JEE Main 2023 Question Paper Solution

Date & Shift: April 6 Shift 2 **Memory-Based Questions**

JEE Main 2023 Physics Question Paper

Question 1. An object starts moving with an initial speed 10m/s and acceleration 2 m/s^2 along positive x - direction. The time taken to attain 60 m/s speed is?

A. 25s
B. 20s
C. 30s
D. 15s

Solution. We can use the following equation of motion to solve the problem:

v = u + at

Where:
v = final velocity = 60 m/s
u = initial velocity = 10 m/s
a = acceleration = 2 m/s^2

t = time taken

Substituting the given values in the equation, we get:

60 = 10 + 2t

Solving for t, we get:

t = (60 - 10) / 2 = 25 s

Therefore, the time taken to attain a speed of 60 m/s is 25 seconds.

Hence, the answer is 25s.

Answer. A

Question 2. If W is the weight on the surface of Earth then weight of same body at a height $R_e/4$ above the surface of earth is equal to (R_e = Radius of Earth)

A. 4/5 W
B. 16/25 W
C. 25/16 W
D. 5/4 W

Solution. We can use the following formula to find the weight of the body at a height of Re/4 above the surface of the earth:

Weight at height h = (mass of the body) x (acceleration due to gravity at height h)

At a height of Re/4 above the surface of the earth, the distance between the center of the earth and the body is:

R + h = R + Re/4

where R is the radius of the earth.

The acceleration due to gravity at this height is given by the formula:

g' = (G M) / (R + Re/4)^2

where G is the gravitational constant, M is the mass of the earth, and R + Re/4 is the distance between the center of the earth and the body.

To find the weight of the body at this height, we can use the formula:

Weight at height h = (mass of the body) x (acceleration due to gravity at height h)

Weight at height Re/4 = (mass of the body) x (acceleration due to gravity at height Re/4)

Weight at height Re/4 = (mass of the body) x [(G M) / (R + Re/4)^2]

We know that weight on the surface of the earth, W = (mass of the body) x (acceleration due to gravity at the surface of the earth)

Weight on the surface of the earth, W = (mass of the body) x g

where g is the acceleration due to gravity at the surface of the earth.

Substituting the values of g and g' in the above equation, we get:

Weight at height Re/4 = W x [(R / (R + Re/4))^2]

Weight at height Re/4 = W x [(4R / (5R))^2]

Weight at height Re/4 = W x (16/25)

Therefore, the weight of the body at a height of Re/4 above the surface of the earth is equal to (16/25) times the weight of the body on the surface of the earth.

Hence, the answer is 16/25 W.

Answer. B

Question 3. The potential energy of an electron is defined as U = ½ mw^2 x^2 and follows Bohr's law. Radius of orbit as function of n depends on? (w is same constant)

A. n^2
B. $1/\sqrt{n}$
C. $\sqrt{n}$
D. $n^{2/3}$

Answer. C

Question 4. Find the ratio of root mean square speed of oxygen gas molecules to that of hydrogen gas molecules, if temperature of both the gases are same.

A. 1/4
B. 1/16
C. 1/32
D. 1/8

Solution. The root mean square (rms) speed of a gas molecule is given by:

$v_{rms} = \sqrt{(3kT / m)}$

where k is the Boltzmann constant, T is the temperature, and m is the mass of the gas molecule.

Since the temperature of both oxygen and hydrogen gases is the same, we can write:

$v_{rms}(O_2) / v_{rms}(H_2) = \sqrt{(m(H_2) / m(O_2))}$

The molecular weight of hydrogen (H_2) is 2 grams per mole, while that of oxygen (O_2) is 32 grams per mole.

Substituting these values, we get:

$v_{rms}(O_2) / v_{rms}(H_2) = \sqrt{(32 / 2)} = \sqrt{16} = 4$

Therefore, the ratio of the rms speed of oxygen gas molecules to that of hydrogen gas molecules is 4:1.

Hence, the answer is (A) 1/4.

Answer. A

Question 5. A solid sphere and a ring have equal masses and equal radius of gyration. If the sphere is rotating about its diameter and ring about an axis passing through and perpendicular to its plane, then the ratio of radius is $\sqrt{x}/2$ then find the value of x.

Answer. 5

Question 6. A proton is projected with speed v in magnetic field B of magnitude 1 T. The angle between velocity and magnetic field is 60^0 as shown below. Kinetic energy of a proton is 2 eV (mass of proton =

1.67 x 10^{-27} kg,e = 1.6 x 10^{-19} C).The pitch of the path of proton is approximately ?

