BC Science 10 Workbook Answers

Unit 1: Sustaining Earth's Ecosystems

Chapter 1 Biomes and ecosystems are divisions of the biosphere.

Section 1.1 Biomes

Cloze Activity

Biomes and ecosystems

Page 4

1. biotic
2. abiotic
3. biome
4. terrestrial
5. temperature; precipitation
6. latitude
7. elevation
8. ocean currents
9. climatograph
10. adaptations
11. structural; physiological; behavioural

Applying Knowledge

Various biomes

Page 5

BIOME	LOCATION(S)	PHYSICAL FEATURES
tundra	upper northern hemisphere	• layer of permanently frozen soil (permafrost) • flat terrain cold and dark most of year
boreal forest	northern hemisphere	• short summer growing season • many marshes, shallow lakes, and wetlands soil is very wet
temperate deciduous forest	eastern Canada, eastern United States, eastern Asia, and western Europe	• large seasonal changes • four distinct seasons • long warm growing season • enriched soil
temperate rainforest	coast of Chile, northwest coast of North America, New Zealand, southern Australia	• narrow strips along coastlines backed by mountains • ocean winds • large amounts of moisture on windward side of mountains
Grassland (temperate and tropical)	temperate: centre of North America (prairies) and in Russia (steppes) tropical: north and south of equator in Africa, South America, northern Australia	• flat land • strong winds • temperate: rich, fertile soil • tropical: heavy rain • precipitation followed by dry period
tropical rainforest	around the equator: northern South America, Central America, central Africa, and southeast Asia	• poor soil • heavy rain • limited plant growth on forest floor due to canopy

desert (hot and cold)	every continent	• hot desert:
		  • very little rainfall or a lot in very short time period
		  • salty soil
		• cold desert:
		  • snow and spring rain
		  • salty soil, little erosion

permanent ice (polar ice)	polar land masses and ice caps of Arctic, Greenland, and Antarctica	• strong winds • little soil • limited fresh water • very cold year round

Interpreting Illustrations

Climatographs

Page 6

A. permanent ice
B. boreal forest
C. temperate rainforest
D. grassland
E. desert (hot)
F. tropical rainforest

Assessment

Biomes

Page 7

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

Section 1.2 Ecosystems

Comprehension

Parts of an ecosystem

Page 10

1. An ecosystem has abiotic components that interact with biotic components, while a habitat is the place in which an organism lives.
2. Three main abiotic components of ecosystems are (any three of) oxygen, water, nutrients, light, and soil.
3. A population refers to all the members of a particular species within an ecosystem, while a community is all the populations of different species within an ecosystem.
4. Symbiosis is the interaction between members of two different species that live together in a close association.
5. Commensalism is a symbiotic relationship in which one species benefits and the other species is not helped or harmed.
6. Mutualism is a symbiotic relationship in which both organisms benefit, while parasitism is a symbiotic relationship in which one species benefits and the other is harmed.
7. Predation is where one organism eats all or part of another organism.

Interpreting illustrations

Biotic interactions in ecosystems

Page 11

1. I. organism
   II. ecosystem
   III. population
   IV. community
   V. biosphere
2. | | |
   |---|---|
   | Largest | Biosphere |
   | | Ecosystem |
   | | Community |
   | | Population |
   | Smallest | Organism |
3. Lists will vary but should include a variety of plants and animals.

Applying Knowledge

Symbiotic relationships

Page 12

1. Term: Mutualism

   Explanation: Both organisms benefit. The ant gets its food and shelter while the plant is protected from insects.
2. Term: Competition

   Explanation: Harmful interaction between two or more organisms as they compete for the same resource. The knapweed prevents other species from populating the soil by releasing a chemical.
3. Term: Predation

   Explanation: One organism (predator) eats all or part of another organism (the prey). The lynx is the predator and the snowshoe hare is the prey.
4. Term: Commensalism

   Explanation: One species benefits and the other species is not helped or harmed.

   The Spanish moss captures nutrients and moisture from the air with no harmful effects on the trees.
5. Term: Parasitism

   Explanation: One species benefits and another is harmed. The pine beetle has its food source and the pine tree is destroyed.

Assessment

Ecosystems

Page 13

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

Chapter 2 Energy flow and nutrient cycles support life in ecosystems.

Section 2.1 Energy Flow in Ecosystems

Cloze activity

Energy flow

Page 16

1. biomass
2. energy flow
3. photosynthesis
4. consumer
5. decomposition
6. biodegradation
7. decomposers
8. food chains; trophic
9. primary producers
10. primary consumers; secondary consumers
11. tertiary consumers
12. food webs; food pyramids

Interpreting Illustrations

Food chains, food webs, and food pyramids

Page 17

1. bunchgrass, algae

2. third trophic level
3. secondary consumers
4. primary consumer
5. secondary or tertiary consumer
6. earthworms, beetles, small insects, bacteria, fungi
7. a model that shows the loss of energy from one trophic level to another
8. producers, such as plants
9. carnivores, such as great horned owls

Illustrating Concepts
Modelling a local ecosystem
Page 19

1. Student should include 12 organisms and cover all four trophic levels.
2. Food chain: student should include four trophic levels: primary producers, primary consumers, secondary consumers, and tertiary consumers.
3. Food web: student should include interconnecting arrows between various organisms to demonstrate the feeding relationships.
4. Food pyramid: student should show a series of boxes decreasing in size from bottom to top. The pyramid should include producers, herbivores, carnivores, and top carnivores.

Assessment
Energy flow in ecosystems
Page 20

1. C **2.** F **3.** H **4.** A **5.** E **6.** G **7.** B **8.** D **9.** D **10.** A **11.** B
12. C **13.** D **14.** D

Section 2.2 Nutrient Cycles in Ecosystems

Comprehension
Nutrient cycles
Page 24

1. Nutrients are stored in Earth's atmosphere, oceans, and land masses.
2. Biotic processes, such as decomposition, and abiotic processes, such as river run-off, can cause nutrients to flow in and out of stores.
3. Photosynthesis converts solar energy into chemical energy. Carbon, in the form of carbon dioxide, enters through the leaves of plants and, in the presence of sunlight, reacts with water to produce carbohydrates and oxygen.
4. Cellular respiration involves carbohydrates reacting with oxygen to form carbon dioxide, water, and energy.
5. Decomposers, such as bacteria and fungi, convert organic molecules, such as cellulose, back into carbon dioxide, which is then released into the atmosphere.
6. Nitrogen fixation is the process in which nitrogen gas is converted into compounds that contain nitrate or ammonium.
7. Denitrification is a process by which denitrifying bacteria, using a series of chemical reactions, convert nitrate back into nitrogen gas.
8. Eutrophication is the process by which excess nutrients result in increased plant production and decay in aquatic ecosystems.

Interpreting Illustrations
The cycling of nutrients in the biosphere
Page 25

1. Human activities that can affect a nutrient cycle could include land clearing, agriculture, urban expansion, mining, industry, and motorized transportation.
2. These human activities increase the amounts of nutrients in a cycle faster than natural biotic and abiotic processes can move them back into stores.
3. Terms and arrows could be similar to Fig 2.17 on page 70. Students may also add other facts or effects that they have thought of.
4. Changes in the carbon, nitrogen, and phosphorus cycles can affect the health and variety of organisms that live in an ecosystem.
5. Answers will vary but they should include a human activity, a description of the activity, and its impact on a specific part of the local ecosystem.

Applying Knowledge
The carbon, nitrogen, and phosphorus cycles
Page 26

The carbon cycle

Why is the carbon cycle important?	cellular respiration provides energy for living things
How is carbon stored?	short term: vegetation, land and marine animals, decaying organic material, carbon dioxide in its dissolved form long term: dissolved carbon dioxide in deeper ocean waters; coal, oil, and gas deposits; marine sediments and sedimentary rock
How is carbon cycled?	photosynthesis, respiration, decomposition, ocean processes, volcanic eruptions, forest fires

Name several human activities that affect the carbon cycle.	industry, motorized transport, land clearing, agriculture, urban expansion

The nitrogen cycle

Why is the nitrogen cycle important?	component of DNA, proteins, muscle function in animals; growth of plants
How is nitrogen stored?	nitrogen gas in atmosphere, oceans, organic matter in soil
How is nitrogen cycled?	nitrogen fixation, nitrification, uptake, denitrification
Name several human activities that affect the nitrogen cycle.	fossil fuel combustion, power plants, sewage treatment, motorized forms of transport, clearing forests, grassland burning, chemical fertilizers leading to eutrophication

The phosphorus cycle

Why is the phosphorus cycle important?	carries energy to plant cells and animal cells; root development in plants; bone development
How is phosphorus stored?	phosphate rock; ocean floor sediments as PO_4^{-3}, HPO_4^{-2}, $H_2PO_4^{-}$
How is phosphorus cycled?	chemical weathering, physical weathering
Name several human activities that affect the phosphorus cycle.	commercial fertilization and detergents negatively affect species, causing fish death

Assessment

Nutrient cycles in ecosystems
Page 29

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

Section 2.3 Effects of Bioaccumulation on Ecosystems

Cloze activity

Bioaccumulation
Page 33

1. bioaccumulation
2. keystone species
3. biomagnification
4. producers
5. PCBs
6. half-life
7. persistent organic pollutants
8. parts per million
9. heavy metals
10. lead; cadmium; mercury
11. bioremediation

Applying Knowledge

Impact of bioaccumulation on consumers
Page 34

CHEMICAL	EFFECTS ON PRODUCERS, PRIMARY CONSUMERS, AND SECONDARY CONSUMERS	EFFECTS ON HUMANS
toxic organic chemicals from red tide	Produces toxic chemicals that affect clams, mussels, and oysters. Toxins bioaccumulate in fish and mammals.	Can cause paralytic shellfish poisoning, leading to serious illness or death.
DDT	Bioaccumulates in plants and then in fatty tissue of fish, birds, and animals that eat the plants. Affects aquatic food chains.	Changed into a chemical form that is stored in fat tissue. Can cause nervous system, immune system, and reproductive disorders.
lead	In fish and birds it can cause nervous system damage, affect fertility rates, kidney failure, and impair mental development.	Harmful effects range from anemia, nervous system damage, sterility in men, low fertility rates in women, impaired mental development, and kidney failure.
cadmium	Plants take up cadmium from the soil and pass it on to the animals that eat them. Highly toxic to earthworms and other soil organisms. In fish, cadmium contributes to higher death rates, and lower reproduction and growth rates.	Accumulates in lung tissues, causing lung diseases, such as cancer. Leads to infertility and damage to central nervous system, immune system, and DNA.
mercury	Bacteria change mercury into methylmercury, a toxin that accumulates in the brain, heart, and kidneys of vertebrates. Levels of methylmercury in fish depend on how high they are on the food chain.	Methylmercury is absorbed in digestion and enters the blood and then the brain. It affects nerve cells, heart, kidney, lungs, and it suppresses the immune system.

