Atomic models and Planck's quantum theory

1. (c) Nucleus. This small, dense, positively charged region at the center of the atom concentrates most of its mass and was named the nucleus by Rutherford

2. (a) The central part consisting whole of the positive charge and most of the mass caused by nucleus, is extremely small in size compared to the size of the atom.

3. (b) Electrons in an atom occupy the extra nuclear region.

4. (b) According to the Bohr model atoms or ions contain one electron.

5. (d) The nucleus occupies much smaller volume compared to the volume of the atom.

6. Positronium consists of an electron and a positron (same mass as an electron but opposite charge) orbiting around their common centre of mass.

   The Rydberg constant depends on the reduced mass μ of the system:
   $R = R_\infty \times (\mu / m_e)$

   For positronium:
   $\mu = (m_e \times m_e) / (m_e + m_e) = m_e / 2$

   So,
   $R = R_\infty \times (m_e/2) / m_e = R_\infty / 2$

   Answer: (b) $R_\infty / 2$

7. (c) α-particles pass through because most part of the atom is empty.

8. (b) An electron jumps from L to K shell energy is released.

9. (c) Neutron is a chargeless particles, so it does not deflected by electric or magnetic field.

10. (a) Energy is always absorbed or emitted in whole number or multiples of quantum.

11. (b) Both *He* and Li^+ contain 2 electrons each.

12. In Bohr's model, the energy of an electron in the nth orbit is:
$E_n = -13.6 / n^2$ eV
For n=1, E = -13.6 eV (most negative, tightly bound). As n increases (moving away from nucleus), energy becomes less negative (−3.4, −1.51, …). Thus, energy increases as we move away from the nucleus.

Answer: (a) Increases as we move away from nucleus

13. Bohr's model explained emission and absorption line spectra of hydrogen. But it could not explain fine spectra (splitting of spectral lines) due to spin-orbit coupling and relativistic effects.
Answer: (d) Fine spectrum

14. Rutherford's α-particle scattering experiment (gold foil experiment) showed that most of the atom is empty space, and all the positive charge and mass are concentrated in a small nucleus.
Answer: (b) α-ray scattering experiments

15. This is Hund's rule of maximum multiplicity: electrons occupy orbitals singly with parallel spins before pairing occurs.
Answer: (b) Hund's Rule

16. By Planck's relation: E = hv = hc/λ, so $\lambda \propto 1/\Delta E$.
Thus, wavelength is inversely proportional to the difference in the energy of the levels involved.

Answer: (c) The difference in the energy of the energy levels involved in the transition

17. When an electron falls to a lower energy state, the atom loses energy in the form of a photon (light emission).
Answer: (a) Energy is emitted

18. (c) During the experimental verification of de-Broglie equation, Davisson and Germer confirmed wave nature of electron.

19. (a) Increases due to absorption of energy and it shows absorption spectra.

20. (d) Rutherford α-Scattering experiment.

21. (d) It represents Heisenberg's uncertainty principle.