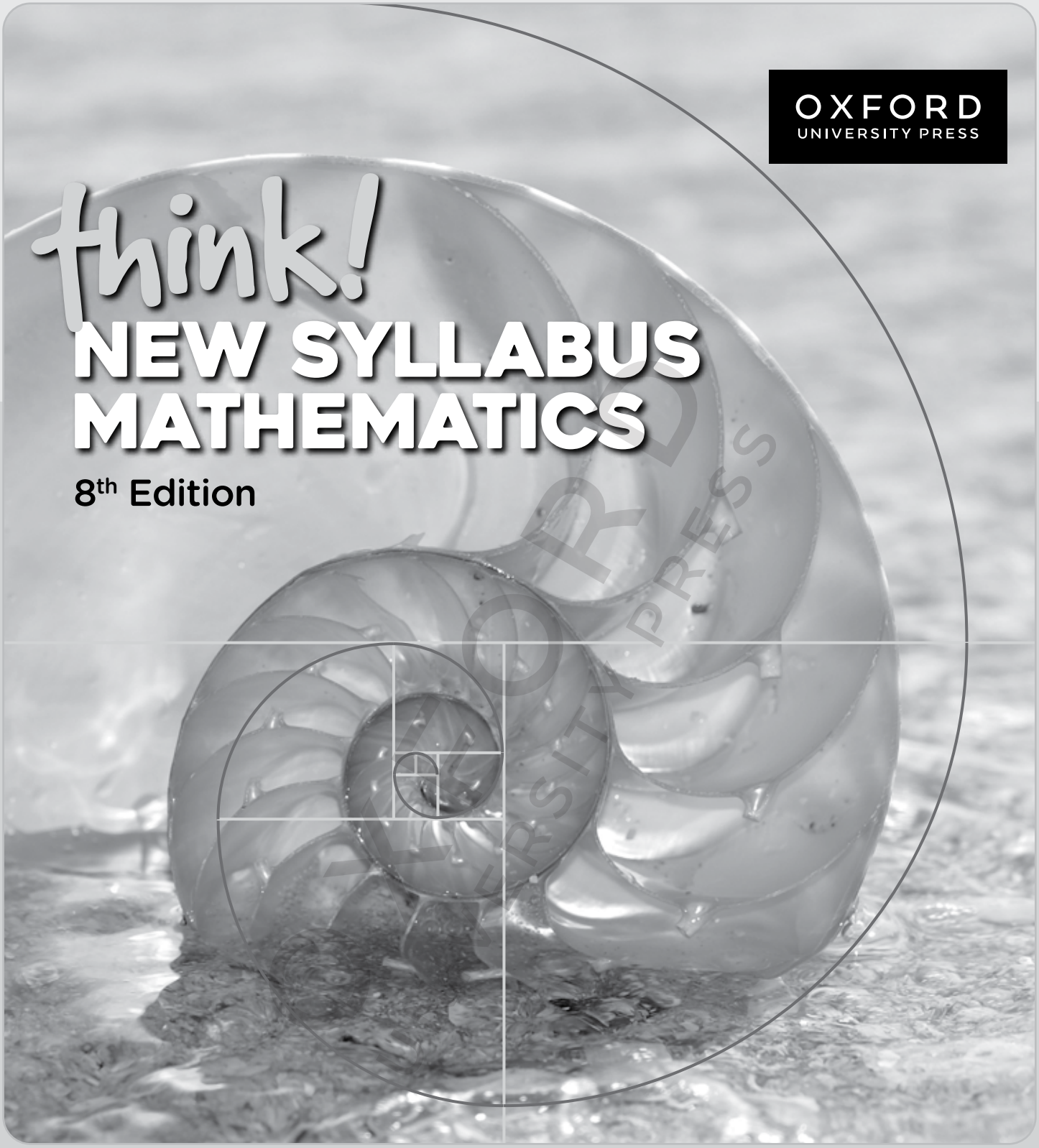

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think!
NEW SYLLABUS MATHEMATICS

8th Edition

Workbook Full Solutions 1

1 Primes, Highest Common Factor and Lowest Common Multiple

Worksheet 1A Prime numbers

1. 1 (2) 4 (7) 12 21 (29)

2. **(a)** Since 26 is divisible by 2, then 26 is a **composite number**.

(b) Since 53 is not divisible by any of the prime numbers less than $\sqrt{53}$, then 53 is a **prime number**.

(c) Since 108 is divisible by 2, then 108 is a **composite number**.

(d) Since 257 is not divisible by any of the prime numbers less than $\sqrt{257}$, then 257 is a **prime number**.

3. **(a)** $2 \times 2 \times 2 \times 2 = \mathbf{2^4}$

(b) $3 \times 5 \times 5 = \mathbf{3 \times 5^2}$

(c) $3 \times 3 \times 3 \times 7 \times 19 = \mathbf{3^3 \times 7 \times 19}$

(d) $5 \times 7 \times 7 \times 7 \times 11 \times 11 = \mathbf{5 \times 7^3 \times 11^2}$

4. **(a)**

2	24
2	12
2	6
3	3
	1

$\therefore 24 = \mathbf{2^3 \times 3}$

(b)

5	95
19	19
	1

$\therefore 95 = \mathbf{5 \times 19}$

(c)

3	225
3	75
5	25
5	5
	1

$\therefore 225 = \mathbf{3^2 \times 5^2}$

(d)

2	442
13	221
17	17
	1

$\therefore 442 = \mathbf{2 \times 13 \times 17}$

(e)

7	539
7	77
11	11
	1

$\therefore 539 = \mathbf{7^2 \times 11}$

(f)

2	1200
2	600
2	300
2	150
3	75
5	25
5	5
	1

$\therefore 1200 = \mathbf{2^4 \times 3 \times 5^2}$

5.

2	1584
2	792
2	396
2	198
3	99
3	33
11	11
	1

$1584 = 2^4 \times 3^2 \times 11$

$\therefore \boldsymbol{x = 4, y = 2}$

6.

3	7875
3	2625
5	875
5	175
5	35
7	7
	1

$7875 = 3^2 \times 5^3 \times 7$

$\therefore \boldsymbol{x = 3, y = 7}$

7. $1 \times (1 + 36) = 1 \times 37$

$= 37$

$\therefore$ The prime number is **37**.

8.

2	160
2	80
2	40
2	20
2	10
5	5
	1

$160 = 2^5 \times 5$

The dimensions could be 2^3 cm $\times$ 2^2 cm $\times$ 5 cm, i.e. **8 cm × 4 cm × 5 cm**, or $(2^2 \times 5)$ cm $\times$ 2^2 cm $\times$ 2 cm, i.e. **20 cm × 4 cm × 2 cm**.

Challenge Myself!

9.

2	250
5	125
5	25
5	5
	1

$250 = 2 \times 5^3$

(a) $2 \times 125 = 250$

False. Since $p = 2$ in this case, it is possible for either p or q to be a prime number.

(b) **True**. The largest possible value of $p + q$ is $1 + 250 = 251$, which is a prime number.

Worksheet 1B Square roots and cube roots

1. **(a)** $\sqrt{400} = \sqrt{2^4 \times 5^2}$
$= 2^2 \times 5$
$= \mathbf{20}$

(b) $\sqrt{3969} = \sqrt{3^4 \times 7^2}$
$= 3^2 \times 7$
$= \mathbf{63}$

(c) $\sqrt{5625} = \sqrt{3^2 \times 5^4}$
$= 3 \times 5^2$
$= \mathbf{75}$

(d) $\sqrt{48\,400} = \sqrt{2^4 \times 5^2 \times 11^2}$
$= 2^2 \times 5 \times 11$
$= \mathbf{220}$

2. $\sqrt[3]{91\,125} = \sqrt[3]{3^6 \times 5^3}$
$= 3^2 \times 5$
$= \mathbf{45}$

3. **(a)** $784 = 2 \times 2 \times 2 \times 2 \times 7 \times 7$
$= 2^4 \times 7^2$
$\therefore \sqrt{784} = \sqrt{2^4 \times 7^2}$
$= 2^2 \times 7$
$= \mathbf{28}$

(b) $1600 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 5 \times 5$
$= 2^6 \times 5^2$
$\therefore \sqrt{1600} = \sqrt{2^6 \times 5^2}$
$= 2^3 \times 5$
$= \mathbf{40}$

(c) $512 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$
$= 2^9$
$\therefore \sqrt[3]{512} = \sqrt[3]{2^9}$
$= 2^3$
$= \mathbf{8}$

(d) $3375 = 3 \times 3 \times 3 \times 5 \times 5 \times 5$
$= 3^3 \times 5^3$
$\therefore \sqrt[3]{3375} = \sqrt[3]{3^3 \times 5^3}$
$= 3 \times 5$
$= \mathbf{15}$

4. **(i)** $1728 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3$
$= \mathbf{2^6 \times 3^3}$

(ii) $\sqrt[3]{1728} = \sqrt[3]{2^6 \times 3^3}$
$= 2^2 \times 3$
$= 12$
$\therefore$ The radius is **12 cm**.

5. **(a)** $16^2 + 5^3 - \sqrt{784} = \mathbf{353}$

(b) $\left(\frac{3}{5}\right)^2 - \left(\frac{1}{4}\right)^3 + \left(\frac{1}{9}\right)^2 = \mathbf{0.3567}$ (to 4 d.p.)

(c) $7.7 \times \sqrt[3]{30} \div \sqrt{6} = \mathbf{9.7676}$ (to 4 d.p.)

(d) $\frac{6\sqrt{970}}{5\sqrt[3]{84}} = \mathbf{8.5338}$ (to 4 d.p.)

(e) $\frac{4^3 + \sqrt[3]{12}}{4^3 + \sqrt{15}} = \mathbf{1.1025}$ (to 4 d.p.)

(f) $\sqrt{100 + \sqrt[3]{100}} = \mathbf{10.2294}$ (to 4 d.p.)

6. Radius of circle $= \sqrt{\frac{57}{2\pi}}$
$= \mathbf{3.01\ cm}$ (to 2 d.p.)

7. Length of field $= \sqrt{650}$ m
Perimeter of field $= 4 \times \sqrt{650}$
$= \mathbf{102.0\ m}$ (to 1 d.p.)

8. Length of frame $= \sqrt{5.8}$
$= 2.408$ m (to 3 d.p.)

Yes. Since the length of the frame is greater than that of the painting, the frame is large enough.

9. $n = (3^2 \times 5)^2$
$= \mathbf{3^4 \times 5^2}$

10. $n = (2^2 \times 7)^3$
$= \mathbf{2^6 \times 7^3}$

11. **(i)** $1225 = 5 \times 5 \times 7 \times 7$
$= 5^2 \times 7^2$
$= (5 \times 7)^2$
$\therefore$ 1225 is a perfect square. (shown)

(ii) $\sqrt{1225} = 5 \times 7$
$= \mathbf{35}$

12. **(i)** $140 = 2 \times 2 \times 5 \times 7$
$= \mathbf{2^2 \times 5 \times 7}$

(ii) For $140k$ to be a perfect square,
smallest positive integer value of $k = 5 \times 7 = \mathbf{35}$.

13. For $\frac{600}{k}$ to be a perfect square,
smallest positive integer value of $k = 2 \times 3 = \mathbf{6}$.

14. **(i)** For $540k$ to be a perfect cube,
smallest positive integer value of $k = 2 \times 5^2 = \mathbf{50}$.

(ii) OPEN $\frac{h}{4} \times 540 = \frac{h}{4} \times (2^2 \times 3^3 \times 5)$
$= h \times 3^3 \times 5$
A possible positive integer value of h is $5^2 = \mathbf{25}$.

15. **(i)** For $130\,977a$ to be a perfect square,
smallest positive integer value of $a = 3 \times 11 = \mathbf{33}$.

(ii) For $130\,977b$ to be a perfect cube,
smallest positive integer value of $b = 3 \times 7 \times 11^2 = \mathbf{2541}$.

(iii) OPEN A possible positive integer value of c is $3^5 \times 7^2 = \mathbf{11\,907}$.

16. **(i)** $\sqrt[3]{A} = \sqrt[3]{2^3 \times 3^3}$
$= 2 \times 3$
$= \mathbf{6}$

(ii) $\sqrt{B} = \sqrt{2^2 \times 3^2 \times 5^2}$
$= 2 \times 3 \times 5$
$= \mathbf{30}$

(iii) For kC to be a perfect square,
smallest positive integer value of $k = 2 \times 3 = \mathbf{6}$.

17. **(i)** $216\,000$
$= 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 \times 5 \times 5 \times 5$
$= \mathbf{2^6 \times 3^3 \times 5^3}$

(ii) $\sqrt[3]{216\,000} = \sqrt[3]{2^6 \times 3^3 \times 5^3}$
$= 2^2 \times 3 \times 5$
$= \mathbf{60}$

18. **(i)** $15\,092 = 2 \times 2 \times 7 \times 7 \times 7 \times 11$
$= 2^2 \times 7^3 \times 11$
$\therefore \boldsymbol{x = 3, y = 1}$

(ii) For $15\,092k$ to be a multiple of 21,
two possible positive values of k are **3** and **9**.

19. **(i)** $21\,952 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 7 \times 7 \times 7$
$= 2^6 \times 7^3$
Length of each stick $= \sqrt[3]{21\,952}$ mm
$= 2^2 \times 7$ mm
$= \mathbf{28\ mm}$

(ii) Total length of sticks $= 12 \times 28$ mm
$= \mathbf{336\ mm}$

20. **(i)** For $p \times a$ to be a perfect square,
smallest positive integer value of $a = 3 \times 7 = \mathbf{21}$.

(ii) For $\frac{q}{b}$ to be a perfect cube,
largest positive integer value of $b = 2^2 \times 3 \times 5^3 = \mathbf{1500}$.

(iii) $p \times q \times r = (2^4 \times 3^2 \times 7) \times (2^2 \times 3 \times 5^3) \times (2^2 \times 3^2 \times 7^2)$
$= 2^9 \times 3^6 \times 5^3 \times 7^3$
$= (2^3 \times 3^2 \times 5 \times 7)^3$
$\therefore$ **Yes**. $p \times q \times r$ is a perfect cube.

21. **(i)** $2704 = 2 \times 2 \times 2 \times 2 \times 13 \times 13$
$= \mathbf{2^4 \times 13^2}$

(ii) $2704 = (2^2 \times 13)^2$
$\therefore$ 2704 is a perfect square.

(iii) For $2704 \times \frac{m}{n}$ to be a perfect cube,
$\boldsymbol{m = 13}$ **and** $\boldsymbol{n = 2}$.

Worksheet 1C Highest common factor and lowest common multiple

1. **(a)**

3	18, 45
3	6, 9
	2, 3

$\therefore$ HCF of 18 and $45 = 3 \times 3$
$= \mathbf{9}$

(b)

11	55, 132
	5, 12

$\therefore$ HCF of 55 and 132 = **11**

(c)

19	95, 361
	5, 19

$\therefore$ HCF of 95 and 361 = **19**

(d)

2	378, 1050
3	189, 525
7	63, 175
	9, 25

$\therefore$ HCF of 378 and $1050 = 2 \times 3 \times 7$
$= \mathbf{42}$

2. **(a)**

3	15, 90, 225
5	5, 30, 75
	1, 6, 15

$\therefore$ HCF of 15, 90 and $225 = 3 \times 5$
$= \mathbf{15}$

(b)

2	98, 126, 238
7	49, 63, 119
	7, 9, 17

$\therefore$ HCF of 98, 126 and $238 = 2 \times 7$
$= \mathbf{14}$

(c)

3	147, 189, 231
7	49, 63, 77
	7, 9, 11

$\therefore$ HCF of 147, 189 and $231 = 3 \times 7$
$= \mathbf{21}$

(d)

3	165, 198, 429
11	55, 66, 143
	5, 6, 13

$\therefore$ HCF of 165, 198 and $429 = 3 \times 11$
$= \mathbf{33}$

3. **(a)** HCF = $\mathbf{2^2 \times 3 \times 5}$

(b) HCF = $\mathbf{3^2 \times 11^2}$

4. **(a)**

5	20, 25
	4, 5

$\therefore$ LCM of 20 and $25 = 5 \times 4 \times 5$
$= \mathbf{100}$

(b)

2	54, 72
3	27, 36
3	9, 12
	3, 4

$\therefore$ LCM of 54 and $72 = 2 \times 3^2 \times 3 \times 4$
$= \mathbf{216}$

(c)

2	104, 130
13	52, 65
	4, 5

$\therefore$ LCM of 104 and $130 = 2 \times 13 \times 4 \times 5$
$= \mathbf{520}$

(d)

2	168, 224
2	84, 112
2	42, 56
7	21, 28
	3, 4

$\therefore$ LCM of 168 and 224 $= 2^3 \times 7 \times 3 \times 4$
$= \mathbf{672}$

5. (a)

2	32, 88, 242
2	16, 44, 121
2	8, 22, 121
11	4, 11, 121
	4, 1, 11

$\therefore$ LCM of 32, 88 and 242 $= 2^3 \times 11 \times 4 \times 11$
$= \mathbf{3872}$

(b)

3	63, 105, 315
7	21, 35, 105
5	3, 5, 15
3	3, 1, 3
	1, 1, 1

$\therefore$ LCM of 63, 105 and 315 $= 3 \times 7 \times 5 \times 3$
$= \mathbf{315}$

(c)

2	110, 132, 176
11	55, 66, 88
2	5, 6, 8
	5, 3, 4

$\therefore$ LCM of 110, 132 and 176 $= 2 \times 11 \times 2 \times 5 \times 3 \times 4$
$= \mathbf{2640}$

(d)

2	136, 204, 272
2	68, 102, 136
2	34, 51, 68
17	17, 51, 34
	1, 3, 2

$\therefore$ LCM of 136, 204 and 272 $= 2^3 \times 17 \times 3 \times 2$
$= \mathbf{816}$

6. (a) LCM $= \mathbf{2^4 \times 3^3 \times 5^2}$
(b) LCM $= \mathbf{2 \times 3^3 \times 5^3 \times 7 \times 11}$

7. $15 \times 13 = 195$
$15 \times 14 = 210$
$\therefore$ The largest possible number is **195**.

8. $28 \times 10 = 280$
$28 \times 11 = 308$
$\therefore$ The smallest possible number is **308**.

9. $12 = 2^2 \times 3$
$16 = 2^4$
Since $300 = 2^2 \times 3 \times 5^2$ is a multiple of 10 and 12, is not a multiple of 16 and not a factor of 1000, then this number could be **300**.

10. (a) **Yes**. A number is prime if it has only 2 factors — 1 and itself.
(b) **Yes**. All perfect squares have an odd number of factors as one of these factors, when multiplied by itself, gives the number.
(c) **Insufficient information to conclude**. It is possible for the number to be an odd number.

11. (a) $390 = \mathbf{2 \times 3 \times 5 \times 13}$
(b) $234 = 2 \times 3 \times 3 \times 13$
$= 2 \times 3^2 \times 13$
$\therefore$ HCF of 390 and 234 $= 2 \times 3 \times 13$
$= \mathbf{78}$

12. (i) HCF of 1200 and 1960 $= 2^3 \times 5$
$= \mathbf{40}$
(ii) LCM of 1200 and 1960 $= 2^4 \times 3 \times 5^2 \times 7^2$
$= \mathbf{58\,800}$

13. (a) $540 = 2 \times 2 \times 3 \times 3 \times 3 \times 5$
$= \mathbf{2^2 \times 3^3 \times 5}$
(b) (i) HCF of 504 and 540 $= 2^2 \times 3^2$
$= \mathbf{36}$
(ii) LCM of 504 and 540 $= 2^3 \times 3^3 \times 5 \times 7$
$= \mathbf{7560}$

14. (a) $440 = 2 \times 2 \times 2 \times 5 \times 11$
$= \mathbf{2^3 \times 5 \times 11}$
(b) (i) LCM of 4356 and 440 $= \mathbf{2^3 \times 3^2 \times 5 \times 11^2}$
(ii) HCF of 4356 and 44 $= 2^2 \times 11$
$= \mathbf{44}$

15. (i) $\sqrt{A} = \sqrt{2^2 \times 3^4}$
$= 2 \times 3^2$
$= \mathbf{18}$
(ii) LCM of A, B and $C = \mathbf{2^3 \times 3^4 \times 5^2 \times 7}$
(iii) HCF of A, B and $C = 2 \times 3^2$
$= \mathbf{18}$

16. (a) $1224 = 2 \times 2 \times 2 \times 3 \times 3 \times 17$
$= \mathbf{2^3 \times 3^2 \times 17}$
(b) (i) $\boldsymbol{p = 2, q = 3, r = 2}$
(ii) $A = 2^2 \times 3 \times 17$
$B = 2^3 \times 3^2 \times 17$
HCF of A and $B = 2^2 \times 3 \times 17$
$= \mathbf{204}$

17. (a) $180 = 2 \times 2 \times 3 \times 3 \times 5$
$= \mathbf{2^2 \times 3^2 \times 5}$
(b) $48 = 2 \times 2 \times 2 \times 2 \times 3$
$= 2^4 \times 3$
$\therefore$ HCF of 180 and 48 $= 2^2 \times 3$
$= \mathbf{12}$
(c) LCM of 180 and 48 $= 2^4 \times 3^2 \times 5$
$= 720$
$\therefore$ Least number of packs of toothpicks $= \frac{720}{180}$
$= \mathbf{4}$

18. (i) Number of boys left $= 214 - 4$
$= 210$
Number of girls left $= 230 - 6$
$= 224$
$210 = 2 \times 3 \times 5 \times 7$
$224 = 2 \times 2 \times 2 \times 2 \times 2 \times 7$
$= 2^5 \times 7$
HCF of 210 and 224 $= 2 \times 7$
$= 14$
$\therefore$ The greatest number of groups that can be formed is **14**.

(ii) Number of boys in each group $= \frac{210}{14}$
$= \mathbf{15}$

Number of girls in each group $= \frac{224}{14}$
$= \mathbf{16}$

Challenge Myself!

19. $6 = 2 \times 3$
$18 = 2 \times 3 \times 3$
$= 2 \times 3^2$
Factors of the number are 1, 2, 3, 2^2, 2×3, 3^2, $2^2 \times 3$, 2×3^2 and $2^2 \times 3^2$, i.e. **1, 2, 3, 4, 6, 9, 12, 18 and 36**.

Review Exercise 1

1. $\sqrt{2660} = 51.6$ (to 1 d.p.)
$\therefore$ The largest prime factor of 2660 is **19**.

2. $1 \times (1 + 42) = 1 \times 43$
$= 43$
$\therefore$ The prime number is **43**.

3. **(i)** For $550k$ to be a perfect square,
smallest positive integer value of $k = 2 \times 11 = \mathbf{22}$.

(ii) For $\frac{550}{k}$ to be a perfect square,
smallest positive integer value of $k = 2 \times 11 = \mathbf{22}$.

4. **(a)** $882 = 2 \times 3 \times 3 \times 7 \times 7$
$= \mathbf{2 \times 3^2 \times 7^2}$

(b) $126 = 2 \times 3^2 \times 7$
$147 = 3 \times 7^2$
$\therefore$ The numbers are **126** and **147**.

5. **(a)** $360 = 2 \times 2 \times 2 \times 3 \times 3 \times 5$
$= \mathbf{2^3 \times 3^2 \times 5}$

(b) $270 = 2 \times 3 \times 3 \times 3 \times 5$
$= 2 \times 3^3 \times 5$
$\therefore$ LCM of 360 and $270 = 2^3 \times 3^3 \times 5$
$= \mathbf{1080}$

(c) A prime number has only 2 factors — 1 and itself.
1 is not a prime number.
A perfect square, say n^2, where $n > 0$, has at least 3 factors — 1, n and n^2.

6. $63 = 3 \times 3 \times 7$
$= 3^2 \times 7$
$81 = 3 \times 3 \times 3 \times 3$
$= 3^4$
$1134 = 2 \times 3 \times 3 \times 3 \times 3 \times 7$
$= 2 \times 3^4 \times 7$
$\therefore$ A possible value of p is **2**.

7. **(i)** For $700h$ to be a multiple of 1050,
smallest positive integer value of $h = \mathbf{3}$.

(ii) For $\frac{1050}{k}$ to be a factor of 700,
smallest positive integer value of $k = \mathbf{3}$.

8. **(a)** $570 = \mathbf{2 \times 3 \times 5 \times 19}$

(b) **(i)** LCM of 2660 and $570 = \mathbf{2^2 \times 3 \times 5 \times 7 \times 19}$

(ii) HCF of 2660 and $570 = 2 \times 5 \times 19$
$= \mathbf{190}$

9. **(i)** $\sqrt[3]{A} = \sqrt[3]{2^3 \times 5^3}$
$= 2 \times 5$
$= \mathbf{10}$

(ii) $\sqrt{C} = \sqrt{2^2 \times 5^2 \times 7^2}$
$= 2 \times 5 \times 7$
$= \mathbf{70}$

(iii) For $k \times B \times C$ to be a perfect square,
smallest positive integer value of $k = 2 \times 3 \times 5 \times 7$
$= \mathbf{210}$.

10. **(i)** $\sqrt[3]{p} = \sqrt[3]{2^6 \times 3^3}$
$= 2^2 \times 3$
$= \mathbf{12}$

(ii) LCM of p, q and $r = \mathbf{2^6 \times 3^3 \times 5^3 \times 7 \times 11}$

(iii) HCF of p, q and $r = 2 \times 3$
$= \mathbf{6}$

11. $18 = 2 \times 3 \times 3$
$= 2 \times 3^2$
$30 = 2 \times 3 \times 5$
LCM of 18 and $30 = 2 \times 3^2 \times 5$
$= 90$

1^{st} July $\xrightarrow{31 \text{ days}}$ 1^{st} August $\xrightarrow{31 \text{ days}}$ 1^{st} September $\xrightarrow{28 \text{ days}}$ 29^{th} September

$\therefore$ Both areas undergo a check together on **29th September**.

12. $784 = 2 \times 2 \times 2 \times 2 \times 7 \times 7$
$= 2^4 \times 7^2$
Since the perimeter of the top of the cuboid is 30 cm, the dimensions of the cuboid are 8 cm × 7 cm × 14 cm.
$\therefore$ The height of the cuboid is **14 cm**.

13. $28 = 2 \times 2 \times 7$
$= 2^2 \times 7$
$70 = 2 \times 5 \times 7$
LCM of 28 and $70 = 2^2 \times 5 \times 7$
$= 140$
10 minutes = 600 seconds
$\therefore$ Most number of times both cameras can scan the trophy cabinet together
$= \frac{600}{140} + 1$
$= \mathbf{5}$ (round down to the nearest integer)

2 Fractions

Worksheet 2A Fractions, improper fractions and mixed numbers

1. **(a)** $\frac{6}{8} = \mathbf{\frac{3}{4}}$ **(b)** $\frac{16}{20} = \mathbf{\frac{4}{5}}$

(c) $\frac{14}{49} = \mathbf{\frac{2}{7}}$ **(d)** $\frac{8}{24} = \mathbf{\frac{1}{3}}$

(e) $\frac{28}{56} = \mathbf{\frac{1}{2}}$ **(f)** $\frac{45}{54} = \mathbf{\frac{5}{6}}$

2. **(a)** $\frac{12}{5} = \mathbf{2\frac{2}{5}}$ **(b)** $\frac{51}{8} = \mathbf{6\frac{3}{8}}$

(c) $\frac{66}{9} = \mathbf{7\frac{1}{3}}$ (d) $\frac{138}{12} = \mathbf{11\frac{1}{2}}$

3. (a) $3\frac{1}{10} = \mathbf{\frac{33}{10}}$ (b) $4\frac{3}{4} = \mathbf{\frac{19}{4}}$

(c) $39\frac{17}{34} = \mathbf{\frac{79}{2}}$ (d) $5\frac{10}{22} = \mathbf{\frac{60}{11}}$

4. (a) $3\frac{5}{6} < 6\frac{3}{5}$ (b) $1\frac{5}{8} > 1\frac{1}{2}$

(c) $\frac{10}{7} > \frac{11}{8}$ (d) $\frac{44}{9} < 5\frac{1}{10}$

(e) $\frac{91}{6} = 15\frac{3}{18}$ (f) $\frac{74}{11} > \frac{100}{15}$

5. (i) $\mathbf{\frac{5}{8}}$ and $\mathbf{\frac{11}{16}}$ (ii) $\mathbf{\frac{5}{8} < \frac{11}{16}}$

Worksheet 2B Adding and subtracting fractions and mixed numbers

1. (a) $\frac{8}{17} + \frac{2}{17} = \mathbf{\frac{10}{17}}$

(b) $\frac{9}{11} - \frac{3}{11} = \mathbf{\frac{6}{11}}$

(c) $\frac{5}{12} + \frac{4}{12} = \frac{9}{12}$

$= \mathbf{\frac{3}{4}}$

(d) $\frac{7}{10} - \frac{3}{10} = \frac{4}{10}$

$= \mathbf{\frac{2}{5}}$

(e) $\frac{5}{8} + \frac{1}{4} = \frac{5}{8} + \frac{2}{8}$

$= \mathbf{\frac{7}{8}}$

(f) $\frac{1}{6} - \frac{5}{48} = \frac{8}{48} - \frac{5}{48}$

$= \frac{3}{48}$

$= \mathbf{\frac{1}{16}}$

(g) $\frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6}$

$= \mathbf{\frac{5}{6}}$

(h) $\frac{1}{2} - \frac{1}{3} = \frac{3}{6} - \frac{2}{6}$

$= \mathbf{\frac{1}{6}}$

(i) $\frac{5}{18} + \frac{5}{19} = \frac{95}{342} + \frac{90}{342}$

$= \mathbf{\frac{185}{342}}$

(j) $\frac{11}{16} - \frac{11}{17} = \frac{187}{272} - \frac{176}{272}$

$= \mathbf{\frac{11}{272}}$

(k) $\frac{3}{5} + \frac{7}{12} = \frac{36}{60} + \frac{35}{60}$

$= \frac{71}{60}$

$= \mathbf{1\frac{11}{60}}$

(l) $\frac{4}{7} - \frac{2}{9} = \frac{36}{63} - \frac{14}{63}$

$= \mathbf{\frac{22}{63}}$

2. (a) $7 + \frac{1}{2} = \mathbf{7\frac{1}{2}}$

(b) $4 + 5\frac{3}{8} = \mathbf{9\frac{3}{8}}$

(c) $3\frac{1}{6} + 2\frac{1}{6} = 5\frac{2}{6}$

$= \mathbf{5\frac{1}{3}}$

(d) $9\frac{2}{15} + 3\frac{1}{5} = 9\frac{2}{15} + 3\frac{3}{15}$

$= 12\frac{5}{15}$

$= \mathbf{12\frac{1}{3}}$

(e) $6\frac{5}{12} + 4\frac{14}{24} = 6\frac{5}{12} + 4\frac{7}{12}$

$= 10\frac{12}{12}$

$= \mathbf{11}$

(f) $8\frac{2}{9} + 1\frac{1}{2} = 8\frac{4}{18} + 1\frac{9}{18}$

$= \mathbf{9\frac{13}{18}}$

(g) $1\frac{2}{3} + 10\frac{5}{9} = 1\frac{6}{9} + 10\frac{5}{9}$

$= 11\frac{11}{9}$

$= \mathbf{12\frac{2}{9}}$

(h) $2\frac{9}{16} + 7\frac{7}{12} = 2\frac{27}{48} + 7\frac{28}{48}$

$= 9\frac{55}{48}$

$= \mathbf{10\frac{7}{48}}$

(i) $8\frac{4}{5} + 3\frac{3}{7} = 8\frac{28}{35} + 3\frac{15}{35}$

$= 11\frac{43}{35}$

$= \mathbf{12\frac{8}{35}}$

(j) $6\frac{13}{20} + 8\frac{24}{25} = 6\frac{65}{100} + 8\frac{96}{100}$

$= 14\frac{161}{100}$

$= \mathbf{15\frac{61}{100}}$

3. **(a)** $9\frac{7}{8} - 2 = \mathbf{7\frac{7}{8}}$

(b) $5 - \frac{1}{3} = \mathbf{4\frac{2}{3}}$

(c) $7\frac{3}{10} - 1\frac{1}{10} = 6\frac{2}{10}$

$= \mathbf{6\frac{2}{5}}$

(d) $6\frac{9}{10} - 5\frac{9}{10} = \mathbf{1}$

(e) $8\frac{8}{9} - 4\frac{1}{3} = 8\frac{8}{9} - 4\frac{3}{9}$

$= \mathbf{4\frac{5}{9}}$

(f) $7\frac{2}{3} - 3\frac{11}{33} = 7\frac{2}{3} - 3\frac{1}{3}$

$= \mathbf{4\frac{1}{3}}$

(g) $9\frac{7}{10} - 3\frac{1}{4} = 9\frac{14}{20} - 3\frac{5}{20}$

$= \mathbf{6\frac{9}{20}}$

(h) $8\frac{1}{8} - 2\frac{1}{6} = 8\frac{3}{24} - 2\frac{4}{24}$

$= 7\frac{27}{24} - 2\frac{4}{24}$

$= \mathbf{5\frac{23}{24}}$

(i) $4\frac{4}{9} - 1\frac{9}{14} = 4\frac{56}{126} - 1\frac{81}{126}$

$= 3\frac{182}{126} - 1\frac{81}{126}$

$= \mathbf{2\frac{101}{126}}$

(j) $10\frac{3}{7} - 6\frac{11}{12} = 10\frac{36}{84} - 6\frac{77}{84}$

$= 9\frac{120}{84} - 6\frac{77}{84}$

$= \mathbf{3\frac{43}{84}}$

4. **(a)** $\frac{7}{4} + \frac{7}{8} = \frac{14}{8} + \frac{7}{8}$

$= \frac{21}{8}$

$= \mathbf{2\frac{5}{8}}$

$\frac{7}{4} - \frac{7}{8} = \frac{14}{8} - \frac{7}{8}$

$= \mathbf{\frac{7}{8}}$

(b) $\frac{15}{14} + \frac{32}{21} = \frac{45}{42} + \frac{64}{42}$

$= \frac{109}{42}$

$= \mathbf{2\frac{25}{42}}$

$\frac{32}{21} - \frac{15}{14} = \frac{64}{42} - \frac{45}{42}$

$= \mathbf{\frac{19}{42}}$

(c) $\frac{19}{6} + \frac{28}{5} = \frac{95}{30} + \frac{168}{30}$

$= \frac{263}{30}$

$= \mathbf{8\frac{23}{30}}$

$\frac{28}{5} - \frac{19}{6} = \frac{168}{30} - \frac{95}{30}$

$= \frac{73}{30}$

$= \mathbf{2\frac{13}{30}}$

(d) $\frac{61}{9} + \frac{11}{10} = \frac{610}{90} + \frac{99}{90}$

$= \frac{709}{90}$

$= \mathbf{7\frac{79}{90}}$

$\frac{61}{9} - \frac{11}{10} = \frac{610}{90} - \frac{99}{90}$

$= \frac{511}{90}$

$= \mathbf{5\frac{61}{90}}$

5. **(a)** $\frac{1}{2} + \frac{1}{3} + \frac{1}{4} = \frac{6}{12} + \frac{4}{12} + \frac{3}{12}$

$= \frac{13}{12}$

$= \mathbf{1\frac{1}{12}}$

(b) $5\frac{6}{7} + 8\frac{1}{3} + 9\frac{3}{4} = 5\frac{72}{84} + 8\frac{28}{84} + 9\frac{63}{84}$

$= 22\frac{163}{84}$

$= \mathbf{23\frac{79}{84}}$

(c) $10 - \frac{3}{5} - \frac{7}{10} = 9\frac{2}{5} - \frac{7}{10}$

$= 9\frac{4}{10} - \frac{7}{10}$

$= 8\frac{14}{10} - \frac{7}{10}$

$= \mathbf{8\frac{7}{10}}$

(d) $7\frac{5}{6} - 2\frac{5}{12} - 1\frac{1}{4} = 7\frac{10}{12} - 2\frac{5}{12} - 1\frac{3}{12}$

$= 4\frac{2}{12}$

$= \mathbf{4\frac{1}{6}}$

(e) $6\frac{5}{8} + 3\frac{1}{2} - 10\frac{1}{8} = 6\frac{5}{8} + 3\frac{4}{8} - 10\frac{1}{8}$

$= 9\frac{9}{8} - 10\frac{1}{8}$

$= 10\frac{1}{8} - 10\frac{1}{8}$

$= \mathbf{0}$

(f) $12\frac{2}{15} - 4\frac{3}{10} + 5\frac{2}{3} = 12\frac{2}{15} + 5\frac{10}{15} - 4\frac{3}{10}$

$= 17\frac{12}{15} - 4\frac{3}{10}$

$= 17\frac{4}{5} - 4\frac{3}{10}$

$= 17\frac{8}{10} - 4\frac{3}{10}$

$= 13\frac{5}{10}$

$= \mathbf{13\frac{1}{2}}$

6. **(i)** $\mathbf{4\frac{9}{10}}$ and $\mathbf{3\frac{1}{5}}$

(ii) $4\frac{9}{10} - 3\frac{1}{5} = 4\frac{9}{10} - 3\frac{2}{10}$

$= \mathbf{1\frac{7}{10}}$

7. **(i)** $\mathbf{16\frac{1}{8}}$ and $\mathbf{5\frac{1}{6}}$

(ii) $16\frac{1}{8} + 5\frac{1}{6} = 16\frac{3}{24} + 5\frac{4}{24}$

$= \mathbf{21\frac{7}{24}}$

Worksheet 2C Multiplying fractions and mixed numbers

1. **(a)** $\frac{1}{4} \times 60 = \mathbf{15}$

(b) $\frac{3}{5} \times 45 = \mathbf{27}$

(c) $\frac{7}{10} \times 2 = \frac{7}{5}$

$= \mathbf{1\frac{2}{5}}$

(d) $\frac{4}{3} \times 10 = \frac{40}{3}$

$= \mathbf{13\frac{1}{3}}$

(e) $42 \times \frac{6}{7} = \mathbf{36}$

(f) $33 \times \frac{11}{9} = \frac{121}{3}$

$= \mathbf{40\frac{1}{3}}$

(g) $\frac{3}{10} \times \frac{20}{27} = \mathbf{\frac{2}{9}}$

(h) $\frac{4}{63} \times \frac{7}{8} = \mathbf{\frac{1}{18}}$

(i) $\frac{4}{5} \times 3\frac{1}{8} = \frac{4}{5} \times \frac{25}{8}$

$= \frac{5}{2}$

$= \mathbf{2\frac{1}{2}}$

(j) $3\frac{5}{9} \times \frac{3}{16} = \frac{32}{9} \times \frac{3}{16}$

$= \mathbf{\frac{2}{3}}$

(k) $4\frac{2}{7} \times 1\frac{5}{16} = \frac{30}{7} \times \frac{21}{16}$

$= \frac{45}{8}$

$= \mathbf{5\frac{5}{8}}$

(l) $\frac{28}{15} \times 7\frac{1}{7} = \frac{28}{15} \times \frac{50}{7}$

$= \frac{40}{3}$

$= \mathbf{13\frac{1}{3}}$

2. **(a)** $\frac{1}{2} \times \frac{3}{4} \times \frac{8}{15} = \mathbf{\frac{1}{5}}$

(b) $\frac{7}{6} \times \frac{9}{10} \times \frac{48}{21} = \frac{12}{5}$

$= \mathbf{2\frac{2}{5}}$

3. Fraction used to purchase goods $= 1 - \left(\frac{3}{8} + \frac{1}{3}\right)$

$= 1 - \left(\frac{9}{24} + \frac{8}{24}\right)$

$= 1 - \frac{17}{24}$

$= \mathbf{\frac{7}{24}}$

4. Fraction of land occupied by the club house

$= \frac{1}{4} \times \left(1 - \frac{7}{10}\right)$

$= \frac{1}{4} \times \frac{3}{10}$

$= \frac{3}{40}$

$\therefore$ Fraction of land not occupied by the club house

$= 1 - \frac{3}{40}$

$= \mathbf{\frac{37}{40}}$

Worksheet 2D Dividing fractions and mixed numbers

1. **(a)** $\frac{14}{15} \div 2 = \frac{14}{15} \times \frac{1}{2}$

$= \mathbf{\frac{7}{15}}$

(b) $\frac{3}{8} \div 8 = \frac{3}{8} \times \frac{1}{8}$

$= \mathbf{\frac{3}{64}}$

(c) $\frac{9}{5} \div 3 = \frac{9}{5} \times \frac{1}{3}$

$= \mathbf{\frac{3}{5}}$

(d) $\frac{6}{17} \div 10 = \frac{6}{17} \times \frac{1}{10}$

$= \mathbf{\frac{3}{85}}$

(e) $4 \div \frac{1}{2} = 4 \times 2$

$= \mathbf{8}$

(f) $11 \div \frac{1}{4} = 11 \times 4$
$= \mathbf{44}$

(g) $\frac{14}{15} \div \frac{1}{2} = \frac{14}{15} \times 2$
$= \frac{28}{15}$
$= \mathbf{1\frac{13}{15}}$

(h) $\frac{4}{9} \div \frac{3}{4} = \frac{4}{9} \times \frac{4}{3}$
$= \mathbf{\frac{16}{27}}$

(i) $\frac{76}{25} \div \frac{57}{5} = \frac{76}{25} \times \frac{5}{57}$
$= \mathbf{\frac{4}{15}}$

(j) $3\frac{11}{12} \div 4 = \frac{47}{12} \times \frac{1}{4}$
$= \mathbf{\frac{47}{48}}$

(k) $3\frac{11}{12} \div \frac{1}{4} = \frac{47}{12} \times 4$
$= \frac{47}{3}$
$= \mathbf{15\frac{2}{3}}$

(l) $8\frac{1}{15} \div 7\frac{1}{3} = \frac{121}{15} \div \frac{22}{3}$
$= \frac{121}{15} \times \frac{3}{22}$
$= \frac{11}{10}$
$= \mathbf{1\frac{1}{10}}$

2. (a) $\frac{25}{8} \div \frac{1}{2} \div \frac{5}{6} = \frac{25}{8} \times \frac{2}{1} \times \frac{6}{5}$
$= \frac{15}{2}$
$= \mathbf{7\frac{1}{2}}$

(b) $\frac{120}{169} \div \frac{15}{52} \div \frac{48}{13} = \frac{120}{169} \times \frac{52}{15} \times \frac{13}{48}$
$= \mathbf{\frac{2}{3}}$

3. (i) $\mathbf{\frac{2}{9}, \frac{2}{5}, \frac{2}{3}}$

(ii) Total time taken $= \frac{2}{5}\text{h} + \frac{2}{3}\text{h} + \frac{2}{9}\text{h}$
$= \frac{18}{45}\text{h} + \frac{30}{45}\text{h} + \frac{10}{45}\text{h}$
$= \frac{58}{45}\text{h}$
$= \mathbf{1\frac{13}{45}\text{h}}$

4. (i) Q is $\mathbf{\frac{5}{11}}$ full.