Comprehension
PCBs and the orca
Page 36

1. PCBs are synthetic chemicals. Their full chemical name is polychlorinated biphenyl.
2. PCBs were used for industrial products, such as heat exchange fluids, paints, plastics, and lubricants for electrical transformers.
3. PCBs stay in the environment for a long time. Aquatic ecosystems and species that feed on aquatic organisms are especially sensitive to the effects of PCBs. PCBs bioaccumulate and biomagnify and also have a long half-life.
4. PCBs become concentrated in the orca's blubber.
5. When salmon stocks are low, the orca's blubber is burned for energy. The PCBs are released into the orca's bloodstream and interfere with its immune system making it more susceptible to disease.
6. Diagram should be similar to Fig. 2.55 on page 95 of the student textbook. The pyramid should include the food chain for orcas and demonstrate the total PCB load that the orca is exposed to.

Assessment
Effects of bioaccumulation on ecosystems
Page 37

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

Chapter 3 Ecosystems continually change over time.

Section 3.1 How Changes Occur Naturally in Ecosystems

Cloze Activity
Change in ecosystems
Page 40

1. natural selection
2. adaptive radiation
3. ecological succession
4. primary succession
5. pioneer species
6. climax community
7. secondary succession
8. flooding
9. tsunami
10. drought
11. insect infestations

Analyzing Information
Primary and secondary succession
Page 41

1. Answer should include the following sequence:
   - Lichens begin to grow. This begins the process of soil formation.
   - Plants, such as mosses, begin to grow.
   - Insects, micro-organisms, and other organisms move in.
   - Grasses, wildflowers, and shrubs begin to grow. More insects and micro-organisms move in.
   - Tree seeds are transported by animals. Deciduous trees grow.
   - Coniferous trees germinate.
   - Mature community develops.
2. Answer should include the following sequence:
   - Exposed soil will contain micro-organisms, worms, and insects as well as the seeds of wildflowers, weeds, grasses, and trees.
   - Other seeds may blow in or be carried in by animals.
   - Deciduous trees grow.
   - Coniferous trees return.
   - Mature community may only take decades to establish.

Applying Knowledge
How natural events affect ecosystems
Page 42

NATURAL EVENT	EFFECTS ON MATURE COMMUNITY
Fire	• causes secondary succession • results in regrowth
Flooding	• causes soil erosion • results in soil and water pollution, leading to widespread disease
Tsunami	• water carries away or destroys plants and animals • disrupts habitats and foods webs • salt from salt water changes composition of soil
Drought	• destroys habitats • results in the death of plants and animals • leads to crop failures and livestock deaths
Insect Infestation	• results in losses to forest canopy • disrupts habitats and food webs

Assessment
How changes occur naturally in ecosystems
Page 43

1. B **2.** A **3.** D **4.** E **5.** C **6.** C **7.** D **8.** C **9.** B

Section 3.2 How Humans Influence Ecosystems

Comprehension

Sustainability

Page 46

1. Sustainability is the ability of an ecosystem to sustain ecological processes and maintain biodiversity over time. It also means that humans use natural resources in a way that maintains ecosystem health now and for future generations.
2. Habitat loss refers to the destruction of habitats while habitat fragmentation is the division of habitats into smaller, isolated fragments.
3. Deforestation is the practice in which forests are logged or cleared for human use and never reforested. This practice results in a reduction of the number of plants and animals living in an ecosystem. Erosion occurs since few plants are left to hold the soil in place. As a result of the erosion, nutrients are lost so plants are not able to grow.
4. Aeration, or breaking up compacted soil, reduces run-off by improving the movement of air and water through soil.
5. Examples of contamination due to mining could include introduction of chemicals, toxins, wastes, or micro-organisms into the environment.
6. Overexploitation can result in extinction of a species and a loss of genetic diversity. In turn, the populations are less resistant to disease and less able to adapt to changes in their environment.
7. Traditional ecological knowledge takes the form of stories, songs, cultural beliefs, rituals, community laws, and practices related to agriculture, forests, and ocean resources. It reflects the knowledge about local climate and resources, biotic and abiotic characteristics, and animal and plant cycles.

Applying Knowledge

Effects of human activities on ecosystems

Page 47

HUMAN ACTIVITY	EFFECTS ON ECOSYSTEM
deforestation	• reduction in number of plants and animals living in an ecosystem • erosion due to lack of plant roots holding soil in place • removal of nutrients from topsoil
agricultural practices, such as leaving fields bare during non-planting seasons	• wind erosion • soil compaction • hindering growth of plants • addition of excess nitrogen and pollutants due to increased run-off
exploitation of mining resources	• contamination of ground water and surface water through introduction of chemicals, toxins, wastes, or micro-organisms • contaminants affect local plant and animals
overexploitation of natural resources, such as fish	• reduction in population of particular fish • loss of genetic diversity in food web • species less resistant to disease and changes in environment

Analyzing Information

Sustainability

Page 48

EXAMPLE OF LAND USE	EFFECTS ON HABITAT	SUSTAINABLE APPROACH SUGGESTIONS
the conversion of grasslands into cattle ranches in the Interior of British Columbia	• livestock overgrazing • soil compaction • vehicles cause erosion and plant destruction • introduced plants compete with native plants	• grassland management programs • protection of natural grasslands • aeration • weed control
clear-cutting of forests on Vancouver Island	• erosion • stream habitat destruction	• forestry management practices that allow more trees to remain uncut • streambed restoration • less harmful road-building
urbanization of the Fraser Valley	• biodiversity loss • greater reliance on motorized vehicles • increased energy consumption	• redevelopment of industrial areas or buildings • mix of residence, business, and industry • waste treatment • storm water collection • native plantings • additional green areas

Assessment

How humans influence ecosystems

Page 49

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

Section 3.3 How Introduced Species Affect Ecosystems

Comprehension

Introduced species

Page 52

1. Native species are plants and animals that naturally inhabit an area.
2. An invasive species are organisms that can take over the habitat of native species or invade their bodies.
3. Invasive species often have high reproduction rates, are aggressive competitors, and lack natural predators in their new habitat. Exploiting the new niche, an invasive species can dramatically change an ecosystem.
4. An introduced species can affect a native species through competition, predation, disease, parasitism, and habitat alteration.
5. Examples could include Eurasian milfoil, purple loosestrife, Norway rat, American bullfrog, European starling, Scotch broom, English ivy, and invasive grasses.
6. Scotch broom, English ivy, and invasive grasses are competing with Garry oak trees.
7. Scotch broom produces up to 18 000 seeds per plant. Its yellow flower attracts bees for pollination and it is well adapted for drought.

Applying Knowledge

The impact of introduced invasive species

Page 53

Answers could vary depending on the ecosystem. Answers given are referenced from textbook pages 140–141.

METHOD	INVASIVE SPECIES	EFFECT ON ECOSYSTEM
competition	carpet burweed	• burweed competes with four native plants • spiny tips pierce skin of animals and humans
predation	yellow crazy ants	• ants build supercolonies • devour all plants and prey on young of reptiles, birds, and mammals • ants killed 20 million land crabs on Christmas Island
disease and/or parasites	parasitic lampreys blister rust	• lampreys use sucker-like mouths to attach to fish, then suck the body fluids from prey • blister rust fungus weakens whitebark pine tree defenses making it more vulnerable to insect infestations
habitat alteration	wild boars	• damage environment by rooting and wallowing • spread weeds that interfere with natural succession • eat native birds, reptiles, frogs, soil organisms, fruit, seeds, and bulbs • boars are considered world's most invasive species

Extension Activity

Invasive species in British Columbia

Page 54

Answers may include:

SPECIES	METHOD OF INTRODUCTION	EFFECT ON ENVIRONMENT
purple loosestrife	seeds from Europe in 1800s	• destroys wetlands and chokes out other plants • too dense to effectively shelter wildife
Eurasian milfoil	brought to North America in 1800s	• cuts off sunlight to organisms below • interferes with recreational activities
Norway rat	escaped from early European explorer and fur-trading ships	• feeds on any food source • eats eggs and young of ground-nesting sea birds, causing their decline
American bullfrog	brought to British Columbia in 1930s for frogs' legs in restaurants	• takes over habitats • eats native frogs • attacks ducks and small mammals
European starling	late 1800s, fifty pairs brought to North America	• outcompetes native birds for nesting sites • devastates fruit and grain crops
Scotch broom	Mid-1800s, introduced as decorative garden plant	• replaces native scrubs • ruins habitat for native birds and butterflies • creates an overload of nitrogen that interferes with growth of some native species

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

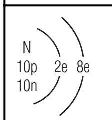
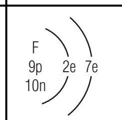
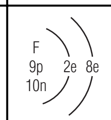
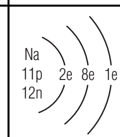
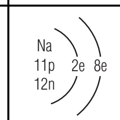
Page 61

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

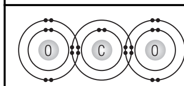
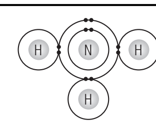
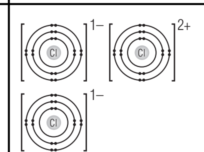
2.

