JEE Main 2023 Question Paper Solution

Date & Shift: April 11 Shift 2   **Memory-Based Questions**

JEE Main 2023 Physics Question Paper

Question 1. Density (p) of a body depends on the force applied (F), its speed (v) and time of motion (t) by the relation $p = KF^a v^b t^c$, where K is a dimensionless constant. Then

   A. a = 1, b = -4 and c = -2
   B. a = 2, b = -4 and c = -1
   C. a = -1, b = -4 and c = 2
   D. a = 1, b = 4 and c = -2

Solution. The density of a body can be expressed as:
p = KF^a * v^b * t^c
where K is a dimensionless constant and a, b, and c are constants.
We can determine the values of a, b, and c by considering the units of the given parameters. The SI units of force, speed, and time are newtons (N), meters per second (m/s), and seconds (s), respectively. The SI unit of density is kilograms per cubic meter (kg/m^3).

From the given relation, we can express K in terms of the units of the parameters:

p = KF^a * v^b * t^c

K = p / (F^a * v^b * t^c)

Substituting the units of the parameters, we get:

K = (kg/m^3) / (N^a * (m/s)^b * s^c)

We can simplify this expression by rearranging the units using the rules of exponents:

K = (kg / N^a * m^b * s^c)^1/m

Comparing the units of the expression inside the parentheses with the units of the given parameters, we can determine the values of a, b, and c:

a = 1 (force has units of N)

b = -4 (speed has units of m/s, which cancels out the length unit of meters in the numerator of K)

c = -2 (time has units of s^1, which cancels out the s^c term in the denominator of K)

Therefore, the correct answer is a = 1, b = -4, and c = -2. (Option A).

Answer. A

Question 2. A body is rotating with kinetic energy E. If angular velocity of body is increased to three times of initial angular velocity then kinetic energy become nE. Find n.

Solution. The kinetic energy of a rotating body can be expressed as:

E = (1/2) I w^2

where E is the initial kinetic energy, I is the moment of inertia, and w is the initial angular velocity.

If the angular velocity is increased by a factor of three, the new angular velocity is 3w. The kinetic energy of the body can be expressed as:

nE = (1/2) I (3w)^2 = 9(1/2) I w^2 = 9E

Therefore, n = 9. So the kinetic energy becomes nine times the initial kinetic energy when the angular velocity is increased to three times the initial angular velocity.

Answer. 9

Question 3. In which of the following process, the internal energy of gas remains constant

    A. Isothermal
    B. Isochoric
    C. Isobaric
    D. Adiabatic

Answer. A

Question 4. Potential at the surface of a uniformly charged non-conducting sphere is V. Then the potential at its centre is?

    A. 0
    B. V/2
    C. 2V
    D. 3V/2
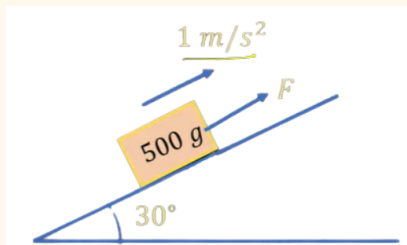
Answer. D

Question 5. A particle is projected at an angle of 30° with ground with speed 40 m/s. The speed of the particle after 2 s is (use g = 10 ms^{-2})

    A. 20√2 m/s
    B. 20√3 m/s
    C. 20m/s
    D. 10√3 m/s

Answer. B

Question 6. Find power delivered by F at t = 10s . Body start from rest.

Answer. 30

Question 7. Proton and electron have equal kinetic energy, the ratio of de-Broglie wavelength of proton and electron is 1/x. Find x. (Mass of proton 1849 times mass of electron)

Solution. The de Broglie wavelength of a particle is given by:
λ = h / p
where λ is the de Broglie wavelength, h is the Planck's constant, and p is the momentum of the particle.
The momentum of a particle is given by:
p = mv
where m is the mass of the particle and v is its velocity.
Let K be the kinetic energy of both proton and electron. Then, we can write:
mv^2/2 = K
The velocity of the proton and the electron will be different since they have different masses and the same kinetic energy. Let v_p and v_e be the velocities of proton and electron respectively.
For proton, we have:
v_p = √(2K / m_p)
For electron, we have:
v_e = √(2K / m_e)
where m_p and m_e are the masses of proton and electron respectively.

