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

1. (a) atomic number
(b) symbol
(c) name
(d) average atomic mass
(e) common ion charge
(f) other ion charge

2. (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
lithium	3	0	**3**	**3**	**4**
calcium	**20**	2+	20	**18**	**20**
nitrogen	**7**	3–	**7**	**10**	**7**
boron	5	0	**5**	**5**	**6**
argon	**18**	**0**	**18**	18	**22**
aluminum	13	**3+**	**13**	10	**14**
chlorine	**17**	0	**17**	**17**	**19**
sodium	**11**	**1+**	11	10	**12**

Applying Knowledge

Bohr diagrams

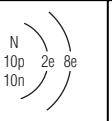
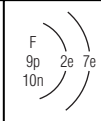
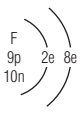
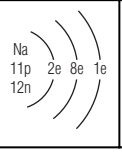
Page 61

1. (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

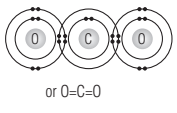
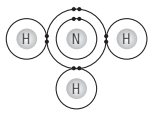
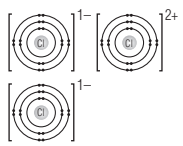
2.

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_2)	ammonia (NH_3)	calcium chloride ($CaCl_2$)
		

Illustrating Concepts

Lewis diagrams

Page 62

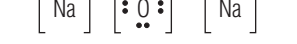
1. (a) a diagram that illustrates chemical bonding by showing only an atom's valence electrons and the chemical symbol
(b) pair of electrons in the valence shell that is not used in bonding
(c) pair of electrons involved in a covalent bond

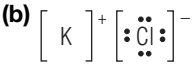
2. (a) 

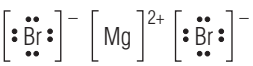
(b) 

(c) 

(d) 

3. (a) 

(b) 

(c) 

4. (a) 

(b) 

(c) 

5. (a) 

(b) 

(c)

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^{2+}	O^{2-}	PbO	lead(II) oxide
(b)	Sb^{4+}	S^{2-}	**SbS_2**	**antimony(IV) sulphide**
(c)	**Tl^+**	**Cl^-**	TlCl	**thallium(I) chloride**
(d)	**Sn^{2+}**	**F^-**	**SnF_2**	tin(II) fluoride
(e)	**Mo^{3+}**	**S^{2-}**	Mo_2S_3	**molybdenum(III) sulphide**
(f)	Rh^{4+}	Br^-	**$RhBr_4$**	**rhodium(IV) bromide**
(g)	**Cu^+**	**Te^{2-}**	**Cu_2Te**	copper(I) telluride
(h)	**Nb^{5+}**	**I^-**	NbI_5	**niobium(V) iodide**
(i)	Pd^{2+}	Cl^-	**$PdCl_2$**	**palladium(II) chloride**

3. (a) $MnCl_2$

(b) Cr_2S_3

(c) TiO_2

(d) UF_6

(e) NiS

(f) V_2O_5

(g) Re_3Ar_7

(h) Pt_3N_4

(i) $NiCN_2$

(j) Bi_3P_5

4.

	Ions	Formula	Compound name
(a)	K^+ NO_3^-	KNO_3	potassium nitrate
(b)	Ca^{2+} CO_3^{2-}	**$CaCO_3$**	**calcium carbonate**
(c)	Li^+ HSO_4^-	**$LiHSO_4$**	**lithium bisulphate or lithium hydrogen sulphate**
(d)	Mg^{2+} SO_3^{2-}	**$MgSO_3$**	**magnesium sulphite**
(e)	Sr^{2+} CH_3COO^-	**$Sr(CH_3COO)_2$**	**strontium acetate**
(f)	NH_4^+ $Cr_2O_7^{2-}$	**$(NH_4)_2Cr_2O_7$**	**ammonium dichromate**
(g)	Na^+ MnO_4^-	**$NaMnO_4$**	**sodium permanganate**
(h)	Ag^+ ClO_3^-	**AgClO**	**silver hypochlorite**
(i)	Cs^+ OH^-	**CsOH**	**cesium hydroxide**
(j)	Ba^{2+} CrO_4^{2-}	**$BaCrO_4$**	**barium chromate**

