Answers

1A EXPONENT LAWS

1 **a** 5^7 **b** x^{6+n} **c** 11^5 **d** y^{20}
e z^{6m} **f** a^{3k+1} **g** b^{7-8r} **h** p^{3-n}

2 **a** 7^2 **b** 2^9 **c** 5^{x+2} **d** 2^{8x}
e 11^{1-x} **f** 3^{2x-4y} **g** 3^{4y-2} **h** 2^{4a+3}

3 **a** m^4n^4 **b** $16x^2$ **c** $\frac{a^3}{b^3}$ **d** $\frac{p^2}{4q^2}$
e $125a^3b^3$ **f** $\frac{9s^2}{t^4}$ **g** $36c^6d^4$ **h** $\frac{64x^3}{125y^3}$

4 **a** $10x^3y$ **b** $8a^5b^2$ **c** $\frac{2p^2q^3}{3}$ **d** $\frac{5m^3}{3}$

5 **a** 1 **b** 10 $\{x \neq 0\}$ **c** $\frac{1}{64}$ **d** $\frac{1}{3}$ **e** $\frac{1}{8}$
f $\frac{5}{2}$ **g** $\frac{55}{7}$ **h** $\frac{9}{16}$

6 **a** 2^{-4} **b** 5^{-7} **c** z^{-5} **d** b^{-11}

7 **a** $\frac{1}{3k}$ **b** $\frac{3}{k}$ **c** $\frac{2b}{a}$ **d** $\frac{1}{4s^2}$
e $\frac{1}{16x^2y^2}$ **f** $\frac{4}{x^2y^2}$ **g** $\frac{p^2q}{5}$ **h** $\frac{16}{9c^2d^6}$

8 2^{80}, 3^{60}, 5^{45}

1B SCIENTIFIC NOTATION

1 **a** 4.12×10^2 **b** 5.7×10^{-2} **c** 6.943×10^5
d 5.81×10^{-4}

2 **a** 4×10^{10} lactic acid bacteria **b** 3.45×10^{-7} mm

3 **a** 72 300 **b** 0.002 01 **c** 8 500 000 **d** 0.000 014 96

4 **a** 48 000 seats **b** 0.000 058 5 g

5 **a** 1.5×10^{10} **b** 4.2×10^{-9} **c** 8.1×10^{13}
d 4×10^7 **e** 3×10^{11} **f** 2.5×10^{-2}

6 **a** Bangladesh **b** ≈ 5 times larger

7 **a** $\approx 2.81 \times 10^{12}$ **b** $\approx 1.36 \times 10^{14}$ **c** $\approx 6.16 \times 10^{-5}$
d $\approx 3.80 \times 10^{-20}$ **e** $\approx 3.69 \times 10^7$ **f** $\approx 2.18 \times 10^{-4}$

8 **a** $\approx 1.12 \times 10^{10}$ emails **b** $\approx 9.78 \times 10^{13}$ emails

REVIEW OF CHAPTER 1

1 **a** x^{13} **b** y^5 **c** $4a^5b^3$ **d** $\frac{m^5n^3}{3}$

2 **a** 3^8 **b** 2^{3x+6} **c** 7^{3k} **d** 3^{10-b}

3 **a** 1 **b** $\frac{13}{3}$ **c** 36 **d** $\frac{8}{125}$

4 **a** $\frac{5}{x^3y^3}$ **b** $\frac{5x}{y^3}$ **c** a^2b^6 **d** $\frac{9p^6q^2}{25}$

5 **a** 7.321×10^2 **b** 9.48×10^{-4} **c** 3.03×10^7
d 1.56×10^{-6}

6 **a** 5 420 000 **b** 0.000 000 319 2 **c** 804 000 000
d 0.000 168

7 **a** 4.5×10^{12} **b** 3.2×10^{-8} **c** 2×10^{-9}
d 1.8×10^{-14}

8 **a** the Pinwheel Galaxy **b** $\approx 1.84 \times 10^7$ light-years
c ≈ 8.36 times farther

2A THE DISTRIBUTIVE LAW

1 **a** $15a + 3b$ **b** $-8 + 4x$ **c** $2x^2 - 6x$ **d** $-x^2 - 2xy$
e $x^3 + 5x^2$ **f** $-p^2q + pq^2$

2 **a** $4x^2 + 12xy - 4x$ **b** $-5m^2 + 25m - 40$

3 **a** $24 - 7x$ **b** $k^2 - k$ **c** $5y^2 - 9y$ **d** $10p - 4p^2$

4 **a** $2x + 8$ **b** $2a^2 + 2a + 12$ **c** $22x + 6$
d $-5x^2 + 4x$ **e** $6x^2 - x^3 - 12x$ **f** $-x^3 - 7x^2$

2B THE PRODUCT $(a + b)(c + d)$

1 **a** $x^2 + 9x + 20$ **b** $x^2 - 10x + 21$ **c** $-x - x^2 + 6$
d $6x^2 - 5x - 4$

2 **a** $3x^2 - 5xy - 2y^2$ **b** $-2x + 6x^2 + y - 3xy$
c $14 - 44x + 6x^2$ **d** $5x^2 - 2x^3 + 20 - 8x$

3 **a** $-4x^2 - x^3 + 5x$ **b** $2x^2 - 5x + 4$
c $x^2 + 14x - 14$ **d** $12t^2 + 5t + 5$

2C THE DIFFERENCE BETWEEN TWO SQUARES

1 **a** $x^2 - 9$ **b** $36 - k^2$ **c** $t^2 - 25$ **d** $x^4 - 4$
e $49 - 16y^2$ **f** $x^2 - 10$

2 **a** $2y^2 - 26$ **b** $9a^4 + 16a^2 - 40$

2D THE PERFECT SQUARES EXPANSION

1 **a** $x^2 + 8x + 16$ **b** $x^2 - 12x + 36$
c $x^2 + 6xy + 9y^2$ **d** $4a^2 - 20a + 25$
e $1 + 14x + 49x^2$ **f** $9a^2 - 24ab + 16b^2$

2 **a** $x^4 + 16x^2 + 64$ **b** $9x^4 + 60x^2y + 100y^2$
c $36m^2 - 48m^3 + 16m^4$

3 **a** $11x + 27$ **b** $17x^2 - 22x + 50$
c $-13t^2 - 12t - 8$ **d** $-3x^2 - 2x^3 + x^4 - y^4 - 4xy^2$

2E FURTHER EXPANSION

1 **a** $x^3 + 7x^2 + 9x - 2$ **b** $3x^3 + 9x^2 - 5x + 28$
c $5x^3 + 27x^2 - 28x + 6$ **d** $5x^2 - 6x^3 - 19x + 6$

2 **a** $x^3 + 9x^2 + 20x + 12$ **b** $x^3 - 2x^2 - 23x + 60$
c $-4x^3 + 21x^2 - 2x - 15$ **d** $3x^3 - 10x^2 + 4x + 8$

2F THE BINOMIAL EXPANSION

1 **a** $x^3 + 6x^2 + 12x + 8$ **b** $x^3 - 9x^2 + 27x - 27$
c $64 + 48a + 12a^2 + a^3$ **d** $125 - 75a + 15a^2 - a^3$
e $125x^3 + 150x^2 + 60x + 8$ **f** $64a^3 - 48a^2 + 12a - 1$

2 **a** $x^4 + 16x^3 + 96x^2 + 256x + 256$
b $x^4 - 12x^3 + 54x^2 - 108x + 81$
c $16 - 32x + 24x^2 - 8x^3 + x^4$
d $81x^4 + 216x^3 + 216x^2 + 96x + 16$

REVIEW OF CHAPTER 2

1 **a** $5x^2 + 30x$ **b** $-28 + 8x^2$ **c** $-3n^3 + 12n^2 - 24n$

2 **a** $x^2 + 9x + 28$ **b** $4x^2 - 2x^3 - 6x$

3 **a** $8x^2 - 10x - 3$ **b** $6 - 3x^2 + 2x - x^3$

c $-x^3 - 5x^2 + 6x$

4 **a** $x^2 - 36$ **b** $9x^2 - 1$ **c** $x^2 - 5$

5 **a** $m^2 - 18m + 81$ **b** $16x^2 + 8xy + y^2$ **c** $y^4 - 6y^3 + 9y^2$

6 **a** $2x^2 - 9x + 9$ **b** $15a^2 - b^2 + a + 6$

7 **a** $4x^3 - 9x^2 + 21x - 20$ **b** $9x^3 - 30x^2 - 23x - 4$

8 $x^3 + 6x^2y + 12xy^2 + 8y^3$

9 $625 - 500x + 150x^2 - 20x^3 + x^4$

3A COMMON FACTORS

1 **a** $5(1 + 2x)$ **b** $2(3c - d)$ **c** $x(4 + x)$

d $7a(2a - 1)$ **e** $3x(1 - 3x^2)$ **f** $m(mn + 2)$

2 **a** $2(x^2 + 3x - 7)$ **b** $x(4 + 3x - x^2)$ **c** $2x(3x^2 + x - 5)$

3 **a** $-2(b - 4)$ **b** $-6(2 - 3k)$ **c** $-7x(x - 4)$

d $-6(x + 2y)$ **e** $-s(r + 3)$ **f** $-8x(2 + 3x)$

4 **a** $(n - 2)(n + 4)$ **b** $(x + 1)(2 - x)$ **c** $(x + 3)(x + 1)$

5 **a** $(a + 5)(2 - a)$ **b** $(x - 3)(x - 2)$ **c** $(x + 3)(x + 5)$

d $(x - 4)(x - 11)$ **e** $(x + 5)(x + 3)$ **f** $(x - 2)(7 - 2x)$

3B DIFFERENCE BETWEEN TWO SQUARES FACTORISATION

1 **a** $(x + 6)(x - 6)$ **b** $(1 + x)(1 - x)$

c no real linear factors **d** $(5x + 2)(5x - 2)$

e no real linear factors **f** $(2y + 7x)(2y - 7x)$

2 **a** $2(x + 5)(x - 5)$ **b** $5(x + 2)(x - 2)$

c $2(3 + x)(3 - x)$ **d** $-3(x + 6)(x - 6)$

e $7(2x + 3)(2x - 3)$ **f** $x(5x + 2)(5x - 2)$

3 **a** $(x + 7)(x - 3)$ **b** $-(5x - 2)(3x + 2)$

c $(5x - 1)(x + 1)$ **d** $3(5x + 4)(x + 2)$

3C PERFECT SQUARES FACTORISATION

1 **a** not a perfect square **b** perfect square

2 **a** $(x + 2)^2$ **b** $(x + 6)^2$ **c** $(x - 11)^2$

d $(a + 8)^2$ **e** $(x - 9)^2$ **f** $(y - 12)^2$

3 **a** $(5x + 1)^2$ **b** $(4x - 1)^2$ **c** $(3x + 5)^2$

d $(7x - 2)^2$ **e** $(10 - 3x)^2$ **f** $(5x + 4y)^2$

4 **a** $3(x - 4)^2$ **b** $-2(x + 5)^2$ **c** $-(2x - 1)^2$

3D EXPRESSIONS WITH FOUR TERMS

1 **a** $(x + 1)(4 + y)$ **b** $(a + 5)(b + c)$ **c** $(m + 1)(n + 4)$

d $(x + 3)(x + 5)$ **e** $(x + 1)(2x + 3)$ **f** $(3x + 1)(x + 6)$

2 **a** $(x - 3)(x + 4)$ **b** $(x - 4)(x - 7)$ **c** $(x + 2)(x - 5)$

d $(x + 7)(x - 9)$ **e** $(x - 8)(2x + 5)$ **f** $(4x - 1)(x - 9)$

3E FACTORISING $x^2 + bx + c$

1 **a** 3 and 6 **b** -2 and 7 **c** -9 and 4

2 **a** $(x + 2)(x + 6)$ **b** $(x + 2)(x + 11)$ **c** $(x - 1)(x - 9)$

d $(x - 7)(x - 8)$

3 **a** $(x + 4)(x - 5)$ **b** $(x + 9)(x - 2)$ **c** $(x + 2)(x - 11)$

d $(x + 11)(x - 4)$ **e** $(x + 3)(x - 12)$ **f** $(x + 4)(x - 10)$

4 **a** $2(x + 2)(x + 5)$ **b** $3(x + 7)(x - 1)$

c $5(x + 1)(x - 4)$ **d** $2(x - 2)(x - 11)$

e $4(x + 3)(x - 8)$ **f** $3(x + 7)(x - 2)$

5 **a** $-(x + 4)(x - 6)$ **b** $-3(x + 2)(x - 6)$

c $-(x + 5)(x + 12)$ **d** $-(x - 3)(x - 5)$

e $2(x + 5)(x + 7)$ **f** $-3(x + 4)(x - 9)$

3F MISCELLANEOUS FACTORISATION

1 **a** $4x(x + 2)$ **b** $x(x + 8)(x - 8)$ **c** $(x - 3)^2$

d $(x + 1)(x + 5)$ **e** $(x + 2)(x + 3)$ **f** $-(x-5)(x-10)$

g $(1 - x)(y - 1)$ **h** $(x + 5)(x - 6)$ **i** $(x + 11)(x - 4)$

2 **a** $2(x + 2)(x - 7)$ **b** $5(3 + 2x)(3 - 2x)$

c $b(b + 1)$ **d** $-3(x + 4)^2$

e $x(x - 3)(x - 7)$ **f** $(x + 5y)^2$

g $(x - 3)(2x - 5)$ **h** $-(x + 8)(x - 10)$

i $(x - 7)(2x + 3)$

3 **a** $-(x + 12)(x - 8)$ **b** no real linear factors

c $2x(x + 9)(x - 6)$

REVIEW OF CHAPTER 3

1 **a** $5x(1 - 2x)$ **b** $(x + 4)(x - 11)$ **c** $(x - 2)(2x - 3)$

2 **a** $(2x + 5)(2x - 5)$ **b** $(a + 11)(a - 3)$ **c** $3(y - 1)(y + 5)$

3 **a** $(10 + x)(10 - x)$ **b** no real linear factors

c $9(x + 3)(x - 3)$

4 **a** $(a - 12)^2$ **b** $(3x + 5)^2$ **c** $2(x + 3)^2$

5 **a** $(a + 1)(b + 3)$ **b** $(2k - 3)(l - 2)$ **c** $(x - 1)(3x + 2)$

6 **a** $(x + 4)(x + 6)$ **b** $2(x + 3)(x - 9)$ **c** $-(x + 5)(x - 8)$

7 **a** $4(x - 10)^2$ **b** $-3(x - 2)(x - 8)$

c $2x(x + 12)(x - 10)$

4A SETS

1 $S = \{16, 25, 36, 49, 64, 81\}$, $n(S) = 6$

2 **a** $A = \{6, 8, 10, 12, 14\}$, $B = \{1, 2, 3, 4, 6, 8, 12, 24\}$

b **i** true **ii** false

c **i** $n(A) = 5$ **ii** $n(B) = 8$ **d** no

3 **a** **i** $C = \{4, 6, 8, 9, 10, 12, 14, 15, 16, 18, 20, 21, 22, 24\}$

ii finite, $n(C) = 14$

b **i** $M = \{5, 10, 15, 20, 25, 30, ...\}$ **ii** infinite

4 **a** yes **b** no

5 **a** $k = 14$, 15, 16, or 17 **b** $k \geqslant 14$

4B COMPLEMENT OF A SET

1 **a** $A' = \{A, C, D, G, H, I, K, L, O, P, R, T, U, V, X, Y\}$

b $B' = \{B, C, D, F, G, H, J, K, M, O, P, Q, T, W, X, Y, Z\}$

2 **a** $P = \{3, 6, 9, 12, 15, 18\}$

b $P' = \{1, 2, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 20\}$

c $Q = \{6, 8, 10, 12, 14, 15, 16, 18, 20\}$

d $Q' = \{1, 2, 3, 4, 5, 7, 9, 11, 13, 17, 19\}$

3 **a** infinite

b **i** infinite **ii** finite **iii** infinite **iv** infinite

4C INTERSECTION AND UNION

1 **a** $A \cap B = \{4, 12\}$
$A \cup B = \{1, 2, 4, 5, 7, 8, 9, 10, 11, 12, 14\}$

b $A \cap B = \{c, m, p, t, z\}$
$A \cup B = \{a, c, e, g, j, m, n, p, q, t, v, w, z\}$

2 **a** **i** $P = \{1, 2, 3, 4, 6, 8, 12, 24\}$

ii $Q = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$

iii $P \cap Q = \{2, 3\}$

iv $P \cup Q = \{1, 2, 3, 4, 5, 6, 7, 8, 11, 12, 13, 17, 19, 23, 24\}$

b $n(P) + n(Q) - n(P \cap Q) = 8 + 9 - 2$
$= 15$
$= n(P \cup Q)$ ✓

3 B and C

4 **a** $P = \{\text{January, March, May, July, August, October, December}\}$
$Q = \{\text{January, February, March, April, May, August}\}$
$R = \{\text{March, April, May}\}$

b **i** $P \cup R = \{\text{January, March, April, May, July, August, October, December}\}$

This set represents the months that have 31 days or are in autumn.

ii $P \cap Q' = \{\text{July, October, December}\}$

This set represents the months which have 31 days and which do not contain the letter A.

iii $P \cap Q \cap R = \{\text{March, May}\}$

This set represents the months in autumn which have 31 days and contain the letter A.

5 finite

4D SPECIAL NUMBER SETS

1 **a** false **b** true **c** true **d** true

2 **a** true **b** false **c** false **d** true

3 $\mathbb{Q}$

4 **a** irrational **b** neither **c** rational

4E INTERVAL NOTATION

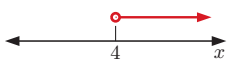
1 **a** The set of real numbers greater than or equal to -4.

b The set of integers greater than or equal to -5 and less than 3.

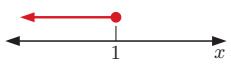
c The set of natural numbers less than or equal to 8 or greater than 13.