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 ($CaCl_2$)
 or O=C=O		

Illustrating Concepts

Lewis diagrams

Page 62

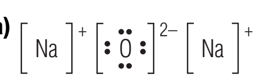
1. **(a)** a diagram that illustrates chemical bonding by showing only an atom's valence electrons and the chemical symbol
(b) pair of electrons in the valence shell that is not used in bonding
(c) pair of electrons involved in a covalent bond

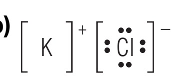
2. **(a)** 

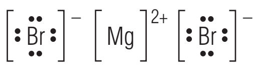
(b) 

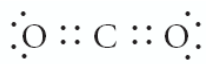
(c) 

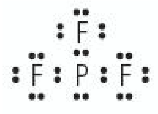
(d) 

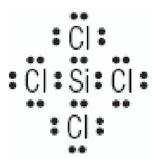
3. **(a)** 

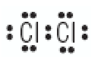
(b) 

(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

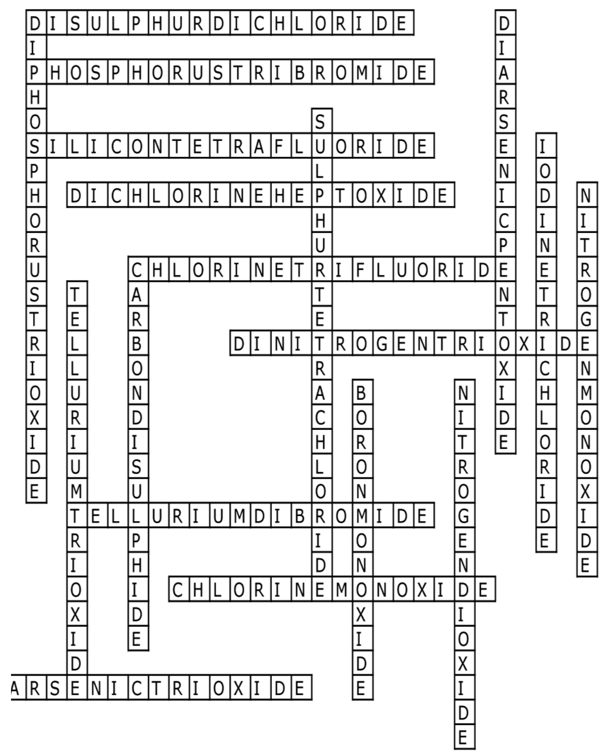
Chemical names and formulas of covalent compounds

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	DOWN
1. S_2Cl_2	1. P_2O_3
3. PBr_3	2. As_2O_5
5. SiF_4	4. SCl_4
7. Cl_2O_7	6. ICl_3
9. ClF_3	8. NO
11. N_2O_3	9. CS_2
14. $TeBr_2$	10. TeO_3
15. ClO	12. BO
16. AsO_3	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

(b)

Substance	pH Value	Acid or Base	Methyl Red	Phenolphthalein	Indigo Carmine
tomato	4	acid	red	colourless	blue
oven cleaner	13	base	yellow	pink	yellow
egg	8	base	yellow	colourless	blue

3.

Substance	pH Value	Acid or Base	pH Indicator	Colour of pH Indicator
black coffee	5	acid	litmus	red
milk of magnesia	10	base	phenolphthalein	pink
battery acid	0	acid	bromothymol blue	yellow
sea water	8	base	indigo carmine	blue
orange juice	3	acid	methyl orange	red
liquid drain cleaner	14	base	methyl red	yellow

Comprehension

Names of acids

Page 86

1. ate

2. ite

3. **(a)** carbonic acid

(b) acetic acid

(c) phosphoric acid

(d) chlorous acid

(e) sulphurous acid

(f) nitric acid

(g) hydrofluoric acid

(h) hydrochloric acid

4. **(a)** HI

(b) H_2SO_4

(c) $HClO_4$

(d) HNO_2

(e) $HClO_3$

(f) HBr

(g) H_3PO_3

(h) HClO

Applying Knowledge

Acids versus bases

Page 87

	ACIDS	BASES
definition	compounds containing hydrogen that produce a solution with a pH of less than 7 when they dissolve in water and that produce a salt and water when they react with ionic compounds containing hydroxide ions	chemical compounds containing hydroxide that produce a solution with a pH of more than 7 when they dissolve in water and produce a salt and water when they react with ionic compounds containing positive hydrogen ions
pH	< 7	> 7
what to look for in chemical formula	H	OH
production of ions	H^+	OH^-
electrical conductivity	conductive	conductive
taste	taste sour	taste bitter
touch	burn skin	feel slippery; burn skin
examples	HCl, H_2SO_4, lemons, stomach acid	NaOH, KOH, drain cleaner, soap

2. **(a)** acid

(b) base

(c) base

(d) acid

(e) base

(f) acid

(g) acid

(h) base

(i) acid

(j) base

(k) base

(l) acid

Assessment

Acids and bases

Page 88

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

Section 5.2 Salts

Comprehension

Recognizing acids, bases, and salts

Page 91

1. **(a)** acid
   (b) acid
   (c) base
   (d) acid
   (e) base
   (f) acid
   (g) acid
   (h) acid
   (i) salt
   (j) base
   (k) base
   (l) salt
   (m) acid
   (n) salt
   (o) salt
   (p) salt
   (q) acid
   (r) acid
   (s) base
   (t) acid
   (u) acid
   (v) salt
2. acetic acid, CH_3COOH
3. sodium chloride, NaCl
4. sulphuric acid, H_2SO_4
5. sodium hydroxide, NaOH
6. magnesium hydroxide, $Mg(OH)_2$
7. hydrochloric acid, HCl

Applying Knowledge

Acid-base neutralization reactions

Page 92

1. **(a)** $H_2SO_4 + 2\ NaOH \rightarrow 2\ H_2O + Na_2SO_4$
   (b) $HNO_3 + KOH \rightarrow H_2O + KNO_3$
   (c) $2\ HCl + Ca(OH)_2 \rightarrow 2\ H_2O + CaCl_2$
   (d) $2\ H_3PO_4 + 3\ Ba(OH)_2 \rightarrow 6\ H_2O + Ba_3(PO_4)_2$
   (e) $CH_3COOH + NaOH \rightarrow H_2O + NaCH_3COO$
   (f) $2\ HNO_3 + Sr(OH)_2 \rightarrow 2\ H_2O + Sr(NO_3)_2$
   (g) $3\ HF + Fe(OH)_3 \rightarrow 3\ H_2O + FeF_3$
   (h) $4\ HBr + Sn(OH)_4 \rightarrow 4\ H_2O + SnBr_4$
2. **(a)** sulphuric acid + potassium hydroxide → water + potassium sulphate
   $H_2SO_4 + 2\ KOH \rightarrow 2\ H_2O + K_2SO_4$
   (b) acetic acid + barium hydroxide → water + barium acetate
   $2\ CH_3COOH + Ba(OH)_2 \rightarrow 2\ H_2O + Ba(CH_3COO)_2$
   (c) phosphoric acid + aluminum hydroxide → water + aluminum phosphate
   $H_3PO_4 + Al(OH)_3 \rightarrow 3\ H_2O + AlPO_4$
   (d) nitric acid + lithium hydroxide → water + lithium nitrate
   $HNO_3 + LiOH \rightarrow H_2O + LiNO_3$
   (e) sulphuric acid + calcium hydroxide → water + calcium sulphate
   $H_2SO_4 + Ca(OH)_2 \rightarrow 2\ H_2O + CaSO_4$
   (f) hydrochloric acid + magnesium hydroxide → water + magnesium chloride
   $2\ HCl + Mg(OH)_2 \rightarrow 2\ H_2O + MgCl_2$

Applying Knowledge

Metal oxides and non-metal oxides

Page 93

1. oxygen
2. metal oxide
3. non-metal oxide
4. it becomes basic
5. it becomes acidic
6. a base
7. an acid
8. **(a)** metal oxide
   (b) non-metal oxide
   (c) non-metal oxide
   (d) metal oxide
   (e) non-metal oxide
   (f) metal oxide
   (g) non-metal oxide
   (h) metal oxide
9. **(a)** a base
   (b) an acid
   (c) a base
   (d) an acid

Assessment

Salts

Page 94

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

Section 5.3 Organic Compounds

Cloze Activity

Organic chemistry

Page 98

1. organic compounds; organic chemistry
2. inorganic compounds
3. carbon
4. hydrocarbons
5. methane
6. ethane
7. propane
8. butane
9. alcohol; oxygen
10. solvent
11. ethanol

Comprehension

Recognizing organic and inorganic compounds

Page 99

1. inorganic
2. organic
3. inorganic
4. inorganic
5. inorganic
6. inorganic
7. organic
8. organic
9. organic
10. organic
11. inorganic
12. inorganic
13. organic
14. inorganic
15. organic
16. organic
17. inorganic
18. organic
19. inorganic
20. inorganic
21. inorganic
22. inorganic
23. organic
24. inorganic
25. organic
26. organic
27. organic
28. organic
29. organic
30. organic

Applying Knowledge

Organic compounds versus inorganic compounds

Page 100

1. organic
2. organic
3. inorganic
4. organic
5. organic
6. organic
7. inorganic
8. organic

Assessment

Organic compounds

Page 101

1. B **2.** A **3.** D **4.** C **5.** A **6.** D **7.** D **8.** A

Chapter 6 Chemical reactions occur in predictable ways.

