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UDUPI

CET25P12 ATOMS

Class 12 - Physics

Time Allowed: 1 hour and 30 minutes **Maximum Marks: 75**

1. The Bohr model of atom **[1]**

   a) predicts continuous emission spectra for atoms

   b) predicts the same emission spectra for all types of atoms

   c) assumes that the angular momentum of electrons is quantized

   d) uses Einstein's photoelectric equation

2. The wavelength of the first line of Lyman series of hydrogen is 1216$\mathring{A}$. The wavelength of the second line of the same series will be: **[1]**

   a) 1026$\mathring{A}$

   b) 3648$\mathring{A}$

   c) 912$\mathring{A}$

   d) 6566$\mathring{A}$

3. An electron is moving round the nucleus of a hydrogen atom in a circular orbit of radius r. The Coulomb force $\vec{F}$ between the two is **[1]**

   a) $-k\frac{e^2}{r^2}\hat{r}$

   b) $k\frac{e^2}{r^2}\hat{r}$

   c) $k\frac{e^2}{r^3}\vec{r}$

   d) $-k\frac{e^2}{r^3}\vec{r}$

4. In the α-particle scattering experiment, the shape of the trajectory of the scattered α-particles depend upon: **[1]**

   a) only on the source of α-particles

   b) both impact parameter and source of α-particles

   c) impact parameter and the screen material of the detector

   d) only on impact parameter

5. In which of the models, the positively charged part of the atom possesses most of the mass? **[1]**

   a) Bohr model only

   b) Thomson’s model only

   c) Thomson’s model and Rutherford’s model

   d) Rutherford’s model only

6. In which of the models an atom has a highly non-uniform mass distribution? **[1]**

   a) Bohr model

   b) Thomson’s model

   c) Gelvin model

   d) Rutherford’s model

7. According to the uncertainty principle for an electron, time measurement will become uncertain if the following is measured with high certainty **[1]**

   a) energy

   b) velocity

   c) location

   d) momentum

8. Of the following pairs of species, which one will have the same electronic configuration for both members? **[1]**

a) He and Ne^+ b) H and Li

c) C and N^+ d) Li^+ and Na^+

9. In which of the models an atom has a nearly continuous mass distribution? **[1]**

a) Thomson's model b) Bohr model

c) Rutherford's model d) Gelvin model

10. The ratio of longest wavelength and the shortest wavelength observed in the Balmer series in the emission spectrum of hydrogen is: **[1]**

a) 2.8 b) 1.8

c) 3.8 d) 4.8

11. If an electron jumps from 1 st orbit to 3 rd orbit, then it will **[1]**

a) no loss of energy b) no gain of energy

c) absorb energy d) release energy

12. An electron orbiting in H atom has energy level -3.4 eV Its angular momentum will be: **[1]**

a) 4×10^{-20} Js b) 2.1×10^{20} Js

c) 4×10^{-34} Js d) 2.1×10^{-34} Js

13. In Thomson's method for finding specific charge of positive rays, the electric and magnetic fields are **[1]**

a) Crossed and simultaneous b) Parallel and separate

c) Parallel and simultaneous d) Crossed and separate

14. In the following transitions of the hydrogen atom, the one which gives an absorption line of highest frequency is **[1]**

a) n = 1 to n = 2 b) n = 2 to n = 1

c) n = 3 to n = 8 d) n = 8 to n = 3

15. The simple Bohr model cannot be directly applied to calculate the energy levels of an atom with many electrons. This is because **[1]**

a) of the electrons not being subject to a central force b) of screening effects

c) the force between the nucleus and an electron will no longer be given by Coulomb's law d) of the electrons colliding with each other

