CHEMISTRY

BOOKS - NTA MOCK TESTS

STRUCTURE OF ATOM TEST -1

Multiple Choice Questions

1. An excited hydrogen atom emits a photon of wavelength λ in returning to the ground state. If R is the Rydberg constant, then the quantum number n of the excited state is

A. $\sqrt{\lambda R}$

B. $\sqrt{\lambda R - 1}$

C. $\sqrt{\lambda(\lambda R - 1)}$

D. $\sqrt{\frac{\lambda R}{\lambda R - 1}}$

Answer: D

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2. The hydrogen-like species Li^{2+} is in a spherically symmetric state S_1 with one radial node. Upon absorbing light, the ion undergoes a transition to the state S_2. The state S_2 has one radial node and its energy is equal to the ground state energy of the hydrogen atom.

The state S_1 is

A. 1s

B. 2s

C. 2p

D. 3s

Answer: D

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3. If the energy of a photon is given as,

$E = 3.03 \times 10^{-19} J$, then, the wavelength (λ) of the photon is

A. 6.53 nm

B. 653 nm

C. 65.6 nm

D. 0.656 nm

Answer: B

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4. The electron energy in a hydrogen atom is given by $E_n = \left(-2.18 \times 10^{-18}\right) / n^2 J$. Calculate the energy required to remove an electron completely from the $n = 2$ orbit. What is the longest wavelength of light in cm that can be used to cause this transition?

A. $5.45 \times 10^{-19}, 3.647 \times 10^{-5}$

B. $2.48 \times 10^{-10}, 4.851 \times 10^{-2}$

C. $6.54 \times 10^{-11}, 6.682 \times 10^{-3}$

D. $8.52 \times 10^{-14}, 9.822 \times 10^{-4}$

Answer: A

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5. By calculating the wavelength for the emission transition, if it starts from the orbit having radius 1.3225 nm and ends at 211.6 pm, name the series to which this transition belongs and the region of the spectrum.

A. Balmer series, visible region.

B. Lyman series, UV-region

C. Paschen series, IR-region.

D. Brackett series, IR-region.

Answer: A

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6. Calculate the minimum and the maximum number of electrons which may have the magnetic quantum number, $m = +1$ and the spin quantum number, $S = -\frac{1}{2}$ in chromium (Cr).

A. 0,1

B. 1,2

C. 4,6

D. 2,3

Answer: D

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7. the wavelength of light that must be absorbed to excite a hydrogen electron from level $n = 1$ to level $n = 2$, will be

$(n = 6.625 \times 10^{-34} Js, C = 3 \times 10^{8} ms^{-1})$

A. $1.325 \times 10^{-10} m$

B. $1.325 \times 10^{-7} m$

C. $5.300 \times 10^{-10} m$

D. $2.650 \times 10^{-7} m$

Answer: B

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8. The ionization energy of gaseous Na atoms is $495.5 kJ \text{mol}^{-1}$. The lowest possible frequency of light that ionizes a sodium atom is $\left(h = 6.626 \times 10^{-34} Js, N_A = 6.022 \times 10^{23} \text{mol}^{-1}\right)$

A. $1.24 \times 10^{15} s^{-1}$

B. $7.50 \times 10^{4} s^{-1}$

C. $4.76 \times 10^{14} s^{-1}$

D. $3.15 \times 10^{15} s^{-1}$

Answer: A

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9. For a hypothetical hydrogen like atom, the potential energy of the system is given by $U(r) = \frac{-ke^2}{r^4}$, where ris the distance between the two particles. If Bohr's model of quantisation of angular momentum is applicable, then the velocity of the particle is given by

A. $\frac{nh}{16ke\pi^2 m^{3/2}}$

B. $\frac{n^2h^2}{8k^2e^2\pi^4m^3}$

C. $\frac{n^3h^3}{2k^2e^3\pi^3m^4}$

D. $\frac{n^2h^2}{8\sqrt{ke\pi^2m^{3/2}}}$

Answer: D

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10. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, $n = 4$ to $n = 2$ of He^+ spectrum?