5. (a) $Ba(HSO_4)_2$

(b) $NaClO_3$

(c) K_2CrO_4

(d) $Ca(CN)_2$

(e) KOH

(f) $Ca_3(PO_4)_2$

(g) $Al_2(SO_4)_3$

(h) $CdCO_3$

(i) $AgNO_2$

(j) NH_4HCO_3

Comprehension

Chemical names and formulas of ionic compounds

Page 70

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) $AlBr_3$
(b) PtS
(c) $SrSO_3$
(d) Sc_2O_3
(e) $Ti(NO_2)_4$
(f) $(NH_4)_2SO_4$
(g) Li_2Se
(h) $Pb(HSO_4)_2$
(i) $NaCH_3COO$
(j) CsCl
(k) $Cd(OH)_2$
(l) $Zn_3(PO_4)_2$
(m) $BaCl_2$
(n) $Sn(MnO_4)_2$
(o) LiClO
(p) $Au_2(SO_4)_3$
(q) $NaNO_3$
(r) $CrCl_3$
(s) K_2CO_3
(t) $Fe(HSO_4)_3$

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

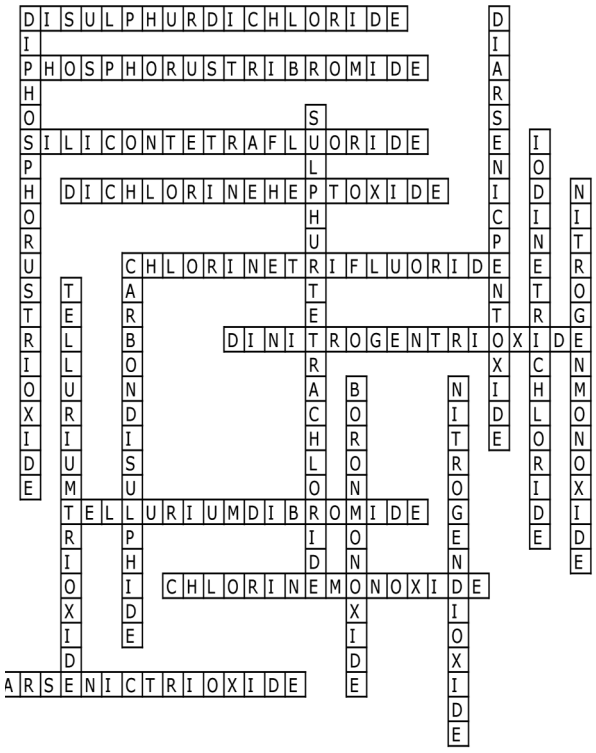
2. covalent bond

3. prefixes: mono, di, tri, tetra, penta, hexa, hepta, octa, nona, deca

4. (a) SiO_2
(b) ClO_2
(c) TeO_2
(d) SeO_3
(e) CS_2
(f) $AsCl_3$
(g) ClO_7
(h) SeF_2
(i) N_2O_5
(j) N_2O
(k) $AsBr_4$
(l) $AsCl_5$
(m) S_2O_5
(n) SCl
(o) PCl_3
(p) P_2O_5

5.

COVALENT COMPOUNDS



Word List
Arsoenic trioxide
Boron monoxide
Carbon disulphide
Chlorine monoxide
Diarsenic pentoxide
Dichlorine heptoxide
Dinitrogen trioxide
Disulphur dichloride
Iodine trichloride
Nitrogen dioxide
Nitrogen monoxide
Phosphorus tribromide
Silicon tetrafluoride
Sulphur tetrachloride
Tellurium dibromide
Tellurium trioxide

ACROSS
1. S_2Cl_2
3. PBr_3
5. SiF_4
7. Cl_2O_7
9. ClF_3
11. N_2O_3
14. $TeBr_2$
15. ClO
16. AsO_3

