

10 Solving equations

10.1 Solving linear equations

Exercise 10A

- 1 a $x = 6$ b $y = 3$ c $t = 4$ d $f = 2\frac{1}{2}$ e $k = 3\frac{1}{2}$
f $x = 2\frac{1}{2}$ g $m = 56$ h $x = 0$ i $h = -7$ j $w = -18$
k $x = 36$ l $y = 36$ m $x = 7$ n $y = 1$ o $x = 11.5$
p $t = 0.2$
- 2 a $x = 3$ b $x = 7$ c $t = 5$ d $x = 1\frac{1}{2}$ e $y = 2\frac{1}{2}$
f $k = \frac{1}{2}$ g $x = -1$ h $t = -2$ i $x = -2$
- 3 Any values that work, e.g. $a = 2$, $b = 3$ and $c = 30$.
- 4 a $x = 2$ b $y = 1$ c $a = 7$ d $k = -1$ e $m = 3$ f $s = -2$
- 5 a $d = 6$ b $x = 11$ c $y = 1$ d $h = 4$
e $b = 9$ f $c = 6$
- 6 $6x + 3 = 6x + 10$; $6x - 6x = 10 - 3$; $0 = 7$, which is obviously false. Both sides have $6x$, which cancels out.
- 7 Check students' examples.

Exercise 10B

- 1 a 1.5 b 2
- 2 a 1.5 cm b 6.75 cm^2
- 3 Length is 5.5 m, width is 2.5 m and area is 13.75 m^2 . Tiles cost 123.75 dollars
- 4 3 years
- 5 9 years
- 6 3 cm
- 7 5
- 8 a $4x + 40 = 180$ b $x = 35^\circ$
- 9 a $\frac{x + 10}{5} = 9.50$ b \$37.50
- 10 No, as $x + x + 2 + x + 4 + x + 6 = 360$ gives $x = 87^\circ$ so the consecutive numbers (87, 89, 91, 93) are not even but odd.
- 11 $4x + 18 = 3x + 1 + 50$, $x = 33$. Large bottle 1.5 litres, small bottle 1 litre

Exercise 10C

- 1 a $x = 7$ b $x = 9$ c $x = 14$ d $x = 5$ e $x = 2.5$ f $x = -2$
- 2 a $x = 3$ b $x = 6$ c $x = 2$ d $x = 5$ e $x = \frac{3}{4}$ f $x = 3$
- 3 a $x = 6$ b $x = 14$ c $x = 7$
- 4 5, 6 and 7
- 5 50, 55 and 75 degrees

Exercise 10D

- 1 -2, -5
- 2 -3, -1
- 3 -6, -4

- 4** $-3, 2$
5 $-1, 3$
6 $-4, 5$
7 $1, -2$
8 $2, -5$
9 $7, -4$
10 $3, 2$
11 $1, 5$
12 $4, 3$
13 $-4, -1$
14 $-9, -2$
15 $2, 4$
16 $3, 5$
17 $-2, 5$
18 $-3, 5$
19 $-6, 2$
20 $-6, 3$
21 $-1, 2$
22 -2
23 -5
24 4
25 $-2, -6$
26 7
27 **a** $x(x-3) = 550, x^2 - 3x - 550 = 0$ **b** $(x-25)(x+22) = 0, x = 25$
28 $x(x+40) = 48000, x^2 + 40x - 48000 = 0, (x+240)(x-200) = 0$.
 Fence is $2 \times 200 + 2 \times 240 = 880$ m.
29 $-6, -4$
30 $2, 16$
31 $-6, 4$
32 $-9, 6$
33 $-10, 3$
34 $-4, 11$
35 $-8, 9$
36 $8, 9$
37 1