(ii) Amount of water that should be transferred
$= \left(\frac{5}{8} - \frac{5}{11}\right) \div 2$ of a container
$= \left(\frac{55}{88} - \frac{40}{88}\right) \div 2$ of a container
$= \frac{15}{88} \div 2$ of a container
$= \frac{15}{88} \times \frac{1}{2}$ of a container
$= \mathbf{\frac{15}{176}}$ of a container

Review Exercise 2

1. (a) $\mathbf{\frac{2}{16}, \frac{4}{32}, \frac{8}{64}}$ **(b)** $\mathbf{\frac{6}{14}, \frac{12}{28}, \frac{24}{56}}$
(c) $\mathbf{\frac{8}{18}, \frac{16}{36}, \frac{24}{54}}$ **(d)** $\mathbf{\frac{10}{12}, \frac{20}{24}, \frac{30}{36}}$

2. (a) $\mathbf{4\frac{1}{3}, 6\frac{3}{7}}$ **(b)** $\mathbf{\frac{9}{2}, \frac{10}{1}}$

3. (a) $\frac{16}{3} = \mathbf{5\frac{1}{3}}$

(b) $\frac{95}{10} = 9\frac{5}{10}$
$= \mathbf{9\frac{1}{2}}$

(c) $7\frac{5}{8} = \mathbf{\frac{61}{8}}$

(d) $4\frac{2}{9} = \mathbf{\frac{38}{9}}$

4. (a) $4\frac{1}{6} + 3\frac{1}{2} = 4\frac{1}{6} + 3\frac{3}{6}$
$= 7\frac{4}{6}$
$= \mathbf{7\frac{2}{3}}$

(b) $8\frac{7}{9} + 2\frac{3}{8} = 8\frac{56}{72} + 2\frac{27}{72}$
$= 10\frac{83}{72}$
$= \mathbf{11\frac{11}{72}}$

(c) $10\frac{4}{5} - 5\frac{7}{25} = 10\frac{20}{25} - 5\frac{7}{25}$
$= \mathbf{5\frac{13}{25}}$

(d) $7\frac{5}{16} - 1\frac{13}{24} = 7\frac{15}{48} - 1\frac{26}{48}$
$= 6\frac{63}{48} - 1\frac{26}{48}$
$= \mathbf{5\frac{37}{48}}$

5. **(i)** Fraction of fiction books $= \frac{3}{8}$

Fraction of assessment books $= \frac{1}{5} \times \frac{5}{8}$

$= \frac{1}{8}$

Fraction of magazines $= \frac{1}{4} \times \frac{5}{8}$

$= \frac{5}{32}$

Fraction of non–fiction books $= 1 - \frac{3}{8} - \frac{1}{8} - \frac{5}{32}$

$= \frac{4}{8} - \frac{5}{32}$

$= \frac{16}{32} - \frac{5}{32}$

$= \mathbf{\frac{11}{32}}$

(ii) **Assessment books, magazines, non–fiction books, fiction books**

3 Decimals

Worksheet 3A Decimals and fractions

1. **(a)** $\frac{1}{2} = \mathbf{0.5}$ **(b)** $\frac{1}{4} = \mathbf{0.25}$

(c) $\frac{3}{4} = \mathbf{0.75}$ **(d)** $\frac{5}{8} = \mathbf{0.625}$

(e) $\frac{7}{10} = \mathbf{0.7}$ **(f)** $\frac{7}{100} = \mathbf{0.07}$

(g) $\frac{7}{50} = \mathbf{0.14}$ **(h)** $\frac{11}{2000} = \mathbf{0.0055}$

(i) $1\frac{2}{5} = \mathbf{1.4}$ **(j)** $6\frac{13}{20} = \mathbf{6.65}$

(k) $\frac{33}{10} = \mathbf{3.3}$ **(l)** $\frac{53}{2} = \mathbf{26.5}$

2. **(a)** $0.1 = \mathbf{\frac{1}{10}}$ **(b)** $0.2 = \mathbf{\frac{1}{5}}$

(c) $0.01 = \mathbf{\frac{1}{100}}$ **(d)** $0.097 = \mathbf{\frac{97}{1000}}$

(e) $0.36 = \mathbf{\frac{9}{25}}$ **(f)** $4.36 = \mathbf{4\frac{9}{25}}$

(g) $0.036 = \mathbf{\frac{9}{250}}$ **(h)** $4.036 = \mathbf{4\frac{9}{250}}$

(i) $5.5 = \mathbf{5\frac{1}{2}}$ **(j)** $8.08 = \mathbf{8\frac{2}{25}}$

(k) $7.004 = \mathbf{7\frac{1}{250}}$ **(l)** $10.942 = \mathbf{10\frac{471}{500}}$

3. **(a)** $0.01 < 0.1$ **(b)** $4.8 > 4.08$

(c) $7.35 > 7.305$ **(d)** $2.93 = \frac{293}{100}$

4. **(a)** $\frac{4}{5} = \mathbf{0.8}$ **(b)** $\frac{4}{9} = \mathbf{0.\dot{4}}$

(c) $\frac{10}{11} = \mathbf{0.\dot{9}\dot{0}}$ **(d)** $3\frac{2}{7} = \mathbf{3.\dot{2}85714\dot{2}}$

5. **(a)** Let $x = 0.\dot{8}$

$10x - x = 8.\dot{8} - 0.\dot{8}$

$9x = 8$

$x = \frac{8}{9}$

$\therefore 0.\dot{8} = \mathbf{\frac{8}{9}}$

(b) Let $x = 0.\dot{4}\dot{9}$

$100x - x = 49.\dot{4}\dot{9} - 0.\dot{4}\dot{9}$

$99x = 49$

$x = \frac{49}{99}$

$\therefore 0.\dot{4}\dot{9} = \mathbf{\frac{49}{99}}$

(c) Let $x = 0.\dot{5}1\dot{5}$

$1000x - x = 515.\dot{5}1\dot{5} - 0.\dot{5}1\dot{5}$

$999x = 515$

$x = \frac{515}{999}$

$\therefore 0.\dot{5}1\dot{5} = \mathbf{\frac{515}{999}}$

(d) Let $x = 0.04\dot{9}\dot{9}$

$1000x - 10x = 49.\dot{4}\dot{9} - 0.\dot{4}\dot{9}$

$990x = 49$

$\therefore 0.04\dot{9}\dot{9} = \mathbf{\frac{49}{990}}$

Challenge Myself!

6. **(a)** $9.8\dot{7} = 9.8 + 0.0\dot{7}$

$= 9\frac{4}{5} + 0.\dot{7} \div 10$

$= 9\frac{4}{5} + \frac{7}{9} \div 10$

$= 9\frac{4}{5} + \frac{7}{90}$

$= \mathbf{\frac{889}{90}}$

(b) $3.45\dot{6}\dot{6} = 3.4 + 0.05\dot{6}\dot{6}$

$= 3\frac{2}{5} + 0.0\dot{5}\dot{6} \div 10$

$= 3\frac{2}{5} + \frac{56}{99} \div 10$

$= 3\frac{2}{5} + \frac{56}{990}$

$= \mathbf{\frac{1711}{495}}$

Worksheet 3B Operations involving decimals

1. **(a)** $7.4 + 2.5 = \mathbf{9.9}$ **(b)** $1.8 + 0.13 = \mathbf{1.93}$

(c) $9.02 + 4.61 = \mathbf{13.63}$ **(d)** $3.56 + 4.28 = \mathbf{7.84}$

(e) $6.53 + 1.48 = \mathbf{8.01}$ **(f)** $2.73 + 8.49 = \mathbf{11.22}$

(g) $8.8 - 6 = \mathbf{2.8}$ **(h)** $12.9 - 2.5 = \mathbf{10.4}$

(i) $5.33 - 1.21 = \mathbf{4.12}$ **(j)** $4.07 - 1.98 = \mathbf{2.09}$

(k) $10 - 3.75 = \mathbf{6.25}$ **(l)** $16.15 - 3.76 = \mathbf{12.39}$

2. **(a)**
$$\begin{array}{r} 3.8 \\ \times\ \ 2 \\ \hline 7.6 \end{array}$$
$\therefore 3.8 \times 2 = \mathbf{7.6}$

(b)
$$\begin{array}{r} 9.15 \\ \times\ \ \ \ 4 \\ \hline 36.60 \end{array}$$
$\therefore 9.15 \times 4 = \mathbf{36.6}$

(c) $2.67 \times 10 = \mathbf{26.7}$

(d)
$$\begin{array}{r} 2.67 \\ \times\ \ 11 \\ \hline 2\ 67 \\ +26\ 70 \\ \hline 29.37 \end{array}$$
$\therefore 2.67 \times 11 = \mathbf{29.37}$

(e)
$$\begin{array}{r} 0.78 \\ \times\ \ \ 5 \\ \hline 3.90 \end{array}$$
$\therefore 0.78 \times 5 = \mathbf{3.9}$

(f)
$$\begin{array}{r} 7.80 \\ \times 0.50 \\ \hline 3.90 \end{array}$$
$\therefore 7.8 \times 0.5 = \mathbf{3.9}$

(g)
$$\begin{array}{r} 6.1 \\ \times\ \ 2.5 \\ \hline 3\ 0\ 5 \\ +12\ 2\ 0 \\ \hline 15.2\ 5 \end{array}$$
$\therefore 6.1 \times 2.5 = \mathbf{15.25}$

(h)
$$\begin{array}{r} 0.61 \\ \times\ \ 0.25 \\ \hline 3\ 05 \\ +\ 12\ 20 \\ \hline 0.15\ 25 \end{array}$$
$\therefore 0.61 \times 0.25 = \mathbf{0.1525}$

(i)
$$\begin{array}{r} 7.00\ 4 \\ \times\ \ \ \ 2.9 \\ \hline 6\ 3\ 03\ 6 \\ +14\ 0\ 08\ 0 \\ \hline 20.3\ 11\ 6 \end{array}$$
$\therefore 7.004 \times 2.9 = \mathbf{20.3116}$

(j)
$$\begin{array}{r} 4\ 0\ 0.8 \\ \times\ \ \ 0.3\ 6 \\ \hline 24\ 0\ 4\ 8 \\ 120\ 2\ 4\ 0 \\ \hline 144.2\ 8\ 8 \end{array}$$
$\therefore 400.8 \times 0.36 = \mathbf{144.288}$

(k)
$$\begin{array}{r} 0.4 \\ \times\ \ 0.4 \\ \hline 0.1\ 6 \end{array}$$
$\therefore 0.4 \times 0.4 = \mathbf{0.16}$

(l) From part **(k)**, $0.4 \times 0.4 \times 0.4 = 0.16 \times 0.4$
$$\begin{array}{r} 0.1\ 6 \\ \times\ \ \ \ 0.4 \\ \hline 0.0\ 6\ 4 \end{array}$$
$\therefore 0.4 \times 0.4 \times 0.4 = \mathbf{0.064}$

3. **(a)** $486 \div 2 = 243$
$\therefore 4.86 \div 2 = \mathbf{2.43}$

(b) $308 \div 4 = 77$
$\therefore 3.08 \div 4 = \mathbf{0.77}$

(c) $717 \div 3 = 239$
$\therefore 7.17 \div 3 = \mathbf{2.39}$

(d) $7.17 \div 3 = 2.39$
$\therefore 7.17 \div 30 = 2.39 \div 10$
$= \mathbf{0.239}$

(e) $0.59 \div 10 = \mathbf{0.059}$

(f)
$$\begin{array}{r} 0.405 \\ 6\overline{)\ 2.430} \\ -2\ 400 \\ \hline 30 \\ -30 \\ \hline 0 \end{array}$$
$\therefore 2.43 \div 6 = \mathbf{0.405}$

(g)
$$\begin{array}{r} 0.69 \\ 15\overline{)\ 10.35} \\ -\ 9\ 00 \\ \hline 1\ 35 \\ -1\ 35 \\ \hline 0 \end{array}$$
$\therefore 10.35 \div 15 = \mathbf{0.69}$

(h) $10.35 \div 0.15 = 1035 \div 15$
$$\begin{array}{r} 69 \\ 15\overline{)\ 1035} \\ -\ 900 \\ \hline 135 \\ -135 \\ \hline 0 \end{array}$$
$\therefore 10.35 \div 0.15 = 1035 \div 15$
$= \mathbf{69}$

(i) $21.6 \div 0.3 = 216 \div 3$
$$\begin{array}{r} 72 \\ 3\overline{)\ 216} \\ -21 \\ \hline 6 \\ -6 \\ \hline 0 \end{array}$$
$\therefore 21.6 \div 0.3 = \mathbf{72}$

(j) $0.216 \div 0.3 = 2.16 \div 3$
$$\begin{array}{r} 0.72 \\ 3\overline{)\ 2.16} \\ -2\ 10 \\ \hline 6 \\ -6 \\ \hline 0 \end{array}$$
$\therefore 0.216 \div 0.3 = \mathbf{0.72}$

(k) $17.01 \div 4.5 = 170.1 \div 45$

$$\begin{array}{r} 3.78 \\ 45\overline{)\,170.10} \\ -135\ 0 \\ \hline 35\ 1 \\ -\ 31\ 5 \\ \hline 3\ 60 \\ -\ 3\ 60 \\ \hline 0 \end{array}$$

$\therefore 17.01 \div 4.5 = \mathbf{3.78}$

(l) $0.2496 \div 0.48 = 24.96 \div 48$

$$\begin{array}{r} 0.52 \\ 48\overline{)\,24.96} \\ -\ 24.00 \\ \hline 96 \\ -\ 96 \\ \hline 0 \end{array}$$

$\therefore 0.2496 \div 0.48 = \mathbf{0.52}$

4. (a)

$$\begin{array}{r} 43.2 \\ \times\ 0.65 \\ \hline 2160 \\ +2592\ 0 \\ \hline 28.080 \end{array}$$

$\therefore 43.2 \times 0.65 = 28.08$

(b) $43.2 \times 0.65 = \frac{432}{10} \times \frac{65}{100}$

$= \frac{28\,080}{1000}$

$= 28.08$

5. (a) $\frac{30.6}{0.15} = \frac{3060}{15}$

$$\begin{array}{r} 204 \\ 15\overline{)\,3060} \\ -30 \\ \hline 60 \\ -\ 60 \\ \hline 0 \end{array}$$

$\therefore \frac{30.6}{0.15} = 204$

(b) $\frac{7.68}{0.24} = \frac{768}{24}$

$$\begin{array}{r} 32 \\ 24\overline{)\,768} \\ -72 \\ \hline 48 \\ -\ 48 \\ \hline 0 \end{array}$$

$\therefore \frac{7.68}{0.24} = 32$

Worksheet 3C Conversion of units of measurement for length, mass and volume

1. (a) 1 m = **100 cm** **(b)** 1 cm = **0.01 m**
(c) 1 km = **1000 m** **(d)** 1 m = **0.001 km**
(e) 1 cm = **10 mm** **(f)** 1 mm = **0.1 cm**
(g) 1 km = **100 000 cm** **(h)** 1 m = **1000 mm**

2. (a) 4.8 m = **480 cm** **(b)** 2.05 m = **205 cm**
(c) 0.71 m = **71 cm** **(d)** 0.9 m = **90 cm**
(e) 6.3 km = **6300 m** **(f)** 1.17 km = **1170 m**
(g) 0.86 km = **860 m** **(h)** 0.4053 km = **405.3 m**
(i) 2.5 km = **250 000 cm** **(j)** 0.31 km = **31 000 cm**

3. (a) 15 cm = **0.15 m** **(b)** 640 cm = **6.4 m**
(c) 3700 cm = **37 m** **(d)** 9.2 cm = **0.092 m**
(e) 4375 m = **4.375 km** **(f)** 816 m = **0.816 km**
(g) 20 m = **0.02 km** **(h)** 50.3 m = **0.0503 km**
(i) 168 000 cm = **1.68 km** **(j)** 7500 cm = **0.075 km**

4. (a) 1 kg = **1000 g** **(b)** 1 g = **0.001 kg**
(c) 1 tonne = **1000 kg** **(d)** 1 kg = **0.001 tonnes**
(e) 1 tonne = **1 000 000 g** **(f)** 1 g = **0.000 001 tonnes**

5. (a) 5.2 kg = **5200 g** **(b)** 1.77 kg = **1770 g**
(c) 0.843 kg = **843 g** **(d)** 0.9 kg = **900 g**
(e) 2.7 tonnes = **2700 kg** **(f)** 6.81 tonnes = **6810 kg**
(g) 0.16 tonnes = **160 kg** **(h)** 0.0503 tonnes = **50.3 kg**
(i) 4.7 tonnes = **4 700 000 g** **(j)** 0.02 tonnes = **20 000 g**

6. (a) 746 g = **0.746 kg** **(b)** 39 g = **0.039 kg**
(c) 2010 g = **2.01 kg** **(d)** 8.5 g = **0.0085 kg**
(e) 4115 kg = **4.115 tonnes** **(f)** 156 kg = **0.156 tonnes**
(g) 73 kg = **0.073 tonnes** **(h)** 61.2 kg = **0.0612 tonnes**
(i) 508 000 g = **0.508 tonnes** **(j)** 4930 g = **0.004 93 tonnes**

7. (a) 1 *l* = **1000 ml** **(b)** 1 ml = **0.001 *l***

8. (a) 2.9 *l* = **2900 ml** **(b)** 0.84 *l* = **840 ml**
(c) 1.06 *l* = **1060 ml** **(d)** 0.075 *l* = **75 ml**
(e) 3290 ml = **3.29 *l*** **(f)** 801 ml = **0.801 *l***
(g) 430 ml = **0.43 *l*** **(h)** 20 ml = **0.02 *l***

9. $5.0\dot{5}$ kg $= 5\frac{5}{90}$ kg

$\frac{5}{999}$ tonnes $= 5\frac{5}{999}$ kg

5050 g = 5.05 kg

$\therefore$ **$5.0\dot{5}$ kg, 5050 g, $\frac{5}{999}$ tonnes**

10. **(a)** 5.7 cm = **0.057 m** **(b)** 4.2 tonnes = **4200 kg**
(c) 330 ml = **0.33 *l***

Review Exercise 3

1. (a) Terminating decimals: $\mathbf{\frac{5}{8}, \frac{9}{2}, 0, \frac{10}{1}}$

(b) Recurring decimals: $\mathbf{4\frac{1}{3}, 6\frac{3}{7}}$

2. (a) $\frac{4}{5} = \mathbf{0.8}$ **(b)** $\frac{3}{8} = \mathbf{0.375}$
(c) $\frac{29}{25} = \mathbf{1.16}$ **(d)** $\frac{97}{10} = \mathbf{9.7}$

3. (a) $0.6 = \mathbf{\frac{3}{5}}$ **(b)** $0.19 = \mathbf{\frac{19}{100}}$
(c) $0.385 = \frac{385}{1000} = \mathbf{\frac{77}{200}}$ **(d)** $4.52 = 4\frac{52}{100} = \mathbf{4\frac{13}{25}}$

4. (a) $0.\dot{4} = \mathbf{\frac{4}{9}}$

(b) $0.\dot{7}\dot{5} = \frac{75}{99} = \mathbf{\frac{25}{33}}$

(c) $0.\dot{6}\dot{3}\dot{1} = \mathbf{\frac{631}{999}}$

(d) $9.0\dot{8} = 9 + \frac{8}{90}$

$= \mathbf{9\frac{4}{45}}$

5. (a) $7.28 + 1.63 = \mathbf{8.91}$

(b) $7.28 - 1.63 = \mathbf{5.65}$

(c)
$$\begin{array}{r} 4.9 \\ \times\ 4.5 \\ \hline 2\ 4\ 5 \\ +19\ 6\ 0 \\ \hline 22.0\ 5 \end{array}$$

$\therefore 4.9 \times 4.5 = \mathbf{22.05}$

(d)
$$\begin{array}{r} 0.462 \\ 9\overline{)\,4.158} \\ -3\ 6\ 0 \\ \hline 5\ 5 \\ -\ 5\ 4 \\ \hline 1\ 8 \\ -\ 1\ 8 \\ \hline 0 \end{array}$$

$\therefore 4.158 \div 9 = \mathbf{0.462}$

(e) $3.409 + 8.82 = \mathbf{12.229}$

(f) $12.06 - 5.77 = \mathbf{6.29}$

(g)
$$\begin{array}{r} 0.68 \\ \times\ 0.09 \\ \hline 0.06\ 12 \end{array}$$

$\therefore 0.68 \times 0.09 = \mathbf{0.0612}$

(h) $13.86 \div 0.15 = 1386 \div 15$

$$\begin{array}{r} 92.4 \\ 15\overline{)\,1386.0} \\ -1350 \\ \hline 36 \\ -\ 30 \\ \hline 60 \\ -\ 60 \\ \hline 0 \end{array}$$

$\therefore 13.86 \div 0.15 = \mathbf{92.4}$

6. (a) 0.56 km = **560 m** = **56 000 cm**

(b) 319 m = **0.319 km** = **31 900 cm**

(c) 4800 cm = **48 m** = **0.048 km**

(d) 2 tonnes = **2000 kg** = **2 000 000 g**

(e) 712 kg = **0.712 tonnes** = **712 000 g**

(f) 900 g = **0.9 kg** = **0.0009 tonnes**

(g) 835 *l* = **835 000 ml**

(h) 835 ml = **0.835 *l***

7. 4.07 *l* = 4070 ml

$4\frac{7}{10}$ *l* = 4700 ml

$\therefore$ **4007 ml, 4.07 *l*, $\mathbf{4\frac{7}{10}}$ *l***

4 Integers, Rational Numbers and Real Numbers

Worksheet 4A Negative numbers

1. (a) **65** (b) **−16**

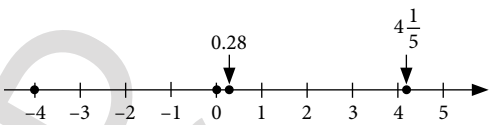
(c) $\mathbf{\frac{2}{7}}$**, 65, 9.8** (d) **−0.4,** $\mathbf{-3\frac{1}{2}}$**, 16**

2. (a) $24 < 49$ (b) $5.1 > 1.5$

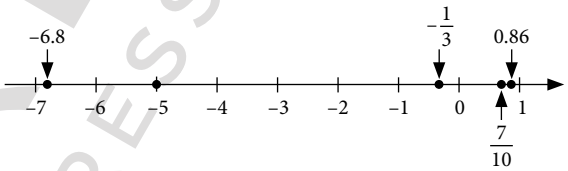
(c) $-3 < 7$ (d) $10 > -10.1$

(e) $0 > -\frac{1}{6}$ (f) $-\frac{1}{8} < -\frac{1}{9}$

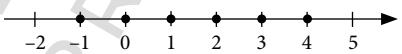
3. (a)



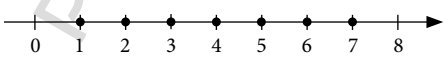
(b)



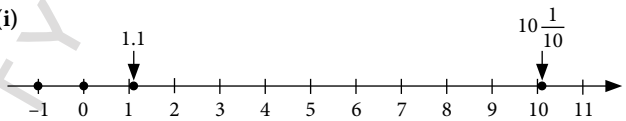
(c)



(d)

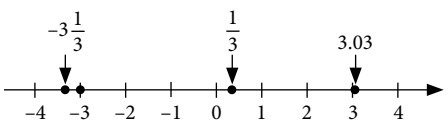


4. (i)



(ii) **−1, 0, 1.1,** $\mathbf{10\frac{1}{10}}$

5. (i)

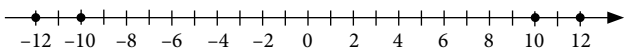


(ii) $\mathbf{3.03, \frac{1}{3}, -3, -3\frac{1}{3}}$

6. (i) **−12 and 4** (ii) **−12 > −15** and **4 > −15**

7. (i) **−25 and −30** (ii) **−25 < −24** and **−30 < −24**

8.



No. 10 is less than 12, and −10 is greater than −12.

9. −413 m

10. −89.2 °C

11. (a) **+$5000** (b) **−$3600**

12. 7 m below ground level

13. 16 km due West

14. An anticlockwise rotation of 51°

15. A 13.5 °C increase in temperature

16. Mrs Lee's monthly salary is either increased or decreased by $80.

17. Karagiye Depression, Kazakhstan; Death Valley, USA; Bukit Timah Hill, Singapore; Cascade Mountain, Canada

Worksheet 4B Addition and subtraction involving negative integers

1. **(a)** $2 + 9 = \mathbf{11}$ **(b)** $-2 + 9 = \mathbf{7}$

(c) $2 + (-9) = 2 - 9$
$= \mathbf{-7}$

(d) $(-2) + (-9) = -2 - 9$
$= \mathbf{-11}$

2. **(a)** $4 - 7 = \mathbf{-3}$ **(b)** $-4 - 7 = \mathbf{-11}$

(c) $4 - (-7) = 4 + 7$
$= \mathbf{11}$

(d) $(-4) - (-7) = -4 + 7$
$= \mathbf{3}$

3. **(a)** $12 + (-15) = 12 - 15$
$= \mathbf{-3}$

(b) $-80 + 70 = \mathbf{-10}$

(c) $26 - 91 = \mathbf{-65}$

(d) $-28 - 28 = \mathbf{-56}$

(e) $17 + (-53) = 17 - 53$
$= \mathbf{-36}$

(f) $-49 + (-34) = -49 - 34$
$= \mathbf{-83}$

(g) $84 - (-20) = 84 + 20$
$= \mathbf{104}$

(h) $-36 - (-36) = -36 + 36$
$= \mathbf{0}$

4. **(a)** $6 + (-3) + (-2) = 6 - 3 - 2$
$= \mathbf{1}$

(b) $40 - 90 - 30 = -50 - 30$
$= \mathbf{-80}$

(c) $18 - (-25) + (-70) = 18 + 25 - 70$
$= 43 - 70$
$= \mathbf{-27}$

(d) $12 - (-31) - (-45) = 12 + 31 + 45$
$= \mathbf{88}$

(e) $-24 + 16 + (-10) = -24 + 16 - 10$
$= -8 - 10$
$= \mathbf{-18}$

(f) $-33 - 33 + (-87) = -33 - 33 - 87$
$= \mathbf{-153}$

(g) $-49 - (-21) + (-15) = -49 + 21 - 15$
$= \mathbf{-43}$

(h) $-27 - (-19) - (-24) = -27 + 19 + 24$
$= -8 + 24$
$= \mathbf{16}$

5. **(a)** $8 + \mathbf{(-6)} = 2$ **(b)** $19 + \mathbf{(-22)} = -3$

(c) $-24 + \mathbf{24} = 0$ **(d)** $-17 + \mathbf{2} = -15$

(e) $30 - \mathbf{36} = -6$ **(f)** $42 - \mathbf{52} = -10$

(g) $-15 - \mathbf{12} = -27$ **(h)** $21 - \mathbf{22} = -1$

6. **(a)** $\mathbf{-8} + 16 = 8$ **(b)** $\mathbf{24} + (-20) = 4$

(c) $\mathbf{-90} + 70 = -20$ **(d)** $\mathbf{-54} + (-39) = -93$

(e) $\mathbf{52} - 54 = -2$ **(f)** $\mathbf{-16} - (-16) = 0$

(g) $\mathbf{-17} - (-31) = 14$ **(h)** $\mathbf{-30} - (-18) = -12$

7. Temperature in the morning $= -11\ °C + 4\ °C$
$= \mathbf{-7\ °C}$

8. Temperature **increase** $= -15\ °C - (-20\ °C)$
$= -15\ °C + 20\ °C$
$= \mathbf{5\ °C}$

9. Take clockwise as positive.
Final position $= 48° + (-25°) + 33°$
$= 48° - 25° + 33°$
$= 23° + 33°$
$= \mathbf{56° \text{ clockwise from the starting position}}$

10. **(i)** Difference in altitude $= 286\ m - (-4\ m)$
$= 286\ m + 4m$
$= \mathbf{290\ m}$

(ii) Altitude of Baku $= -4\ m - 24\ m$
$= \mathbf{-28\ m}$

11. Bank balance in March $= \$3000 + (-\$4750) + (-\$2200)$
$= \$3000 - \$4750 - \$2200$
$= -\$1750 - \$2200$
$= -\$3950$

Amount he could have deposited in April
$= \$600 - (-\$3950)$
$= \mathbf{\$4550}$

Challenge Myself!

12. **(a)** Let $x = -40$ and $y = -23$.
$x + y = -40 + (-23)$
$= -40 - 23$
$= -63$
$\therefore$ A possible pair of numbers is $\boldsymbol{x = -40}$ **and** $\boldsymbol{y = -23}$.

(b) Let $x = -40$ and $y = -76$.
$y - x = -76 - (-40)$
$= -76 + 40$
$= -36$
$\therefore$ A possible pair of numbers is $\boldsymbol{x = -40}$ **and** $\boldsymbol{y = -76}$.

Worksheet 4C Multiplication, division and combined operations involving negative integers

1. **(a)** $7 \times 8 = \mathbf{56}$ **(b)** $(-7) \times 8 = \mathbf{-56}$

(c) $7 \times (-8) = \mathbf{-56}$ **(d)** $(-7) \times (-8) = \mathbf{56}$

2. **(a)** $24 \div 4 = \mathbf{6}$ **(b)** $(-24) \div 4 = \mathbf{-6}$

(c) $24 \div (-4) = \mathbf{-6}$ **(d)** $(-24) \div (-4) = \mathbf{6}$

3. **(a)** $15 \times (-6) = \mathbf{-90}$ **(b)** $(-12) \times (-10) = \mathbf{120}$

(c) $(-1) \times (-84) = \mathbf{84}$ **(d)** $(-99) \times 0 = \mathbf{0}$

(e) $\frac{-34}{2} = \mathbf{-17}$ **(f)** $\frac{75}{-5} = \mathbf{-15}$

(g) $\frac{0}{-73} = \mathbf{0}$ **(h)** $\frac{-96}{-4} = \mathbf{24}$

4. **(a)** $4 = 1 \times 4$
$= 2 \times 2$
$\therefore$ The positive and negative factors of 4 are $\mathbf{\pm 1, \pm 2}$ **and** $\mathbf{\pm 4}$.

(b) $20 = 1 \times 20$
$= 2 \times 10$
$= 4 \times 5$
$\therefore$ The positive and negative factors of 20 are $\mathbf{\pm 1, \pm 2, \pm 4, \pm 5, \pm 10}$ **and** $\mathbf{\pm 20}$.

(c) $15 = 1 \times 15$
$= 3 \times 5$
$\therefore$ The positive and negative factors of -15 are $\mathbf{\pm 1, \pm 3, \pm 5}$ **and** $\mathbf{\pm 15}$.

(d) $1 = 1 \times 1$

$\therefore$ The positive and negative factors of -1 are $\pm\mathbf{1}$.

5. **(a)** A positive multiple is **12**.
A negative multiple is **–9**.

(b) A positive multiple is **60**.
A negative multiple is **–36**.

(c) A positive multiple is **25**.
A negative multiple is **–10**.

(d) A positive multiple is **44**.
A negative multiple is **–33**.

