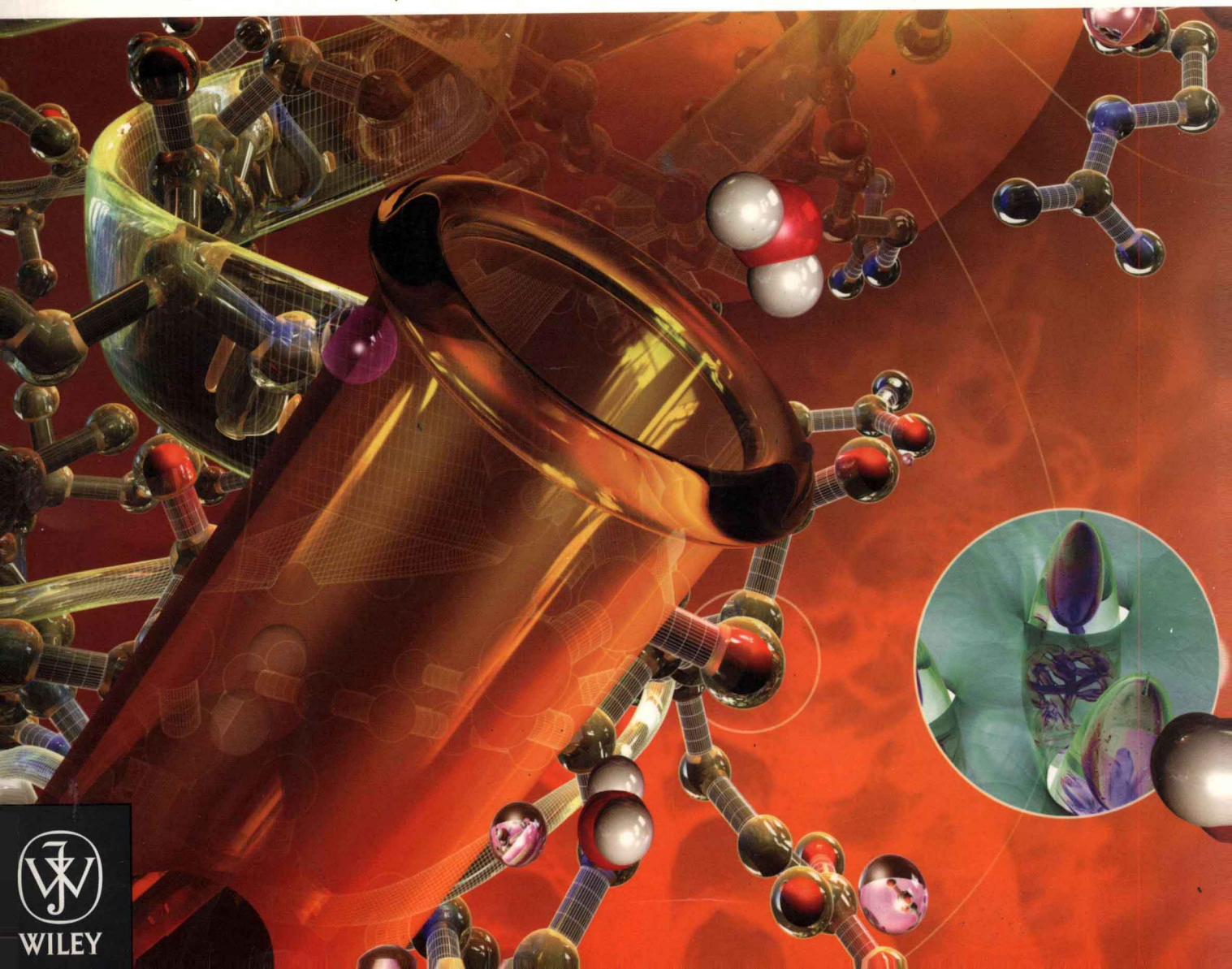


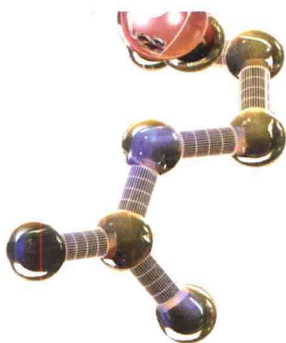
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1	1	2	atomic number										chemical symbol										18
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17						
2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
	H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar					
3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
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4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
	H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar					
5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
	H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar					
6	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18					
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*lanthanide series	57	La	138.9	58	Ce	140.1	59	Pr	140.9	60	Nd	144.2	61	Pm	(145)	62	Sm	150.4	63	Eu	152.0	64	Gd	157.3	65	Tb	158.9	66	Dy	162.5	67	Ho	164.9	68	Er	167.3	69	Tm	168.9	70	Yb	173.0	71	Lu	175.0	
	**actinide series	89	Ac	(227)	90	Th	232.0	91	Pa	231.0	92	U	238.0	93	Np	(237)	94	Pu	(244)	95	Am	(243)	96	Cm	(247)	97	Bk	(247)	98	Cf	(251)	99	Es	(252)	100	Fm	(257)	101	Md	(258)	102	No	(259)	103	Lr	(262)