Exercise 10E

- 1** **a** $\frac{1}{3}, -3$ **b** $1\frac{1}{3}, -\frac{1}{2}$ **c** $-\frac{1}{5}, 2$
d $-2\frac{1}{2}, 3\frac{1}{2}$ **e** $-\frac{1}{6}, -\frac{1}{3}$ **f** $\frac{2}{3}, 4$
g $\frac{1}{2}, -3$ **h** $\frac{5}{2}, -\frac{7}{6}$ **i** $-1\frac{2}{3}, 1\frac{2}{5}$
j $1\frac{3}{4}, 1\frac{2}{7}$ **k** $\frac{2}{3}, \frac{1}{8}$ **l** $\pm\frac{1}{4}$
m $-2\frac{1}{4}, 0$ **n** $\pm 1\frac{2}{5}$ **o** $-\frac{1}{3}, 3$
2 **a** $-6, 7$ **b** $-\frac{5}{2}, \frac{3}{2}$ **c** $-6, 7$
d $-1, \frac{11}{13}$ **e** $-2, 3$ **f** $-\frac{2}{5}, \frac{1}{2}$

- d** $(x+3)^2 - 9$ **e** $(x-1.5)^2 - 2.25$ **f** $(x-4.5)^2 - 20.25$
g $(x+6.5)^2 - 42.25$ **h** $(x+5)^2 - 25$ **i** $(x+4)^2 - 16$
j $(x-1)^2 - 1$ **k** $(x+1)^2 - 1$
- 2 a** $(x+2)^2 - 5$ **b** $(x+7)^2 - 54$ **c** $(x-3)^2 - 6$
d $(x+3)^2 - 2$ **e** $(x-1.5)^2 - 3.25$ **f** $(x+3)^2 - 6$
g $(x-4.5)^2 - 10.25$ **h** $(x+6.5)^2 - 7.25$ **i** $(x+4)^2 - 22$
j $(x+1)^2 - 2$ **k** $(x-1)^2 - 8$ **l** $(x+1)^2 - 10$
- 3 a** $-2 \pm \sqrt{5}$ **b** $-7 \pm 3\sqrt{6}$ **c** $3 \pm \sqrt{6}$
d $-3 \pm \sqrt{2}$ **e** $1.5 \pm \sqrt{3.25}$ **f** $3 \pm \sqrt{6}$
g $4.5 \pm \sqrt{10.25}$ **h** $-6.5 \pm \sqrt{7.25}$ **i** $-4 \pm \sqrt{22}$
j $-1 \pm \sqrt{2}$ **k** $1 \pm 2\sqrt{2}$ **l** $-1 \pm \sqrt{10}$
- 4 a** 1.45, -3.45 **b** 5.32, 1.32 **c** 4.16, 2.16
- 5 a** $2(x+1)^2 + 5$ **b** $3(x+2)^2 - 9$ **c** $6(x+1)^2 - 2$
d $5(x-3)^2 - 33$ **e** $8(x-2)^2 - 22$ **f** $9(x+0.5)^2 + 6.75$
g $12(x-1.5)^2 - 13$ **h** $5(x+1)^2 + 1$ **i** $7(x+1)^2 - 2$
j $7(x+0.5)^2 + 0.25$ **k** $10(x-1)^2 + 5$ **l** $11(x+1)^2 - 5$
- 6** $a = 24, b = 4, c = -41$
7 $a = 4, b = 4, c = 9$
8 $a = 9, b = 2$
- 9 a** $x = 1.5 \pm \sqrt{3.75}$ **b** $x = 1 \pm \sqrt{0.75}$
c $x = 1.25 \pm \sqrt{6.5625}$ **d** $x = 7.5 \pm \sqrt{40.25}$
- 10** $p = -14, q = -3$
11 third, first, fourth, second, in that order.

Exercise 10I

- 1 a** $x: -4, -3, -2, -1, 0, 1, 2$ $y: 7, 2, -1, -2, -1, 2, 7$
b 0.25
c The line on the graph goes through $(-2, -1)$ and $(1, 2)$.
d $x = -2$ or 1
e Check students' own explanation and checks.
- 2 a** $x: -4, -3, -2, -1, 0, 1, 2, 3, 4$ $y: -4, 3, 8, 11, 0, 11, 8, 3, -4$
b 9.75 **c** ± 3.5
d The line passes through 6 on each axis
e $x = -2$ or 3
- 3 a**

g $x = -\frac{1}{2}, y = -6\frac{1}{2}$ **h** $x = 3\frac{1}{2}, y = 1\frac{1}{2}$ **i** $x = -2\frac{1}{2}, y = -3\frac{1}{2}$

- 6** (1, -2) is the solution to equations A and C; (-1, 3) is the solution to equations A and D; (2, 1) is the solution to B and C; (3, -3) is the solution to B and D.
- 7** Intersection points are (0, 6), (1, 3) and (2, 4). Area is 2 cm^2 .
- 8** Intersection points are (0, 3), (6, 0) and (4, -1). Area is 6 cm^2 .

