 1, s = 1/2$

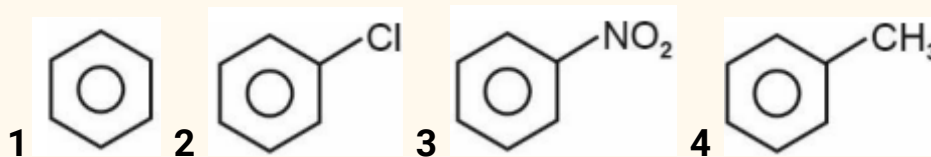
Ans. A

Ques 13. Choose the correct answers.

- (A) Mn_2O_7 is a oil at room temperature.
 - (B) V_2O_4 react with acid to give VO_2^+
 - (C) CrO is a basic oxide
 - (D) V_2O_5 does not react with acids.
- A. A, B and C only
 - B. B, C and D only
 - C. A only
 - D. B and C only

Ans. A

Ques 14. What will be the reactivity order of following compounds towards electrophilic substitution reaction?



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

Ans. A

Ques 15. Statement-I : Aniline on reaction with concentrated H_2SO_4 at 475 K gives p-amino benzene sulphonic acid. This gives blood red colour with Lassaigne's test.

Statement-II : Aniline forms a salt with anhydrous AlCl_3 in Friedel Craft's reaction.

- A. Both Statement-I and Statement-II are correct
- B. Both Statement-I and Statement-II are incorrect
- C. Statement-I is correct and Statement-II incorrect
- D. Statement-I is incorrect and Statement-II correct

Ans. A

Ques 16. How many of the following vitamins are stored in Human Body?

A, B, C, D, E, K?

Ans. 4

Ques 17. Number of moles of H^+ required by 1 mole MnO_4^- to oxidize oxalate ion to CO_2 is _____.

Ans. 8

JEE Main Mathematics Questions

Ques 1. Let $f: \mathbb{R} \rightarrow (0, \infty)$ be increasing function such that

$\lim_{x \rightarrow \infty} \frac{f(7x)}{f(x)} = 1$ then $\lim_{x \rightarrow \infty} \left\{ \frac{f(5x)}{f(x)} - 1 \right\}$ is equal to

- A. 0
- B. 4
- C. 1
- D. $\frac{4}{5}$

Ans. A

Ques 2. $z_1^3 + z_2^3 = 20 + 15i$ then $|z_1^4 + z_2^4|$ is equal to

- A. $15\sqrt{15}$
- B. 75
- C. $30\sqrt{3}$
- D. $25\sqrt{3}$.

Ans. B

Ques 3. $a = \sin^{-1}(\sin(5))$ and

$b = \cos^{-1}(\cos(5))$ then $a^2 + b^2 =$

Ans. $8\pi^2 - 40\pi + 50$

Ques 4. A coin is biased so that a head is twice as likely as a tail. If the coin is tossed 3 times, then the probability of getting two tails and one head is

- A. $\frac{1}{9}$
- B. $\frac{2}{9}$
- C. $\frac{2}{27}$
- D. $\frac{1}{27}$

Ans. B

Solution: Let's denote:

- $P(H)$ as the probability of getting a head,
- $P(T)$ as the probability of getting a tail.

Given that a head is twice as likely as a tail, we have:

$$P(H) = 2 \times P(T)$$

$$P(T) = \frac{1}{3}$$

$$P(H) = 2 \times \frac{1}{3} = \frac{2}{3}$$

Now, to find the probability of getting two tails and one head when the coin is tossed 3 times, we can use the binomial probability formula:

Ques 5. The number of solution of equation $e^{\sin x} - 2e^{-\sin x} = 2$ is

- A. more than 2**
- B. 2**
- C. 1**
- D. 0**

Ans. D

Ques 6. Let mean and variance of 6 observations a, b, 68, 44, 40, 60 be 55 and 194. If $a > b$ then find $a + 3b$

- A. 211.83**
- B. 201.59**
- C. 189.57**
- D. 198.87**

Ans. B

Ques 7. If 2nd, 8th, 44th terms of A.P. are 1st, 2nd and 3rd terms respectively of G.P. and first term of A.P. is 1 then the sum of first 20 terms of A.P. is

- A. 970
- B. 916
- C. 980
- D. 990

Ans. A

Ques 8. The area of the region enclosed by the parabolas $y = 4 - x^2$ and $3y = (x - 4)^2$ is in (sq. unit)?

- A. 14/3
- B. 4
- C. 32/3
- D. 6

Ans. D

Ques 9. Let z_1 and z_2 be two complex numbers such that $z_1 + z_2 = 5$ and $z_1^3 + z_2^3 = 20 + 15i$, then the value of $|z_1^4 + z_2^4|$ is equal to

- A. 75
- B. $15\sqrt{15}$
- C. $25\sqrt{5}$
- D. $30\sqrt{3}$

Ans. A

Ques 10. The line passes through the centre of circle $x^2 + y^2 - 16x - 4y = 0$, it intersects with the positive coordinate axis at A & B. Then find the minimum value of OA + OB, where O is origin.

- A. 20
- B. 18
- C. 12

D. 24

Ans. A

Ques 11. If (α, β, γ) is mirror image of the point $(2, 3, 4)$ with respect to the line $(x-1)/2=(y-2)/3=(z-3)/4$. Then $2\alpha + 3\beta + 4\gamma$ is

- A. 29
- B. 30
- C. 31
- D. 32

Ans. A

Ques 12. A parabola has vertex $(2, 3)$, equation of directrix is $2x - y = 1$ and equation of ellipse is $x^2/a^2 + y^2/b^2 = 1$, $e=1/\sqrt{2}$ and ellipse passing through focus of parabola then square of length of latus rectum of ellipse is

- A. $6564/25$
- B. $3288/25$
- C. $6272/25$
- D. $4352/25$

Ans. D

Ques 13. The value of $\frac{120}{\pi^3} \left| \int_0^\pi \frac{x^2 \sin x \cdot \cos x}{(\sin x)^4 + (\cos x)^4} dx \right|$ is

Ans. 15

Ques 14. The number of ways to distribute the 21 identical apples to three children's so that each child gets at least 2 apples.

Ans. 136

Ques 15. If $A = \{1, 2, 3, \dots, 100\}$, $R = \{(x, y) \mid 2x = 3y, x, y \in A\}$ is symmetric relation on A and the number of elements in R is n , the smallest integer value of n is

Ans. 0