6. **(a)** $(-1)^2 = \mathbf{1}$ **(b)** $(-1)^3 = \mathbf{-1}$

(c) $(-8)^2 = \mathbf{64}$ **(d)** $(-8)^3 = \mathbf{-512}$

(e) $\sqrt{64} = \mathbf{8}$ **(f)** $\sqrt[3]{64} = \mathbf{4}$

(g) $-\sqrt{25} = \mathbf{-5}$ **(h)** $\sqrt[3]{-125} = \mathbf{-5}$

7. **(a)** $4 \times (-3) \times (-1) = (-12) \times (-1)$
$= \mathbf{12}$

(b) $(-10) \times (-2) \times (-4) = 20 \times (-4)$
$= \mathbf{-80}$

(c) $5 \times (-6) \div (-2) = (-30) \div (-2)$
$= \mathbf{15}$

(d) $28 \div (-7) \times 9 = (-4) \times 9$
$= \mathbf{-36}$

(e) $(-60) \div (-5) \div (-3) = 12 \div (-3)$
$= \mathbf{-4}$

(f) $(-9)^2 \times (-1) = 81 \times (-1)$
$= \mathbf{-81}$

(g) $(-6)^3 \div (-1)^2 = (-216) \div 1$
$= \mathbf{-216}$

(h) $(-4) \div (-2)^2 \div (-1)^3 = (-4) \div 4 \div (-1)$
$= (-1) \div (-1)$
$= \mathbf{1}$

8. **(a)** $7 \times \mathbf{(-5)} = -35$ **(b)** $(-23) \times \mathbf{4} = -92$

(c) $\mathbf{(-6)} \times 9 = -54$ **(d)** $\mathbf{(-7)} \times (-4) = 28$

(e) $80 \div \mathbf{(-5)} = -16$ **(f)** $(-76) \div \mathbf{4} = -19$

(g) $\mathbf{100} \div (-5) = -20$ **(h)** $\mathbf{(-90)} \div (-6) = 15$

9. **(a)** $6 \times (-3)^2 + (-10) = 6 \times 9 - 10$
$= 54 - 10$
$= \mathbf{44}$

(b) $(-7 - 5) \div (-7 + 4) = (-12) \div (-3)$
$= \mathbf{4}$

(c) $-19 + (-2) \times (-5) \div (-1) = -19 + 10 \div (-1)$
$= -19 - 10$
$= \mathbf{-29}$

(d) $[(-8) + (-3)] \times (-2)^3 = (-11) \times (-8)$
$= \mathbf{88}$

(e) $(-4) \times 25 - 3^2 \times (-4) = -100 - 9 \times (-4)$
$= -100 + 36$
$= \mathbf{-64}$

(f) $\dfrac{(-5)^2 - (-5)}{29 - (-8) + (-7)} = \dfrac{25 + 5}{29 + 8 - 7}$
$= \dfrac{30}{30}$
$= \mathbf{1}$

(g) $(5^3 - 5^2) \div \sqrt{100} = (125 - 25) \div 10$
$= 100 \div 10$
$= \mathbf{10}$

(h) $\sqrt[3]{4^3 + (-8^2)} = \sqrt[3]{64 - 64}$
$= \sqrt[3]{0}$
$= \mathbf{0}$

(i) $(-5) \times \left[(-4) + \sqrt[3]{-216}\right] = (-5) \times (-4 - 6)$
$= (-5) \times (-10)$
$= \mathbf{50}$

(j) $\sqrt{79 + (-3) \times (-7)} - 0 \times 123^2 = \sqrt{79 + 21} - 0$
$= \sqrt{100}$
$= \mathbf{10}$

10. **(i)** Amount he spends in 20 days $= 20 \times \$7$
$= \mathbf{\$140}$

(ii) Amount he has borrowed $= \$140 - \$80$
$= \mathbf{\$60}$

(iii) Number of days he has enough money
$= \dfrac{\$80}{\$7}$
$= 11$ (round down to the nearest integer)
$\therefore$ He does not have enough money on the **12th day**.

11. Prime numbers: 2, 3 and 5
Sarah's score
$= -(3 \times 1) + (0 \times 2) + (7 \times 3) - (0 \times 4) + (4 \times 5) - (1 \times 6)$
$= -3 + 0 + 21 - 0 + 20 - 6$
$= \mathbf{32}$

12. **(a)** Amount of profit or loss $= 4 \times \$6 - 3 \times \$3 - 5 \times \$4$
$= -\$5$
$\therefore$ She makes **a loss of $5**.

(b) $5 \times \$6 - 7 \times \$3 - 7 \times \$4 = -\$19$
$\therefore$ She could have sold **5 blouses, 7 scarves and 7 skirts**.

Worksheet 4D Negative fractions and mixed numbers

1. **(a)** $\dfrac{1}{4} + \dfrac{1}{3} = \dfrac{3}{12} + \dfrac{4}{12}$
$= \mathbf{\dfrac{7}{12}}$

(b) $\dfrac{5}{14} - \dfrac{1}{2} = \dfrac{5}{14} - \dfrac{7}{14}$
$= -\dfrac{2}{14}$
$= \mathbf{-\dfrac{1}{7}}$

(c) $-\dfrac{4}{5} + \dfrac{3}{10} = -\dfrac{8}{10} + \dfrac{3}{10}$
$= -\dfrac{5}{10}$
$= \mathbf{-\dfrac{1}{2}}$

(d) $-\dfrac{2}{3} - \dfrac{1}{12} = -\dfrac{8}{12} - \dfrac{1}{12}$
$= -\dfrac{9}{12}$
$= \mathbf{-\dfrac{3}{4}}$

(e) $\frac{6}{7} + \left(-\frac{3}{14}\right) = \frac{6}{7} - \frac{3}{14}$

$= \frac{12}{14} - \frac{3}{14}$

$= \mathbf{\frac{9}{14}}$

(f) $-\frac{4}{5} + \left(-\frac{3}{20}\right) = -\frac{4}{5} - \frac{3}{20}$

$= -\frac{16}{20} - \frac{3}{20}$

$= \mathbf{-\frac{19}{20}}$

(g) $-\frac{1}{3} - \frac{1}{15} = -\frac{5}{15} - \frac{1}{15}$

$= -\frac{6}{15}$

$= \mathbf{-\frac{2}{5}}$

(h) $-\frac{5}{12} - \left(-\frac{1}{6}\right) = -\frac{5}{12} + \frac{1}{6}$

$= -\frac{5}{12} + \frac{2}{12}$

$= -\frac{3}{12}$

$= \mathbf{-\frac{1}{4}}$

(i) $4\frac{2}{5} + \left(-3\frac{3}{10}\right) = 4\frac{2}{5} - 3\frac{3}{10}$

$= 4\frac{4}{10} - 3\frac{3}{10}$

$= \mathbf{1\frac{1}{10}}$

(j) $-1\frac{4}{7} + \left(-1\frac{3}{7}\right) = -1\frac{4}{7} - 1\frac{3}{7}$

$= \mathbf{-3}$

(k) $-6\frac{1}{2} + \frac{4}{5} = -6\frac{5}{10} + \frac{8}{10}$

$= \left(-5 - \frac{10}{10}\right) - \frac{5}{10} + \frac{8}{10}$

$= \mathbf{-5\frac{7}{10}}$

(l) $-3\frac{8}{9} - \left(-5\frac{5}{6}\right) = -3\frac{8}{9} + 5\frac{5}{6}$

$= 5\frac{15}{18} - 3\frac{16}{18}$

$= \left(4 + \frac{18}{18}\right) + \frac{15}{18} - 3\frac{16}{18}$

$= \mathbf{1\frac{17}{18}}$

2. (a) $\frac{1}{2} \times \left(-\frac{34}{15}\right) = -\frac{17}{15}$

$= \mathbf{-1\frac{2}{15}}$

(b) $1\frac{3}{7} \times \left(-2\frac{4}{5}\right) = \frac{10}{7} \times \left(-\frac{14}{5}\right)$

$= \mathbf{-4}$

(c) $\left(-3\frac{3}{11}\right) \times 8\frac{5}{9} = \left(-\frac{36}{11}\right) \times \frac{77}{9}$

$= \mathbf{-28}$

(d) $\left(-6\frac{3}{8}\right) \times \left(-3\frac{5}{17}\right) = \left(-\frac{51}{8}\right) \times \left(-\frac{56}{17}\right)$

$= \mathbf{21}$

(e) $\frac{22}{9} \div \frac{11}{6} = \frac{22}{9} \times \frac{6}{11}$

$= \frac{4}{3}$

$= \mathbf{1\frac{1}{3}}$

(f) $\frac{25}{7} \div \left(-\frac{40}{49}\right) = \frac{25}{7} \times \left(-\frac{49}{40}\right)$

$= -\frac{35}{8}$

$= \mathbf{-4\frac{3}{8}}$

(g) $\left(-5\frac{1}{3}\right) \div \frac{20}{9} = \left(-\frac{16}{3}\right) \times \frac{9}{20}$

$= -\frac{12}{5}$

$= \mathbf{-2\frac{2}{5}}$

(h) $\left(-10\frac{5}{8}\right) \div \left(-2\frac{11}{20}\right) = \left(-\frac{85}{8}\right) \div \left(-\frac{51}{20}\right)$

$= \left(-\frac{85}{8}\right) \times \left(-\frac{20}{51}\right)$

$= \frac{25}{6}$

$= \mathbf{4\frac{1}{6}}$

3. (a) $\left(\frac{1}{3} - \frac{1}{2} + \frac{1}{4}\right) \times \left(-\frac{2}{7}\right) = \left(\frac{4}{12} - \frac{6}{12} + \frac{3}{12}\right) \times \left(-\frac{2}{7}\right)$

$= \frac{1}{12} \times \left(-\frac{2}{7}\right)$

$= \mathbf{-\frac{1}{42}}$

(b) $\left(\frac{1}{6} - \frac{4}{9}\right) \times \left(-4\frac{1}{2}\right) = \left(\frac{3}{18} - \frac{8}{18}\right) \times \left(-\frac{9}{2}\right)$

$= \left(-\frac{5}{18}\right) \times \left(-\frac{9}{2}\right)$

$= \frac{5}{4}$

$= \mathbf{1\frac{1}{4}}$

(c) $\left(-\frac{5}{12}\right) \div \left(-\frac{5}{3}\right) \div \left(\frac{1}{2}\right)^2 = \left(-\frac{5}{12}\right) \times \left(-\frac{3}{5}\right) \div \frac{1}{4}$

$= \frac{1}{4} \times 4$

$= \mathbf{1}$

(d) $\left[-\frac{5}{6} - \left(-\frac{2}{3}\right)\right] \times \left(-\frac{1}{3}\right)^3 = \left(-\frac{5}{6} + \frac{2}{3}\right) \times \left(-\frac{1}{27}\right)$

$= \left(-\frac{5}{6} + \frac{4}{6}\right) \times \left(-\frac{1}{27}\right)$

$= \left(-\frac{1}{6}\right) \times \left(-\frac{1}{27}\right)$

$= \mathbf{\frac{1}{162}}$

(e) $8 + \left(\frac{4}{15} - 1\frac{1}{5}\right) \div \left(\frac{1}{2} \times 1\frac{3}{4}\right)$

$= 8 + \left(\frac{4}{15} - \frac{18}{15}\right) \div \left(\frac{1}{2} \times \frac{7}{4}\right)$

$= 8 + \left(-\frac{14}{15}\right) \div \frac{7}{8}$

$= 8 + \left(-\frac{14}{15}\right) \times \frac{8}{7}$

$= 8 - \frac{16}{15}$

$= 8 - 1\frac{1}{15}$

$= \mathbf{6\frac{14}{15}}$

(f) $\sqrt{\left(-\frac{91}{23}\right) \div \left(-\frac{13}{46}\right) + \frac{16}{3} \times \frac{2^2 - 1}{2^3}}$

$= \sqrt{\left(-\frac{91}{23}\right) \times \left(-\frac{46}{13}\right) + \frac{16}{3} \times \frac{3}{8}}$

$= \sqrt{14 + 2}$

$= \sqrt{16}$

$= \mathbf{4}$

Worksheet 4E Negative decimals

1. (a) $23.8 + 5.49 = \mathbf{29.29}$

(b) $10.1 - 7.64 = \mathbf{2.46}$

(c) $9 - 4.6 = 4.4$

$\therefore 4.6 - 9 = \mathbf{-4.4}$

(d) $3.25 + (-8.1) = 3.25 - 8.1$

$8.1 - 3.25 = 4.85$

$\therefore 3.25 + (-8.1) = \mathbf{-4.85}$

(e) $3.07 + (-4.18) = 3.07 - 4.18$

$4.18 - 3.07 = 1.11$

$\therefore 3.07 + (-4.18) = \mathbf{-1.11}$

(f) $6.2 - 3.49 = 2.71$

$\therefore -6.2 + 3.49 = \mathbf{-2.71}$

(g) $-0.92 + (-1.5) = -0.92 - 1.5$

$0.92 + 1.5 = 2.42$

$\therefore -0.92 + (-1.5) = \mathbf{-2.42}$

(h) $-8.8 - (-0.12) = -8.8 + 0.12$

$8.8 - 0.12 = 8.68$

$\therefore -8.8 - (-0.12) = \mathbf{-8.68}$

2. (a) $3.5 \times 4 = 14$

$\therefore -3.5 \times 4 = \mathbf{-14}$

(b) $0.16 \times 12 = 1.92$

$\therefore -0.16 \times 12 = \mathbf{-1.92}$

(c) $9.8 \times 3.2 = 31.36$

$\therefore -9.8 \times 3.2 = \mathbf{-31.36}$

(d) $7.75 \times 0.8 = 6.2$

$\therefore -7.75 \times (-0.8) = \mathbf{6.2}$

(e) $20 \div 0.5 = 20 \div \frac{1}{2}$

$= 20 \times 2$

$= 40$

$\therefore 20 \div (-0.5) = \mathbf{-40}$

(f) $0.95 \div 1.9 = \frac{0.95}{1.9}$

$= \frac{9.5}{1.9}$

$= \frac{1}{2}$

$\therefore 0.95 \div (-1.9) = \mathbf{-0.5}$

(g) $121.8 \div 2.1 = 58$

$\therefore -121.8 \div (-2.1) = \mathbf{58}$

(h) $13.34 \div 4.6 = 2.9$

$\therefore -13.34 \div (-4.6) = \mathbf{2.9}$

3. (a) $4.56 + (-6.78) - (-8.09) = 4.56 - 6.78 + 8.09$

$= \mathbf{5.87}$

(b) $-2.2 - (-1)^{99} \times [7.4 - (-3.6)] = -2.2 - (-1) \times (7.4 + 3.6)$

$= -2.2 + 11$

$= \mathbf{8.8}$

(c) $5.95 + 0.33 - (-4.27) \times (-2) = 5.95 + 0.33 - 8.54$

$= \mathbf{-2.26}$

(d) $-0.9 - (-0.9)^2 \times (-1)^3 = -0.9 - 0.81 \times (-1)$

$= -0.9 + 0.81$

$= \mathbf{-0.09}$

(e) $0.1^2 \times [(-7.6) \div (-0.4)] = 0.01 \times 19$

$= \mathbf{0.19}$

(f) $\sqrt[3]{(-0.6)^2 + (-0.8)^2} = \sqrt[3]{0.36 + 0.64}$

$= \sqrt[3]{1}$

$= \mathbf{1}$

Worksheet 4F Rational, irrational and real numbers

1. (a) Rational numbers: $\mathbf{-5.1}, \mathbf{\frac{22}{7}}, \mathbf{0}, \mathbf{-3\frac{2}{9}}, \mathbf{\sqrt[3]{-64}}$

(b) Irrational numbers: $\mathbf{\sqrt{85}}, \boldsymbol{\pi}$

2. $\mathbf{-\frac{5}{6}}, \mathbf{4.06}, \mathbf{\sqrt[3]{-1000}}, \mathbf{1\frac{7}{9}}, \mathbf{-0.\dot{2}}$

3. (a) $\left(\frac{3}{4}\right)^2 + \left(-5\frac{5}{6}\right)^3 - \left(-\frac{9}{8}\right) = \mathbf{-196.808}$ (to 3 d.p.)

(b) $-11.7 + (-0.16)^2 \times \pi = \mathbf{-11.620}$ (to 3 d.p.)

(c) $\left(\frac{\sqrt{15}}{10 + \sqrt[3]{25}}\right)^3 = \mathbf{0.027}$ (to 3 d.p.)

(d) $\frac{22}{7} \times 1.5^2 - 2 \times \pi \times 1.5 \times \sqrt{\frac{44}{9}} = \mathbf{-13.768}$ (to 3 d.p.)

(e) $\sqrt[3]{\frac{14}{15} \times \left(\frac{7}{3^2} + 6 \div \frac{5}{23}\right)} = \mathbf{2.981}$ (to 3 d.p.)

(f) $\frac{4.5^2 + (-5.5)^2}{\sqrt{9^2 - 8^2}} = \mathbf{12.248}$ (to 3 d.p.)

Review Exercise 4

1. (a) $-9 + (-12) = -9 - 12$

$= -21$

$4 - (-20) = 4 + 20$

$= 24$

$\therefore -9 + (-12) < 4 - (-20)$

(b) $5 \times (-3) = -15$

$(-17) \times 3 = -51$

$\therefore 5 \times (-3) > (-17) \times 3$

(c) $\frac{3}{4} \times 2\frac{5}{6} = \frac{3}{4} \times \frac{17}{6}$

$= 2\frac{1}{8}$

$2\frac{5}{6} \div \frac{8}{9} = \frac{17}{6} \times \frac{9}{8}$

$= 3\frac{3}{16}$

$\therefore \frac{3}{4} \times 2\frac{5}{6} < 2\frac{5}{6} \div \frac{8}{9}$

(d) $(-2)^3 - (-2) \times (-2)^2 = -8 - (-2) \times 4$

$= -8 - (-8)$

$= -8 + 8$

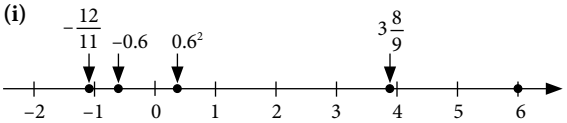
$= 0$

$4.8 \div (-1.2) = -4$

$\therefore (-2)^3 - (-2) \times (-2)^3 > 4.8 \div (-1.2)$

2. $p = \frac{5}{7}, q = 0.75, r = \frac{15}{7}, s = \frac{3\pi}{4}$

3. **(i)**



(ii) $\mathbf{6, 3\frac{8}{9}, 0.6^2, -0.6, -\frac{12}{11}}$

4. **(a)** $\frac{12.7 \times 4}{8.1 - 4.9} = \mathbf{15.875}$

(b) $\sqrt{3.5^2 + 4.5} = \mathbf{4.1}$ (to 1 d.p.)

5. **(a)** $\frac{5}{6}$ is greater.

(b) Consider the difference between each fraction and 1.

Since $1 - \frac{4}{5} = \frac{1}{5}$, $1 - \frac{5}{6} = \frac{1}{6}$ and $1 - \frac{100}{101} = \frac{1}{101}$, then $\mathbf{\frac{100}{101}}$ is the greatest.

(c) Since $\frac{4}{5} = \frac{96}{120}$ and $\frac{5}{6} = \frac{100}{120}$,

two possible rational numbers are $\mathbf{\frac{97}{120}}$ **and** $\mathbf{\frac{33}{40}}$.

(d) There are an **infinite** number of rational numbers between $\frac{4}{5}$ and $\frac{5}{6}$.

6. **(i)** Fraction of non-fiction books $= \left(1 - \frac{1}{5} - \frac{1}{4}\right) \times \frac{5}{8}$

$= \frac{11}{20} \times \frac{5}{8}$

$= \mathbf{\frac{11}{32}}$

(ii) **Non-fiction books, magazines, assessment books, fiction books**

7. **(a)** **−1.7 m**

(b) Increase = 1.5 m − (−1.7 m)

= 1.5 m + 1.7 m

= **3.2 m**

8. **(i)** Difference = 32 °C − (−10 °C)

= 32 °C + 10 °C

= **42 °C**

(ii) A possible value is **−1 °C**.

9. **(i)** Actual lifespan of battery D = 4 h + (−1.3 h)

= 4 h − 1.3 h

= **2.7 h**

(ii) Total lifespan

= {[4 + (−0.2)] + [4 + 1.4] + [4 + 0.8] + [4 + (−1.3)] + [4 + (−0.5)]} h

= **20.2 h**

10. **(a)** **(i)** **9 a.m. on 5th January**

(ii) **11 p.m. on 4th January**

(b) 9.25 p.m. $\xrightarrow{5 \text{ h}}$ 2.25 p.m.

The local time in Kenya is −5 hours relative to the local time in Singapore.

5 Approximation and Estimation

Worksheet 5A Rounding and significant figures

1. **(a)** 50.7 = **51** (to the nearest integer)

(b) 398.4 = **398** (to the nearest integer)

2. **(a)** 4279 = **4300** (to the nearest 100)

(b) 1605.5 = **1600** (to the nearest 100)

3. **(a)** 63.184 = **63.2** (to 1 d.p.)

(b) 956.02 = **956.0** (to 1 d.p.)

4. **(a)** 22.0536 = **22.05** (to 2 d.p.)

(b) 0.197 414 = **0.20** (to 2 d.p.)

5. **(a)** 15.2784 = **15.278** (to the nearest 0.001)

(b) 3.001 009 = **3.001** (to the nearest 0.001)

6. **(a)** 97.132 565 = **97.1326** (to the nearest ten thousandth)

(b) 0.406 081 = **0.4061** (to the nearest ten thousandth)

7. **(a)** 3916 = **4000** (to 1 s.f.)

(b) 504 = **500** (to 1 s.f.)

(c) 2.807 = **3** (to 1 s.f.)

(d) 0.3099 = **0.3** (to 1 s.f.)

8. **(a)** 71 448 = **71 000** (to 2 s.f.)

(b) 239 = **240** (to 2 s.f.)

(c) 19.506 = **20** (to 2 s.f.)

(d) 0.080 75 = **0.081** (to 2 s.f.)

9. **(a)** 254.810 = **255** (to 3 s.f.)

(b) 72 167 = **72 200** (to 3 s.f.)

(c) 3.9986 = **4.00** (to 3 s.f.)

(d) 0.580 339 = **0.580** (to 3 s.f.)

10. **(a)** **5 s.f.** **(b)** **5 s.f.**

(c) **6 s.f.** **(d)** **4 s.f.**

11. $\frac{204.16}{13.8 - 1.07^2} = \mathbf{20}$ (to 1 s.f.)

12. **(a)** $\frac{5}{14} = \mathbf{0.357\ 142\ 857\ 1}$ **(b)** **0.36** (to 2 s.f.)

13. **(a)** $\frac{0.9413}{7.026 + 15.58} = \mathbf{0.041\ 639\ 387\ 77}$

(b) **(i)** **0.0416** (to 3 s.f.) **(ii)** **0.042** (to 3 d.p.)

14. **(i)** 524 000 has at least 3 significant figures.
(ii) k = **3, 4, 5 or 6**

15. OPEN Examples of this number are **0.040 75, 0.040 80 and 0.040 818**.

16. 12 813 = **13 000** (to the nearest thousand)

17. The minimum mass of the baby is **3.35 kg**.

18. **(a)** **(i)** **19 386 499** **(ii)** **19 385 500**
(b) OPEN Two possible values are **19 386 012** and **19 385 999**.

19. **(i)** **4 s.f.** **(ii)** 728.6 = **730** (to 2 s.f.)

20. Area of the court = 23.77 m × 8.23 m
= **200 m²** (to 2 s.f.)

21. **(i)** Least possible mass = **49.5 g**
(ii) Greatest possible mass of 1 cm³ of metal = $\frac{50.5\text{ g}}{12.5}$
= **4.04 g**

22. Amount payable using credit card = \$70.38
Amount payable in cash = \$70.40
∴ The customer should use a **credit card** to pay.

Worksheet 5B Limits of accuracy

1. **(a)** $\mathbf{6 < x < 10}$
(b) $\mathbf{0.5 \leqslant y < 3}$
(c) $\mathbf{17.2 \leqslant z \leqslant 18.1}$

2.

	number	lower bound	upper bound
(a)	10	**9.5**	**10.5**
(b)	4.5	**4.45**	**4.55**
(c)	8.8	**8.75**	**8.85**
(d)	6.97	**6.965**	**6.975**

3. **(a)** Upper bound of $p + q$ = 7.5 + 4.35
= **11.85**
Lower bound of $p + q$ = 6.5 + 4.25
= **10.75**
(b) Upper bound of $p - q$ = 7.5 – 4.25
= **3.25**
Lower bound of $p - q$ = 6.5 – 4.35
= **2.15**
(c) Upper bound of $p \times q$ = 7.5 × 4.35
= **32.625**
Lower bound of $p \times q$ = 6.5 × 4.25
= **27.625**
(d) Upper bound of $p \div q$ = 7.5 ÷ 4.25
= **1.765** (to 3 d.p.)
Lower bound of $p \div q$ = 6.5 ÷ 4.35
= **1.494** (to 3 d.p.)

4. Upper bound = 28.5 × 28.5
= **812.25 cm²**
Lower bound = 27.5 × 27.5
= **756.25 cm²**

5. Upper bound = $\frac{7.35}{6.045}$
= **1.2** (to 2 s.f.)
Lower bound = $\frac{7.25}{6.055}$
= **1.2** (to 2 s.f.)

Worksheet 5C Approximation and approximation errors in real-world contexts

1. **(i)** Length = $\sqrt{352}$ cm
= **18.8 cm** (to 3 s.f.)
(ii) Perimeter = $4 \times \sqrt{352}$ cm
= **75.0 cm** (to 3 s.f.)

2. **(i)** Radius = $\frac{248}{2\pi}$ cm
= **39.5 cm** (to 3 s.f.)
(ii) Area = $\pi\left(\frac{248}{2\pi}\right)^2$ cm²
= **4890 cm²** (to 3 s.f.)

3. **(i)** Greatest number of bags
= $\frac{\$30}{\$3.95}$
= **7** (round down to the nearest integer)
(ii) Amount Susie has left = \$30 – 7 × \$3.95
= **\$2.35**

4. He should indicate it as **10 amperes** (round down to the nearest integer).
Indicating it as 11 amperes may be dangerous as a current between 10.52 amperes and 11 amperes continues to flow in the circuit.

5. **(a) (i), (b) (i)**

Finalist	Number of votes	Percentage of votes (to 1 d.p.)	Percentage of votes (to 2 d.p.)
Amazing ballerina	3551	38.0%	38.04%
Dance addict	2036	**21.8%**	**21.81%**
Young flamingo	3748	**40.1%**	**40.15%**
Total	9335	**99.9%**	**100%**

(a) **(ii)** The total percentage is not 100%.
(b) **(ii)** The number of decimal places used in the intermediate steps in the fourth column is greater than that in the third column, hence it is more accurate.

6. In the calculation of the percentage of votes for each destination, the values were written to 1 decimal place instead of 2 decimal places.
Bintan: $\frac{24}{80} \times 100\% = 30.00\%$
Phuket: $\frac{35}{80} \times 100\% = 43.75\%$
Sentosa: $\frac{21}{80} \times 100\% = 26.25\%$
Using 2 decimal places in the intermediate steps would yield a total percentage of 100%.

Worksheet 5D Estimation and estimation errors in real-world contexts

1. **(a)** $\sqrt{63.8} \approx \sqrt{64}$
$= \mathbf{8}$

(b) $\sqrt[3]{1002} \approx \sqrt[3]{1000}$
$= \mathbf{10}$

2. **(a)** $\frac{4.03 \times 4.97}{10.2} \approx \frac{4 \times 5}{10}$
$= \mathbf{2}$

(b) $\frac{\sqrt{81.12} + \sqrt{24.99}}{\sqrt{48.88}} \approx \frac{\sqrt{81} + \sqrt{25}}{\sqrt{49}}$
$= \frac{9+5}{7}$
$= \mathbf{2}$

3. **(a)** **(i)** 718.469 = **720** (to 2 s.f.)
(ii) 23.858 = **24** (to 2 s.f.)

(b) $\frac{718.469}{23.858} \approx \frac{720}{24}$
$= \mathbf{30}$

4. **(i)** $42.8 + 3.16 - 5.907 \approx 43 + 3 - 6$
$= 40$
∴ Her answer is **not reasonable**.

(ii) 42.8 + 3.16 − 5.907 = 40.053
Yes. It is close to the actual value.

5. **400 cm**

6. **1800 g**

7. **2.5 *l***

8. **(i)** **280 000 ÷ 7 = 40 000**

(ii) 279 566 ÷ 7 = **39 938**
Yes. It is close to the actual value.

9. 1 baht ≈ S$0.04
1000 baht ≈ S$40
9000 baht ≈ S$360
∴ The price of the watch is about **S$360**.

10. Amount of money needed ≈ 4 × $3 + 5 × $2
= $22
∴ **No**. He does not have enough money.

11. Fang omitted a "zero" when expressing 192.34 correct to 2 significant figures.
She should write: 192.34 m² = **190 m²** (2 s.f.)

12. Total amount ≈ 2 × $3 + 3 × $5 + 4 × $8 + 4 × $5 + 2 × $4
= **$81**

13. Consider Plan A.
Price of 600 GB ≈ 6 × $25
= $150
Consider Plan B.
Price of 600 GB ≈ 5 × $ 33
= $165
∴ **Plan A** is better value for money.

Challenge Myself!

14. **(a)** Consider the Buddy Combo.
Price of 50 g $\approx \frac{\$7.95}{3}$
= $2.65
Consider the Family Combo.
Price of 50 g $\approx \frac{\$10}{4}$
= $2.50
∴ The **Family Combo** is better value for money.

(b) LCM of 150 and 200 is 600.
Consider the Buddy Combo.
Price of 600 g ≈ $8 × 4
= $32
Consider the Family Combo.
Price of 600 g ≈ $10 × 3
= $30
∴ The Family Combo is better value for money.

Review Exercise 5

1. **(a)** $\frac{10.59^2}{16.33 - 2.24} \approx$ **7.9594** **(b)** **8.0** (to 2 s.f.)

2. **(a)** Upper bound = **0.612** (to (3 s.f.)
Lower bound = **0.611** (to 3 s.f.)

(b) $\sqrt{\frac{4.26 \times 8.53}{97.1}} \approx \sqrt{\frac{4 \times 9}{100}}$
$= \sqrt{\frac{9}{25}}$
$= \mathbf{\frac{3}{5}}$

3. **(a)** $\left(\frac{6}{7}\right)^3$ = **0.629 737 609 3**

(b) **(i)** **0.6** (to 1 s.f.) **(ii)** **0.630** (to 3 s.f.)

4. The minimum mass of the jelly beans is **0.55 kg**.

5. **(i)** ***k* = 3, 4 or 5**

(ii) When *k* = 3,
Difference = 37 649 − 37 550 = **99**

6. **8 kg**

7. **13 m**

8. **120 s**

9. 100 yen ≈ S$1
34 000 yen ≈ S$340
∴ The price of the pair of in-ear headphones is about **S$340**.

10. **(i)** Rp1000 ≈ S$0.09
Rp100 000 ≈ S$9
Rp900 000 ≈ S$81
∴ The price of the leather bag is **S$81**.

(ii) ₩1000 ≈ S$1
₩90 000 ≈ S$90
∴ The bag is more expensive in **South Korea**.

11. **(i)** **6 305 649** **(ii)** **6 305 550**

12. **(i)** **1230 million dollars** (to the nearest ten million dollars)

(ii) Average amount $= \frac{3664}{12}$ million dollars
= **310 million dollars** (to 2 s.f.)

(iii) Maximum amount = (13 440 + 980) million dollars
= **14 420 million dollars**

13. (i) **$28.9542** **(ii)** **$28.95**

14. Consider the Twin Pack.

Price of 100 ml $\approx \frac{\$17}{17}$
= $1

Consider the Plus Pack.

Price of 100 ml $\approx \frac{\$11}{10}$
= $1.10

∴ The **Twin Pack** is better value for money.

6 Basic Algebra and Algebraic Manipulation

Worksheet 6A Basic algebraic concepts and notations

1. (a) $4x + 5y$ **(b)** $10y - 3x$

(c) $16xyz$ **(d)** $\frac{7x}{9yz}$

(e) $\sqrt{xy}$ **(f)** $\sqrt[3]{3z}$

2. (a) $8x + 7y + 6z$ **(b)** $9y + 2z - 5x$

(c) $15y - 4x$ **(d)** $90yz$

(e) $\frac{x+4y}{z}$ **(f)** $\frac{3y}{2x+6z}$

3. (a) **sum of $6x$ and $11y$**

(b) **subtract $4y$ from $9x$**

(c) **product of x and the square of y**

(d) **divide $5x$ by 8**

4. (a) **($x - 28$) years** **(b)** **($x - 3$) years**

5.

Area = $3x^2$ cm^2	Width = x cm
Length = $3x$ cm	

6. (a) $4x + 9y = 4(5) + 9(-2)$
$= 20 - 18$
$= \mathbf{2}$

(b) $4x - 9y = 4(5) - 9(-2)$
$= 20 + 18$
$= \mathbf{38}$

(c) $3xy = 3(5)(-2)$
$= \mathbf{-30}$

(d) $\frac{xy}{3} = \frac{(5)(-2)}{3}$
$= -\frac{10}{3}$
$= \mathbf{-3\frac{1}{3}}$

7. (a) $-11x - 2y = -11(-4) - 2(7)$
$= 44 - 14$
$= \mathbf{30}$

(b) $5x - 3(7x + y) = 5(-4) - 3[7(-4) + 7]$
$= -20 - 3(-28 + 7)$
$= -20 - 3(-21)$
$= -20 + 63$
$= \mathbf{43}$

(c) $\frac{x}{5y} + \frac{y}{5x} = \frac{-4}{5(7)} + \frac{7}{5(-4)}$
$= -\frac{4}{35} - \frac{7}{20}$
$= -\mathbf{\frac{13}{28}}$

(d) $x^2 + y^2 = (-4)^2 + 7^2$
$= 16 + 49$
$= \mathbf{65}$

8. (a) $3y - 2x = 3\left(\frac{1}{4}\right) - 2(-5)$
$= \frac{3}{4} + 10$
$= \mathbf{10\frac{3}{4}}$

(b) $\frac{1}{y} - \frac{1}{x} = \frac{1}{\frac{1}{4}} - \frac{1}{-5}$
$= 4 + \frac{1}{5}$
$= \mathbf{4\frac{1}{5}}$

(c) $\frac{x-y}{x+y} = \frac{-5-\frac{1}{4}}{-5+\frac{1}{4}}$
$= \frac{-\frac{21}{4}}{-\frac{19}{4}}$
$= \frac{21}{19}$
$= \mathbf{1\frac{2}{19}}$

(d) $\sqrt{-5xy} = \sqrt{-5(-5)\left(\frac{1}{4}\right)}$
$= \sqrt{\frac{25}{4}}$
$= \frac{5}{2}$
$= \mathbf{2\frac{1}{2}}$

9. (a) $7 - 12xy = 7 - 12\left(\frac{1}{3}\right)\left(-\frac{1}{4}\right)$
$= 7 + 1$
$= \mathbf{8}$

(b) $\frac{3}{x} + \frac{4}{y} - 6 = \frac{3}{\frac{1}{3}} + \frac{4}{-\frac{1}{4}} - 6$
$= 9 - 16 - 6$
$= \mathbf{-13}$

(c) $5(x+2y)-9x = 5\left[\frac{1}{3}+2\left(-\frac{1}{4}\right)\right]-9\left(\frac{1}{3}\right)$

$= 5\left(\frac{1}{3}-\frac{1}{2}\right)-3$

$= 5\left(-\frac{1}{6}\right)-3$

$= -\frac{5}{6}-3$

$= \mathbf{-3\frac{5}{6}}$

(d) $\sqrt[3]{\frac{y}{2}}+\frac{3x}{2} = \sqrt[3]{\frac{-\frac{1}{4}}{2}}+\frac{3\left(\frac{1}{3}\right)}{2}$

$= \sqrt[3]{-\frac{1}{8}}+\frac{1}{2}$

$= -\frac{1}{2}+\frac{1}{2}$

$= \mathbf{0}$

10. (a) $99xyz = 99\left(-\frac{1}{2}\right)(0)(4)$

$= \mathbf{0}$

(b) $(x^2-yz)^3 = \left[\left(-\frac{1}{2}\right)^2-(0)(4)\right]^3$

$= \left(\frac{1}{4}\right)^3$

$= \mathbf{\frac{1}{64}}$

(c) $\frac{x^2z}{5}-\frac{3z-y}{2x+z} = \frac{\left(-\frac{1}{2}\right)^2(4)}{5}-\frac{3(4)-0}{2\left(-\frac{1}{2}\right)+4}$

$= \frac{\left(\frac{1}{4}\right)(4)}{5}-\frac{12}{-1+4}$

$= \frac{1}{5}-4$

$= \mathbf{-3\frac{4}{5}}$

(d) $(x+z)(z^2-xz+z)^2 = \left(-\frac{1}{2}+4\right)\left[4^2-\left(-\frac{1}{2}\right)(4)+4\right]^2$

$= \left(\frac{7}{2}\right)(16+2+4)^2$

$= \left(\frac{7}{2}\right)(22)^2$

$= \mathbf{1694}$

11. (a) $xy-yz+xz = 3(-5)-(-5)\left(\frac{1}{2}\right)+3\left(\frac{1}{2}\right)$

$= \mathbf{-11}$

(b) $(x+y-z)^2 = \left[3+(-5)-\frac{1}{2}\right]^2$

$= \mathbf{6\frac{1}{4}}$

(c) $\frac{x-y}{z}-\frac{y-z}{x} = \frac{3-(-5)}{\frac{1}{2}}-\frac{-5-\frac{1}{2}}{3}$

$= \mathbf{17\frac{5}{6}}$

(d) $\frac{x+z}{y^2}\times 5xz = \frac{3+\frac{1}{2}}{(-5)^2}\times 5(3)\left(\frac{1}{2}\right)$

$= \mathbf{1\frac{1}{20}}$

12. $2x + 3y$ is equivalent to $3y + 2x$, as the sum of $2x$ and $3y$ can be written in either way.
$2x - 3y$ is not the same as $3y - 2x$, just as $2 - 3$ is not equal to $3 - 2$.

Challenge Myself!