16. In Rutherford's model, the size of the nucleus of the atom is **[1]**

a) 10^{-16} to 10^{-17} m b) 10^{-5} to 10^{-6} m

c) 10^{-10} to 10^{-12} m d) 10^{-15} to 10^{-14} m

17. The ionisation energy of a hydrogen atom is 13.6 eV, the ionisation energy of a singly ionised helium atom would be **[1]**

a) 13.6 eV b) 27.2 eV

c) 54.4 eV

d) 6.8 eV

18. According the Bohr principle, the relation between principle quantum number (n) and radius of orbit is **[1]**

a) $r \propto n$

b) $r \propto 1/n$

c) $r \propto 1/n^2$

d) $r \propto n^2$

19. The longest wavelength in the ultraviolet region of the hydrogen spectrum is 122 nm. The shortest wavelength in the infrared region of the hydrogen spectrum (to the nearest integer) is **[1]**

a) 823 nm

b) 802 nm

c) 1882 nm

d) 1648 nm

20. The binding energy of a H-atom, considering an electron moving around a fixed nuclei (proton), is **[1]**
$B = -\frac{me^4}{8n^2\varepsilon_0^2h^2}$ (m = electron mass). If one decides to work in a frame of reference where the electron is at rest, the proton would be moving around it. By similar arguments, the binding energy would be $B = -\frac{Me^4}{8n^2\varepsilon_0^2h^2}$ (M= proton mass).
This last expression is not correct because

a) n would not be integral.

b) Bohr-quantisation applies only to electron.

c) the motion of the proton would not be in circular orbits, even approximately.

d) the frame in which the electron is at rest is not inertial.

21. The wavelength of a light emitted from the second orbit to the first orbit in a hydrogen atom is **[1]**

a) 1.215×10^{-7} m

b) 1.215×10^{-4} m

c) 1.215×10^{-5} m

d) 1.215×10^{-3} m

22. The wavelengths involved in the spectrum of deuterium ($_1H^2$) are slightly different from that of hydrogen spectrum, because **[1]**

a) nuclear forces are different in the two cases

b) masses of the two nuclei are different

c) attraction between the electron and the nucleus is different in the two cases

d) sizes of the two nuclei are different

23. In a hydrogen atom, an electron excites from the ground state to a higher energy state and its orbital velocity is reduced to $\left(\frac{1}{3}\right)^{rd}$ of its initial value. The radius of the orbit in the ground state is R. The radius of the orbit in that higher energy state is **[1]**

a) 27 R

b) 9R

c) 2R

d) 3R

24. The potential energy of an electron in the second excited state in hydrogen atom is: **[1]**

a) - 3.4 eV

b) -6.8 eV

c) -3.02 eV

d) -1.51 eV

25. The longest wavelength in Balmer series of hydrogen spectrum will be **[1]**

a) 5600 $\mathring{A}$

b) 1216 $\mathring{A}$

c) 4800 $\mathring{A}$

d) 6557 $\mathring{A}$

26. Average angle of deflection of α -particles by a thin gold foil predicted by Thomson's model is **[1]**

a) incomparable to Rutherford's model

b) more than that predicted by Rutherford's model

c) about the same as predicted by Rutherford's model

d) less than that predicted by Rutherford's model

27. Hydrogen atom initially in the ground state, absorbs a photon which excites it to n = 5 level. The wavelength of the photon is: **[1]**

a) 975 nm

b) 523 nm

c) 95 nm

d) 740 nm

28. The ground state energy of hydrogen atom is –13.6 eV. What are the kinetic and potential energies of the electron in this state? **[1]**

a) 13.6 eV, –27.2 eV

b) 14.6 eV, –27.2 eV

c) 14.6 eV, –29.2 eV

d) 13.1 eV, –29.2 eV

29. According to Bohr's theory, the moment of momentum of an electron revolving in second orbit of hydrogen atom will be: **[1]**

a) $\frac{2h}{\pi}$

b) $\frac{h}{\pi}$

c) $2\pi rh$

d) πh

30. The K_α line from molybdenum (atomic number = 42) has a wavelength of 0.7078 $\mathring{A}$. The wavelength of K_α line of zinc (atomic number = 30) will be **[1]**