The momentum of the proton is given by:

$p\_p = m\_p \, v\_p$

The momentum of the electron is given by:

$p\_e = m\_e \, v\_e$

The ratio of the de Broglie wavelengths of proton and electron is given by:

$λ\_p / λ\_e = (p\_e / p\_p) = (m\_e \, v\_e) / (m\_p \, v\_p)$

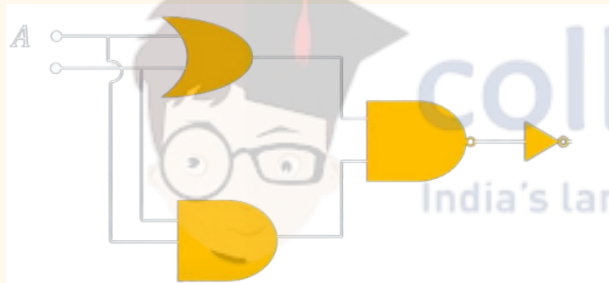Substituting the expressions for v_p and v_e, we get:

$λ\_p / λ\_e = √(m\_e / m\_p)$

Given that the mass of proton is 1849 times the mass of electron, we have:

$λ\_p / λ\_e = √(m\_e / (1849 \, m\_e)) = 1/43$

Therefore, the value of x is 43. The ratio of de Broglie wavelengths of proton and electron is 1/x = 1/43.
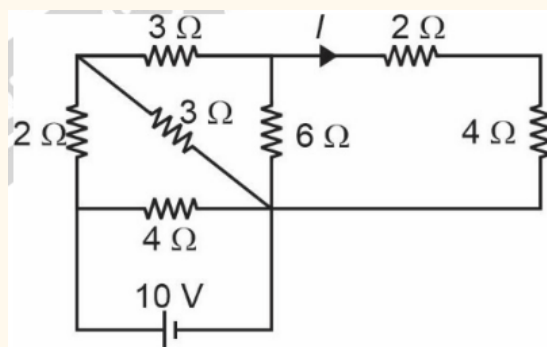
Answer. 43

Question 8. The resultant gate is

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

Answer. D

Question 9. For the given circuit diagram, find the current I.

A. 5/16 A
B. 5/48 A
C. 5/12 A
D. 1/16 A

Answer. C

Question 10. A source of sound is moving away from a stationary observer with constant velocity 40 m/s. Find frequency heard by observer, if original frequency of source is 400 Hz and speed of sound in air is 360 m/s

A. 330 Hz
B. 320 Hz
C. 360 Hz
D. 280 Hz

Answer. C

JEE Main 2023 Chemistry Question Paper

Question 1. Red ppt. by Benedict solution is?

A. Glucose

B. RNA

C. DNA

D. Sucrose

Solution. The formation of a red precipitate (ppt.) by Benedict's solution indicates the presence of reducing sugars. Out of the options given, glucose is a reducing sugar, while RNA, DNA, and sucrose are not. Therefore, if Benedict's solution is added to a substance containing glucose, a red ppt. will be formed. However, if it is added to a substance containing RNA, DNA, or sucrose, no red ppt. will be formed.

Answer. A

Question 2. What is the chemical formula of freon gas?

A. $C_2Cl_2F_4$

B. $C_2F_2H_4$

C. CHF_3

D. CCl_2F_2

Solution. The chemical formula of Freon gas is CCl2F2, which is also known as dichlorodifluoromethane.

Answer. D

Question 3. Which of the following has minimum boiling point?

A. Na

B. K

C. Rb

D. Cs

Solution. Out of the given options, the element with the minimum boiling point is Cs (Cesium). This is because the boiling point of alkali metals generally decreases down the group due to the increasing size of the atoms and the weakening of the metallic bonds. Cesium (Cs) has the largest size among the given options, so it will have the weakest metallic bond and the lowest boiling point.