13. The product of p and $12q$,
the product of $6p$ and $2q$,
the product of $3p$ and $4q$.

Worksheet 6B Addition and subtraction of linear terms

1. (a) $7x + 4x = \mathbf{11x}$

(b) $5x - 2x = \mathbf{3x}$

(c) $8x + (-3x) = 8x - 3x$

$= \mathbf{5x}$

(d) $-6x + x = \mathbf{-5x}$

(e) $-2x - 9x = \mathbf{-11x}$

(f) $-4x - (-5x) = -4x + 5x$

$= \mathbf{x}$

2. (a) $3x + 10 - 6x + 5 = 3x - 6x + 10 + 5$

$= \mathbf{-3x + 15}$

(b) $9x - 4 + (-x) - (-1) = 9x - 4 - x + 1$

$= \mathbf{8x - 3}$

(c) $5x + 8y + 7x - y = 5x + 7x + 8y - y$

$= \mathbf{12x + 7y}$

(d) $4y - 10x - 3y + 6x = 4y - 3y - 10x + 6x$

$= \mathbf{y - 4x}$

(e) $-9x - 2y + (-x) - (-2y) = -9x - 2y - x + 2y$

$= -9x - x - 2y + 2y$

$= \mathbf{-10x}$

(f) $-8y + (-3x) - 5y + (-4x) = -8y - 3x - 5y - 4x$

$= -8y - 5y - 3x - 4x$

$= \mathbf{-13y - 7x}$

(g) $4x - y + 12 + 5y - 9 - 9x = 4x - 9x - y + 5y + 12 - 9$

$= \mathbf{-5x + 4y + 3}$

(h) $3 - 6y + (-2x) - 8 - (-7y) + x$
$= 3 - 6y - 2x - 8 + 7y + x$
$= -2x + x - 6y + 7y + 3 - 8$
$= \mathbf{-x + y - 5}$

3. (a) $24x + 5y + y - 10x = 24x - 10x + 5y + y$

$= \mathbf{14x + 6y}$

(b) $-7x - 15 + 2x - 3y + 9 = -7x + 2x - 3y - 15 + 9$

$= \mathbf{-5x - 3y - 6}$

4. (a) $(7yx + 5 - xy) - (6xy - 11) = (6xy + 5) - (6xy - 11)$

$= 6xy + 5 - 6xy + 11$

$= 6xy - 6xy + 5 + 11$

$= \mathbf{16}$

(b) $(7xy - 8yz + 3x) - (4x - 8yz)$
$= 7xy - 8yz + 3x - 4x + 8yz$
$= 7xy - 8yz + 8yz + 3x - 4x$
$= \mathbf{7xy - x}$

5. **(a)** Sum of the 3 integers $= x + (x + 2) + (x + 4)$
$= x + x + 2 + x + 4$
$= x + x + x + 2 + 4$
$= \mathbf{3x + 6}$

(b) Sum of the 3 integers $= x + (x - 2) + (x - 4)$
$= x + x - 2 + x - 4$
$= x + x + x - 2 - 4$
$= \mathbf{3x - 6}$

6. **(i)** Amount Hannah spends $= \mathbf{\$(2x + 5y)}$

(ii) Amount she has left $= \$[50 - (2x + 5y)]$
$= \mathbf{\$(50 - 2x - 5y)}$

7. Cost of a roll of dental floss $= \$2x$
Cost of an electric toothbrush $= \$8x \neq \$6x$
$\therefore$ It is **incorrect** to conclude that the electric toothbrush costs six times as much as a tube of toothpaste.

8. **(a)** Total amount received $= \mathbf{\$(x + 6y)}$

(b) Since $y = 240$,
amount of commission for 7 vans $= 7 \times \$240$
$= \mathbf{\$1680}$

Worksheet 6C Expansion and factorisation of linear expressions

1. **(a)** $5(x + 7) = \mathbf{5x + 35}$ **(b)** $6(x - 10) = \mathbf{6x - 60}$
(c) $4(3x + 8) = \mathbf{12x + 32}$ **(d)** $9(2x - 1) = \mathbf{18x - 9}$
(e) $-(x + 12) = \mathbf{-x - 12}$ **(f)** $-2(x - 7) = \mathbf{-2x + 14}$
(g) $-6(2x + 9) = \mathbf{-12x - 54}$ **(h)** $-4(5x - 3) = \mathbf{-20x + 12}$
(i) $3(1 + 6x) = \mathbf{3 + 18x}$ **(j)** $5(12 - 4x) = \mathbf{60 - 20x}$
(k) $-2(8 - 3x) = \mathbf{-16 + 6x}$ **(l)** $-9(9 - 10x) = \mathbf{-81 + 90x}$
(m) $7(5x + 4y) = \mathbf{35x + 28y}$ **(n)** $8(3x - 8y) = \mathbf{24x - 64y}$
(o) $-3(6y + x) = \mathbf{-18y - 3x}$ **(p)** $-5(2y - 9x) = \mathbf{-10y + 45x}$

2. **(a)** $8 \times x \times y = \mathbf{8xy}$ **(b)** $11 \times x \times 2 \times y = \mathbf{22xy}$
(c) $3 \times x \times (-9) \times y = \mathbf{-27xy}$ **(d)** $4x \times 10y = \mathbf{40xy}$
(e) $5x \times (-6y) = \mathbf{-30xy}$ **(f)** $(-12x) \times (-12y) = \mathbf{144xy}$
(g) $6x \times y \times 7z = \mathbf{42xyz}$ **(h)** $(-3x) \times 8y \times (-4z) = \mathbf{96xyz}$

3. **(a)** $2a(9x + 4y) = \mathbf{18ax + 8ay}$
(b) $7a(8x - 3y) = \mathbf{56ax - 21ay}$
(c) $-a(5x + y) = \mathbf{-5ax - ay}$
(d) $-6a(x - 10y) = \mathbf{-6ax + 60ay}$
(e) $4bc(6y - 11x) = \mathbf{24bcy - 44bcx}$
(f) $-5bc(3y + 16x) = \mathbf{-15bcy - 80bcx}$

4. **(a)** $12(3x + y) - 10y = 36x + 12y - 10y$
$= \mathbf{36x + 2y}$

(b) $-(5x + 7y) + 11x = -5x - 7y + 11x$
$= -5x + 11x - 7y$
$= \mathbf{6x - 7y}$

(c) $8x + 3y - (3x + 8y) = 8x + 3y - 3x - 8y$
$= 8x - 3x + 3y - 8y$
$= \mathbf{5x - 5y}$

(d) $-(4x - 9y) - 9y = -4x + 9y - 9y$
$= \mathbf{-4x}$

(e) $6(2x - y) + 4(x - 5y) = 12x - 6y + 4x - 20y$
$= 12x + 4x - 6y - 20y$
$= \mathbf{16x - 26y}$

(f) $3(3x + 8y) - 2(4x - 9y) = 9x + 24y - 8x + 18y$
$= 9x - 8x + 24y + 18y$
$= \mathbf{x + 42y}$

(g) $6x + 2(x - 3y + 2z) + 5y = 6x + 2x - 6y + 4z + 5y$
$= 6x + 2x - 6y + 5y + 4z$
$= \mathbf{8x - y + 4z}$

(h) $-4x - 3(2x + 12y - 3z) - 9z = -4x - 6x - 36y + 9z - 9z$
$= \mathbf{-10x - 36y}$

5. **(a)** $-2\{5x - 6a[y - (14y + x)]\} = -2[5x - 6a(y - 14y - x)]$
$= -2[5x - 6a(-13y - x)]$
$= -2(5x + 78ay + 6ax)$
$= \mathbf{-10x - 156ay - 12ax}$

(b) $10\{7y + (-3a)[8x - 3y - 2(x - 4y)]\}$
$= 10[7y - 3a(8x - 3y - 2x + 8y)]$
$= 10[7y - 3a(8x - 2x - 3y + 8y)]$
$= 10[7y - 3a(6x + 5y)]$
$= 10(7y - 18ax - 15ay)$
$= \mathbf{70y - 180ax - 150ay}$

6. $4(2y - 9x + 11) + (7x - 3y + 5)$
$= 8y - 36x + 44 + 7x - 3y + 5$
$= 8y - 3y - 36x + 7x + 44 + 5$
$= \mathbf{5y - 29x + 49}$

7. $[7x + 2y + [-(4y - 10x)]\} - (-6)[x - 5y + 2(3y - 4x)]$
$= [7x + 2y - (4y - 10x)] + 6(x - 5y + 6y - 8x)$
$= (7x + 2y - 4y + 10x) + 6(x - 8x - 5y + 6y)$
$= (7x + 10x + 2y - 4y) + 6(-7x + y)$
$= 17x - 2y - 42x + 6y$
$= 17x - 42x - 2y + 6y$
$= \mathbf{-25x + 4y}$

8. **(a)** $16x + 12 = \mathbf{4(4x + 3)}$
(b) $9x - 45 = \mathbf{9(x - 5)}$
(c) $10 - 15x = \mathbf{5(2 - 3x)}$
(d) $-33x - 44 = \mathbf{-11(3x + 4)}$
(e) $14ax + 6ay = \mathbf{2a(7x + 3y)}$
(f) $-21ax + 56ay = 7a(-3x + 8y)$
$= \mathbf{7a(8y - 3x)}$
(g) $24x - 27y + 3z = \mathbf{3(8x - 9y + z)}$
(h) $-8ax + 10bx + 12cx = \mathbf{2x(-4a + 5b + 6c)}$

9. **(a)** $9x + 18x(a + b) = 9x[1 + 2(a + b)]$
$= \mathbf{9x(1 + 2a + 2b)}$

(b) $5ax - 20a(y - z) = 5a[x - 4(y - z)]$
$= \mathbf{5a(x - 4y + 4z)}$

(c) $-3x(4y + 7z) - 12x = -3x[(4y + 7z) + 4]$
$= \mathbf{-3x(4y + 7z + 4)}$

(d) $-17x^2 - 34xy = \mathbf{-17x(x + 2y)}$

(e) $7a(1 - 4x) + 3a(5x - 6) = a[7(1 - 4x) + 3(5x - 6)]$
$= a(7 - 28x + 15x - 18)$
$= a(7 - 18 - 28x + 15x)$
$= a(-11 - 13x)$
$= \mathbf{-a(11 + 13x)}$

(f) $-2x(9a + b) - 8x(3a - 5b) = -2x[(9a + b) + 4(3a - 5b)]$
$= -2x(9a + b + 12a - 20b)$
$= -2x(9a + 12a + b - 20b)$
$= \mathbf{-2x(21a - 19b)}$

Challenge Myself!

10. $-34a^4bx^2 - 85a^3b^2x^2 - 68a^3bc^2x^2 = \mathbf{-17a^3bx^2(2a + 5b + 4c^2)}$

Worksheet 6D Linear expressions with fractional coefficients

1. **(a)** $\frac{1}{5}x+\frac{1}{4}y+\frac{1}{7}x+\frac{1}{8}y = \frac{1}{5}x+\frac{1}{7}x+\frac{1}{4}y+\frac{1}{8}y$

$= \mathbf{\frac{12}{35}x+\frac{3}{8}y}$

(b) $\frac{2}{3}x-\frac{1}{2}y-\frac{1}{6}x+\frac{2}{5}y = \frac{2}{3}x-\frac{1}{6}x-\frac{1}{2}y+\frac{2}{5}y$

$= \mathbf{\frac{1}{2}x-\frac{1}{10}y}$

(c) $3x-\frac{6}{7}y+\frac{4}{5}x-\frac{9}{14}y = 3x+\frac{4}{5}x-\frac{6}{7}y-\frac{9}{14}y$

$= \mathbf{\frac{19}{5}x-\frac{3}{2}y}$

(d) $\frac{5}{6}x-\frac{3}{4}y+z+\frac{3}{4}x-2y+\frac{1}{2}z$

$= \frac{5}{6}x+\frac{3}{4}x-\frac{3}{4}y-2y+z+\frac{1}{2}z$

$= \mathbf{\frac{19}{12}x-\frac{11}{4}y+\frac{3}{2}z}$

2. **(a)** $\frac{4}{5}[2(11x+7)-4+23x] = \frac{4}{5}(22x+14-4+23x)$

$= \frac{4}{5}(22x+23x+14-4)$

$= \frac{4}{5}(45x+10)$

$= \mathbf{36x+8}$

(b) $\frac{1}{2}[7x-3(4y-5x)] = \frac{1}{2}(7x-12y+15x)$

$= \frac{1}{2}(7x+15x-12y)$

$= \frac{1}{2}(22x-12y)$

$= \mathbf{11x-6y}$

(c) $-\frac{1}{3}[6(2y-5x)-(-9y)] = -\frac{1}{3}(12y-30x+9y)$

$= -\frac{1}{3}(12y+9y-30x)$

$= -\frac{1}{3}(21y-30x)$

$= -7y+10x$

$= \mathbf{10x-7y}$

(d) $-\frac{3}{4}[(12x+28y)-8(7x-y)]$

$= -\frac{3}{4}(12x+28y-56x+8y)$

$= -\frac{3}{4}(12x-56x+28y+8y)$

$= -\frac{3}{4}(-44x+36y)$

$= \mathbf{33x-27y}$

3. **(a)** $1+\frac{5x}{14} = \mathbf{\frac{14+5x}{14}}$

(b) $\frac{6x}{11}-3 = \mathbf{\frac{6x-33}{11}}$

(c) $\frac{7}{8}-x = \mathbf{\frac{7-8x}{8}}$

(d) $\frac{2}{9}+4x = \mathbf{\frac{2+36x}{9}}$

4. **(a)** $\frac{3x}{4}+\frac{7x}{12} = \frac{9x+7x}{12}$

$= \frac{16x}{12}$

$= \mathbf{\frac{4x}{3}}$

(b) $\frac{2x}{3}-\frac{2x}{9} = \frac{6x-2x}{9}$

$= \mathbf{\frac{4x}{9}}$

(c) $x+\frac{5x-3}{6} = \frac{6x+5x-3}{6}$

$= \mathbf{\frac{11x-3}{6}}$

(d) $\frac{1-5x}{8}-6x = \frac{1-5x-48x}{8}$

$= \mathbf{\frac{1-53x}{8}}$

(e) $\frac{x}{8}+\frac{4x-1}{2} = \frac{x+16x-4}{8}$

$= \mathbf{\frac{17x-4}{8}}$

(f) $\frac{3x}{5}-\frac{x+1}{4} = \frac{12x-5x-5}{20}$

$= \mathbf{\frac{7x-5}{20}}$

(g) $-\frac{7-x}{2}-\frac{x}{10} = \frac{x-7}{2}-\frac{x}{10}$

$= \frac{5x-35-x}{10}$

$= \mathbf{\frac{4x-35}{10}}$

(h) $\frac{7x-4}{9}+\frac{8x-3}{5} = \frac{35x-20+72x-27}{45}$

$= \mathbf{\frac{107x-47}{45}}$

(i) $\frac{9x+1}{6}-\frac{10x-3}{7}+\frac{1}{3} = \frac{63x+7-60x+18+14}{42}$

$= \frac{3x+39}{42}$

$= \mathbf{\frac{x+13}{14}}$

(j) $\frac{2x+5}{4}-\frac{x}{6}-\frac{7-6x}{8} = \frac{12x+30-4x-21+18x}{24}$

$= \mathbf{\frac{26x+9}{24}}$

5. **(a)** $\frac{5x+y}{6}+\frac{4x+9y}{3} = \frac{5x+y+8x+18y}{6}$

$= \mathbf{\frac{13x+19y}{6}}$

(b) $\frac{10y}{7}+\frac{3x-8y}{2} = \frac{20y+21x-56y}{14}$

$= \mathbf{\frac{21x-36y}{14}}$

(c) $\frac{3y-10x}{4}-\frac{x+2y}{5} = \frac{15y-50x-4x-8y}{20}$

$= \mathbf{\frac{7y-54x}{20}}$

(d) $\frac{7x}{8} - \frac{4y-5x}{3} = \frac{21x-32y+40x}{24}$

$= \mathbf{\frac{61x-32y}{24}}$

(e) $\frac{9x+y}{6} + \frac{3x}{4} + \frac{2y-5x}{12}$

$= \frac{18x+2y+9x+2y-5x}{12}$

$= \frac{22x+4y}{12}$

$= \mathbf{\frac{11x+2y}{6}}$

(f) $\frac{5y-6x}{3} + \frac{9y}{2} - \frac{4x+y}{9}$

$= \frac{30y-36x+81y-8x-2y}{18}$

$= \mathbf{\frac{109y-44x}{18}}$

(g) $x + \frac{7x-4y}{3} + \frac{10y+3x}{5}$

$= \frac{15x+35x-20y+30y+9x}{15}$

$= \mathbf{\frac{59x+10y}{15}}$

(h) $4y - \frac{3x+2y}{7} + \frac{2x-3y}{4}$

$= \frac{112y-12x-8y+14x-21y}{28}$

$= \mathbf{\frac{2x+83y}{28}}$

(i) $2x - y + \frac{6x-9y}{2} - \frac{5x+2y}{8}$

$= \frac{16x-8y+24x-36y-5x-2y}{8}$

$= \mathbf{\frac{35x-46y}{8}}$

(j) $3y - x - \frac{4x-5y}{10} - \frac{7y+2x}{4}$

$= \frac{60y-20x-8x+10y-35y-10x}{20}$

$= \mathbf{\frac{35y-38x}{20}}$

6. (a) $\frac{9(x+y)}{12} + \frac{2x-y}{4}$

$= \frac{3(x+y)}{4} + \frac{2x-y}{4}$

$= \frac{3x+3y+2x-y}{4}$

$= \mathbf{\frac{5x+2y}{4}}$

(b) $\frac{7(4x-y)}{20} + \frac{2y}{5} = \frac{28x-7y+8y}{20}$

$= \mathbf{\frac{28x+y}{20}}$

(c) $\frac{6x}{7} - \frac{3(3x+5y)}{14} = \frac{12x-9x-15y}{14}$

$= \mathbf{\frac{3x-15y}{14}}$

(d) $\frac{8x+8y}{9} - \frac{2(6x-y)}{45} = \frac{40x+40y-12x+2y}{45}$

$= \mathbf{\frac{28x+42y}{45}}$

(e) $\frac{7(2x-3y)}{5} + \frac{2(4x+5y)}{3}$

$= \frac{21(2x-3y)+10(4x+5y)}{15}$

$= \frac{42x-63y+40x+50y}{15}$

$= \mathbf{\frac{82x-13y}{15}}$

(f) $\frac{11(2y-x)}{6} - \frac{3(7x-4y)}{8}$

$= \frac{44(2y-x)-9(7x-4y)}{24}$

$= \frac{88y-44x-63x+36y}{24}$

$= \mathbf{\frac{124y-107x}{24}}$

(g) $\frac{y-x}{4} - \left[\frac{4(3x+2y)}{3} - \frac{3(x-9y)}{6}\right]$

$= \frac{y-x}{4} - \frac{4(3x+2y)}{3} + \frac{x-9y}{2}$

$= \frac{3(y-x)-16(3x+2y)+6(x-9y)}{12}$

$= \frac{3y-3x-48x-32y+6x-54y}{12}$

$= -\frac{-45x-83y}{12}$

$= \mathbf{-\frac{45x+83y}{12}}$

(h) $\frac{8(5y-4x)}{15} - \left[-\frac{3(x+7y)}{2} + 3x - 4y\right]$

$= \frac{8(5y-4x)}{15} + \frac{3(x+7y)}{2} - 3x + 4y$

$= \frac{16(5y-4x)+45(x+7y)-90x+120y}{30}$

$= \frac{80y-64x+45x+315y-90x+120y}{30}$

$= \mathbf{\frac{515y-109x}{30}}$

7. $\frac{1}{4}x + \frac{1}{5}y + \frac{h}{2}x + \frac{k}{10}y = \frac{1}{4}x + \frac{h}{2}x + \frac{1}{5}y + \frac{k}{10}y$

$= \frac{1+2h}{4}x + \frac{2+k}{10}y$

Let $h = 2$. Then $p = 1 + 2h$

$= 1 + 2(2)$

$= 5.$

Let $k = 7$. Then $q = 2 + k$

$= 2 + 7$

$= 9.$

$\therefore$ A possible set of values is $\boldsymbol{h = 2, k = 7, p = 5}$ **and** $\boldsymbol{q = 9}$.

8. $\frac{ax+7y}{3} + \frac{y-bx}{12} = \frac{4ax+28y+y-bx}{12}$

$= \frac{4ax-bx+29y}{12}$

$= \frac{4ax-bx}{12} + \frac{29y}{12}$

Let $a = 5$ and $b = 3$. Then $c = 4a - b$

$= 4(5) - 3$

$= 17.$

$\therefore$ A possible set of values is $\boldsymbol{a = 5, b = 3}$ **and** $\boldsymbol{c = 17}$.

9. **(i)** The LCM of 12 and 18 is 36, but 5 is not a factor of 36.

(ii) $\frac{19x+10y}{12} + \frac{4x-15y}{18} = \frac{57x+30y+8x-30y}{36}$

$= \frac{65x}{36}$

$\therefore$ $\boldsymbol{a = 65, b = 0}$

10. A mistake was made in the third line of the working, which should be $\frac{5(4x-y)}{6} - \frac{11(x-2y)-18(3y-2x)}{21}$.

Another mistake was made in the second last line of the working, in which the wrong operation sign was used.

$\frac{5(4x-y)}{6} - \frac{11(x-2y)}{21} + \frac{6(3y-2x)}{7}$

$= \frac{35(4x-y)-22(x-2y)+36(3y-2x)}{42}$

$= \frac{140x-35y-22x+44y+108y-72x}{42}$

$= \boldsymbol{\frac{46x+117y}{42}}$

Review Exercise 6

1. **(a)** $4x + 9y = 4(2) + 9\left(-\frac{1}{3}\right)$

$= 8 - 3$

$= \mathbf{5}$

(b) $\frac{1}{x} - \frac{1}{y} = \frac{1}{2} - \frac{1}{-\frac{1}{3}}$

$= \frac{1}{2} + 3$

$= \mathbf{3\frac{1}{2}}$

(c) $\frac{xy}{x+y} = \frac{2\left(-\frac{1}{3}\right)}{2+\left(-\frac{1}{3}\right)}$

$= \frac{-\frac{2}{3}}{\frac{5}{3}}$

$= \mathbf{-\frac{2}{5}}$

(d) $(3x-y)^2 = \left[3(2) - \left(-\frac{1}{3}\right)\right]^2$

$= \left(6+\frac{1}{3}\right)^2$

$= \mathbf{40\frac{1}{9}}$

2. **(a)** $-5(6x - 11y) + 2(x - 3y) = -30x + 55y + 2x - 6y$

$= -30x + 2x + 55y - 6y$

$= \boldsymbol{-28x + 49y}$

(b) $4[7y + 2(-5x)] - 3(8x - 9y) = 4(7y - 10x) - 24x + 27y$

$= 28y - 40x - 24x + 27y$

$= 28y + 27y - 40x - 24x$

$= \boldsymbol{55y - 64x}$

3. **(a)** $3abxy - 12acxz + 6ax = \boldsymbol{3ax(by - 4cz + 2)}$

(b) $-40ay - 56y - 24bcy = \boldsymbol{-8y(5a + 7 + 3bc)}$

4. $-8\{-2(10x + 3y) + [-5(6y - 7x)]\}$

$= -8(-20x - 6y - 30y + 35x)$

$= -8(15x - 36y)$

$= -120x + 288y$

$= \boldsymbol{288y - 120x}$

5. **(a)** $\frac{3(7x-y)}{5} - \frac{5(x+9y)}{8}$

$= \frac{24(7x-y)-25(x+9y)}{40}$

$= \frac{168x-24y-25x-225y}{40}$

$= \boldsymbol{\frac{143x-249y}{40}}$

(b) $4y - \left(\frac{6x+5y}{7} + \frac{8x-2y}{3}\right)$

$= 4y - \frac{6x+5y}{7} - \frac{8x-2y}{3}$

$= \frac{84y-3(6x+5y)-7(8x-2y)}{21}$

$= \frac{84y-18x-15y-56x+14y}{21}$

$= \boldsymbol{\frac{83y-74x}{21}}$

6. **(i)** $3(v - 2) - 3u = 3v - 6 - 3u$

$= 3(x + 3) - 6 - 3(2x - 1)$

$= 3x + 9 - 6 - 6x + 3$

$= \boldsymbol{6 - 3x}$

(ii) $\frac{u}{5} + \frac{v}{3} = \frac{2x-1}{5} + \frac{x+3}{3}$

$= \frac{6x-3+5x+15}{15}$

$= \boldsymbol{\frac{11x+12}{15}}$

7. **(a)** Let $x = 4$ and $y = 3$.

$10x - 7y = 10(4) - 7(3)$

$= 40 - 21$

$= 19$

$7y - 10x = 7(3) - 10(4)$

$= 21 - 40$

$= -19$

$\therefore$ $10x - 7y$ is not always the same as $7y - 10x$.

(b) Yes.

When $x = 7$ and $y = 10$,

$10x - 7y = 10(7) - 7(10)$

$= 70 - 70$

$= 0$

and

$7y - 10x = 7(10) - 10(7)$

$= 70 - 70$

$= 0.$

$\therefore 10x - 7y$ can have the same value as $7y - 10x$.

8. (a) Sum of the 3 integers $= x + (x + 2) + (x + 4)$

$= x + x + 2 + x + 4$

$= \mathbf{3x + 6}$

(b) Sum of the 3 integers $= x + (x - 2) + (x - 4)$

$= x + x - 2 + x - 4$

$= \mathbf{3x - 6}$

(c) $x - (x - 4) = x - x + 4$

$= 4$

$\therefore$ The difference is always 4.

9. (i) Breadth of rectangle

$= \dfrac{6x + 12y - 10 - 2(2x + 4y - 3)}{2}$ cm

$= \dfrac{6x + 12y - 10 - 4x - 8y + 6}{2}$ cm

$= \dfrac{2x + 4y - 4}{2}$ cm

$= \mathbf{(x + 2y - 2)\ cm}$

(ii) When $x = 5$ and $y = 1$,

Length of rectangle $= [2(5) + 4(1) - 3]$ cm

$= 11$ cm

Breadth of rectangle $= [5 + 2(1) - 2]$ cm

$= 5$ cm

$\therefore$ Area of rectangle $= 11\ \text{cm} \times 5\ \text{cm}$

$= \mathbf{55\ cm^2}$

10. (i) Sum of heights $= \mathbf{(2h + 4k)\ m}$

(ii) Average height $= \dfrac{2h + 4k}{6}$ m

$= \mathbf{\dfrac{h + 2k}{3}\ m}$

11. (a) $\mathbf{(x - 30)\ years}$

(b) $\mathbf{\dfrac{1}{2}(x - 30)\ years}$

(c) Sum of ages $= \left[x + (x - 30) + \dfrac{1}{2}(x - 30)\right]$ years

$= \left(x + x - 30 + \dfrac{1}{2}x - 15\right)$ years

$= \mathbf{\left(\dfrac{5}{2}x - 45\right)\ years}$

12. (a) Number of Japanese books $= \boldsymbol{p - q}$

(b) Total amount spent $= \$[8q + 9(p - q)]$

$= \$(8q + 9p - 9q)$

$= \mathbf{\$(9p - q)}$

13. (i) Total mass $= \left(\dfrac{120}{20}x + \dfrac{50}{10}y + 2\right)$ kg

$= \mathbf{(6x + 5y + 2)\ kg}$

(ii) Assume that the mass of the bag is negligible.

14. (i) Cost of a lunch box $= \$(x + 6)$

Total amount spent $= \$[3x + 2(x + 6)]$

$= \$(3x + 2(x + 6)]$

$= \mathbf{\$(5x + 12)}$

(ii) OPEN Let $x = 16$.

Then the total amount spent $= \$(5(16) + 12]$

$= \$92$

and the amount left $= \$100 - \$92$

$= \$8$

$\therefore$ A water bottle could cost **$16**.

7 Linear Equations

Worksheet 7A Linear equations

1. (a) $x + 4 = 15$

$x + 4 - 4 = 15 - 4$

$x = \mathbf{11}$

(b) $x + 7 = -7$

$x + 7 - 7 = -7 - 7$

$x = \mathbf{-14}$

(c) $x - 6 = 10$

$x - 6 + 6 = 10 + 6$

$x = \mathbf{16}$

(d) $x - 12 = -1$

$x - 12 + 12 = -1 + 12$

$x = \mathbf{11}$

(e) $3x = 27$

$\dfrac{3x}{3} = \dfrac{27}{3}$

$x = \mathbf{9}$

(f) $5x = -55$

$\dfrac{5x}{5} = \dfrac{-55}{5}$

$x = \mathbf{-11}$

(g) $-2x = 42$

$\dfrac{-2x}{-2} = \dfrac{42}{-2}$

$x = \mathbf{-21}$

(h) $-6x = -84$

$\dfrac{-6x}{-6} = \dfrac{-84}{-6}$

$x = \mathbf{14}$

(i) $9x + 1 = 82$

$9x + 1 - 1 = 82 - 1$

$9x = 81$

$\dfrac{9x}{9} = \dfrac{81}{9}$

$x = \mathbf{9}$

(j) $4x - 3 = 25$

$4x - 3 + 3 = 25 + 3$

$4x = 28$

$\dfrac{4x}{4} = \dfrac{28}{4}$

$x = 7$

(k) $7x + 10 = -4$

$7x + 10 - 10 = -4 - 10$

$7x = -14$

$\frac{7x}{7} = \frac{-14}{7}$

$x = \mathbf{-2}$

(l) $2x - 9 = -9$

$2x - 9 + 9 = -9 + 9$

$2x = 0$

$\frac{2x}{2} = \frac{0}{2}$

$x = \mathbf{0}$

(m) $2 - 5x = 67$

$2 - 5x - 2 = 67 - 2$

$-5x = 65$

$\frac{-5x}{-5} = \frac{65}{-5}$

$x = \mathbf{-13}$

(n) $11 - 3x = -16$

$11 - 3x - 11 = -16 - 11$

$-3x = -27$

$\frac{-3x}{-3} = \frac{-27}{-3}$

$x = \mathbf{9}$

(o) $4x + 1 = -\frac{3}{5}$

$4x + 1 - 1 = -\frac{3}{5} - 1$

$4x = -\frac{8}{5}$

$\frac{4x}{4} = \frac{-\frac{8}{5}}{4}$

$x = \mathbf{-\frac{2}{5}}$

(p) $8x - 0.7 = 4.9$

$8x - 0.7 + 0.7 = 4.9 + 0.7$

$8x = 5.6$

$\frac{8x}{8} = \frac{5.6}{8}$

$x = \mathbf{0.7}$

2. (a) $3x = 2x + 25$

$3x - 2x = 2x + 25 - 2x$

$x = \mathbf{25}$

(b) $7x = x + 12$

$7x - x = x + 12 - x$

$6x = 12$

$\frac{6x}{6} = \frac{12}{6}$

$x = \mathbf{2}$

(c) $9x - 14 = 2x$

$9x - 14 - 2x = 2x - 2x$

$7x - 14 = 0$

$7x - 14 + 14 = 0 + 14$

$7x = 14$

$\frac{7x}{7} = \frac{14}{7}$

$x = \mathbf{2}$

(d) $5x + 1 = 4x + 6$

$5x + 1 - 4x = 4x + 6 - 4x$

$x + 1 = 6$

$x + 1 - 1 = 6 - 1$

$x = \mathbf{5}$

(e) $10x - 3 = 8x - 17$

$10x - 3 - 8x = 8x - 17 - 8x$

$2x - 3 = -17$

$2x - 3 + 3 = -17 + 3$

$2x = -14$

$\frac{2x}{2} = \frac{-14}{2}$

$x = \mathbf{-7}$

(f) $11 - 2x = 5 - 3x$

$11 - 2x + 3x = 5 - 3x + 3x$

$11 + x = 5$

$11 + x - 11 = 5 - 11$

$x = \mathbf{-6}$

(g) $2(4x + 1) = 16$

$\frac{2(4x+1)}{2} = \frac{16}{2}$

$4x + 1 = 8$

$4x + 1 - 1 = 8 - 1$

$4x = 7$

$\frac{4x}{4} = \frac{7}{4}$

$x = \mathbf{1\frac{3}{4}}$

(h) $-6(x - 1) = 18$

$\frac{-6(x-1)}{-6} = \frac{18}{-6}$

$x - 1 = -3$

$x - 1 + 1 = -3 + 1$

$x = \mathbf{-2}$

(i) $30 = 5(3x - 2)$

$5(3x - 2) = 30$

$\frac{5(3x-2)}{5} = \frac{30}{5}$

$3x - 2 = 6$

$3x - 2 + 2 = 6 + 2$

$3x = 8$

$\frac{3x}{3} = \frac{8}{3}$

$x = \mathbf{2\frac{2}{3}}$

(j) $14 = -7(2x + 7)$

$-7(2x + 7) = 14$

$\frac{-7(2x+7)}{-7} = \frac{14}{-7}$

$2x + 7 = -2$

$2x + 7 - 7 = -2 - 7$

$2x = -9$

$\frac{2x}{2} = \frac{-9}{2}$

$x = \mathbf{-4\frac{1}{2}}$

(k) $4(9x + 4) = 19x - 1$

$36x + 16 = 19x - 1$

$36x + 16 - 19x = 19x - 1 - 19x$

$17x + 16 = -1$

$17x + 16 - 16 = -1 - 16$

$17x = -17$

$\frac{17x}{17} = \frac{-17}{17}$

$x = \mathbf{-1}$

(l) $21x = 3(8x + 5)$

$21x = 24x + 15$

$21x - 24x = 24x + 15 - 24x$

$-3x = 15$

$\frac{-3x}{-3} = \frac{15}{-3}$

$x = \mathbf{-5}$

(m) $3(x + 1) = 8\left(x - \frac{1}{4}\right)$

$3x + 3 = 8x - 2$

$3x + 3 - 8x = 8x - 2 - 8x$

$-5x + 3 = -2$

$-5x + 3 - 3 = -2 - 3$

$-5x = -5$

$\frac{-5x}{-5} = \frac{-5}{-5}$

$x = \mathbf{1}$

(n) $7\left(7x + \frac{1}{2}\right) - 5\left(5x - \frac{1}{2}\right) = 0$

$49x + \frac{7}{2} - 25x + \frac{5}{2} = 0$

$24x + 6 = 0$

$24x + 6 - 6 = 0 - 6$

$24x = -6$

$\frac{24x}{24} = \frac{-6}{24}$

$x = \mathbf{-\frac{1}{4}}$

(o) $7(2x - 3.9) = 4(x + 1.3)$

$14x - 27.3 = 4x + 5.2$

$14x - 27.3 - 4x = 4x + 5.2 - 4x$

$10x - 27.3 = 5.2$

$10x - 27.3 + 27.3 = 5.2 + 27.3$

$10x = 32.5$

$\frac{10x}{10} = \frac{32.5}{10}$

$x = \mathbf{3.25}$

(p) $5(2x + 0.4) + 6(x - 1.5) = 0$

$10x + 2 + 6x - 9 = 0$

$16x - 7 = 0$

$16x - 7 + 7 = 0 + 7$

$16x = 7$

$\frac{16x}{16} = \frac{7}{16}$

$x = \mathbf{\frac{7}{16}}$

Worksheet 7B Linear equations with fractional coefficients and fractional equations

1. (a) $\frac{1}{6}x = 3$

$\frac{1}{6}x \times 6 = 3 \times 6$

$x = \mathbf{18}$

(b) $\frac{2}{5}x = 4$

$\frac{2}{5}x \times \frac{5}{2} = 4 \times \frac{5}{2}$

$x = \mathbf{10}$

(c) $\frac{1}{4}x + 5 = 9$

$\frac{1}{4}x + 5 - 5 = 9 - 5$

$\frac{1}{4}x = 4$

$\frac{1}{4}x \times 4 = 4 \times 4$

$x = \mathbf{16}$

(d) $\frac{3}{8}x - 1 = 2$

$\frac{3}{8}x - 1 + 1 = 2 + 1$

$\frac{3}{8}x = 3$

$\frac{3}{8}x \times \frac{8}{3} = 3 \times \frac{8}{3}$

$x = \mathbf{8}$

(e) $-\frac{2}{3}x + 7 = 1$

$-\frac{2}{3}x + 7 - 7 = 1 - 7$

$-\frac{2}{3}x = -6$

$-\frac{2}{3}x \times \left(-\frac{3}{2}\right) = -6 \times \left(-\frac{3}{2}\right)$

$x = \mathbf{9}$

(f) $10 - \frac{3}{4}x = -5$

$10 - \frac{3}{4}x - 10 = -5 - 10$

$-\frac{3}{4}x = -15$

$-\frac{3}{4}x \times \left(-\frac{4}{3}\right) = -15 \times \left(-\frac{4}{3}\right)$

$x = \mathbf{20}$

(g) $x = \frac{4}{5}x - 6$

$x - \frac{4}{5}x = \frac{4}{5}x - 6 - \frac{4}{5}x$

$\frac{1}{5}x = -6$

$\frac{1}{5}x \times 5 = -6 \times 5$

$x = \mathbf{-30}$

(h) $\frac{2}{7}x = 3x + 19$

$\frac{2}{7}x - 3x = 3x + 19 - 3x$

$-\frac{19}{7}x = 19$

$-\frac{19}{7}x \times \left(-\frac{7}{19}\right) = 19 \times \left(-\frac{7}{19}\right)$

$x = \mathbf{-7}$

(i) $3 - \frac{5}{6}x = -\frac{2}{9}x - 8$

$3 - \frac{5}{6}x + \frac{2}{9}x = -\frac{2}{9}x - 8 + \frac{2}{9}x$

$3 - \frac{11}{18}x - 3 = -8 - 3$

$-\frac{11}{18}x = -11$

$-\frac{11}{18}x \times \left(-\frac{18}{11}\right) = -11 \times \left(-\frac{18}{11}\right)$

$x = \mathbf{18}$

(j) $\frac{3}{5}x + 4 = \frac{1}{2}(x - 1)$

$= \frac{1}{2}x - \frac{1}{2}$

$\frac{3}{5}x + 4 - \frac{1}{2}x = \frac{1}{2}x - \frac{1}{2} - \frac{1}{2}x$

$\frac{1}{10}x + 4 - 4 = -\frac{1}{2} - 4$

$\frac{1}{10}x = -\frac{9}{2}$

$\frac{1}{10}x \times 10 = -\frac{9}{2} \times 10$

$x = \mathbf{-45}$

(k) $\frac{1}{2}(x + 1) = \frac{1}{3}(2x - 1)$

$\frac{1}{2}x + \frac{1}{2} = \frac{2}{3}x - \frac{1}{3}$

$\frac{1}{2}x + \frac{1}{2} - \frac{2}{3}x = \frac{2}{3}x - \frac{1}{3} - \frac{2}{3}x$

