

JEE Main 2023 Question Paper Solution

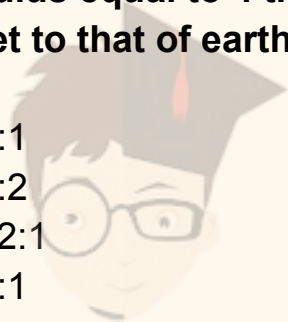
Date & Shift: April 12 Shift 1

Memory-Based Questions

JEE Main 2023 Physics Question Paper

Question 1. If a planet has mass equal to 16 times the mass of earth, and radius equal to 4 times that of earth. The ratio of escape speed of a planet to that of earth is?

- A. 2:1
- B. 1:2
- C. $\sqrt{2}$:1
- D. 4:1



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Answer. A

Question 2. A particle is thrown vertically upward with initial velocity of 150m/s. Find the ratio of its speed at $t = 3s$ and $t = 5s$. (Take $g = 10ms^{-2}$)

Solution. Let's consider the upward direction as positive.

The initial velocity of the particle, $u = 150 \text{ m/s}$

Acceleration due to gravity, $g = -10 \text{ m/s}^2$ (negative sign as it acts in the downward direction)

Using the kinematic equation, we can find the velocity of the particle at any time t as:

$$v = u + gt$$

At $t = 3$ s, the velocity of the particle is:

$$v_1 = u + gt = 150 - 10(3) = 120 \text{ m/s}$$

At $t = 5$ s, the velocity of the particle is:

$$v_2 = u + gt = 150 - 10(5) = 100 \text{ m/s}$$

Therefore, the ratio of the speed of the particle at $t=3$ s and $t=5$ s is:

$$v_1/v_2 = 120/100 = 6/5$$

Hence, the ratio of the speed of the particle at $t=3$ s and $t=5$ s is 6:5. i.e; 1.20

Answer. 1.20

Question 3. Find the ratio of de-Broglie wavelength of a proton and a α - particle, when accelerated through a potential difference of 2V and 4V respectively.

- A. 4:1
- B. 2:1
- C. 1:8
- D. 16:1

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Answer. A

Question 4. If a body of mass 5 kg is in equilibrium due to forces F_1 , F_2 and F_3 . F_2 and F_3 are perpendicular to each other. If F_1 is removed then find the acceleration of the body. Given $F_2 = 6$ N and $F_3 = 8$ N

- A. 2 m/s^2
- B. 3 m/s^2
- C. 4 m/s^2
- D. 5 m/s^2

Solution. Since the body is in equilibrium, the net force acting on it is zero. Hence, we have:

$$F_1 + F_2 + F_3 = 0$$

If we remove F_1 , the body will no longer be in equilibrium and will experience acceleration due to the remaining forces F_2 and F_3 .

The magnitude of the net force acting on the body is:

$$|F_{\text{net}}| = \sqrt{F_2^2 + F_3^2} = \sqrt{6^2 + 8^2} = 10\text{N}$$

The direction of the net force is given by the angle between F_2 and F_3 :

$$\tan\theta = F_3/F_2 = 8/6$$

$$\theta = \tan^{-1}(8/6) = 53.13 \text{ degrees}$$

So, the net force is acting at an angle of 53.13 degrees with F_2 .

Now, we can use Newton's second law to find the acceleration of the body:

$$F_{\text{net}} = ma$$

$$a = F_{\text{net}}/m = 10/5 = 2 \text{ m/s}^2$$

Therefore, the acceleration of the body is 2 m/s^2 .

Answer. A

Question 5. 64 identical balls made of conducting material each having a potential of 10 mV are joined to form a bigger ball. The potential of a bigger ball is?

Solution. Since the balls are made of conducting material, the potential will be distributed uniformly over the surface of each ball. When the balls are joined to form a bigger ball, they will form a parallel combination, and the total charge will remain the same.

Let the potential of the bigger ball be V .

Then, by the principle of conservation of charge, we have:

total charge of the 64 balls = charge of the bigger ball

$$q = CV = 64C(0.01V)$$

where C is the capacitance of each ball and $0.01V$ is the potential of each ball.