a) 0.5 $\mathring{A}$

b) 1.3872 $\mathring{A}$

c) 0.3541 $\mathring{A}$

d) 1 $\mathring{A}$

31. The radius of the hydrogen atom, in the ground state, is of the order of **[1]**

a) 10^{-7} cm

b) 10^{-6} cm

c) 10^{-4} cm

d) 10^{-8} cm

32. Band spectrum is also called **[1]**

a) Molecular spectrum

b) Atomic spectrum

c) Flash spectrum

d) Line absorption spectrum

33. The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom, is **[1]**

a) 2 : -1

b) 1 : 1

c) 1 : -1

d) 1 : - 2

34. The Bohr model of atoms **[1]**

a) predicts the same emission spectra for all types of atoms

b) assumes that the angular momentum of electrons is quantised

c) uses Einstein's photoelectric equation

d) predicts continuous emission spectra for atoms

35. When a hydrogen atom is raised from the ground state to an excited state, **[1]**

a) both K.E. and P.E. decrease

b) the P.E. increases and K.E. decreases

c) the P.E. decreases and K.E. increases

d) both P.E. and P.E. increases

36. According to Rutherford's atomic model, the electrons inside an atom are **[1]**

a) non centralized

b) non stationary

c) centralized

d) stationary

37. The energy of the ground electronic state of hydrogen atom is -13.6 eV. The energy of the first excited state will be **[1]**

a) -3.4 eV

b) -52.4 eV

c) -6.8 eV

d) -27.2 eV

38. Solid targets of different elements are bombarded by highly energetic electron beams. The frequency (f) of the characteristic X-rays emitted from different targets varies with atomic number Z as **[1]**

a) $f \propto \sqrt{Z}$

b) $f \propto Z$

c) $f \propto Z^2$

d) $f \propto Z^{\frac{3}{2}}$

39. The wavelength of Lyman series for first member is **[1]**

a) $\frac{3}{4} \times 1.097 \times 10^7$ m

b) $\frac{4 \times 1.097 \times 10^7}{3}$ m

c) $\frac{4}{3 \times 10.97 \times 10^7}$ m

d) $\frac{4}{3 \times 1.097 \times 10^7}$ m

40. When highly energetic cathode rays strike a heavy target of high melting point, then the rays produced are **[1]**

a) α-rays

b) X-rays

c) β-rays

d) γ-rays

41. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be **[1]**

a) $\frac{16}{25}\lambda$

b) $\frac{20}{7}\lambda$

c) $\frac{20}{13}\lambda$

d) $\frac{9}{16}\lambda$

42. In a Rutherford scattering experiment when a projectile of charge z_1 and mass M_1 approaches a target nucleus of charge z_2 and mass M_2, the distance of the closest approach is r_0. The energy of the projectile is **[1]**

a) directly proportional to z_1z_2

b) inversely proportional to z_1

c) directly proportional to mass M_1

d) directly proportional to $M_1 \times M_2$

43. Taking the Bohr radius as a_0 = 53pm, the radius of Li^{++} ion in its ground state, on the basis of Bohr's model, will be about **[1]**

a) 27 pm

b) 18 pm

c) 53 pm

d) 13 pm

44. Using the Bohr's model, calculate the orbital period of the electron in a hydrogen atom in the n = 1 level. **[1]**

a) 1.42×10^{-16} s

b) 3.62×10^{-16} s

c) 1.52×10^{-16} s

d) 5.72×10^{-16} s

45. The ground state energy of H-atom 13.6 eV. The energy needed to ionize H-atom from its second excited state **[1]**

a) 1.51 eV

b) 3.4 eV

c) 13.6 eV

d) 12.6 eV

46. The ratios between Bohr radii are **[1]**

a) 1 : 4 : 9

b) 1 : 3 : 5

c) 2 : 4 : 6

d) 1 : 2 : 3

47. An electron in the hydrogen atom jumps from an excited state n to the ground state. The wavelength so emitted illuminates a photosensitive material having a work function of 2.75 eV. If the stopping potential of the photoelectron is 10 V, then the value of n is **[1]**