Name	Symbol	Atomic number	Atomic mass (g mol ⁻¹) ^(a)	Name	Symbol	Atomic number	Atomic mass (g mol ⁻¹) ^(a)
actinium	Ac	89	227.0278 ^(a)	neodymium	Nd	60	144.242(3)
aluminium	Al	13	26.981 5386(8)	neon	Ne	10	20.1797(6)
americium	Am	95	241.0568 ^(a)	neptunium	Np	93	237.0482 ^(a)
antimony	Sb	51	121.760(1)	nickel	Ni	28	58.6934(2)
argon	Ar	18	39.948(1)	niobium	Nb	41	92.906 38(2)
arsenic	As	33	74.921 60(2)	nitrogen	N	7	14.0067(2)
astatine	At	85	209.9871 ^(a)	nobelium	No	102	259.1010 ^(a)
barium	Ba	56	137.327(7)	osmium	Os	76	190.23(3)
berkelium	Bk	97	247.0703 ^(a)	oxygen	O	8	15.9994(3)
beryllium	Be	4	9.012 182(3)	palladium	Pd	46	106.42(1)
bismuth	Bi	83	208.980 40(1)	phosphorus	P	15	30.973 762(2)
bohrium	Bh	107	272.1380 ^(a)	platinum	Pt	78	195.084(9)
boron	B	5	10.811(7)	plutonium	Pu	94	244.0642 ^(a)
bromine	Br	35	79.904(1)	polonium	Po	84	208.9824 ^(a)
cadmium	Cd	48	112.411(8)	potassium	K	19	39.0983(1)
caesium	Cs	55	132.905 4519(2)	praseodymium	Pr	59	140.907 65(2)
calcium	Ca	20	40.078(4)	promethium	Pm	61	144.9127 ^(a)
californium	Cf	98	251.0796 ^(a)	protactinium	Pa	91	231.035 88(2) ^(b)
carbon	C	6	12.0107(8)	radium	Ra	88	226.0254 ^(a)
cerium	Ce	58	140.116(1)	radon	Rn	86	222.0176 ^(a)
chlorine	Cl	17	35.453(2)	roentgenium	Rg	111	280.1645 ^(a)
chromium	Cr	24	51.9961(6)	rhenium	Re	75	186.207(1)
cobalt	Co	27	58.933 195(5)	rhodium	Rh	45	102.905 50(2)
copper	Cu	29	63.546(3)	rubidium	Rb	37	85.4678(3)
curium	Cm	96	247.0704 ^(a)	ruthenium	Ru	44	101.07(2)
darmstadtium	Ds	110	281.162 ^(a)	rutherfordium	Rf	104	267.1215 ^(a)
dubnium	Db	105	268.1255 ^(a)	samarium	Sm	62	150.36(2)
dysprosium	Dy	66	162.500(1)	scandium	Sc	21	44.955 912(6)
einsteinium	Es	99	252.0830 ^(a)	seaborgium	Sg	106	271.1355 ^(a)
erbium	Er	68	167.259(3)	selenium	Se	34	78.96(3)
europium	Eu	63	151.964(1)	silicon	Si	14	28.0855(3)
fermium	Fm	100	257.0951 ^(a)	silver	Ag	47	107.8682(2)
fluorine	F	9	18.998 4032(5)	sodium	Na	11	22.989 769 28(2)
francium	Fr	87	223.0197 ^(a)	strontium	Sr	38	87.62(1)
gadolinium	Gd	64	157.25(3)	sulfur	S	16	32.065(5)
gallium	Ga	31	69.723(1)	tantalum	Ta	73	180.947 88(2)