11.2 Linear and non-linear equations

Exercise 11B

- 1** **a** (5, -1) **b** (4, 1) **c** (8, -1)
- 2** **a** (1, 2) and (-2, -1) **b** (-4, 1) and (-2, 2)
- 3** **a** (3, 4) and 4, 3) **b** (0, 3) and (-3, 0) **c** (3, 2) and (-2, 3)
- 4** **a** (2, 5) and (-2, -3) **b** (-1, -2) and (4, 3) **c** (3, 3) and (1, -1)
- 5** **a** (-3, -3), (1, 1) **b** (3, -2), (-2, 3) **c** (-2, -1), (1, 2)
- d** (2, -1), (3, 1) **e** (-2, 1), (3, 6) **f** (1, -4), (4, 2)
- g** (4, 5), (-5, -4)

11.3 Using graphs to solve linear equations

Exercise 11C

- 1** **a** $x = 2, y = 6$ **b** $x = 6, y = 2$ **c** $x = 4, y = 4$ **d** $x = 0, y = 4$
- 2** **a** $x = 4, y = 8$ **b** $x = 6, y = 4$ **c** $x = 6, y = 0$
- 3** (4, 1)
- 4** (2, 3)
- 5** (3, 10)
- 6** (5, 5)
- 7** (1, 5)
- 8** (3, 16)
- 9** (-2, 6)
- 10** (-6, -9)
- 11** (1, -1)
- 12** (2, 6)
- 13** (2, 8)
- 14** $(7\frac{1}{2}, 3\frac{1}{2})$
- 15** **a** P and R **b** R and S **c** P and Q
- d** Q and S **e** $(-\frac{2}{5}, -\frac{3}{5})$
- 16** (0, 0), (-3, 3), (-3, -3), (-3, 2), (-2, 2), (2, 2)

11.4 Using graphs to solve simultaneous equations, one linear and one non-linear

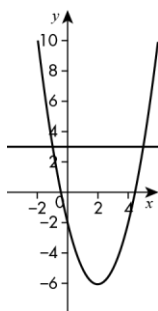
Exercise 11D

- 1 a (0.7, 0.7), (-2.7, -2.7) b (6, 12), (-1, -2) c (4, -3), (-3, 4)
 d (0.8, 1.8), (-1.8, -0.8) e (4.6, 8.2), (0.5, 0) f (3, 6), (-2, 1)
 g (4.8, 6.6), (0.2, -2.6) h (2.6, 1.6), (-1.6, -2.6)
- 2 a (1, 0) b Only one intersection point c $x^2 + x(3 - 5) + (-4 + 5) = 0$
 d $(x - 1)^2 = 0 \Rightarrow x = 1$ e Only one solution as line is a tangent to curve
- 3 a There is no solution b The graphs do not intersect c $x^2 + x + 4 = 0$
 d $b^2 - 4ac = -15$
 e No solution as the discriminant is negative and there is no square root of a negative number

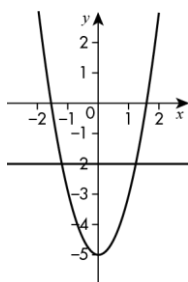
11.5 Solving equations by the method of intersection

Exercise 11E

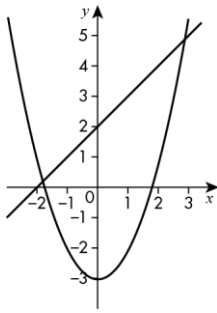
- 1 a i -1.4, 4.4 ii -2, 5 iii -0.6, 3.6 b 2.6, 0.4
- 2 a -5, 1 b i -5.3, 1.3 ii -4.8, 0.8 iii -3.4, -0.6
- 3 a i 0, 6 ii 4.3, 0.7 b i 4.8, 0.2 ii 5.4, -0.4
- 4 a i -1.6, 2.6 ii 1.4, -1.4 b i 2.3, -2.3 ii 2, -2
- 5 a 0, 2 b 2.5 c -0.6, 1, 1.6 d 2.8
 e -0.8, 0.6, 2.2
- 6 a -0.4, 4.4 b -1, 5



