Rutherford model

1. Atomic radius is of the order of 10^{-8} cm and nuclear radius is of the order of 10^{-13} cm. The fraction of atom that is occupied by nucleus is :
(A) 10^{-5} (B) 10^{5} (C) 10^{-15} (D) None of these

2. Rutherford's experiment, which established the nuclear model of the atom, used a beam of :
(A) β-particles, which impinged on a metal foil & got absorbed.
(B) γ-rays, which impinged on a metal foil & ejected electrons.
(C) helium atoms, which impinged on a metal foil & got scattered.
(D) helium nuclei, which impinged on a metal foil & got scattered.

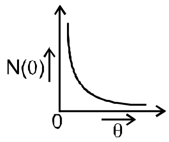
3. The potential energy of the electron present in the ground state of Li^{2+} ion is represented by :
(r = Radius of ground state)

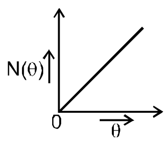
(A) $+\dfrac{3e^2}{4\pi \epsilon_0 r}$ (B) $-\dfrac{3e}{4\pi \epsilon_0 r}$ (C) $-\dfrac{3e^2}{4\pi \epsilon_0 r^2}$ (D) $-\dfrac{3e^2}{4\pi \epsilon_0 r}$

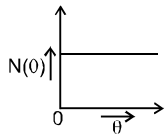
4. As an electron is brought from an infinite distance close to the nucleus of an atom, the potential energy of the electron-nucleus system :
(A) Increases to a greater positive value (B) Decreases to a smaller positive value
(C) Decrease to a greater negative value (D) Increases to a smaller negative value

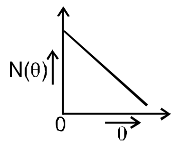
5. If the diameter of two different nuclei are in the ratio 1 : 2, then their mass number are in the ratio :
(A) 1 : 2 (B) 8 : 1 (C) 1 : 8 (D) 1 : 4

6. Select the correct graph :

(A) 

(B) 

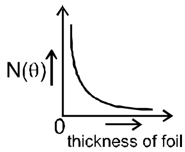
(C) 

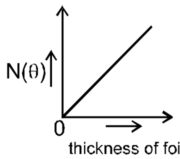
(D) 

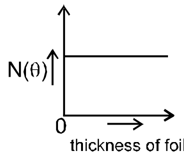
7. In Rutherford experiment, minimum number of α-particles will be deflected on using the thin foil of same thickness of which of the following metals?
(A) Ag (B) Au (C) Pt (D) Al

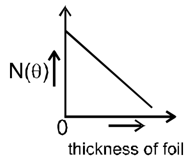
8. In Rutherford formula, maximum number of α-particles deflecting is for which among the following angles
(A) 30º (B) 45º (C) 60º (D) 90º

9. Select the correct graph :

(A) 

(B) 

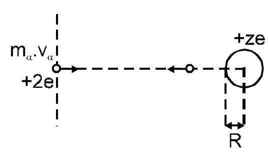
(C) 

(D) 

COMPREHENSION : Read the following passage carefully and answer the questions **:**

RUTHERFORD MODEL :

The approximate size of the nucleus can be calculated by using energy conservation theorem in Rutherford's α-scattering experiment. If an α-particle is projected from infinity with speed v, towards the nucleus having Z protons, then the α-particle which is reflected back or which is deflected by 180^0 must have approached closest to the nucleus. It can be approximated that α-particle collides with the nucleus and gets back. Now, if we apply the energy conservation equation at initial point and collision point, then :



$$(\text{Total Energy})_{\text{initial}} = (\text{Total Energy})_{\text{final}}$$
$$(\text{K.E.})_i + (\text{P.E.})_i = (\text{K.E.})_f + (\text{P.E.})_f$$

$(P.E.)_i = 0$, since P.E. of two charge system separated by infinite distance is zero. Finally the particle stops and then starts coming back.

$$\Rightarrow \frac{1}{2} m_\alpha v_\alpha^2 + 0 = 0 + \frac{Kq_1q_2}{R}$$

$$\Rightarrow \frac{1}{2} m_\alpha v_\alpha^2 = K\frac{2e \times Ze}{R}$$

$$\Rightarrow R = \frac{4KZe^2}{m_\alpha v_\alpha^2}$$

Thus the radius of nucleus can be calculated using above equation. The nucleus is so small a particle that we can't define a sharp boundary for it.

10. An α-particle with initial speed v_0 is projected from infinity and it approaches up to r_0 distance from a nuclie. Then, the initial speed of α-particle, which approaches upto $2r_0$ distance from the nucleus, is :

(A) $\sqrt{2}v_0$ (B) $\frac{v_0}{\sqrt{2}}$ (C) $2v_0$ (D) $\frac{v_0}{2}$

11. Radius of a particular nucleus is calculated by the projection of α-particle from infinity at a particular speed. Let this radius is the true radius. If the radius calculation for the same nucleus is made by another α-particle with half of the earlier speed, then the percentage error involved in the radius calculation is :

(A) 75% (B) 100% (C) 300% (D) 400%

Electromagnetic wave

12. Match the following with respect to waves :

Column-I	**Column-II**
(1) Frequency	(p) Linear distance travelled by a wave per unit time.
(2) Wavelength	(q) Number of waves passing through a point per unit time.
(3) Wave number	(r) Linear distance between starting and end point of one complete wave.
(4) Speed	(s) Number of waves contained in a unit length.

(A) [1 – q] ; [2 – p] ; [3 – s] ; [4 – r] (B) [1 – s] ; [2 – r] ; [3 – q] ; [4 – p]

(C) [1 – q] ; [2 – r] ; [3 – s] ; [4 – p] (D) [1 – s] ; [2 – p] ; [3 – q] ; [4 – r]

13. If the frequency of violet radiation is 7.5×10^{14} Hz, find the value of wavenumber ($\bar{v}$) (in m^{-1}) for it :

(A) 2.5×10^6 (B) 4×10^{-7} (C) 1.33×10^{-15} (D) Data insufficient

14. Visible spectrum contains light of following colours "Violet - Indigo - Blue - Green - Yellow - Orange - Red" (VIBGYOR).

Its frequency ranges from Violet (7.5×10^{14} Hz) to Red (4×10^{14} Hz). Find out the maximum wavelength in this range :

(A) 400 Å (B) 750 Å (C) 4000 Å (D) 7500 Å

15. Select the incorrect statement :

(A) Cathode rays are electromagnetic waves, but anode rays are not.

(B) Electromagnetic waves need a material medium for their propagation.

(C) Electromagnetic waves may have different frequencies.

(D) Electromagnetic waves consist of some material particles travelling with the speed of light.

16. A wavelength of 400 nm of an electromagnetic radiation corresponds to :

(A) frequency $= 7.5 \times 10^{14}$ Hz (B) wave number $= 2.5 \times 10^6\ m^{-1}$.

(C) velocity $= 3 \times 10^8\ ms^{-1}$ (D) $\lambda = 40$ Å

17. For a wave, frequency is 10 Hz and wavelength is 2.5 m. How much linear distance will it travel in 40 seconds:

Answers

RACE # 25

1.	(C)	**2.**	(D)	**3.**	(D)	**4.**	(C)	**5.**	(C)	**6.**	(A)	**7.**	(D)	**8.**	(A)	**9.**	(B)	**10.**	(B)
11.	(C)	**12.**	(C)	**13.**	(A)	**14.**	(D)	**15.**	(ABD)			**16.**	(ABC)			**17.**	(1000m)		