

## Assessment

### How introduced species affect ecosystems

#### Page 55

1. E 2. A 3. G 4. D 5. B 6. F 7. C 8. A 9. A 10. D 11. B  
12. C

## UNIT 2 Chemical Reactions and Radioactivity

### Chapter 4 Atomic theory explains the formation of compounds.

#### Section 4.1 Atomic Theory and Bonding

##### Comprehension

##### The atom and the subatomic particles

#### Page 60

- (a) atomic number  
(b) symbol  
(c) name  
(d) average atomic mass  
(e) common ion charge  
(f) other ion charge
- (a) 35  
(b) 79.9  
(c) 1-  
(d) 35  
(e) bromine  
(f) 45

3.

Element Name	Atomic Number	Ion Charge	Number of Protons	Number of Electrons	Number of Neutrons
potassium	19	1+	19	18	20
phosphorus	15	0	15	15	16
<b>lithium</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>3</b>	<b>4</b>
<b>calcium</b>	<b>20</b>	<b>2+</b>	<b>20</b>	<b>18</b>	<b>20</b>
nitrogen	7	3-	7	10	7
<b>boron</b>	<b>5</b>	<b>0</b>	<b>5</b>	<b>5</b>	<b>6</b>
argon	18	0	18	18	22
<b>aluminum</b>	<b>13</b>	<b>3+</b>	<b>13</b>	<b>10</b>	<b>14</b>
chlorine	17	0	17	17	19
<b>sodium</b>	<b>11</b>	<b>1+</b>	<b>11</b>	<b>10</b>	<b>12</b>

##### Applying Knowledge

##### Bohr diagrams

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- (a) a diagram that shows how many electrons are in each shell surrounding the nucleus

- (b) an arrangement of eight electrons in the outermost shell  
(c) outermost shell that contains electrons  
(d) electrons in the outermost shell

2.

Atom/ion	Atomic Number	Number of Protons	Number of Electrons	Number of Neutrons	Number of Electron Shells
neon atom	10	20	10	10	2
fluorine atom	9	9	9	10	2
fluorine ion	9	9	10	10	2
sodium atom	11	11	11	12	3
sodium ion	11	11	10	12	2

3.

neon atom	fluorine atom	fluorine ion	sodium atom	sodium ion

4.

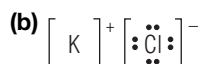
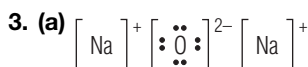
carbon dioxide (CO <sub>2</sub> )	ammonia (NH <sub>3</sub> )	calcium chloride (CaCl <sub>2</sub> )

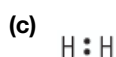
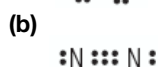
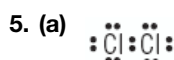
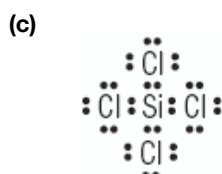
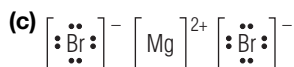
##### Illustrating Concepts

##### Lewis diagrams

#### Page 62

- (a) a diagram that illustrates chemical bonding by showing only an atom's valence electrons and the chemical symbol  
(b) pair of electrons in the valence shell that is not used in bonding  
(c) pair of electrons involved in a covalent bond
- (a)  $\cdot \ddot{\text{B}} \cdot$   
(b)  $\cdot \ddot{\text{N}} :$   
(c)  $\cdot \ddot{\text{Al}} \cdot$   
(d)  $:\ddot{\text{Cl}}:$





### Assessment

#### Atomic theory and bonding

##### Page 63

1. C 2. A 3. B 4. E 5. D 6. B 7. D 8. D 9. D 10. A 11. B  
12. B 13. A 14. A 15. C 16. B

## Section 4.2 Names and Formulas of Compounds

### Comprehension

#### Multivalent metals and polyatomic ions

##### Page 68

1. (a) a compound made up of a metal and a non-metal  
(b) a metal that has more than one ion charge  
(c) an ion composed of more than one type of atom joined by covalent bonds
- 2.

	Positive ion	Negative ion	Formula	Compound name
(a)	Pb <sup>2+</sup>	O <sup>2-</sup>	PbO	lead(II) oxide
(b)	Sb <sup>4+</sup>	S <sup>2-</sup>	SbS <sub>2</sub>	antimony(IV) sulphide
(c)	Tl <sup>+</sup>	Cl <sup>-</sup>	TlCl	thallium(I) chloride
(d)	Sn <sup>2+</sup>	F <sup>-</sup>	SnF <sub>2</sub>	tin(II) fluoride
(e)	Mo <sup>3+</sup>	S <sup>2-</sup>	Mo <sub>2</sub> S <sub>3</sub>	molybdenum(III) sulphide
(f)	Rh <sup>4+</sup>	Br <sup>-</sup>	RhBr <sub>4</sub>	rhodium(IV) bromide
(g)	Cu <sup>+</sup>	Te <sup>2-</sup>	Cu <sub>2</sub> Te	copper(I) telluride
(h)	Nb <sup>5+</sup>	I <sup>-</sup>	NbI <sub>5</sub>	niobium(V) iodide
(i)	Pd <sup>2+</sup>	Cl <sup>-</sup>	PdCl <sub>2</sub>	palladium(II) chloride