2 **a** $\{6, 7, 8, 9\}$ **b** $\{1, 2, 3, 4\}$ **c** $\{-5, -4, -3, -2, -1\}$

3 **a**



b



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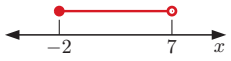

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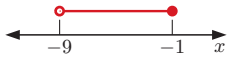
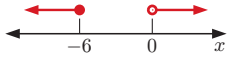


e

f



4 **a** $\{x \mid x > -1\}$ **b** $\{x \mid 3 \leqslant x < 9\}$

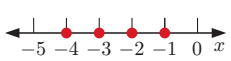
c $\{x \mid -5 \leqslant x \leqslant 0\}$ **d** $\{x \mid x \leqslant -10 \text{ or } x > -4\}$

e $\{x \in \mathbb{N} \mid 1 \leqslant x \leqslant 5\}$ **f** $\{x \in \mathbb{Z} \mid -2 \leqslant x \leqslant 3\}$

5 **a**

b

c

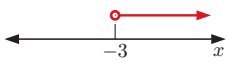


6 **a** infinite **b** finite **c** infinite

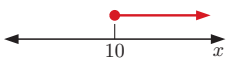
7 **a** yes **b** no

8 **a** **i** $A' = \{x \mid x < 7\}$ **ii** $A \cap B = \{x \mid 7 \leqslant x < 10\}$

b **i**



ii



REVIEW OF CHAPTER 4

1 **a** $A = \{A, D, E, I, L, Q, R, T, U\}$

b $n(A) = 9$ **c** **i** false **ii** true

2 **a** infinite **b** $n(P) = 7$ **c** yes

3 **a** $A' = \{4, 5, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20\}$

b $n(B') = 7$

4 **a** **i** $A \cup C = \{1, 3, 4, 9, 16, 25, 27, 36, 49, 64, 81\}$

ii $B \cap C = \{27\}$

b A and B

5 infinite

6 **a** true **b** false **c** false **d** true

7 **a** $\{x \in \mathbb{Z} \mid x \leqslant 9\}$ **b** $\{x \in \mathbb{Q} \mid 2 < x \leqslant 5\}$

c $\{x \in \mathbb{N} \mid 4 \leqslant x \leqslant 10\}$ **d** $\left\{x \in \mathbb{Z}^- \;\middle|\; x \leqslant -3\right\}$

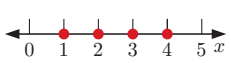
8 **a** $A = \{-3, -2, -1, 0, 1, 2, 3, 4\}$
$B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

b $n(A) = 8, \quad n(B) = 10$

c **i** $A' = \{x \in \mathbb{Z} \mid x < -3 \text{ or } x > 4\}$

ii $A \cup B = \{x \in \mathbb{Z} \mid -3 \leqslant x < 11\}$

d



5A EVALUATING ALGEBRAIC FRACTIONS

1 **a** 2 **b** 5 **c** -4 **d** $\frac{2}{3}$

2 **a** -3 **b** -1 **c** 2 **d** -5 **e** $-\frac{8}{5}$ **f** 15

g $-\frac{7}{5}$ **h** $-\frac{1}{4}$

5B SIMPLIFYING ALGEBRAIC FRACTIONS

1 **a** $\frac{m}{4}$ **b** $3x$ **c** $\frac{1}{2}$ **d** $3a$ **e** $\frac{2a}{b}$ **f** $\frac{3y}{5x}$

2 **a** $-\frac{1}{2m}$ **b** $\frac{3a}{b}$ **c** $-\frac{y}{3}$

3 **a** cannot be simplified **b** a **c** cannot be simplified

4 **a** $9a$ **b** $\frac{2a}{3}$ **c** $\frac{1}{8b^3}$

5 **a** $x+2$ **b** $9(a-5)$ **c** $\frac{3}{4(n+7)}$

6 **a** $\frac{5}{x+4}$ **b** $\frac{2}{3(x+3)}$ **c** $\frac{x-7}{2}$

7 **a** $x+3$ **b** $\frac{x-4}{3}$ **c** $\frac{2}{x+4}$ **d** $\frac{3(b+2)}{5}$
e $\frac{2a-1}{2}$ **f** $\frac{2(2x+3)}{5}$

8 **a** $\frac{2}{3}$ **b** $\frac{3}{2}$ **c** $2a$ **d** $\frac{2x}{5}$ **e** $\frac{x}{2}$ **f** $\frac{1}{x}$

9 **a** -3 **b** $-\frac{1}{2}$ **c** $-\frac{a}{2}$

10 **a** $a-2$ **b** $-\frac{1}{x+3}$ **c** $\frac{3(1-x)}{x}$ **d** $-\frac{b}{a+2b}$
e $\frac{1}{x+5}$ **f** $\frac{x+6}{2x}$ **g** $\frac{x+2}{x+7}$ **h** $\frac{x-2}{x+2}$
i $\frac{5-x}{x-4}$

5C MULTIPLYING ALGEBRAIC FRACTIONS

1 **a** $\frac{2a}{3b}$ **b** $\frac{5}{2}$ **c** $\frac{k^2}{15}$ **d** $6n$ **e** $\frac{9}{m^2}$
f $\frac{1}{y}$ **g** $4xy$ **h** $\frac{3}{4xy}$

2 **a** $\frac{2x}{9}$ **b** $\frac{2}{3k}$

5D DIVIDING ALGEBRAIC FRACTIONS

1 **a** $\frac{4}{3}$ **b** $\frac{9}{2a}$ **c** 7 **d** $\frac{50}{b^2}$ **e** $4m$
f $\frac{18}{p^3}$ **g** $\frac{6a}{b}$ **h** $\frac{25}{3y^3}$

2 **a** 6 **b** $\frac{2}{k(k-3)}$

5E ADDING AND SUBTRACTING ALGEBRAIC FRACTIONS

1 **a** $\frac{7a}{10}$ **b** $\frac{3x}{8}$ **c** $\frac{13k}{21}$ **d** $-\frac{7y}{12}$
e $\frac{23m}{20}$ **f** $-\frac{3x}{40}$ **g** $\frac{7a}{10}$ **h** $\frac{7t}{24}$

2 **a** $\frac{a-8}{4}$ **b** $\frac{6x}{5}$ **c** $\frac{3x+2}{x}$ **d** $\frac{7-c^2}{c}$

3 **a** $\frac{5y+2x}{xy}$ **b** $\frac{5}{2a}$ **c** $\frac{14-3x}{7x}$ **d** $\frac{4b+3}{ab}$
e $\frac{15+m^2}{3m}$ **f** $\frac{13}{12x}$ **g** $\frac{x+4}{x^2}$ **h** $\frac{7x-6}{2x^2}$

4 **a** $\frac{x+5}{x^2y}$ **b** $\frac{a^2-2b}{ab^2}$ **c** $\frac{18-p^2}{3p^2q}$

5 **a** $\frac{3x+1}{4}$ **b** $\frac{11x-5}{10}$ **c** $\frac{5x+4}{6}$ **d** $\frac{14x+3}{15}$
e $\frac{5x}{12}$ **f** $\frac{-15x-8}{21}$

6 **a** $\frac{5x+2}{x(x+1)}$ **b** $\frac{3x-9}{(x+2)(x-1)}$ **c** $\frac{2x-5}{x-4}$
d $\frac{-x^2-2x+2}{(x+2)(x+3)}$ **e** $\frac{x^2+6x-4}{(x-2)(x+2)}$ **f** $\frac{5x}{(x-6)(x-1)}$

REVIEW OF CHAPTER 5

1 **a** $-\frac{5}{12}$ **b** $\frac{1}{4}$ **c** -3

2 **a** $\frac{a}{2b}$ **b** $\frac{3x}{4}$ **c** $\frac{3(a+b)}{8}$

3 **a** $\frac{4}{7}$ **b** $-\frac{3(x+2)}{10}$ **c** $\frac{x+3}{x+6}$

4 **a** $\frac{b}{2}$ **b** $\frac{15}{2x^2}$ **c** $\frac{4}{mn}$ **d** $24x$

5 **a** $\frac{5}{2x}$ **b** $-8(a-1)$

6 **a** $\frac{17x}{28}$ **b** $\frac{17x}{60}$ **c** $\frac{b^2-5}{b}$ **d** $\frac{4x-7}{2x^2}$

7 **a** $\frac{5x-4}{12}$ **b** $\frac{5x-9}{x(x-3)}$ **c** $\frac{x^2+4x+28}{(x-2)(x+6)}$

6A LINEAR EQUATIONS

1 **a** $x=-8$ **b** $x=7$ **c** $x=-5$ **d** $x=-24$

2 **a** $x=3$ **b** $x=4$ **c** $x=-2$ **d** $x=3$
e $x=7$ **f** $x=-5$

3 **a** $x=-8$ **b** $x=10$ **c** $x=5$ **d** $x=-66$
e $x=2$ **f** $x=\frac{21}{2}$

4 **a** $x=-3$ **b** $x=-\frac{7}{2}$

5 **a** $x=5$ **b** $x=-12$ **c** $x=-2$ **d** $x=-1$

6 **a** $x=1$ **b** $x=\frac{7}{6}$ **c** $x=-\frac{2}{3}$ **d** $x=3$
e $x=\frac{4}{11}$ **f** $x=-\frac{7}{2}$

6B EQUATIONS WITH FRACTIONS

1 **a** $x=-\frac{12}{5}$ **b** $x=-7$ **c** $x=7$

2 **a** $x=\frac{5}{2}$ **b** $x=-\frac{27}{4}$ **c** $x=-2$ **d** $x=\frac{6}{5}$

3 **a** $x=8$ **b** $x=\frac{15}{4}$ **c** $x=-\frac{9}{20}$ **d** $x=-\frac{6}{7}$
e $x=-\frac{10}{13}$ **f** $x=\frac{9}{19}$

4 **a** $x=-13$ **b** $x=-16$ **c** $x=\frac{20}{3}$ **d** $x=-7$

5 **a** $x=\frac{1}{7}$ **b** $x=8$ **c** $x=-\frac{7}{5}$

6C PROBLEM SOLVING

1 The smallest integer is 37. **2** The number is 15.

3 There were 55 cars and 15 motorbikes on display.

4 Holly's plant has 19 tomatoes, Chris' plant has 28 tomatoes, and Dave's plant has 7 tomatoes.

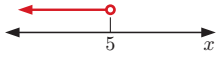
5 The fraction is $\frac{9}{15}$. **6** There are 48 houses on the street.

7 Sanjeev has 27 10 cent coins.

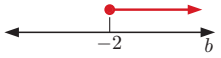
8 Gihun bought 6 carrots.

6D LINEAR INEQUALITIES

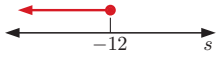
1 **a** $x<5$



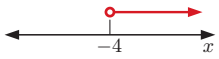
b $b \geqslant -2$



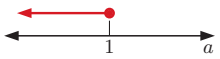
c $s \leqslant -12$



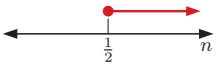
2 **a** $x > -4$



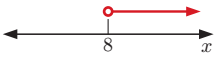
b $a \leqslant 1$



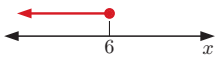
c $n \geqslant \frac{1}{2}$



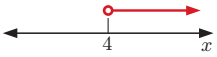
3 **a** $x > 8$



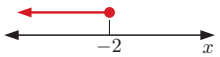
b $x \leqslant 6$



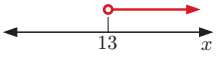
c $x > 4$



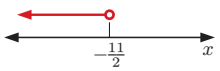
d $x \leqslant -2$



e $x > 13$

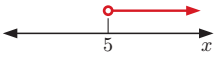


f $x < -\frac{11}{2}$

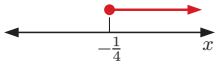


4 **a** $a \leqslant 3$ **b** $b > 14$ **c** $x > 7$

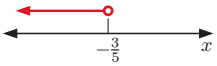
5 **a** $x > 5$



b $x \geqslant -\frac{1}{4}$



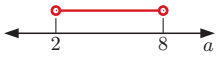
c $x < -\frac{3}{5}$



6 **a** $x < 3$ **b** $x \leqslant 0$ **c** $x \geqslant \frac{24}{43}$

7 **a** $-8 \leqslant x \leqslant -3$

b $2 < a < 8$



c $-10 < y \leqslant 6$

8 **a** $2 \leqslant x \leqslant 4$

b $-3 < x < 4$

c $-30 < x \leqslant 3$

d $12 \leqslant x \leqslant 24$

e $-13 \leqslant x < -4$

f $-5 < x < 3$

9 **a** $-\frac{5}{2} \leqslant x < 20$ **b** $-\frac{16}{3} \leqslant x < -\frac{4}{3}$ **c** $-\frac{1}{2} \leqslant x \leqslant \frac{11}{2}$

6E PROBLEM SOLVING WITH INEQUALITIES

1 Each person can have at most 220 g of lamb for dinner.

2 It is cheaper to use *Carpet Solutions* for cleaning more than 3 rooms.

3 Scott weighs between 93 kg and 103 kg, and Paul weighs between 77 kg and 87 kg.

4 Justin and Phil spent more than 5 minutes but at most 20 minutes warming up.

REVIEW OF CHAPTER 6

1 **a** $x = -4$ **b** $x = 36$ **c** $x = -\frac{23}{4}$

2 **a** $x = -2$ **b** $x = -5$

3 **a** $x = 27$ **b** $x = \frac{8}{19}$

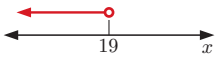
4 **a** $x = \frac{35}{6}$ **b** $x = \frac{5}{17}$ **c** $x = \frac{12}{11}$

5 **a** $x = \frac{7}{9}$ **b** $x = -13$

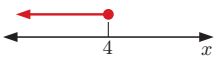
6 The number is 7. **7** Adam kicked 13 behinds.

8 **a** $x \geqslant 2$ **b** $x > -8$ **c** $x \geqslant \frac{2}{3}$

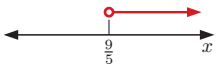
9 **a** $x < 19$



b $x \leqslant 4$



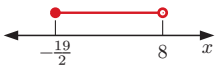
c $x > \frac{9}{5}$



10 **a** $-3 \leqslant x \leqslant 5$

b $3 \leqslant x < 18$

c $-\frac{19}{2} \leqslant x < 8$



11 Richard must sell more than 13 items per week to earn more with *Option 2*.

7A VENN DIAGRAMS

1 **a** $R = \{2, 4, 5, 7, 9\}$ **b** $S = \{1, 2, 4, 5, 6, 8, 9\}$

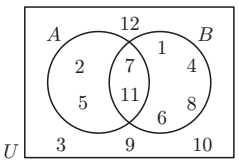
c $R \cup S = \{1, 2, 4, 5, 6, 7, 8, 9\}$

d $R \cap S = \{2, 4, 5, 9\}$ **e** $R' = \{1, 3, 6, 8, 10\}$

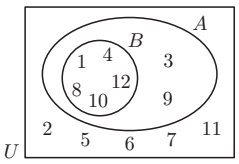
f $S' = \{3, 7, 10\}$

g $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

2 **a**



b



3 **a** **i** $A = \{1, 2, 3, 4, 6, 8, 12, 24\}$

ii $B = \{3, 6, 9, 12, 15, 18, 21, 24\}$

iii $A \cap B = \{3, 6, 12, 24\}$

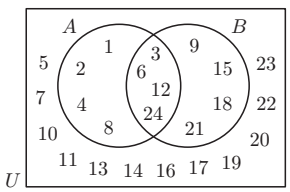
iv $A \cup B = \{1, 2, 3, 4, 6, 8, 9, 12, 15, 18, 21, 24\}$

b **i** $n(A) = 8$ **ii** $n(B) = 8$ **iii** $n(A \cap B) = 4$

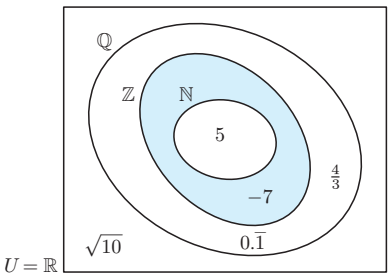
iv $n(A \cup B) = 12$

c $n(A) + n(B) - n(A \cap B) = 8 + 8 - 4 = 12 = n(A \cup B)$ ✓

d



4



5 **a** **i** $A = \{c, e, f, g, j, o, q, r\}$

ii $B = \{b, c, d, e, m, o, p, q, r, s\}$

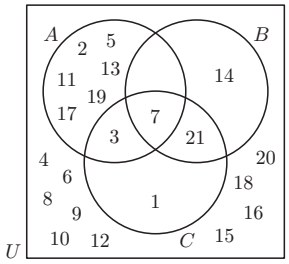
iii $A \cap C = \{g, j, r\}$

iv $A \cup B = \{b, c, d, e, f, g, j, m, o, p, q, r, s\}$

b **i** $n(B \cup C) = 13$ **ii** $n(A' \cap B') = 7$

iii $n(A \cap B \cap C) = 1$

6 **a**

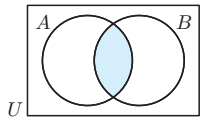


b **i** $\{3, 7\}$ **ii** $\{1, 3\}$ **iii** $\{21\}$ **iv** $\{7\}$

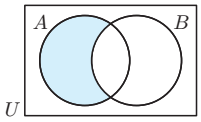
v $\{4, 6, 8, 9, 10, 12, 15, 16, 18, 20\}$

7B VENN DIAGRAM REGIONS

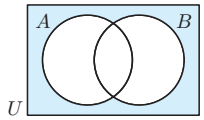
1 **a**



b

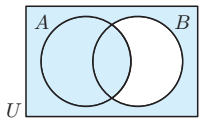


c

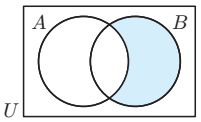


2 **a** in L or not in K **b** not in K or not in L

3 **a** **i**



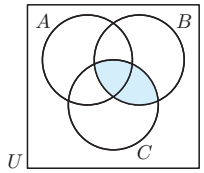
ii



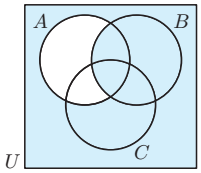
b The shaded region in **a ii** is the same as the unshaded region in **a i**.

$\therefore \ (A \cup B')' = A' \cap B$

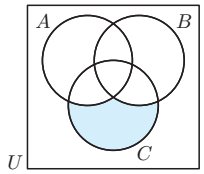
4 **a**



b



c

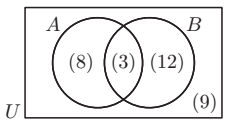


7C NUMBERS IN REGIONS

1 **a** 9 elements **b** 10 elements **c** 14 elements

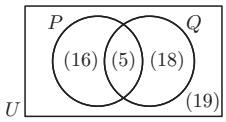
d 7 elements **e** 5 elements **f** 15 elements

2 **a**



b **i** 23 elements **ii** 8 elements

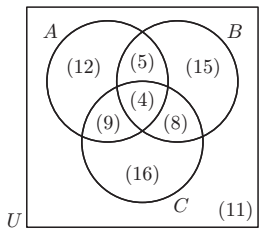
3 **a**



b **i** 5 elements **ii** 34 elements

4 **a** **i** $n(A \cap B \cap C) = 4$ **ii** $n(B) = 32$

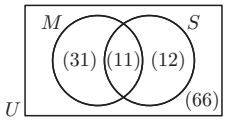
b



c **i** 30 elements **ii** 37 elements **iii** 22 elements

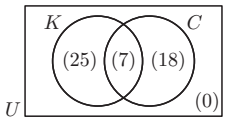
7D PROBLEM SOLVING WITH VENN DIAGRAMS

1 **a**



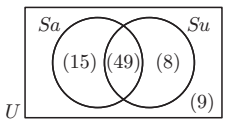
b **i** 31 students **ii** 54 students

2 **a**



b **i** 7 customers **ii** 43 customers

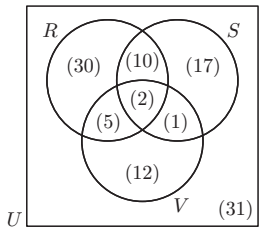
3 **a**



b **i** 49 restaurants **ii** 23 restaurants

4 8%

5 **a**



b **i** 31 customers **ii** 65 customers **iii** 47 customers **iv** 18 customers

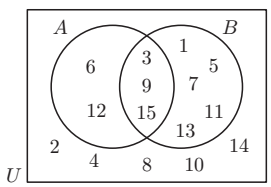
REVIEW OF CHAPTER 7

1 **a** **i** $A = \{3, 6, 9, 12, 15\}$

ii $B = \{1, 3, 5, 7, 9, 11, 13, 15\}$

iii $A \cap B = \{3, 9, 15\}$

b



2 **a** **i** $Q = \{3, 4, 10, 11, 15, 16, 17, 18, 21\}$

ii $P \cap R = \{1, 11, 15\}$

iii $Q \cup R = \{1, 3, 4, 8, 10, 11, 15, 16, 17, 18, 19, 21, 22\}$

iv $P \cap Q \cap R' = \{3, 10, 16\}$

b **i** $n(P) = 8$ **ii** $n(P \cap Q') = 3$

iii $n((P \cup Q \cup R)') = 7$

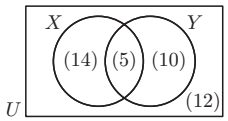
3 **a** in A and C but not in B **b** in exactly one of A, B, or C

