Atomic and ionic radii

1. (b) Value of Z for hydrogen =1
Value of Z for helium = 2
Value of n for both is = 1

$r_H = \frac{0.52\times1^2}{1}$ $r_{He^+} = \frac{0.52\times1^2}{1}$

$\frac{r_H}{r_{He^+}} = 1:1$ or $r_{He^+}:r_H = 1:1$

2. (d) The size of an species decreases with increasing nuclear charge because the attraction for the electrons increases. Thus $Al^{3+}$is smaller in size.

3. (c) As the nuclear charge per electron is maximum in F^-. Therefore it is smallest in size.

4. (a) During the formation of cation the size decreases.

5. **(a) Cl^-**

(a) Cl^- (Z=17, gains $1e^-$ → $18e^-$ total)

Extra electron increases repulsion → radius **increases**.
Ionic radius ≈ **181 pm**.
(b) Ar (Z=18, neutral atom)
Noble gas, no extra electron cloud expansion.
Atomic radius ≈ **71 pm**.
(c) K^+ (Z=19, loses $1e^-$ → $18e^-$ total)
Positive charge shrinks radius (due to increased nuclear pull).
Ionic radius ≈ **138 pm**.
(d) Ca^{2+} (Z=20, loses $2e^-$ → $18e^-$ total)
Higher positive charge shrinks size even more.
Ionic radius ≈ **100 pm**.
Order of sizes: **Cl^- > K^+ > Ca^{2+} > Ar**

6. (d) Highest the nuclear charge smallest the atomic size as well as radius also.

7. (a) Atomic radius decreases on going from left to right in a period. Thus size of $O > F$. As O^{2-} and $F^{-}$are isoelectronic, therefore, size of $O^{2-} > F^{-}$.

8. (b) As the nuclear charge per e^{-} is maximum in Mg^{+2}, it has smallest size among Na^{+}, Mg^{+2}, Cl^{-} and F^{-}.

9. (b) S^{2-} and Cl^{-}both are isoelectronic but nuclear charge of Cl^{-} is more than S^{2-}. So it has largest size.

10. (d) In completely filled shell inter atomic repulsion is more so have greater size.

12. (d) I^{-} as it has the biggest size.

13. (d) *Mg*, as we move across the period atomic radius decreases.

14. (a) O^{-2} has the highest value of ionic radii as this can be explained on the basis of $Z/e\left\{\frac{\text{Nucleaus charge}}{\text{No. of electron}}\right\}$

Whereas *Z* / *e* ration increases, the size decreases and when *Z* / *e* ration decreases the size increases.

15. (a) Continuous increase as no. of shells increases down the group.

16. (d) $Na^{+} < F^{-} < O^{2-} < N^{3-}$

All are isoelectronic, effective number charge is highest for Na^{+} so it has smallest size.

17. (d) $I^{-}_{54} > I_{53} > I^{+}_{52}$ atmoic number

19. (a) Continuously decreases as the effective nuclear charge increases.

20. (a) $Mg^{2+} < Na^{+} < F^{-} < Al$

F^{-} has bigger size than Mg^{2+} and Na^{+} due to small nuclear charge.

21. (b) More than F^{-} as K^{+} has more no of shells in atomic state.

22. (d) All are isoelectronic but O^{2-} has lowest charge among them. So it is largest in size.

23. (a) As effective nuclear charge on Na^{+} is maximum. It has smallest size.

24. **(a) Atomic number**

As we move **down a group**, a **new electron shell (energy level)** is added each time.

This increases **atomic number (Z)**, atomic size, and ionic radius.
The **cause** is **increasing atomic number**, not weight or mass.