Also, capacitance of each ball, $C = 4\pi\epsilon_0 r$ where r is the radius of each ball and ϵ_0 is the permittivity of free space.

Since all the balls are identical, r is the same for each ball.

So, we have:

$$q = 64(4\pi\epsilon_0 r)(0.01V)$$

And, the capacitance of the bigger ball, C' is given by:

$$C' = 4\pi\epsilon_0 R$$

where R is the radius of the bigger ball.

Since the balls are joined to form a bigger ball, the radius of the bigger ball, R , is equal to the radius of one ball multiplied by the cube root of 64.

So, we have:

$$R = \sqrt[3]{64} = 4r$$

Therefore, the capacitance of the bigger ball is:

$$C' = 4\pi\epsilon_0(4r) = 16\pi\epsilon_0 r$$

Now, equating the expressions for q and C' , we get:

$$64C(0.01V) = 16\pi\epsilon_0 rV$$

$$\text{or, } V = (64C)(0.01)/(16\pi\epsilon_0 r)$$

Substituting the value of capacitance C , we get:

$$V = (64(4\pi\epsilon_0 r))(0.01)/(16\pi\epsilon_0 r)$$

Simplifying, we get:

$$V = 0.16 \text{ V}$$

Therefore, the potential of the bigger ball is 0.16 V.

Answer. 0.16V

Question 6. Ratio between rms speed of Ar to the most probable speed of O₂ at 27°C is

- A. $\sqrt{8/\pi}$
- B. $\sqrt{8/3}$
- C. $\sqrt{4/\pi}$
- D. $\sqrt{4/3}$

Answer. B

Question 7. If an object cools down from 80°C to 60°C in 5 min in a surrounding of temperature 20°C . The time taken to cool from 60°C to 40°C will be (Assume Newton's law of cooling to be valid)

- A. $25/3$ min
- B. 5 min
- C. $25/4$ min
- D. 9 min

Answer. A

Question 8. In a ice cube of thickness 24 cm, has bubbles trapped in it as shown in figure. If apparent side are 12 cm and 4 cm from side 1 and side 2 respectively, then refractive index of ice cube is

- A. $4/3$
- B. $3/2$
- C. 2
- D. 2.4



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Answer. 2

Question 9. A dipole having dipole moment M is placed in two magnetic fields of strength B_1 and B_2 respectively. The dipole oscillates 60 times in 20 seconds in the B_1 magnetic field and 60 oscillations in 30 seconds in the B_2 magnetic field. Then find the B_1/B_2

- A. $3/2$
- B. $2/3$
- C. $4/9$
- D. $9/4$

Solution. The time period of oscillation of a dipole in a magnetic field is given by:

$$T = 2\pi\sqrt{I/MB}$$

where I is the moment of inertia of the dipole about its axis of rotation.

For a given dipole, the moment of inertia and the dipole moment are constant. Therefore, the time period of oscillation is directly proportional to the square root of the magnetic field strength.

Let the time period of oscillation in the B_1 magnetic field be T_1 and in the B_2 magnetic field be T_2 . Then:

$$T_1/T_2 = \sqrt{B_2/B_1}$$

60 oscillations in 20 seconds in the B_1 magnetic field gives:

$$T_1 = 20/60 = 1/3 \text{ seconds}$$

60 oscillations in 30 seconds in the B_2 magnetic field gives:

$$T_2 = 30/60 = 1/2 \text{ seconds}$$

Substituting these values in the above equation, we get:

$$1/3 / 1/2 = \sqrt{B_2/B_1}$$

$$2/3 = \sqrt{B_2/B_1}$$

Squaring both sides, we get:

$$4/9 = B_2/B_1$$

Therefore, $B_1/B_2 = 9/4$.

Answer. D

Question 10. Suppose a situation in which two planets orbits around the sun in the same orbit. If the mass of planet 1 is twice the mass of planet 2, then what do they have same?