Section 6.1 Types of Chemical Reactions

Comprehension

Classifying chemical reactions

Page 105

1. S
   $N_2 + 3\ F_2 \rightarrow 2\ NF_3$
2. D
   $2\ KClO_3 \rightarrow 2\ KCl + 3\ O_2$
3. C
   $C_{12}H_{22}O_{11} + 12\ O_2 \rightarrow 12\ CO_2 + 11\ H_2O$
4. SR
   $3\ CuSO_4 + 2\ Fe \rightarrow Fe_2(SO_4)_3 + 3\ Cu$
5. DR
   $MgF_2 + Li_2CO_3 \rightarrow MgCO_3 + 2\ LiF$
6. N
   $H_3PO_4 + 3\ NH_4OH \rightarrow 3\ H_2O + (NH_4)_3PO_4$
7. SR
   $2\ NaF + Br_2 \rightarrow 2\ NaBr + F_2$
8. C
   $2\ CH_3OH + 3\ O_2 \rightarrow 2\ CO_2 + 4\ H_2O$
9. D
   $ZnCl_2 \rightarrow Zn + Cl_2$
10. DR
    $2\ RbNO_3 + BeF_2 \rightarrow Be(NO_3)_2 + 2\ RbF$

11. S

$S_8 + 8\ H_2 \rightarrow 8\ H_2S$

12. SR

$2\ LiCl + Br_2 \rightarrow 2\ LiBr + Cl_2$

13. N

$H_2SO_4 + 2\ KOH \rightarrow 2\ H_2O + K_2SO_4$

14. C

$C_{10}H_8 + 12\ O_2 \rightarrow 10\ CO_2 + 4\ H_2O$

15. D

$2\ HI \rightarrow H_2 + I_2$

16. SR

$6\ HCl + 2\ Al \rightarrow 3\ H_2 + 2\ AlCl_3$

17. S

$2\ P + 3\ Cl_2 \rightarrow 2\ PCl_3$

18. C

$2\ C_6H_6 + 15\ O_2 \rightarrow 12\ CO_2 + 6\ H_2O$

19. DR

$K_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2\ KCl$

20. N

$2\ H_3PO_4 + 3\ Ca(OH)_2 \rightarrow 6\ H_2O + Ca_3(PO_4)_2$

21. D

$2\ NF_3 \rightarrow N_2 + 3\ F_2$

22. S

$2\ Al + N_2 \rightarrow 2\ AlN$

23. N

$HF + Fe(OH)_3 \rightarrow 3\ H_2O + FeF_3$

24. SR

$GaF_3 + 3\ Cs \rightarrow 3\ CsF + Ga$

25. DR

$3\ Ca(NO_3)_2 + 2\ Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6\ NaNO_3$

26. N

$3\ HCl + Al(OH)_3 \rightarrow AlCl_3 + 3\ H_2O$

27. C

$C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$

28. D

$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

29. DR

$NH_4HCO_3 + NaCl \rightarrow NaHCO_3 + NH_4Cl$

30. S

$2\ Na + O_2 \rightarrow Na_2O_2$

Applying Knowledge

Types of chemical reactions — Word equations
Page 107

1. S

$MgS + S \rightarrow MgS$

2. N

$2\ KOH + H_2SO_4 \rightarrow 2H_2O + K_2SO_4$

3. SR

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

4. DR

$AlCl_3 + 3\ NaOH \rightarrow Al(OH)_3 + 3\ NaCl$

5. D

$2\ PbO \rightarrow 2\ Pb + O_2$

6. SR

$Mg + 2\ AgNO_3 \rightarrow 2\ Ag + Mg(NO_3)_2$

7. DR

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

8. N

$Sn(OH)_4 + 4\ HBr \rightarrow 4\ H_2O + SnBr_4$

9. S

$4\ Na + O_2 \rightarrow 2\ Na_2O$

10. D

$2\ Na_3N \rightarrow 6\ Na + N_2$

11. N

$3\ Ca(OH)_2 + 2\ H_3PO_4 \rightarrow 6\ H_2O + Ca_3(PO_4)_2$

12. DR

$BaCl_2 + Na_2CO_3 \rightarrow BaCO_3 + 2\ NaCl$

13. SR

$Zn + Ni(NO_3)_2 \rightarrow Zn(NO_3)_2 + Ni$

14. S

$2\ Sb + 3\ I_2 \rightarrow 2\ SbI_3$

15. D

$CO_2 \rightarrow C + O_2$

16. SR

$Fe_2(SO_4)_3 + 3\ Pb \rightarrow 3\ PbSO_4 + 2\ Fe$

17. DR

$Ba(NO_3)_2 + (NH_4)_2CO_3 \rightarrow 2\ NH_4NO_3 + BaCO_3$

18. N

$Zn(OH)_2 + 2\ HCl \rightarrow 2\ H_2O + ZnCl_2$

19. DR

$(NH_4)_2CO_3 + MgCl_2 \rightarrow 2\ NH_4Cl + MgCO_3$

20. N

$2\ RbOH + H_2SO_4 \rightarrow 2\ H_2O + Rb_2SO_4$

Applying Knowledge

Predicting the products
Page 109

1. **(a)** D

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

(b) S

$H_2 + Cl_2 \rightarrow 2\ HCl$

(c) SR
$2\ NaI + F_2 \rightarrow 2\ NaF + I_2$

(d) DR
$3\ AgNO_3 + Na_3PO_4 \rightarrow Ag_3PO_4 + 3\ NaNO_3$

(e) N
$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2\ H_2O$

(f) S
$P_4 + 6\ Cl_2 \rightarrow 4\ PCl_3$

(g) C
$2\ CH_3OH + 3\ O_2 \rightarrow 2\ CO_2 + 4\ H_2O$

(h) N
$3\ Sr(OH)_2 + 2\ H_3PO_4 \rightarrow Sr_3(PO_4)_2 + 6\ H_2O$

(i) D
$FeI_2 \rightarrow Fe + I_2$

(j) SR
$CuCl_2 + Fe \rightarrow FeCl_2 + Cu$

(k) DR
$Cr_2(SO_4)_3 + 3\ K_2CO_3 \rightarrow Cr_2(CO_3)_3 + 3\ K_2SO_4$

(l) C
$C_2H_5OH + 3\ O_2 \rightarrow 2\ CO_2 + 3\ H_2O$

(m) S
$H_2 + F_2 \rightarrow 2\ HF$

(n) D
$2\ Ag_2O \rightarrow 4\ Ag + O_2$

(o) SR
$Cl_2 + 2\ KI \rightarrow 2\ KCl + I_2$

2. **(a)** S
sodium + chlorine → sodium chloride
$2\ Na + Cl_2 \rightarrow 2\ NaCl$

(b) SR
gallium fluoride + cesium → cesium fluoride + gallium
$GaF_3 + 3\ Cs \rightarrow 3\ CsF + Ga$

(c) N
calcium hydroxide + nitric acid → calcium nitrate + water
$Ca(OH)_2 + 2\ HNO_3 \rightarrow Ca(NO_3)_2 + 2\ H_2O$

(d) DR
barium chloride + silver nitrate → barium nitrate + silver chloride
$BaCl_2 + 2\ AgNO_3 \rightarrow Ba(NO_3)_2 + 2\ AgCl$

(e) D
cobalt(II) bromide → cobalt + bromine
$CoBr_2 \rightarrow Co + Br_2$

(f) SR
copper(II) iodide + bromine → copper(II) bromide + iodine
$CuI_2 + Br_2 \rightarrow CuBr_2 + I_2$

(g) N
phosphoric acid + magnesium hydroxide → magnesium phosphate + water
$2\ H_3PO_4 + 3\ Mg(OH)_2 \rightarrow Mg_3(PO_4)_2 + 6\ H_2O$

(h) S
zinc + iodine → zinc iodide
$Zn + I_2 \rightarrow ZnI_2$

(i) D
beryllium chloride → beryllium + chlorine
$BeCl_2 \rightarrow Be + Cl_2$

(j) DR
iron(III) sulphate + calcium hydroxide → iron(III) hydroxide + calcium sulphate
$Fe_2(SO_4)_3 + 3\ Ca(OH)_2 \rightarrow 2\ Fe(OH)_3 + 3\ CaSO_4$

Assessment
Types of chemical reactions
Page 111

1. D **2.** A **3.** C **4.** B **5.** E **6.** F **7.** A **8.** D **9.** B **10.** D **11.** D
12. D **13.** A **14.** D **15.** C **16.** C **17.** C **18.** A

Section 6.2 Factors Affecting the Rate of Chemical Reactions

Cloze Activity
Rate of chemical reactions
Page 115

1. rate of reaction
2. heat; energy
3. temperature
4. concentration; collisions
5. dilute
6. surface area
7. catalyst
8. catalytic converter

Comprehension
Different rates of reaction
Page 116

1. **(a)** increases rate of reaction
(b) decreases rate of reaction
(c) increases rate of reaction
(d) decreases rate of reaction
(e) decreases rate of reaction

(f) decreases rate of reaction
(g) increases rate of reaction
(h) decreases rate of reaction
(i) increases rate of reaction
(j) increases rate of reaction

2.

	Situation X	Situation Y	Situation with a higher reaction rate (X or Y)	Factor affecting the rate of reaction
(a)	1 g of sugar (cubes)	1 gram of sugar (grains)	**Y**	**surface area**
(b)	5O°C	O°C	**X**	**temperature**
(c)	low number of particles = few collisions	high number of particles = more collisions	**Y**	**concentration**
(d)	enzyme added	no enzyme added	**X**	**catalyst**
(e)	twigs	logs	**X**	**surface area**

Applying Knowledge

Four factors affecting the rate of reactions

Page 118

1. **(a)** line Y
   (b) line X
   (c) line Y
   (d) line X
   (e) line Y
   (f) line X
   (g) line Y
   (h) line X
2. **(a)** surface area
   (b) catalyst
   (c) temperature
   (d) concentration

Assessment

Factors affecting the rate of chemical reactions

Page 119

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

Chapter 7 The atomic theory explains radioactivity.

Section 7.1 Atomic Theory Isotopes, and Radioactive Decay

Applying Knowledge

Isotopes

Page 123

1. different atoms of a particular element that have the same number of protons but different numbers of neutrons
2. mass number
3. mass number
4. number of neutrons
5. "13" represents the mass number; "5" represents the atomic number
6. boron-13 or B-13
7. **(a)** 5
   (b) 5
   (c) 8
8. **(a)** neon with 11 neutrons
   (b) sulphur with 16 neutrons
   (c) actinium with 141 neutrons
   (d) thorium with 144 neutrons
9.

