c) What is the oxidation number of Cr in Cr^{3+} ?

This one is obvious: the oxidation number (charge on the atom) is +3.

Conclusion: The oxidation number of a monatomic ion is the charge on the ion.

d) What is the oxidation number of S in SO_4^{2-} ?

	S	O_4 $^{2-}$
individual charge for an atom ⟶	x	−2
total charge (all atoms) ⟶	x	−8 = **−2**

The ion has a 2− charge overall, requiring the solution of the equation:

$$x - 8 = -2 \text{ , which gives } x = +6.$$

Therefore, **the oxidation number of S is +6.**

***EXERCISES*:**

3. Calculate the oxidation number of the atom in **bold** type.

a) $H\mathbf{N}O_3$	e) $\mathbf{N}H_4^+$	i) $\mathbf{Al}(OH)_4^-$	m) $H\mathbf{Cl}O_3$	q) $K_2\mathbf{U}O_4$
b) $\mathbf{N}O_2^-$	f) $\mathbf{N}_3^-$	j) $\mathbf{S}_2F_{10}$	n) $\mathbf{N}_2H_5^+$	r) $\mathbf{C}_3H_6O$
c) $\mathbf{Cr}O_4^{2-}$	g) $\mathbf{C}_2H_6$	k) $\mathbf{N}_2O_3$	o) $\mathbf{N}H_2OH$	s) $\mathbf{S}_8$
d) $\mathbf{Cr}_2O_7^{2-}$	h) $\mathbf{C}_3H_8$	l) $H\mathbf{Cl}O_4$	p) $\mathbf{C}_2O_4^{2-}$	t) $\mathbf{C}_4H_6$

4. Assign oxidation numbers to the **bold** species in each of the following unbalanced reaction equations. Then determine which species undergoes oxidation in each reaction.

a) $\mathbf{ClO_2} + \mathbf{C} \longrightarrow \mathbf{ClO_2^-} + \mathbf{CO_3^{2-}}$

b) $\mathbf{Sn^{2+}} + Cl^- + \mathbf{BrO_3^-} \longrightarrow \mathbf{SnCl_6^{2-}} + \mathbf{Br^-}$

c) $\mathbf{MnO_4^-} + \mathbf{C_2O_4^{2-}} \longrightarrow \mathbf{MnO_2} + \mathbf{CO_2}$

d) $\mathbf{NO_3^-} + H_2\mathbf{Te} \longrightarrow \mathbf{NO} + \mathbf{TeO_4^{2-}}$

5. Which of the following are redox reactions?

a) $I_2 + 5\,HOBr + H_2O \longrightarrow 2\,IO_3^- + 5\,Br^- + 7\,H^+$

b) $4\,Ag^+ + Cr_2O_7^{2-} + H_2O \longrightarrow 2\,Ag_2CrO_4 + 2\,H^+$

c) $KHCO_3 + HI \longrightarrow KI + CO_2 + H_2O$

d) $2\,H_2O \longrightarrow 2\,H_2 + O_2$

e) $H_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2\,HCl$

f) $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$

SNEAKY TRICK!

You will sometimes find that the solution to a problem only requires you to determine which species have been oxidized and which have been reduced. Look at the following oxidations and reductions.

i) $ClO_3^- \longrightarrow ClO_4^-$ (oxidation: $Cl^{5+} \longrightarrow Cl^{7+}$)

ii) $H_2O_2 \longrightarrow H_2O$ (reduction: $O^- \longrightarrow O^{2-}$)

iii) $Cr^{3+} \longrightarrow CrO_4^{2-}$ (oxidation: $Cr^{3+} \longrightarrow Cr^{6+}$)

iv) $NO_2 \longrightarrow N_2O_3$ (reduction: $N^{4+} \longrightarrow N^{3+}$)

In each of these cases, **THE NUMBER OF ATTACHED OXYGEN ATOMS INCREASES DURING AN OXIDATION,** and **THE NUMBER OF ATTACHED OXYGENS DECREASES DURING A REDUCTION.** In the last example, (iv), the number of oxygens go from 2 O's per N–atom to 1.5 O's per N–atom.