- A. Potential energy
- B. Kinetic energy
- C. Total energy
- D. Velocity

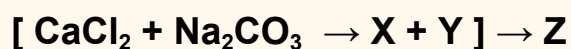
Answer. D

JEE Main 2023 Chemistry Question Paper

Question 1. pH of 1 litre of HCL solution is 1. How much water (in litres) is added to make pH=2?

Answer. 9

Question 2. Consider the following reaction sequence:



- A. X: CaCO_3 , Y: NaCl, Z: NCl
- B. X: CaO, Y: NaCl + CO_2 , Z: KCl
- C. X: CaO, Y: NaCl + CO_2 , Z: NaCl
- D. X: CaCO_3 , Y: NaCl, Z: KCl

Answer. A

Question 3. Match the following

Column 1 (Type of hydride)	Column II
A. Electron	1. MgH_2
B. Electron precise	2. HF
C. Electron rich	3. CH_4
D. Saline Hydride	4. B_2H_6

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

Answer. C

Question 4. Match the columns

Column I		Column II	
(a)	Biodegradable	(p)	polyacrylonitrie
(b)	Synthetic	(q)	PHBV
(c)	Natural	(r)	dacron
(d)	Polyester	(s)	Rubber

- A. a-q; b-p; c-s; d-r
 B. a-q; b-p; c-r; d-s
 C. a-p; b-q; c-s; d-r
 D. a-q; b-r; c-s; d-p

Answer. A

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Question 5. A metal chloride contains 55% by mass of chlorine. 100 mL of vapours gives 0.57 gm of chlorine at STP. Calculate the molecular mass of metal chloride. (Nearest integer)

Answer. 232

Question 6. Given $P_i = 3 \text{ atm}$

$$V_{\text{initial}} = 2 \text{ L}$$

$$V_{\text{final}} = 3 \text{ L}$$

$$T = 350 \text{ K}$$

If isothermal reversible process is carried out, calculate ΔS for system (in Joules)

Answer. 0.72

Question 7. How many of the given metals will show photoelectric effect when light of 400 nm falls on below metal?

Metal	Li	Na	K	Mg	Cu	Ag
W(eV)	2.42	2.3	2.25	3.7	4.8	4.3

Answer. 3

Question 8. Select correct statements about lead storage battery:

- A. PbSO_4 converts into PbO_2 at anode during discharging
- B. PbSO_4 converts into PbO_2 at cathode during discharge
- C. 38% H_2SO_4 solution is taken as the electrolyte
- D. H_2SO_4 is produced during discharging

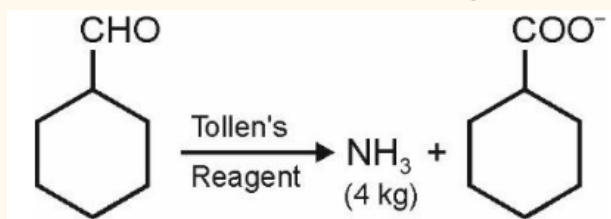
Answer. C

Question 9. The number of sp^2 hybridized carbon atoms in the following peptide is

Ala – Phe – Gly – Ala – Phe - Ley

Answer. 18

Question 10. Calculate mass of Tollen's Reagent Required?



A. 18.70 kg

- B. 37.40 kg
- C. 9.35 kg
- D. 55.10 kg

Answer. A

JEE Main 2023 Mathematics Question Paper

Question 1. Two circles having radius r_1 and r_2 touch both the coordinate axes. Line $x + y = 2$ makes intercept as 2 on both the circles. The value of $r_1^2 + r_2^2 - r_1r_2$ is:

- A. $9/2$
- B. 6
- C. 7
- D. 8

Answer. 7

Question 2. ${}^nC_n / n+1 + {}^nC_{n-1} / n + \dots + \frac{1}{2} {}^nC_1 + {}^nC_0 = 255/8$, Then value of n is

Answer. 7

Question 3. If the value of $\int_{-0.15}^{0.15} |100x^2 - 1| dx = k/3000$, then the value of k is?

Answer. 575

Question 4. $N > 40000$, where N is divisible by 5. How many such 5 digit numbers can be formed using 0,1,3,5,7,9 without repetition.



