CHEMISTRY

NCERT - NCERT CHEMISTRY(GUJRATI)

ATOMIC STRUCTURE - II

Problem

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

particle wave. (Planck's constant, $h = 6.626 \times 10^{-34}$ 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 9.1×10^{-31} kg) moving with a velocity of $10^3 m \sec^{-1} \left(h = 6.626 \times 10^{-34} kgm^2 \sec^{-1}\right)$.

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

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5. Calculate the kinetic energy of a moving electron which has a wavelength of 4.8 pm. [mass of electron $= 9.11 \times 10^{-31} kg, h = 6.626 \times 10^{-34} Kgm^2 s^{-1}$].

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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 ± 10 pm (Planck's constant = $6.626 \times 10^{-34} Kgm^2 s^{-1}$.

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

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3. The ionization energy of hydrogen atom in the ground state is $1312 kJ \mathrm{mol}^{-1}$. 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, $h = 6.626 \times 10^{-34} Js$, velocity of light, $c = 3 \times 10^{8} ms^{-1}$, 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 -2.18×10^{-18} J per atom. Calculate what will happen to the position of the electron in this

atom if an energy of 1.938×10^{-18}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 1Å. $\left[h = 6.626 \times 10^{-34} kgm^2 s^{-1}\right]$

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

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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 100Å?

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

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6. Calculate the wavelength of a particle of mass $m = 6.62 \times 10^{-27}$ kg moving with kinetic energy $7.425 \times 10^{-13} J \left(h = 6.626 \times 10^{-34} kgm^2 \sec^{-1}\right)$.

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

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

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9. A moving electron has 4.9×10^{-25} joules of kinetic energy. Find out its de - Broglie wavelength (Given $h = 6.626 \times 10^{-34} Js, m_e = 9.1 \times 10^{-31}$ 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 uncertainity in position and velocity for an electron of mass 9.1×10^{-31} kg according to Heisenberg uncertainty principle.

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12. Calculate the uncertainty in velocity (Δv) of a cricket ball (mass = 0.15 kg) if the

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

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

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14. The uncertainity 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:

2. Dual character of an electron was explained by

A. Bohr

B. Heisenberg

C. de-Broglie

D. Pauli

Answer: Bohr

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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: $\lambda = \frac{h}{mv}$

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4. The value of Bohr radius for hydrogen atom is

A. 0.529×10^{-8}

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

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

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

Answer: 0.529×10^{-8}

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5. Which of the following particle having same kinetic energy, would have the maximum de-Broglie wave length

A. α - particle

B. proton

C. β - particle

D. neutron

Answer: β - particle

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6. If the energy of an electron in the second Bohr orbit of H-atom is -E, what is the energy of the electron in the Bohr's first orbit?

A. 2E

B. $-4E$

C. $-2E$

D. $4E$

Answer: $-4E$

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7. The bond order of oxygen molecule is

A. 2.5

B. 1

C. 3

D. 2

Answer: (d) 2

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8. The hybridisation in SF6 molecule is

A. sp^3

B. sp^3d^2

C. sp^3d

D. sp^2d^3

Answer: (b) sp^3d^2

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9. The intramolecular hydrogen bonding is present in

A. o-nitrophenol

B. m-nitro phenol

C. p-nitrophenol

D. None

Answer: (a) o-nitrophenol

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Self Evaluation Answer In One Or Two Sentences

1. Define an orbital

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2. What are molecular orbitals?

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3. Why He_2 is not formed?

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4. What is bond order?

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5. Define hybridisation

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Self Evaluation Answer Not Exceeding 60 Words

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

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

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