

CALCULATING OXIDATION NUMBERS

1. (a) Deduce the oxidation state of the *elements* in the following chemical species.

(i) Ar	□	(iv) H ₂	□	(vii) P ₄	□
(ii) Cu	□	(v) Cl ₂	□	(viii) S ₈	□
(iii) O ₂	□	(vi) O ₃	□	(ix) C ₆₀	□

(b) What pattern emerges for the oxidation state displayed by any element existing in the elemental state ?

2. (a) Deduce the oxidation number both of the **metallic** and **non-metallic** components in the following binary chemical compounds. Use the space to the left of the respective answer columns to show any working.

	<i>metal</i>	<i>non-metal</i>
(i) Na Cl		
(ii) Ca Br ₂		
(iii) Al F ₃		
(iv) K ₂ O		
(v) Ba S		
(vi) Sb ₂ O ₃		
(vii) Li ₃ N		
(viii) Mg ₃ P ₂		
(ix) Al N		
(x) Na H		

(b) What pattern emerges for the oxidation states displayed by the

(i) Group I or Alkali metals, Li, Na & K ?

[1]

(ii) Group II or Alkaline Earth metals, Mg, Ca & Ba ?

[1]

In fact, one of the key chemical characteristics of elements in the **s-block**, compared to those in the *p*- and *d*-blocks, is their restriction to a **single, fixed oxidation state**.

3. (a) Deduce the oxidation number of the **emboldened** element in the following binary covalent compounds. Use the space to the left of the respective answer columns to show any working.

(i)	B ₂ O ₃		
(ii)	B F ₃		
(iii)	C Cl ₄		
(iv)	C O		
(v)	C O ₂		
(vi)	Si O ₂		
(vii)	Si Cl ₄		
(viii)	N H ₃		
(ix)	N ₂ O		
(x)	N O		
(xi)	N Cl ₃		
(xii)	N O ₂		
(xiii)	N ₂ O ₄		
(xiv)	N ₂ O ₅		
(xv)	P Cl ₃		
(xvi)	P ₄ O ₁₀		
(xvii)	S O ₂		
(xviii)	S O ₃		
(xix)	I Cl		
(xx)	Cl O		
(xxi)	Cl ₂ O ₇		
(xxii)	Br F ₅		
(xxiii)	I F ₇		

- (b) What pattern emerges for the maximum observed oxidation states displayed by Group III, IV, V, VI and VII elements in their compounds ?

[1]

In fact, *it is not normally possible for an element to possess an oxidation state in excess of its Group number.*

5. (a) Deduce the oxidation number of the element present in the following ions. (The right-hand column should be used to name any species as appropriate).

		O.N.	name of species
(i)	H^{1+}		
(ii)	Mg^{2+}		
(iii)	N^{3-}		
(iv)	O^{2-}		
(v)	S^{2-}		
(vi)	Cl^{1-}		
(vii)	O_2^{2-}		
(viii)	O_2^{1-}		
(ix)	H^{1-}		
(x)	C_2^{2-}		
(xi)	N_3^{1-}		

- (b) Calculate the oxidation number of the **emboldened** element in the following polyatomic ions and attempt to assign a name to each of the chemical species. Use the space to the left of the respective answer column to show any working.

		O.N.	name of species
(i)	O H^{1-}		
(ii)	B O_3^{3-}		
(iii)	C O_3^{2-}		
(iv)	Si O_3^{2-}		
(v)	N H_4^{1+}		
(vi)	N O_3^{1-}		
(vii)	P O_4^{3-}		
(viii)	S O_3^{2-}		
(ix)	S O_4^{2-}		
(x)	Cl O^{1-}		
(xi)	I O_3^{1-}		
(xii)	Br O_4^{1-}		

6. Calculate the oxidation number of the **emboldened** element in the following polyatomic ions. Use the space to the left of the respective answer column to show any working.

		O.N.
(a)	Al O ₂ ¹⁻	
(b)	Al (OH) ₄ ¹⁻	
(c)	Al Cl ₄ ¹⁻	
(d)	C ₂ O ₄ ²⁻	
(e)	Si F ₆ ²⁻	
(f)	Sn O ₂ ²⁻	
(g)	Pb (OH) ₆ ⁴⁻	
(h)	N H ₂ ¹⁻	
(i)	N ₂ H ₅ ¹⁺	
(j)	P Cl ₄ ¹⁺	
(k)	P Cl ₆ ¹⁻	
(l)	Sb O ¹⁺	
(m)	Bi O ₃ ¹⁻	
(n)	S ₂ O ₃ ²⁻	
(o)	S ₄ O ₆ ²⁻	
(p)	Se O ₃ ²⁻	
(q)	Te O ₂ ²⁻	
(r)	Cl O ₂ ¹⁻	
(s)	I Cl ₄ ¹⁻	

7. Calculate the oxidation number of the **emboldened** element in the following *d*-block ions. Use the space to the left of the respective answer column to show any working.

		O.N.
(a)	V O ²⁺	
(b)	V O ₂ ¹⁺	
(c)	Cr O ₄ ²⁻	
(d)	Cr ₂ O ₇ ²⁻	
(e)	Mn O ₄ ¹⁻	
(f)	Mn O ₄ ²⁻	
(g)	Fe O ₄ ²⁻	
(h)	Fe (CN) ₆ ⁴⁻	
(i)	Fe (CN) ₆ ³⁻	
(j)	Co (NH ₃) ₆ ³⁺	
(k)	Co (H ₂ O) ₆ ²⁺	
(l)	Co Cl ₄ ²⁻	
(m)	Ni (H ₂ O) ₆ ²⁺	
(n)	Cu (NH ₃) ₄ ²⁺	
(o)	Cu Cl ₂ ¹⁻	
(p)	Ag (NH ₃) ₂ ¹⁺	
(q)	Zn O ₂ ²⁻	

8. Assigning an oxidation number (state) to an element in an ion or compound requires accurate knowledge of the bonding present in that species.

Find out the oxidation number of the **emboldened** element in the following species and ascertain if anything is unusual about any bonding present.



Comments
on bonding



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