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Answer. 120

Question 5. If $(1+x^2)dy = y(y-x)dx$ and $y(1) = 1$. Then $y(2\sqrt{2})$ is:

- A. $4/\sqrt{2}$
- B. $3/\sqrt{2}$
- C. $1/\sqrt{2}$
- D. $\sqrt{2}$

Solution. We can solve the given differential equation using separation of variables.

$$(1+x^2)dy = y(y-x)dx$$

Dividing both sides by $y(y-x)$, we get:

$$(1/x - 1/(x^2+y^2)) dy - 1/y dx = 0$$

Now, we can integrate both sides:

$$\int (1/x - 1/(x^2+y^2)) dy - \int 1/y dx = C$$

where C is the constant of integration.

For the first integral, we can substitute $u = x^2 + y^2$, $du/dy = 2y$:

$$\int (1/x - 1/(x^2+y^2)) dy = \int (1/u) (du/dy) dy$$

$$= \int (2y/u) dy$$

$$= \ln|u| + K$$

$$= \ln(x^2 + y^2) + K$$

For the second integral, we can directly integrate:

$$\int 1/y dx = \ln|y| + K'$$

Therefore, the equation becomes:

$$\ln(x^2 + y^2) - \ln|y| = C'$$

Taking exponential of both sides, we get:

$$x^2 + y^2 = e^{(C')} |y|$$

Since $y(1) = 1$, we have:

$$1^2 + 1^2 = e^{(C')} |1|$$

$$e^{(C')} = 2$$

$$C' = \ln(2)$$

So, the equation becomes:

$$x^2 + y^2 = 2|y|$$

Substituting $x = 2\sqrt{2}$, we get:

$$(2\sqrt{2})^2 + y^2 = 2|y|$$

$$8 + y^2 = 2|y|$$

Since y is positive, we can simplify this as:

$$y^2 - 2y + 8 = 0$$

Solving for y , we get:

$$y = 1 \pm 3i$$

Since we want to find the value of $y(2\sqrt{2})$, we can substitute $x = 2\sqrt{2}$ in the equation $x^2 + y^2 = 2|y|$ and solve for y :

$$(2\sqrt{2})^2 + y^2 = 2|y|$$

$$8 + y^2 = 2|y|$$

Squaring both sides, we get:

$$64 + 16y^2 + y^4 = 4y^2$$

$$y^4 + 12y^2 - 64 = 0$$

Solving for y^2 , we get:

$$y^2 = 4 \text{ or } y^2 = -16 \text{ (not possible since } y \text{ is real)}$$

So, we have:

$$y = \pm 2$$

Since $y(1) = 1$, we have $y = 2$.

Therefore, $y(2\sqrt{2}) = 2$, so the answer is option (d) $\sqrt{2}$.

Answer. D

Question 6. For the expression $(1-x)^{100}$. Then sum of coefficient of first 50 terms is:

A. ${}^{99}C_{49}$

B. $-({}^{100}C_{50})/2$

C. $-{}^{99}C_{49}$

D. $-{}^{101}C_{50}$

Answer. B

Question 7. Three numbers a, b, c are in A.P. and they are used to make a 9-digits number using each digit thrice, such that at least 3 consecutive digits are in A.P. then number of such numbers is?

Answer. 1260

Question 8. Given A, B, C represents angles of a $\triangle ABC$ and $\cos A + 2 \cos B + \cos C = 2$ and $AB = 3$ and $BC = 7$ then $\cos A - \cos C$ is?

- A. $-10/7$
- B. $10/7$
- C. $5/7$
- D. $-5/7$

Answer. A

Question 9. Positive numbers a_1, a_2, \dots, a_5 are in geometric progression. Their mean and variance are $31/10$ and m/n respectively. The mean of the reciprocals is $31/40$, then $m + n$ is?

- A. 209
- B. 211
- C. 113
- D. 429

Answer. B

Question 10. Area of region enclosed by curve $y = x^3$ and its tangent at $(-1, -1)$

- A. 4
- B. 27
- C. $4/27$
- D. $27/4$

Answer. D