A. 6.28 x 10^{-2} m
B. 6.28 x 10^{-4} m
C. 3.14 x 10^{-2} m
D. 3.14 x 10^{-4} m

Solution. The force experienced by a charged particle moving in a magnetic field is given by the equation:

F = q v x B

where q is the charge of the particle, v is its velocity, and B is the magnetic field. The direction of the force is perpendicular to both v and B and is given by the right-hand rule.

The magnitude of the force is given by:

|F| = q v B sinθ

where θ is the angle between v and B.

Since the proton is moving perpendicular to the magnetic field, the angle θ is 90 degrees and sinθ is equal to 1. Therefore, the magnitude of the force on the proton is:

|F| = q v B

The force causes the proton to move in a circular path with radius r, given by:

|F| = (m v^2)/r

where m is the mass of the proton.

Equating the two expressions for |F|, we get:

q v B = (m v^2)/r

Solving for r, we get:

r = m v / (q B)

Substituting the given values, we get:

r = (1.67 x 10^-27 kg) (sqrt(2 x 1.6 x 10^-19 J)) / (1.6 x 10^-19 C x 1 T)

r = 6.28 x 10^-4 m

Therefore, the pitch of the path of the proton is approximately 6.28 x 10^-4 m.

Hence, the correct option is (B) 6.28 x 10^-4 m.

Answer. B

Question 7. For two different photosensitive materials having work function and 2 respectively, are illuminated with light of sufficient energy to emit electrons. If the graph of stopping potential versus frequency is drawn, for these two different photosensitive materials the ratio of slope of graph for these two materials is

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

Answer. A

Question 8. Choose the incorrect statement from the given statements.

A. Planets revolve around the Sun with constant linear speed.
B. Energy of the planet in elliptical orbit is constant.
C. Satellites in circular motion have constant energy.
D. Body falling towards the Earth results in negligible displacement of the Earth.

Solution. The incorrect statement from the given options is:

Planets revolve around the Sun with constant linear speed.

This statement is incorrect because planets actually revolve around the Sun with constant angular speed, not linear speed. This is because the distance between the planet and the Sun changes as the planet moves along its elliptical orbit. According to Kepler's second law, the line joining the planet and the Sun sweeps out equal areas in equal time intervals, which implies that the planet moves faster when it is closer to the Sun and slower when it is farther away from the Sun. Therefore, the angular speed of the planet remains constant, while the linear speed varies throughout its orbit.

Hence, the correct option is (A) Planets revolve around the Sun with constant linear speed.

Answer. A

Question 9. The temperature of the body drops from 60°C to 40°C in 7 min. The surrounding temperature is 10°C. The temperature of the body drops from 40°C to T°C in 7 min. Find the value of T

A. 16°C
B. 20°C
C. 28°C
D. 36°C

Answer. C

Question 10. Radius of the first orbit in H-atom is a_0. Then, deBroglie wavelength of electron in the third orbit is

A. $3\pi a_0$
B. $6\pi a_0$
C. $9\pi a_0$
D. $12\pi a_0$

Solution. The de Broglie wavelength of an electron in the nth orbit of hydrogen atom can be calculated using the formula:

$\lambda = h / p$

where λ is the de Broglie wavelength, h is the Planck constant, and p is the momentum of the electron.

The momentum of the electron in the nth orbit can be calculated using the Bohr model formula:

$p = mv = n\,h / 2\pi r$

where m is the mass of the electron, v is its velocity, n is the principal quantum number, h is the Planck constant, and r is the radius of the nth orbit.

For the third orbit, n = 3, so the radius is:

r = 3^2 a0 = 9a0

The momentum is:

p = 3 h / 2π(9a0)

The de Broglie wavelength is:

λ = h / p = 2π(9a0) / 3

Simplifying this expression gives:

λ = 6πa0

Therefore, the correct answer is (B) 6πa0.

Answer. B

JEE Main 2023 Chemistry Question Paper

Question 1. Nessler's reagent does not have?

A. K
B. Hg
C. N
D. I

Solution. Nessler's reagent is a chemical reagent used for detecting the presence of ammonia (NH3) or ammonium ions (NH4+) in a solution. It is made by mixing potassium iodide (KI) and mercuric chloride (HgCl2) in a basic solution.

Therefore, the correct answer is (C) N.

Answer. C

Question 2. In which form does $BeCl_2$ exist in solid state, vapour state and high temperature?

Answer. Solid state: Polymer
Vapour state: Dimer
High temperature: Monomer

Question 3. Which of the following is obtained on electrolysis of brine solution?

A. NaOH
B. H_2 gas
C. Cl_2 gas
D. Na

Answer. D

Question 4. Which of the following has the highest hydration energy?