Answer. D

Question 4. 2 gm of x is present in 1 mole of H_2O. Find the mass % of x.

    A. 10%
    B. 20%
    C. 5%
    D. 7%

Solution. Assuming that x is dissolved in water, we can use the given information to calculate the mass percent of x as follows:
1 mole of H2O contains 2 gm of x.
Therefore, the molar mass of x = 2 gm/mol.
Let M be the molar mass of the solution.
Then, the mass of water in the solution = M - 2 gm.
We know that 1 mole of water weighs 18 gm.
So, the number of moles of water in the solution = (M - 2)/18.
Therefore, the number of moles of x in the solution = 1/18.
Hence, the mass percent of x = (mass of x/mass of solution) x 100
= (2 gm/[(M-2) gm + 18 gm]) x 100
= (2 gm/(M+16) gm) x 100
We can see that the mass percent of x depends only on the molar mass of the solution (M). We do not have enough information to determine the value of M, so we cannot determine the exact value of the mass percent of x. However, we can estimate the value as follows:

The molar mass of H_2O is 18 gm/mol.

The molar mass of x is 2 gm/mol.

Therefore, the molar mass of the solution is approximately 20 gm/mol.

Using this value of M, we can calculate the mass percent of x as follows:

Mass percent of x = (2 gm/(20 gm)) x 100

= 10%

Therefore, the estimated mass percent of x in the solution is 10%.

Answer. A

Question 5. Statement-1: Sulphides are converted into oxide first.
Statement-2: Because oxides can be reduced easily.

 A. Only 1st is correct
 B. Only 2nd is correct
 C. Both are correct
 D. Both are incorrect

Solution. Both statements are incorrect.

Sulphides are not necessarily converted into oxides first. They can also be directly oxidized to produce sulphates or sulphite compounds, depending on the reaction conditions.

The second statement is partially true, as oxides can indeed be reduced easily. However, it is not the only reason why sulphides are converted to oxides first, as sulphides can also be directly oxidized to produce sulphates or sulphite compounds.

Answer. C

Question 6. Which of the following has maximum number of l.p. at central atom?

 A. ClO_3^-
 B. SF4

C. XeF4

D. I_3^-

Answer. D

Question 7. Glucose is added in 100 gm of water. Lowering in vapor pressure is 0.2 mm Hg. Vapour pressure of pure water is 54.2 mm Hg. Then the weight of glucose is?

A. 3.70 gm
B. 4.92 gm
C. 6.73 gm
D. 8.74 gm

Answer. A

Question 8. Least stable Hydride is?
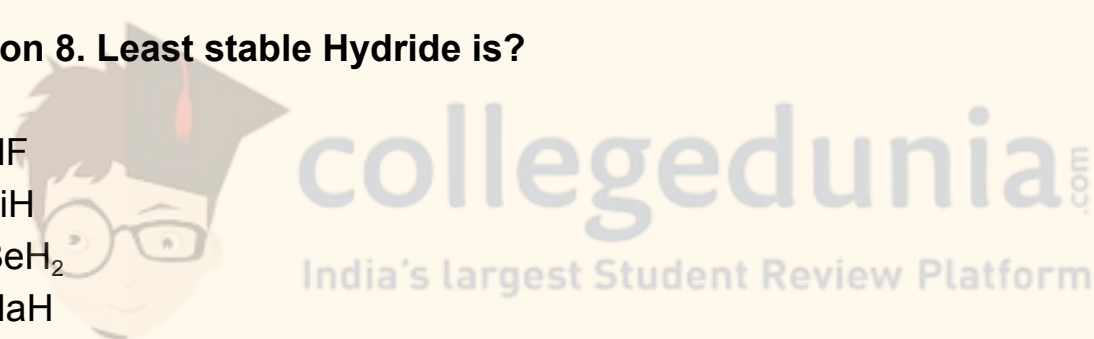
A. HF
B. LiH
C. BeH_2
D. NaH

Answer. C

Question 9. When 2 gm magnesium reacts with excess of HCl and H_2 gas is produced then the volume of H_2 gas produced is _____ × 10^{-2} liter at STP? (Nearest Integer)

Answer. 187

Question 10. Find the root mean square velocity for Nitrogen gas at 27ºC (in m/sec)

A. 426

B. 517

C. 327

D. 646

Solution. The root mean square velocity of a gas can be calculated using the formula:

vrms = √(3RT/M)

where R is the gas constant, T is the temperature in Kelvin, and M is the molar mass of the gas.