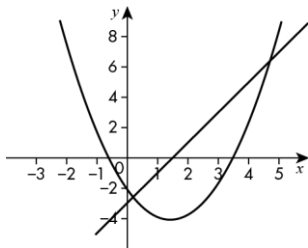
- 7 a 1.6, -1.6 b -1.2, 1.2



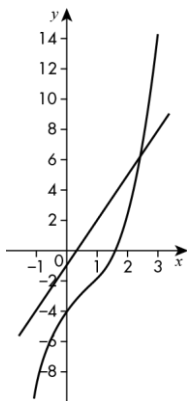
8 a 2.2, -2.2 **b** -1.8, 2.8



9 a 3.3, -0.3 **b** 4.8, 0.2



10 a 2 **b** 2.5



11 a C and D **b** A and D **c** $x^2 + 4x - 1 = 0$ **d** (-1.5, -10.25)

12 a $a(x + 2)(x - 1) = 0$ **b** $5 - -2 = +7$, not -7 **c** $y = 2x + 7$

Exam-style questions

1 $x = 5, y = 0.5$

2 $x = 7, y = 1$

3 $x = 2, y = 5$

4 $x = 4, y = -3$

5 $x = 7, y = 3$

6 $x = 4, y = 2$

- 7 $x = 5$ and $y = 1$, or $x = -3$ and $y = -3$
- 8 $(5, 0)$, and $(-4, 3)$
- 9 $(4, 6)$ and $(4, -6)$
- 10 $x = 1.62$ and $y = 4.24$, or $x = -0.62$ and $y = -0.24$


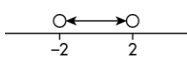


Chapter 12 Inequalities

12.1 Linear inequalities

Exercise 12A

- 1 a $x < 3$ b $t > 8$ c $p \geq 10$ d $x < 5$ e $y \leq 3$ f $t > 5$
 g $x < 6$ h $y \leq 15$ i $t \geq 18$ j $x < 7$ k $x \leq 3$ l $t \geq 5$
- 2 a 8 b 6 c 16 d 3 e 7
- 3 a 11 b 16 c 16
- 4 $2x + 3 < 20$, $x < 8.50$, so the most each could cost is \$8.49
- 5 a Because $3 + 4 = 7$, which is less than the third side of length 8
 b $x + x + 2 > 10$, $2x + 2 > 10$, $2x > 8$, $x > 4$, so smallest value of x is 5
- 6 a $x = 6$ and $x < 3$ scores -1 (nothing in common), $x < 3$ and $x > 0$ scores 1 (1 in common for example), $x > 0$ and $x = 2$ scores 1 (2 in common), $x = 2$ and $x \geq 4$ scores -1 (nothing in common), so we get $-1 + 1 + 1 - 1 = 0$
 b $x > 0$ and $x = 6$ scores $+1$ (6 in common), $x = 6$ and $x \geq 4$ scores $+1$ (6 in common), $x \geq 4$ and $x = 2$ scores -1 (nothing in common), $x = 2$ and $x < 3$ scores $+1$ (2 in common), $+1 + 1 - 1 + 1 = 2$
 c Any acceptable combination, e.g. $x = 2$, $x < 3$, $x > 0$, $x \geq 4$, $x = 6$
- 7 a $x \geq -6$ b $t \leq \frac{8}{3}$ c $y \leq 4$ d $x \geq -2$ e $w \leq 5.5$ f $x \leq \frac{14}{5}$
- 8 a $x \leq 2$ b $x > 38$ c $x < 6\frac{1}{2}$ d $x \geq 7$ e $t > 15$ f $y \leq \frac{7}{5}$
- 9 a 4 b 99 c 11 d 11 e 6
- 10 a 0, 10 - 10 b $x < 16$
- 11 a $x < 9$ b $x \geq 11$ c $x \geq 3$
- 12 a $x \geq 7.5$ b $x \leq -2$ c $x < 6$ d $x > 1.5$ e $x \geq -5$ f $x < 0.5$