$-\frac{1}{6}x + \frac{1}{2} - \frac{1}{2} = -\frac{1}{3} - \frac{1}{2}$

$-\frac{1}{6}x = -\frac{5}{6}$

$-\frac{1}{6}x \times (-6) = -\frac{5}{6} \times (-6)$

$x = \mathbf{5}$

(l) $\frac{1}{8}(5x + 7) - \frac{4}{9}(2x - 3) = 0$

$\frac{5}{8}x + \frac{7}{8} - \frac{8}{9}x + \frac{4}{3} = 0$

$-\frac{19}{72}x + \frac{53}{24} = 0$

$-\frac{19}{72}x + \frac{53}{24} - \frac{53}{24} = 0 - \frac{53}{24}$

$-\frac{19}{72}x = -\frac{53}{24}$

$-\frac{19}{72}x \times \left(-\frac{72}{19}\right) = -\frac{53}{24} \times \left(-\frac{72}{19}\right)$

$x = \mathbf{8\frac{7}{19}}$

2. (a) $x + \frac{x}{8} = 27$

$\frac{9x}{8} = 27$

$\frac{9x}{8} \times \frac{8}{9} = 27 \times \frac{8}{9}$

$x = \mathbf{24}$

(b) $5x - \frac{x}{3} = 42$

$\frac{14x}{3} = 42$

$\frac{14x}{3} \times \frac{3}{14} = 42 \times \frac{3}{14}$

$x = \mathbf{9}$

(c) $\frac{x}{2} + \frac{x}{7} = 5$

$\frac{9x}{14} = 5$

$\frac{9x}{14} \times \frac{14}{9} = 5 \times \frac{14}{9}$

$x = \mathbf{7\frac{7}{9}}$

(d) $\frac{x}{4} - \frac{x}{9} = 10$

$\frac{5x}{36} = 10$

$\frac{5x}{36} \times \frac{36}{5} = 10 \times \frac{36}{5}$

$x = \mathbf{72}$

(e) $\frac{4x - 1}{9} = 3$

$\frac{4x - 1}{9} \times 9 = 3 \times 9$

$4x - 1 = 27$

$4x - 1 + 1 = 27 + 1$

$4x = 28$

$x = \mathbf{7}$

(f) $\frac{7x + 2}{6} - 4 = 0$

$\frac{7x + 2}{6} - 4 + 4 = 0 + 4$

$\frac{7x + 2}{6} = 4$

$\frac{7x + 2}{6} \times 6 = 4 \times 6$

$7x + 2 = 24$

$7x + 2 - 2 = 24 - 2$

$7x = 22$

$x = \mathbf{3\frac{1}{7}}$

(g) $\frac{5x}{6} + \frac{x - 1}{3} = 0$

$\left(\frac{5x}{6} + \frac{x - 1}{3}\right) \times 6 = 0 \times 6$

$5x + 2x - 2 = 0$

$7x - 2 = 0$

$7x - 2 + 2 = 0 + 2$

$7x = 2$

$x = \mathbf{\frac{2}{7}}$

(h) $\frac{3x+7}{8} - \frac{2x+1}{5} = 0$

$\left(\frac{3x+7}{8} - \frac{2x+1}{5}\right) \times 40 = 0 \times 40$

$15x + 35 - 16x - 8 = 0$

$-x + 27 = 0$

$-x + 27 + x = 0 + x$

$27 = x$

$x = \mathbf{27}$

(i) $1 - \frac{x}{4} = \frac{5x+8}{8}$

$\left(1 - \frac{x}{4}\right) \times 8 = \frac{5x+8}{8} \times 8$

$8 - 2x = 5x + 8$

$8 - 2x - 5x = 5x + 8 - 5x$

$8 - 7x = 8$

$8 - 7x - 8 = 8 - 8$

$-7x = 0$

$x = \mathbf{0}$

(j) $\frac{9-2x}{4} + \frac{3(x+3)}{10} = x$

$\left(\frac{9-2x}{4} + \frac{3(x+3)}{10}\right) \times 20 = x \times 20$

$45 - 10x + 6x + 18 = 20x$

$63 - 4x = 20x$

$63 - 4x + 4x = 20x + 4x$

$63 = 24x$

$24x = 63$

$x = \mathbf{2\frac{5}{8}}$

(k) $\frac{7(x-1)}{2} - \frac{4(8x+1)}{9} = 2\frac{1}{4}$

$\left(\frac{7x-7}{2} - \frac{32x+4}{9}\right) \times 36 = 2\frac{1}{4} \times 36$

$126x - 126 - 128x - 16 = 81$

$-2x - 142 = 81$

$-2x - 142 + 142 = 81 + 142$

$-2x = 223$

$x = \mathbf{-111\frac{1}{2}}$

(l) $2x + \frac{2-5x}{7} = \frac{20x-9}{6} + 11$

$\left(2x + \frac{2-5x}{7}\right) \times 42 = \left(\frac{20x-9}{6} + 11\right) \times 42$

$84x + 12 - 30x = 140x - 63 + 462$

$54x + 12 = 140x + 399$

$54x + 12 - 140x = 140x + 399 - 140x$

$-86x + 12 = 399$

$-86x + 12 - 12 = 399 - 12$

$-86x = 387$

$x = \mathbf{-4\frac{1}{2}}$

3. (a) $\frac{10}{x+1} = 5$

$\frac{10}{x+1} \times (x+1) = 5 \times (x+1)$

$10 = 5x + 5$

$5x + 5 = 10$

$5x = 5$

$x = \mathbf{1}$

(b) $\frac{32}{x-3} = 8$

$\frac{32}{x-3} \times (x-3) = 8 \times (x-3)$

$32 = 8x - 24$

$8x - 24 = 32$

$8x = 56$

$x = \mathbf{7}$

(c) $\frac{21}{4x+6} = -7$

$\frac{21}{4x+6} \times (4x+6) = -7 \times (4x+6)$

$21 = -28x - 42$

$-28x - 42 = 21$

$-28x = 63$

$x = \mathbf{-2\frac{1}{4}}$

(d) $9 = \frac{45}{1-2x}$

$9 \times (1-2x) = \frac{45}{1-2x} \times (1-2x)$

$9 - 18x = 45$

$-18x = 36$

$x = \mathbf{-2}$

(e) $\frac{28}{5x+3} - 1 = \frac{3}{4}$

$\frac{28}{5x+3} = \frac{7}{4}$

$\frac{28}{5x+3} \times 4(5x+3) = \frac{7}{4} \times 4(5x+3)$

$112 = 35x + 21$

$35x + 21 = 112$

$35x = 91$

$x = \mathbf{2\frac{3}{5}}$

(f) $\frac{6}{7} = \frac{1}{x+6} + 1$

$-\frac{1}{7} = \frac{1}{x+6}$

$-\frac{1}{7} \times 7(x+6) = \frac{1}{x+6} \times 7(x+6)$

$-x - 6 = 7$

$-x = 13$

$x = \mathbf{-13}$

(g) $\dfrac{x+7}{x+9} = \dfrac{15}{19}$

$\dfrac{x+7}{x+9} \times 19(x+9) = \dfrac{15}{19} \times 19(x+9)$

$19x + 133 = 15x + 135$

$4x = 2$

$x = \mathbf{\dfrac{1}{2}}$

(h) $\dfrac{3x-2}{4x+2} = 6$

$\dfrac{3x-2}{4x+2} \times (4x+2) = 6 \times (4x+2)$

$3x - 2 = 24x + 12$

$-21x = 14$

$x = \mathbf{-\dfrac{2}{3}}$

(i) $\dfrac{8}{x-3} = \dfrac{3}{x+4}$

$\dfrac{8}{x-3} \times (x-3)(x+4) = \dfrac{3}{x+4} \times (x-3)(x+4)$

$8x + 32 = 3x - 9$

$5x = -41$

$x = \mathbf{-8\dfrac{1}{5}}$

(j) $\dfrac{4}{5x+12} = \dfrac{2}{2x-11}$

$\dfrac{4}{5x+12} \times (5x+12)(2x-11)$

$= \dfrac{2}{2x-11} \times (5x+12)(2x-11)$

$8x - 44 = 10x + 24$

$-2x = 68$

$x = \mathbf{-34}$

(k) $\dfrac{5}{3x+10} + \dfrac{2}{x+1} = 0$

$\left(\dfrac{5}{3x+10} + \dfrac{2}{x+1}\right) \times (3x+10)(x+1)$

$= 0 \times (3x+10)(x+1)$

$5x + 5 + 6x + 20 = 0$

$11x + 25 = 0$

$11x = -25$

$x = \mathbf{-2\dfrac{3}{11}}$

(l) $\dfrac{12}{15x-14} = \dfrac{13}{15x-14}$

$\dfrac{12}{15x-14} \times (15x-14) = \dfrac{13}{15x-14} \times (15x-14)$

$12 = 13$

$\therefore$ The equation has **no solution**.

4. When $x = \dfrac{34}{75}$,

LHS $= 2\left(\dfrac{34}{75} + \dfrac{1}{5}\right) = \dfrac{98}{75}$

RHS $= \dfrac{3}{4}\left(\dfrac{34}{75}\right) - \dfrac{1}{6} = \dfrac{13}{75}$

Since LHS $\neq$ RHS, $x = \dfrac{34}{75}$ is **not** the solution of the equation.

5. **(i)** Consider $3x + 8 = 20$.

$3x = 12$

$x = 4$

Consider $10 - x = 6$.

$-x = -4$

$x = 4$

$\therefore x = \mathbf{4}$

(ii) Two possible equations are $\mathbf{5x + 1 = 21}$ **and** $\mathbf{7 - x = 3}$.

6. **(a)** $5x + 2y = 3x + 8y$

$2x = 6y$

$x = 3y$

No. There are other possible solutions such as $x = 3$ and $y = 1$.

(b) From $x = 3y$,

$\dfrac{x}{y} = 3$

$\dfrac{x}{y} \times \dfrac{7}{9} = 3 \times \dfrac{7}{9}$

$\dfrac{7x}{9y} = \mathbf{2\dfrac{1}{3}}$

7. $\dfrac{1}{4}(7 + 3x) = 0.75x + 2.25$

$7 + 3x = 3x + 9$

$7 = 9$

$\therefore$ The equation has no solution. (shown)

8. The possible equations are $\mathbf{5x + 17 = 7}$, $\mathbf{-\dfrac{2}{3}x - \dfrac{1}{3} = 1}$ **and** $\mathbf{\dfrac{5}{0.125x + 1.5} = 4}$.

Worksheet 7C Applications of linear equations in real-world contexts

1. Let the smallest integer be x.

$x + (x + 1) + (x + 2) = 138$

$3x + 3 = 138$

$3x = 135$

$x = 45$

$\therefore$ The integers are **45, 46 and 47**.

2. Let the smallest integer be x.

$x + (x + 2) + (x + 4) = 165$

$3x + 6 = 165$

$3x = 159$

$x = 53$

$\therefore$ The integers are **53, 55 and 57**.

3. Let the smallest integer be x.

Sum of 3 consecutive even integers

$= x + (x + 2) + (x + 4)$

$= 3x + 6$

$= \mathbf{3(x + 2)}$, which is a multiple of 3

4. Let Paul's mass now be x kg.

$x = \dfrac{8}{9}(x + 8)$

$9x = 8x + 64$

$x = 64$

$\therefore$ His present mass is **64 kg**.

5. Let the number of \$10-notes be x.

$10x + 50(x - 3) = 330$

$10x + 50x - 150 = 330$

$60x = 480$

$x = 8$

∴ Wayne has **8 \$10-notes and 5 \$50-notes**.

6. **(i)** **\$(3x + 320)**

(ii) **3x + 320 + 6x = 860**

(iii) $9x = 540$

$x = 60$

∴ Price of the dining table = \$[3(60) + 320]

= **\$500**

7. **(i)** Let Kate's present age be x years.

$(x + 6) + (3x + 6) = 60$

$4x + 12 = 60$

$4x = 48$

$x = 12$

∴ Kate is **12 years old** now.

(ii) Mrs Wong's present age = 3(12) years

= 36 years

Mrs Wong's age when Kate was born = 36 – 12

= **24 years**

8. **(a)** **No.** It is possible that more people used entrance C than D, such as when $x = 40$.

(b) $x + 2x + 2x + 70 + 3x + 20 = 850$

$8x + 90 = 850$

$8x = 760$

$x = 95$

∴ Number of people who used entrance C

= 2(95) + 70

= **260**

9. **(i)** $12p + 3 = 7(p + 4) + 5$

$12p + 3 = 7p + 28 + 5$

$12p + 3 = 7p + 33$

$5p = 30$

$p =$ **6**

(ii) Amount of money = \$[12(6) + 3]

= **\$75**

(iii) Number of bowls she can buy

$= \frac{\$75 - 5(\$12)}{7}$

= **2** (round down to the nearest integer)

10. **(i)** Perimeter of $\triangle PQR$ = (5x + 2 + 3x – 1 + 8x – 3) cm

= **(16x – 2) cm**

(ii) $16x - 2 = 30$

$16x = 32$

$x =$ **2**

(iii) $PQ = 5(2) + 2 = 12$ cm

$PR = 8(2) - 3 = 13$ cm

∴ The length of the longest side is **13 cm**.

11. **(i)** $5x - \frac{2}{3} - 3x = 3\frac{20}{60}$

$2x - \frac{2}{3} = 3\frac{1}{3}$

$2x = 4$

$x =$ **2**

(ii) Total flight time = $\left[5(2) - \frac{2}{3}\right]$ h

$= 9\frac{1}{3}$ h

= **9 h 20 min**

Challenge Myself!

12. A piece of chocolate weighs 8 grams more than a piece of candy. Seven pieces of candy weigh 10 grams more than five pieces of chocolate.

Worksheet 7D Mathematical formulae

1. When $x = 56$,

$y = \frac{4}{7}(56) - 3$

= **29**

2. When $a = -2$ and $b = -3$,

$w = \frac{[-2 + (-3)]^2}{10}$

$= \mathbf{2\frac{1}{2}}$

3. A possible third number is **11**.

$A = \frac{10 + 11 + 12}{3}$

= 11

∴ The corresponding average is **11**.

4. **(i)** Let the smallest number be x.

$S = x + (x + 2) + (x + 4) + (x + 6)$

= **4x + 12**

(ii) When $x = -22$,

Sum of four consecutive even numbers = 4(–22) + 12

= **–76**

5. **(a)** When $c = 35$,

$f = 1.8(35) + 32$

= 95

∴ 35 °C is **95 °F**.

(b) When $f = 104$,

$c = \frac{5(104 - 32)}{9}$

= 40

∴ 104 °F is **40 °C**.

6. **(a)** When $r = 6$,

$C = 2\pi(6)$

$= 12\pi$

= 37.7 (to 3 s.f.)

∴ The circumference of the circle is **37.7 cm**.

(b) When $C = 24$,

$2\pi r = 24$

$r = \frac{24}{2\pi}$

= 3.820 (to 3 d.p.)

∴ The radius of the circle is **3.820 cm**.

7. **(a)** When $m = 0.2$ and $v = 0.3$,

$E = \frac{1}{2}(0.2)(0.3)^2$

= 0.009

∴ Its kinetic energy is **0.009 joules**.

(b) When $v = 0.4$ and $E = 0.16$,

$$0.16 = \frac{1}{2}m(0.4)^2$$
$$= 0.08m$$
$$0.08m = 0.16$$
$$m = 2$$

$\therefore$ The mass of the object is **2 kg**.

8. (i) $\boldsymbol{(7m + 5n)}$ **s**

(ii) When $m = 24$ and $n = 10$,

Total time taken $= [7(24) + 5(10)]$ s
$= 218$ s
$=$ **3 min 38 s**

9. (i) $\boldsymbol{C = mx}$

(ii) $8 \times \$6 = \$48$

$\therefore$ She could buy **8** plant pots.

10. (i) $n + x + 3x = \boldsymbol{n + 4x}$

(ii) Given that $x = 28$,

$n + 4(28) = 622$
$n + 112 = 622$
$n =$ **510**

11. (i) Total premium $= \$[32 + 4(5)]$
$=$ **\$52**

(ii) Total premium $= \$[80 + 11(n - 3)]$
$= \$(80 + 11n - 33)$
$= \$\boldsymbol{(11n + 47)}$

(iii) Consider the individual policy.

Total premium $= 3 \times \$[32 + 5(n - 3)]$
$= 3 \times \$(32 + 5n - 15)$
$= \$(15n + 51)$

Let $15n + 51 = 11n + 47$
$4n = -4$
$n = -1$

$\therefore$ It is **not possible**.

Challenge Myself!

12. (a) Number of packets of fish required $= \frac{x}{3}$

Number of sacks of potatoes required $= \frac{x}{8}$

$\therefore$ Total amount spent $= \$\left(\frac{\boldsymbol{ax}}{\boldsymbol{3}} + \frac{\boldsymbol{bx}}{\boldsymbol{8}}\right)$

(b) **No.** It only applies if x is a multiple of 24, so that there is an integer number of packets of fish and sacks of potatoes.

Review Exercise 7

1. (a) $4x + 21 = 5$
$4x = -16$
$x = \boldsymbol{-4}$

(b) $1 - 3x = \frac{1}{4}$
$-3x = -\frac{3}{4}$
$x = \boldsymbol{\frac{1}{4}}$

(c) $-8(x - 2) + 9 = 0$
$-8x + 16 + 9 = 0$
$-8x = -25$
$x = \boldsymbol{3\frac{1}{8}}$

(d) $2(7x - 3) = 6x + 15$
$14x - 6 = 6x + 15$
$8x = 21$
$x = \boldsymbol{2\frac{5}{8}}$

(e) $5 - \frac{2x}{3} = \frac{4x + 1}{6}$
$30 - 4x = 4x + 1$
$-8x = -29$
$x = \boldsymbol{3\frac{5}{8}}$

(f) $\frac{2x + 1}{3x - 1} = \frac{4}{7}$
$14x + 7 = 12x - 4$
$2x = -11$
$x = \boldsymbol{-5\frac{1}{2}}$

2. When $x = 1$,

LHS $= \frac{1}{5}[4(1) - 1] = \frac{3}{5}$

RHS $= \frac{1}{2}(1) + \frac{1}{10} = \frac{3}{5}$

Since LHS = RHS, $\boldsymbol{x = 1}$ **is the solution** of the equation.

3. Two possible equations are $\boldsymbol{10x + 9 = 3}$ **and** $\boldsymbol{4 - x = 4.6}$.

4. Let the number be x.

$3x = x + 32$
$2x = 32$
$x = 16$

$\therefore$ The number is **16**.

5. Let the numbers be x and $\frac{3}{4}x$.

$x + \frac{3}{4}x = 49$
$\frac{7}{4}x = 49$
$x = 28$

$\therefore$ Product of the numbers $= 28 \times \frac{3}{4}(28)$
$=$ **588**

6. $4(x - 7) = 8(40 - x)$
$4x - 28 = 320 - 8x$
$12x = 348$
$x =$ **29**

7. Let the original fraction be $\frac{x}{x + 3}$.

$\frac{x + 7}{x + 3 + 7} = \frac{6}{7}$
$\frac{x + 7}{x + 10} = \frac{6}{7}$
$7x + 49 = 6x + 60$
$x = 11$

$\therefore$ The original fraction is $\boldsymbol{\frac{11}{14}}$.

8. **(a)** $4x - 7y = x + 3y$

$3x = 10y$

$10y = 3x$

$\frac{y}{x} = \frac{3}{10}$

$\therefore \frac{y}{x} - \frac{1}{2} = \frac{3}{10} - \frac{1}{2}$

$= -\frac{\mathbf{1}}{\mathbf{5}}$

(b) $\frac{y-1}{x-2}$ cannot be simplified.

$\therefore$ It is **not possible to find** the value.

9. **(i)** $QT = PQ - PT$

$= [(7x + 3) - 2(2x - 1)]$ cm

$= (7x + 3 - 4x + 2)$ cm

$= \mathbf{(3x + 5)\ cm}$

(ii) Given that $PQ = \frac{3}{2} QR$,

$7x + 3 = \frac{3}{2}(5x + 1)$

$14x + 6 = 15x + 3$

$x = \mathbf{3}$

(iii) $PQ = 7(3) + 3$

$= 24$ cm

$QR = 5(3) + 1$

$= 16$ cm

$\therefore$ Area of $PQRS = 24\text{ cm} \times 16\text{ cm} = \mathbf{384\ cm^2}$

10. When $r = 6$ and $h = 11$,

$A = 2\pi(6)(6 + 11)\text{ cm}^2$

$= 204\pi\text{ cm}^2$

$= \mathbf{641\ cm^2}$ (to 3 s.f.)

11. **(i)** $\mathbf{\$(12m + 20n)}$

(ii) When $m = 22$ and $n = 3$,

Total amount earned $= \$[12(22) + 20(3)]$

$= \mathbf{\$324}$

(iii) OPEN $12m + 20n = 460$

$3m + 5n = 115$

Two possible sets of values are $\boldsymbol{m = 10}$ **and** $\boldsymbol{n = 17}$, and $\boldsymbol{m = 30}$ **and** $\boldsymbol{n = 5}$.

Mid-year Checkpoint A

Section A

1. When $x = 5$, $y = 0$ and $z = -\frac{1}{2}$,

$\frac{4xz}{y-1} = \frac{4(5)\left(-\frac{1}{2}\right)}{0-1}$

$= \mathbf{10}$ **[1]**

2. **(a)** Composite numbers: **16**, **33**, **49, 511**, **1000** **[1]**

(b) Perfect cubes: **1**, **1000** **[1]**

3. **(a)** 3.6 kg = **3600 g** **[1]**

(b) 70 ml = **0.07 *l*** **[1]**

4. **(a)** $\frac{(-14.8)^2}{23.56 \times 0.979} = \mathbf{9.4965}$ **[1]**

(b) **9.50** **[1]**

5. $5 - \frac{2}{3} \times \frac{7}{8} \div \left(-\frac{1}{2}\right)^2$

$= 5 - \frac{2}{3} \times \frac{7}{8} \div \frac{1}{4}$

$= 5 - \frac{2}{3} \times \frac{7}{8} \times \frac{4}{1}$ **[1]**

$= 5 - 2\frac{1}{3}$

$= \mathbf{2\frac{2}{3}}$ **[1]**

6. $5[5x - 2y(4x - 3) + 6y] - 10x$

$= 5(5x - 8xy + 6y + 6y) - 10x$

$= 5(5x - 8xy + 12y) - 10x$ **[1]**

$= 25x - 40xy + 60y - 10x$

$= \mathbf{15x - 40xy + 60y}$ **[1]**

7. **(a)** $12abc - 28abcx + 36acx$

$= \mathbf{4ac(3b - 7bx + 9x)}$ **[1]**

(b) $169 \times 1003 - 3 \times 169$

$= 169 \times (1003 - 3)$

$= 169 \times 1000$

$= \mathbf{169\ 000}$ **[1]**

8. Upper bound $= 10.5 \times 10.5$ **[1]**

$= \mathbf{110.25\ cm^2}$ **[1]**

9. $\frac{5x + y}{7x - 3y} = \frac{1}{2}$

$10x + 2y = 7x - 3y$ **[1]**

$5y = -3x$

$\frac{y}{x} = -\frac{\mathbf{3}}{\mathbf{5}}$ **[1]**

10. Consider the small tin.

Price of 100 g $= \frac{\$1.45}{425} \times 100$

$= \$0.34$ (to 2 d.p.)

Consider the large tin.

Price of 100 g $= \frac{\$2.95}{925} \times 100$

$= \$0.32$ (to 2 d.p.) **[1]**

$\therefore$ The **large** tin gives better value. **[1]**

11. It is incorrect to equate the respective numerators and the denominators, such as in the case $\frac{3}{6} = \frac{1}{2}$, where $3 \neq 1$ and $6 \neq 2$. **[1]**

$\frac{5x + 1}{7x - 4} = \frac{2}{3}$

$15x + 3 = 14x - 8$

$x = -11$

$\therefore$ The solution is -11. **[1]**

12. $\frac{3x + 7}{2} - 1 = \frac{2x}{3}$

$3(3x + 7) - 6 = 2(2x)$ **[1]**

$9x + 21 - 6 = 4x$ **[1]**

$5x = -15$

$x = \mathbf{-3}$ **[1]**

13. (a) $\sqrt{2}, \pi$ **[1]**

(b) Let $x = 0.\dot{3}\dot{9}$.

$100x - x = 39.\dot{3}\dot{9} - 0.\dot{3}\dot{9}$

$99x = 39$

$x = \frac{39}{99}$ **[1]**

$= \frac{13}{33}$

$\therefore 0.\dot{3}\dot{9} = \mathbf{\frac{13}{33}}$ **[1]**

Section B

14. Fraction of land for roses $= \frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$ **[1]**

Fraction of land for tulips $= 0.75 \times \left(1 - \frac{1}{5} - \frac{8}{15}\right) = \frac{1}{5}$ **[2]**

$\therefore$ Fraction of land not occupied by the flowers

$= 1 - \left(\frac{1}{5} + \frac{8}{15} + \frac{1}{5}\right)$ **[1]**

$= \mathbf{\frac{1}{15}}$ **[1]**

15. (a) $68 \times 153 = (2 \times 2 \times 17) \times (3 \times 3 \times 17)$ **[1]**

$= 2^2 \times 3^2 \times 17^2$ **[1]**

$= (2 \times 3 \times 17)^2$ **[1]**

$\therefore 68 \times 153$ is a perfect square.

(b) For $68k$ to be a perfect cube,

Smallest positive integer value of $k = 2 \times 17^2 = \mathbf{578}$. **[2]**

(c) LCM of 68 and 153 $= \mathbf{2^2 \times 3^2 \times 17}$ **[1]**

(d) $\frac{1}{3}(68 \times 108) = 68 \times 36$

$= (2 \times 2 \times 17) \times (2 \times 2 \times 3 \times 3)$

$= 2^4 \times 3^2 \times 17$

$\therefore \mathbf{x = 4, y = 2, z = 1}$ **[2]**

Mid-year Checkpoint B

Section A

1. $\left(\frac{3}{5}\right)^2, \frac{3}{5}, \mathbf{0.62}, \frac{3}{4}$ **[1]**

2. $\pi = 3.1416$ (to 5 s.f.) and $\frac{22}{7} = 3.1429$ (to 5 s.f.)

The numerical values of π, $\frac{22}{7}$ and 3.142 are **not identical**. **[1]**

3. When $a = 4$, $b = -2$,

$p = -3^4 - (-2)^3$

$= -81 - (-8)$ **[1]**

$= \mathbf{-73}$ **[1]**

4. $5(x + 6y) - 2[4(3y - x) + 7x]$

$= 5x + 30y - 2(12y - 4x + 7x)$

$= 5x + 30y - 2(12y + 3x)$

$= 5x + 30y - 24y - 6x$ **[1]**

$= \mathbf{6y - x}$ **[1]**

5. $\frac{hay}{5}(7a + kx) = \frac{7ha^2y}{5} + \frac{hkaxy}{5}$

$= \frac{hkaxy}{5} + \frac{7ha^2y}{5}$

Comparing $\frac{hkaxy}{5} + \frac{7ha^2y}{5}$ with $-8axy + \frac{7a^2y}{5}$,

$7h = 7$ and $\frac{hk}{5} = -8$

$h = 1$ **[1]** $\frac{k}{5} = -8$

$k = -40$ **[1]**

$\therefore \mathbf{h = 1, k = -40}$

6. $\frac{11}{15} = 0.7\dot{3}$ **[1]**

$\therefore$ It can be expressed as **a recurring decimal**. **[1]**

7. **No.** 2 and 8 are factors of 24, but 16 is not a factor of 24. **[2]**

8. (a) $\frac{5}{1 - 3x} = \frac{7}{4(x + 2)}$

$20(x + 2) = 7(1 - 3x)$ **[1]**

$20x + 40 = 7 - 21x$

$41x = -33$

$x = \mathbf{-\frac{33}{41}}$ **[1]**

(b) $\mathbf{41x + 33 = 0}$ **[1]**

9. Upper bound of $(p \times q) = 5.5 \times 6.95$

$= 38.225$ **[1]**

Lower bound of $(p \div q) = 6.85 \div 5.5$

$= 1.245\,45$ (to 5 s.f.) **[1]**

Required difference $= 38.225 - 1.245\,45$

$= \mathbf{37.0}$ (to 3 s.f.) **[1]**

10. $315 = 3 \times 3 \times 5 \times 7$

$= 3^2 \times 5 \times 7$ **[1]**

Since the perimeter of the top of the cuboid is 24 cm, the dimensions of the cuboid are 7 cm × 5 cm × 9 cm.

$\therefore$ The height of the cuboid is **9 cm**. **[1]**

11. Let the integer be x.

$(4x - 23) \div 3 + 22 = 37$ **[1]**

$\frac{4x - 23}{3} = 15$

$4x - 23 = 45$

$4x = 68$ **[1]**

$x = 17$

$\therefore$ Robert is thinking of the integer **17**. **[1]**

12. $\frac{1}{4}a \times (-6b) + 3ba - \left(-\frac{1}{2}b\right) \div \left(-\frac{1}{7a}\right)$

$= -\frac{3}{2}ab + 3ab - \left(-\frac{b}{2}\right) \times \left(-\frac{7a}{1}\right)$ **[1]**

$= \frac{3}{2}ab - \frac{7}{2}ab$ **[1]**

$= \mathbf{-2ab}$ **[1]**

13. (a) $198 = 2 \times 3 \times 3 \times 11$

$= \mathbf{2 \times 3^2 \times 11}$ **[1]**

(b) For $198k$ to be a perfect square,

smallest positive integer value of $k = 2 \times 11$

$= \mathbf{22}$ **[1]**

(c) $33 = 3 \times 11$

Smallest possible value of $x = 3 \times 7 \times 11$ **[1]**

$= \mathbf{231}$ **[1]**

Section B

14. $2\left[(x+1)+\left(\frac{5}{2}x-2\right)\right]+0.5$

$= (2.8x + 0.1) + (x + 1.5) + (3x - 2.5)$ **[3]**

$2(3.5x - 1) + 0.5 = 6.8x - 0.9$

$7x - 1.5 = 6.8x - 0.9$ **[1]**

$0.2x = 0.6$

$x = \mathbf{3}$ **[1]**

15. **(i)** Cost of printing = $\boldsymbol{(x + 5y)}$ **cents** **[1]**

(ii) An example is **6.5 cents** to print 4 pages in colour and **1.5 cents** to print 4 pages in black. **[1]**

(iii) S$0.20 ≈ ¥1

S$2.20 ≈ ¥11 **[1]**

∴ One newsletter costs about **¥11**. **[1]**

(iv) Mass of the newsletter $= \frac{4+20}{2} \times 4.5$ g

$= \mathbf{54}$ **g** **[1]**

8 Percentage

Worksheet 8A Percentage

1. **(a)** $40\% = \frac{40}{100}$

$= \frac{\mathbf{2}}{\mathbf{5}}$

(b) $105\% = \frac{105}{100}$

$= \mathbf{1}\frac{\mathbf{1}}{\mathbf{20}}$

(c) $37.5\% = \frac{37.5}{100}$

$= \frac{\mathbf{3}}{\mathbf{8}}$

(d) $66\frac{2}{3}\% = \frac{66\frac{2}{3}}{100}$

$= \frac{\mathbf{2}}{\mathbf{3}}$

2. **(a)** $86\% = \frac{86}{100}$

$= \mathbf{0.86}$

(b) $290\% = \frac{290}{100}$

$= \mathbf{2.9}$

(c) $14.3\% = \frac{14.3}{100}$

$= \mathbf{0.143}$

(d) $7\frac{1}{5}\% = \frac{7\frac{1}{5}}{100}$

$= \mathbf{0.072}$

3. **(a)** $\frac{11}{20} = \frac{11}{20} \times 100\%$

$= \mathbf{55\%}$

(b) $\frac{6}{7} = \frac{6}{7} \times 100\%$

$= \mathbf{85}\frac{\mathbf{5}}{\mathbf{7}}\mathbf{\%}$

(c) $6\frac{3}{4} = 6\frac{3}{4} \times 100\%$

$= \mathbf{675\%}$

(d) $5\frac{1}{9} = 5\frac{1}{9} \times 100\%$

$= \mathbf{511}\frac{\mathbf{1}}{\mathbf{9}}\mathbf{\%}$

4. **(a)** $0.27 = 0.27 \times 100\%$

$= \mathbf{27\%}$

(b) $0.1 = 0.1 \times 100\%$

$= \mathbf{10\%}$

(c) $9.34 = 9.34 \times 100\%$

$= \mathbf{934\%}$

(d) $6.5 = 6.5 \times 100\%$

$= \mathbf{650\%}$

5. **(a)** 35% of 80 cm $= \frac{35}{100}$ cm

$= \mathbf{28}$ **cm**

(b) 140% of 9.2 kg $= \frac{140}{100} \times 9.2$ kg

$= \mathbf{12.88}$ **kg**

(c) 22.8% of \$45 $= \frac{22.8}{100} \times \$45$

$= \mathbf{\$10.26}$

(d) $12\frac{1}{2}\%$ of 360° $= \frac{12\frac{1}{2}}{100} \times 360°$

$= \mathbf{45°}$

6. Percentage of students who do not live within 2 km of the school

$= 100\% - 75\%$

$= 25\%$

Number of students who do not live within 2 km of the school

$= 25\%$ of 1100

$= \frac{25}{100} \times 1100$

$= \mathbf{275}$

7. 50%, or $\frac{1}{2}$, of 240 apples is 120 apples. Since 30% is less than 50%, then fewer than 120 apples are green.

8. 65% of the passengers are adults.

65% of 240 = 156

35% of 240 = 84

∴ There could be **156 adults** and **84 children** on the cruise ship.

9. **(a)** $\frac{8\text{ cm}}{4\text{ m}} \times 100\% = \frac{8\text{ cm}}{(4\times100)\text{ cm}} \times 100\%$

$= \mathbf{2\%}$

(b) $\frac{60\text{ s}}{1\text{ h}} \times 100\% = \frac{60\text{ s}}{(60\times60)\text{ s}} \times 100\%$

$= \mathbf{1}\frac{\mathbf{2}}{\mathbf{3}}\mathbf{\%}$

(c) $\frac{90\text{ cents}}{\$7.20} \times 100\% = \frac{90\text{ cents}}{(7.20\times100)\text{ cents}} \times 100\%$

$= \mathbf{12.5\%}$

(d) $\frac{5\text{ kg}}{50\text{ g}} \times 100\% = \frac{(5 \times 1000)\text{ g}}{50\text{ g}} \times 100\%$

$= \mathbf{10\ 000\%}$

10. Smallest number as a percentage of the prime number

$= \frac{24}{29} \times 100\%$

$= \mathbf{82.8\%}$ (to 3 s.f.)

11. 5.8413 = 5.8 (to 2 s.f.)

Difference between the answers $= \frac{5.8413 - 5.8}{5.8413} \times 100\%$

$= \mathbf{0.707\%}$ (to 3 s.f.)

12. Time taken by Chan = 125% of time taken by Kai

$= \frac{5}{4}$ of time taken by Kai

Time taken by Kai $= \frac{4}{5}$ of time taken by Chan

= 80% of time taken by Chan

∴ **No.** Yan is incorrect.

13. Percentage of students who did their internship locally in 2022

$= \frac{95}{150} \times 100\%$

$= 63\frac{1}{3}\%$

Percentage of students who did their internship locally in 2023

$= \frac{155 - 55}{155} \times 100\%$

$= 64\frac{16}{31}\%$

∴ A higher percentage of students did their internship locally in **2023**.

14. Percentage of sugar in milk tea $= \frac{9.2\text{ g}}{21\text{ g}} \times 100\%$

= 43.8% (to 3 s.f.)

Percentage of sugar in vanilla coffee $= \frac{27.4\text{ g}}{40\text{ g}} \times 100\%$

= 68.5%

Percentage of sugar in hazelnut coffee $= \frac{18.4\text{ g}}{38\text{ g}} \times 100\%$

= 48.4% (to 3 s.f.)

Percentage of sugar in caramel coffee $= \frac{12\text{ g}}{16\text{ g}} \times 100\%$

= 75%

∴ **Caramel coffee, vanilla coffee, hazelnut coffee, milk tea**

15. Initial amount of pineapple juice $= \frac{45}{100} \times 300$ ml

= 135 ml

Let the volume of water that must be added be x ml.

$\frac{135}{300 + x} = \frac{40}{100}$

$100(135) = 40(300 + x)$

$13\ 500 = 12\ 000 + 40x$

$40x = 1500$

$x = 37.5$

∴ **37.5 ml** of water must be added.

Challenge Myself!

16. OPEN There are two machines in a factory. Machines A and B are switched on for 5 hours and 10 hours respectively each day. In one hour, machine A produces 500 more units than machine B.

Worksheet 8B Percentage

1. **(a)** New value = (100% + 45%) of 90

$= \frac{145}{100} \times 90$

$= \mathbf{130.5}$

(b) New value = (100% + 0.7%) of 5600

$= \frac{100.7}{100} \times 5600$

$= \mathbf{5639.2}$

(c) New value = (100% – 20%) of 48

$= \frac{80}{100} \times 48$

$= \mathbf{38.4}$

(d) New value $= \left(100\% - 12\frac{1}{2}\%\right)$ of 100

$= \frac{87\frac{1}{2}}{100} \times 100$

$= \mathbf{87.5}$

2. **(a)** 15% of the number = 90

1% of the number $= \frac{90}{15}$

100% of the number $= \frac{90}{15} \times 100$

$= \mathbf{600}$

(b) 280% of the number = 336

1% of the number $= \frac{336}{280}$

100% of the number $= \frac{336}{280} \times 100$

$= \mathbf{120}$

(c) 140% of the number = 2.1

1% of the number $= \frac{2.1}{140}$

100% of the number $= \frac{2.1}{140} \times 100$

$= \mathbf{1.5}$

(d) 75% of the number = 195

1% of the number $= \frac{195}{75}$

100% of the number $= \frac{195}{75} \times 100$

$= \mathbf{260}$

3. When increased by 50%, the number becomes

150% of 3600

$= \frac{150}{100} \times 3600$

= 5400.