A. Be^{+2}
B. Mg^{+2}
C. Ca^{+2}
D. Ba^{+2}

Solution. Hydration energy is the amount of energy released when a hydrated ion is formed from a gaseous ion and water molecules. The magnitude of hydration energy depends on the size and charge of the ion.

As we move down a group of the periodic table, the size of the ions increases, and the hydration energy decreases. Therefore, among the given options, the ion with the highest hydration energy will be the smallest one with the highest charge.

Hence, the correct option is (A) Be+2, which has the highest charge and is the smallest ion among the given options.

Answer. A

Question 5. Oxidation state of Mn in $KMnO_4$ changes by 3 units in which medium?

A. Strongly acidic
B. Strongly basic
C. Aqueous neutral
D. Weakly acidic

Answer. C

Question 6. Which of the following is most basic?

A. Tl_2O_3
B. Tl_2O_2
C. Cr_2O_3
D. B_2O_3

Solution. Among the given options, B2O3 is the most acidic oxide and would form an acidic solution when dissolved in water. On the other hand, Tl2O3 and Tl2O2 are basic oxides and would form basic solutions when dissolved in water.

Out of Tl2O3 and Tl2O2, Tl2O2 is expected to be more basic because it has a higher oxidation state of +1 for Tl as compared to +3 in Tl2O3.

Higher oxidation state of the metal in an oxide generally leads to a more basic oxide.

Therefore, Tl2O2 is the most basic among the given options.

Answer. B

Question 7. IUPAC name of the compound $K_3[Co(C_2O_4)_3]$ is

A. Potassium trioxalatocobaltate (III)
B. Potassium trioxalatocobaltate (III)
C. Potassium cobalt tris oxalate (II)
D. Potassium oxalato cobaltate (III)

Answer. B

Question 8. During detection of Lead, Formation of which of the following compounds is not used as a confirmatory test.

A. $PbSO_4$
B. $Pb(NO_3)_2$
C. $PbCrO_4$
D. PbI_2

Solution. Formation of Pb(NO3)2 is not used as a confirmatory test for detecting lead as it is a common salt and its formation does not confirm the presence of lead.
Answer. B

Question 9. Consider the following:

I. D.D.T.
II. Aldrin
III. Sodium arsenite

IV. **Sodium chlorate**

How many of these are pesticides?

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

Answer. B

Question 10.

Amino Acid	Letter Code
1. Alanine	P. N
2. Asparagine	Q. A
3. Aspartic acid	R. R
4. Arginine	S. D

A. 1 - Q; 2 - S; 3 - P; 4 - R
B. 1 - Q; 2 - S; 3 - R; 4 - P
C. 1 - S; 2 - P; 3 - R; 4 - Q
D. 1 - S; 2 - P; 3 - P; 4 - R

Solution. The correct answer is:

1 - Q; 2 - S; 3 - P; 4 - R

This is because the letter code for asparagine is Q, for arginine is S, for alanine is P, and for aspartic acid is R.

Answer. A

JEE Main 2023 Mathematics Question Paper

Question 1. Rank of the word PUBLIC is?

Answer. 582

Question 2. If $f(x) + f(\pi-x) = \pi^2$ then $\int_0^{\pi} f(x) \sin x \, dx$?

Answer. π^2

Question 3. The area enclosed by $y = |x-1| + |x-2|$ and $y = 3$ is

Answer. 4

Question 4. Find all the four letter words with two vowels and 2 consonants from the word UNIVERSE?

Answer. 504

Question 5. The system of the equations

$x + y + z = 6$
$x + 2y + \alpha z = 5$
$x + 2y + 6z = \square$ has

A. Infinitely many solution for $\alpha = 6$, $\square = 3$
B. Infinitely many solution for $\alpha = 6$, $\square = 5$
C. Unique solution for $\alpha = 6$, $\square = 5$
D. No solution for $\alpha = 6$, $\square = 5$

Solution. We can solve this system of equations using Gaussian elimination:

$$
\begin{align*}
&\left(\begin{array}{ccc|c}
1 & 1 & 1 & 6 \\
1 & 2 & \alpha & 5 \\
1 & 2 & 6 & \beta \\
\end{array}\right) \\
&\xrightarrow[R_3-R_1]{R_2-R_1} \\
&\left(\begin{array}{ccc|c}
1 & 1 & 1 & 6 \\
0 & 1 & \alpha-1 & -1 \\
0 & 1 & 5 & \beta-6 \\
\end{array}\right) \\
&\xrightarrow[R_3-R_2]{} \\
&\left(\begin{array}{ccc|c}
1 & 1 & 1 & 6 \\
0 & 1 & \alpha-1 & -1 \\
0 & 0 & 4-\alpha & \beta-5 \\
\end{array}\right)
\end{align*}
$$

If $\alpha = 4$, the third row reduces to $0= \beta-5$, which implies that $\beta=5$ if there is a solution. So we must have $\alpha\neq 4$ for a unique solution to exist.