a) 2

b) 3

c) 4

d) 5

48. V_1 is the frequency of the series limit of Lyman series V_2 is the frequency of the first line of Lyman series and V_3 is the frequency of the series limit of the Balmer series. Then **[1]**

a) $v_1 - v_2 = v_3$

b) $v_1 = v_2 - v_3$

c) $\frac{1}{v_2} = \frac{1}{v_1} + \frac{1}{v_3}$

d) $\frac{1}{v_1} = \frac{1}{v_2} + \frac{1}{v_3}$

49. The radius of the n^{th} orbit in Bohr model of hydrogen atom is proportional to: **[1]**

a) $\frac{1}{n}$

b) n^2

c) $\frac{1}{n^2}$

d) n

50. The total energy of an electron in the first excited state of hydrogen atom is about - 3.4 eV. Its kinetic energy in this state is: **[1]**

a) -3.4 eV

b) 3.4 eV

c) -6.8 eV

d) 6.8 eV

51. What is the energy of He^+ electron in first orbit? **[1]**

a) - 13.6 eV

b) 40.8 eV

c) - 54.4 eV

d) - 27.2 eV

52. The H_α line of hydrogen **[1]**

a) has a wavelength 4860

b) has a wavelength 6060

c) has a wavelength smaller than that of the H_{β^-} line

d) is emitted in the transition from the second excited state to the first excited state

53. The ratio of maximum frequency and minimum frequency of light emitted in Balmer series of hydrogen spectrum, in Bohr's model is: **[1]**

a) $\frac{9}{5}$

b) $\frac{11}{9}$

c) $\frac{11}{7}$

d) $\frac{16}{7}$

54. If the radius of first Bohr orbit of hydrogen atom is 'x' then de Broglie wavelength of electron in 3^{rd} Orbit is **[1]**

nearly

a) $\frac{x}{3}$

b) $2\pi x$

c) $9x$

d) $6\pi x$

55. Find the longest wavelength present in the Balmer series of hydrogen, corresponding to the H - line. **[1]**

a) 666 nm

b) 656 nm

c) 686 nm

d) 676 nm

56. A difference of 2.3 eV separates two energy levels in an atom. The frequency of radiation emitted when the atom make a transition from the upper level to the lower level is _____ **[1]**

a) 7.6×10^{14} Hz

b) 3.1×10^{14} Hz

c) 5.6×10^{14} Hz

d) 5.1×10^{14} Hz

57. In accordance with the Bohr's model, find the quantum number that characterizes the earth's revolution around the sun in an orbit of radius 1.5×10^{11} m with orbital speed 3×10^4 m/s. (Mass of earth = 6.0×10^{24} kg) **[1]**

a) 2.6×10^{74}

b) 3.7×10^{74}

c) 5.9×10^{74}

d) 4.8×10^{74}

58. The transition from the state n = 3 to n = 1 in a hydrogen-like atom results in ultraviolet radiation Infrared radiation will be obtained in the transition from **[1]**

a) $4 \rightarrow 3$

b) $3 \rightarrow 2$

c) $2 \rightarrow 1$

d) $4 \rightarrow 2$

59. Ionisation potential of hydrogen atom is -13.6 eV. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. According to Bohr's theory, the spectral lines emitted by hydrogen will be **[1]**

a) four

b) three

c) two

d) one

60. Which of the following statements is **not** correct according to Rutherford model? **[1]**

a) The electrons revolve around the nucleus under the influence of coulomb force acting on them.

b) Most of the space inside an atom is empty.

c) The stability of atom was established by the model.

d) Most part of the mass of the atom and its positive charge are concentrated at its centre.

