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

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

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

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

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

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

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

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

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

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

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

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

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

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

15. $^{254}_{98} Cf^* \rightarrow Cf + ^{254}_{98} \gamma \ ^{0}_{0}$ 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
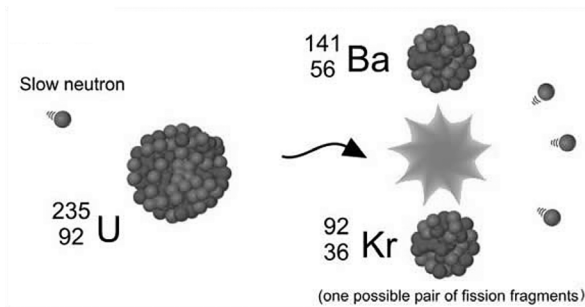**Page 141**

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

(one possible pair of fission fragments)
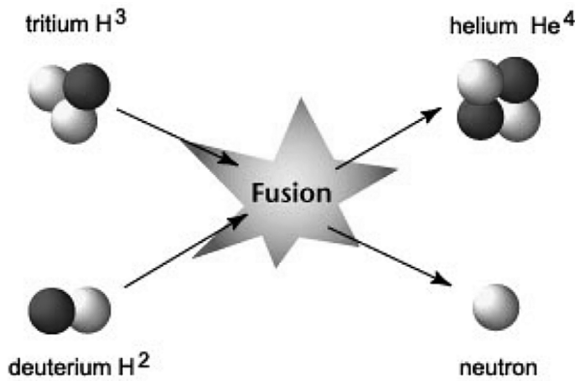
Applying Knowledge
Nuclear fission and fusion reactions
Page 142

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]**