Isotope	Standard atomic notation	Atomic number	Mass number	Number of protons	Number of neutrons
carbon-14	$^{14}_{6}C$	6	14	6	8
cobalt-52	$^{52}_{27}Co$	27	52	**27**	**25**
nickel-60	$^{60}_{28}Ni$	**28**	**60**	**28**	**32**
nitrogen-14	$^{14}_{7}N$	**7**	14	7	**7**
thallium-201	$^{201}_{81}Tl$	**81**	**201**	**81**	**120**
radium-226	$^{226}_{88}Ra$	**88**	**226**	**88**	**138**
lead-208	$^{208}_{82}Pb$	**82**	**208**	82	126

Comprehension

Alpha, beta, and gamma radiation

Page 125

1. diagram labelling: alpha particle (on the first line); beta particle (on the second line); gamma ray (on the third line)
2. **(a)** gamma ray
   (b) beta particle
   (c) alpha particle
   (d) gamma ray

(e) beta particle

(f) alpha particle

(g) alpha particle

(h) beta particle

(i) alpha particle, beta particle, and gamma ray

(j) beta particle

(k) alpha particle

(l) beta particle

(m) gamma ray

(n) alpha particle and beta particle

(o) gamma ray

(p) gamma ray

(q) gamma ray

(r) alpha particle

(s) gamma ray

Applying Knowledge

Radioactive decay and nuclear equations

Page 126

1. ${}^{32}_{15}\text{P} \rightarrow \text{S} + {}^{32}_{16}\text{e or } {}^{0}_{-1}\beta\ {}^{0}_{-1}$ BETA DECAY

2. ${}^{218}_{84}\text{Po} \rightarrow \text{Pb} + {}^{214}_{82}\text{He}\ {}^{4}_{2}$ ALPHA DECAY

3. ${}^{35}_{17}\text{Cl} \rightarrow \text{Ar} + {}^{35}_{5}\text{e}\ {}^{0}_{-1}$ BETA DECAY

4. ${}^{24}_{12}\text{Mg}^{*} \rightarrow \text{Mg} + {}^{24}_{12}\gamma\,{}^{0}_{0}$ GAMMA DECAY

5. ${}^{234}_{91}\text{Pa} \rightarrow \text{Ac} + {}^{230}_{89}\alpha\,{}^{4}_{2}$ ALPHA DECAY

6. ${}^{141}_{58}\text{Ce} \rightarrow \text{Pr} + \text{e}\,{}^{141}_{59}\ {}^{0}_{-1}$ BETA DECAY

7. ${}^{216}_{84}\text{Po} \rightarrow \text{At} + \beta\,{}^{216}_{85}\ {}^{0}_{-1}$ BETA DECAY

8. ${}^{20}_{9}\text{F} \rightarrow \text{Ne} + {}^{20}_{10}\text{e or } {}^{0}_{-1}\beta\ {}^{0}_{-1}$ BETA DECAY

9. ${}^{58}_{26}\text{Fe}^{*} \rightarrow \text{Fe} + \gamma\,{}^{58}_{26}\ {}^{0}_{0}$ GAMMA DECAY

10. ${}^{225}_{89}\text{Ac} \rightarrow \text{Fr} + {}^{221}_{87}\alpha\ {}^{4}_{2}$ ALPHA DECAY

11. ${}^{149}_{64}\text{Gd}^{*} \rightarrow \text{Gd} + {}^{149}_{64}\gamma\ {}^{0}_{0}$ GAMMA DECAY

12. ${}^{226}_{88}\text{Ra} \rightarrow \text{Rn} + {}^{222}_{86}\alpha\text{ or He}{}^{4}_{2}\ {}^{4}_{2}$ ALPHA DECAY

13. ${}^{212}_{81}\text{Tl} \rightarrow \text{Pb} + {}^{212}_{82}\ \beta\,{}^{0}_{-1}$ BETA DECAY

14. ${}^{214}_{83}\text{Bi} \rightarrow \text{Tl} + {}^{210}_{81}\alpha\text{ or } {}^{4}_{2}\text{He}\ {}^{4}_{2}$ ALPHA DECAY

15. ${}^{254}_{98}\text{Cf}^{*} \rightarrow \text{Cf} + {}^{254}_{98}\gamma\ {}^{0}_{0}$ GAMMA DECAY

Assessment

Atomic theory, isotopes, and radioactive decay

Page 127

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

Section 7.2 Half-Life

Applying Knowledge

Radioactive decay

Page 132

1. (a) the time required for half the nuclei in a sample of a radioactive isotope to decay; a constant for any radioactive isotope

(b) a curved line on a graph that shows the rate at which radioisotopes decay

(c) the isotope that undergoes radioactive decay

(d) the stable product of radioactive decay

2.

Half-life	Percent of parent isotope	Percent of daughter isotope
0	100	0
1	50	50
2	25	75
3	12.5	87.5
4	6.25	93.75

Half-life	Fraction of parent isotope	Fraction of daughter isotope
0	1	0
1	$\frac{1}{2}$	$\frac{1}{2}$
2	$\frac{1}{4}$	$\frac{3}{4}$
3	$\frac{1}{8}$	$\frac{7}{8}$
4	$\frac{1}{16}$	$\frac{15}{16}$

3. (a)

Half-life	Time (a)	Mass (g)
0	0	**120**
1	5	**60**
2	10	**30**
3	15	**15**
4	20	**7.5**
5	25	**3.75**

(b) 3.75 g

(c) 3 half-lives

(d) 20 years

(e) The graph should show a decay curve.

4. (a)

Half-life	Time (a)	Mass of parent isotope (g)	Mass of daughter isotope (g)
0	0	**80**	**0**
1	20	**40**	**40**
2	40	**20**	**60**
3	60	**10**	**70**
4	80	**5**	**75**
5	100	**2.5**	**77.5**

(b) 5 g
(c) 2.5 g
(d) 70 g
(e) 100 years
(f) 1:3

Comprehension
Calculating half-life
Page 134

1. **(a)** $\frac{1}{8}$
   (b) 6.25%
   (c) $\frac{3}{4}$
   (d) 96.875%
2. 18 g
3. 12.5%
4. 48 g
5. 1420 million years old
6. 3.9 billion years old
7. 9 billion years
8. 5 years
9. 10 g

Analyzing Information
Decay curves
Page 135

1. **(a)** 2 days
   (b) 20 g
   (c) 70 g
   (d) $\frac{1}{16}$
   (e) 8 days
2. **(a)** potassium-40 and argon-40
   (b) 1.3 billion years
   (c) equal amounts of daughter and parent isotopes
   (d) $\frac{15}{16}$
   (e) 1:3

Assessment
Half-life
Page 136

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

Section 7.3 Nuclear Reactions

Cloze Activity
Radioactivity
Page 140

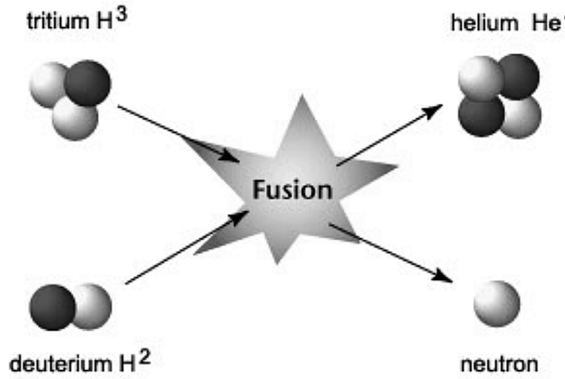
1. nuclear fission
2. unstable
3. energy
4. nuclear reaction; isotope
5. subatomic particles
6. induced
7. proton
8. neutron
9. chain reaction
10. CANDU reactor
11. nuclear fusion; Sun

Comprehension
Comparing nuclear fission and fusion
Page 141

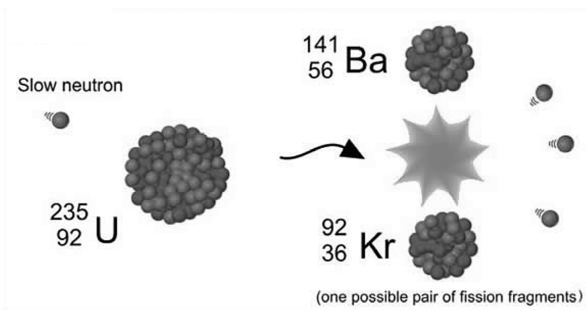
1.

	Nuclear fission	Nuclear fusion
Give a description of the process.	one heavy unstable nucleus splits up into lighter nuclei	two small nuclei combine to form one large nucleus
What is produced as a result of this nuclear process?	huge amounts of energy; neutrons; radioactive isotopes	huge amounts of energy; neutron(s)
Are the products radioactive?	products are often radioactive	products are not often radioactive
What is needed for this nuclear reaction to occur?	a neutron	high temperature and sufficient pressure
Where does this process occur?	induced fission in nuclear fission reactors; atom bombs	Sun; stars; hydrogen bombs
Give an example of a nuclear equation.	answers may vary $^{1}_{0}n + ^{235}_{92}U \rightarrow ^{92}_{36}Kr + ^{141}_{56}Ba + 3^{1}_{0}n$ + energy	answers may vary $^{2}_{1}H + ^{3}_{1}H \rightarrow ^{4}_{2}He + ^{1}_{0}n$ + energy

2. (a) nuclear fusion



(b) nuclear fission



Applying Knowledge

Nuclear fission and fusion reactions

Page 142

1. 3 $^{1}_{0}$n, Fission $^{239}_{94}$Pu

2. 2 $^{2}_{1}$H, Fusion

3. $^{80}_{32}$Ge, Fission

4. $^{1}_{0}$n, Fusion

5. $^{235}_{92}$U, Fission

6. $^{1}_{0}$n, Fusion

7. $^{113}_{46}$Pd, Fission

8. $^{127}_{53}$I, Fission

9. 3 $^{1}_{0}$n, Fission

10. $^{239}_{94}$Pu, Fission

Assessment

Nuclear reactions

Page 143

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

UNIT 3 Motion

Chapter 8 Average velocity is the rate of change in position.

Section 8.1 The Language of Motion

Comprehension

Scalars versus vectors

Page 147

1. (a) scalar: a quantity that has a magnitude but not a direction

(b) vector: a quantity that has both a magnitude and a direction

(c) magnitude: the size of a measurement or an amount

(d) reference point: the point from which the change is measured

2.