4 The regions $(A \cup B) \cap C$ and $A \cup (B \cap C)$ are not the same.

$\therefore\ (A \cup B) \cap C \neq A \cup (B \cap C)$

5 **a** $x = 12$ **b** **i** 16 elements **ii** 23 elements

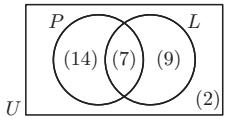
6 **a**



b **i** 29 elements

ii 24 elements

7 **a**



b **i** 7 stores

ii 9 stores

8A RADICALS

1 **a** not a surd, 4 **b** surd, ≈ 7.2111 **c** surd, ≈ 0.2887

d not a surd, $\frac{1}{5}$

2 **a** C **b** A **c** B

3 **a** 7 **b** $11\sqrt{11}$ **c** $4\sqrt{2}$ **d** $\frac{1}{6}$ **e** $\frac{49}{5}$

f $\frac{13}{17}$

4 **a** 27 **b** 200 **c** 44

5 **a** 30 **b** 28 **c** -12 **d** 72 **e** -60

f $54\sqrt{2}$

6 **a** 5 **b** $-\frac{1}{2}$ **c** 11

8B PROPERTIES OF RADICALS

1 **a** $\sqrt{15}$ **b** $\sqrt{26}$ **c** $18\sqrt{6}$ **d** $-10\sqrt{35}$

e $\sqrt{130}$ **f** $10\sqrt{10}$

2 **a** 2 **b** $\sqrt{5}$ **c** $\frac{1}{6}$ **d** 15

3 **a** $\frac{1}{3}$ **b** $\frac{3}{5}$ **c** $\frac{3}{4}$ **d** $\frac{7}{4}$

4 **a** $6\sqrt{2}$ **b** $8\sqrt{2}$ **c** $11\sqrt{2}$

5 **a** $4\sqrt{3}$ **b** $6\sqrt{3}$ **c** $100\sqrt{3}$

8C SIMPLEST SURD FORM

1 **a** $2\sqrt{5}$ **b** $3\sqrt{2}$ **c** $5\sqrt{3}$ **d** $2\sqrt{21}$

e $2\sqrt{30}$ **f** $6\sqrt{7}$

2 **a** $\frac{\sqrt{3}}{5}$ **b** $\frac{2\sqrt{6}}{3}$ **c** $\frac{5\sqrt{2}}{9}$ **d** $\frac{3\sqrt{5}}{7}$

3 **a** $2 + \sqrt{2}$ **b** $3 + \sqrt{15}$ **c** $\frac{1}{2} - \frac{1}{2}\sqrt{3}$ **d** $1 - \frac{1}{4}\sqrt{5}$

8D POWER EQUATIONS

1 **a** $x \approx \pm 2.65$ **b** no real solution **c** $x \approx 9.64$

d $x \approx -2.47$ **e** $x = \pm 5$ **f** no real solution

2 **a** $x = \pm 3\sqrt{3}$ **b** $x = \pm 3\sqrt{6}$ **c** $x = \pm 10\sqrt{2}$

3 **a** $x = \pm 5$ **b** no real solution **c** $x = \pm 4$

d $x = \pm 2\sqrt{2}$ **e** $x = 2$ **f** $x = \pm 4$

4 **a** $x = \pm\sqrt{6}$ **b** $x = \pm 9$ **c** no real solution

5 **a** $x = 16$ **b** $x = 75$ **c** $x = 81$

8E OPERATIONS WITH RADICALS

1 **a** $4\sqrt{2}$ **b** $8\sqrt{5}$ **c** $6\sqrt{7}$ **d** $-3\sqrt{3}$

e $8\sqrt{3}$ **f** $-\sqrt{2}$

2 **a** $6\sqrt{2} + 4\sqrt{5}$ **b** $-2\sqrt{3} + 6\sqrt{7}$ **c** $6\sqrt{11} - 3\sqrt{6}$

3 **a** $2\sqrt{3}$ **b** $8\sqrt{5}$ **c** $-3\sqrt{2}$

4 **a** $\frac{8\sqrt{2}}{15}$ **b** $\frac{7\sqrt{5}}{12}$ **c** $\frac{17\sqrt{13}}{10}$

5 **a** $2\sqrt{2} + 8$ **b** $10 - 5\sqrt{7}$ **c** $\sqrt{3} - 3$

d $2\sqrt{3} - 15$ **e** $21 + 4\sqrt{7}$ **f** $\sqrt{30} - 12$

6 **a** $-7\sqrt{3} - 3$ **b** $-2 + 9\sqrt{2}$ **c** $-6\sqrt{6} + 12$

d $-\sqrt{35} - 10$ **e** $-4 + 4\sqrt{2}$ **f** $-6\sqrt{5} + 4\sqrt{15}$

7 **a** $5 + 3\sqrt{3}$ **b** $4 - \sqrt{2}$ **c** $-7 - \sqrt{5}$ **d** $8 - 2\sqrt{6}$

8 **a** $3 + 2\sqrt{2}$ **b** $9 - 4\sqrt{5}$ **c** $8 + 4\sqrt{3}$ **d** $79 - 20\sqrt{3}$

9 **a** 1 **b** 6 **c** 19

REVIEW OF CHAPTER 8

1 **a** ≈ 3.317 **b** ≈ 9.110 **c** ≈ 12.247 **d** ≈ 15.395

2 **a** 20 **b** $\frac{9}{5}$ **c** 12

3 **a** $\sqrt{21}$ **b** $-8\sqrt{14}$ **c** $\frac{1}{3}$

4 **a** $4\sqrt{5}$ **b** $6\sqrt{5}$ **c** $10\sqrt{5}$

5 **a** $2\sqrt{7}$ **b** $10\sqrt{3}$ **c** $\frac{3\sqrt{5}}{2}$

6 **a** $x = \pm 4\sqrt{2}$ **b** $x = \pm 8$ **c** no real solution

d $x = 3$ **e** $x = \pm 2\sqrt{6}$ **f** $x = 144$

7 **a** $8\sqrt{5}$ **b** $4\sqrt{6}$ **c** $-2\sqrt{2} + 5\sqrt{7}$

8 $\sqrt{2} + \sqrt{32} = \sqrt{2} + 4\sqrt{2} = 5\sqrt{2}$, $\sqrt{50} = 5\sqrt{2}$

$\therefore\ \sqrt{2} + \sqrt{32} = \sqrt{50}$

9 **a** $\frac{11\sqrt{3}}{28}$ **b** $\frac{13\sqrt{2}}{15}$ **c** $-\frac{5\sqrt{5}}{24}$

10 **a** $6\sqrt{2} + 2$ **b** $-1 - 3\sqrt{5}$ **c** $28 - 10\sqrt{3}$ **d** 15

9A PYTHAGORAS' THEOREM

1 **a** $\sqrt{29}$ cm **b** $\sqrt{137}$ cm **c** $7\sqrt{2}$ m **d** $\sqrt{105}$ km

e $3\sqrt{7}$ m **f** 24 cm

2 **a** ≈ 4.5 cm **b** ≈ 10.2 cm **c** ≈ 17.8 m

3 **a** $x = \sqrt{33}$ **b** $x = \sqrt{11}$ **c** $x = 3\sqrt{5}$

4 $x = \sqrt{65}$, $y = 2\sqrt{14}$

5 **Hint:** Write the length of the hypotenuse of the largest triangle in two different ways.

6 **a** AB $= \sqrt{14}$ cm **b** AB $= \sqrt{85}$ m

9B PYTHAGOREAN TRIPLES

1 **a** yes **b** no **c** no

2 **a** $k = 10$ **b** $k = 35$ **c** $k = 24$

3 **a** $(8m)^2 + (m^2 - 16)^2 = 64m^2 + m^4 - 32m^2 + 256$

$= m^4 + 32m^2 + 256$

$= (m^2 + 16)^2$

$\therefore\ \{8m,\ m^2 - 16,\ m^2 + 16\}$ is a Pythagorean triple for any $m \in \mathbb{Z}^+,\ m > 4$.

b $\{96, 128, 160\}$

9C PROBLEM SOLVING

1 ≈ 11.3 cm **2** ≈ 6.71 cm by ≈ 13.4 cm

3 ≈ 1.56 m

4 **a** ≈ 62.2 km **b** ≈ 2.84 hours or ≈ 2 h 51 min

5 **a** ≈ 4.53 m **b** ≈ 2.12 m

6 Eliza jogs about 1.02 km farther than Damien.

7 ≈ 6.03 cm **8** ≈ 4.35 cm **9** 7.7 m

9D CIRCLE PROBLEMS

1 **a** $x = 3\sqrt{5}$ **b** $x = \sqrt{51}$ **2** BC ≈ 9.75 cm

3 **a** $x \approx 2.24$ **b** $x \approx 7.12$ **4** ≈ 25.3 cm

5 ≈ 31.7 cm^2 **6** **a** $x \approx 10.6$ **b** $x \approx 13.9$

7 AB ≈ 13.7 cm

8 The smaller circle has radius ≈ 7.07 m and the larger circle has radius ≈ 14.1 m.

9E THE CONVERSE OF PYTHAGORAS' THEOREM

1 **a** not right angled **b** not right angled **c** right angled

2 **a** It is right angled at B. **b** It is right angled at C.
c It is not right angled.

3 No, the park is not a right angled triangle.

4 $AB^2 + BC^2 = AC^2$
$\therefore$ yes, triangle ABC is right angled at B.

REVIEW OF CHAPTER 9

1 **a** $\sqrt{97}$ m **b** $2\sqrt{19}$ cm

2 **a** $x \approx 3.46$ **b** $x = 12$

3 $x = 2\sqrt{5}$, $y = 2\sqrt{21}$ **4** yes **5** $k = 6$

6 The shorter diagonal is $\approx$ 17.9 cm and the longer diagonal is $\approx$ 35.8 cm.

7 ≈ 42.4 km east **8** ≈ 33.2 cm

9 **a** $x = 8$ **b** $x = 12$

10 $2^2 + 6^2 = 40 \neq (\sqrt{38})^2$
$\therefore$ the triangle is not right angled.

11 **a** $AD^2 + BD^2 = 48 = AB^2$
$\therefore$ $\widehat{ADB}$ is a right angle, so [AB] is a diameter of the circle.

b $BC^2 = 2^2 + (2\sqrt{3})^2 = 16$
$\therefore$ BC = 4 m
$BC^2 + AB^2 = 64 = AC^2$
$\therefore$ $\widehat{ABC}$ is a right angle, so [BC] is a tangent to the circle.

10A FORMULA CONSTRUCTION

1 **a** $M = 6 \times 8$ **b** $M = 6w$ **c** $M = bw$

2 **a** $C = 1200 + 40 \times 3$ **b** $C = 1200 + 40t$
c $C = 1200 + xt$ **d** $C = P + xt$

3 **a** $T = 5 \times 30 + 3(5 - 1)$ **b** $T = 6 \times 40 + b(6 - 1)$
c $T = 4m + b(4 - 1)$ **d** $T = im + b(i - 1)$

10B SUBSTITUTING INTO FORMULAE

1 **a** 58.8 joules **b** 200 g

2 **a** **i** $L = 54$ **ii** $L = 384$ **b** $n = 5$

3 **a** ≈ 13.9 m/s **b** ≈ 20.7 m

10C REARRANGING FORMULAE

1 **a** $y = \frac{5 - x}{2}$ **b** $y = \frac{3x - 7}{4}$ **c** $y = \frac{-2x - 5}{5}$

2 **a** $x = \frac{n}{m}$ **b** $x = 3z - 4$ **c** $x = \frac{t - 5y}{a}$
d $x = \frac{y - w}{7}$ **e** $x = 1 - pq$ **f** $x = \frac{a + b}{c}$

3 **a** $x = \sqrt{3K}$ **b** $x = \sqrt{5m - p}$ **c** $x = \sqrt[3]{\frac{s + T}{2}}$

4 **a** $z = \frac{y}{ax}$ **b** $z = -\frac{bd}{a}$ **c** $z = \sqrt{2mn}$

5 **a** $r = \frac{mv^2}{F}$ **b** $v = \sqrt{\frac{Fr}{m}}$

6 **a** $a = 16M^2$ **b** $a = \frac{9x}{K^2}$ **c** $a = \sqrt{P^2 - 1}$

7 **a** $x = \frac{3 - Ty}{T}$ **b** $x = \frac{2M - p}{M}$ **c** $x = 1 - \frac{5}{y - 4}$

8 **a** $x = \frac{b - a}{4 - k}$ **b** $x = \frac{1 - n}{m + p}$ **c** $x = \frac{s - t}{v - 1}$

9 **a** $x = \frac{2}{1 - 3y}$ **b** $x = \frac{4y + 1}{y - 2}$ **c** $x = \frac{5y + 2}{3 + 4y}$

10D REARRANGEMENT AND SUBSTITUTION

1 **a** $t = \frac{n^2 - H}{2p}$ **b** **i** $t = 11$ **ii** $t = \frac{19}{24}$

2 **a** 7 runs per over **b** $x = \frac{50R - A - 1 + B}{R}$ **c** 34 overs

3 **a** $m = \frac{\pi r^2 V^2}{35.26}$ **b** **i** ≈ 5.01 kg **ii** ≈ 1.27 kg

4 **a** $b = \sqrt{2R^2 - a^2}$ **b** **i** $b = 7$ **ii** $b = 17$

10E PREDICTING FORMULAE

1 **a** $2n + 3$ **b** $7n - 5$ **c** 3^n

2 **a**

Diagram	1	2	3	4
Number of matchsticks	6	11	16	21

b $M = 5n + 1$ **c** 101 matchsticks

3 **a** **i** $T_1 = 1$ **ii** $T_2 = 4$ **iii** $T_3 = 9$ **iv** $T_4 = 16$
b $T_n = n^2$ **c** $T_{50} = 2500$

REVIEW OF CHAPTER 10

1 **a** $C = 80 + 15 \times 52$ **b** $C = 80 + 15w$
c $C = 80 + xw$ **d** $C = F + xw$

2 **a** 3 m/s^2 **b** 7 m/s

3 **a** $y = \frac{q - p}{2}$ **b** $y = \frac{wz}{5}$ **c** $y = \sqrt{4K - m}$

4 **a** $a = 25F^2$ **b** $a = \frac{36b}{M^2}$ **c** $a = \sqrt{2c - T^2}$

5 **a** $x = -4 + \frac{3}{y - 2}$ **b** $x = \frac{d - a}{5 + f}$ **c** $x = \frac{y - 2}{y + 1}$

6 **a** $r = \frac{Tv}{2\pi}$ **b** **i** ≈ 4.77 m **ii** ≈ 20.3 m

7 **a** $a = \sqrt[3]{\frac{6\sqrt{6}\,V}{\pi}}$ **b** **i** ≈ 6.16 cm **ii** ≈ 9.78 cm

8 **a**

Diagram	1	2	3	4
Number of matchsticks	5	9	13	17

b $M = 4n + 1$ **c** 81 matchsticks

11A LENGTH AND PERIMETER

1 **a** 36 000 cm **b** 8.3 km **c** 127 500 cm

2 **a** 23.1 km **b** 22 cm **c** 15.6 m

3 28.5 mm

4 **a** ≈ 18.8 m **b** ≈ 8.80 cm **c** ≈ 22.0 km

5 **a** ≈ 21.3 m **b** ≈ 12.6 cm **c** ≈ 126 cm

6 **a** ≈ 50.9 m **b** ≈ 27.5 mm

7 **a** $P = (5x + 2)$ m **b** $P = (8a - 4)$ mm

c $P = (\sqrt{2}r + \frac{1}{2}\pi r)$ cm

8 **a** ≈ 8.73 cm **b** $\approx 22.9°$

11B AREA

1 **a** 200 000 m^2 **b** 7.2 m^2 **c** 48.5 cm^2

2 **a** 27 cm^2 **b** 44 cm^2 **c** 28 cm^2

d 120 m^2 **e** ≈ 21.2 cm^2 **f** ≈ 24.0 cm^2

3 **a** $a = 4$ **b** $a \approx 8.54$

4 **a** 1.425 L **b** 575 mL

5 **a** 44 m^2 **b** ≈ 263 cm^2 **c** ≈ 2.65 cm^2

6 **a** 3000 cm^2 **b** 48%

7 perimeter ≈ 8.19 cm, area ≈ 4.19 cm^2

8 **a** $A = a\sqrt{b^2 - c^2}$ **b** $A = ax + \frac{3}{4}\pi x^2$ **c** $A = \frac{1}{4}\pi d^2 - \frac{d^2}{2}$

11C SURFACE AREA

1 **a** 650 cm^2 **b** 756 cm^2 **c** 2100 cm^2

2 $A = 6x^2$ **3** **a** 0.3072 m^2 **b** $5.01

4 ≈ 16.8 cm **5** **a** ≈ 691 cm^2 **b** ≈ 209 mm^2

6 **a** ≈ 154 cm^2 **b** ≈ 151 km^2

7 **a** ≈ 148 m^2 **b** ≈ 39.5 cm^2

8 ≈ 0.785 m^2 **9** **a** ≈ 76.0 cm **b** ≈ 2860 cm^2

10 **a** ≈ 5.97 cm **b** ≈ 6.99 m **11** $A = 2\pi r^2$

11D VOLUME

1 **a** 52 cm^3 **b** 8 100 000 cm^3 **c** 3.421 m^3

2 588 235 rings

3 **a** 140 cm^3 **b** 390 m^3 **c** ≈ 503 cm^3

4 ≈ 68.4 cm^3 **5** **a** 0.039 44 m^3 **b** 26.8192 kg

6 $V = \frac{1}{8}\pi bc(2a + b)$

7 **a** 50 cm^3 **b** ≈ 75.4 cm^3 **c** ≈ 302 m^3

8 ≈ 539 cm^3 **9** **a** ≈ 5110 mm^3 **b** $\approx 74.4\%$

10 **a** ≈ 289 cm^3 **b** ≈ 56.5 m^3

11 ≈ 12.8 cm^3 **12** $V = \frac{2}{3}\pi(R^3 - r^3)$

11E CAPACITY

1 **a** 7200 L **b** 0.35 L **c** 0.0104 ML

2 **a** 2400 mL = 2.4 L **b** ≈ 254 kL

3 ≈ 262 mL **4** 305 004 cans **5** ≈ 3.45 cm

6 ≈ 0.672 m

REVIEW OF CHAPTER 11

1 **a** perimeter ≈ 59.3 mm, area ≈ 173 mm^2

b perimeter ≈ 22.5 cm, area ≈ 14.3 cm^2

2 184 m **3** ≈ 41.1 m **4** ≈ 150 cm^2

5 **a** 138 mm^2 **b** ≈ 285 cm^2

6 **a** 600 cm^2 **b** 750 cm^3

7 **a** 2618 m^3 **b** ≈ 1810 cm^3 **c** ≈ 75.4 cm^3

8 ≈ 617 cm^3 **9** 45.408 L **10** ≈ 22 minutes 53 seconds

12A BUSINESS CALCULATIONS

1 $464 **2** **a** $225 **b** $815.90

3 $5.94 per kg **4** 75% profit **5** 22% discount

6 55 cents **7** $75

8 **a** $72.60 **b** $6.60 **9** **a** $69 **b** $6.90

12B APPRECIATION AND DEPRECIATION

1 $1365 **2** $17 190.40 **3** **a** $7500 **b** 18.8%

4 $\approx 3.81\%$ appreciation **5** **a** $625.27 **b** $610.18

12C SIMPLE INTEREST

1 **a** $1050 **b** $172.50

2 **a** $883.20 **b** $27 255.25

3 **a** $40 320 **b** $420 **4** $2500 **5** $12 500

6 **a** 2.2% p.a. **b** 7.5% p.a. **7** 5.25% p.a.