When decreased by 75%, the number becomes
25% of 5400
$= \frac{25}{100} \times 5400$
$= 1350.$
$\therefore$ The final number is **1350**.

4. Percentage increase $= \frac{10.5\text{ cm} - 8\text{ cm}}{8\text{ cm}} \times 100\%$
$= \mathbf{31\frac{1}{4}\%}$

5. Percentage decrease $= \frac{\$740 - \$680}{\$740} \times 100\%$
$=$ **8.11%** (to 3 s.f.)

6. **(i)** When $t = 0$,
$N = 500 \times 2^0$
$= 500$
$\therefore$ **500** bacteria were introduced into the culture.

(ii) When $t = 1$,
$N = 500 \times 2^1$
$= 1000$
Percentage increase $= \frac{1000 - 500}{500} \times 100\%$
$=$ **100%**

7. Percentage of sheets that are blue $= \frac{5}{8} \times 100\%$
$= 62.5\%$
Percentage of sheets that are pink
$= 30\%$ of $(100\% - 62.5\%)$
$= \frac{30}{100} \times 37.5\%$
$= 11.25\%$
Percentage of sheets that are green
$= 100\% - 62.5\% - 11.25\%$
$= 26.25\%$
Total number of sheets of paper $= \frac{100\%}{26.25\%} \times 105$
$=$ **400**

8. 106.4% of the land area in 2017 = 76 600 hectares
1% of the land area in 2017 $= \frac{76\,600}{106.4}$ hectares
100% of the land area in 2017
$= \frac{76\,600}{106.4} \times 100$ hectares
$=$ **71 990 hectares** (to 4 s.f.)

9. **(i)** New length of the rectangle $= \left(\frac{125}{100} \times 2p\right)$ cm
$= 2.5p$ cm
New breadth of the rectangle $= \left(\frac{75}{100} \times p\right)$ cm
$= 0.75p$ cm
New perimeter of the rectangle $= 2(2.5p + 0.75p)$ cm
$= 6.5p$ cm
Original perimeter of the rectangle $= 2(2p + p)$ cm
$= 6p$ cm
Percentage change in the perimeter
$= \frac{6.5p - 6p}{6p} \times 100\%$
$= \mathbf{8\frac{1}{3}\%}$

(ii) New area of the rectangle $= 2.5p\text{ cm} \times 0.75p\text{ cm}$
$= 1.875p^2\text{ cm}^2$
Original area of the rectangle $= 2p\text{ cm} \times p\text{ cm}$
$= 2p^2\text{ cm}^2$
Percentage change in the area
$= \frac{1.875p^2 - 2p^2}{2p^2} \times 100\%$
$= \mathbf{-6\frac{1}{4}\%}$

10. New cost of materials $= \frac{110}{100} \times \$250$
$= \$275$
New labour cost $= \frac{108}{100} \times \$120$
$= \$129.60$
New warehousing cost $= \frac{82}{100} \times \$60$
$= \$49.20$
New total cost $= \$275 + \$129.60 + \$49.20$
$= \$453.80$
Original total cost $= \$250 + \$120 + \$60$
$= \$430$
Percentage change in the cost $= \frac{\$453.80 - \$430}{\$430} \times 100\%$
$=$ **5.53%** (to 3 s.f.)
It is an **increase**.

11. Percentage increase in the number of supermarkets from
2001 to 2011 $= \frac{367 - 193}{193} \times 100\%$
$= 90.2\%$ (to 3 s.f.)
Percentage increase in the number of supermarkets from
2011 to 2021 $= \frac{632 - 367}{367} \times 100\%$
$= 72.2\%$ (to 3 s.f.)
Percentage increase in the number of supermarkets from
2001 to 2021 $= \frac{632 - 193}{193} \times 100\%$
$= 227\%$ (to 3 s.f.)
Only the first percentage increase is calculated correctly.

12. **(i)** The sales decreased by 10.3% from December 2021 (100%) to December 2022 (89.7%).

(ii) Amount of sales $= \frac{100}{100 - 10.3} \times \$400$ million
$=$ **\$446 million** (to 3 s.f.)

(iii) OPEN There could be a lower Certificate of Entitlement (COE) quota in December 2022 as compared to in December 2021.

Review Exercise 8

1. Since x is 40% of y,
then $x = \frac{2}{5}y$.
$\frac{x}{y} = \frac{2}{5}$
$\frac{x}{y} \times \frac{7}{8} = \frac{2}{5} \times \frac{7}{8}$
$\frac{7x}{8y} = \mathbf{\frac{7}{20}}$

2. $p\%$ of $q = \frac{p}{100} \times q = \frac{pq}{100}$

$q\%$ of $p = \frac{q}{100} \times p = \frac{pq}{100}$

$\therefore$ They have the **same value**.

3. Population in 1960 $= \frac{100}{237} \times 1\,500\,000$

$=$ **633 000** (to 3 s.f.)

4. $p\% = \frac{\$22.40}{\$28} \times 100\%$

$= 80\%$

$\therefore p =$ **80**

5. Distance he drove in 2022 $= \frac{100}{145} \times 20\,822$

$=$ **14 360 km**

6. Let $\$x$ be the original price of a T-shirt.

$x + \frac{85}{100}x = 51.8$

$1.85x = 51.8$

$x = 28$

$\therefore$ The non-discounted price of each T-shirt is **$28**.

9 Ratio and Rate

Worksheet 9A Ratio

1. **(a)** $\frac{1}{6} : 1 = \frac{1}{6} \times 6 : 1 \times 6$

$=$ **1 : 6**

(b) $0.3 : 0.09 = 0.3 \times 100 : 0.09 \times 100$

$= 30 : 9$

$=$ **10 : 3**

(c) $\frac{3}{4} : \frac{2}{5} : \frac{1}{2} = \frac{3}{4} \times 20 : \frac{2}{5} \times 20 : \frac{1}{2} \times 20$

$=$ **15 : 8 : 10**

(d) $1.8 : 0.6 : 7.2 = 1.8 \times 10 : 0.6 \times 10 : 7.2 \times 10$

$= 18 : 6 : 72$

$=$ **3 : 1 : 12**

2. 2.4 m $= (2.4 \times 100)$ cm

$= 240$ cm

$\therefore$ Ratio is 240 : 204 = **20 : 17**

3. OPEN Two equivalent ratios of 11 : 12 are **22 : 24** and **88 : 96**.

4. If $2x = 3y$, then $\frac{x}{y} = \frac{3}{2}$, i.e. $x : y = 3 : 2$.

$\therefore$ **Yes.** He is correct.

5. Since $\frac{x}{4} = \frac{2y}{3}$,

then $\frac{x}{y} = \frac{8}{3}$.

$\therefore x : y =$ **8 : 3**

6. $x : y = \frac{1}{2} : \frac{1}{3} = 3 : 2$

$z : x = \frac{1}{4} : \frac{1}{3} = 3 : 4$, i.e. $x : z = 4 : 3$

Since $x : y = 3 : 2 = 12 : 8$

and $x : z = 4 : 3 = 12 : 9$,

then $x : y : z =$ **12 : 8 : 9**.

7. $\boldsymbol{6p : 6q}$ and $\boldsymbol{\frac{1}{q} : \frac{1}{p}}$ are equivalent to $p : q$.

8. Fraction of girls in the choir $= \frac{4}{4+5}$

$= \boldsymbol{\frac{4}{9}}$

9. Amount of vegetable broth $= (2 \times 1000)$ ml

$= 2000$ ml

$\therefore$ chicken stock : vegetable broth $= 450 : 2000$

$=$ **9 : 40**

10. Amount of money Tim had $= \frac{11}{9-4} \times \$100$

$=$ **$220**

11. Time taken by the fastest child = 24 minutes

Time taken by the first child $= \frac{7}{6} \times 24$ minutes

$= 28$ minutes

28 minutes after 16 50 is 17 18.

Time taken by the second child $= \frac{9}{6} \times 24$ minutes

$= 36$ minutes

36 minutes after 16 50 is 17 26.

$\therefore$ The other two children completed the homework at **17 18** and **17 26** respectively.

12. **(i)** Length of longer part of the rope $= \frac{6}{6+5} \times 33$ m

$=$ **18 m**

Length of shorter part of the rope = 33 m – 18 m

$=$ **15 m**

(ii) Let the length of the piece of rope that is removed be x m.

$\frac{18-x}{15-x} = \frac{4}{3}$

$54 - 3x = 60 - 4x$

$x = 6$

$\therefore$ Emma cuts **6 m** from each part of the rope.

13. **(a)** Amount Zac pays = \$1560 – \$680

$=$ \$880

$\therefore$ Ratio is 680 : 880 = **17 : 22**

(b) Amount Bill paid $= \frac{3}{2} \times \$596$

$=$ **$894**

14. **(a)** **(i)** Amount of apple juice $= \frac{5}{7} \times 2.8$ litres

$=$ **2 litres**

(ii) Total amount of fruit drink $= \frac{5+3+7}{7} \times 2.8$

$=$ **6 litres**

(b) Apple juice : pear juice = 3 : 5 = 9 : 15

Pear juice : strawberry juice = 3 : 8 = 15 : 40

$\therefore$ Apple juice : pear juice : strawberry juice

$=$ **9 : 15 : 40**

15. **(i)** Number of boys $= \frac{5}{5+7} \times 60$
$= \mathbf{25}$

(ii) Let the number of boys who joined the camp on the second day be x.
$\frac{25+x}{35} = \frac{6}{7}$
$175 + 7x = 210$
$7x = 35$
$x = 5$
$\therefore$ **5** boys joined the camp.

16. Leo's share : Molly's share : Nick's share
$= 25\,000 : 37\,500 : 87\,500$
$= 2 : 3 : 7$

Amount Leo received $= \frac{2}{2+3+7} \times \$240\,000 - \$25\,000$
$= \$15\,000$

Amount Molly received
$= \frac{3}{2+3+7} \times \$240\,000 - \$37\,500$
$= \$22\,500$

Amount Nick received
$= \frac{7}{2+3+7} \times \$240\,000 - \$87\,500$
$= \$52\,500$

$\therefore$ They received **\$15 000**, **\$22 500** and **\$52 500** respectively.

17. Since $8 : 7 = 72 : 63$ and $16 : 9 = 112 : 63$,
fraction not covered by the marketing collateral
$= \frac{112 - 72}{112}$
$= \mathbf{\frac{5}{14}}$

Challenge Myself!

18. Let the two original numbers be $4p$ and $11p$, where p is a positive integer, and the number that is to be added be x.
$\frac{4p+x}{11p+x} = \frac{3}{5}$
$20p + 5x = 33p + 3x$
$2x = 13p$
$x = 6.5p$
Let $p = 20$, then the two original numbers are 80 and 220.
$\therefore$ The two positive integers could be **80** and **220**.

Worksheet 9B Rate

1. Output rate $= \frac{250 \text{ words}}{10 \text{ s}}$
$= \frac{25 \text{ words}}{1 \text{ s}}$
$= \frac{1500 \text{ words}}{60 \text{ s}}$
$=$ **1500 words/min**

2. **(a)** Number of characters created in 6 h $= 12 \times 6$
$=$ **72**

(b) 10 min $= \frac{1}{6}$ h
Number of characters created in 10 min $= 12 \times \frac{1}{6}$
$=$ **2**

3. In 1 h, Julie can pack $\frac{18}{5}$ hampers.
In 1 h, Kyle can pack $\frac{14}{4} = \frac{7}{2}$ hampers.
In 1 h, they can pack $\left(\frac{18}{5} + \frac{7}{2}\right)$ hampers $= \frac{71}{10}$ hampers.
$\frac{71}{10}$ hampers take 1 h.
40 hampers take $\left(\frac{1}{\frac{71}{10}} \times 40\right)$ h $= 5\frac{45}{71}$ h
$=$ **5 h 38 min** (to the nearest min).

4. Amount of electricity used $= 20\,822 \times 0.20$
$= 4164.4$ kWh
Total amount paid for electricity consumption
$= 4164.4 \times \$0.50$
$= \$$**2082** (to the nearest dollar)

5.
(a) Although plan A (\$12) costs more than plan B (\$8), Keiko may choose plan A if she estimates that her daily usage exceeds 1.5 GB, but her total usage is not more than 100 GB.

(b) Keiko may choose plan B if she is confident that her daily usage will not exceed 1.5 GB, hence she will pay less than for plan A.

6. **(a)** 7.78 kr = 13.65 R
1 kr $= \frac{13.65}{7.78}$ R
1 kr = 1.75 R (to 3 s.f.)

(b) Price of 1 kg of rice in South Africa
$= \$\left(\frac{24}{13.65}\right)$
$= \$1.76$ (to 2 d.p.)
Price of 1 kg of rice in Sweden
$= \$\left(\frac{30}{7.78}\right)$
$= \$3.86$ (to 2 d.p.)
$\therefore$ Rice is the cheapest in South Africa and the most expensive in Sweden.

7. **(a)** 294 Singapore Dollars = 29 650 Japanese Yen
1 Singapore Dollar $= \frac{29\,650}{294}$ Japanese Yen
1 Singapore Dollar = 101 Japanese Yen (to the nearest Yen)

(b) 101 Japanese Yen = 1 Singapore Dollar
33 610 Japanese Yen $= \frac{33\,610}{101}$ Singapore Dollars
$= 333$ Singapore Dollars (to the nearest dollar)
Amount she will save
$= (333 - 294)$ Singapore Dollars
$= 39$ Singapore Dollars
$\therefore$ She should buy the train pass from the **authorised agent in Singapore**, to save **\$39**.

8. Amount she gets if she changes in Singapore
= (600 × 22.72)
= 13 632 Taiwan Dollars
Amount she gets if she changes in Taiwan
$= \left(\frac{600}{4.39} \times 100\right)$ Taiwan Dollars
= 13 667.43 Taiwan Dollars (to 2 d.p.)
Difference in amounts
= (13 667.43 – 13 632) Taiwan Dollars
= **35 Taiwan Dollars** (to the nearest dollar)

Worksheet 9C Speed

1. **(a)** $2 \text{ m/s} = \frac{2 \text{ m}}{1 \text{ s}}$
$= \frac{(2 \div 1000) \text{ km}}{(1 \div 3600) \text{ h}}$
$= \mathbf{7.2 \text{ km/h}}$

(b) $66 \text{ km/h} = \frac{66 \text{ km}}{1 \text{ h}}$
$= \frac{(66 \times 1000) \text{ m}}{(1 \times 3600) \text{ s}}$
$= \mathbf{18\frac{1}{3} \text{ m/s}}$

2. Flight time $= \frac{\text{Distance}}{\text{Speed}}$
$= \frac{6199 \text{ km}}{720 \text{ km/h}}$
= 8.6097 h (to 5 s.f.)
= **8 h 37 min** (to the nearest min)

3. Time taken = 20 min
$= \frac{1}{3}$ h
Distance = Speed × time
$= 40 \times \frac{1}{3}$
= **13.3 km** (to 3 s.f.)

4. **(i)** Time taken to walk 1000 m $= \frac{\text{Distance}}{\text{Speed}}$
$= \frac{1000 \text{ m}}{4 \text{ km/h}}$
$= \frac{(1000 \div 1000) \text{ km}}{4 \text{ km/h}}$
$= \frac{1}{4}$ h
= **15 min**

(ii) Running speed $= \frac{\text{Distance}}{\text{Time}}$
$= \frac{2.2 \text{ km}}{10 \text{ min}}$
$= \frac{2.2 \text{ km}}{(10 \div 60) \text{ h}}$
= **13.2 km/h**

(iii) Average speed $= \frac{\text{Total distance}}{\text{Total time}}$
$= \frac{1 \text{ km} + 2.2 \text{ km}}{\frac{1}{4} \text{h} + \frac{1}{6} \text{h}}$
= **7.68 km/h**

5. Total distance $= \left(60 \times 2\frac{1}{2} + 55 \times 3\right)$ km
= 315 km
Total time $= \left(2\frac{1}{2} + 3\right)$ h
$= 5\frac{1}{2}$ h
Average speed $= \frac{\text{Total distance}}{\text{Total time}}$
$= \frac{315}{5\frac{1}{2}}$
= **57.3 km/h** (to 3 s.f.)

6. **(i)** 7 h 55 min after 12.45 a.m. (Singapore time) is 8.40 a.m. (Singapore time).
8.40 a.m. (Singapore time) is 11.40 a.m. (Sydney time).
∴ The plane arrived in Sydney at **11.40 a.m.** local time.

(ii) Average speed $= \frac{\text{Total distance}}{\text{Total time}}$
$= \frac{6300 \text{ km}}{7\frac{55}{60} \text{h}}$
= **796 km/h** (to 3 s.f.)

7. **(i)** $45 \text{ km/h} = \frac{45 \text{ km}}{1 \text{ h}}$
$= \frac{(45 \times 1000) \text{ m}}{(1 \times 3600) \text{ s}}$
= **12.5 m/s**

(ii) Total distance = 4.9 km + 230 m
= 4900 m + 230 m
= 5130 m
Time taken $= \frac{\text{Total distance}}{\text{Average speed}}$
$= \frac{5130 \text{ m}}{12.5 \text{ m/s}}$
= 410.4 s
= **6 min 50 s** (to the nearest second)

Review Exercise 9

1. 1 h = 60 min
Number of posters $= \frac{105}{60}$
= **1.75**

2. **(i)** Rate of burning $= \frac{16 \text{ cm} - 12 \text{ cm}}{2 \text{ min}}$
= 2 cm/min
Time taken to burn out completely $= \frac{12 \text{ cm}}{2 \text{ cm/min}}$
= **6 min**

(ii) Assume that the candle burns at a constant rate.

3. Amount he pays = y dollars
$= 100y$ cents
Number of litres he buys = $\frac{\mathbf{100}\,\boldsymbol{y}}{\boldsymbol{x}}$

4. **(i)** Mei's age : Zhen's age = 8 : 10
$=$ **4 : 5**

(ii) Zhen's share = $\frac{5}{4} \times \$32$
$=$ **\$40**

(iii) A year later, Mei is 9 years old and Zhen is 11 years old.
Mei's share = $\frac{9}{9+11} \times \$60$
$=$ **\$27**

5. If the money had been divided equally,
$A : B : C = 4 : 4 : 4$.
Total sum of money = $12 \times \$30$
$=$ **\$360**

6. Rate at which Janice can paint = $\frac{9 \text{ panels}}{5 \text{ h}}$
$= 1.8$ panels/h
Rate at which Kris can paint = $\frac{10 \text{ panels}}{6 \text{ h}}$
$= 1.67$ panels/h (to 3 s.f.)
Rate at which Lesley can paint = $\frac{(30 - 9 - 10) \text{ panels}}{8 \text{ h}}$
$= 1.375$ panels/h
$\therefore$ **Janice** can paint at the fastest rate.

7. \$1 = 26 baht
\$600 = (600 × 26) baht
$= 15\,600$ baht
Remaining amount = (15 600 – 12 538) baht
$= 3062$ baht
25 baht = \$1
3062 baht = $\$\frac{3062}{25}$
$= \$122.48$
$\therefore$ She receives **\$122.48**.

8. **(i)** Electricity consumption = $\frac{36 \text{ kWh}}{180 \text{ km}}$
$= \frac{0.2 \text{ kWh}}{1 \text{ km}}$
$= \frac{20 \text{ kWh}}{100 \text{ km}}$
$\therefore$ The electricity consumption of the car is **20 kWh per 100 km**.

(ii) **(a)** Distance he can travel = $\left(\frac{60}{7.8} \times 100\right)$ km
$=$ **769 km** (to 3 s.f.)

(b) Amount of petrol needed = $\left(\frac{140}{100} \times 7.8\right) l$
$= 10.92\, l$
Cost of petrol = \$2.55 × 10.92
$=$ **\$27.85** (to the nearest cent)

9. Time taken = 7 h 40 min
$= 7\frac{2}{3}$ h
Average speed = $\frac{\text{Total distance}}{\text{Total time}}$
$= \frac{330 \text{ km}}{7\frac{2}{3} \text{ h}}$
$=$ **43.0 km/h** (to 3 s.f.)

10. Total distance = $\left(20 \times \frac{39}{60} + 7.5\right)$ km
$= 20.5$ km
Average speed = $\frac{\text{Total distance}}{\text{Total time}}$
$= \frac{20.5 \text{ km}}{\left(\frac{39}{60} + 0.5\right) \text{h}}$
$=$ **17.8 km/h** (to 3 s.f.)

10 Basic Geometry

Worksheet 10A Basic geometrical concepts and notations

1. **(a)** $a° = 63°$, $b° = 105°$ **(b)** $c° = 132°$, $d° = 23°$
(c) $e° = 142°$, $f° = 279°$ **(d)** $g° = 90°$, $h° = 264°$

2. **(a)** $\angle a$ is an **acute** angle.
$\angle b$ is an **obtuse** angle.
(b) $\angle c$ is an **obtuse** angle.
$\angle d$ is an **acute** angle.
(c) $\angle e$ is an **obtuse** angle.
$\angle f$ is a **reflex** angle.
(d) $\angle g$ is a **right** angle.
$\angle h$ is a **reflex** angle.

3. **(a)** Complementary angle of 21° = 90° – 21°
$=$ **69°**
(b) Complementary angle of 43° = 90° – 43°
$=$ **47°**
(c) Complementary angle of 67° = 90° – 67°
$=$ **23°**
(d) Complementary angle of 85° = 90° – 85°
$=$ **5°**

4. **(a)** Supplementary angle of 19° = 180° – 19°
$=$ **161°**
(b) Supplementary angle of 30° = 180° – 30°
$=$ **150°**
(c) Supplementary angle of 145° = 180° – 145°
$=$ **35°**
(d) Supplementary angle of 172° = 180° – 172°
$=$ **8°**

Worksheet 10B Properties of angles formed by intersecting lines

1. **(a)** $x° + 45° = 180°$ (adj. $\angle$s on a str. line)
$x° = 135°$
$\therefore x =$ **135**

(b) $35° + x° + 115° = 180°$ (adj. ∠s on a str. line)
$x° + 150° = 180°$
$x° = 30°$
$\therefore x = \mathbf{30}$

(c) $7x° + 90° + 2x° = 180°$ (adj. ∠s on a str. line)
$9x° + 90° = 180°$
$9x° = 90°$
$x° = 10°$
$\therefore x = \mathbf{10}$

(d) $(4x + 20)° + (3x - 15)° = 180°$ (adj. ∠s on a str. line)
$4x° + 20° + 3x° - 15° = 180°$
$7x° + 5° = 180°$
$7x° = 175°$
$x° = 25°$
$\therefore x = \mathbf{25}$

(e) $2(x - 1)° + 80° + (75 - x)° = 180°$ (adj. ∠s on a str. line)
$2x° - 2° + 80° + 75° - x° = 180°$
$x° + 153° = 180°$
$x° = 27°$
$\therefore x = \mathbf{27}$

(f) $90° + \left(\frac{2}{3}x + 5\right)° + \frac{1}{4}x° + \frac{1}{2}x° = 180°$ (adj. ∠s on a str. line)
$90° + \frac{2}{3}x° + 5° + \frac{1}{4}x° + \frac{1}{2}x° = 180°$
$\frac{17}{12}x° + 95° = 180°$
$\frac{17}{12}x° = 85°$
$x° = 60°$
$\therefore x = \mathbf{60}$

2. (a) $114° + 90° + 3x° = 360°$ (∠s at a pt.)
$3x° + 204° = 360°$
$3x° = 156°$
$x° = 52°$
$\therefore x = \mathbf{52}$

(b) $6x° + 5x° + 4x° = 360°$ (∠s at a pt.)
$15x° = 360°$
$x° = 24°$
$\therefore x = \mathbf{24}$

(c) $(x + 25)° + (x - 13)° + 108° = 360°$ (∠s at a pt.)
$x° + 25° + x° - 13° + 108° = 360°$
$2x° + 120° = 360°$
$2x° = 240°$
$x° = 120°$
$\therefore x = \mathbf{120}$

(d) $2x° + (3x - 35)° + (2x - 5)° + x° = 360°$ (∠s at a pt.)
$2x° + 3x° - 35° + 2x° - 5° + x° = 360°$
$8x° - 40° = 360°$
$8x° = 400°$
$x° = 50°$
$\therefore x = \mathbf{50}$

(e) $72° + 90° + (80 - x)° + 90° + (2x + 7)° = 360°$ (∠s at a pt.)
$72° + 90° + 80° - x° + 90° + 2x° + 7° = 360°$
$x° + 339° = 360°$
$x° = 21°$
$\therefore x = \mathbf{21}$

(f) $(6.5x - 7)° + (77 - 0.25x)° + (3x - 11)° + 1.5x°$
$= 360°$ (∠s at a pt.)
$6.5x° - 7° + 77° - 0.25x° + 3x° - 11° + 1.5x° = 360°$
$10.75x° + 59° = 360°$
$10.75x° = 301°$
$x° = 28°$
$\therefore x = \mathbf{28}$

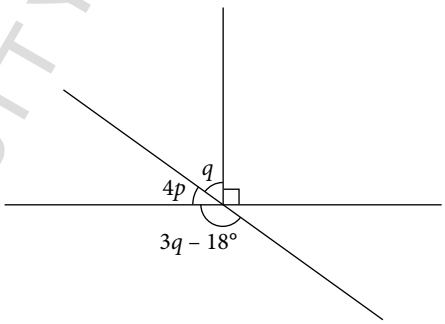
3. (a) $(x + 20)° = 38°$ (vert. opp. ∠s)
$x° + 20° = 38°$
$x° = 18°$
$\therefore x = \mathbf{18}$

(b) $2x° + 57° = 123°$ (vert. opp. ∠s)
$2x° = 66°$
$x° = 33°$
$\therefore x = \mathbf{33}$

4. $\angle DOF = \angle COE$ (vert. opp. ∠s)
$= 80°$
$3x° + 80° + 2x° = 180°$ (adj.∠s on a str. line)
$5x° + 80° = 180°$
$5x° = 100°$
$x° = 20°$
$\angle AOF = \angle BOE$ (vert. opp. ∠s)
$y° = 3x°$
$= 3(20°)$
$= 60°$
$\therefore \boldsymbol{x = 20, y = 60}$

Challenge Myself!

5.



Worksheet 10C Properties of angles formed by two parallel lines and transversal

1. (a) $5x° + 70° = 180°$ (adj. ∠s on a str. line)
$5x° = 110°$
$x° = 22°$
$2y° = 5x°$ (corr. ∠s, // lines)
$= 5(22°)$
$= 110°$
$y° = 55°$
$\therefore \boldsymbol{x = 22, y = 55}$

(b) $x° + 105° = 180°$ (adj. ∠s on a str. line)
$x° = 75°$
Acute $\angle B = x°$ (corr. ∠s, // lines)
$= 75°$
$y° + 75° = 360°$ (∠s at a pt.)
$y° = 285°$
$\therefore \boldsymbol{x = 75, y = 285}$

2. **(a)** $(52 - 3x)° = (9x + 4)°$ (vert. opp. ∠s)

$52° - 3x° = 9x° + 4°$

$-12x° = -48°$

$x° = 4°$

$8y° = (52 - 3x)°$ (alt. ∠s, AB // CD)

$= 52° - 3(4°)$

$= 40°$

$y° = 5°$

$\therefore$ **$x = 4$, $y = 5$**

(b) Let the point of intersection of CD and PQ be N.

Then $\angle PNC = 70°$. (corr. ∠s, AB // CD)

$4x° + 70° = 180°$ (adj. ∠s on a str. line)

$4x° = 110°$

$x° = 27.5°$

$(120 - y)° = 4x°$ (vert. opp. ∠s)

$120° - y° = 110°$

$-y° = -10°$

$y° = 10°$

$\therefore$ **$x = 27.5$, $y = 10$**

3. **(a)** $x° = 82°$ (alt. ∠s, AB // CD)

Let the point of intersection of AB and RS be N.

Then $\angle BNS = 100°$. (vert. opp. ∠s)

$y° + 100° = 180°$ (int. ∠s, AB // CD)

$y° = 80°$

$z° = y°$ (vert. opp. ∠s)

$= 80°$

$\therefore$ **$x = 82$, $y = 80$, $z = 80$**

(b) $x° + 106° = 180°$ (int. ∠s, AB // CD)

$x° = 74°$

$y° + 135° = 180°$ (int. ∠s, AB // CD)

$y° = 45°$

Let the point of intersection of AB, PQ and RS be N.

Then $\angle SNQ = z°$. (vert. opp. ∠s)

$x° + z° + y° = 180°$ (adj. ∠s on a str. line)

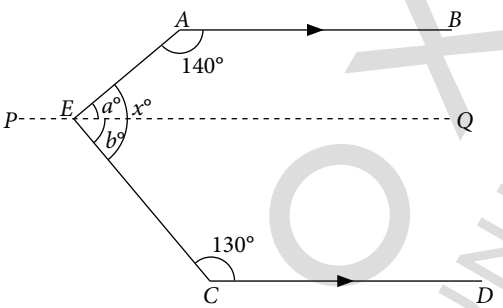
$74° + z° + 45° = 180°$

$z° + 119° = 180°$

$z° = 61°$

$\therefore$ **$x = 74$, $y = 45$, $z = 61$**

4. **(a)**



$a° + 140° = 180°$ (int. ∠s, AB // PQ)

$a° = 40°$

$b° + 130° = 180°$ (int. ∠s, PQ // CD)

$b° = 50°$

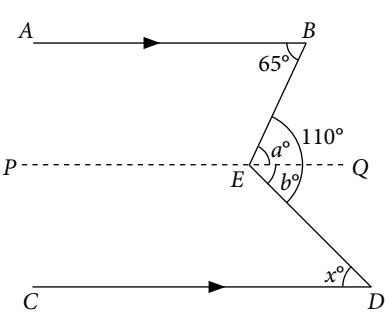
$x° = a° + b°$

$= 40° + 50°$

$= 90°$

$\therefore$ $x =$ **90**

(b)



$a° = 65°$ (alt. ∠s, AB // PQ)

$a° + b° = 110°$

$65° + b° = 110°$

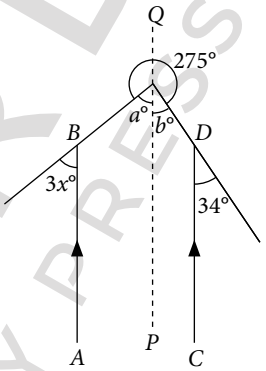
$b° = 45°$

$x° = b°$ (alt. ∠s, PQ // CD)

$= 45°$

$\therefore$ $x =$ **45**

(c)



$a° = 3x°$ (corr. ∠s, AB // PQ)

$b° = 34°$ (corr. ∠s, PQ // CD)

$3x° + 34° + 275° = 360°$ (∠s at a pt.)

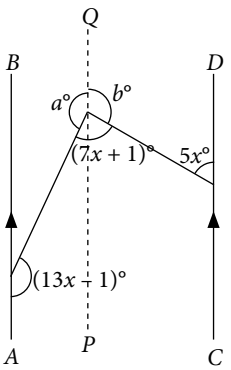
$3x° + 309° = 360°$

$3x° = 51°$

$x° = 17°$

$\therefore$ $x =$ **17**

(d)



$a° = (13x - 1)°$ (alt. ∠s, AB // PQ)

$b° + 5x° = 180°$ (int. ∠s, PQ // CD)

$b° = 180° - 5x°$

$13x° - 1° + 180° - 5x° + 7x° + 1° = 360°$ (∠s at a pt.)

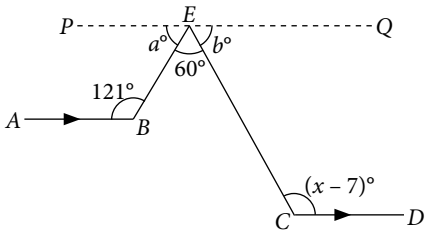
$15x° + 180° = 360°$

$15x° = 180°$

$x° = 12°$

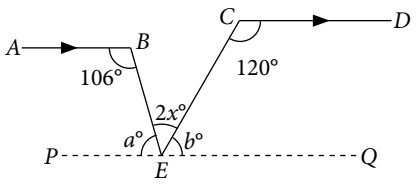
$\therefore$ $x =$ **12**

(e)



$a° + 121° = 180°$ (int. ∠s, AB // PQ)
$a° = 59°$
$b° + x° - 7° = 180°$ (int. ∠s, PQ // CD)
$b° = 187° - x°$
$59° + 60° + 187° - x° = 180°$ (adj. ∠s on a str. line)
$306° - x° = 180°$
$x° = 126°$
$\therefore x =$ **126**

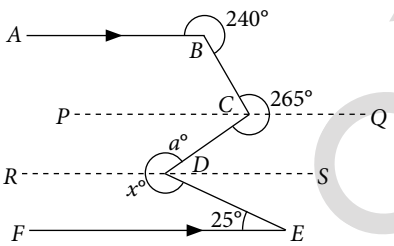
(f)



$a° + 106° = 180°$ (int. ∠s, AB // PQ)
$a° = 74°$
$b° + 120° = 180°$ (int. ∠s, CD // PQ)
$b° = 60°$
$74° + 2x° + 60° = 180°$ (adj. ∠s on a str. line)
$2x° + 134° = 180°$
$2x° = 46°$
$x° = 23°$
$\therefore x =$ **23**

5. $\angle ABC = 114°$ (alt. ∠s, AB // CD)
$114° + x° + 40° = 180°$ (adj. ∠s on a str. line)
$x° + 154° = 180°$
$x° = 26°$
$\therefore x =$ **26**

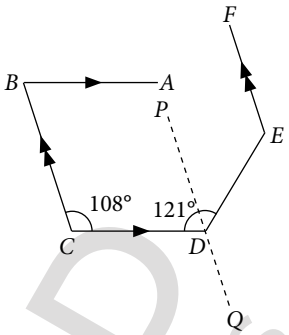
6.



Obtuse $\angle ABC = 360° - 240°$ (∠s at a pt.)
$= 120°$
$\angle BCP + 120° = 180°$ (int. ∠s, AB // PQ)
$\angle BCP = 60°$
$\angle PCD = 360° - 60° - 265°$ (∠s at a pt.)
$= 35°$
$\angle CDS = 35°$ (alt. ∠s, PQ // RS)
$\angle SDE = 25°$ (alt. ∠s, RS // FE)
$x° = 360° - 35° - 25°$ (∠s at a pt.)
$= 300°$
$\therefore x =$ **300**

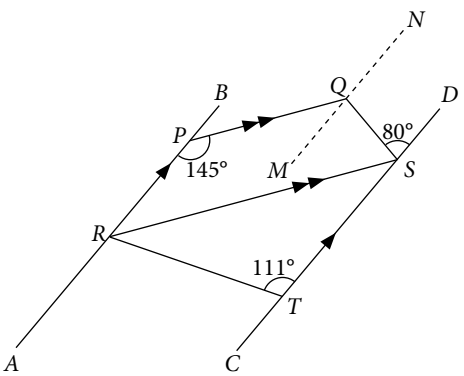
7. **(a)** $x°$ is an acute angle, but 246° is a reflex angle.
(b) Obtuse $\angle ABC = 360° - 246°$ (∠s at a pt.)
$= 114°$
$\angle BCD = 114°$ (alt. ∠s, DC // BA)
$x° + 114° = 180°$ (int. ∠s, CB // DE)
$x° = 66°$
$\therefore x =$ **66**

8.



(i) $\angle ABC + 108° = 180°$ (int. ∠s, BA // CD)
$\angle ABC =$ **72°**
(ii) $\angle PDC + 108° = 180°$ (int.∠s, CB // QP)
$\angle PDC = 72°$
$\angle PDE = 121° - 72°$
$= 49°$
$\angle DEF + 49° = 180°$ (int. ∠s, QP // EF)
$\angle DEF =$ **131°**

9. **(i)** $\angle PRS + 145° = 180°$ (int. ∠s, PQ // RS)
$\angle PRS = 35°$
$35° + \angle SRT + 111° = 180°$ (int. ∠s, AB // CD)
$\angle SRT + 146° = 180°$
$\angle SRT =$ **34°**
(ii) $\angle RST = 35°$ (alt. ∠s, AB // CD)
$35° + \angle RSQ + 80° = 180°$ (adj. ∠s on a str. line)
$\angle RSQ + 115° = 180°$
$\angle RSQ =$ **65°**
(iii)



$\angle PQN = 145°$ (alt. ∠s, AB // MN)
$\angle NQS + 80° = 180°$ (int. ∠s, MN // CD)
$\angle NQS = 100°$
Reflex $\angle PQS = 145° + 100°$
$=$ **245°**

10. $\angle ABC = \angle BCD$ (alt. $\angle$s, AB // CD)
$\angle BCD = \angle CDE$ (alt. $\angle$s, CB // ED)
$\angle CDE + \angle DEF = 180°$ (int. $\angle$s, CD // FE)
$\angle ABC + \angle DEF = 180°$
$\angle DEF = 180° - \angle ABC$
Reflex $\angle DEF + (180° - \angle ABC) = 360°$ ($\angle$s at a pt.)
Reflex $\angle DEF = 180° + \angle ABC$

11. $(180 - x)° = 108°$ (alt. $\angle$s, AB // CD)
$180° - x° = 108°$
$x° = 72°$
$y° + 0.5x° = 108°$ (corr. $\angle$s, CD // EF)
$y° + 0.5(72°) = 108°$
$y° + 36° = 108°$
$y° = 72°$
$\angle DRQ + 36° = 180°$ (int. $\angle$s, CD // EF)
$\angle DRQ = 144°$
$z° + 144° = 360°$ ($\angle$s at a pt.)
$z° = 216°$
$\therefore$ **$x = 72$, $y = 72$, $z = 216$**

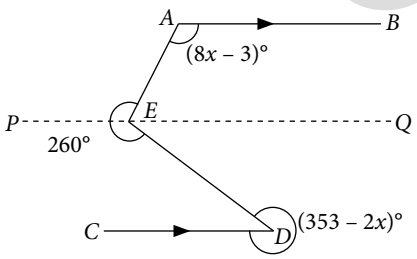
12. OPEN
Since $115° + 65° = 180°$, then AB and CD are parallel (converse of alt. $\angle$s).
One other angle at the intersection of AB and QR or at the intersection of CD and QR is required.

