

- 1) Define Effective Nuclear Charge (Z_{eff})—what it represents, not how to calculate it
Effective nuclear charge is the net positive nuclear charge attracting the valence electrons in the atom.
- 2) Define what shielding electrons are
Shielding electrons are the “core” electrons in lower energy levels than the valence electrons that shield the valence electrons from the full positive nuclear charge.
- 3) Indicate how to determine the Z_{eff} for an element
Subtract the shielding electrons from the number of protons: $Z_{\text{eff}} = Z - \text{shielding “core” electrons}$
- 4) For the following elements, indicate the nuclear charge (Z), write the electron configuration (Noble Gas notation), indicate which electrons are the shielding electrons, and calculate Z_{eff} :

	Z	e ⁻ config	shielding e ⁻ config & #of e	Z_{eff}
a) O	8	[He]2s ² 2p ⁴	[He], 2	8 – 2 = 6+
b) P	15	[Ne]3s ² 3p ³	[Ne], 10	15 – 10 = 5+
c) K	19	[Ar]4s ¹	[Ar], 18	19 – 18 = 1+
d) Ge	32	[Ar]4s ² 3d ¹⁰ 4p ²	[Ar]3d ¹⁰ , 28	32 – 28 = 4+
e) Kr	36	[Ar]4s ² 3d ¹⁰ 4p ⁶	[Ar]3d ¹⁰ , 28	36 – 28 = 8+
f) Sr	38	[Kr]5s ²	[Kr], 36	38 – 36 = 2+
g) Sb	51	[Kr]5s ² 4d ¹⁰ 5p ³	[Kr]4d ¹⁰ , 46	51 – 46 = 5+
h) Bi	83	[Xe]6s ² 4f ¹⁴ 5d ¹⁰ 6p ³	[Xe]4f ¹⁴ 5d ¹⁰ , 78	83 – 78 = 5+

- 5) What happens to the effective nuclear charge across a period (row)? Down a group (column)?
 Z_{eff} increases by one for each element across a period; Z_{eff} is constant down a group.

Answer the following questions by referring to the trend. Do not use the tables of actual radii.

- 6) Which element has a larger radius – P or Sb? Sb Sb is lower in the group so it is larger.
- 7) Which element has a larger radius – Cl or Na? Na Na is further left in the period so it is larger.
- 8) Which element has a larger radius – Ga or F? Ga Ga is lower and further left so it is larger.
- 9) Why is it not possible to determine whether Sb or Po has a larger radius, without more information?
Sb is to the left of Po, and this trend would make it larger, but Po is lower than Sb so it should be larger. The positions of the elements are along the wrong diagonal, so the trends are contradictory.
- 10) Rank the following elements in order of *increasing* atomic radius: Cs, Al, S, Mg, Cl, Na
Moving from right to left, then top to bottom: Cl < S < Al < Mg < Na < Cs
- 11) Which ion has a larger radius – F⁻ or Br⁻? Br⁻ Br⁻ is lower in the group so it is larger
- 12) Which ion has a larger radius – I⁻ or In³⁺? I⁻ I⁻ is an anion with larger config so it is larger
- 13) Which ion has a larger radius – Mg²⁺ or Ba²⁺? Ba²⁺ Ba²⁺ is lower in the group so it is larger