8 7 years **9** **a** 4 years 6 months **b** $537.97

12D COMPOUND INTEREST

1 **a**

Year	*Initial amount*	*Interest*	*Final amount*
1	$25 000	4% of $25 000 = $1000	$26 000
2	$26 000	4% of $26 000 = $1040	$27 040
3	$27 040	4% of $27 040 = $1081.60	$28 121.60
4	$28 121.60	4% of $28 121.60 = $1124.86	$29 246.46

b **i** $29 246.46 **ii** $4246.46

2 **a** $9540.24 **b** $2040.24

3 **a** $32 949.12 **b** $2949.12

4 **a** $9729.84 **b** Yes, by about $3.38 .

5 $2900

REVIEW OF CHAPTER 12

1 \$16.50 **2** 35% loss **3** \$29.60 **4** \$153.98

5 **a** \$6080 **b** \$6400 **c** 14.5% depreciation

6 **a** \$2520 **b** \$1260

7 **a** 3.5% p.a. **b** \$100.84

8 **B** would earn more interest **9** \$7500

13A EQUATIONS OF THE FORM $x^2 = k$

1 **a** $x = \pm 2$ **b** $x = 0$ **c** $x = \pm\sqrt{3}$

2 **a** $x = -1$ or 7 **b** no real solutions **c** $x = 2$

d $x = -7 \pm \sqrt{3}$ **e** $x = -1$ or 4 **f** $x = \dfrac{1 \pm \sqrt{7}}{3}$

3 **a** $x = \pm 3$ **b** $x = \pm\sqrt{6}$ **c** $x = \pm 6$

13B THE NULL FACTOR LAW

1 **a** $m = 0$ or $n = 0$ **b** $a = 0$ **c** $x = 0$ or $y = 0$

2 **a** $x = 0$ or -1 **b** $x = 0$ or 3 **c** $x = 0$ or $\frac{5}{2}$

3 **a** $x = 3$ or -5 **b** $x = -1$ **c** $x = 1$ or -3

d $x = 4$ or $-\frac{3}{2}$ **e** $x = \frac{7}{4}$ **f** $x = -\frac{4}{5}$ or $\frac{2}{3}$

13C SOLVING BY FACTORISATION

1 **a** $x = 0$ or 6 **b** $x = 0$ or -2 **c** $x = 0$ or $\frac{1}{3}$

2 **a** $x = 0$ or 3 **b** $x = 0$ or $\frac{4}{3}$ **c** $x = 0$ or 4

3 **a** $x = -2$ or 3 **b** $x = 5$ or -4

4 **a** $x = \pm 3$ **b** no real solutions **c** $x = \pm 4$

5 **a** $x = \pm\frac{5}{3}$ **b** $x = \pm\frac{3}{2}$

6 **a** $x = -2$ **b** $x = -5$ or -4 **c** $x = 7$ or 1

d $x = -4$ or 3 **e** $x = -5$ or 6 **f** $x = 2$ or 7

7 **a** $x = 1$ or 5 **b** $x = -9$ or -4 **c** $x = -12$ or 2

8 **a** $x = -2$ or 3 **b** $x = -1$ or 3 **c** $x = -9$ or 5

9 **a** $x = -4$ or 3 **b** $x = -7$ or 5 **c** $x = -6$ or 1

13D COMPLETING THE SQUARE

1 **a** **i** 2^2 **ii** $(x + 2)^2 = 10$

b **i** 5^2 **ii** $(x - 5)^2 = 17$

2 **a** $x = -2$ or 4 **b** $x = -2 \pm \sqrt{13}$ **c** $x = -5 \pm \sqrt{30}$

d $x = \dfrac{7 \pm \sqrt{41}}{2}$

3 **a** no real solutions **b** $x = \dfrac{-3 \pm 3\sqrt{5}}{2}$

13E THE QUADRATIC FORMULA

1 **a** $x = \dfrac{1 \pm \sqrt{5}}{2}$ **b** $x = -2 \pm \sqrt{7}$ **c** $x = \dfrac{2 \pm \sqrt{10}}{2}$

d $x = \dfrac{5 \pm \sqrt{13}}{6}$

2 **a** $x \approx -2.78$ or -0.72 **b** $x \approx -1.23$ or 1.90

3 The value of the discriminant $b^2 - 4ac = -32$ is negative.

4 **a** $x = 1 \pm \sqrt{7}$ **b** $x = \dfrac{-1 \pm \sqrt{17}}{2}$ **c** no real solutions

d $x = \dfrac{5 \pm 5\sqrt{17}}{8}$

13F PROBLEM SOLVING

1 The number is 8 or -9.

2 The numbers are -9 and 3, or -3 and 9.

3 11 cm **4** $x = 21$ **5** 100 m by 60 m

6 $\frac{2}{6}$ or $\frac{-8}{-4}$

7 The number is $\dfrac{11 - \sqrt{21}}{10}$ or $\dfrac{11 + \sqrt{21}}{10}$. **8** 2.5 cm

REVIEW OF CHAPTER 13

1 **a** $x = \pm\sqrt{3}$ **b** $x = -5$ or 1 **c** $x = \pm 2\sqrt{3}$

2 **a** $x = 0$ or $-\frac{1}{2}$ **b** $x = 3$ **c** $x = \frac{5}{2}$ or -5

3 **a** $x = 0$ or $\frac{3}{2}$ **b** $x = -2$ or 4

4 **a** $x = \pm\frac{4}{9}$ **b** $x = \frac{1}{4}$

5 **a** $x = -11$ or 3 **b** $x = 5$ or 7 **c** $x = -6$ or 3

6 **a** $x = 2 \pm \sqrt{21}$ **b** $x = \dfrac{5 \pm \sqrt{37}}{2}$

7 **a** $x = \dfrac{7 \pm \sqrt{109}}{10}$ **b** $x = -6 \pm \sqrt{39}$

8 The numbers are $3 - \sqrt{7}$ and $3 + \sqrt{7}$. **9** $x = 12$

14A THE DISTANCE BETWEEN TWO POINTS

1 **a** $2\sqrt{5}$ units **b** $\sqrt{58}$ units **c** $5\sqrt{2}$ units **d** 5 units

2 **a** The town is at $(-2, -2)$, the school is at $(5, 5)$, and the hospital is at $(-3, 4)$.

b **i** $21\sqrt{2} \approx 29.7$ km **ii** $3\sqrt{37} \approx 18.2$ km

3 isosceles with AB = BC = 13 units

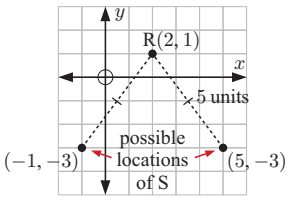
4 right angled at C

5 AB = AD = $\sqrt{13}$ units and BC = CD = $\sqrt{65}$ units

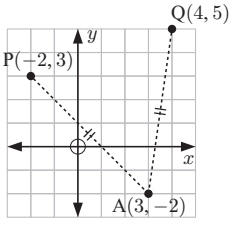
So there are 2 pairs of equal adjacent sides.

$\therefore$ ABCD is a kite.

6 **a** $a = -1$ or 5



b $a = -2$



14B MIDPOINTS

1 **a** M(4, 4) **b** M$\left(-3\frac{1}{2}, 1\right)$ **c** M$\left(2\frac{1}{2}, \frac{1}{2}\right)$ **d** M(2, 2)

2 **a** B(0, 0) **b** B(5, 7) **3** C$\left(\frac{1}{2}, -\frac{1}{2}\right)$

4 **a** C(0, −1), D(−2, 3)

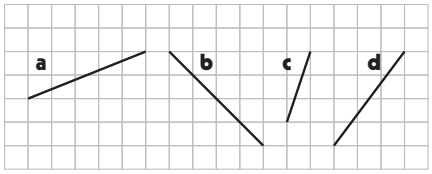
b **i** $2\sqrt{10}$ units **ii** $2\sqrt{10}$ units

c ABCD is a square.

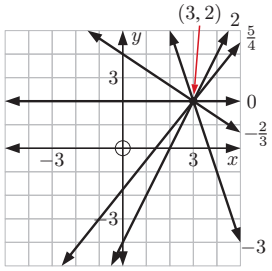
14C GRADIENT

1 **a** $\frac{3}{2}$ **b** $-\frac{3}{4}$ **c** -3 **d** 0

2



3



4 **a** 1 **b** $-\frac{3}{2}$ **c** $\frac{1}{2}$

5 **a** $t = 7$ **b** $t = 1$ **6** C$(0, 4)$

14D PARALLEL AND PERPENDICULAR LINES

1 **a** $-\frac{7}{5}$ **b** -3 **c** $\frac{1}{2}$ **d** $\frac{4}{11}$

2 **a** perpendicular **b** not perpendicular **c** perpendicular
d perpendicular

3 **a** $a = -2$ **b** $a = 2$

4 **a** $t = 2$ **b** $t = 4\frac{8}{9}$ **5** $k = 2$

6 **a** collinear **b** not collinear **7** $c = -2$

14E USING COORDINATE GEOMETRY

1 **a** $\text{AB}^2 + \text{BC}^2 = (\sqrt{13})^2 + (\sqrt{52})^2 = 13 + 52 = 65$
and $\text{AC}^2 = (\sqrt{65})^2 = 65$
$\therefore$ $\text{AB}^2 + \text{BC}^2 = \text{AC}^2$
$\therefore$ $\triangle$ABC is right angled at B.

b gradient of [AB] $= -\frac{2}{3}$, gradient of [BC] $= \frac{3}{2}$,
and $-\frac{2}{3} \times \frac{3}{2} = -1$
$\therefore$ [AB] $\perp$ [BC]
$\therefore$ $\triangle$ABC is right angled at B.

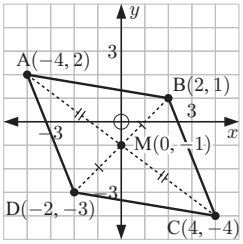
2 **a** M$(0, -1)$

b gradient of [BM] = gradient of [MD] $= 1$
$\therefore$ B, M, and D are collinear.

c N$(0, -1)$

d The midpoints of [AC] and [BD] are the same point {from **a** and **c**}.
$\therefore$ the diagonals of the quadrilateral bisect each other.
$\therefore$ ABCD is a parallelogram.

e



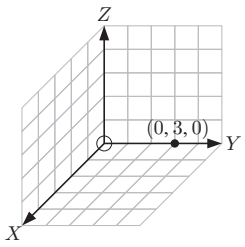
3 **a** $a = -3$ **b** M$\left(\frac{1}{2}, 3\frac{1}{2}\right)$

c **i** $-\frac{1}{7}$ **ii** 7

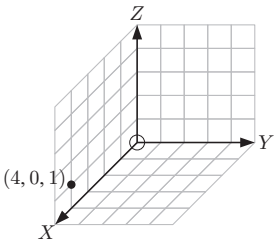
d gradient of [AB] $\times$ gradient of [OM] $= -\frac{1}{7} \times 7 = -1$
$\therefore$ [AB] $\perp$ [OM]
$\therefore$ $\widehat{\text{OMA}}$ is a right angle.

14F 3-DIMENSIONAL COORDINATE GEOMETRY

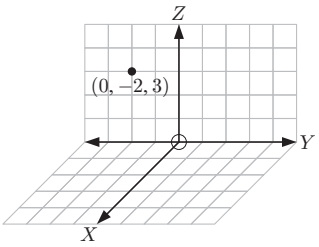
1 **a**



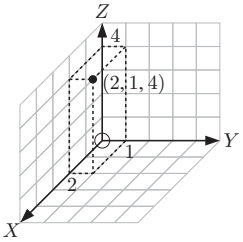
b



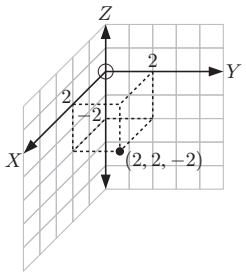
c



d



e



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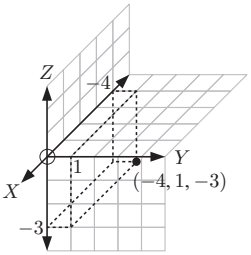


2 **a** **i** 6 units **ii** $(2, -4, 4)$

b **i** $\sqrt{182}$ units **ii** $\left(\frac{1}{2}, 2\frac{1}{2}, 1\right)$

3 AC = BC $= \sqrt{90}$ units
$\therefore$ $\triangle$ABC is isosceles.

4 $k = -2$ or 8

REVIEW OF CHAPTER 14

1 **a** 10 units **b** $4\sqrt{2}$ units **c** $\sqrt{82}$ units

2 $t = -7$ or 3

3 **a** $(4, 3)$ **b** $\left(\frac{1}{2}, -4\right)$ **c** $\left(-\frac{1}{2}, -4\frac{1}{2}\right)$

4 **a** Q$(-2, -6)$ **b** 10 units

5 **a** 3 **b** -6 **c** $-\frac{5}{14}$

6 $k = 1$ **7** $k = -17$ **8** $t = -1$

9 **a** **i** gradient of [EF] = gradient of [HG] = $\frac{1}{7}$

$\therefore$ [EF] $\parallel$ [HG]

ii gradient of [FG] = gradient of [EH] = 1

$\therefore$ [FG] $\parallel$ [EH]

iii gradient of [EG] $= -2$, gradient of [FH] $= \frac{1}{2}$

and $-2 \times \frac{1}{2} = -1$ $\therefore$ [EG] $\perp$ [FH].

b Opposite sides are parallel and diagonals meet at right angles.

$\therefore$ EFGH is a rhombus.

10 **a** AB $= \sqrt{218}$ units **b** $\left(-3, 2\frac{1}{2}, -2\frac{1}{2}\right)$

15A THE EQUATION OF A LINE

1 **a** gradient-intercept form **b** general form

c general form **d** gradient-intercept form

2 **a** gradient is 3, y-intercept is -1

b gradient is -2, y-intercept is 4

c gradient is $\frac{1}{4}$, y-intercept is $\frac{3}{7}$

d gradient is $-\frac{9}{10}$, y-intercept is $\frac{3}{10}$

3 **a** $4x - y = 1$ **b** $2x - 3y = 15$ **c** $3x + 10y = 4$

4 **a** **i** $y = 3x - \frac{7}{2}$ **ii** 3

b **i** $y = -\frac{7}{5}x + \frac{11}{5}$ **ii** $-\frac{7}{5}$

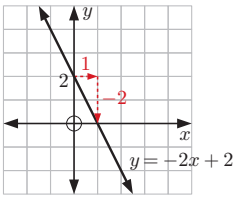
5 **a** no **b** yes **c** no **d** yes

6 **a** $k = -3$ **b** $k = -12$ **c** $k = 12$ **d** $k = \frac{20}{3}$

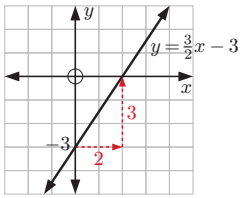
7 **a** -4 **b** 8 **c** $-\frac{1}{5}$

15B GRAPHING STRAIGHT LINES

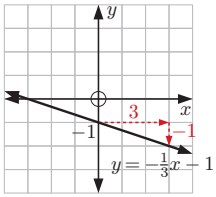
1 **a**



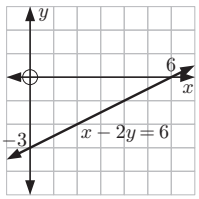
b



c



2 **a**



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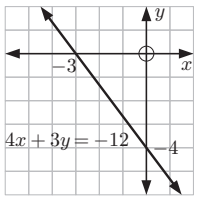

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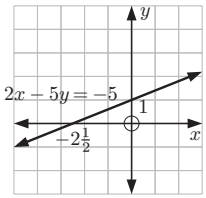
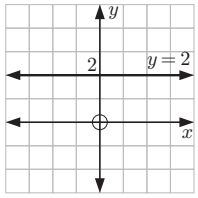
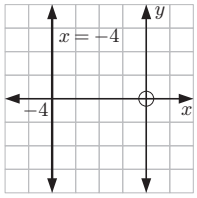


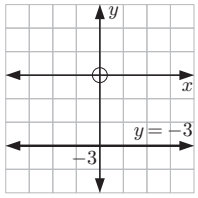
3 **a**



b



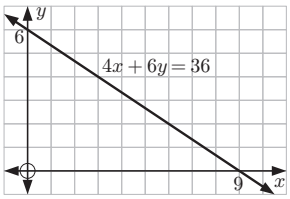
c



4 **a** The total cost of x goldfish at \$4 each, and y ricefish at \$6 each is \$36.

$\therefore$ $4x + 6y = 36$

b



c **i** x-intercept is 9; this is the number of goldfish bought if no ricefish were bought.

ii y-intercept is 6; this is the number of ricefish bought if no goldfish were bought.

iii The points (x, y) on the line for which $x, y \in \mathbb{N}$ represent the possible combinations of goldfish and ricefish Kate could buy.

15C FINDING THE EQUATION OF A LINE

1 **a** $y = 3x - 5$ **b** $y = -\frac{1}{4}x + 2$ **c** $y = \frac{2}{7}x - \frac{3}{7}$

2 **a** $y = -\frac{3}{5}x + 3$ **b** $3x + 5y = 15$

3 **a** $y = \frac{1}{2}x + 1$ **b** $y = -\frac{3}{4}x + \frac{17}{4}$

4 **a** $3x - 5y = 7$ **b** $x + 6y = -41$

5 **a** $y = -4x - 3$ **b** $y = \frac{2}{5}x + \frac{3}{5}$

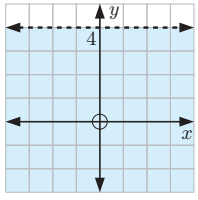
6 **a** $3x - y = 1$ **b** $5x + 6y = -13$

7 $y = -2x - 13$ **8** $3x - 5y = 44$

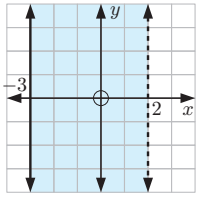
15D LINEAR INEQUALITIES IN THE CARTESIAN PLANE

1 **a** $x \leqslant -3$ **b** $-2 < y < 5$ **c** $-3 \leqslant y \leqslant -1$ and $x \leqslant 4$

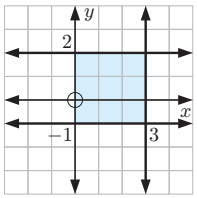
2 **a**



b



c



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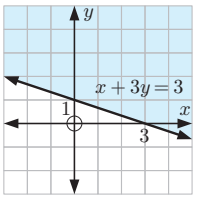

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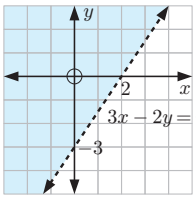

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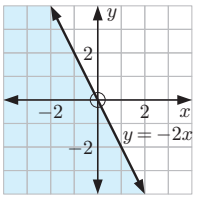
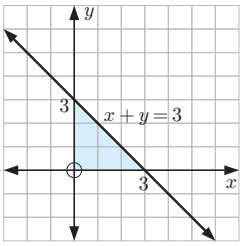
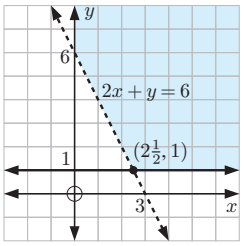


3 a



b



4 a $4x + 3y > 12$ **b** $2x - 5y \geqslant -10$

5 a $x + y \leqslant 4$, $y \geqslant 0$, and $y < 2x$

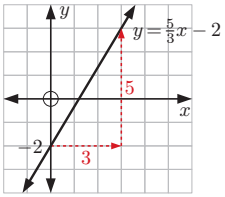
b $x + y \leqslant 8$, $y \geqslant \frac{1}{2}x$, and $x > 2$

REVIEW OF CHAPTER 15

1 a $y = \frac{3}{5}x + \frac{4}{5}$ **b** $\frac{3}{5}$ **c** $-\frac{4}{3}$

2 a no **b** $a = -33$

3 a



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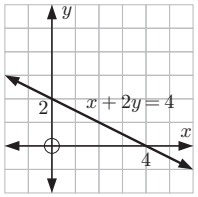
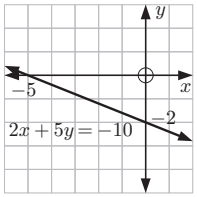
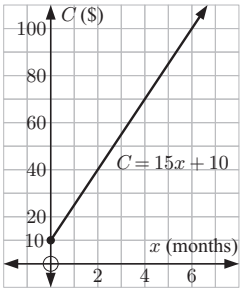


c



4 a $C = 15x + 10$

b



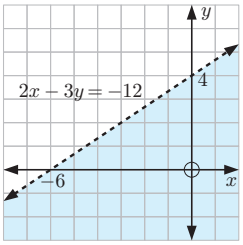
c gradient is 15; the cost for the streaming service is \$15 per month.