61. Which one of the relations is correct between time period and a number of orbits while an electron is revolving in an orbit? **[1]**

a) $T \propto \frac{1}{n^2}$

b) $T \propto \frac{1}{n}$

c) $T \propto n^2$

d) $T \propto n^3$

62. The atomic number of an atom represents: **[1]**

a) number of protons in nucleus.

b) total number of protons and electrons in the atom.

c) total number of protons and neutrons in nucleus.

d) number of neutrons in nucleus.

63. Consider 3rd orbit of He^+ (Helium), using the non-relativistic approach, the speed of an electron in this orbit will be [given Z = 2 and h (Planck's constant) = 6.6×10^{-34}Js] **[1]**

a) 1.46×10^6 m/s

b) 0.73×10^6 m/s

c) 2.92×10^6 m/s

d) 3.0×10^6 m/s

64. The energy of hydrogen atom in the n^{th} orbit is E_n, then the energy in the n^{th} orbit of single ionised helium atom is **[1]**

a) $\frac{E_n}{4}$

b) 4 E_n

c) $\frac{E_n}{2}$

d) $2E_n$

65. The total energy of the electron in the ground state of hydrogen atom is -13.6 eV. The kinetic energy of the electron in the first excited state will be **[1]**

a) 13.6 eV

b) 6.8 eV

c) 1.7 eV

d) 3.4 eV

66. In terms of the Bohr radius a_0, the radius of the second Bohr orbit of a hydrogen atom is given by **[1]**

a) $\sqrt{2}$ a_0

b) 2 a_0

c) 4 a_0

d) 8 a_0

67. A hydrogen atom in its ground state absorbs 10.2 eV of energy. The orbital angular momentum is increased by **[1]**

a) 2.11×10^{-34} Js

b) 4.22×10^{-3} Js

c) 1.05×10^{-34} Js

d) 3.16×10^{-34} Js

68. The energy of a hydrogen atom in its ground state is -13.6 eV. The energy of the level corresponding to the quantum number n = 5 is **[1]**

a) -0.85 eV

b) -5.40 eV

c) -0.54 eV

d) -2.75 eV

69. When in hydrogen-like ion-electron jumps from n = 3 to n = 1, the emitted photon has a frequency of 2.7×10^{15} Hz. When electron jumps from n = 4 to n = 1 the frequency is **[1]**

a) 1.6×10^{15}

b) 2.8×10^{15}

c) 4.8×10^{15}

d) 6.4×10^{15}

70. The size of the atom is approximately **[1]**

a) 10^{-6} m

b) 10^{-8} m

c) 10^{-10} m

d) 10^{-14} m

71. The atomic number of silicon is 14. Its ground-state electron configuration is **[1]**

a) $1s^2 2s^2 2p^2 2s^4$

b) $1s^2 2s^2 2p^6 3s^1 3p^3$

c) $1s^2 2s^2 2p^6 3s^2 3p^2$

d) $1s^2 2s^2 2p^8 3s^2$

72. A hydrogen atom is in a state with energy -1.51 eV. In the Bohr model, what is the angular momentum of the electron in the atom, with respect to an axis at the nucleus? **[1]**

a) $3.56 \times 10^{-34} kgm^2/s$

b) $3.16 \times 10^{-34} kgm^2/s$

c) $3.76 \times 10^{-34} kgm^2/s$

d) $3.36 \times 10^{-34} kgm^2/s$

73. Two H atoms in the ground state collide inelastically. The maximum amount by which their combined kinetic energy is reduced is **[1]**

a) 20.40 eV

b) 13.6 eV

c) 10.20 eV

d) 27.2 eV

74. What would be the radius of second orbit of He^+ ion? **[1]**

a) 1.058 $\mathring{A}$

b) 3.023 $\mathring{A}$

c) 4.458 $\mathring{A}$

d) 2.068 $\mathring{A}$

75. A set of atoms in an excited state decays **[1]**

a) into a lower state only when excited by an external electric field

b) to emit photons only when they collide

c) in general to any of the states with lower energy

d) all together simultaneously into a lower state