



# CHEMISTRY

## NCERT - FULL MARKS

### CHEMISTRY(TAMIL)

## ATOMIC STRUCTURE - II

### Problem

1. The kinetic energy of sub-atomic particle is  $5.85 \times 10^{-25}$  J. Calculate the frequency of the

particle wave. (Planck's constant,

$$h = 6.626 \times 10^{-34} \text{ Js})$$



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2. Calculate the de-Broglie wavelength of an electron that has been accelerated from rest through a potential difference of 1 kV



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3. Calculate the wavelength associated with an electron (mass  $9.1 \times 10^{-31}$  kg) moving with a velocity of  $10^3 \text{ m sec}^{-1}$  ( $h = 6.626 \times 10^{-34} \text{ kgm}^2 \text{ sec}^{-1}$ ).



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4. A moving electron has  $4.55 \times 10^{-25}$  joules of kinetic energy. Calculate its wavelength (mass =  $9.1 \times 10^{-31}$  kg and  $h = 6.626 \times 10^{-34} \text{ kgm}^2 \text{ s}^{-1}$ ).



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5. Calculate the kinetic energy of a moving electron which has a wavelength of 4.8 pm.

[mass of electron

$$= 9.11 \times 10^{-31} \text{ kg}, h = 6.626 \times 10^{-34} \text{ Kgm}^2 \text{ s}^{-1}$$

].



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6. Two particles A and B are in motion. If the wavelength associated with the particle A is

$5 \times 10^{-8} m$  , calculate the wavelength of particle B, if its momentum is half of A.



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## Example

1. Calculate the uncertainty in the velocity of a wagon of mass 3000kg whose position is known to an accuracy of  $\pm 10$  pm (Planck's constant =  $6.626 \times 10^{-34} Kgm^2s^{-1}$  .



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2. Calculate the uncertainty in the position of an electron if the uncertainty in its velocity is  $5.7 \times 10^5 \text{ m/sec}$  ( $h = 6.626 \times 10^{-34} \text{ kgm}^2 \text{ s}^{-1}$ , mass of the electron =  $9.1 \times 10^{-31} \text{ kg}$ ).



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3. The ionization energy of hydrogen atom in the ground state is  $1312 \text{ kJmol}^{-1}$ . Calculate the wavelength of radiation emitted when the electron in hydrogen atom makes a transition

from  $n = 2$  state to  $n = 1$  state (Planck's constant,  $h = 6.626 \times 10^{-34} \text{ Js}$ , velocity of light,  $c = 3 \times 10^8 \text{ ms}^{-1}$ , Avogadro's constant,  $N_A = 6.0237 \times 10^{23} \text{ mol}^{-1}$  ).



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4. The electron energy of hydrogen atom in the ground state works out to be  $-2.18 \times 10^{-18} \text{ J}$  per atom. Calculate what will happen to the position of the electron in this

atom if an energy of  $1.938 \times 10^{-18} \text{J}$  is supplied to the each hydrogen atom.



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5. Calculate the ionisation energy of hydrogen atom as well as energy needed to promote its electron from first energy level to third energy level



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## Problem For Practice

1. Calculate the momentum of a particle which has a de-Broglie wavelength of  $1\text{\AA}$ .  $[h = 6.626 \times 10^{-34} \text{kgm}^2 \text{s}^{-1}]$



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2. What is the mass of a photon of sodium light with a wavelength of  $5890 \text{\AA}$ ?  $[h = 6.626 \times 10^{-34} \text{Js}]$



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3. Calculate the wavelength of 1000 kg rocket moving with a velocity of 300 km per hour.



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4. What must be the velocity of a beam of electrons if they are to display a de- Broglie wavelength of  $100\text{\AA}$ ?



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5. The wavelength of a moving body of mass 0.1 mg is  $3.31 \times 10^{-29}$  m. Calculate its kinetic energy ( $h = 6.626 \times 10^{-34} \text{ Js}$ ).



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6. Calculate the wavelength of a particle of mass  $m = 6.62 \times 10^{-27}$  kg moving with kinetic energy

$7.425 \times 10^{-13} \text{ J}$  ( $h = 6.626 \times 10^{-34} \text{ kgm}^2 \text{ sec}^{-1}$ )

.