The molar mass of nitrogen gas (N2) is approximately 28 g/mol.

Converting the temperature to Kelvin:

27°C + 273.15 = 300.15 K

Substituting the values in the formula:

vrms = √(3 * 8.314 * 300.15 / 0.028)

vrms = 517 m/s (approx)

Therefore, the root mean square velocity of Nitrogen gas at 27°C is approximately 517 m/s.

Answer. B

JEE Main 2023 Mathematics Question Paper

Question 1. Using all the letters of the word MATHS, then rank of the word THAMS is:

   A. 101
   B. 102
   C. 103
   D. 104

Answer. C

Question 2. dy/dx + 5/x(1+x⁵)y = (1+x⁵)² / x⁷
If y(1) = 2, then the value of y(2) is:

    A. 693/128
    B. 697/128
    C. 637/128
    D. 627/128

Solution. This is a first-order linear differential equation. We can use the integrating factor method to solve it.
Multiplying both sides by x^5(1 + x^5)^(-5) gives:
x^5(1 + x^5)^(-5) dy/dx + 5x^4(1 + x^5)^(-5)y = (1 + x^5)^(-3)/x^2
Now we can recognize the left-hand side as the product rule of
(x^5y(1+x^5)^(-5)). Applying the product rule and simplifying, we get:
d/dx (x^5y(1+x^5)^(-5)) = (1 + x^5)^(-3)/x^2
Integrating both sides with respect to x gives:
x^5y(1+x^5)^(-5) = 1/6 (1 + x^5)^(-2) - 1/6(1 + 1^5)^(-2)
Multiplying both sides by (1 + 2^5)^5, we get:
y(2) = [1/6(1 + 2^5)^3 - 1/6]/2^5
y(2) = 693/128
Therefore, the value of y(2) is 693/128.

Answer. A

Question 3. Let mean and variance of the data 1,2,4,5,x,y are 5 and 10
Then mean deviation about the mean of data is?

    A. 5/2
    B. 7/2
    C. 5/6
    D. 7/6

Answer. A

Question 4. If $e^{8x} - e^{6x} - 3e^{4x} - e^{2x} + 1 = 0$, then number of solutions of above equation is?

Answer. 2

Question 5. The area between the curve $y = 2x^2 + 1$ and tangent to it at (1, 3) and x + y = 1 is?

   A. 1/15
   B. 1/60
   C. 4/15
   D. 8/3

Answer. C

Question 6. If the ratio of three consecutive terms is 1:3:5 in the expansion of $(1 + x)^{n+2}$. Then sum of consecutive terms is?

   A. 41
   B. 64
   C. 63
   D. 43

Answer. C

Question 7. If a + b + c + d = 11 (a, b, c, d > 0) then maximum value of $a^5b^3c^2d = 3750\beta$ the β is?

   A. 90
   B. 115
   C. 120
   D. 85

Answer. A

Question 8. A circle with center at (2, 0) and maximum radius "r" is inscribed in the ellipse $x^2/36 + y^2/9 = 1$. The value of $12r^2$ is?

    A. 108
    B. 172
    C. 83
    D. 92

Answer. D

Question 9. $(4x/5 - 5/2x)^{2022}$ then $(1011)^{th}$ term from end is equal to (1024) times $(1011)^{th}$ term from starting then $|x|$ is?

    A. 16/7
    B. 16/5
    C. 5/16
    D. 8/5

Answer. C

Question 10. For a biased coin, the probability of getting head is ¼. It is tossed n times till we get head. Given a quadratic equation $64x^2 + 2nx + 1 = 0$. If the probability that the quadratic equation has no real roots is P/Q (where P and Q are coprime), then the value of Q – P is?

Answer. 2187