3. (a) MnCl<sub>2</sub>  
(b) Cr<sub>2</sub>S<sub>3</sub>  
(c) TiO<sub>2</sub>  
(d) UF<sub>6</sub>  
(e) NiS  
(f) V<sub>2</sub>O<sub>5</sub>  
(g) Re<sub>3</sub>Ar<sub>7</sub>  
(h) Pt<sub>3</sub>N<sub>4</sub>  
(i) NiCN<sub>2</sub>  
(j) Bi<sub>3</sub>P<sub>5</sub>

4.

	Ions	Formula	Compound name
(a)	K <sup>+</sup> NO <sub>3</sub> <sup>-</sup>	KNO <sub>3</sub>	potassium nitrate
(b)	Ca <sup>2+</sup> CO <sub>3</sub> <sup>2-</sup>	CaCO <sub>3</sub>	calcium carbonate
(c)	Li <sup>+</sup> HSO <sub>4</sub> <sup>-</sup>	LiHSO <sub>4</sub>	lithium bisulphate or lithium hydrogen sulphate
(d)	Mg <sup>2+</sup> SO <sub>3</sub> <sup>2-</sup>	MgSO <sub>3</sub>	magnesium sulphite
(e)	Sr <sup>2+</sup> CH <sub>3</sub> COO <sup>-</sup>	Sr(CH <sub>3</sub> COO) <sub>2</sub>	strontium acetate
(f)	NH <sub>4</sub> <sup>+</sup> Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	(NH <sub>4</sub> ) <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>	ammonium dichromate
(g)	Na <sup>+</sup> MnO <sub>4</sub> <sup>-</sup>	NaMnO <sub>4</sub>	sodium permanganate
(h)	Ag <sup>+</sup> ClO <sub>3</sub> <sup>-</sup>	AgClO	silver hypochlorite
(i)	Cs <sup>+</sup> OH <sup>-</sup>	CsOH	cesium hydroxide
(j)	Ba <sup>2+</sup> CrO <sub>4</sub> <sup>2-</sup>	BaCrO <sub>4</sub>	barium chromate

5. (a) Ba(HSO<sub>4</sub>)<sub>2</sub>  
(b) NaClO<sub>3</sub>  
(c) K<sub>2</sub>CrO<sub>4</sub>  
(d) Ca(CN)<sub>2</sub>  
(e) KOH  
(f) Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub>  
(g) Al<sub>2</sub>(SO<sub>4</sub>)<sub>3</sub>  
(h) CdCO<sub>3</sub>  
(i) AgNO<sub>2</sub>  
(j) NH<sub>4</sub>HCO<sub>3</sub>

### Comprehension

#### Chemical names and formulas of ionic compounds

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1. (a) beryllium sulphide  
(b) mercury(II) nitride  
(c) copper(II) nitrate  
(d) silver oxide  
(e) cobalt(II) bromide  
(f) bismuth(V) phosphate  
(g) calcium fluoride

- (h) manganese(III) oxide  
 (i) chromium(III) sulphate  
 (j) zinc chloride  
 (k) nickel(II) hydroxide  
 (l) potassium dichromate  
 (m) scandium fluoride  
 (n) sodium iodide  
 (o) lead(II) carbonate  
 (p) rubidium chlorite  
 (q) potassium phosphide  
 (r) magnesium cyanide  
 (s) tin(II) sulphide  
 (t) sodium bicarbonate or sodium hydrogen carbonate

2. (a)  $\text{AlBr}_3$   
 (b)  $\text{PtS}$   
 (c)  $\text{SrSO}_3$   
 (d)  $\text{Sc}_2\text{O}_3$   
 (e)  $\text{Ti}(\text{NO}_2)_4$   
 (f)  $(\text{NH}_4)_2\text{SO}_4$   
 (g)  $\text{Li}_2\text{Se}$   
 (h)  $\text{Pb}(\text{HSO}_4)_2$   
 (i)  $\text{NaCH}_3\text{COO}$   
 (j)  $\text{CsCl}$   
 (k)  $\text{Cd}(\text{OH})_2$   
 (l)  $\text{Zn}_3(\text{PO}_4)_2$   
 (m)  $\text{BaCl}_2$   
 (n)  $\text{Sn}(\text{MnO}_4)_2$   
 (o)  $\text{LiClO}$   
 (p)  $\text{Au}_2(\text{SO}_4)_3$   
 (q)  $\text{NaNO}_3$   
 (r)  $\text{CrCl}_3$   
 (s)  $\text{K}_2\text{CO}_3$   
 (t)  $\text{Fe}(\text{HSO}_4)_3$

