CALCULATING OXIDATION NUMBERS

(a)	Dec	luce the d	oxidatic	on stat	e of the	eleme	e <i>nt</i> s in th	e follo	wing chem	ical spe	cies.
(i)	Ar			(iv)	H_2			(vii)	P_4	
(i	i)	Cu			(v)	Cl	2		(viii)	S ₈	
(i	ii)	O ₂			(vi)	O ₃			(ix)	C ₆₀	
(b)		at pattern ting in th				datior	n state d	isplaye	ed by any e	element	<u>-</u>
(a)	con		in the f	followi	ng binar	y che	mical co	mpoun	non-meta ds. Use the king.		to the
							metal	S		noi	n-metal
	(i)	Na Cł						b			
	(ii)	Ca Br ₂					Oll				
	(iii)	Al F_3				0					
	(iv)	K_2O			(1)	31					
	(v)	Ba S			.27						
	(vi)	Sb_2O_3		,5							
	(vii)	Li ₃ N		M.							
	(viii)	Mg_3P_2 (J/\'								
	(ix)	AlN									
	(x) (Na H									
(b)	Wh	at pattern	emero	aes fo	r the oxi	datior	states (display	ed by the	J	
	(i)				als, Li, I			1 -7	,		
											[1
	/::\	Group I	I or Alk	aline I	Earth me	etals,	Mg, Ca 8	Ba ?			
	(ii)					,	J,				

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)	$\mathbf{B}_2 O_3$		
(ii)	B F ₃		
(iii)	C Cl ₄		
(iv)	C O		, 60
(v)	C O ₂		,07
(vi)	Si O ₂		
(vii)	Si Cl ₄		
(viii)	N H ₃	CH	
(ix)	N ₂ O	40/0	
(x)	NO	5	
(xi)	N Cl ₃	8	
(xii)	N O ₂		
(xiii)	N ₂ O ₄	0.0	
(xiv)	N ₂ O ₅	1201	
(xv)	P Cl ₃	A Transfer of the second of th	
(xvi)	P ₄ O ₁₀		
(xvii)	S O ₂		
(xviii)	S O ₃		
(xix)	t Cl		
O(xx)	Cł O		
(xxi)	C l ₂ O ₇		
(xxii)	Br F ₅		
(xxiii)	IF 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.

		ne respective answer columns to show any working.	
	(i)	Sc ₂ O ₃	
	(ii)	Ti O ₂	
	(iii)	$V_2 O_5$	
	(iv)	$\operatorname{Cr}_2\operatorname{O}_3$, (
	(v)	Cr O₃	10
	(vi)	Mn Cl ₂	
	(vii)	Mn_2O_3	
	(viii)	Mn O ₂	
	(ix)	Mn Cl ₂ Mn ₂ O ₃ Mn O ₂ Mn ₂ O ₇ Fe ₃ O ₄	
	(x)	Fe ₃ O ₄	
	(xi)	Fe ₂ O ₃	
	(xii)	Fe ₃ O ₄ Fe ₂ O ₃ Co Cl ₂ Co ₂ O ₃ Ni O Cu ₂ O	
	(xiii)	Co ₂ O ₃	
	(xiv)	Ni O	
	(xv)	Cu ₂ O	
	(xvi)	Cu O	
	(xvii)	Zn F ₂	
	(xviii)	ZnO	
(b)	scandi	ng left to right across the first row transition elements from ym, Sc , to zinc, Zn , what patterns in the displayed oxidation if any, are discernable.	
X	,		
Q,			

(a) Deduce the oxidation number of the **emboldened** element in the following

compounds containing a 3d metal (aka transition metals). Use the space to the

4.

Probably the most important chemical characteristic of **transition elements** is that, in their compounds and ions, they can exist in a **multiplicity of oxidation states**. However, Sc and Zn, the first and last members of the first (3*d*) transition series, are restricted to a single, fixed oxidation state, +3 and +2, respectively, and so considered distinct.

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⁻		40
(v)	S ²⁻		76
(vi)	Cl ¹⁻		
(vii)	O ₂ ²⁻		,,0)
(viii)	O ₂ ¹⁻		(C)
(ix)	H ¹⁻	6	
(x)	C ₂ ²⁻	94	
(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⁻	,,,5		
(ii)	B O ₃ ³⁻			
(iii)	C O ₃ ²⁻	CX.		
(iv)	Si O ₃ 2-			
(v)	N H ₄			
(vi)	NO ₃ 1-			
(vii)	P O ₄ 3-			
(viii)	S O ₃ ²⁻			
(ix)	S O ₄ ²⁻			
(x)	C l 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)	A l O ₂ ¹⁻			. 4
	(b)	A l (OH) ₄ ¹⁻			127 co.114
	(c)	Al Cl ₄ ¹⁻			2
	(d)	C ₂ O ₄ ²⁻			
	(e)	Si F ₆ ²⁻		NOW	
	(f)	Sn O ₂ ²⁻	×0	0	
	(g)	Pb (OH) ₆ ⁴⁻	9		
	(h)	N H ₂ ¹⁻			
	(i)	$N_2 H_5^{1+}$	0.CO.		
	(j)	P Cl ₄ ¹⁺	201		
	(k)	P C ₆ 1-	*		
	(I)	Sb O ¹ +			
	(m)	Bi O ₃ 1-			
Copyright	(n)	S ₂ O ₃ ²⁻			
_ ((b)	S ₄ O ₆ ²⁻			
	(p)	Se O ₃ ² -			
C064,	(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 0 ²⁺			
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(b)
$$V O_2^{1+}$$

(c) $Cr O_4^{2-}$
(d) $Cr_2 O_7^{2-}$
(e) $Mn O_4^{1-}$

(c)
$$\operatorname{Cr} O_4^{2-}$$

(d)
$$\mathbf{Cr}_2 O_7^{2-}$$

(e) **Mn**
$$O_4^{1-}$$

(f)
$$Mn O_4^{2-}$$

(j)
$$\text{Co (NH}_3)_6^{3+}$$

(o) **Cu** C
$$\ell_2^{1-}$$

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.

(i)	F ₂ O		
	Comments on bonding		
(ii)	Na ₂ O ₂		,Q1.
	Comments on bonding		
(iii)	H ₂ O ₂		
	Comments on bonding		
(iv)	K O ₂		
	Comments on bonding		
(v)	K ReO ₄	12	
	Comments on bonding		
(vi)	Li AlH ₄	<u> </u>	
	Comments on bonding		
(vii)	S ₂ O ₈ ²⁻		
	Comments on bonding		
(viii)	Cr O ₅		
	Comments on bonding		