C-intercept is 10; the fixed joining fee is \$10.

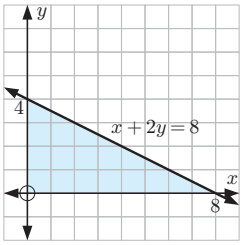
5 a $y = 7x - 2$ **b** $y = 5x + 3$

6 a $x - 3y = 11$ **b** $7x + 2y = -14$

7 a



b



8 $6x + 5y < -30$

16A GRAPHICAL SOLUTION

1 a $x = 1$, $y = -2$ **b** $x = -2$, $y = -3$

c $x = 2$, $y = 2$

2 a no solutions **b** infinitely many solutions

3 a $x = 0.2$, $y = 1.6$ **b** $x = -2$, $y = 1$

c $x = -1.25$, $y = -2.75$

16B SOLUTION BY SUBSTITUTION

1 a $x = 2$, $y = 8$ **b** $x = 1$, $y = 2$

c $x = \frac{5}{4}$, $y = \frac{3}{2}$ **d** $x = 3$, $y = 1$

e $x = -10$, $y = -\frac{9}{2}$ **f** $x = -\frac{1}{5}$, $y = -\frac{2}{5}$

2 a $x = -13$, $y = \frac{23}{2}$ **b** $x = 0$, $y = -\frac{8}{3}$

3 Substituting $y = 3x - 1$ into $6x - 2y = 2$ gives $2 = 2$, which is always true.

$\therefore$ there are infinitely many solutions.

16C SOLUTION BY ELIMINATION

1 a $x = 5$, $y = 3$ **b** $x = \frac{2}{3}$, $y = \frac{5}{2}$

2 a $-8x - 20y = 12$ **b** $-20x + 35y = 30$

3 a $x = 2$, $y = 3$ **b** $x = -4$, $y = 5$

c $x = \frac{1}{2}$, $y = -3$ **d** $x = -6$, $y = -\frac{4}{3}$

4 a $x = -3$, $y = 5$ **b** $x = -3$, $y = 4$

c $x = -\frac{1}{3}$, $y = \frac{4}{3}$ **d** $x = -\frac{5}{7}$, $y = \frac{2}{7}$

16D PROBLEM SOLVING

1 The numbers are 4 and 9.

2 movie tickets: \$15, popcorn bucket: \$8 **3** 500 minutes

4 seven \$1 coins **5** 42 cm **6** B$\left(\frac{13}{3}, 13\right)$

REVIEW OF CHAPTER 16

1 $x = -1$, $y = -2$

2 a $x = -0.2$, $y = -3.8$ **b** $x = -5.4$, $y = 3.4$

3 a $x = 4$, $y = 3$ **b** $x = \frac{3}{2}$, $y = -2$

4 a $x = -2$, $y = -5$ **b** $x = \frac{15}{7}$, $y = \frac{8}{7}$

5 a The system reduces to $0 = -20$ which is absurd.

b There are no solutions.

6 The numbers are 6 and 7.

7 It takes 6 minutes for small planes to take off, and 9 minutes for large planes to take off.

8 $x = 5$, $y = 2$

17A CONGRUENT TRIANGLES

1 **a** $\triangle LMN \cong \triangle PQR$ {SSS} **b** not enough information
c $\triangle PQR \cong \triangle YXZ$ {AAcorS}

2 **a** **B** and **C** {AAcorS} **b** **B** and **D** {SAS}

3 $\triangle AXC \cong \triangle BXC$ {RHS}

17B PROOF USING CONGRUENCE

1 **Hint:** Show $\triangle AOX \cong \triangle BOX$

2 **Hint:** Show $\triangle PXY \cong \triangle RZY$

3 **Hint:** Show $\triangle ADG$ and $\triangle ACF$ are isosceles.

17C SIMILARITY

1 **a** yes **b** no **2** **a** $x = \frac{10}{3}$ **b** $x = 9$

3 **a** The equal angles are not in corresponding positions.
b No, the corresponding side lengths could be in different ratios.

17D SIMILAR TRIANGLES

1 **a** $\widehat{QPT} = \widehat{RST}$ {given}
$\widehat{QTP} = \widehat{RTS}$ {vertically opposite angles}
b $\widehat{BAD} = \widehat{DAC}$ {given}
$\widehat{ADB} = \widehat{ACD}$ {angle sum of a triangle}

2 **a** $\widehat{PQR} = \widehat{STR}$ {equal alternate angles}
$\widehat{PRQ} = \widehat{SRT}$ {vertically opposite angles}; $x = 4$
b $\widehat{BAE} = \widehat{DCB}$ {given}
$\widehat{AEB} = \widehat{CBD}$ {exterior angle of a triangle}; $x = 6$
c angle X is common,
$\widehat{XYW} = \widehat{XZV}$ {equal corresponding angles}; $x = 6$

3 4.2 m **4** no **5** **a** $x = 2$ **b** $x = 10$

17E AREAS AND VOLUMES OF SIMILAR OBJECTS

1 **a** $x = 50$ **b** $x = 6$

2 **a** $x = 125$ **b** $x = 12$

3 **a** angle A is common,
$\widehat{ABE} = \widehat{ACD}$ {equal corresponding angles}
b 20.25 cm^2

4 37.5 cm **5** similar

6 **a** $\frac{5}{2}$ **b** 7.5 cm **c** 25.6 cm^3

REVIEW OF CHAPTER 17

1 **A** and **C** {SAS}

2 **a** $\triangle AOP \cong \triangle BOP$ {RHS} **b** $\widehat{BOP} = 55°$

3 **a** $\triangle ABD \cong \triangle CBD$ {SAS}
b AB = CB $\{\triangle ABD \cong \triangle CBD\}$
$\therefore$ $\triangle ABC$ is isosceles

4 $x = 15$

5 **a** angle A is common,
$\widehat{ABE} = \widehat{ACD}$ {equal corresponding angles}; $x = 12$
b angle S is common,
$\widehat{QPS} = \widehat{TRS}$ {given}; $x = 5$

6 25 m **7** **a** $x = 363$ **b** $x = 15$ **8** $x = 8$

18A LABELLING RIGHT ANGLED TRIANGLES

1 **a** **i** [BC] **ii** [AB] **iii** [AC]
b **i** [PQ] **ii** [QR] **iii** [PR]

2 **a** [XZ] **b** [XY] **c** [YZ] **d** [YZ] **e** [XY]

18B THE TRIGONOMETRIC RATIOS

1 **a** MN ≈ 5.8 cm, OM ≈ 3.4 cm, ON ≈ 4.7 cm
b **i** ≈ 0.586 **ii** ≈ 0.810 **iii** ≈ 0.723
c **i** ≈ 0.588 **ii** ≈ 0.809 **iii** ≈ 0.727

2 **a** **i** $\frac{24}{25}$ **ii** $\frac{7}{25}$ **iii** $\frac{24}{7}$
b **i** $\frac{12}{37}$ **ii** $\frac{35}{37}$ **iii** $\frac{12}{35}$

18C FINDING SIDE LENGTHS

1 **a** $\sin 23° = \frac{a}{x}$ **b** $\tan 14° = \frac{b}{x}$ **c** $\cos 71° = \frac{x}{c}$

2 **a** $x \approx 6.93$ **b** $x \approx 1.82$ **c** $x \approx 19.53$
d $x \approx 3.85$ **e** $x \approx 25.51$ **f** $x \approx 10.69$

3 $\theta = 49°$, $a \approx 7.48$, $b \approx 9.91$ **4** ≈ 52.1 cm^2

18D FINDING ANGLES

1 **a** $\theta \approx 52.0°$ **b** $\theta \approx 21.8°$ **c** $\theta \approx 36.4°$ **d** $\theta \approx 41.8°$

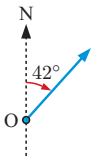
2 $x \approx 5.7$, $\alpha \approx 34.8°$, $\beta \approx 55.2°$

18E PROBLEM SOLVING

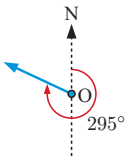
1 ≈ 9.29 m **2** ≈ 248 m **3** ≈ 56.4°
4 ≈ 83.2 m **5** ≈ 56.9° **6** ≈ 14.1 cm
7 ≈ 30.1 cm **8** ≈ 132 cm^2 **9** ≈ 29.0°
10 **a** ≈ 17.5 m **b** ≈ 14.5°
11 **a** FH ≈ 9.85 cm **b** $\widehat{DFH} \approx 16.9°$

18F TRUE BEARINGS

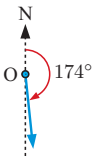
1 **a**



b



c



2 **a** 217° **b** 342° **c** 063°

3 **a** 105° **b** 212° **c** 337°

4 **a** 335° **b** 280° **c** 155° **d** 245°

5 **a** 289 m **b** ≈ 304°

6 **a** ≈ 5.22 km **b** ≈ 3.36 km

7 ≈ 500 km on bearing ≈ 185°

REVIEW OF CHAPTER 18

1 **a** **i** ≈ 0.359 **ii** ≈ 0.622 **iii** ≈ 0.530 **iv** ≈ 2.60

b **i** ≈ 0.358 **ii** ≈ 0.625 **iii** ≈ 0.530 **iv** ≈ 2.61

2 $x \approx 6.09$ **3** $\theta \approx 62.2°$

4 $x \approx 8.13$, $\theta \approx 32.1°$, $\phi \approx 57.9°$

5 **a** ≈ 15.0 m **b** ≈ 12.7 m **6** $\widehat{AOB} \approx 77.4°$

7 **a** $\widehat{BEC} \approx 16.1°$ **b** $\widehat{AMD} \approx 23.5°$

8 **a** 204° **b** 048° **c** 318°

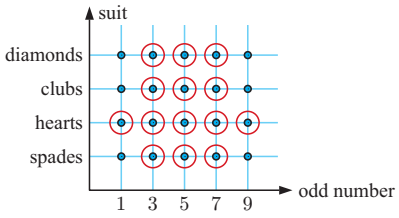
9 ≈ 27.2 km **10** ≈ 26.6 km on bearing $\approx 285°$

19A SAMPLE SPACE AND EVENTS

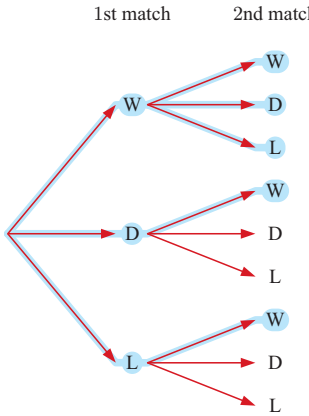
1 **a** {AA, AB, AC, BA, BB, BC, CA, CB, CC}

b {KLM, KML, MKL, MLK, LKM, LMK}

2



3 **a**



b **i** $E = \{WW, WD, WL, DW, LW\}$

ii $E' = \{DD, DL, LD, LL\}$

19B THEORETICAL PROBABILITY

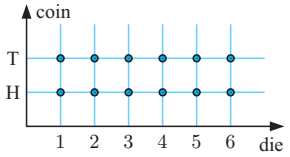
1 **a** {ACT, ATC, TAC, TCA, CAT, CTA}

b **i** $\frac{1}{6}$ **ii** $\frac{1}{3}$ **iii** $\frac{2}{3}$ **iv** $\frac{1}{3}$

2 **a** {BBBB, BBBG, BBGB, BGBB, GBBB, BBGG, BGBG, BGGB, GBBG, GBGB, GGBB, BGGG, GBGG, GGBG, GGGB, GGGG}

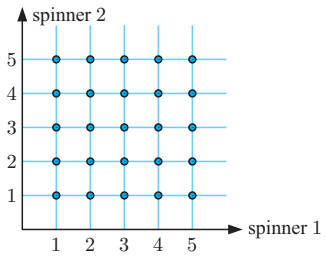
b **i** $\frac{1}{16}$ **ii** $\frac{3}{8}$ **iii** $\frac{1}{2}$ **iv** $\frac{15}{16}$

3 **a**



b **i** $\frac{1}{12}$ **ii** $\frac{1}{2}$ **iii** $\frac{3}{4}$

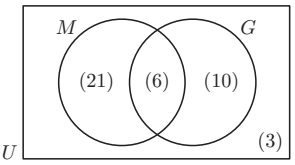
4 **a**



b **i** $\frac{2}{25}$ **ii** $\frac{9}{25}$ **iii** $\frac{16}{25}$ **iv** $\frac{2}{5}$

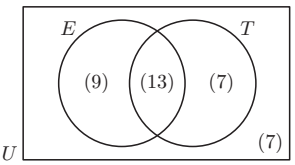
5 **a** 14 people **b** **i** $\frac{5}{14}$ **ii** $\frac{9}{14}$ **iii** $\frac{3}{7}$

6 **a**



b **i** $\frac{21}{40}$ **ii** $\frac{31}{40}$ **iii** $\frac{3}{40}$

7 **a**



b **i** $\frac{7}{36}$ **ii** $\frac{29}{36}$

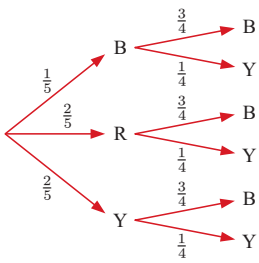
19C INDEPENDENT EVENTS

1 **a** $\frac{1}{24}$ **b** $\frac{5}{12}$ **2** **a** $\frac{6}{25}$ **b** $\frac{9}{25}$

3 **a** 0.6545 **b** 0.1155

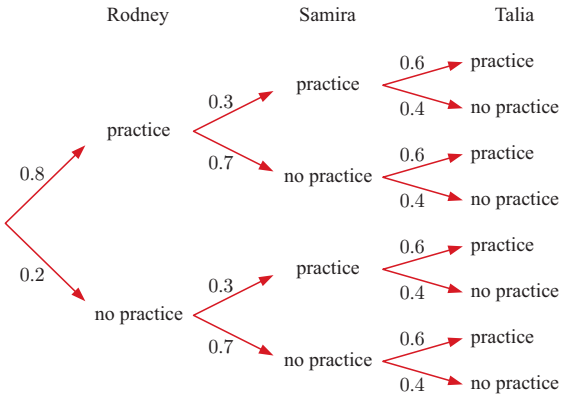
4 **a** ≈ 0.264 **b** ≈ 0.0376 **c** ≈ 0.119 **d** ≈ 0.253

5 **a**



b **i** $\frac{1}{10}$ **ii** $\frac{3}{4}$ **iii** $\frac{13}{20}$

6 **a**

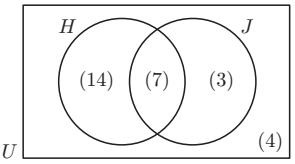


b 0.332

19D DEPENDENT EVENTS

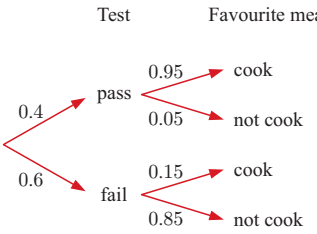
1 **a** $\frac{1}{6}$ **b** $\frac{5}{18}$ **2** $\frac{14}{95}$

3 **a**



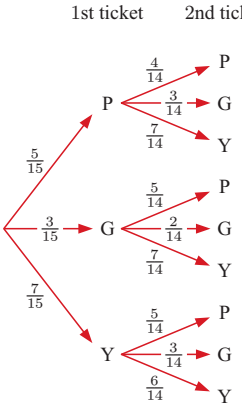
b $\frac{13}{54}$

4 **a**



b 0.47

5 **a**



b **i** $\frac{34}{105}$ **ii** $\frac{8}{15}$

6 $\frac{133}{300}$

19E EXPERIMENTAL PROBABILITY

1 ≈ 0.339 **2** **a** ≈ 0.27 **b** ≈ 0.533

3 **a**

Brand	*Frequency*	*Relative frequency*
Great Barrier Teeth	35	0.4375
Brush Hour	24	0.3
Decay Away	21	0.2625
Total	80	1

b 80 people **c** **i** ≈ 0.3 **ii** ≈ 0.2625

4 **a** 59 pizzas **b** **i** ≈ 0.424 **ii** ≈ 0.458

5 **a**

Licence type	*Car type*			
	Sedan	Hatchback	Ute	*Total*
Full	19	18	11	48
Provisional	3	4	4	11
Learner's	9	5	2	16
Total	31	27	17	75

b 75 car drivers

c **i** ≈ 0.413 **ii** ≈ 0.147 **iii** ≈ 0.493

19F EXPECTATION

1 ≈ 7 times **2** 80 occasions

3 **a**

Burger	*Frequency*	*Relative frequency*
Beef	24	≈ 0.358
Chicken	33	≈ 0.493
Vegetable	10	≈ 0.149
Total	67	1

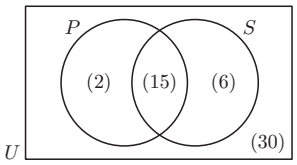
b ≈ 45 burgers

4 **a** 9 times **b** ≈ 1 time **c** ≈ 13 times

5 125 people **6** ≈ 41 matches

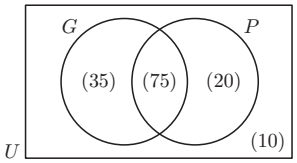
19G CONDITIONAL PROBABILITY

1 **a**



b **i** $\frac{2}{53}$ **ii** $\frac{15}{17}$

2 **a**



b **i** $\frac{15}{22}$ **ii** $\frac{2}{3}$

3 **a** ≈ 0.427 **b** ≈ 0.339 **c** ≈ 0.125

4 **a**

	Spanish	Indonesian	French	*Total*
Male	4	9	3	16
Female	7	5	8	20
Total	11	14	11	36

b **i** $\frac{1}{4}$ **ii** $\frac{3}{11}$ **iii** $\frac{11}{25}$

5 $\frac{2}{9}$ **6** $\frac{2}{3}$

19H SIMULATIONS

1 **a** 3 trials **b** ≈ 0.375

c This estimate may not be accurate as the number of trials was small.

