Model objective Questions (MCQ)

Select the Correct answer :-

Q. (1). (i) Which of the following is an acceptable wave function-

(a) $\psi = x$ (b) $\psi = x^2$ (c) $\psi = \sin x$ (d) $\psi = e^x$

(ii) A wave function is given as $\psi = \sin x$, then

(a) ψ is normalised (b) ψ is not normalised (c) ψ is orthogonal (d) none of these.

(iii) The function $f_1(x) = N_1(a^2 - x^2)$ in the interval $x = -a$ & $x = +a$, the normalisation constant N_1 is

(a) $\left(\frac{15}{16a^5}\right)^{1/2}$ (b) $\left(\frac{15}{16a^4}\right)^{1/2}$ (c) $\left(\frac{105}{16a^7}\right)^{1/2}$ (d) $\left(\frac{45}{64a^9}\right)^{1/2}$

(iv) If the operators $\hat{U} = \sqrt{\ }$, $\hat{V} = 4$ & function $f(x) = x^2$

(a) $\hat{U}$ & $\hat{V}$ commute (b) $\hat{U}$ & $\hat{V}$ do not commute (c) $\hat{U}$ & $\hat{V}$ are linear operator (d) None of the above.

(v) Which of the following is a linear operator

(a) taking logarithm (b) taking differential (c) taking Sq. root

(d) all of the above.

(vi) If two Hermitian operators $\hat{A}$ & $\hat{B}$ commute, then ~~the~~

(a) they must have a common eigen function (b) Common eigen-function is not necessary (c) their eigen ~~function~~ values will be same (d) none of these.

(vii) Which of the following is incorrect

(a) $[\hat{A}, \hat{B}] = -[\hat{B}, \hat{A}]$ (b) $[\hat{A}^2, \hat{B}] = \hat{A}[\hat{A}, \hat{B}] + [\hat{A}, \hat{B}]\hat{A}$ (c) $[\hat{A}, [\hat{B}, \hat{C}]] = [[\hat{A}\hat{B}]\hat{C}] + [\hat{B}[\hat{A}, \hat{C}]]$

(d) None of these.

(viii) Which of the following is an eigen function of the operator d^2/dx^2.

(a) $\psi = x$ (b) $\psi = x^2$ (c) $\psi = \sin 2x$ (d) none of the above

(ix) Which of the following is incorrect

(a) The vibrational energies are equally spaced ($h\nu$) for harmonic oscillator

(b) The lowest value i.e. zero point energy for harmonic oscillator is zero.

(c) The energy of the harmonic oscillator is quantised.

(d) zero point energy is $\frac{1}{2} h\nu$.

(x) Which of the following MO is not normalised

(a) $\psi_1 = \frac{1}{\sqrt{2}}(\phi_1 + \phi_2)$ (b) $\psi_2 = \frac{1}{\sqrt{3}}(\phi_1 + \phi_2 + \phi_3)$

(c) $\psi_3 = \frac{1}{2}(\phi_1 - 2\phi_2 + \phi_3)$

(d) None of the above

(Where ϕs are the orthonormal atomic orbitals)

(xi) Bonding MO (BMO) and antibonding (ABMO) for H_2 molecule are

(a) Orthogonal (b) not orthogonal (c) eigen function

(d) None of the above.

(xii) In the Hamiltonian for H_2^+, the term $\frac{1}{r_{AB}}$ represents

(a) Kinetic energy operator of the single electron

(b) Coulombic attraction of electron with nuclei A & B.

(c) Coulombic repulsion between two nuclei A & B.

(d) electronic repulsion potential energy.

(xiii) The eigen value for the eigen function $\psi = \sin 2x$ of the operator d^2/dx^2 is:

(a) 4 (b) −4 (c) 2 (d) −2

(xiv) The time-dependent Schrodinger equation is given by

(a) $\hat{H}\psi = \frac{ih}{2\pi}\frac{\partial\psi}{\partial t}$ (b) $\hat{H}\psi = \frac{-ih}{2\pi}\frac{\partial\psi}{\partial t}$

(c) $\hat{H}\psi = \frac{i\hbar}{4\pi}\frac{\partial\psi}{\partial t}$ (d) $\hat{H}\psi = \frac{-i\hbar}{4\pi}\frac{\partial\psi}{\partial t}$

(xv) If the operator $\hat{U} = \left(\frac{\partial}{\partial x}\right)_y$

& $\hat{V} = \left(\frac{\partial}{\partial y}\right)_x$

then,

(a) operators $\hat{U}$ & $\hat{V}$ commute (b) they cannot commute

(c) they are Hermitian operators (d) None of the above.

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