A. $n = 3$ to $n = 2$

B. $n = 4$ to $n = 2$

C. $n = 3$ to $n = 1$

D. $n = 2$ to $n = 1$

Answer: D

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11. The energy of second Bohr orbit of the hydrogen atom is $-328KkJmol^{-1}$. Hence , the energy of fourth Bohr orbit would be

A. $-41kJmol^{-1}$

B. $-1312 kJ \mathrm{mol}^{-1}$

C. $-164 kJ \mathrm{mol}^{-1}$

D. $-82 kJ \mathrm{mol}^{-1}$

Answer: D

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12. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metals is :

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
$\phi(eV)$	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

A. 2

B. 4

C. 6

D. 8

Answer: B

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13. Which of the following statements in relation to the hydrogen atom is correct?

A. 3s, 3p and 3d-orbitals all have the same energy.

B. 3s and 3p-orbitals has lower energy than 3d-orbital.

C. 3p-orbital has lower energy than 3d-orbital

D. 3s-orbital has lower energy than 3p-orbital

Answer: A

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14. An electron jumps from an outer orbit to an inner orbit with an energy difference of 3.0 eV. What will be the wavelength of the photon emitted?

A. 3660Å

B. 3620Å

C. 4140Å

D. 4560Å

Answer: C

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15. The shortest wavelength of H atom in Lyman series is x, then the longest wavelength of He^+ in Balmer series is

A. $\frac{9x}{5}$

B. $\frac{36x}{5}$

C. $\frac{x}{4}$

D. $\frac{5x}{9}$

Answer: A

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16. Calculate the angular momentum of an electron in the third orbit of a hydrogen atom, if the angular momentum in the second orbit of the hydrogen atom is L

A. L

B. 3L

C. $\frac{3}{2}$ L

D. $\frac{2}{3}$ L

Answer: C

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17. For a certain atom, there are energy levels A, B, C corresponds to energy values $E_A < E_B < E_C$. Choose the correct option if $\lambda_1, \lambda_2, \lambda 3$ are the wavelength of radiations corresponding to the transition from C to B, B to A and C to A respectively.

A. $\lambda_3 = \lambda_1 + \lambda_2$

B. $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

C. $\lambda_1 + \lambda_2 + \lambda_3 = 0$

D. $3\lambda_2 = \lambda_3 + 2\lambda_2$

Answer: B

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18. If the uncertainty in the position of a particle is equal to its de-Broglie wavelength, the minimum uncertainty In its velocity should be

A. $\frac{1}{4\pi}$

B. $\frac{v}{4\pi}$

C. $\frac{v}{4\pi m}$

D. $\frac{mv}{4\pi}$

Answer: D

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19. Rutherford's α particle dispersion experiment concludes

A. All positive ions are deposited at small part

B. All negative ions are deposited at small part

C. Proton moves around the electron

D. Neutrons are charged particles

Answer: A

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20. If E_1, E_2 and E_3 represent, respectively, the kinetic energies of an electron, an alpha partile and proton , each having the same de Broglie wavelength, then

A. $E_1 > E_3 > E_2$

B. $E_2 > E_3 > E_1$

C. $E_1 > E_2 > E_3$

D. $E_1 = E_2 = E_3$

Answer: A

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21. If the nitrogen atom had electronic configuration $1s^7$ it would have energy lower than that of the normal ground state configuration

$1s^2 2s^2 2p^3$ because the electrons would be closer to the nucleus. Yet $1s^7$ is not observed. It violates

A. Heisenberg's uncertainty principle

B. Hund's rule

C. Pauli exclusion principle

D. Bohr postulate of stationary orbits

Answer: C

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22. According to the Bohr's Theory, which of the following transitions in the hydrogen atom will give rise to the least energetic photon?