Review Exercise 10

1. $69° + 2x° + 65° = 180°$ (adj. $\angle$s on a str. line)
$2x° + 134° = 180°$
$2x° = 46°$
$x° = 23°$
$69° + 3y° = 180°$ (adj. $\angle$s on a str. line)
$3y° = 111°$
$y° = 37°$
$\therefore$ **$x = 23$, $y = 37$**

2. **(i)** $(7x - 11)° + (15x - 7)° = 180°$ (int. $\angle$s, AB // CD)
$7x° - 11° + 15x° - 7° = 180°$
$22x° - 18° = 180°$
$22x° = 198°$
$x° = 9°$
$\therefore$ $x =$ **9**

(ii) $0.2y° = 15(9°) - 7°$ (vert. opp. $\angle$s)
$= 128°$
$y° = 640°$
$\therefore$ $y =$ **640**

3.


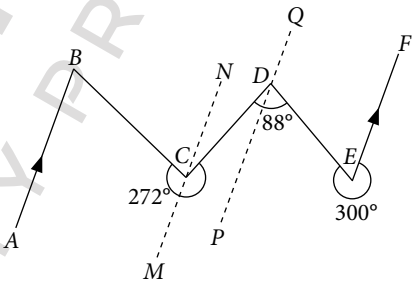
$\angle AEQ + (8x - 3)° = 180°$ (int. $\angle$s, AB // PQ)
$\angle AEQ = 183° - 8x°$
$\angle CDE + (353 - 2x)° = 360°$ ($\angle$s at a pt.)
$\angle CDE = 2x° + 7°$
$\angle QED = 2x° + 7°$ (alt. $\angle$s, PQ // CD)
$260° + 183° - 8x° + 2x° + 7° = 360°$ ($\angle$s at a pt.)
$450° - 6x° = 360°$
$-6x° = -90°$
$x° = 15°$
$\therefore$ $x =$ **15**

4. Since $112° + 68° = 180°$, then AB and CD are parallel (converse of alt. $\angle$s).
$x° + 78° = 180°$ (int. $\angle$s, AB // CD)
$x° = 102°$
$\therefore$ $x =$ **102**

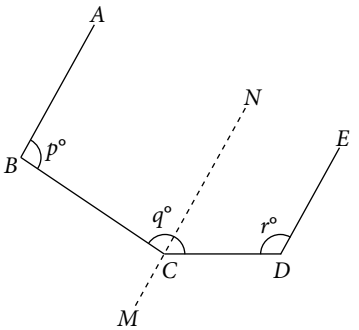
5. **(i)** $\angle BCF = 40°$ (alt. $\angle$s, AB // CF)
$\angle FCD = 65°$ (alt. $\angle$s, DC // FG)
$\angle BCD = 40° + 65°$
$= 105°$
Obtuse $\angle CDE =$ **105°** (alt. $\angle$s, ED // CB)

(ii) Obtuse $\angle FGH =$ obtuse $\angle BCD$
$= 105°$
Reflex $\angle FGH = 360° - 105°$ ($\angle$s at a pt.)
$=$ **255°**

6. **(i)** $\angle BCD = 360° - 272°$ ($\angle$s at a pt.)
$= 88°$
Since $\angle BCD = \angle CDE$, then BC is parallel to DE (converse of alt. $\angle$s).

(ii)


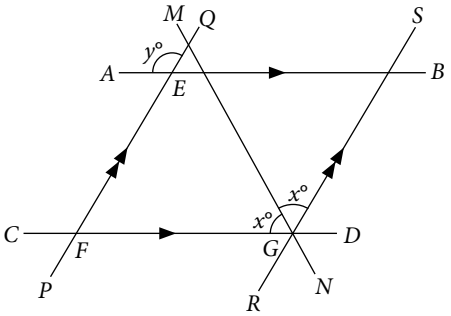
$\angle DEF = 360° - 300°$ ($\angle$s at a pt.)
$= 60°$
$\angle PDE = 60°$ (alt. $\angle$s, PQ // EF)
$\angle CDP = 88° - 60°$
$= 28°$
$\angle NCD = 28°$ (alt. $\angle$s, MN // PQ)
$\angle BCN = 360° - 28° - 272°$ ($\angle$s at a pt.)
$= 60°$
$\angle ABC =$ **60°** (alt. $\angle$s, AB // MN)

7. **(a)**


$\angle BCM = p°$ (alt. $\angle$s, BA // MN)
$\angle NCD = r°$ (alt. $\angle$s, MN // DE)
$p° + q° + r° = 360°$ ($\angle$s at a pt.)

(b) OPEN A possible set of values is **$p = 95$, $q = 145$ and $r = 120$**.

8.



$\angle CGS = 2x°$
$\angle CFQ = 2x°$ (corr. $\angle$s, PQ // RS)
$\angle AEQ = 2x°$ (corr. $\angle$s, AB // CD)
$\therefore y° = 2x°$, i.e. $y = 2x$ (shown)

11 Polygons and Geometrical Constructions

Worksheet 11A Triangles

1. **(a)** $x° + 32° + 90° = 180°$ ($\angle$ sum of $\triangle$)
$x° + 122° = 180°$
$x° = 58°$
$\therefore x =$ **58**

(b) $x° + 43° + 43° = 180°$ ($\angle$ sum of $\triangle$)
$x° + 86° = 180°$
$x° = 94°$
$\therefore x =$ **94**

(c) $x° + x° + x° = 180°$ ($\angle$ sum of $\triangle$)
$3x° = 180°$
$x° = 60°$
$\therefore x =$ **60**

(d) $x° + 15° + 56° = 180°$ ($\angle$ sum of $\triangle$)
$x° + 71° = 180°$
$x° = 109°$
$\therefore x =$ **109**

2. **(a)** $x° + x° + 50° = 180°$ ($\angle$ sum of $\triangle$)
$2x° + 50° = 180°$
$2x° = 130°$
$x° = 65°$
$y° + 50° + 50° = 180°$ ($\angle$ sum of $\triangle$)
$y° + 100° = 180°$
$y° = 80°$
$\therefore$ **$x = 65$, $y = 80$**

(b) Consider the smaller triangle.
$31° + 31° + (360 - x)° = 180°$ ($\angle$ sum of $\triangle$)
$422° - x° = 180°$
$-x° = -242°$
$x° = 242°$
Consider the larger triangle.
Base angle $= \dfrac{180° - 68°}{2}$
$= 56°$
$y° = 56° - 31°$
$= 25°$
$\therefore$ **$x = 242$, $y = 25$**

3. **(a)** $x° + (x + 2)° = 80°$ (ext. $\angle$ of $\triangle$)
$2x° + 2° = 80°$
$2x° = 78°$
$x° = 39°$
$\therefore x =$ **39**

(b) $\angle BAC + \angle ABC = 68°$ (ext. $\angle$ of $\triangle$)
$2\angle ABC = 68°$
$\angle ABC = 34°$
$x° = 360° - 34°$ ($\angle$s at a pt.)
$= 326°$
$\therefore x =$ **326**

4. $80° + 53° + \angle BCD = 180°$ (int. $\angle$s, AB // CD)
$\angle BCD + 133° = 180°$
$\angle BCD = 47°$
$\angle BDC + 123° = 180°$ (adj. $\angle$s on a str. line)
$\angle BDC = 57°$
$\angle CBD + 47° + 57° = 180°$ ($\angle$ sum of $\triangle$)
$\angle CBD + 104° = 180°$
$\angle CBD = 76°$
$\therefore$ **No.** $\triangle CBD$ is not a right-angled triangle.

5. **(i)** $\angle DEC + 118° = 180°$ (int. $\angle$s, DE // BC)
$\angle DEC =$ **62°**

(ii) $\angle DAE + \angle ADE = 62°$ (ext. $\angle$ of $\triangle$)
$2\angle DAE = 62°$
$\angle DAE =$ **31°**

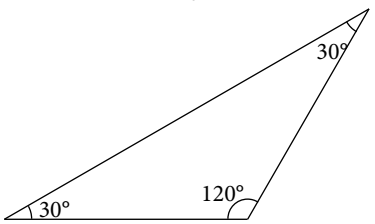
(iii) $\angle DBC + 31° + 118° = 180°$ ($\angle$ sum of $\triangle$)
$\angle DBC + 149° = 180°$
$\angle DBC =$ **31°**

6. **(a)** **(i)** $\angle DBC =$ **42°** (base $\angle$ of isos. $\triangle$)

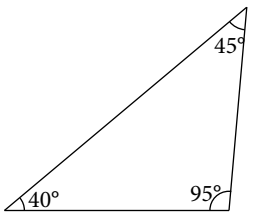
(ii) $\angle ADB = \angle DBC + \angle DCB$ (ext. $\angle$ of $\triangle$)
$= 42° + 42°$
$=$ **84°**

(b) $\angle BAC = 180° - 90° - 42°$ ($\angle$ sum of $\triangle$)
$= 48°$
$\angle ABD = 90° - 42°$
$= 48°$
Since $\angle BAD = \angle ABD$, then $\triangle ABD$ is isosceles.

7. **(a)**
A possible set of angles is **30°, 30° and 120°**.



(b)
A possible set of angles is **40°, 45° and 95°**.



8. Let $\angle ABC = x°$ and $\angle BAC = 4x°$.

$4x° + x° + 60° = 180°$ ($\angle$ sum of $\triangle$)

$5x° + 60° = 180°$

$5x° = 120°$

$x° = 24°$

$\therefore \angle BAC = 4(24°) = \mathbf{96°}$

Challenge Myself!

9. OPEN

$\angle ACD = w° + x°$ (ext. $\angle$ of $\triangle$)

$z° = w° + x° + y°$ (ext. $\angle$ of $\triangle$)

Two possible sets of values are $\boldsymbol{w = 20, x = 45, y = 35}$ **and** $\boldsymbol{z = 100}$, and $\boldsymbol{w = 15, x = 50, y = 40}$ **and** $\boldsymbol{z = 105}$.

Worksheet 11B Quadrilaterals

1. (a) $x° + x° = 54°$ (ext. $\angle$ of $\triangle$)

$2x° = 54°$

$x° = 27°$

$\angle AED = 54°$ (vert. opp. $\angle$s)

$y° + y° + 54° = 180°$ ($\angle$ sum of $\triangle$)

$2y° + 54° = 180°$

$2y° = 126°$

$y° = 63°$

$\therefore \boldsymbol{x = 27, y = 63}$

(b) $x° + 22° + 90° = 180°$ ($\angle$ sum of $\triangle$)

$x° + 112° = 180°$

$x° = 68°$

$\angle DEC = 180° - 33° - 68°$ (adj. $\angle$s on a str. line)

$= 79°$

$y° + 90° + 79° = 180°$ ($\angle$ sum of $\triangle$)

$y° + 169° = 180°$

$y° = 11°$

$\therefore \boldsymbol{x = 68, y = 11}$

2. (a) $x° = 90°$

$y° = \frac{90°}{2}$

$= 45°$

$\therefore \boldsymbol{x = 90, y = 45}$

(b) $x° = \frac{90°}{2}$

$= 45°$

$y° + 45° = 180°$ (int. $\angle$s, DA // FE)

$y° = 135°$

$\therefore \boldsymbol{x = 45, y = 135}$

3. (a) $3x° + (5x + 12)° = 180°$ (int. $\angle$s, AB // DC)

$3x° + 5x° + 12° = 180°$

$8x° = 168°$

$x° = 21°$

$y° + 5(21°) + 12° = 180°$ (int. $\angle$s, DA // CB)

$y° + 117° = 180°$

$y° = 63°$

$\therefore \boldsymbol{x = 21, y = 63}$

(b) $x° = 23°$ (alt. $\angle$s, AB // DC)

$\angle DAE = 84°$ (alt. $\angle$s, DA // CB)

$y° = 35° + 84°$ (ext. $\angle$ of $\triangle$)

$= 119°$

$\therefore \boldsymbol{x = 23, y = 119}$

4. (a) $\angle CBD = 34°$ (base $\angle$ of isos. $\triangle$)

$x° + 90° + 34° = 180°$ ($\angle$ sum of $\triangle$)

$x° + 124° = 180°$

$x° = 56°$

$y° = 56°$ (base $\angle$ of isos. $\triangle$)

$\therefore \boldsymbol{x = 56, y = 56}$

(b) $\angle ACD = 4x°$ (AB // DC)

$\angle DAC = 4x°$ (base $\angle$ of isos. $\triangle$)

$7x° + 4x° + 4x° = 180°$ ($\angle$ sum of $\triangle$)

$15x° = 180°$

$x° = 12°$

$12y° = 7x°$

$= 7(12°)$

$= 84°$

$y° = 7°$

$\therefore \boldsymbol{x = 12, y = 7}$

5. (a) $x° + x° + 126° = 180°$ ($\angle$ sum of $\triangle$)

$2x° + 126° = 180°$

$2x° = 54°$

$x° = 27°$

$y° + 37° + 37° = 180°$ ($\angle$ sum of $\triangle$)

$y° + 74° = 180°$

$y° = 106°$

$\therefore \boldsymbol{x = 27, y = 106}$

(b) $x° = 28°$

$\angle DBC = 55°$

$y° + 28° + 55° = 180°$ ($\angle$ sum of $\triangle$)

$y° + 83° = 180°$

$y° = 97°$

$\therefore \boldsymbol{x = 28, y = 97}$

6. (a) $x° + 90° = 180°$ (int. $\angle$s, AB // DC)

$x° = 90°$

$y° + 65° = 180°$ (int. $\angle$s, AB // DC)

$y° = 115°$

$\therefore \boldsymbol{x = 90, y = 115}$

(b) $5x° + 6x° + 7x° = 180°$ ($\angle$ sum of $\triangle$)

$18x° = 180°$

$x° = 10°$

$2y° + 75° + 6(10°) = 180°$ (int. $\angle$s, AB // DC)

$2y° + 135° = 180°$

$2y° = 45°$

$y° = 22.5°$

$\therefore \boldsymbol{x = 10, y = 22.5}$

7. (i) Obtuse $\angle DAE = 180° - 59°$ (int. $\angle$s, AB // DC)

$= 121°$

Reflex $\angle DAE = 360° - 121°$ ($\angle$s at a pt.)

$= \mathbf{239°}$

(ii) $\angle EFD = \mathbf{130°}$ (alt. $\angle$s, AB // DC)

(iii) $\angle AFD = 180° - 59° - 59°$ ($\angle$ sum of $\triangle$)

$= 62°$

$\angle AFE = 130° - 62°$

$= \mathbf{68°}$

8. **(i)** $x = \mathbf{10.5}$

(ii) $y° + 28° + 90° = 180°$ ($\angle$ sum of $\triangle$)

$y° + 118° = 180°$

$y° = 62°$

$\therefore y = \mathbf{62}$

9. **(i)** $\angle BCD = 360° - 96° - 105° - 105°$ ($\angle$ sum of quadrilateral)

$= \mathbf{54°}$

(ii) $\angle FEC = 105°$ (corr. $\angle$s, AB // FE)

$\angle FGC = 105°$ (corr. $\angle$s, AD // FG)

$\angle EFG = 360° - 54° - 105° - 105°$ ($\angle$ sum of quadrilateral)

$= \mathbf{96°}$

10. **(a)** **(i)** $\angle BCD = \mathbf{47°}$ (corr. $\angle$s, BC // FD)

(ii) $\angle ABD + 55° + 47° = 180°$ (int. $\angle$s, AB // DC)

$\angle ABD + 102° = 180°$

$\angle ABD = \mathbf{78°}$

(iii) $\angle BDF = 55°$ (alt. $\angle$s, BC // FD)

$\angle AFD + 99° + 78° + 55° = 360°$ ($\angle$ sum of quadrilateral)

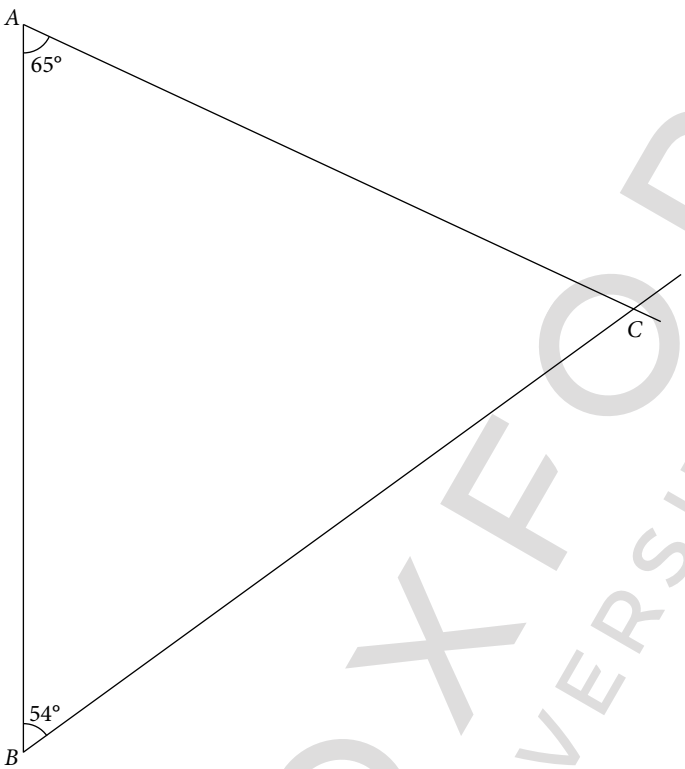
$\angle AFD + 232° = 360°$

$\angle AFD = \mathbf{128°}$

(b) Since $\angle ABD + \angle BAF = 78° + 99° = 177° \neq 180°$, then there are no pairs of parallel lines in $ABDF$, i.e. $ABDF$ is **not a trapezium**.

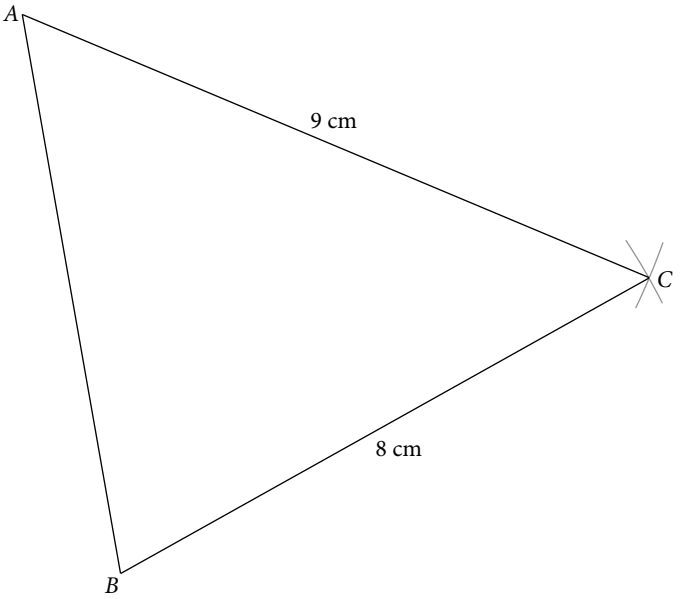
Worksheet 11C Geometrical constructions of triangles and quadrilaterals

1. **(a)**



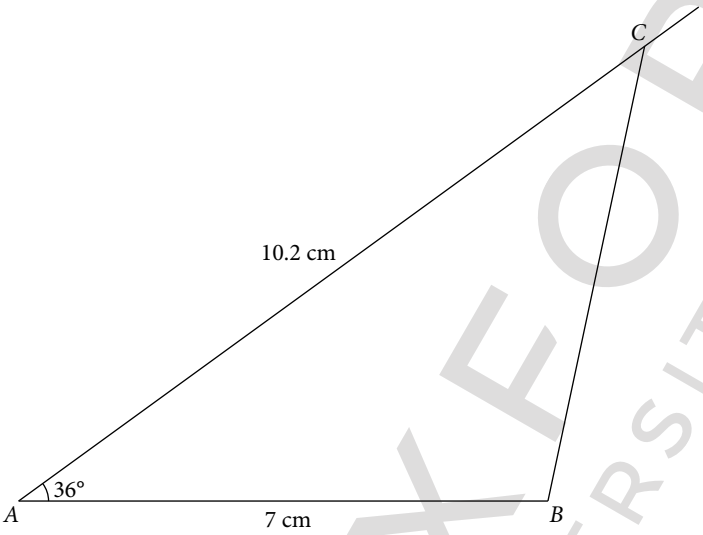
(b) $AC = \mathbf{8.9\ cm}$

2. **(a)**



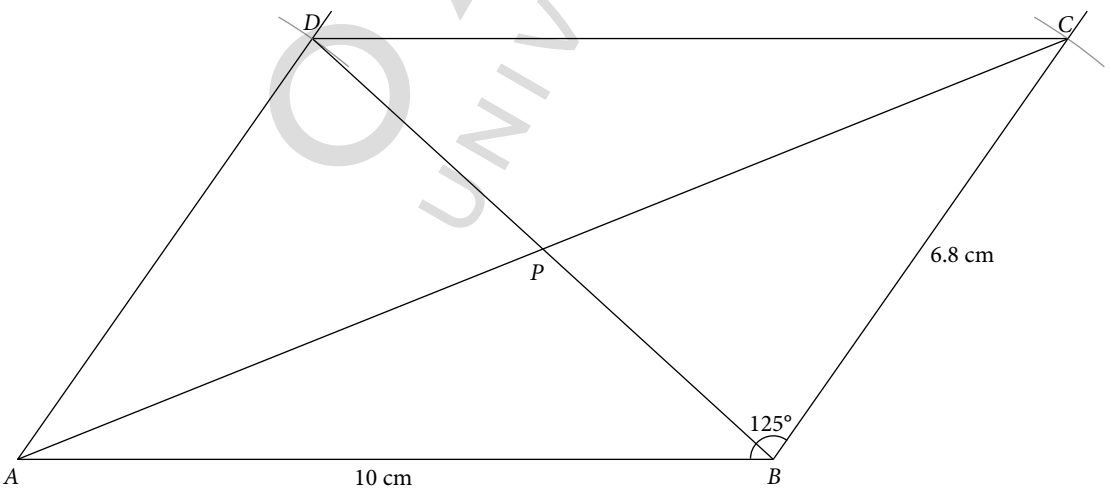
(b) $\angle ACB = \mathbf{52°}$

3. **(a)**



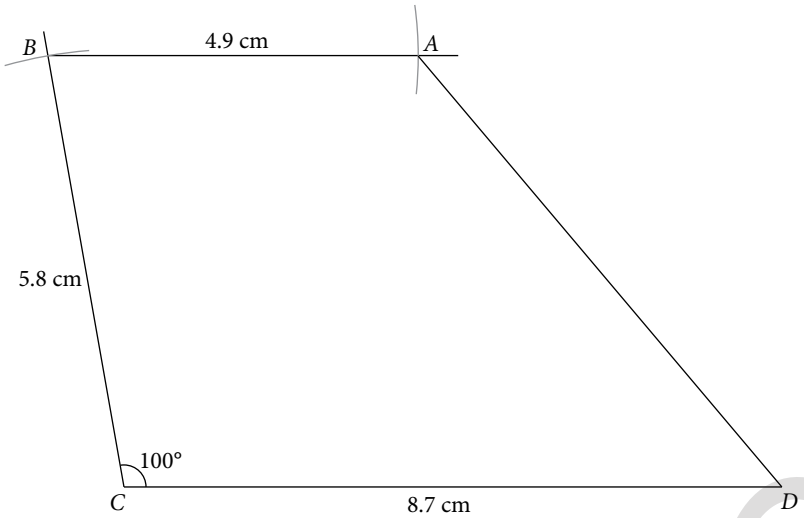
(b) $\angle ABC = \mathbf{102°}$

4. **(a)**



(b) $PA = \mathbf{7.5\ cm}$

5. **(a)**

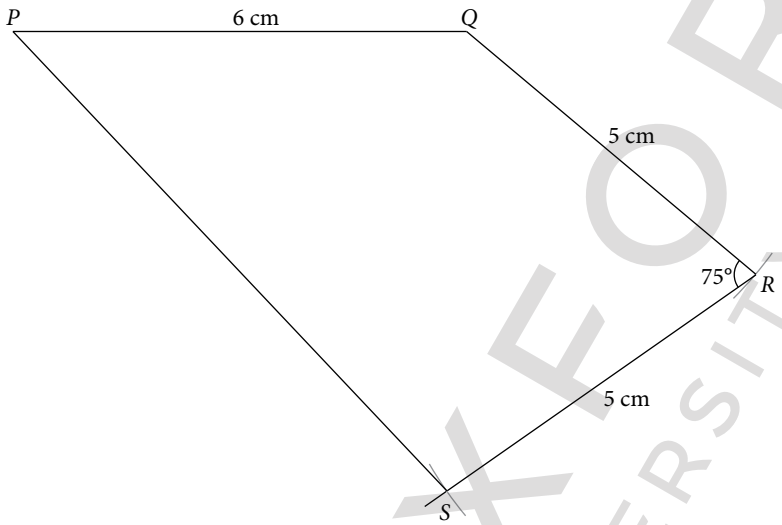


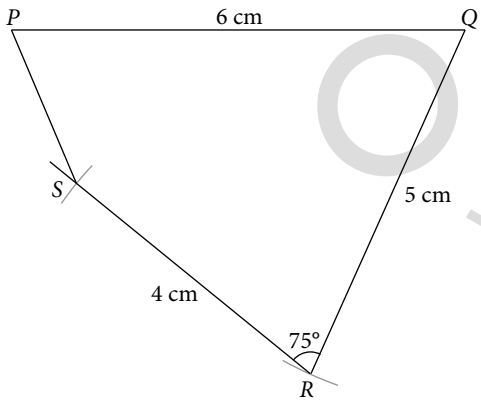
(b) AD = **7.5 cm**

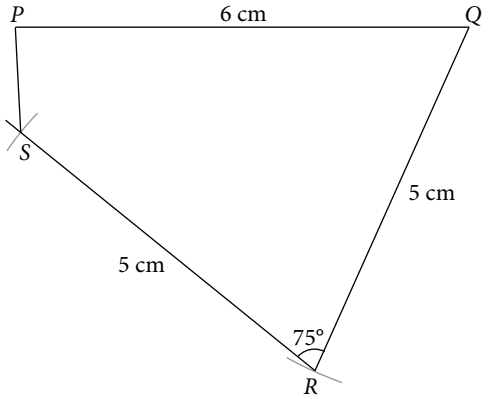
(c) $\angle ADC$ = **50°**

Challenge Myself!

6.







Worksheet 11D Polygons

1. **(a)** Sum of interior angles of a 16-gon = $(16 - 2) \times 180°$
$= \mathbf{2520°}$

(b) Sum of interior angles of a 22-gon = $(22 - 2) \times 180°$
$= \mathbf{3600°}$

2. **(a)** Each interior angle of a 18-gon = $\dfrac{(18-2)\times 180°}{18}$
$= \mathbf{160°}$

(b) Each interior angle of a 30-gon = $\dfrac{(30-2)\times 180°}{30}$
$= \mathbf{168°}$

3. **(a)** Each exterior angle of a hexagon = $\dfrac{360°}{6}$
$= \mathbf{60°}$

(b) Each exterior angle of a nonagon = $\dfrac{360°}{9}$
$= \mathbf{40°}$

4. **(a)** Number of sides = $\dfrac{360°}{24°}$
$= \mathbf{15}$

(b) Number of sides = $\dfrac{360°}{15°}$
$= \mathbf{24}$

5. **(a)** Each exterior angle = $180° - 150°$
$= 30°$
Number of sides = $\dfrac{360°}{30°}$
$= \mathbf{12}$

(b) Each exterior angle = $180° - 168°$
$= 12°$
Number of sides = $\dfrac{360°}{12°}$
$= \mathbf{30}$

6. Exterior angle = $\dfrac{1}{12} \times 180°$
$= 15°$
Number of sides = $\dfrac{360°}{15°}$
$= \mathbf{24}$

7. Each exterior angle = $180° - 160°$
$= 20°$
Number of sides = $\dfrac{360°}{20°}$
$= \mathbf{18}$

8. Each interior angle of a regular pentagon = $\dfrac{(5-2)\times 180°}{5}$
$= 108°$
Each interior angle of a regular heptagon = $\dfrac{(7-2)\times 180°}{7}$
$= 128.571°$ (to 3 d.p.)
$x° = 360° - 108° - 128.571°$ ($\angle$s at a pt.)
$= 123.4°$ (to 1 d.p.)
$\therefore x = \mathbf{123.4}$

9. **(i)** Sum of interior angles of a pentagon = $(5 - 2) \times 180°$
$= \mathbf{540°}$

(ii) $x° + (3x - 50)° + 100° + 2x° + (2x + 10)° = 540°$
$8x° + 60° = 540°$
$8x° = 480°$
$x° = 60°$
$\therefore x = \mathbf{60}$

10. **(i)** Sum of exterior angles of a hexagon = 360°
$8x° + 3x° + (11x + 3)° + (6x + 7)° + (7x - 3)° + (5x - 7)°$
$= 360°$
$40x° = 360°$
$x° = 9°$
$\therefore x = \mathbf{9}$

(ii) Smallest exterior angle of the hexagon = $3(9°)$
$= 27°$
$\therefore$ Largest interior angle of the hexagon
$= 180° - 27°$
$= \mathbf{153°}$

11. Sum of interior angles of a hexagon = $(6 - 2) \times 180°$
$= 720°$
Each remaining interior angle = $\dfrac{720° - 3(100°)}{3}$
$= 140°$
$x° = 360° - 140°$ ($\angle$s at a pt.)
$= 220°$
$\therefore x = \mathbf{220}$

12. **(i)** Sum of interior angles of a 9-sided polygon = $(9 - 2) \times 180°$
$= \mathbf{1260°}$

(ii) $6(135°) + x° + (x + 10)° + (2x - 84)° = 1260°$
$4x° + 736° = 1260°$
$4x° = 524°$
$x° = 131°$
Largest angle = $2(131°) - 84°$
$= \mathbf{178°}$

13. Sum of interior angles of an n-sided polygon = $(n - 2) \times 180°$
$4(115°) + (n - 4)x° = (n - 2) \times 180°$
$460 + (n - 4)x = 180n - 360$
$(n - 4)x = 180n - 820$
$\boldsymbol{x = \dfrac{180n - 820}{n - 4}}$

14. **(i)** $\angle ABC = \dfrac{(8-2)\times 180°}{8}$
$= \mathbf{135°}$

(ii) Since GC bisects $\angle BCG$,
$\angle BCG = \dfrac{135°}{2}$
$= \mathbf{67.5°}$

(iii) $\angle BCF = 90°$
$\angle GCF = 90° - 67.5°$
$= \mathbf{22.5°}$

15. (a) $\angle ABC = \dfrac{(8-2)\times 180°}{8}$

$= 135°$

$\angle QBC = 135° - 90°$

$= 45°$

$\therefore \angle BQC = \dfrac{180° - 45°}{2}$ (base $\angle$s of isos. $\triangle$)

$= \mathbf{67.5°}$

(b) By symmetry, BC is parallel to QD and BQ is parallel to CD.

$\therefore BCDQ$ is a parallelogram.

In addition, $BQ = AB$ (sides of a square) and $AB = BC = CD$ (sides of a regular polygon).

$\therefore BQ = BC = CD$

$\therefore BCDQ$ is a **rhombus**.

Challenge Myself!

16. (a) (i) $\angle COD = \dfrac{360°}{10}$

$= \mathbf{36°}$

(ii) $\angle ABC = \dfrac{(10-2)\times 180°}{10}$

$= 144°$

$\angle BCA = \dfrac{180° - 144°}{2}$ (base $\angle$ of isos. $\triangle$)

$= 18°$

$\angle ACD = 144° - 18°$

$= \mathbf{126°}$

(b) Trapezium

Review Exercise 11

1. $5y° + 4y° = 180°$ (int. $\angle$s, // lines)

$9y° = 180°$

$y° = 20°$

$\therefore y = \mathbf{20}$

2. $x° + (x - 20)° + (x - 25)° = 180°$ ($\angle$ sum of $\triangle$)

$3x° - 45° = 180°$

$3x° = 225°$

$x° = 75°$

$\therefore$ The angles are **75°, 50° and 55°**.

3. Let the first angle be $x°$, i.e. the other two angles are $3x°$ and $(3x + 19)°$.

$x° + 3x° + (3x + 19)° = 180°$ ($\angle$ sum of $\triangle$)

$7x° + 19° = 180°$

$7x° = 161°$

$x° = 23°$

$\therefore$ The angles are **23°, 69° and 88°**.

4. (i) $\angle BCD + 55° = 180°$ (int. $\angle$s, AB // DC)

$\angle BCD = \mathbf{125°}$

(ii) $\angle DAB = 125°$ (opp. $\angle$s of a parallelogram are equal)

$\angle ADE + 125° + 32° = 180°$ ($\angle$ sum of $\triangle$)

$\angle ADE + 157° = 180°$

$\angle ADE = \mathbf{23°}$

5. (i) $\angle CED = 180° - 61° - 61°$ ($\angle$ sum of $\triangle$)

$= \mathbf{58°}$

(ii) $\angle CEF = \mathbf{61°}$ (alt. $\angle$s, AD // FE)

(iii) $\angle FAC + 70° = 180°$ (int. $\angle$s, AD // FE)

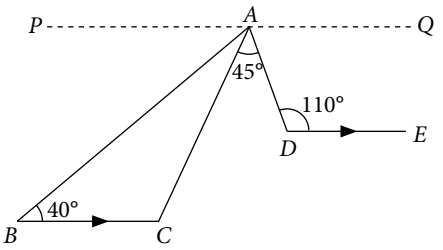
$\angle FAC = \mathbf{110°}$

(iv) $\angle ABC + 70° + 61° = 180°$ ($\angle$ sum of $\triangle$)

$\angle ABC + 131° = 180°$

$\angle ABC = \mathbf{49°}$

6.



(i) $\angle PAB = 40°$ (alt. $\angle$s, PQ // BC)

$\angle PAD = 110°$ (alt. $\angle$s, PQ // DE)

$40° + \angle BAC + 45° = 110°$

$\angle BAC + 85° = 110°$

$\angle BAC = \mathbf{25°}$

(ii) $\angle BCA + 25° + 40° = 180°$ ($\angle$ sum of $\triangle$)

$\angle BCA + 65° = 180°$

$\angle BCA = \mathbf{115°}$

7. (i) $AC = \mathbf{4\ cm}$

(ii) $\angle ADC + 132° + 60° + 132° = 360°$ ($\angle$ sum of quadrilateral)

$\angle ADC + 324° = 360°$

$\angle ADC = \mathbf{36°}$

8. (i) $\angle ADC + 135° + 105° + 80° = 360°$ ($\angle$ sum of quadrilateral)

$\angle ADC + 320° = 360°$

$\angle ADC = \mathbf{40°}$

(ii) $\angle ACB = \dfrac{180° - 105°}{2}$ (base $\angle$s of isos. $\triangle$)

$= 37.5°$

$\angle ACE = 80° - 37.5°$

$= \mathbf{42.5°}$

(iii) $\angle CAE = \mathbf{37.5°}$ (alt. $\angle$s, EA // CB)

9. (a) Each exterior angle of the polygon $= 180° - 170°$

$= 10°$

Number of sides $= \dfrac{360°}{10°}$

$= \mathbf{36}$

(b) Exterior angle of a regular octagon $= \dfrac{360°}{8}$

$= \mathbf{45°}$

10. Sum of interior angles in a hexagon $= (6 - 2) \times 180°$

$= 720°$

Let the sixth angle be $x°$, i.e. each of the other five angles is $2x°$.

$5(2x°) + x° = 720°$

$11x° = 720°$

$x° = 65.5°$ (to 1 d.p.)

$\therefore$ The smallest angle in the hexagon is **65.5°**.