Quantity	Symbol	SI Unit	Scalar or Vector
time	t	s (seconds)	scalar
time interval	Δt	s (seconds)	scalar
distance	d	m (metres)	scalar
position	$\vec{d}$	m (metres)	vector
displacement	$\Delta\vec{d}$	m (metres)	vector

3. (a) V **(b)** S **(c)** S **(d)** V

4. (a) positive (+)

(b) negative (–)

(c) positive (+)

(d) negative (–)

Applying Knowledge

Distance, position, and displacement

Page 148

1.

t_i (s)	t_f (s)	Δt (s)	d_i (m)	d_f (m)	Δd (m)	Direction of Motion
6.0	7.5	**1.5**	+18.4	+22.6	**+4.2**	right
5.7	8.5	2.8	+24.3	**+30.1**	+5.8	up
20.2	**38.4**	18.2	**+39.1**	+24.8	–14.3	south
12.4	18.8	**6.4**	**+54.8**	+46.2	–8.6	west

2. (a) 12 m

(b) 0 m

3. (a)

Time	Position
0 min	0 m
1 min	**180 m [E]**
2 min	40 m [E]
3 min	**140 m [E]**

Time Interval	Distance Travelled	Displacement
0 min–1 min	180 m	**180 m [E]**
1 min–2 min	**140 m**	**140 [W]**
2 min–3 min	**100 m**	100 m [E]

(b) 420 m

(c) 140 m [E]

Comprehension

Positive, negative, and zero slopes

Page 150

1. Graph B
2. Graph A
3. Graph C
4. Graphs A, B and C
5. Graph B
6. Graph C
7. Graph A

Analyzing Information

Uniform motion

Page 151

1. **(a)** non-uniform motion
   (b) uniform motion
   (c) non-uniform motion
2.

Time Interval	Slope of Line	Description of Motion
0 s–10 s	positive	The object is moving to the right of the origin with uniform motion.
10 s–15 s	zero	The object is at rest.
15 s–30 s	negative	The object is moving back toward the origin with uniform motion.
30 s–40 s	negative	The object is moving to the left of the origin with uniform motion.
40 s–55 s	positive	The object is moving back toward the origin with uniform motion.

3. 10 s–15 s
4. 15 s–30 s
5. 0–2 s and 7–12 s
6. pacing backward away from the bus stop
7. pacing forward toward the bus stop
8. 2 m in front of the bus stop
9. –8m, that is 8 m backward
10. 20 m
11. 0 m

Assessment

The language of motion

Page 153

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

Section 8.2 Applying Knowledge

Applying Knowledge

Calculating average velocity

Page 156

1. **(a)** $U_{av} = \frac{\Delta\vec{d}}{\Delta t}$
   (b) $\Delta\vec{d} = \vec{v}_{av}\,\Delta t$
   (c) $\Delta t = \frac{\Delta\vec{d}}{\vec{v}_{av}}$
2.

Displacement	Time	Average Velocity	Formula Used and Calculation Shown
15.6 m	3 s	5.2 m/s	$\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t} = \frac{15.6}{3} = 5.2$ m/s
357.5 km	6.5 h	**55 km/h**	$\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t} = \frac{357.5}{6.5} = 55$ km/h
22.6 m	**4 s**	5.65 m/s	$\Delta t = \frac{\Delta\vec{d}}{\vec{v}_{av}} = \frac{22.6}{5.65} = 4$ s
243.75 km	3.25 h	75 km/h	$\Delta\vec{d} = \vec{v}_{av}\,\Delta t = 75 \times 3.25 =$ 243.75 km
12.6 m	3.15 s	**4 m/s**	$\vec{v}_{av} = \frac{\Delta\vec{d}}{\Delta t} = \frac{12.6}{3.15} = 4$ m/s
24 km	**0.75 h**	32 km/h	$\Delta t = \frac{\Delta\vec{d}}{\vec{v}_{av}} = \frac{24}{32} = 0.75$ h
480 m	8 s	60 m/s	$\Delta\vec{d} = \vec{v}_{av}\,\Delta t = 60 \times 8 = 480$ m

3. **(a)** 150 s
   (b) 70 s
   (c) 255 m [E]
   (d) 14 s
   (e) 0.375 km/min
   (f) 800 000 a (years)
   (g) 0.65 km, or 650 m

Applying Knowledge

Slopes of position-time graphs

Page 157

1. average velocity
2. uniform motion; constant velocity
3. Slope is the change in the vertical distance divided by the change in the horizontal distance.
4. slope = $\frac{\text{rise}}{\text{run}}$
5.

Line	Rise	Run	Slope Calculation	Slope
A	4	15	4 ÷ 15	0.27 m/s
B	0	20	0 ÷ 20	0 m/s
C	8	5	8 ÷ 5	1.6 m/s
D	–6	15	–6 ÷ 15	–0.4 m/s

Analyzing Information

Analyzing position-time graphs

Page 158

1. (a)

Time Interval	Displacement	Average Velocity
0 s–2 s	0 m	0 m/s
2 s–5 s	–3 m	–1 m/s
5 s–7s	+ 5 m	+ 2.5 m/s
7 s–12 s	0 m	0 m/s
12 s–14 s	–8 m	–4 m/s
14 s–16 s	+ 4 m	+ 2 m/s
16 s–18 s	0 m	0 m/s
18 s–19 s	+ 2 m	+ 2 m/s
19 s–20 s	0 m	0 m/s

(b) at 14 seconds

(c) 0 m

2. (a) C

(b) E

(c) B

(d) D

(e) F

(f) A

3. (a) The *y*-intercept represents the position at which the runner starts.

(b) No. Runner B starts out farther ahead than Runner A.

(c) Runner B is running faster at 2 s because Runner B has a steeper slope than Runner A.

(d) At 5 s, both runners are at the same position.

(e) Runner A is ahead at 10 s.

Extension Activity

Constructing and interpreting position-time graphs

Page 160

1. (a) Graph should have a negative slope crossing the *x*-axis at 5 s.

(b) 3 seconds

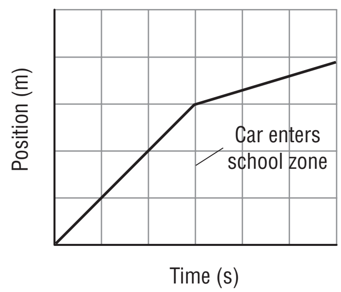
(c) 100 m [E]

(d) –12.5 m [W]

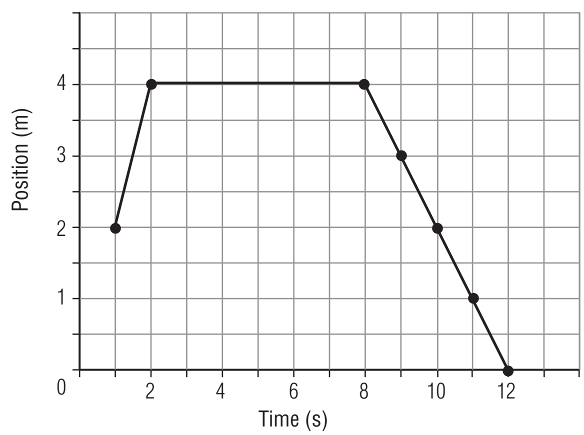
(e) –25 m/s

(f) The car is moving westward toward the origin with constant velocity.

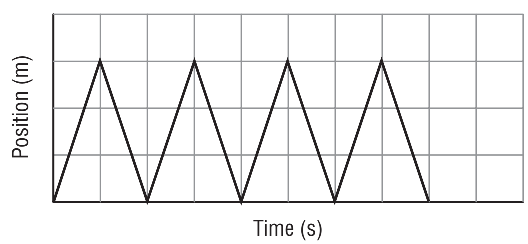
2. (a)



(b)



(c)



Assessment

Average velocity

Page 162

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

Chapter 9 Acceleration is the rate of change in velocity.

Section 9.1 Describing Acceleration

Cloze Activity

Velocity and acceleration

Page 166

1. vector, speed

2. positive

3. negative

4. constant velocity
5. velocity
6. positive acceleration
7. negative acceleration
8. same direction
9. opposite direction
10. deceleration

Applying Knowledge
Calculating change in velocity
Page 167

1.

$\vec{v}_i$	$\vec{v}_f$	$\Delta\vec{v}$	Description of $\Delta\vec{v}$
+ 14 m/s	+ 5 m/s	–9 m/s	object is slowing down
+ 8 m/s	**+8 m/s**	0 m/s	object is in uniform motion
+13 m/s	+ 25 m/s	+ 12 m/s	object is speeding up
+ 20 m/s	–30 m/s	**–50 m/s**	object is slowing down
–38 m/s	**–48 m/s**	–10 m/s	object is slowing down
–16 m/s	–16 m/s	0 m/s	object is in uniform motion
–3 m/s	+ 22 m /s	**+ 25 m/s**	object is speeding up

2. **(a)** + 15 m/s
   (b) + 13 m/s
   (c) 0 m/s
   (d) – 6 m/s
   (e) – 10 m/s

Interpreting Illustrations
Positive, negative, and zero acceleration
Page 168

1. **(a)** positive acceleration
   (b) zero acceleration
   (c) negative acceleration
   (d) zero acceleration
2. **(a)** positive acceleration
   (b) negative acceleration
   (c) positive acceleration
   (d) negative acceleration
   (e) zero acceleration
   (f) positive acceleration

Assessment
Describing acceleration
Page 169

1. A **2.** B **3.** C **4.** D **5.** A **6.** B **7.** B **8.** A **9.** D

Section 9.2 Calculating Acceleration

Applying Knowledge
Calculating acceleration
Page 172

1. **(a)** $\Delta\vec{a} = \frac{\Delta v}{\Delta t}$
   (b) $\Delta v = a\Delta t$
   (c) $\Delta t = \frac{\Delta v}{a}$
2.