A. $n = 6 \text{ to } n = 1$

B. $n = 5 \text{ to } n = 4$

C. $n = 6 \text{ to } n = 5$

D. $n = 5 \text{ to } n = 3$

Answer: C

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23. The radiation with maximum frequency is

A. X-rays

B. Radio waves

C. UV rays

D. IR rays

Answer: A

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24. Find out the angular momentum, spherical nodes and angular nodes of Ψ_{210}

A. $\frac{h}{\sqrt{2}n}, 0, 1$

B. $\frac{h}{2\pi}, 5, 2$

C. $\frac{h}{6\pi}, 2, 2$

D. $\frac{h}{4\pi}, 1, 1$

Answer: A

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25. Two electrons are revolving around a nucleus at distances r and 4r. The ratio of their time periods is:

A. $1:4$

B. $4:1$

C. $8:1$

D. $1:8$

Answer: D

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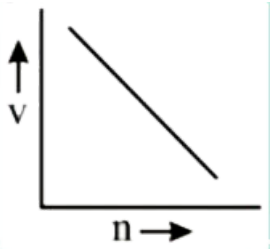
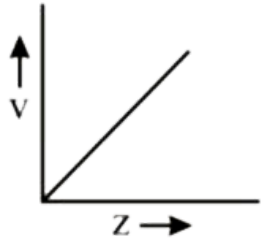
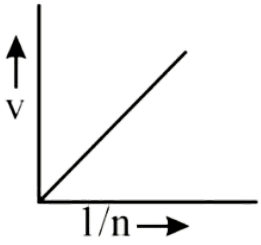
26. Which of the following is not correct for the velocity of electron?

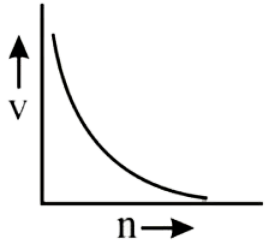
A. 

B. 

C.



D.



Answer: A

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27. The radii of two of the first four Bohr orbits of the hydrogen atom are in the ratio 1:4. The energy difference between them may be

A. Either 12.09 eV or 3.4 eV

B. Either 2.55 eV or 10.2 eV

C. Either 13.6 eV or 3.4 eV

D. Either 3.4 eV or 0.85 eV

Answer: B

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28. Which is the correct relation between energies of one electron species?

E_1 =Energy of electron in the first Bohr orbit,

E_2 =Energy of electron in the second Bohr orbit,

E_3 =Energy of electron in the third Bohr orbit,

E_4 =Energy of electron in the fourth Bohr orbit.

A.

$$E_1 \text{ of } H = 1/2E_2 of He^+ = 1/3E_3 \text{ of } Li^{2+} = 1/4E_4 \text{ of } Be^{3+}$$

B. $E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$

C. $E_1(H) = 2E_2(He^+) = 3E_3(Li^{2+}) = 4E_4(Be^{3+})$

D. None of the above relations are correct

Answer: B

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29. In a certain electronic transition in the hydrogen atoms from an initial state (1) to the final state (2), the difference in the orbital radius $(r_1 - r_2)$ is 24 times the first Bohr radius. Identify the transition.

A. $5 \rightarrow 1$

B. $25 \rightarrow 1$

C. $8 \rightarrow 3$

D. $6 \rightarrow 5$

Answer: A

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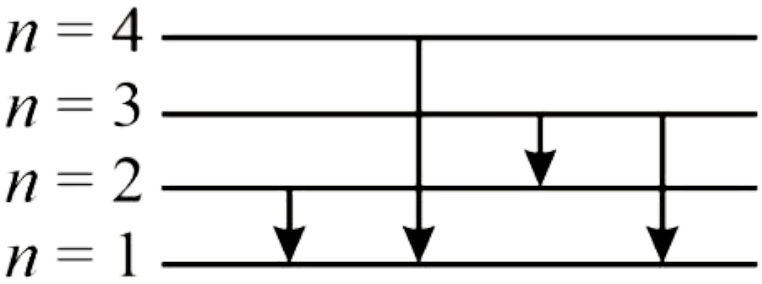
30. Suppose that a hypothetical atom gives a red, green, blue and violet line in the spectrum. Which Jump according to figure would give off the red spectral line?



A. $3 \rightarrow 1$

B. $2 \rightarrow 1$

C. $4 \rightarrow 1$

D. $3 \rightarrow 2$

Answer: D

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