germanium	Ge	32	72.64(1)	technetium	Tc	43	97.9072 ^(a)
gold	Au	79	196.966 569(4)	tellurium	Te	52	127.60(3)
hafnium	Hf	72	178.49(2)	terbium	Tb	65	158.925 35(2)
hassium	Hs	108	277.150 ^(a)	thallium	Tl	81	204.3833(2)
helium	He	2	4.002 602(2)	thorium	Th	90	232.038 06(2) ^(b)
holmium	Ho	67	164.930 32(2)	thulium	Tm	69	168.934 21(2)
hydrogen	H	1	1.007 94(7)	tin	Sn	50	118.710(7)
indium	In	49	114.818(3)	titanium	Ti	22	47.867(1)
iodine	I	53	126.904 47(3)	tungsten	W	74	183.84(1)
iridium	Ir	77	192.217(3)	ununbium ^(c)	Uub	112	285.174 ^(a)
iron	Fe	26	55.845(2)	ununhexium ^(c)	Uuh	116	(d)
krypton	Kr	36	83.798(2)	ununoctium ^(c)	Uuo	118	(d)
lanthanum	La	57	138.905 47(7)	ununpentium ^(c)	Uup	115	288.192 ^(a)
lawrencium	Lr	103	262.1096 ^(a)	ununquadium ^(c)	Uuq	114	289.189 ^(a)
lead	Pb	82	207.2(1)	ununtrium ^(c)	Uut	113	284.178 ^(a)
lithium	Li	3	6.941(2)	uranium	U	92	238.028 91(3) ^(b)
lutetium	Lu	71	174.967(1)	vanadium	V	23	50.9415(1)
magnesium	Mg	12	24.3050(6)	xenon	Xe	54	131.293(6)
manganese	Mn	25	54.938 045(5)	ytterbium	Yb	70	173.04(3)
meitnerium	Mt	109	276.1512 ^(a)	yttrium	Y	39	88.905 85(2)
mendelevium	Md	101	258.0984 ^(a)	zinc	Zn	30	65.409(4)
mercury	Hg	80	200.59(2)	zirconium	Zr	40	91.224(2)
molybdenum	Mo	42	95.94(2)				

(a) All known significant digits are given. Parentheses indicate that the digit is uncertain.

(b) Element has no stable nuclides. The atomic mass of the longest lived isotope is given.

(c) Unnamed at July 2007

(d) Accurate atomic mass has not yet been determined.

Source: Weiser, ME, 'Atomic weights of the elements 2005' *Pure Appld. Chem.* vol. 78, no. 11, pp. 2051–66, © IUPAC 2006

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The primary goal of *Chemistry* is to present organic, inorganic and physical chemistry concepts in a manner that is appropriate for the majority of Australasian chemistry courses. In particular, the presentation of the content recognises that, in Australasia, organic chemistry is a major component of the typical first-year curriculum and, accordingly, organic concepts are introduced early and integrated throughout the book.

