PHYSICS

BOOKS - PSEB

ATOMS

Exercise

1. Choose the correct alternative from the clues given at the end of the each statement: The size of the atom in Thomson model is.....

the atomic size in Rutherford model(much greater than /no different from/ much less than.)

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2. Choose the correct alternative from the clues given at the end of the each statement:In the ground state of ..... electrons are in stable equilibrium,while in ..... electrons always experience a net force. (Thomson model/ Rutherford model)

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3. Choose the correct alternative from the clues given at the end of the each statement: A classical atom based on ..... is doomed to collapse.(Thomson model/ Rutherford model)

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4. Choose the correct alternative from the clues given at the end of the each statement: An atom has a nearly continuous mass

distribution in a .....but has a highly non-uniform mass distribution in .....(Thomson Model/ Rutherford model)

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5. Choose the correct alternative from the clues given at the end of the each statement: The positively charged part of the atom possesses most of the mass in ..... (Rutherford model/ Thomson model)

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6. Suppose you are given a chance to repeat the alpha-particle scattering experiment using a thin sheet of solid hydrogen in place of the gold foil. (Hydrogen is a solid at temperatures below 14 K.) What results do you expect?

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7. What is the shortest wavelength present in the Paschen series of spectral lines?

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8. A difference of 2.3 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom make a transition from the upper level to the lower level?

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9. The ground state energy of hydrogen atom is -13.6eV. what is the potential energy of the

electron in this state?

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10. A hydrogen atom initially in the ground level absorbs a photon, which excites it to the n = 4 level. Determine the wavelength and frequency of photon.

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11. (a) Using the Bohr's model calculate speed of electron in hydrogen atom in the n = 1, 2, and 3 levels. (b) Calculate the orbital period in each of these levels.

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12. The radius of the innermost electron orbit of a hydrogen atom is 5.3x 10^ -11m. What are the radii of the n = 2 and n =3 orbits?

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13. A 12.5 eV electron beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted?

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14. In accordance with the Bohr's model, find the quantum number that characterises the earth's revolution around the sun in an orbit of radius $1.5 \times 10^{11} m$ with orbital speed $3 \times 10^4 \frac{m}{s}$. (Mass of earth = $6.0 \times 10^{24} kg$.)

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15. Answer the following questions, which help you understand the difference b/w thomson's model and rutherford model: Is the average angle of deflection of α-particles by a thin gold foil predicted by Thomson's model much less, about the same or much greater than that predicted by Rutherford's model?

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16. Answer the following questions, which help you understand the difference b/w thomson's model and rutherford model: Is the average angle of deflection of α-particles by a thin gold foil predicted by Thomson's model much less, about the same or much greater than that predicted by Rutherford's model?

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17. Answer the following questions, which help you understand the difference between

Thomson and rutherford- Keeping other factors fixed, it is found experimentally that for small thickness t, the number of α-particles scattered at moderate angles is proportional to t. What clue does this linear dependence on t provide?

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18. Answer the following question, which help you understand the difference between Thomson's model and Rutherford's model

better- In which model is it completely wrong to ignore multiple scattering for the calculation of average angle of scattering of α-particles by a thin foil?

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19. The gravitational attraction between electron and proton in a hydrogen atom is weaker than the coulomb attraction by a factor of about 10^ -40 . An alternative way of looking at this fact is to estimate the radius of

the first Bohr orbit of a hydrogen atom if the electron and proton were bound by gravitational attraction. You will find the answer interesting.

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20. Obtain an expression for the frequency of radiation emitted when a hydrogen atom de-excites form n to n-1 ,show that this frequency equals the classical frequency of revolution of the electron in the orbit.

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21. Classically, an electron can be in any orbit around the nucleus of an atom. Then what determines the typical atomic size? Why is an atom not, say, thousand times bigger than its typical size? The question had greatly puzzled Bohr before he arrived at his famous model of the atom that you have learnt in the text. To simulate what he might well have done before his discovery, let us play as follows with the basic constants of and see if we can get a

quantity with the dimensions of length that is roughly equal to the known of an atom (~ 10^ -10 m).- Construct a quantity with the dimensions of length from the fundamental constants e, m_e, and c. Determine its numerical value.

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atom not, say, thousand times bigger than its typical size? Thequestion had greatly puzzled Bohr before he arrived at his famous model of the atom that you have learnt in the text. To simulate what he might well have done before his discovery, let us play as followswith the basic constants of nature e, me, c and see if we can get a quantity with the dimensions of length that is roughly equal to the known size of an atom (~ 10 m).- You will find that the length obtained above is many orders of magnitude smaller than the atomic dimensions. Further, it involves c. But energies

of atoms are mostly in non-relativistic domain where c is not expected to play any role. This is what may have suggested Bohr to discard c and look for else h had already made its appearance elsewhere. Bohr lay in recognising that h, m_e, and e will yield the right atomic size. Construct a quantity with the dimension of length from h, me, and e and confirm that its numerical value has indeed the correct order of magnitude.

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23. The total energy of an electron in the first excited state of the hydrogen atom is about-3.4ev What is the kinetic energy of the electron in this state?

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24. The total energy of an electron in the first excited state of the hydrogen atom is about-3.4ev What is the potential energy of the electron in this state?

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25. The total energy of an electron in the first excited state of the hydrogen atom is about -3.4 eV. (A) What is the kinetic energy of the electron in this state? (B) What is the potential energy of the electron in this state? (C) Which of the answers above would change if the choice of the zero of potential energy is changed?

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26. If Bohr $n\frac{h}{2}\pi\Big)$ is a basic law of nature, it should be equally valid for the case of planetary motion also. Why then do we never speak of quantisation of orbits of planets around the sun?

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27. Obtain the first Bohr radius of muonic hydrogen atom [i.e., an atom in which a negatively charged muon (μ) of mass about $207m_e$ orbits around a proton].

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