Exercise 12B

- 1 a $-4 \leq x \leq 4$ 
- b $-2 < x < 2$ 
- c $x < -2.5$ or $x > 2.5$ 
- d $x \leq -1$ or $x \geq 1$ 

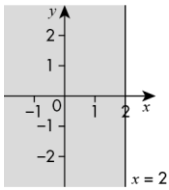
- 2 a $-3 < x < 3$
 b $x < -5$ or $x > 5$
 c $x \leq -1.5$ or $x \geq 1.5$
 d $-0.5 \leq x \leq 0.5$
- 3 a $-2 \leq x \leq 2$ (not $-2 \leq x \leq 4$)
 b $x < -3.5$ or $x > 3.5$
 c $-2.5 < x < 2.5$
 d $-3 \leq x \leq 3$

- 4 a $-3 \leq x \leq 1$ b $x > \frac{2}{3}$ or $x < -3$ c $-1 \leq x \leq \frac{5}{9}$
 d $x \geq \frac{3}{5}$ or $x \leq -5$ e $-\frac{1}{3} \leq x \leq 4$

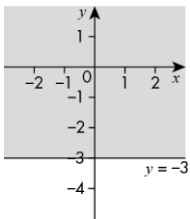
- 5 2, 3, 4
 6 1, 2

Exercise 12C

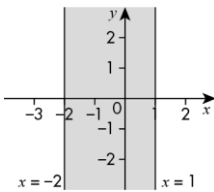
- 1 a & b



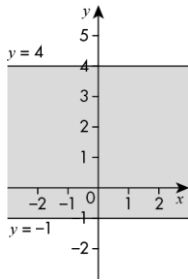
- 2 a & b



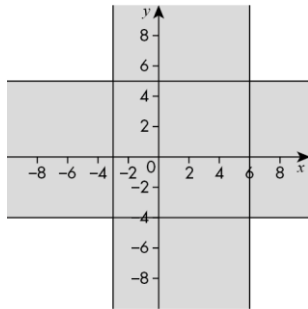
- 3 a-c



4 a-c

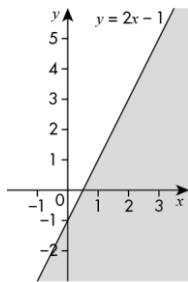


5

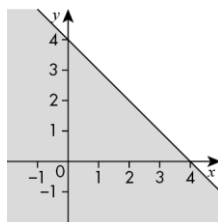


b i Yes ii Yes iii No

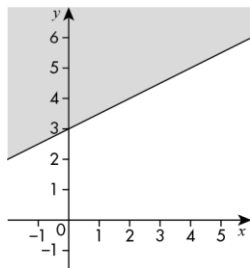
6 a & b



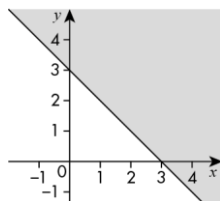
7 a & b



8 a & b

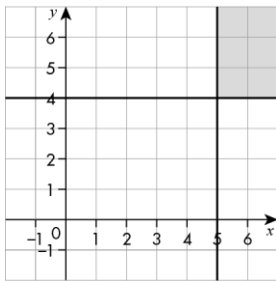


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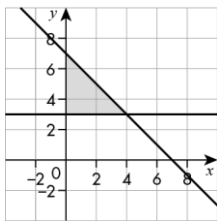


Exercise 12D

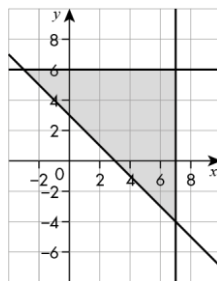
1



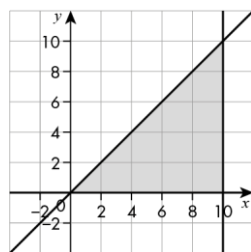
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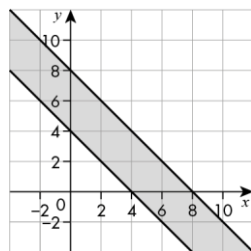
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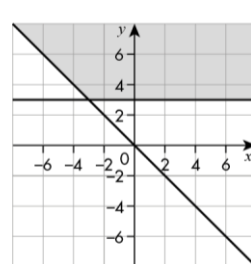
4



