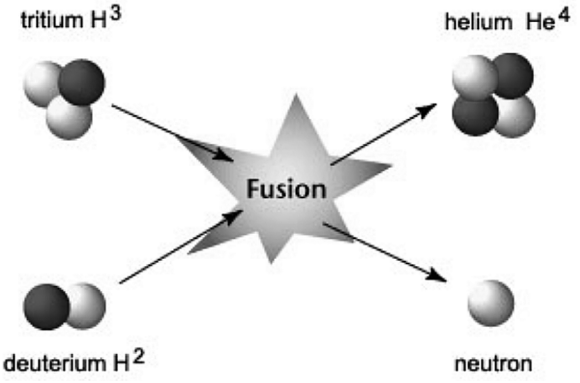
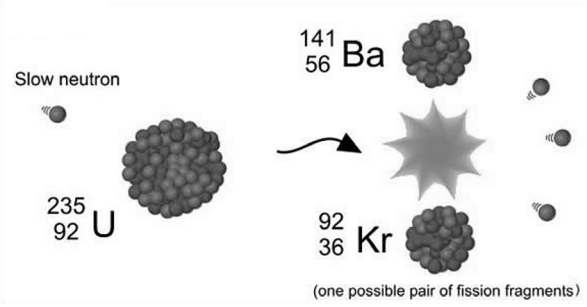
2. (a) nuclear fusion



(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

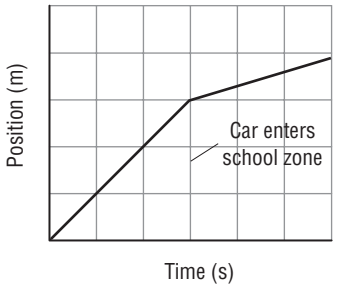
(c) 100 m [E]

(d) –12.5 m [W]

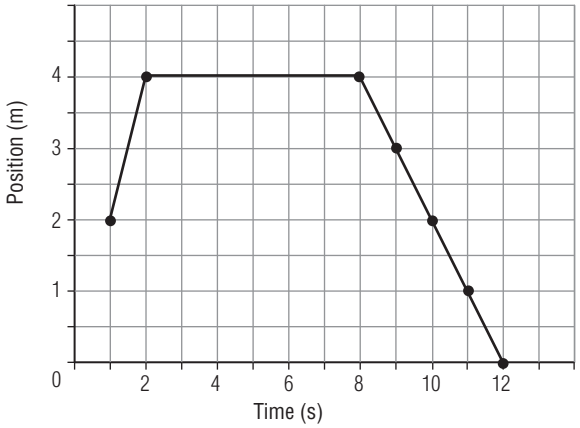
(e) –25 m/s

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

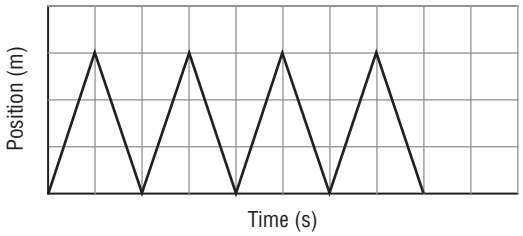
2. (a)



(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