Change in Velocity	Time	Acceleration	Formula Used and Calculation Shown
140 m/s	8 s	17.5 m/s^2	$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{140}{8} = 17.5$ m/s^2
–60 km/h	4 h	**–15 km/h^2**	$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{-60}{4} = -15$ km/h^2
120 km/h	**2.5 h**	48 km/h^2	$t = \frac{\vec{v}}{\vec{a}} = \frac{120}{48} = 2.5$ h
–52.5 m/s	15 s	–3.5 m/s^2	$\vec{v} = \vec{a}\,t = (-3.5)(15) =$ –52.5 m/s
12 m/s	2.5 s	**4.8 m/s^2**	$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{12}{2.5} = 4.8$ m/s^2
–25 m/s	**2 s**	–12.5 m/s^2	$\vec{a} = \frac{\Delta\vec{v}}{\Delta t} = \frac{12}{2.5} = 4.8$ m/s^2
48 km/h	9.6 h	5 km/h^2	$\vec{v} = \vec{a}t = (5)(9.6) = 48$ km/h

3. **(a)** 7.8 m/s^2 [north]
   (b) 6 m/s [forward]
   (c) 1.52 s
   (d) +1700 m/s

Analyzing Information
Analyzing velocity-time graphs
Page 173

1. **(a)** acceleration
   (b) positive velocity
   (c) negative velocity
   (d) positive acceleration
   (e) negative acceleration
   (f) constant velocity; zero acceleration
   (g) zero velocity
2.

MOTION OF A BALL			
Time Interval	Slope	Acceleration	Velocity
0 s – 2 s	positive	positive	positive
2 s – 6 s	zero	zero	positive
6 s – 8 s	negative	negative	positive
8 s – 10 s	zero	zero	zero

3. **(a)** ball starts from rest and increases its velocity at a constant rate, heading to the right
   (b) ball travels right at a constant velocity and has zero acceleration

(c) ball slows down to a stop at a constant rate, while still travelling to the right

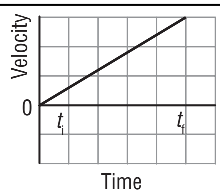
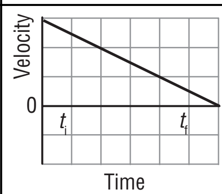
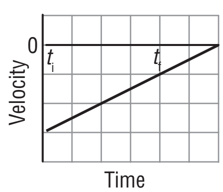
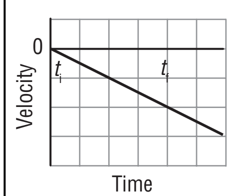
(d) ball is at rest (it has stopped)

Illustrating Concepts
Sketching and interpreting velocity-time graphs
Page 174

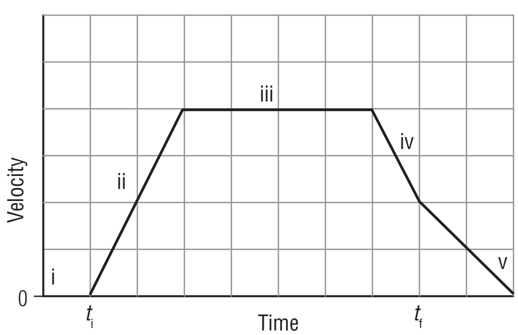
1.

	Graph A	Graph B	Graph C
Slope	zero	positive	negative
Acceleration	zero acceleration	positive acceleration	negative acceleration

2.

	Positive Acceleration	Negative Acceleration
Positive Velocity		
Negative Velocity		

3. (a)



(b) (i) zero slope
(ii) positive slope
(iii) zero slope
(iv) negative slope
(v) zero slope

(c) (i) zero acceleration
(ii) positive acceleration
(iii) zero acceleration
(iv) negative acceleration
(v) zero acceleration

Assessment
Calculating acceleration
Page 176

1. D **2.** A **3.** B **4.** C **5.** A **6.** B **7.** D **8.** B

UNIT 4 Energy Transfer in Natural Systems

Chapter 10 The kinetic molecular theory explains the transfer of thermal energy.

Section 10.1 Temperature, Thermal Energy, and Heat

Illustrating concepts
Kinetic molecular theory and temperature
Page 180

1. Kinetic energy is the energy of a particle or object due to its motion.

2.

	Solid	Liquid	Gas
spaces between particles	very close	farther apart	even farther apart
movement of particles	vibrate slowly	move faster	move even faster
kinetic energy of particles	very little	increases	increases as collisions increase

3. Temperature is a measure of the average kinetic energy of all the particles in a sample of matter.

4. Hot water: Drawing should show long arrows (see textbook page 425, figure 10.2).
   Cold water: Drawing should show shorter arrows (see textbook page 425, figure 10.2).

5.

	Fahrenheit	Celsius	Kelvin
absolute zero	–459° F	–273°C	0 K
water freezes	32°F	0°C	273 K
water boils	212°F	100°C	373 K

Comprehension
Thermal energy, kinetic energy, potential energy
Page 181

1. Thermal energy is the total energy of all the particles in a solid, liquid, or gas.
2. Kinetic energy is the energy of a particle or an object due to its motion.
3. Potential energy is the stored energy of an object or particle, due to its position or state.

4. As the temperature of an object rises, the amount of thermal energy rises.
5. As the kinetic energy of a group of molecules increases, the molecules move faster.
6. As the potential energy of a group of molecules increases, the molecules move farther apart.
7. Heat is the amount of thermal energy that transfers from an area or object of high temperature to an area or object of low temperature.
8. Answers may vary. Concept should show initial thermal energy having high levels then transferring this energy to an area or object with low thermal energy. End result of the transfer of energy would be increase in molecules moving and temperature then rising.
9. Thermal energy is transferred by conduction, convection, and radiation.

Applying Knowledge

Thermal energy transfer

Page 182

1.

Type of thermal energy transfer	What is happening in the diagram
conduction	Thermal energy from stove is transferred to pot. Stove has higher temperature and greater kinetic energy.
convection	Thermal energy is transferred within a fluid and a current is created moving the fluid from one place to another.
radiation	Any material with a temperature greater that absolute zero radiates some thermal energy

2. Metals are good thermal conductors.
3. Air, snow, wood, and Styrofoam are materials that do not transfer thermal energy easily and are called insulators.
4. Heating the liquid causes the particles to move faster. The warmer liquid moves to the top of the lamp because it is less dense than the surrounding liquid. At the top of the lamp, the liquid cools, contracts, and sinks only to be reheated and recirculated. The lava lamp operates by a convection current.
5. Radiant energy is the energy carried by electromagnetic waves.

Assessment

Temperature, thermal energy, and heat

Page 183

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

Section 10.2 Energy Transfer in the Atmosphere

Applying Knowledge

The Earth's atmosphere

Page 188

1. Air is a combination of gases in the lower atmosphere.
2. Nitrogen and oxygen make up 99 percent of dry air.
3. The Earth's rotation, the effects of day and night, and the Sun are some of the factors that cause the atmosphere to constantly change.
4.

Layer	Altitude above sea level	Average temperature	Factors affecting composition
troposphere	10 km	Drops 6.5°C per 1 km increase	• water vapour • solar radiation • thermal energy • particulate matter
stratosphere	10–50 km	– 55°C	• clear dry air • warmer at top • winds • ozone layer
mesosphere	50–80 km	– 100°C	• dust • meteors crashing
thermosphere	80–500 km	1500°C–3000°C	• solar radiation
exosphere	Over 500 km	Not defined	• merges with outer space

Comprehension

What is weather?

Page 189

1. Weather is the condition of the atmosphere in a specific place and at a specific time.
2. Convection moves air and thermal energy throughout the troposphere.
3. An aneroid barometer contains a small capsule made of flexible metal. As atmospheric pressure changes, the capsule expands or contracts.
4. The SI unit for atmospheric pressure is the kilopascal (kPA). The kPA represents the vertical forces per unit area.
5. As the altitude increases, the density of the air decreases. Your ears try to balance the higher atmospheric pressure within your middle ear with lower external pressure.
6. **(a)** molecules spread out, resulting in lower atmospheric pressure
   (b) atmospheric pressure drops
   (c) atmospheric pressure increases

7. Wind is the movement of air from an area of higher pressure to lower pressure while an air mass is a parcel of air with similar temperature and humidity throughout.
8. When a high pressure system forms, the air mass cools, particles in the air lose kinetic energy, and the air becomes more dense. Wind is created. Clear skies often occur.
9. When a low pressure system forms, the air mass warms, it expands and rises, making the layer of air thicker. As the air rises, it cools. The water vapour may condense, producing clouds or precipitation.

Interpreting Illustrations

Weather patterns

Page 190

1. **(a)** cool temperatures, forming rain or snow, depending on elevation

   (b) strong, dry, warm winds called Chinooks form
2. Arrows should deflect to the right in the northern hemisphere and to the left in the southern hemisphere.
3. **(a)** polar easterlies

   (b) prevailing westerlies

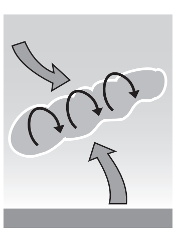
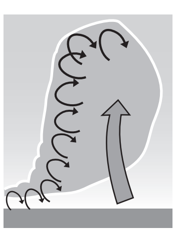
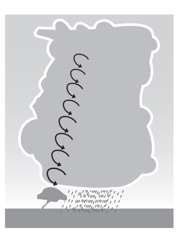
   (c) northeast trade winds

   (d) southeast trade winds

   (e) prevailing westerlies

   (f) polar easterlies
4. **(a)** Warm air replaces cold air, therefore precipitation will result.

   (b) Cold air replaces warm air, therefore cooler, drier weather will occur.
5.

(a) funnel cloud develops	**(b)** funnel cloud becomes vertical and touches ground	**(c)** tornado moves along ground
		

6. Warm ocean water and winds lift moist air high into the atmosphere. The water vapour condenses, producing clouds and rain. The rising air produces a low pressure area at the ocean's surface. Warm air rushes down towards the low pressure area. The Coriolis effect forces the air to rotate, causing a massive, spinning storm.

Assessment

Energy transfer in the atmosphere

Page 192

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

Chapter 11 Climate change occurs through natural processes and human activities.