5

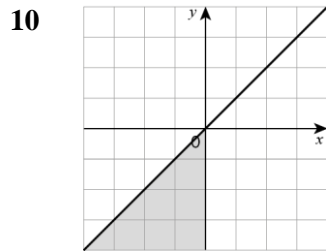
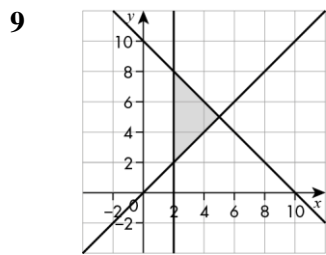


6

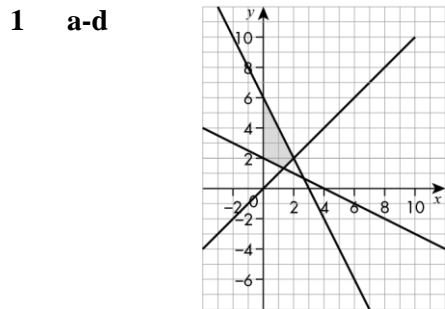


7 $x \geq -2$ and $y \geq 3$. The $>$ sign can be used instead.

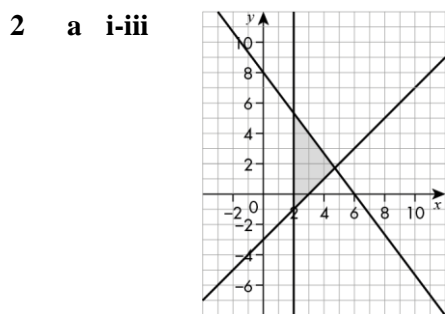
8 $x + y \geq 5$ and $x \geq 2$ and $y \geq 1$. The $>$ sign can be used instead.



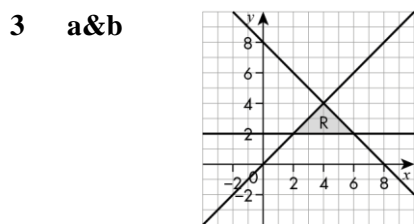
Exercise 12E



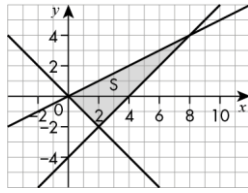
e i No ii Yes iii Yes



b i No ii Yes iii Yes iv No



4 a&b

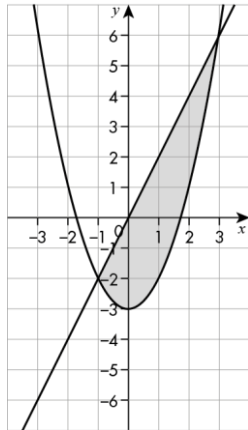


c 4 d -2 e 12

5 Test a point such as the origin (0, 0), so $0 < 0 + 2$, which is true. So the side that includes the origin is the required side.

6 a $x + y \geq 3, y \leq \frac{1}{2}x + 3$ and $y \geq 5x - 15$ b 9 c 3 at (3,0)

7 a&b



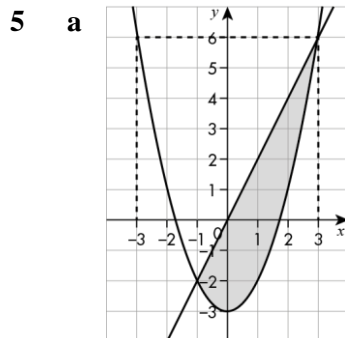
Exam-style questions

1 $x \geq 4.4$

2 $x < 2$

3 $x < -5$ or $x > -1$

4 -1, 0, 1, 2, 3



b $-1 \leq x \leq 3$

6 a $x(3x + 4) \geq 160$ b $x \leq -8$ or $x \geq 6\frac{2}{3}$; AD is at least $6\frac{2}{3}$ cm

7 a $\frac{1}{2}N^2 \sin 60^\circ \geq 100$ **b** 16