2 **a** 1 to 2 = Hikaru wins, 3 = Wesley wins, 4 to 10 = draw

Note: Your answer may be different.

b

Trial number	*Random numbers*	*Result*
1	4, 8, 7	DDD
2	4, 5, 8	DDD
3	10, 8, 8	DDD
4	3, 3, 7	WWD
5	9, 2, 9	DHD
6	10, 2, 1	DHH
7	9, 2, 9	DHD
8	10, 7, 7	DDD
9	10, 2, 5	DHD
10	7, 4, 10	DDD
11	8, 5, 3	DDW
12	4, 1, 7	DHD
13	1, 10, 9	HDD
14	5, 2, 3	DHW
15	2, 3, 5	HWD
16	6, 3, 7	DWD
17	9, 4, 1	DDH
18	2, 1, 10	HHD
19	4, 4, 4	DDD
20	4, 10, 6	DDD

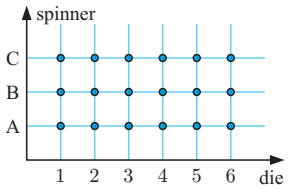
c ≈ 0.55

Note: Your answer may be different.

d The estimate can be made more accurate by using more sets of random numbers.

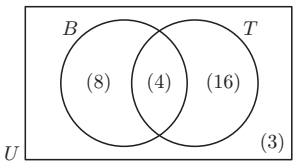
REVIEW OF CHAPTER 19

1 a



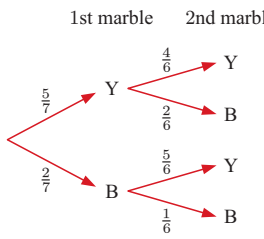
b **i** $\frac{1}{6}$ **ii** $\frac{2}{3}$

2 a



b **i** $\frac{4}{31}$ **ii** $\frac{16}{19}$ **iii** $\frac{3}{11}$

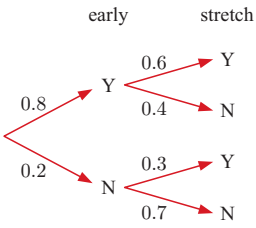
3 a



b **i** $\frac{10}{21}$ **ii** $\frac{10}{21}$

4 14 lessons

5 a



b 0.54

c $\approx$ 17 times

6 ≈ 0.262

7 a

	Walk	Bicycle	Car	Bus	*Total*
Male	8	4	25	11	48
Female	6	2	22	18	48
Total	14	6	47	29	96

b **i** 48 students **ii** 6 students

c **i** ≈ 0.146 **ii** ≈ 0.621 **iii** ≈ 0.573

8 a 1 to 3 = strike (X), 4 to 5 = not a strike (O)

b

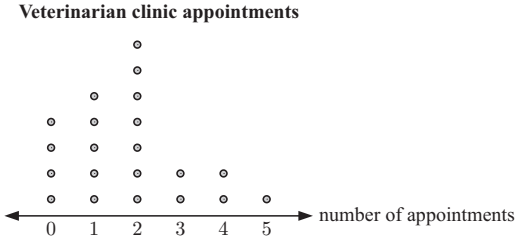
Game number	*Random numbers*	*Result*
1	3, 1, 4, 1, 4, 5, 5, 5, 4, 3	X X O X O O O O O X
2	1, 1, 3, 2, 5, 5, 3, 5, 2, 4	X X X X O O X O X O
3	4, 4, 5, 2, 3, 2, 4, 4, 2, 4	O O O X X X O O X O
4	2, 5, 4, 3, 4, 5, 4, 3, 1, 1	X O O X O O O X X X
5	1, 2, 1, 3, 1, 4, 3, 1, 3, 5	X X X X X O X X X O
6	4, 3, 3, 5, 1, 5, 2, 3, 5, 5	O X X O X O X X O O
7	4, 5, 1, 1, 4, 2, 3, 1, 3, 2	O O X X O X X X X X
8	1, 4, 5, 5, 2, 2, 3, 5, 5, 1	X O O O X X X O O X
9	1, 1, 3, 4, 4, 2, 5, 3, 2, 1	X X X O O X O X X X
10	4, 1, 2, 4, 1, 1, 2, 2, 1, 1	O X X O X X X X X X

c ≈ 0.8

Note: Your answer may be different.

20A DISCRETE NUMERICAL DATA

1 a



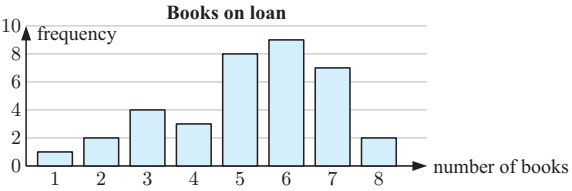
b 2 appointments; it is the most common number of appointments in one day.

c $\frac{3}{7}$

2 a

Number of books	*Tally*	*Frequency*
1	|	1
2	||	2
3	||||	4
4	|||	3
5	𝍸 |||	8
6	𝍸 ||||	9
7	𝍸 ||	7
8	||	2
	Total	36

b

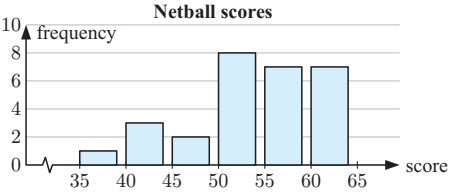


c 50%

3 a

Score	*Tally*	*Frequency*
35 to 39	|	1
40 to 44	|||	3
45 to 49	||	2
50 to 54	𝍸 |||	8
55 to 59	𝍸 ||	7
60 to 64	𝍸 ||	7
	Total	28

b

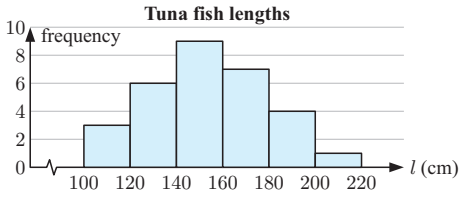


c 50 to 54

20B CONTINUOUS NUMERICAL DATA

1 a *Length* can take any numerical value within a certain range.

b



c $140 \leqslant l < 160$ cm; more tuna fish have lengths between 140 cm and 160 cm than in any other interval.

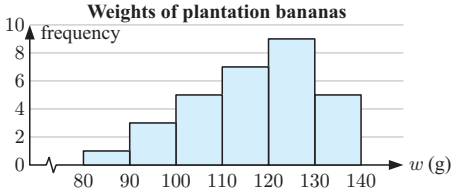
d $\approx 73.3\%$

2 a

Weight (w g)	*Frequency*
$80 \leqslant w < 90$	1
$90 \leqslant w < 100$	3
$100 \leqslant w < 110$	5
$110 \leqslant w < 120$	7
$120 \leqslant w < 130$	9
$130 \leqslant w < 140$	5
Total	30

b 70%

c



d $120 \leqslant w < 130$ g

20C DESCRIBING THE DISTRIBUTION OF DATA

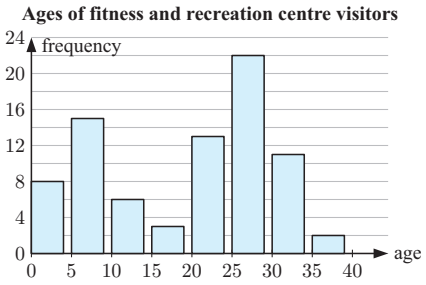
1 a positively skewed **b** symmetric **c** bimodal

2 a 24 students **b** 37.5%

c positively skewed, "10" is an outlier

3 a 80 people **b** 40%

c



d 25 to 29 **e** bimodal

20D MEASURES OF CENTRE

1 a mean = 7, median = 8, mode = 3

b mean = 6.15, median = 6.5, mode = 6.9

2 a mean = 8.025, median = 7.75, mode = 7.5

b The mode, as it gives the most common shoe size, so the bowling alley knows to order more new shoes in that size than other sizes.

3 a School A: mean = 14.9, median = 15
School B: mean $\approx$ 9.33, median = 9.5

b School A as both the mean and median are higher, so school A generally has older students.

4 33.125 points **5** 5, 8, 11, 13, 14, 14, 19

6 a i 1 sibling **ii** 1 sibling **iii** ≈ 1.29 siblings

b positively skewed

c The mean is higher than the median and mode.

7 a

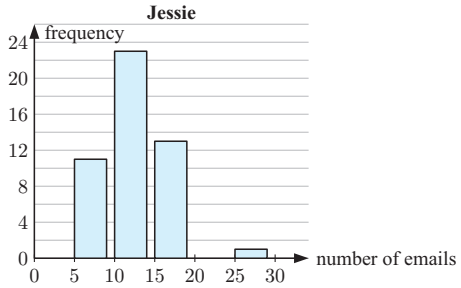
Rating	*Frequency*
1	1
2	4
3	9
4	8
5	2
Total	24

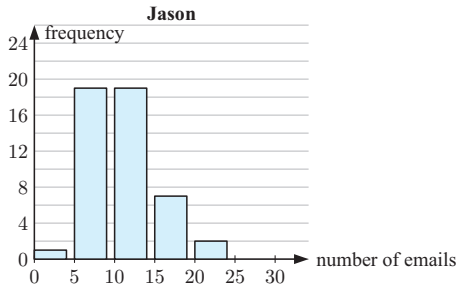
b 24 audience members **c** the mode

d i 3 **ii** 3 **iii** 3.25

8 a 35 students **b** $5 \leqslant t < 10$ minutes **c** ≈ 10.5 minutes

9 a





b Jessie: approximately symmetric, "25 to 29" is an outlier
Jason: positively skewed

c Jessie: ≈ 12.5 emails per week
Jason: ≈ 11.0 emails per week

d Jessie; the answer is fairly reliable since the sample is quite large, and there is a reasonable difference in the estimates of the means.

20E BOX-AND-WHISKER PLOTS

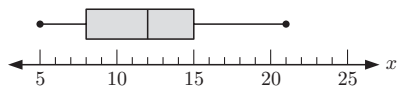
1 a min = 12, Q_1 = 18, median = 23, Q_3 = 26, max = 30

b 18 **c** 8

2 a min = 5, Q_1 = 8, median = 12, Q_3 = 15, max = 21

b range = 16, IQR = 7

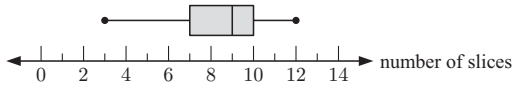
c



3 a negatively skewed **b** symmetric **c** positively skewed

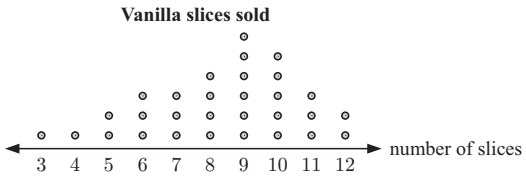
4 a min = 3, Q_1 = 7, median = 9, Q_3 = 10, max = 12

b



c negatively skewed

d



5 **a** Butternut:
min $= 2.9$ kg, $Q_1 = 3$ kg, median $= 3.3$ kg, $Q_3 = 3.8$ kg, max $= 4.3$ kg

Japanese Kent:
min $= 1.1$ kg, $Q_1 = 1.8$ kg, median $= 2.6$ kg, $Q_3 = 3$ kg, max $= 3.4$ kg

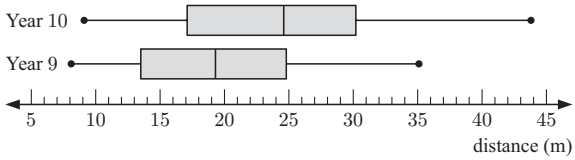
b **i** Butternut: 1.4 kg **ii** Butternut: 0.8 kg
Japanese Kent: 2.3 kg Japanese Kent: 1.2 kg

c Butternut **d** Japanese Kent

6 **a** Year 9:
min $= 8.1$ m, $Q_1 = 13.5$ m, median $= 19.3$ m, $Q_3 = 24.8$ m, max $= 35.1$ m

Year 10:
min $= 9.1$ m, $Q_1 = 17.1$ m, median $= 24.6$ m, $Q_3 = 30.2$ m, max $= 43.8$ m

b



c The Year 10 students generally kick the ball further than the Year 9 students, but also have a greater variation in distances.

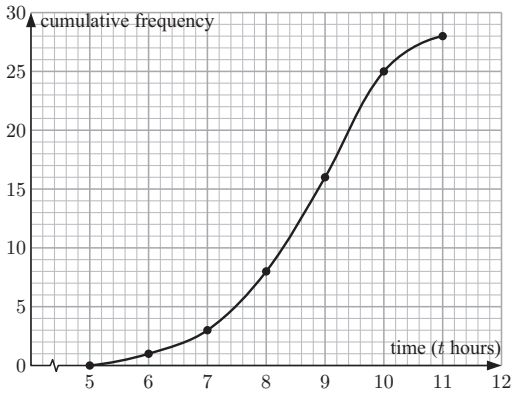
20F CUMULATIVE FREQUENCY GRAPHS

1 **a** 50 rose bushes **b** ≈ 90 cm **c** ≈ 8 rose bushes
d ≈ 26 cm

2 **a**

Time (t hours)	*Frequency*	*Cumulative frequency*
$5 \leqslant t < 6$	1	1
$6 \leqslant t < 7$	2	3
$7 \leqslant t < 8$	5	8
$8 \leqslant t < 9$	8	16
$9 \leqslant t < 10$	9	25
$10 \leqslant t < 11$	3	28

b

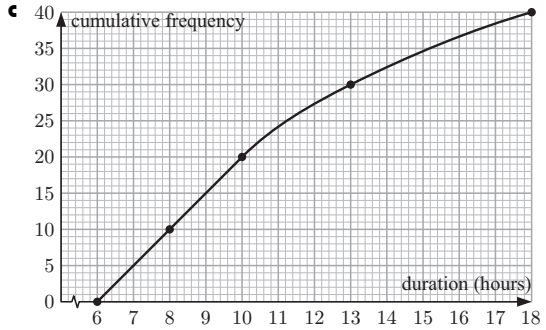


c **i** ≈ 8.8 hours **ii** 26 athletes **iii** ≈ 1.7 hours
iv ≈ 9.8 hours; 85% of the athletes slept less than 9.8 hours.

3 **a** min $= 6$ hours, $Q_1 = 8$ hours, median $= 10$ hours, $Q_3 = 13$ hours, max $= 18$ hours

b 13 hours to 18 hours

c



d ≈ 13.8 hours

20G EVALUATING REPORTS

1 **a** The sample is biased as students borrowing books are more likely to be in favour of expanding the library. Also, the sample size is too small.

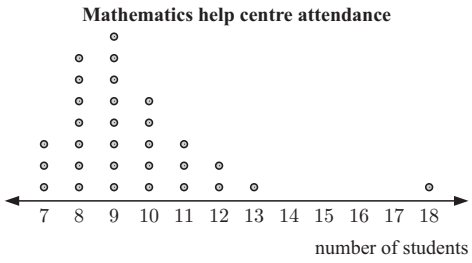
b The graph is misleading as the vertical axis does not begin at zero.

c The conclusion does not take other factors into account such as the trees producing more fruit as they mature. Also, the sample size is small.

REVIEW OF CHAPTER 20

1 **a** discrete

b



c positively skewed, "18" is an outlier

d 9 students, this is the most common number of students visiting the mathematics help centre in a day.

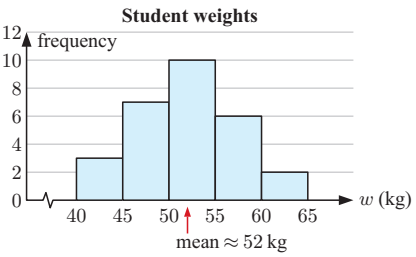
2 **a** 10.6 **b** 10.5 **c** 15

3 90 points

4 **a** 5 and 6 complaints **b** 5 complaints
c ≈ 5.29 complaints

5 **a** ≈ 52.0 kg

b



c $50 \leqslant w < 55$ kg **d** symmetric

6 **a** **i** Boat A:
min $= 18.5$ cm, $Q_1 = 22$ cm, median $= 24$ cm, $Q_3 = 25$ cm, max $= 27$ cm

Boat B:
min $= 17$ cm, $Q_1 = 19$ cm, median $= 20.5$ cm, $Q_3 = 22$ cm, max $= 24$ cm

ii Boat A: 8.5 cm
Boat B: 7 cm

iii Boat A: 3 cm
Boat B: 3 cm

b Boat A has a negatively skewed distribution, whereas boat B has a symmetric distribution. The fish caught by boat A were generally longer than those caught by boat B. The boats had a similar spread in the length of fish caught.

c **i** 75% **ii** 25%

7 **a** 30 dogs **b** **i** $\approx 83.3\%$ **ii** $\approx 66.7\%$

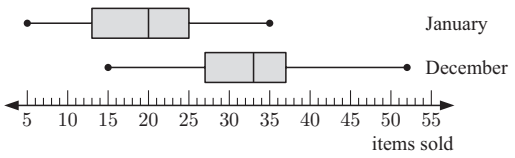
c **i** ≈ 25 kg **ii** ≈ 13 kg

8 **a** December: ≈ 32.4, January: ≈ 19.7

b December:
min $= 15$, $Q_1 = 27$, median $= 33$, $Q_3 = 37$, max $= 52$

January:
min $= 5$, $Q_1 = 13$, median $= 20$, $Q_3 = 25$, max $= 35$

c



d December

e Both data sets are approximately symmetric.

f This conclusion is unreliable as it does not take other factors into account such as toys being bought as Christmas presents in December.

21A ASSOCIATION BETWEEN CATEGORICAL VARIABLES

1 **a** **i** Jennifer won 9 matches when she did not practise beforehand.

ii Jennifer practised before a total of 25 matches.

b

Practised \ *Outcome*	*Win*	*Lose*
Yes	76%	24%
No	60%	40%

c Jennifer won 76% of the matches that she practised before.

d Jennifer is generally more likely to win a match when she practises beforehand.

2 **a**

	Yes	*No*	*Total*
Junior	49	111	160
Middle	93	117	210
High	171	109	280
Total	313	337	650

Travelled overseas

b

	Yes	*No*
Junior	$\approx 30.6\%$	$\approx 69.4\%$
Middle	$\approx 44.3\%$	$\approx 55.7\%$
High	$\approx 61.1\%$	$\approx 38.9\%$

Travelled overseas

c $\approx 44.3\%$

d As students get older, they are generally more likely to have travelled overseas.

21B ASSOCIATION BETWEEN NUMERICAL VARIABLES

1 **a** independent variable: *shots taken*
dependent variable: *goals scored*

b 3 players (E, G, and H)

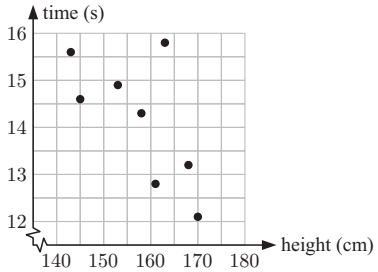
c D **d** F and H **e** C

2 **a** 12 students **b** **i** I **ii** J **c** H and D

d 4 students (A, G, F, L)

3 **a** independent variable: *height*
dependent variable: *time*

b



21C CORRELATION

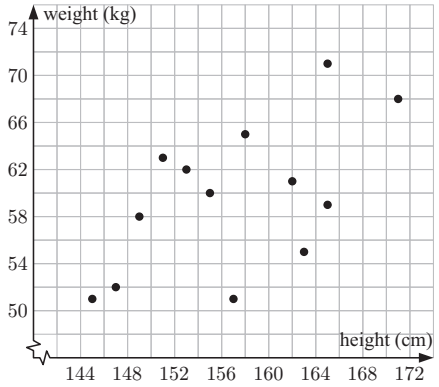
1 **a** **i** no association **ii** not linear **iii** zero

b **i** positive association **ii** not linear **iii** strong

c **i** negative association **ii** linear **iii** moderate

d **i** positive association **ii** linear **iii** weak

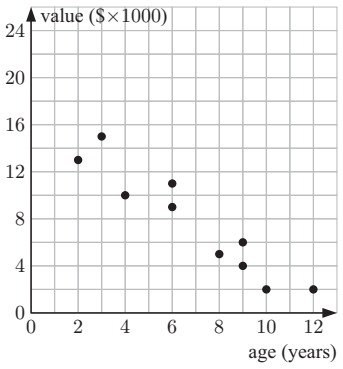
2 **a**



b A weak, positive, linear correlation.