Section 11.1 Natural Causes of Climate Change

Cloze Activity

Natural causes of climate change

Page 196

1. climate
2. paleoclimatologists
3. natural greenhouse effect
4. tilt; wobble; shape
5. water vapour
6. convection currents
7. Coriolis effect
8. El Niño-Southern Oscillation
9. carbon sink
10. weathering
11. catastrophic events

Comprehension

Factors that affect climate

Page 197

1. A decrease in the amount of greenhouse gases would lower the temperature on Earth.
2. An increase in the tilt of Earth would result in extreme seasonal changes. In the northern hemisphere, winters would be colder and summers would be warmer.
3. A change in Earth's wobble will affect the angle of incidence of the Sun's rays.
4. When Earth's orbit is elliptical, Earth's orbit takes it farther from the Sun, and less solar radiation reaches Earth's surface.
5. As yearly temperatures increase, the atmosphere holds more water vapour and traps more thermal energy. The resulting increase in temperature causes more water to evaporate.

6. Melting glaciers add large amounts of salt-free water to the oceans. This raises the water levels and changes the environment of the ocean, threatening the survival of many species living in the ocean.
7. As the levels of carbon dioxide increase, the temperature on Earth increases.
8. A volcanic eruption results in molten rock and ash blocking out sunlight, and a release of water vapour and sulphur dioxide, which forms sulphuric acid. The sulphuric acid can reflect solar radiation and result in the lower levels of the atmosphere cooling.

Interpreting Illustrations

El Niño and La Niña

Page 198

1.

(a) El Niño **(b)** • Winds blowing west weaken and may even reverse. • Warm waters in the Pacific move eastward, preventing cold water from upwelling. • Alters precipitation and temperatures across North America.	**(c)** La Niña **(d)** • Stronger-than-normal winds push warm Pacific waters farther west, toward Asia. Cold, deep-sea waters then well up strongly in the Eastern Pacific, bringing cooler temperatures to northwestern North America.

2.

(a) La Niña. **(b)** • Warm ocean water, clouds, and moisture are pushed away from North America. • A weaker jet stream brings cooler weather to the northern parts of the continent and hot, dry weather to southern areas.	**(c)** El Niño **(d)** • Sun-warmed surface water spans the Pacific Ocean. • Clouds form above the warm ocean, carrying moisture aloft. • The jet stream helps bring warm, moist air to the United States. • Coasts of Canada will be warmer than usual.

Assessment

Natural causes of climate change

Page 199

1. D **2.** A **3.** E **4.** B **5.** H **6.** C **7.** G **8.** F **9.** D **10.** B **11.** D **12.** C **13.** C **14.** B

Section 11.2 Human Activity and Climate Change

Comprehension

Climate Change

Page 203

1.
   - amount of Arctic sea ice is shrinking by 2 percent to 3 percent every decade
   - average sea level is rising by about 3 mm per year
   - average global temperature has risen by about 0.55°C since 1970
2. The greenhouse gases produced by human activity are carbon dioxide, methane, nitrous oxide (dinitrogen oxide), ozone, and chlorofluorocarbons.
3. Nitrous oxide is formed from the biological process of bacteria in ocean water, soil, and manure. Humans produce large amounts of nitrous oxide from the use of nitrogen-rich chemical fertilizers in farming and the improper disposal of human and animal waste.
4. The main cause of the depletion of Earth's protective ozone layer are chlorofluorocarbons (CFCs).
5. Albedo is the amount of radiation reflected by a surface.
6. GMCs take into account changes in greenhouse gas concentrations, albedo, ocean currents, winds, and surface temperatures.
7. Northern Canada has rising temperatures especially in the arctic regions. Areas of permafrost are melting, and the ice cover in the Arctic Ocean is rapidly shrinking.
8. The plans by the Canadian government include reducing greenhouse gas emission from trucks and cars, introducing policies requiring greenhouse gas-producing industries to reduce emissions, increasing the types of energy-efficient products available, and setting guidelines for improving indoor air quality.

Applying Knowledge

Greenhouse gases

Page 204

1. See figure 11.16 on page 484 in BC Science 10 textbook.

   Water vapour: 65 percent

   Carbon dioxide: 25 percent

Other gases, such as methane, nitrous oxide, CFCs, and ozone: 10 percent

2.

Greenhouse gas	Chemical formula	Source from human activity	Global Warming Potential (GWP)
carbon dioxide	CO_2	• combustion of fossil fuels • deforestation	1
methane	NH_4	• combustion of fossil fuels • livestock • waste dumps • rice paddies	25
nitrous oxide	N_2O	• chemical fertilizers • burning waste • industrial processes	298
chlorofluoro carbons (CFCs)	various	• liquid coolants • refrigeration • air conditioning	4750–5310

3. Water vapour is not included in the table because human activities have very little direct effect on the amount of water vapour in the atmosphere. Ozone is not included in the table because it is continually broken down and reformed in the atmosphere, and so it is very difficult to determine its GWP.

Extension Activity

Strategies for addressing climate change
Page 205

1. Answers will vary. Table 11.4 on page 496 gives some general strategies for reducing greenhouse gas emissions.
2. Answers will vary depending on the individual and his or her local environment.

Assessment

Human activity and climate change
Page 206

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

Chapter 12 Thermal energy transfer drives plate tectonics.

Section 12.1 Evidence for Continental Drift

Cloze activity

Evidence for continental drift
Page 210

1. supercontinent
2. Pangaea
3. geological structures; fossils; ancient glaciers
4. mountain ranges
5. tectonic plates
6. Mid-Atlantic Ridge
7. magnetic striping
8. magma
9. spreading ridge
10. hot spot
11. plate tectonic theory

Applying Knowledge

Theories related to continental drift
Page 211

Continental drift Proposed by: Alfred Wegener Main points: • continents were in motion • Pangaea (supercontinent) existed • continental shelves matched up • compared geological structures, fossils, and evidence of ancient glaciers	**Paleomagnetism** Main points: • Earth's magnetic field does change—evidence shows an average of four to five changes per million years • magnetometer shows magnetic striping at Mid-Atlantic Ridge
Sea floor spreading Proposed by: Harry Hess Main points: • observed data on the age of ocean rocks, sediment thickness, and magnetic striping • convection currents under Earth's surface bring up magma which caused the sea floor to spread apart	**Plate tectonic theory** Proposed by: J. Tuzo Wilson Main points: • suggested chains of volcanic islands were formed when a tectonic plate passes over a stationary hot spot • continents break up at certain areas, move across Earth's surface, then rejoin

Interpreting Illustrations

Visual observations supporting continental drift
Page 212

1. Wegener used analysis of rocks and ridges, fossils, and evidence of ancient glaciers.
2. **(a)** These magnetic patterns were measured by a magnetometer.
   (b) These patterns show that Earth's magnetic field switches over time.
3. The Hawaiian Islands were formed when a tectonic plate passed over a stationary hot spot.

Assessment

Evidence for continental drift
Page 213

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

Section 12.2 Features of Plate Tectonics

Interpreting Illustrations
Layers of the Earth
Page 218

1. **(a)** inner core
   (b) outer core
   (c) lower mantle
   (d) upper mantle
   (e) crust
2.

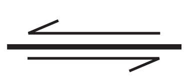
Layer	Thickness	State	General composition
(a) inner core	1216 km	solid	iron, nickel
(b) outer core	2270 km	liquid	iron, nickel
(c) lower mantle	2225 km	solid	magnesium, iron
(d) upper mantle	660 km	solid, molten	iron, magnesium
(e) crust	5–60 km	solid, brittle	granite, basalt

3. The lithosphere is the layer made up of the crust and the uppermost mantle while the asthenosphere is a partly molten layer in Earth's upper mantle just below the lithosphere.

Comprehension
Features of plate tectonics
Page 219

1. Geologists believe that the asthenosphere is heated by radioactive decay from large quantities of radioactive elements such as uranium.
2. Scientists hypothesize the mantle convection is one of the driving forces behind plate movement.
3. A rift valley occurs on land, while a spreading ridge occurs in the ocean.
4. The heavy oceanic plate will dive deep under the lighter continental plate in an event known as subduction.
5. Earthquakes and volcanic eruptions occur at subduction zones.
6. **(a)** divergent 

   (b) convergent 

   (c) transform 

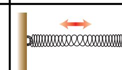
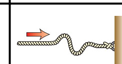
7.

Geographic location	Plate interaction
1. East African Rift	divergence
2. Juan de Fuca plate	oceanic-continental convergence
3. Islands of Japan	oceanic-oceanic convergence
4. Himalayan mountains	continental-continental convergence
5. San Andreas Fault	transform fault

8. Subduction does not occur when continental plates collide. The plates have similar densities so this prevents either one from being forced down into the mantle.

Applying Knowledge
Seismic waves, earthquakes, and volcanoes
Page 220

1.

Seismic wave	Abbreviation	General diagram of wave	Description of action	Type of material it travels through	Speed it travels at
primary wave	P		ground squeezes and stretches	solids, liquids, gases	fast
secondary wave	S		ground motion is perpendicular to direction of wave travel	solids, but not liquids	slower
surface wave	L		rolling action	solids	slowest

2. A seismometer is a device that measures the amount of ground motion caused by an earthquake.
3. Magnitude is a number that rates the strength (energy) of an earthquake. Higher magnitude numbers indicate larger, more devastating earthquakes.
4. The Richter scale is often used to measure the magnitude of an earthquake.
5. The focus is the location inside Earth where an earthquake starts, and the epicentre is the point on Earth's surface directly above the focus.

6. Shallow focus occurs 1–70 km below the surface, intermediate focus occurs 70–300 km below the surface, while deep focus occurs at depths greater than 300 km.

7.

Geographic location	Type of volcano	Description of events
Mount Garibaldi volcano	composite	repeated eruptions at subduction zone
Anahim Volcanic Belt	shield	located over hot spot
Krafla volcano	rift eruptions	rift eruptions along cracks in lithosphere

Assessment

Features of plate tectonics

Page 221

1. E **2.** A **3.** J **4.** B **5.** H **6.** C **7.** D **8.** I **9.** F **10.** G **11.** A **12.** D **13.** C **14.** C **15.** C