Chemistry is also supported by numerous engaging local examples designed to highlight the connections between chemistry and the world around you. A hallmark feature of the text is the showcasing of some inspirational local research work that relates to the chemical concepts taught in each chapter. These research profiles will help you to appreciate the positive contribution that chemistry has made and will continue to make to our lives. Our thanks goes out to the following researchers who provided information and/or materials for these profiles.

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Chapter 3: Chemical Reactions and Stoichiometry

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Stoichiometry (from the Greek *stoicheion* meaning 'element' and *metreia* meaning 'measuring') is concerned with the relative amounts of reactants and products in a chemical reaction. In the equation for the reaction of hydrogen and oxygen, the number 2 precedes the formulae of hydrogen and water. The numbers in front of the formulae are called **stoichiometric coefficients**, and they indicate the number of molecules of each kind among the reactants and products. Thus, 2H_2 means 2 molecules of H_2 , and $2\text{H}_2\text{O}$ means 2 molecules of H_2O . When no number is written, the stoichiometric coefficient is 1 (so the coefficient of O_2 equals 1). Stoichiometric coefficients can also refer to ions or atoms.

Stoichiometric coefficients are used to ensure the equation conforms to the law of conservation of mass. Because atoms cannot be created or destroyed in a chemical reaction, we must have the same number of atoms of each kind present before and after the reaction (i.e. on both sides of the arrow), as shown in figure 3.1. When this condition is met, we say the equation is a **balanced chemical equation**. Another example is the equation for the reaction of butane, C_4H_{10} , with oxygen, O_2 (a combustion reaction). Butane is the fluid in camp burners (figure 3.2).

FIGURE 3.1 The reaction between 2 molecules of hydrogen and 1 molecule of oxygen to form 2 molecules of water.

2 molecules of C_4H_{10} | 13 molecules of O_2 | 8 molecules of CO_2

3.23 Balance the chemical equations for...

☐ Your answer is incorrect. Try again.

Balance the chemical equations for the following reactions:

a) Nitrogen oxide and ammonia react to give nitrogen and water.

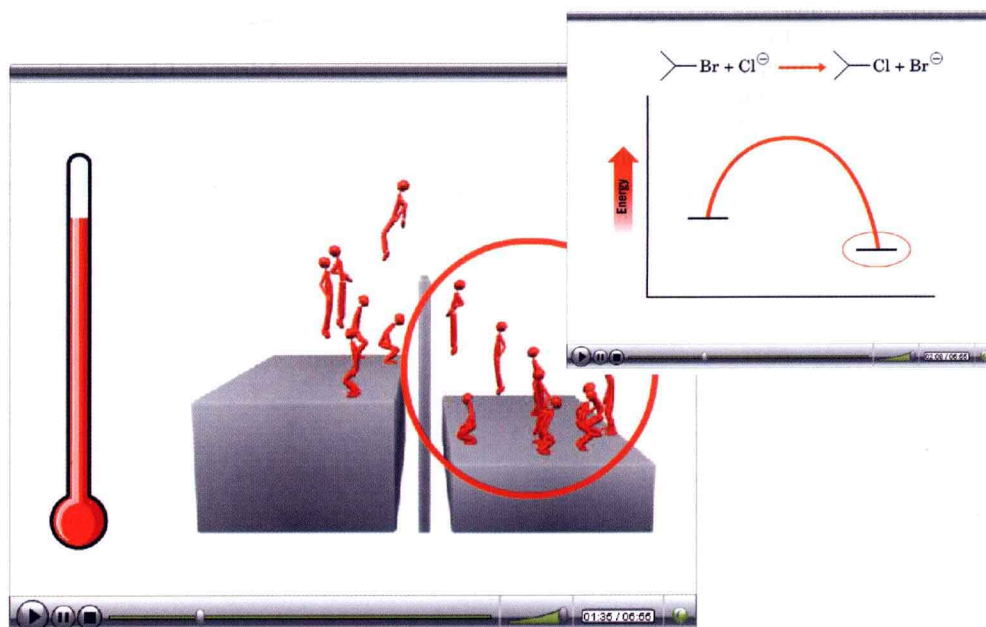
$6\text{NO} + 4\text{NH}_3 \rightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$

b) Water and nitrogen oxide react to give molecular oxygen and ammonia.