### Comprehension

#### Chemical names and formulas of covalent compounds

#### Page 71

1. a compound consisting of two non-metals; a compound that involves the sharing of electrons
2. covalent bond
3. prefixes: mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca
4. (a)  $\text{SiO}_2$   
 (b)  $\text{ClO}_2$   
 (c)  $\text{TeO}_2$   
 (d)  $\text{SeO}_3$

- (e)  $\text{CS}_2$   
 (f)  $\text{AsCl}_3$   
 (g)  $\text{ClO}_7$   
 (h)  $\text{SeF}_2$   
 (i)  $\text{N}_2\text{O}_5$   
 (j)  $\text{N}_2\text{O}$   
 (k)  $\text{AsBr}_4$   
 (l)  $\text{AsCl}_5$   
 (m)  $\text{S}_2\text{O}_5$   
 (n)  $\text{SCI}$   
 (o)  $\text{PCl}_3$   
 (p)  $\text{P}_2\text{O}_5$

### 5.

#### COVALENT COMPOUNDS

Word List	ACROSS	DOWN
Arsoenic trioxide	1. $\text{S}_2\text{Cl}_2$	1. $\text{P}_2\text{O}_3$
Boron monoxide	3. $\text{PBr}_3$	2. $\text{As}_2\text{O}_5$
Carbon disulphide	5. $\text{SiF}_4$	4. $\text{SCL}_4$
Chlorine monoxide	7. $\text{Cl}_2\text{O}_7$	6. $\text{ICl}_3$
Diarsenic pentoxide	9. $\text{ClF}_3$	8. $\text{NO}$
Dichlorine heptoxide	11. $\text{N}_2\text{O}_3$	9. $\text{CS}_2$
Dinitrogen trioxide	14. $\text{TeBr}_2$	10. $\text{TeO}_3$
Disulphur dichloride	15. $\text{ClO}$	12. $\text{BO}$
Iodine trichloride	16. $\text{AsO}_3$	13. $\text{NO}_2$
Nitrogen dioxide		
Nitrogen monoxide		
Phosphorus tribromide		
Silicon tetrafluoride		
Sulphur tetrachloride		
Tellurium dibromide		
Tellurium trioxide		

## Assessment

Names and formulas of compounds

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1. F 2. C 3. I 4. B 5. C 6. D 7. A 8. C 9. D 10. D 11. C  
12. B

## Section 4.3 Chemical Equations

### Comprehension

#### Balancing equations

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- $\text{H}_2 + \text{F}_2 \rightarrow 2 \text{HF}$
- $2 \text{Sn} + \text{O}_2 \rightarrow 2 \text{SnO}$
- $\text{MgCl}_2 \rightarrow \text{Mg} + \text{Cl}_2$
- $2 \text{KNO}_3 \rightarrow 2 \text{KNO}_2 + \text{O}_2$
- $2 \text{BN} + 3 \text{F}_2 \rightarrow 2 \text{BF}_3 + \text{N}_2$
- $\text{CuI}_2 + \text{Fe} \rightarrow \text{FeI}_2 + \text{Cu}$
- $2 \text{Li} + 2 \text{H}_2\text{O} \rightarrow 2 \text{LiOH} + \text{H}_2$
- $4 \text{NH}_3 + 3 \text{O}_2 \rightarrow 2 \text{N}_2 + 6 \text{H}_2\text{O}$
- $\text{V}_2\text{O}_5 + 5 \text{Ca} \rightarrow 5 \text{CaO} + 2 \text{V}$
- $2 \text{C}_9\text{H}_6\text{O}_4 + 17 \text{O}_2 \rightarrow 18 \text{CO}_2 + 6 \text{H}_2\text{O}$
- $\text{H}_2\text{S} + \text{PbCl}_2 \rightarrow \text{PbS} + 2 \text{HCl}$
- $2 \text{C}_3\text{H}_7\text{OH} + 9 \text{O}_2 \rightarrow 6 \text{CO}_2 + 8 \text{H}_2\text{O}$
- $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$
- $\text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2 \rightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$
- $\text{C}_2\text{H}_5\text{OH} + 3 \text{O}_2 \rightarrow 2 \text{CO}_2 + 3 \text{H}_2\text{O}$
- $2 \text{Al} + 3 \text{H}_2\text{SO}_4 \rightarrow 3 \text{H}_2 + \text{Al}_2(\text{SO}_4)_3$
- $2 \text{FeCl}_3 + 3 \text{Ca}(\text{OH})_2 \rightarrow 2 \text{Fe}(\text{OH})_3 + 3 \text{CaCl}_2$
- $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{CrO}_4 \rightarrow \text{PbCrO}_4 + 2 \text{KNO}_3$
- $\text{Cd}(\text{NO}_3)_2 + (\text{NH}_4)_2\text{S} \rightarrow \text{CdS} + 2 \text{NH}_4\text{NO}_3$
- $\text{Ca}(\text{OH})_2 + 2 \text{NH}_4\text{Cl} \rightarrow 2 \text{NH}_3 + \text{CaCl}_2 + 2 \text{H}_2\text{O}$