DOWN
1. P_2O_3
2. As_2O_5
4. SCl_4
6. ICl_3
8. NO
9. CS_2
10. TeO_3
12. BO
13. NO_2

Assessment

Names and formulas of compounds

Page 73

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

Page 77

1. $H_2 + F_2 \rightarrow 2\ HF$

2. $2\ Sn + O_2 \rightarrow 2\ SnO$

3. $MgCl_2 \rightarrow Mg + Cl_2$

4. $2\ KNO_3 \rightarrow 2\ KNO_2 + O_2$

5. $2\ BN + 3\ F_2 \rightarrow 2\ BF_3 + N_2$

6. $CuI_2 + Fe \rightarrow FeI_2 + Cu$

7. $2\ Li + 2\ H_2O \rightarrow 2\ LiOH + H_2$

8. $4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$

9. $V_2O5 + 5\ Ca \rightarrow 5\ CaO + 2\ V$

10. $2\ C_9H_6O_4 + 17\ O_2 \rightarrow 18\ CO_2 + 6\ H_2O$

11. $H_2S + PbCl_2 \rightarrow PbS + 2\ HCl$

12. $2\ C_3H_7OH + 9\ O_2 \rightarrow 6\ CO_2 + 8\ H_2O$

13. $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

14. $C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$

15. $C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

16. $2\ Al + 3\ H_2SO4 \rightarrow 3\ H_2 + Al_2(SO_4)_3$

17. $2\ FeCl_3 + 3\ Ca(OH)_2 \rightarrow 2\ Fe(OH)_3 + 3\ CaCl_2$

18. $Pb(NO_3)_2 + K_2CrO_4 \rightarrow PbCrO_4 + 2\ KNO_3$

19. $Cd(NO_3)_2 + (NH_4)_2S \rightarrow CdS + 2\ NH_4NO_3$

20. $Ca(OH)_2 + 2\ NH_4Cl \rightarrow 2\ NH_3 + CaCl_2 + 2\ H_2O$

Applying Knowledge

Word equations

Page 78

1. $2\ H_2 + O_2 \rightarrow 2\ H_2O$

2. $Fe_2O_3 + 3\ H_2 \rightarrow 3\ H_2O + 2\ Fe$

3. $2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$

4. $Ca_2C + O_2 \rightarrow 2\ Ca + CO_2$

5. $2\ KI + Cl_2 \rightarrow 2KCl + I_2$

6. $4\ Cr + 3\ SnCl_4 \rightarrow 4\ CrCl_3 + 3\ Sn$

7. $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

8. $ZnSO_4 + SrCl_2 \rightarrow ZnCl_2 + SrSO_4$

9. $3\ NH_4Cl + Pb(NO_3)_3 \rightarrow 3\ NH_4NO_3 + PbCl_3$

10. $2\ Fe(NO_3)_3 + 3\ MgS \rightarrow Fe_2S_3 + 3\ Mg(NO_3)_2$

11. $2\ AlCl_3 + 3\ Na_2CO_3 \rightarrow Al_2(CO_3)_3 + 6\ NaCl$

12. $2\ Na_3PO_4 + 3\ Ca(OH)_2 \rightarrow 6\ NaOH + Ca_3(PO_4)_2$

Extension

Chemical reactions and chemical equations

Page 79

1. iron + oxygen → iron(II) oxide

$2Fe + O_2 \rightarrow 2\ FeO$

2. hydrogen chloride + sodium carbonate → carbon dioxide + sodium chloride + water

$2\ HCl + Na_2CO_3 \rightarrow CO_2 + 2\ NaCl + H_2O$

3. aluminum + oxygen → aluminum oxide

$4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$

4. water + sodium oxide → sodium hydroxide

$H_2O + Na_2O \rightarrow 2\ NaOH$

5. hydrogen + nitrogen trifluoride → nitrogen + hydrogen fluoride

$3\ H_2 + 2\ NF_3 \rightarrow N_2 + 6\ HF$

6. chromium(III) sulphate + potassium carbonate → chromium(III) carbonate + potassium sulphate

$Cr_2(SO4)_3 + 3\ K_2CO_3 \rightarrow Cr_2(CO_3)_3 + 3\ K_2SO_4$

7. potassium chlorate → oxygen + potassium chloride

$2\ KClO_3 \rightarrow 3\ O_2 + 2\ KCl$

8. zinc + copper(II) sulphate → copper + zinc sulphate

$Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

Assessment

Chemical equations

Page 80

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

Page 84

1. (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

2. (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