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7. Calculate the wavelength of an electron in a 10 MeV particle accelerator ( $1\text{MeV} = 10^6\text{eV}$ ).



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8. What will be the wavelength of oxygen molecule in picometers moving with a velocity of  $660\text{ms}^{-1}$  ( $h = 6.626 \times 10^{-34}\text{kgm}^2\text{s}^{-1}$ ).



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9. A moving electron has  $4.9 \times 10^{-25}$  joules of kinetic energy. Find out its de - Broglie wavelength (Given

$$h = 6.626 \times 10^{-34} \text{ Js}, m_e = 9.1 \times 10^{-31} \text{ kg}).$$



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10. The approximate mass of an electron is  $10^{-27}$  g. Calculate the uncertainty in its velocity if the uncertainty in its position were of the order of  $10^{-11}$  m



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**11.** Calculate the product of uncertainty in position and velocity for an electron of mass  $9.1 \times 10^{-31}$  kg according to Heisenberg uncertainty principle.



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**12.** Calculate the uncertainty in velocity ( $\Delta v$ ) of a cricket ball (mass = 0.15 kg) if the

uncertainty position ( $\Delta x$ ) is of the order of 1 Å (*i. e.*  $10^{-10}m$ ) .



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**13.** Using uncertainty principle, calculate the uncertainty in velocity of an electron if the uncertainty in position is  $10^{-4}m$  .



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14. The uncertainty in the position of a moving bullet of mass 10 g is  $10^{-5}$  m. Calculate the uncertainty in its velocity .



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Self Evaluation Choose The Correct Answer

1.  $E_n = -\frac{313.6}{n^2}$  , If the value of  $E_i = -34.84$

to which value 'n' corresponds

A. 4



B. 3

C. 2

D. 1

**Answer:**



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**2. What is an electron?**

A. Bohr

B. Heisenberg

C. de-Broglie

D. Pauli

**Answer:**



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3. de-Broglie equation is

A.  $\lambda = \frac{mv}{h}$

B.  $\lambda = hmv$

C.  $\lambda = \frac{hv}{m}$

$$D. \lambda = \frac{h}{mv}$$

**Answer:**



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**4.** The value of Bohr radius for hydrogen atom is

A.  $0.529 \times 10^{-8} \text{ cm}$

B.  $0.529 \times 10^{-10} \text{ cm}$

C.  $0.529 \times 10^{-6} \text{ cm}$

D.  $0.529 \times 10^{-12} \text{ cm}$

**Answer:**



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5. An electron and an alpha particle have same kinetic energy. How are the de Broglie wavelengths associated with them related ?

A.  $\alpha$  - particle

B. proton

C.  $\beta$  - particle

D. neutron

**Answer:**



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6. The total energy of electron in the ground state of hydrogen atom is  $(-13.6eV)$ . The kinetic energy of an electron in the first excited state is

A.  $2E$

B.  $-4E$

C.  $-2E$

D.  $4E$

**Answer:**



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7. The bond order of oxygen molecule is

A. 2.5

B. 1

C. 3

D. 2

**Answer:**



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**8. The hybridisation in SF<sub>6</sub> molecule is**

A.  $sp^3$

B.  $sp^3d^2$

C.  $sp^3 d$

D.  $sp^2 d^3$

**Answer:**



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9. which one of the following does not have intramolecular hydrogen bonding?

A. o-nitrophenol

B. m-nitro phenol



C. p-nitrophenol

D. None

**Answer:**



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**Self Evaluation Answer In One Or Two Sentences**

1. What do you understand by the dual character of matter?



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2. State Heisenberg's uncertainty principle and give its mathematical expression.



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3. What is the significance of negative electronic energy?



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4. Define orbital velocity and establish an expression for it.



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5. What are molecular solids ? Explain the types of molecular solids.



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6. Why  $He_2$  is not formed?



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**7. What is bond order?**



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**8. Define hybridisation**



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**Self Evaluation Answer Not Exceeding 60 Words**

1. With what purpose was famous Davisson-Germer experiment with electrons performed ?



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2. Derive de-Broglie's equation. What is its significance?



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3. Discuss the shapes of s, p and d orbitals.



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4. Explain the formation of  $O_2$  molecule by molecular orbital theory.



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5. Explain the formation of  $O_2$  molecule by molecular orbital theory.



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