### Applying Knowledge

#### Word equations

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- $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$
- $\text{Fe}_2\text{O}_3 + 3 \text{H}_2 \rightarrow 3 \text{H}_2\text{O} + 2 \text{Fe}$
- $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
- $\text{Ca}_2\text{C} + \text{O}_2 \rightarrow 2 \text{Ca} + \text{CO}_2$
- $2 \text{KI} + \text{Cl}_2 \rightarrow 2 \text{KCl} + \text{I}_2$
- $4 \text{Cr} + 3 \text{SnCl}_4 \rightarrow 4 \text{CrCl}_3 + 3 \text{Sn}$
- $\text{Mg} + \text{CuSO}_4 \rightarrow \text{MgSO}_4 + \text{Cu}$
- $\text{ZnSO}_4 + \text{SrCl}_2 \rightarrow \text{ZnCl}_2 + \text{SrSO}_4$
- $3 \text{NH}_4\text{Cl} + \text{Pb}(\text{NO}_3)_2 \rightarrow 3 \text{NH}_4\text{NO}_3 + \text{PbCl}_2$
- $2 \text{Fe}(\text{NO}_3)_3 + 3 \text{MgS} \rightarrow \text{Fe}_2\text{S}_3 + 3 \text{Mg}(\text{NO}_3)_2$
- $2 \text{AlCl}_3 + 3 \text{Na}_2\text{CO}_3 \rightarrow \text{Al}_2(\text{CO}_3)_3 + 6 \text{NaCl}$
- $2 \text{Na}_3\text{PO}_4 + 3 \text{Ca}(\text{OH})_2 \rightarrow 6 \text{NaOH} + \text{Ca}_3(\text{PO}_4)_2$

## Extension

### Chemical reactions and chemical equations

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- iron + oxygen  $\rightarrow$  iron(II) oxide  
 $2\text{Fe} + \text{O}_2 \rightarrow 2 \text{FeO}$
- hydrogen chloride + sodium carbonate  $\rightarrow$  carbon dioxide + sodium chloride + water  
 $2 \text{HCl} + \text{Na}_2\text{CO}_3 \rightarrow \text{CO}_2 + 2 \text{NaCl} + \text{H}_2\text{O}$
- aluminum + oxygen  $\rightarrow$  aluminum oxide  
 $4 \text{Al} + 3 \text{O}_2 \rightarrow 2 \text{Al}_2\text{O}_3$
- water + sodium oxide  $\rightarrow$  sodium hydroxide  
 $\text{H}_2\text{O} + \text{Na}_2\text{O} \rightarrow 2 \text{NaOH}$
- hydrogen + nitrogen trifluoride  $\rightarrow$   
nitrogen + hydrogen fluoride  
 $3 \text{H}_2 + 2 \text{NF}_3 \rightarrow \text{N}_2 + 6 \text{HF}$
- chromium(III) sulphate + potassium carbonate  $\rightarrow$   
chromium(III) carbonate + potassium sulphate  
 $\text{Cr}_2(\text{SO}_4)_3 + 3 \text{K}_2\text{CO}_3 \rightarrow \text{Cr}_2(\text{CO}_3)_3 + 3 \text{K}_2\text{SO}_4$
- potassium chlorate  $\rightarrow$  oxygen + potassium chloride  
 $2 \text{KClO}_3 \rightarrow 3 \text{O}_2 + 2 \text{KCl}$
- zinc + copper(II) sulphate  $\rightarrow$  copper + zinc sulphate  
 $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$

### Assessment

#### Chemical equations

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1. B 2. A 3. E 4. D 5. F 6. C 7. G 8. D 9. D 10. D 11. A  
12. C 13. B

## Chapter 5 Compounds are classified in different ways.

### Section 5.1 Acids and Bases

#### Applying Knowledge

#### pH scale and pH indicators

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- (a) chemical that changes colour depending on the pH of the solution it is placed in  
(b) number scale for measuring how acidic or basic a solution is
- (a)

Substance	pH Value	Acid or Base	Methyl Orange	Bromothymol Blue	Litmus
lemon	2	acid	red	yellow	red
ammonia	11	base	yellow	blue	blue
milk	6	acid	yellow	yellow	red