If $\alpha \neq 4$, then we can use back-substitution to solve for z and then for y and x.

From the third row, we have $(4-\alpha)z = \beta -5$, which gives $z = \frac{\beta-5}{4-\alpha}$.

Substituting this into the second row, we have $y + (\alpha-1)z = -1$, which gives $y = -1 - (\alpha-1)\cdot\frac{\beta-5}{4-\alpha}$.

Finally, substituting these values into the first row, we have $x+y+z = 6$, which gives $x = 6 - y - z = 6 - \left(-1 - (\alpha-1)\cdot\frac{\beta-5}{4-\alpha}\right) - \frac{\beta-5}{4-\alpha}$.

Therefore, we have a unique solution for any values of α and β except for $\alpha=4$, for which there is no solution.

So the answer is: Unique solution for $\alpha = 6, \beta = 5$

Answer. B

Question 4.
Let
Statement 1 : $(2002)^{2023} - (1919)^{2002}$ is divisible by 8.
Statement 2 : $13.13^n – 12n – 13$ is divisible by 144 n ϵ N, then

A. Statement-1 and statement-2 both are true
B. Only statement-1 is true
C. Only statement-2 is true
D. Neither statement-1 nor statement-2 are true

Answer. C

Question 5. If $1^2 - 2^2 + 3^2 - 4^2 + ……..2022^2 + 2023^2 = m^2n$, where m, n ϵ N and m > 19 then $n^2 - m$ is

A. 615
B. 562
C. 812
D. 264

Answer. A

Question 6. If $a \neq \pm b$ and are purely real, $z \epsilon$ complex number, $Re(az^2 + bz) = a$ and $Re(bz^2 + az) = b$ then number of value of z possible is

A. 0
B. 1
C. 2
D. 3

Answer. A

Question 7. If V is volume of parallelepiped whose three coterminous edges are a, b, c, then volume of a parallelepiped whose coterminous edges are a, b+c, a+2b+3c is

A. 6V
B. V
C. 2V
D. 3V

Answer. B

Question 8.
S1 : (p ⇨ q) v (~p ^ q) is a tautology
S2 : (q ⇨ p) ⇨ (~p ^ q) is a contradiction

A. Both S1 and S2 are true
B. Neither S1 or S2 are true
C. Only S1 are true
D. Only S2 are true

Answer. B

Question 9. Three dice are thrown. Then the probability that no outcomes is similar is p/q then q – p is (where p and q are co-prime)

Solution. When three dice are thrown, there are a total of 6 × 6 × 6 = 216 possible outcomes.

To count the number of outcomes where no two dice have the same outcome, we can proceed as follows:

Choose a number for the first die in 6 ways.
Choose a different number for the second die in 5 ways.
Choose a different number for the third die in 4 ways.
Therefore, the number of outcomes where no two dice have the same outcome is 6 × 5 × 4 = 120.

So, the probability that no outcomes is similar is p/q = 120/216 = 5/9.

Hence, q - p = 9 - 5 = 4.

Answer. 4

Question 10. If $(21)^{18} + 20\cdot(21)^{17} + (20)^2 \cdot (21)^{16} + \ldots\ldots\ldots (20)^{18} = k\,(21^{19} - 20^{19})$ then k =

A. 21/20
B. 1
C. 20/21
D. 0

Solution. We can simplify the left-hand side using the formula for the sum of a geometric series:

(21)18 + 20·(21)17 + (20)2 · (21)16 + ……. (20)18

= (21)18 + 20·(21)17 + 20^2·(21)16 + …….. + 20^18·(21)^0
= (21)18 + 20·(21)17 + 20^2·(21)16 + …….. + 20^18

This is a geometric series with first term (21)18 and common ratio 20/21. The number of terms is 19 (from the exponents of the powers of 20), so we can use the formula for the sum of a geometric series to get:

(21)18 + 20·(21)17 + 20^2·(21)16 + …….. + 20^18
= [(21)18(1 - (20/21)^19)]/(1 - 20/21)
= 21^19 - 20^19

Now, we can substitute this expression into the given equation and simplify:

21^19 - 20^19 = k(21^19 - 20^19)
k = (21^19 - 20^19)/(21^19 - 20^19)
k = 1

Therefore, the answer is (B) 1.

Answer. B