3 **a** *age*

b

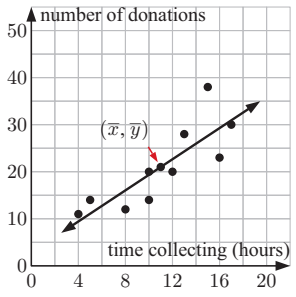


c A strong, negative, linear correlation.

21D LINE OF BEST FIT

1 **a** $\overline{x} = 11$ hours, $\overline{y} = 21$ donations

b

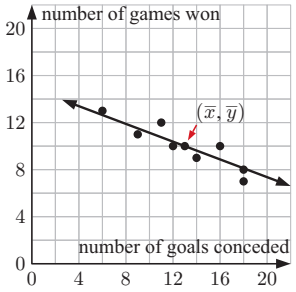


c **i** $\approx$ 12 donations

ii We expect the estimate to be reliable as it is an interpolation.

2 **a** (13, 10)

b



c **i** $\approx$ 12 games

ii $\approx$ 7 games

d We expect the prediction in **c i** to be reliable as it is an interpolation. The prediction in **c ii** may not be reliable as it is an extrapolation.

REVIEW OF CHAPTER 21

1 **a** **i** 98 adults played the 9 hole golf course.

ii 24 children played the 18 hole golf course.

b

	9 holes	*18 holes*	*Total*
Adult	98	92	190
Child	63	24	87
Total	161	116	277

c

	9 holes	*18 holes*
Adult	$\approx 51.6\%$	$\approx 48.4\%$
Child	$\approx 72.4\%$	$\approx 27.6\%$

d $\approx 72.4\%$

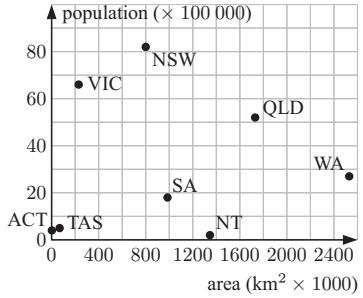
e Children generally preferred playing the 9 hole golf course.

2 **a** I **b** **i** A **ii** F

c 4 televisions (A, D, E, and J)

d 2 televisions (B and I)

3 **a**



b **i** WA

ii NT

c no

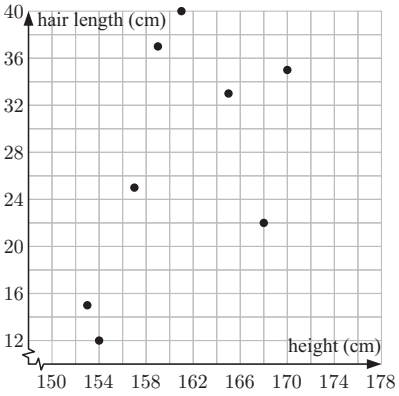
4 **a** **i** negative association **ii** not linear **iii** strong

b **i** positive association **ii** linear **iii** moderate

c **i** no association **ii** not linear **iii** zero

5 **a** *height*

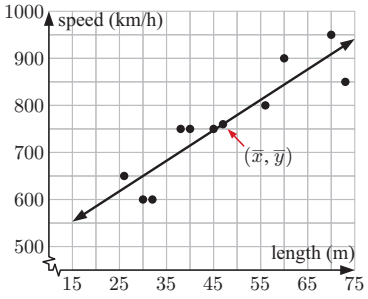
b



c A weak, positive, linear correlation.

6 **a** $\overline{x} = 47$ m, $\overline{y} = 760$ km/h

b



c **i** $\approx$ 800 km/h **ii** $\approx$ 550 km/h

d We expect the prediction in **c i** to be reliable as it is an interpolation. The prediction in **c ii** may not be reliable as it is an extrapolation.

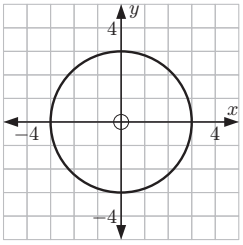
22A RELATIONS AND FUNCTIONS

1 **a** is a function because no two points have the same x-coordinate.

b is not a function as $(-2, 4)$ and $(-2, -1)$ have the same x-coordinate.

2 **a** and **d** are functions.

3 **a**



b no

22B FUNCTION NOTATION

1 **a** 5 **b** -1 **c** $\frac{19}{2}$

2 **a** 3 **b** -3 **c** 39

3 **a** **i** -2 **ii** -1

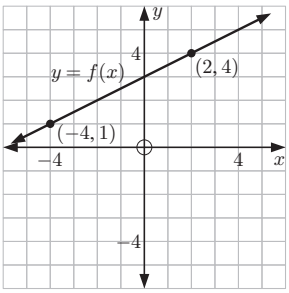
b $x = -3$, $x = -1$, and $x = 1$

c $x = -2$ and $x = 1$

4 **a** **i** 4 **ii** -1 **iii** $\frac{7}{8}$ **b** $x = \frac{1}{2}$

c $x = 3$

5 **a**



b $f(x) = \frac{1}{2}x + 3$

6 **a** $g(-x) = 2x^2 + 5x + 4$ **b** $g(x-3) = 2x^2 - 17x + 37$

c $g\left(\frac{x}{2}\right) + 1 = \frac{x^2}{2} - \frac{5x}{2} + 5$

22C DOMAIN AND RANGE

1 **a** Domain is $\{x \mid 2 \leqslant x < 9\}$. Range is $\{y \mid 1 < y \leqslant 7\}$.

b Domain is $\{x \in \mathbb{R}\}$. Range is $\{y \mid y = 3\}$.

c Domain is $\{x \mid x \geqslant -4\}$. Range is $\{y \mid y \geqslant -5\}$.

d Domain is $\{x \in \mathbb{R}\}$. Range is $\{y \mid y \leqslant 4\}$.

e Domain is $\{x \mid x \geqslant 2\}$. Range is $\{y \in \mathbb{R}\}$.

f Domain is $\{x \mid x \neq 0\}$. Range is $\{y \mid y \neq -2\}$.

2 **a** At any point in time, the temperature of the bedroom can only take one value.

$\therefore$ the temperature graph must be a function.

b Domain is $\{t \mid 0 \leqslant t \leqslant 12\}$. Range is $\{T \mid 15 \leqslant T \leqslant 35\}$.

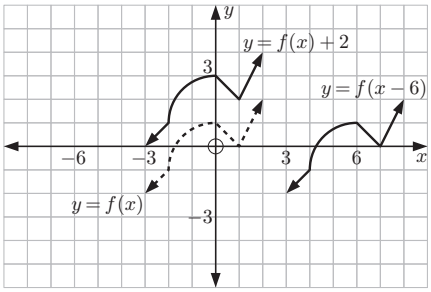
22D TRANSFORMATIONS OF GRAPHS

1 **a** A translation 3 units downwards.

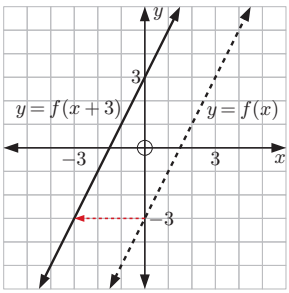
b A translation 4 units to the left.

c A translation 5 units to the right, and 6 units upwards.

2



3



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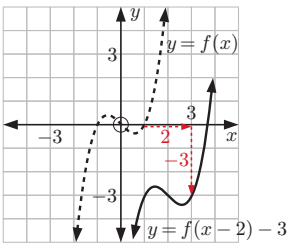


5 **a** $g(x) = -2x + 7$ **b** $g(x) = x^2 + 8x + 16$

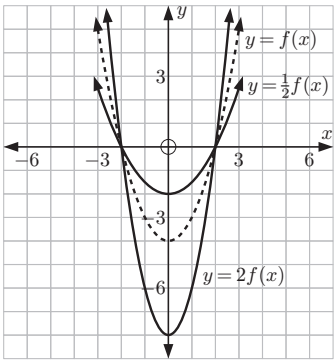
6 **a** Domain is $\{x \mid 3 \leqslant x \leqslant 7\}$. Range is $\{y \mid -9 \leqslant y \leqslant -2\}$.

b Domain is $\{x \mid -2 \leqslant x \leqslant 2\}$. Range is $\{y \mid -2 \leqslant y \leqslant 5\}$.

7 **a** A vertical stretch with scale factor 5.

b A vertical stretch with scale factor $\frac{3}{4}$.

8



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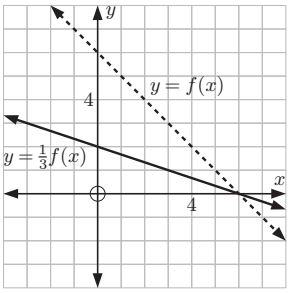
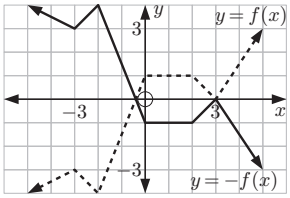
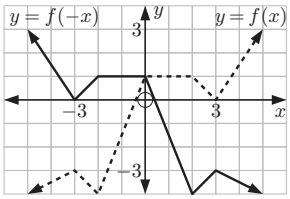


10 **a** $g(x) = 30x - 12$ **b** $g(x) = \frac{1}{4}x^2 - 5$

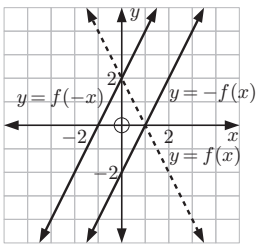
11 **a**



b



12



13 **a** $g(x) = \frac{2}{x} - 5x$ **b** $g(x) = 3x^2 + 7x + 2$

14 **a** Domain is $\{x \mid x > -2\}$. Range is $\{y \mid -7 < y \leqslant 1\}$.

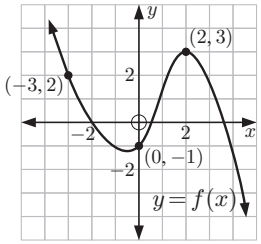
b Domain is $\{x \mid x < 2\}$. Range is $\{y \mid -1 \leqslant y < 7\}$.

REVIEW OF CHAPTER 22

1 **a** and **c** are functions.

2 **a** 11 **b** $f(x-1) = 2x^2 - 4x - 5$ **c** $x = -2$ or 2

3 **Note:** Other answers are possible.



4 **a** **i** -3 **ii** 3

b **i** $x = -3$ and 4 **ii** $x = -1$ and 4 **iii** $x = -4$ and 5

5 **a** Domain is $\{x \in \mathbb{R}\}$. Range is $\{y \mid y \leqslant 3\}$.

b Domain is $\{x \mid x < 5\}$. Range is $\{y \mid y > -4\}$.

c Domain is $\{x \mid -4 \leqslant x \leqslant 5\}$. Range is $\{y \mid -7 \leqslant y \leqslant 4\}$.

6 **a** A translation 2 units upwards.

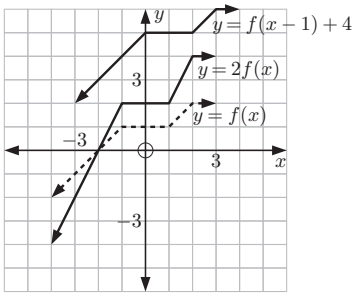
b A vertical stretch with scale factor 4.

c A reflection in the y-axis.

7 **a** $g(x) = 2 - \frac{3}{5}x$ **b** $g(x) = x^2 - 7x + 8$

c $g(x) = -3x^3 - x - 1$

8



9 **a** Domain is $\{x \mid -5 \leqslant x < 1\}$. Range is $\{y \mid y \geqslant -9\}$.

b Domain is $\{x \mid -4 \leqslant x < 2\}$. Range is $\{y \mid y \leqslant 3\}$.

23A QUADRATIC FUNCTIONS

1 **a** quadratic function; $a = 1$, $b = 2$, $c = -5$

b not a quadratic function; contains x^3 term

c not a quadratic function; no x^2 term

d quadratic function; $a = 4$, $b = 0$, $c = -5$

2 **a** $y = 30$ **b** $y = -18$

3 **a** no **b** yes **c** no

4 **a** $x = 0$ or 3 **b** $x = -3$ or 7

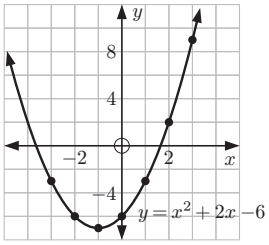
5 **a** $x = -4$ or 5 **b** $x = -2$

6 **a** **i** 100 m **ii** 160 m **b** 5 seconds and 7 seconds

23B GRAPHS OF QUADRATIC FUNCTIONS

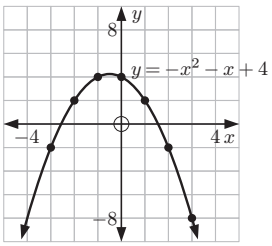
1 **a**

x	-3	-2	-1	0	1	2	3
y	-3	-6	-7	-6	-3	2	9

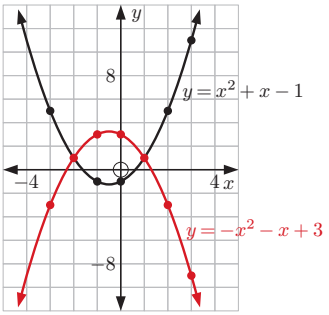


b

x	-3	-2	-1	0	1	2	3
y	-2	2	4	4	2	-2	-8



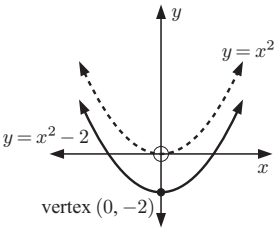
2 **a**



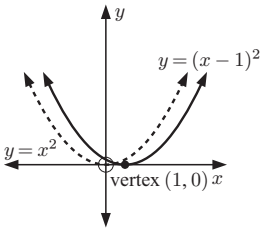
b, c $x = -2$ or 1

23C USING TRANSFORMATIONS TO GRAPH QUADRATICS

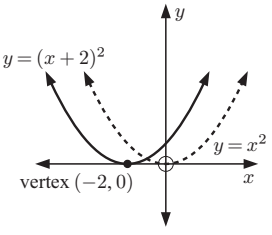
1 **a**



b



c



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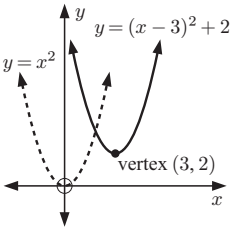
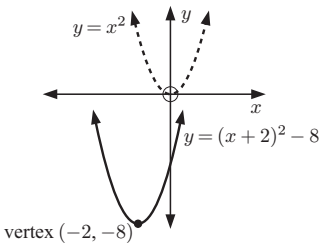
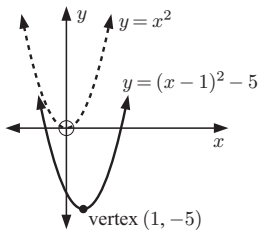


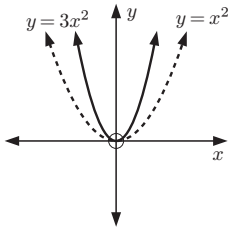
e



f

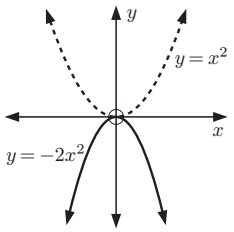


2 a



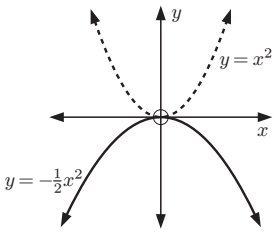
$y = 3x^2$ is "thinner" than $y = x^2$ and the graph opens upwards.

b



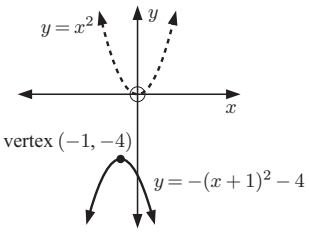
$y = -2x^2$ is "thinner" than $y = x^2$ and the graph opens downwards.

c

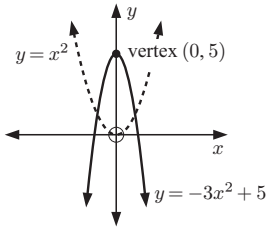


$y = -\frac{1}{2}x^2$ is "wider" than $y = x^2$ and the graph opens downwards.