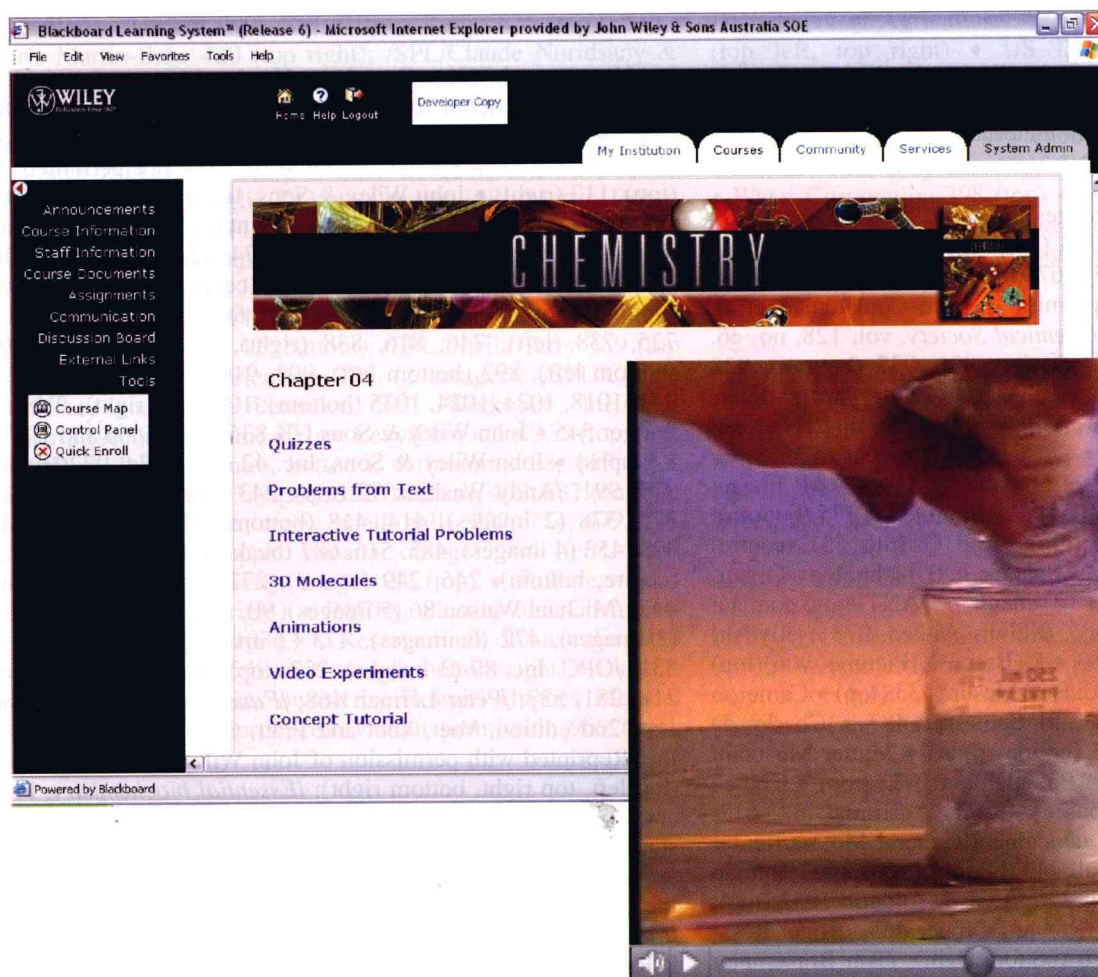
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