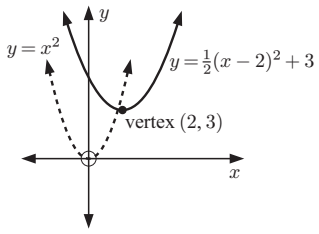
3 a



b

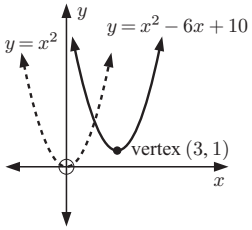


c

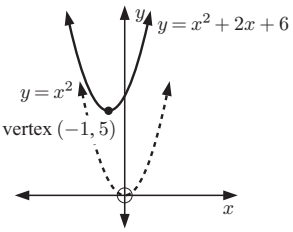


4 a D **b** A **c** E **d** B **e** C

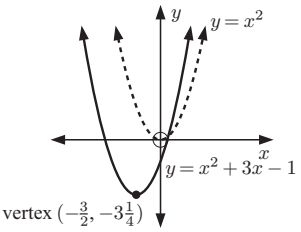
5 a $y = (x-3)^2 + 1$



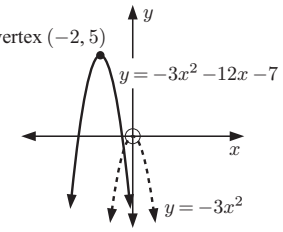
b $y = (x+1)^2 + 5$



c $y = (x + \frac{3}{2})^2 - 3\frac{1}{4}$



6 b



23D AXES INTERCEPTS

1 a 7 **b** -1 **c** 3

2 a x-intercepts 2 and -5, y-intercept -10

b x-intercepts -1 and 4, y-intercept 12

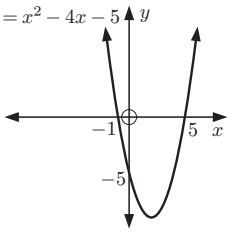
c x-intercept 1, y-intercept 3

3 a -4 and 4 **b** 0 and -6 **c** -4 and -7

d 5 and -3 **e** 5 and -7 **f** -4

4 a $-3 \pm \sqrt{14}$ **b** $\frac{-1 \pm \sqrt{17}}{4}$

5 a $y = x^2 - 4x - 5$



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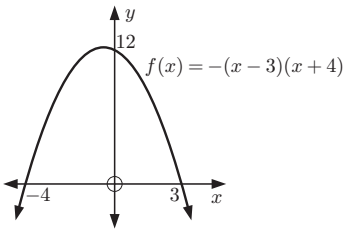

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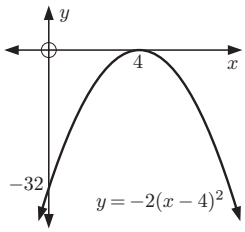
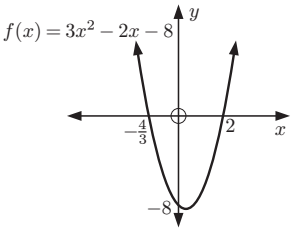


d



23E AXIS OF SYMMETRY OF A QUADRATIC

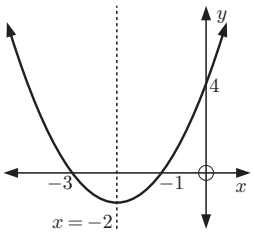
1 a $x = 2$ **b** $x = \frac{5}{2}$ **c** $x = -4$

2 a $x = 1$ **b** $x = \frac{3}{2}$ **c** $x = -2$

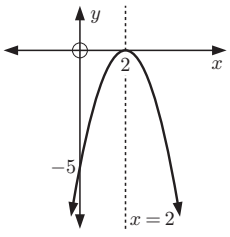
3 a $x = -5$ **b** $x = 2$ **c** $x = 6$ **d** $x = \frac{7}{10}$

4 2 and -8

5 a



b



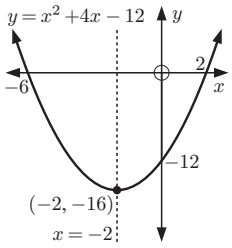
23F VERTEX OF A QUADRATIC

1 a i $(2, 1)$ **ii** minimum **iii** $\{y \mid y \geqslant 1\}$

b i $(1, 9)$ **ii** maximum **iii** $\{y \mid y \leqslant 9\}$

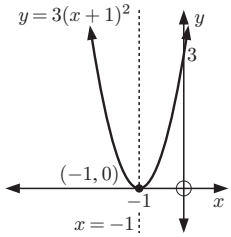
2 a i x-intercepts -6 and 2, y-intercept -12 **ii** $x = -2$

iii $(-2, -16)$ **iv**



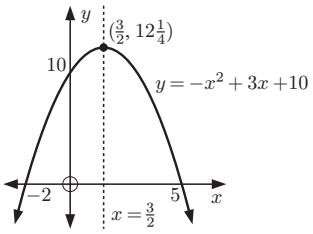
b i x-intercept -1, y-intercept 3 **ii** $x = -1$

iii $(-1, 0)$ **iv**



c i x-intercepts -2 and 5, y-intercept 10 **ii** $x = \frac{3}{2}$

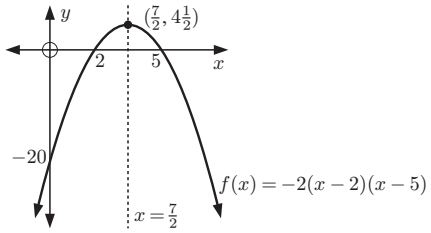
iii $\left(\frac{3}{2}, 12\frac{1}{4}\right)$ **iv**



d i x-intercepts 2 and 5, y-intercept -20 **ii** $x = \frac{7}{2}$

iii $\left(\frac{7}{2}, 4\frac{1}{2}\right)$

iv



3 a $b = -6, \quad c = 7$ **b** $b = 1, \quad c = -\frac{5}{4}$

23G FINDING A QUADRATIC FUNCTION

1 a $f(x) = 4(x - 1)^2 - 3$ **b** $f(x) = -2(x + 5)^2 + 8$

2 a $b = -3, \quad c = 0$ **b** $b = 1, \quad c = -6$

3 a $f(x) = -(x + 5)(x - 2)$ **b** $f(x) = 3(x + 3)(x - 6)$

4 a $f(x) = 7(x + 1)^2$ **b** $f(x) = -5(x - 4)^2$

23H PROBLEM SOLVING WITH QUADRATIC FUNCTIONS

1 a 1 m **b** 2 seconds **c** 21 m

2 a 25 items **b** \$475 profit **c** \$150 loss

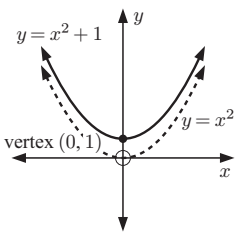
3 a 60 km/h **b** 2.5 seconds **c** 22.5 km/h

4 b $x = 30$ **c** 900 m^2

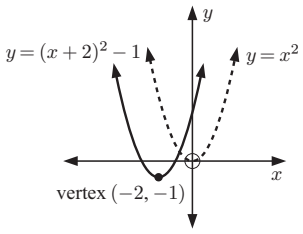
REVIEW OF CHAPTER 23

1 a $y = -25$ **b** $x = -5$ or 7 **2** no

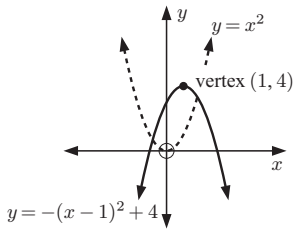
3 a



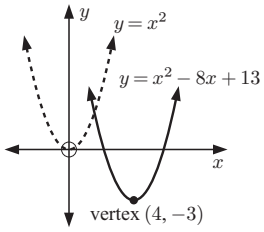
b



c



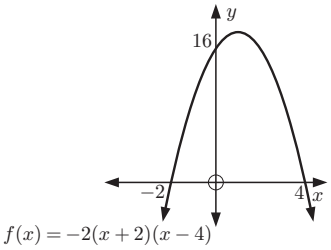
4 **a** $y = (x-4)^2 - 3$ **b**



5 **a** x-intercepts -3 and 1, y-intercept -3

b x-intercepts -4 and 7, y-intercept 28

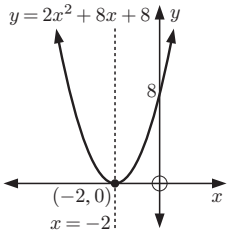
6



7 $x = -\frac{3}{2}$

8 **a** x-intercept -2, y-intercept 8 **b** $x = -2$

c $(-2, 0)$ **d**



9 $b = -3$, $c = \frac{1}{4}$

10 **a** $f(x) = 4(x+2)^2 + 2$ **b** $f(x) = -2(x-2)(x-3)$

11 **a** 30 seconds **b** 25 m

24A EXPONENTIAL FUNCTIONS

1 **a**, **c**, and **d** are exponential functions.

2 **a** 9 **b** $\frac{1}{3}$ **c** 3^{3x} **d** 3^{x+1}

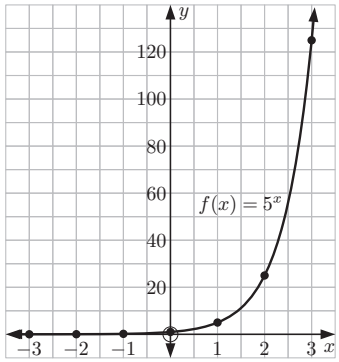
3 **a** -1 **b** $-\frac{7}{4}$ **c** $2^x - 2$ **d** $2^{-x} + 1$

24B GRAPHS OF EXPONENTIAL FUNCTIONS

1 **a** **i**

x	-3	-2	-1	0	1	2	3
y	$\frac{1}{125}$	$\frac{1}{25}$	$\frac{1}{5}$	1	5	25	125

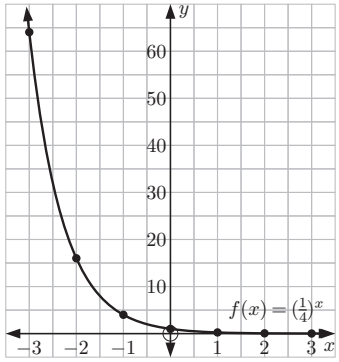
ii



b **i**

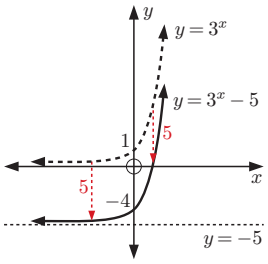
x	-3	-2	-1	0	1	2	3
y	64	16	4	1	$\frac{1}{4}$	$\frac{1}{16}$	$\frac{1}{64}$

ii

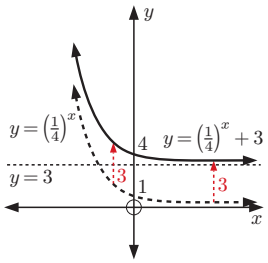


2 **a** C **b** D **c** B **d** A

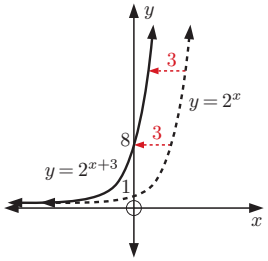
3 **a**



b



c



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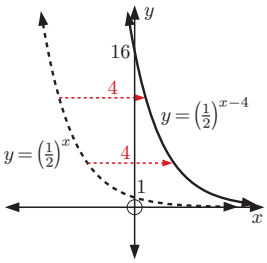

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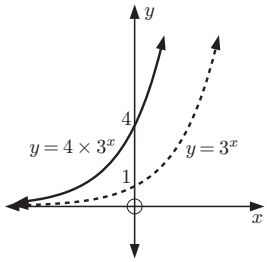
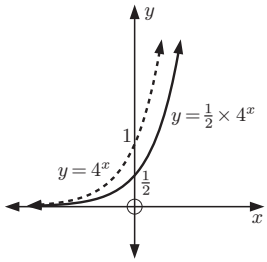
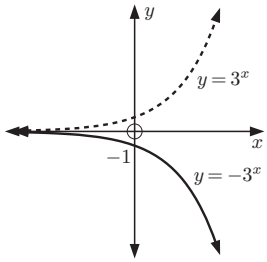


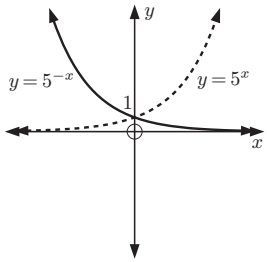
f



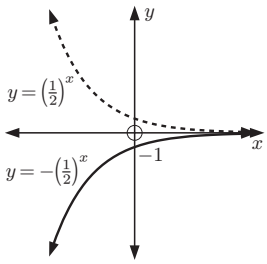
4 a



b

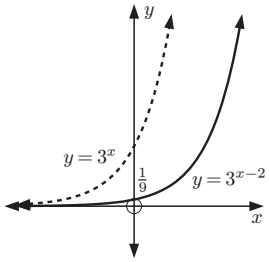


c

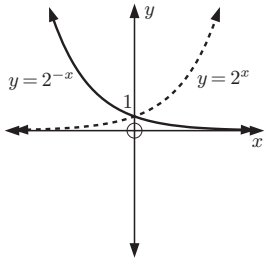


5 $a = \frac{2}{3}, \quad k = 90$

6 a $y = 3^{x-2}$



b $y = 2^{-x}$



24C EXPONENTIAL EQUATIONS

1 a $x = 4$ **b** $x = 3$ **c** $x = -1$

d $x = 0$ **e** $x = -2$ **f** $x = -3$

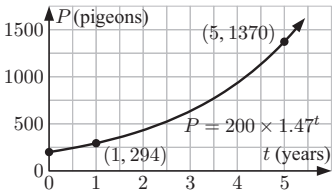
2 a $x = 2$ **b** $x = -3$ **c** $x = -1$

3 a $x \approx 4.096$ **b** $x \approx -9.381$ **c** $x \approx 3.763$

24D EXPONENTIAL GROWTH

1 a 200 pigeons **b i** 294 pigeons **ii** $\approx$ 1370 pigeons

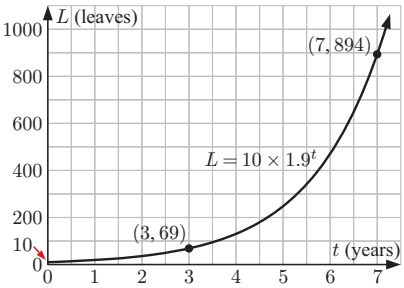
c



d ≈ 4.18 years

2 a $L_0 = 10$ **b i** $\approx$ 69 leaves **ii** $\approx$ 894 leaves

c



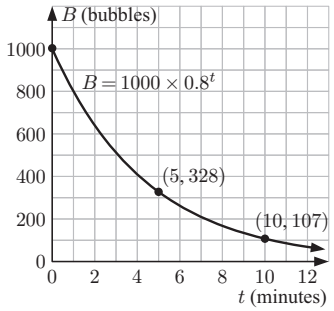
d ≈ 8.25 years

24E EXPONENTIAL DECAY

1 a 1000 bubbles

b i $\approx$ 328 bubbles **ii** $\approx$ 107 bubbles

c

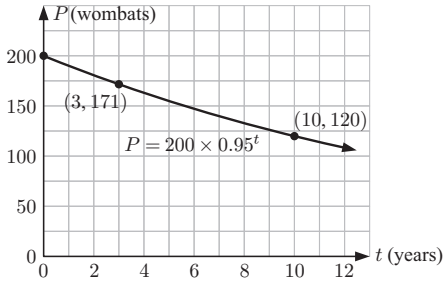


d $\approx 89.3\%$ decrease **e** ≈ 3.11 minutes

2 **a** $P = 200 \times 0.95^t$

b **i** ≈ 171 wombats **ii** ≈ 120 wombats

c

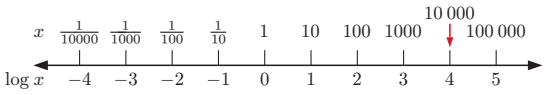


d ≈ 27.0 years

24F LOGARITHMS

1 **a** 3 **b** 0 **c** -4

2 **a**



b **i** 1 and 2, $\log 67 \approx 1.826$

ii -1 and 0, $\log(0.23) \approx -0.638$

iii 3 and 4, $\log 5187 \approx 3.715$

iv -3 and -2, $\log(0.0049) \approx -2.310$

3 **a** $\log 150 \approx 2.18$ **b** $150 \approx 10^{2.18}$

24G LOGARITHM OF A PRODUCT

1 **a** $\log 28$ **b** $\log 66$ **c** $\log 50$ **d** $\log 9000$

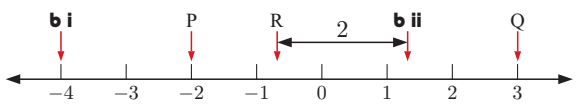
2 **a** $\log 3 + 1$ **b** $\log 3 + 3$ **c** $\log 3 - 2$ **d** $\log 3 - 4$

3 **a** $\log(0.7)$ **b** $\log(0.06)$

24H LOGARITHMIC SCALES

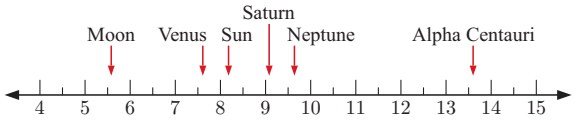
1 **a** P $= \frac{1}{100}$, Q $= 1000$

b



2 **a**

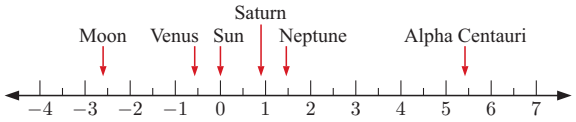
Object	*Distance from Earth* (km)	*Logarithm*
Moon	3.8×10^5	≈ 5.58
Venus	4.1×10^7	≈ 7.61
Sun	1.5×10^8	≈ 8.18
Saturn	1.2×10^9	≈ 9.08
Neptune	4.4×10^9	≈ 9.64
Alpha Centauri	4.1×10^{13}	≈ 13.6



b

Object	*Distance from Earth* (AU)	*Logarithm*
Moon	$\approx 2.53 \times 10^{-3}$	≈ -2.60
Venus	≈ 0.273	≈ -0.563
Sun	1	0
Saturn	8	≈ 0.903
Neptune	≈ 29.3	≈ 1.47
Alpha Centauri	$\approx 2.73 \times 10^5$	≈ 5.44

c



d The scale in **c** is obtained by shifting the scale in **a** by $\log(1.5 \times 10^8) \approx 8.18$ units to the left.

3 **a** A more toxic substance requires less of it to be lethal. As D decreases, $R = -\log D$ increases, so more toxic substances will have a higher value of R.

b **i** ≈ 1.82 **ii** ≈ 3.14

c **i** $D = 0.000\,05$ **ii** ≈ 4.30

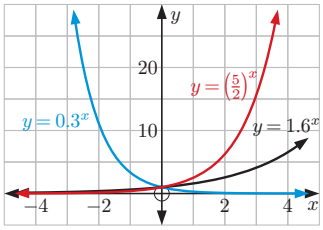
d **i** $D = 10^{-7}$ **ii** 6 mg

REVIEW OF CHAPTER 24

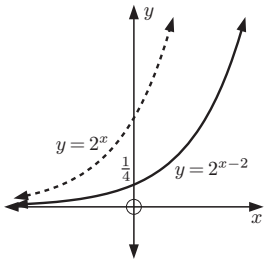
1 **a** and **c** are exponential.

2 **a** 1 **b** $\frac{1}{5}$ **c** $5^{x-2} + 3$ **d** 5^{x-6}

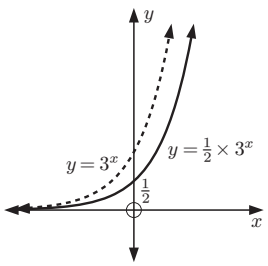
3



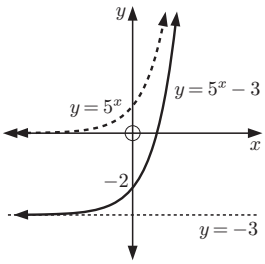
4 **a**



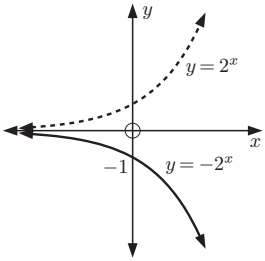
b



5 **a** $y = 5^x - 3$



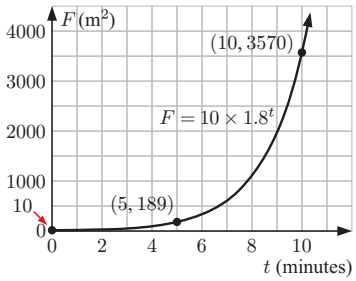
b $y = -2^x$



6 **a** $x = 4$ **b** $x = -2$ **c** $x = -4$

7 **a** **i** 10 m^2 **ii** $\approx 189 \text{ m}^2$ **iii** $\approx 3570 \text{ m}^2$

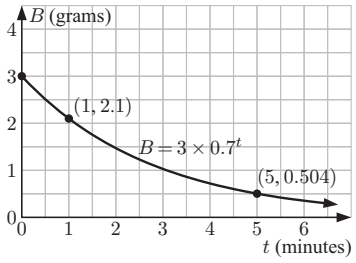
b



c ≈ 12.9 minutes

8 **a** **i** 3 grams **ii** 2.1 grams **iii** ≈ 0.504 grams

b



c ≈ 3.08 minutes

9 **a** $\log(0.2) \approx -0.699$ **b** $0.2 \approx 10^{-0.699}$

10 **a** $\log 72$ **b** $\log 400$ **c** $\log(0.003)$

11 **a**

Substance	*Density* (g/cm^3)	*Logarithm*
Water	1	0
Nitrogen	0.001 25	≈ -2.90
Titanium	4.54	≈ 0.657
Helium	1.79×10^{-4}	≈ -3.75
Platinum	21.5	≈ 1.33
Hydrogen	8.99×10^{-5}	≈ -4.05

b