11. Sum of interior angles in a pentagon $= (5 - 2) \times 180°$

$= 540°$

$2x° + (3x - 4)° + x° + 136° + 90° = 540°$

$6x° = 318°$

$x° = 53°$

$\therefore x = \mathbf{53}$

12. (i) Each exterior angle of the polygon $= 180° - 162°$

$= 18°$

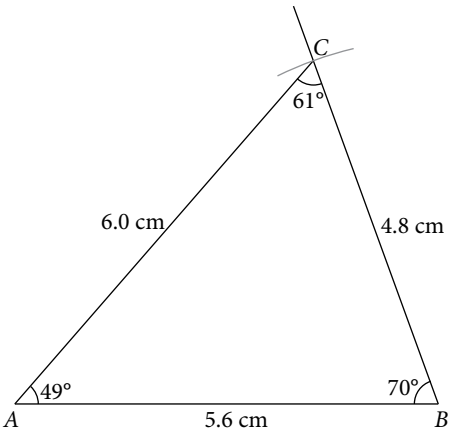
$n = \dfrac{360°}{18°}$

$= \mathbf{20}$

(ii) $\angle BCA = \dfrac{180° - 162°}{2}$ (base $\angle$s of isos. $\triangle$)
$= \mathbf{9°}$

(iii) $\angle ACE = 162° - 9° - 9°$
$= 144°$
$\angle CEA = \dfrac{180° - 144°}{2}$ (base $\angle$s of isos. $\triangle$)
$= 18°$
$\angle DEA = 9° + 18°$
$= \mathbf{27°}$

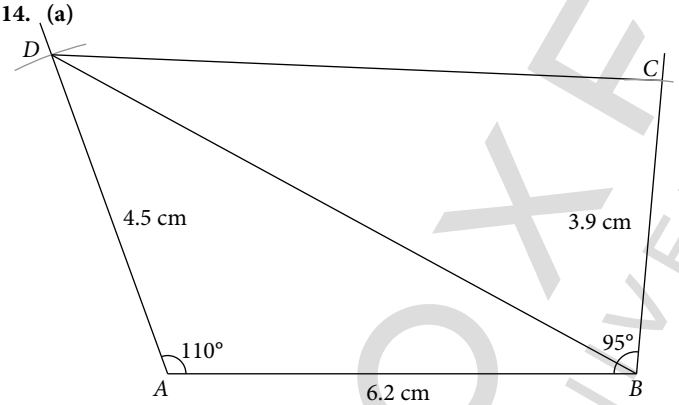
13. (a)



(b) $AC = \mathbf{6.0\ cm}$

(c) $\angle ACB = 61°$ and $\angle CAB = 49°$
The longest side of the triangle ($AC = 6.0$ cm) is opposite the largest angle ($\angle ABC = 70°$) and the shortest side of the triangle ($BC = 4.8$ cm) is opposite the smallest angle ($\angle CAB = 49°$). (shown)

14. (a)



(b) $BD = \mathbf{8.8\ cm}$

(c) $\angle ADC = \mathbf{68°}$

12 Perimeter and Area of Plane Figures

Worksheet 12A Conversion of units

1. (a) $1\ m^2 = 100\ cm \times 100\ cm$
$= \mathbf{10\,000\ cm^2}$

(b) $4\ m^2 = 4 \times 10\,000\ cm^2$
$= \mathbf{40\,000\ cm^2}$

(c) $17\ m^2 = 17 \times 10\,000\ cm^2$
$= \mathbf{170\,000\ cm^2}$

(d) $0.1\ m^2 = 0.1 \times 10\,000\ cm^2$
$= \mathbf{1000\ cm^2}$

(e) $0.05\ m^2 = 0.05 \times 10\,000\ cm^2$
$= \mathbf{500\ cm^2}$

(f) $\dfrac{1}{8}\ m^2 = \dfrac{1}{8} \times 10\,000\ cm^2$
$= \mathbf{1250\ cm^2}$

2. (a) $10\,000\ cm^2 = \dfrac{10\,000}{100 \times 100}\ m^2$
$= \mathbf{1\ m^2}$

(b) $30\,000\ cm^2 = \dfrac{30\,000}{100 \times 100}\ m^2$
$= \mathbf{3\ m^2}$

(c) $68\,000\ cm^2 = \dfrac{68\,000}{100 \times 100}\ m^2$
$= \mathbf{6.8\ m^2}$

(d) $714\,000\ cm^2 = \dfrac{714\,000}{100 \times 100}\ m^2$
$= \mathbf{71.4\ m^2}$

(e) $920\ cm^2 = \dfrac{920}{100 \times 100}\ m^2$
$= \mathbf{0.092\ m^2}$

(f) $2\ cm^2 = \dfrac{2}{100 \times 100}\ m^2$
$= \mathbf{0.0002\ m^2}$

3. $39\,100\,000\ cm^2 = \dfrac{39\,100\,000}{100 \times 100}\ m^2$
$= 3910\ m^2$
Difference in area $= 4050\ m^2 - 3910\ m^2$
$= 140\ m^2$
$\therefore$ The **rectangular field** is larger by $\mathbf{140\ m^2}$.

Worksheet 12B Perimeter and area of rectangles and triangles

1. (a) Area of square $= 7\ cm \times 7\ cm$
$= \mathbf{49\ cm^2}$
Perimeter of square $= (4 \times 7)\ cm$
$= \mathbf{28\ cm}$

(b) Area of square $= 3x\ cm \times 3x\ cm$
$= \mathbf{9x^2\ cm^2}$
Perimeter of square $= (4 \times 3x)\ cm$
$= \mathbf{12x\ cm}$

2. **(a)** Length of side of square $= \frac{52\text{ cm}}{4}$
$= 13\text{ cm}$
Area of square $= 13\text{ cm} \times 13\text{ cm}$
$= \mathbf{169\text{ cm}^2}$

(b) Length of side of square $= \sqrt{196}\text{ cm}$
$= 14\text{ cm}$
Perimeter of square $= (4 \times 14)\text{ cm}$
$= \mathbf{56\text{ cm}}$

3. **(a)** Area of rectangle $= 11\text{ cm} \times 4\text{ cm}$
$= \mathbf{44\text{ cm}^2}$
Perimeter of rectangle $= 2(11\text{ cm} + 4\text{ cm})$
$= \mathbf{30\text{ cm}}$

(b) Area of rectangle $= 9\text{ cm} \times (5x + 1)\text{ cm}$
$= \mathbf{(45x + 9)\text{ cm}^2}$
Perimeter of rectangle $= 2[9\text{ cm} + (5x + 1)\text{ cm}]$
$= 2(5x + 10)\text{ cm}$
$= \mathbf{(10x + 20)\text{ cm}}$

4. 

(i) $8\text{ cm} \times 6\text{ cm} = 48\text{ cm}^2$
The length and breadth of the rectangle could be **8 cm and 6 cm** respectively.

(ii) Perimeter $= 2(8\text{ cm} + 6\text{ cm})$
$= \mathbf{28\text{ cm}}$

5. **(a)** Area of triangle $= \frac{1}{2} \times 10\text{ cm} \times 4\text{ cm}$
$= \mathbf{20\text{ cm}^2}$

(b) Area of triangle $= \frac{1}{2} \times x\text{ cm} \times y\text{ cm}$
$= \mathbf{\frac{1}{2}\,xy\text{ cm}^2}$

6. **(a)** Area of triangle $= \frac{1}{2} \times 26\text{ cm} \times h\text{ cm}$
$130 = 13h$
$13h = 130$
$h = \mathbf{10}$

(b) Area of triangle $= \frac{1}{2} \times z\text{ cm} \times 9\text{ cm}$
$130 = \frac{9}{2}z$
$\frac{9}{2}z = 130$
$z = \mathbf{28.9}$ (to 3 s.f.)

7. $2a + 3(12) = 45$
$2a + 36 = 45$
$2a = 9$
$a = 4.5$
$12 \times b = 60 \times 4.5$
$12b = 270$
$b = 22.5$
$22.5 + 5c = 60$
$5c = 37.5$
$c = 7.5$
$\therefore \boldsymbol{a = 4.5, b = 22.5, c = 7.5}$

Worksheet 12C Perimeter and area of parallelograms

1. **(a)** Area of parallelogram $= 24\text{ cm} \times 16\text{ cm}$
$= \mathbf{384\text{ cm}^2}$

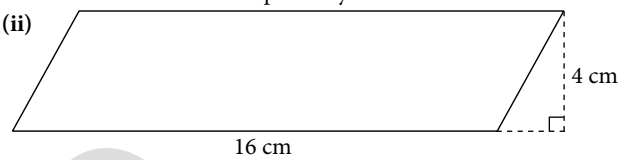
(b) Area of parallelogram $= 10\text{ cm} \times 9\text{ cm}$
$= \mathbf{90\text{ cm}^2}$

(c) Area of parallelogram $= 10\text{ cm} \times 25\text{ cm}$
$= \mathbf{250\text{ cm}^2}$

(d) Area of parallelogram $= 31\text{ cm} \times 19\text{ cm}$
$= \mathbf{589\text{ cm}^2}$

2. 

(i) $16\text{ cm} \times 4\text{ cm} = 64\text{ cm}^2$
The length of the base and height of the parallelogram could be **16 cm and 4 cm** respectively.

(ii)


3. Perimeter of parallelogram $= 2[(15 - 2x) + (6x + 1)]\text{ cm}$
$52 = 2(4x + 16)$
$8x + 32 = 52$
$8x = 20$
$x = 2.5$
$5y = 15 - 2(2.5)$
$= 10$
$y = 2$
$\therefore \boldsymbol{x = 2.5, y = 2}$

4. **(i)** Area of parallelogram $= 14\text{ cm} \times 19\text{ cm}$
$= \mathbf{266\text{ cm}^2}$

(ii) Area of parallelogram $= 20\text{ cm} \times AQ$
$20\text{ cm} \times AQ = 266\text{ cm}^2$
$AQ = \mathbf{13.3\text{ cm}}$

5. **(i)** **(a)** Perimeter of the letter
$= [2(30) + 2(10) + 4(18) + 2(10)]\text{ cm}$
$= 172\text{ cm}$
$= 1.72\text{ m}$
$\therefore$ Kathy should buy the **2 m-long** fairy lights.

(b) Amount of change $= \$10 - \$6.90$
$= \mathbf{\$3.10}$

(ii) Total area $= 30\text{ cm} \times 10\text{ cm} + 2 \times 10\text{ cm} \times 15\text{ cm}$
$= \mathbf{600\text{ cm}^2}$

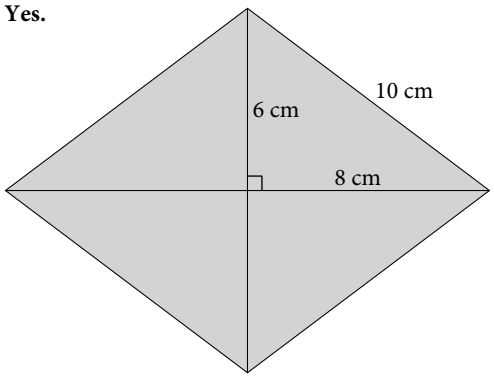
6. The parallelogram can be divided into 6 equal triangles.
$\therefore$ Area of parallelogram $ABCD = \mathbf{6p\text{ units}^2}$

7. **(a)** **True.** Triangles ABC and PBC have the same area because they have the same base and the same height.

(b) **False.** Triangles ABC and PBC have the same area if $\angle PCB = 90°$ and $CP = AB$.

Challenge Myself!

8. **Yes.**



Worksheet 12D Perimeter and area of trapeziums

1. **(a)** Area of trapezium $= \frac{1}{2} \times (12 \text{ cm} + 20 \text{ cm}) \times 11 \text{ cm}$
$= \mathbf{176 \text{ cm}^2}$

(b) Area of trapezium $= \frac{1}{2} \times (33 \text{ cm} + 17 \text{ cm}) \times 21 \text{ cm}$
$= \mathbf{525 \text{ cm}^2}$

(c) Area of trapezium $= \frac{1}{2} \times (4.4 \text{ cm} + 9.2 \text{ cm}) \times 7.6 \text{ cm}$
$= \mathbf{51.68 \text{ cm}^2}$

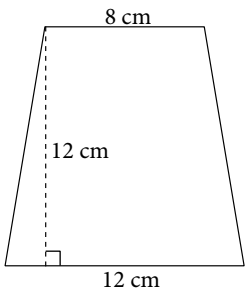
(d) Area of trapezium $= \frac{1}{2} \times (6 \text{ cm} + 4 \text{ cm}) \times 4.8 \text{ cm}$
$= \mathbf{24 \text{ cm}^2}$

2. 

(i) $\frac{1}{2} \times (12 \text{ cm} + 8 \text{ cm}) \times 12 \text{ cm} = 120 \text{ cm}^2$

The lengths of the parallel sides of the trapezium could be **12 cm and 8 cm**, and the height could be **12 cm**.

(ii)



3. Divide the pentagon into a rectangle and a trapezium.

Area of pentagon $= \left[16 \times 10 + \frac{1}{2} \times (10 + 4) \times 9\right] \text{ cm}^2$
$= \mathbf{223 \text{ cm}^2}$

Alternatively, find the difference in areas of a rectangle and a triangle.

Area of pentagon $= \left[(25 \times 10) - \frac{1}{2} \times 9 \times 6\right] \text{cm}^2$
$= \mathbf{223 \text{ cm}^2}$

4. **(i)** $DC = \{(11.5x - 14) - [1.5x + (3x - 4) + 2(x - 1)]\}$ cm
$= (11.5x - 14 - 1.5x - 3x + 4 - 2x + 2)$ cm
$= \mathbf{(5x - 8) \text{ cm}}$

(ii) Since $AD = BC$,
$1.5x = 2(x - 1)$
$= 2x - 2$
$-0.5x = -2$
$x = 4$
Perimeter of trapezium $= [11.5(4) - 14]$ cm
$= \mathbf{32 \text{ cm}}$

(iii) $AB = [3(4) - 4]$ cm
$= 8$ cm
$DC = [5(4) - 8]$ cm
$= 12$ cm
Area of trapezium $= \frac{1}{2} \times (8 \text{ cm} + 12 \text{ cm}) \times 5.7 \text{ cm}$
$= \mathbf{57 \text{ cm}^2}$

5. Area of parallelogram $= 30 \text{ cm} \times 6 \text{ cm}$
$= 180 \text{ cm}^2$
Area of trapezium $= 90 \text{ cm}^2$
$\frac{1}{2} \times (4 + x) \times 10 = 90$
$5(4 + x) = 90$
$20 + 5x = 90$
$5x = 70$
$x = \mathbf{14}$

6. 

(a) He assumes that $AD = BC$.

(b) Let $DE = 7.5$ cm.
Area of $\triangle ADE = 75 \text{ cm}^2$
$\frac{1}{2} \times 7.5 \times AE = 75 \text{ cm}^2$
$AE = 20$ cm
$\therefore$ Another possible value of the area of trapezium $ABCD = \frac{1}{2} \times (40 \text{ cm} + 20 \text{ cm}) \times 20 \text{ cm} = \mathbf{600 \text{ cm}^2}$.

Worksheet 12E Circumference and area of circles

1. **(a)** Area $= \pi(5)^2 \text{ cm}^2$
$= 3.142(5)^2 \text{ cm}^2$
$= \mathbf{78.55 \text{ cm}^2}$
Circumference $= 2\pi(5)$ cm
$= 10(3.142)$ cm
$= \mathbf{31.42 \text{ cm}}$

(b) Radius $= 6$ m
Circumference $= 2\pi(6)$ m
$= \mathbf{37.7 \text{ m}}$ (to 3 s.f.)
Area $= \pi(6)^2 \text{ m}^2$
$= \mathbf{113 \text{ m}^2}$ (to 3 s.f.)

(c) Radius $= \sqrt{\frac{770}{\pi}}$ mm
$= \mathbf{15.7 \text{ mm}}$ (to 3 s.f.)
Diameter $= 2 \times \sqrt{\frac{770}{\pi}}$ mm
$= \mathbf{31.3 \text{ mm}}$ (to 3 s.f.)

(d) Let the radius of the circle be r.
Area $= \pi r^2$
$\frac{22}{7} r^2 = 38.5$
$r^2 = 12.25$
$r = 3.5$
Circumference $= 2\pi r$
$= 2\left(\frac{22}{7}\right)(3.5)$
$= \mathbf{22 \text{ cm}}$

(e) Let the radius of the circle be r.
Circumference $= 2\pi r$
$\pi x = 2\pi r$
$x = 2r$
$r = 0.5x$
Area $= \pi(0.5x)^2$
$= \mathbf{0.25\pi x^2}$

2. **(a)** Area $= \frac{1}{2} \times \pi(8)^2$ cm^2

$= \mathbf{101\ cm^2}$ (to 3 s.f.)

Perimeter $= \left[8 + 8 + \frac{1}{2} \times 2\pi(8)\right]$ cm

$= \mathbf{41.1\ cm}$ (to 3 s.f.)

(b) Radius = 21 mm

Area $= \frac{1}{2} \times \pi(21)^2$ mm^2

$= \mathbf{693\ mm^2}$ (to 3 s.f.)

Perimeter $= \left[42 + \frac{1}{2} \times 2\pi(21)\right]$ cm

$= \mathbf{108\ mm}$ (to 3 s.f.)

(c) Radius $= \sqrt{\frac{2 \times 1}{\pi}}$ m

$= \mathbf{0.798\ m}$ (to 3 s.f.)

Perimeter $= \left[2 \times \sqrt{\frac{2 \times 1}{\pi}} + \frac{1}{2} \times 2\pi\left(\sqrt{\frac{2 \times 1}{\pi}}\right)\right]$m

$= \mathbf{4.10\ m}$ (to 3 s.f.)

3. **(a)** Area $= \frac{1}{4} \times \pi(11)^2$ cm^2

$= \mathbf{95.0\ cm^2}$ (to 3 s.f.)

Perimeter $= \left[11 + 11 + \frac{1}{4} \times 2\pi(11)\right]$ cm

$= \mathbf{39.3\ cm}$ (to 3 s.f.)

(b) Radius $= \sqrt{\frac{4 \times 0.9}{\pi}}$ m

$= \mathbf{1.07\ m}$ (to 3 s.f.)

Perimeter $= \left[\sqrt{\frac{4 \times 0.9}{\pi}} + \sqrt{\frac{4 \times 0.9}{\pi}} + \frac{1}{4} \times 2\pi\left(\sqrt{\frac{4 \times 0.9}{\pi}}\right)\right]$m

$= \mathbf{3.82\ m}$ (to 3 s.f.)

4. **(i)** Perimeter of shape

$= \left[14 + 5 + \frac{1}{4} \times 2\pi(5) + 16 + 12\right]$ cm

$= \mathbf{54.9\ cm}$ (to 3 s.f.)

(ii) Area of shape

$= \left[\frac{1}{2} \times (14 + 21) \times 10 - \frac{1}{4}\pi(5)^2\right]$ cm^2

$= \mathbf{155\ cm^2}$ (to 3 s.f.)

5. **(i)** Radius of quadrant $= \frac{8\text{ m} - 5.2\text{ m}}{2}$

$= 1.4$ m

Perimeter

$= \left[5.2 + \frac{1}{2} \times 2\pi(1.4) + 2(3) + (8 - 5) + \frac{1}{2} \times 2\pi(2.5)\right]$cm

$= \mathbf{26.5\ m}$ (to 3 s.f.)

(ii) Area $= \left[(8 \times 4.4) - \frac{1}{2} \times 2\pi(2.5)^2 + \frac{1}{2} \times 2\pi(2.4)^2\right]$m^2

$= \mathbf{22.3\ m^2}$ (to 3 s.f.)

6. **(i)** Radius of large circle $= \frac{d + kd}{2}$

$= \frac{1}{2} d(k + 1)$

Area of large circle $= \pi\left[\frac{1}{2}d(k+1)\right]^2$

$= \pi\left[\frac{1}{4}d^2(k+1)^2\right]$

$= \frac{1}{4}\pi d^2(k + 1)^2$ (shown)

(ii) Area of large semicircle $= \frac{1}{2} \times \frac{1}{4}\pi d^2(4 + 1)^2$

$= \frac{25}{8}\pi d^2$

Area of shaded semicircle $= \frac{1}{2}\pi\left(\frac{d}{2}\right)^2$

$= \frac{1}{2}\pi\left(\frac{d}{4}\right)^2$

$= \frac{1}{8}\pi d^2$

Area of unshaded semicircle $= \frac{1}{2}\pi\left(\frac{4d}{2}\right)^2$

$= \frac{1}{2}\pi\left(\frac{16d^2}{4}\right)$

$= 2\pi d^2$

Area of shaded section $= \frac{25}{8}\pi d^2 - 2\pi d^2 + \frac{1}{8}\pi d^2$

$= \frac{5}{4}\pi d^3$

Area of unshaded section $= \frac{25}{8}\pi d^2 + 2\pi d^2 - \frac{1}{8}\pi d^2$

$= 5\pi d^2$

$\therefore$ Difference in area $= 5\pi d^2 - \frac{5}{4}\pi d^2$

$= \mathbf{\frac{15}{4}\pi d^2}$

Review Exercise 12

1. **(i)** Perimeter of shape $= 2[5x + 9 + 16 + 2(x + 10) + (3x - 1)]$ cm

$= 2(5x + 25 + 2x + 20 + 3x - 1)$ cm

$= 2(10x + 44)$ cm

$= \mathbf{(20x + 88)\ cm}$

(ii) Perimeter of shape = 308 cm

$20x + 88 = 308$

$20x = 220$

$x = \mathbf{11}$

(iii) $5x + 9 = 5(11) + 9 = 64$

$2(x + 10) = 2(11 + 10) = 42$

$3x - 1 = 3(11) - 1 = 32$

Area of shape $= [64 \times 42 + (64 + 16) \times 32]$ cm^2

$= \mathbf{5248\ cm^2}$

2. **(i)** Perimeter of shape $= \left[\frac{1}{2} \times 2\pi(6) + 5 + \frac{1}{4} \times 2\pi(5) + 13\right]$ cm

$= \mathbf{44.7\ cm}$ (to 3 s.f.)

(ii) Area of shape $= \left[\frac{1}{2} \times \pi(6)^2 + \frac{1}{4} \times \pi(5)^2 + \frac{1}{2} \times 12 \times 5\right]$ cm^2

$= \mathbf{106\ cm^2}$ (to 3 s.f.)

3. Area of quadrant $= \frac{1}{4} \times \pi x^2 \text{ cm}^2$

$= \frac{1}{4}\pi x^2 \text{ cm}^2$

Area of shaded region $= \left(\frac{1}{4}\pi x^2 - \frac{1}{2} \times x \times x\right) \text{ cm}^2$

$= \left(\frac{1}{4}\pi x^2 - \frac{1}{2}x^2\right) \text{ cm}^2$

$= \left(\frac{1}{4}\pi - \frac{1}{2}\right) \text{ cm}^2$

Required percentage $= \frac{\text{Area of shaded region}}{\text{Area of quadrant}} \times 100\%$

$= \frac{\left(\frac{1}{4}\pi - \frac{1}{2}\right)x^2}{\frac{1}{4}\pi x^2} \times 100\%$

$= 36.3\%$ (to 3 s.f.) (shown)

4.

(i) Let $x = 7$.

Let the radius of arc PQR be l cm,

then $\frac{\frac{1}{2} \times 2\pi(l+7)}{\frac{1}{2} \times 2\pi l} = \frac{3}{2}$.

$\frac{l+7}{l} = \frac{3}{2}$

$2l + 14 = 3l$

$l = 14$

$\therefore$ A possible value of x is **7** and a possible value for the length of PR is **28 cm**.

(ii) Perimeter of shape

$= \left[\frac{1}{2} \times 2\pi(14) + 7 + 7 + \frac{1}{2} \times 2\pi(21)\right] \text{ cm}$

$= (14\pi + 14 + 21\pi) \text{ cm}$

$= \mathbf{(35\pi + 14) \text{ cm}}$

Area of shape $= \left[\frac{1}{2} \times \pi(21)^2 - \frac{1}{2} \times \pi(14)^2\right] \text{ cm}^2$

$= \mathbf{122.5\pi \text{ cm}^2}$

5. Let the perpendicular distance from B to CE be h units.

Area of $ABCD = 56 \text{ units}^2$

$AB \times h \text{ units} = 56 \text{ units}^2$

$AB = \frac{56}{h} \text{ units}$

Area of $\triangle ABE = \left(\frac{1}{2} \times AB \times h\right) \text{ units}^2$

$= \left(\frac{1}{2} \times \frac{56}{h} \times h\right) \text{ units}^2$

$= \mathbf{28 \text{ units}^2}$

6. **(i)** Area of rhombus $= \left(2 \times \frac{1}{2} \times 24 \times 9\right) \text{ cm}^2$

$= \mathbf{216 \text{ cm}^2}$

(ii) Area of $\triangle ABC = \left(\frac{1}{2} \times 216\right) \text{ cm}^2$

$= 108 \text{ cm}^2$

$\frac{1}{2} \times 15 \text{ cm} \times AE = 108 \text{ cm}^2$

$AE = \mathbf{14.4 \text{ cm}}$

7. **(a)** Shapes **A**, **B**, **C** and **E** exist.

(b) Consider Shape A.

Let the radius of the circle be r cm.

$2\pi r = 12\pi$

$r = 6$

Area of circle $= \pi(6)^2$

$= 36\pi \text{ cm}^2$

Consider Shape B.

Area of triangle $= \left(\frac{1}{2} \times 6 \times 8\right) \text{ cm}^2$

$= 24 \text{ cm}^2$

Consider Shape C.

Area of parallelogram $= (10 \times 5) \text{ cm}^2$

$= 50 \text{ cm}^2$

Consider Shape E.

Area of trapezium $= \left[\frac{1}{2} \times (7+3) \times 4.8\right] \text{ cm}^2$

$= 24 \text{ cm}^2$

$\therefore$ Shapes **B** and **E** have the same area.

8. **(i)** Let the radius of the semicircle be r cm.

$\frac{1}{2} \times 2\pi r = 35\pi$

$r = 35$

Area of cardboard left

$= \left[\frac{1}{2} \times \pi(35)^2 - \frac{1}{2} \times (12+70) \times 8\right] \text{ cm}^2$

$= \left(\frac{1225}{2}\pi - 328\right) \text{ cm}^2$

$= \mathbf{1600 \text{ cm}^2}$ (to 3 s.f.)

(ii) Area of cardboard left : area of semicircle

$= \left(\frac{1225}{2}\pi - 328\right) : \frac{1225}{2}\pi$

$= \mathbf{1 : 1.21}$ (to 3 s.f.)

13 Statistical Data Handling

Worksheet 13A Frequency table

1. **(a)** Number of students who chose a tote bag

$= 840 - 109 - 73 - 330$

$= \mathbf{328}$

(b) Difference $= 330 - 73$

$= \mathbf{257}$

2. **(a)** Total number of people $= 0 + 3 + 15 + 4 + 2 + 1$

$= \mathbf{25}$

(b) Number of people who drank at least 3 l of water each day

$= 4 + 2 + 1$

$= \mathbf{7}$

(c) Required percentage $= \frac{18}{25} \times 100\%$

$= \mathbf{72\%}$

Worksheet 13B Pictogram

1. **(i)** Number of children in the playgroup $= 16\frac{3}{4} \times 4$
$= \mathbf{67}$

(ii) Difference in the number of children $= \left(5 - 1\frac{1}{2}\right) \times 4$
$= \mathbf{14}$

2. **(i)** Number of luxury cars sold in 2021 $= 1\frac{1}{2} \times 10$
$= \mathbf{15}$

(ii) Difference in the number of luxury cars $= \left(3 - 2\frac{1}{2}\right) \times 10$
$= \mathbf{5}$

(iii)

2020	
2021	
2022	
2023	

represents 10 luxury cars

3. **(a)** **(i)** **No.** He ate 6 bananas, but 16 cherries.
(ii) **No.** He ate more cherries (16) than pears (6).

(b)
Use identical pictures, or pictures of the same size, to represent each fruit.

4. **(i)**

Adventure Cove	
Gardens by the Bay	
National Gallery	

represents 10 students

(ii) Ratio is 80 : 35 = **16 : 7**

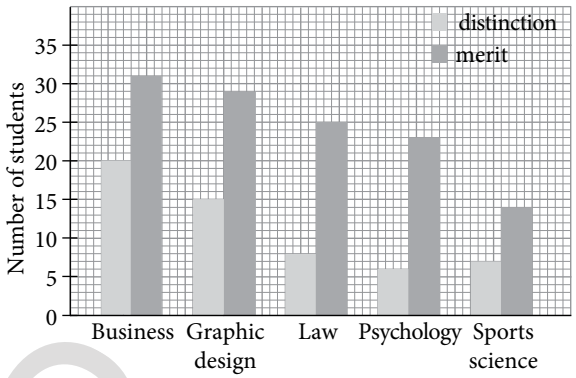
(iii) Number of Secondary 1 students
$= \frac{100}{100 - 15} \times (80 + 35 + 55)$
$= \mathbf{200}$

Worksheet 13C Bar graph

1. **(i)** Difference in the number of people per km^2
$= 7800 - 1100$
$= \mathbf{6700}$

(ii) Number of people living in Hong Kong
$= 6350 \times 1104$
$= \mathbf{7\,010\,400}$

2. **(i)** Number of students who graduated with distinction in psychology = **6**
Number of students who graduated with merit in graphic design = **29**



(ii) Total number of students who graduated with distinction
$= 20 + 15 + 8 + 6 + 7$
$= \mathbf{56}$

(iii) Required percentage $= \frac{14}{7 + 14} \times 100\%$
$= \mathbf{66\frac{2}{3}\ \%}$

(iv) **No.** 33 students from the law faculty graduated with distinction or merit, but there may be others who graduated with neither.

Worksheet 13D Pie chart

1. Angle representing the colour red $= \frac{5}{4 + 3 + 11 + 5 + 7} \times 360°$
$= \mathbf{60°}$

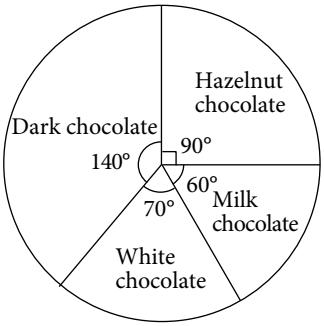
2. (105° – 45°) = 60° represents 5 votes
Number of students in Secondary 1A who took part in the survey
$= \frac{360°}{60°} \times 5$
$= \mathbf{30}$

3. **(i)** $p° = \frac{1}{6} \times 360°$
$= 60°$
Number of students who chose Korean $= \frac{60°}{180°} \times 45$
$= \mathbf{15}$

(ii) $q° + 60° + 2q° + 180° = 360°$
$3q° + 240° = 360°$
$3q° = 120°$
$q° = 40°$
Number of students who chose Japanese $= \frac{80°}{60°} \times 15$
$= \mathbf{20}$

4. Angle of sector corresponding to Engineering = 75°
Number of students who chose Engineering $= \frac{75°}{360°} \times 72$
$= \mathbf{15}$

5.



6. **(a)** Angle of sector corresponding to running

$= \frac{7}{18} \times 15$

$=$ **140°**

(b) Amount of time spent cycling each day

$= \frac{1}{7} \times \frac{155°}{360°} \times 18$ h

$= 1.1071$ h (to 5 s.f.)

$=$ **66 min** (to the nearest minute)

7. **(a)**

	College	Polytechnic	Employment	TOTAL
Males	41	68	26	135
Females	54	**45**	**6**	**105**
TOTAL	95	113	**32**	240

$\therefore$ **6** females chose employment.

(b) Angle representing males choosing college

$= \frac{41}{135} \times 360°$

$=$ **109.3°** (to 1 d.p.)

(c) Percentage of males who chose employment

$= \frac{26}{135} \times 100\%$

$= 19.259\%$ (to 5 s.f.)

Percentage of females who chose employment

$= \frac{6}{105} \times 100\%$

$= 5.7143\%$ (to 5 s.f.)

$\therefore$ A greater percentage of **males** chose employment.

8. **(a)** Total number of students $= 25 + 11 + 36$

$= 72$

	Frequency	Sector angle
At home	25	$\frac{25}{72} \times 360° =$ **125°**
At the food centre near the school	11	$\frac{11}{72} \times 360° =$ **55°**
At the school cafeteria	36	$\frac{36}{72} \times 360° =$ **180°**

(b) There are likely to be more than 72 students in the school, and it cannot be assumed that this sample of 72 students is representative of the entire student population.

Worksheet 13E Evaluation of statistical representations

1. **(a)** **(i)** It is likely that the people coming out of the library read books.

(ii) She could conduct her survey at a train station or online instead.

(b) The question does not indicate a time frame, such as one week.

2. Based on the graph, it is not clear whether the area or the height of each picture is to be used in comparing the amount of mobile data used.

Review Exercise 13

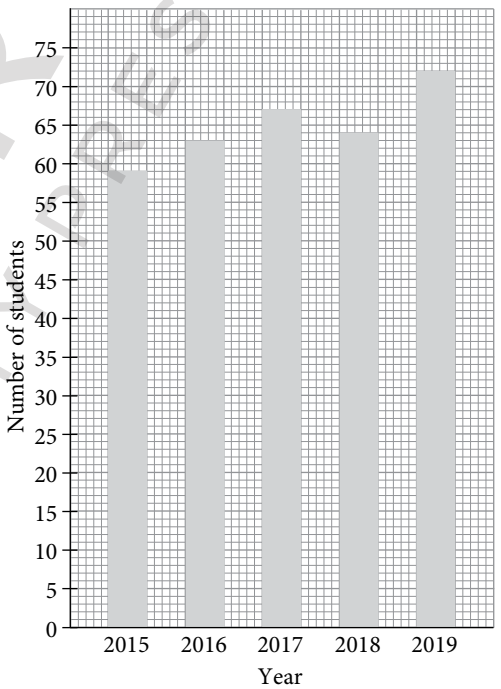
1. **(i)** 1. The question does not indicate a time frame, such as one day.

2. The options do not include 0 h or 9 h.

(ii)

Indicate the time frame, such as one day.
Include an option for 0 h, and change the "over 9" to "9 or more".

2. **(i)**



(ii) **No.** It is tedious to draw so many pictures to represent the number of students as it is not possible to use a picture to represent a certain number of students.

(iii) The total number of Secondary 1 students in the school may be decreasing from year to year.

3. **(a)** A possible ratio is 8 : 24 : 12 = **2 : 6 : 3**.

(b) Angle corresponding to fiction $= \frac{47}{90} \times 360°$
$= 188°$

Angle corresponding to comics $= \frac{23}{90} \times 360°$
$= 92°$

Number of travel books and history books
$= 90 - 47 - 23$
$= 20$

Angle corresponding to travel $= \frac{3}{5} \times \frac{20}{90} \times 360°$
$= 48°$

Angle corresponding to history $= \frac{2}{5} \times \frac{20}{90} \times 360°$
$= 32°$

$\therefore$ The angles are **188° (fiction), 92° (comics), 48° (travel) and 32° (history)**.

End-of-year Checkpoint A

Section A

1. $7x - 4(x - 4) = 7x - 4x + 16$
$= \mathbf{3x + 16}$ **[1]**

2. $8abx - 28acx + 32ax = \mathbf{4ax(2b - 7c + 8)}$ **[1]**

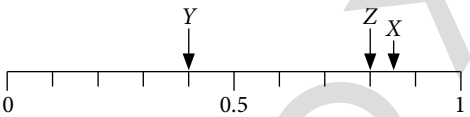
3. $\frac{9}{x+3} = \frac{7}{2x-1}$
$9(2x - 1) = 7(x + 3)$ **[1]**
$18x - 9 = 7x + 21$
$11x = 30$
$x = \mathbf{2\frac{8}{11}}$ **[1]**

4. **(a)** Based on the graph, it is not clear whether the area or the height of each picture is to be used in comparing the water bill. **[1]**

(b) The cost of water per m^3 may be lower in July than in June. **[1]**

5. **(a)** **0.85** **[1]**

(b)



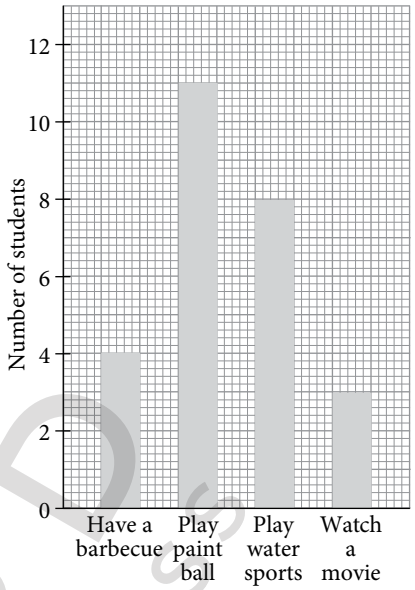
[2]

6. $\angle BCD + 72° = 180°$ (int. $\angle$s, BA // CD)
$\angle BCD = 108°$ **[1]**
$\angle CDE = 108°$ (alt. $\angle$s, BC // DE)
$\therefore$ Reflex $\angle CDE = 360° - 108°$ ($\angle$s at a pt.)
$= \mathbf{252°}$ **[1]**

7. Required percentage $= \frac{\pi(4)^2}{9 \times 7} \times 100\%$ **[2]**
$= \mathbf{79.8\%}$ (to 3 s.f.) **[1]**

8. **(i)** Number of students in Secondary 1A $= 13 \times 2$
$= \mathbf{26}$ **[1]**

(ii)



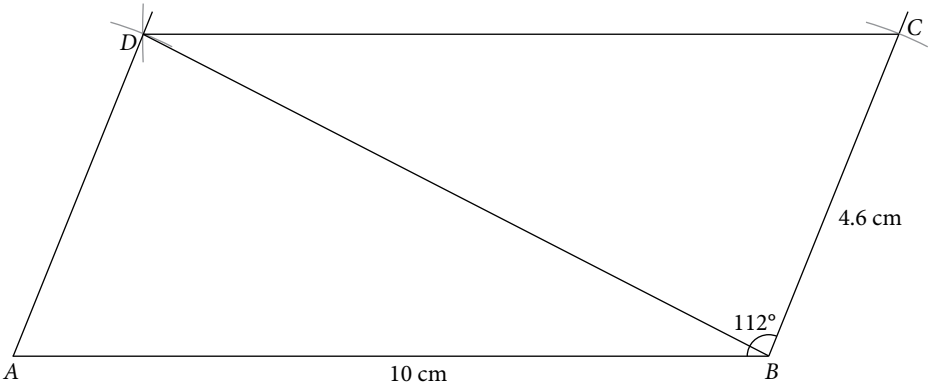
[2]

9. Let the first angle be $x°$, i.e. the other two angles are $(x - 24)°$ and $4(x - 24)°$.
$x° + (x - 24)° + 4(x - 24)° = 180°$ ($\angle$ sum of $\triangle$) **[1]**
$6x° - 120° = 180°$
$6x° = 300°$
$x° = 50°$ **[1]**
$\therefore$ The angles are **50°, 26° and 104°**. **[1]**

10. **(i)** Amount Anne spent $= \$(2.35x + 3 \times 2.85)$
$= \$(2.35x + 8.55)$
Amount Dave spent $= \$[2.35(x + 2)]$
$= \$(2.35x + 4.7)$
$\therefore$ Total amount spent
$= \$(2.35x + 8.55) + \$(2.35x + 4.7)$
$= \$(4.7x + 13.25)$ (shown) **[1]**

(ii) $4.7x + 13.25 = 32.05$ **[1]**
$4.7x = 18.8$
$x = 4$
$\therefore$ Anne buys **4** coconuts. **[1]**

11. (i)



[3]

(ii) $\angle ADB = \mathbf{86°}$ **[1]**

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12. (a) $76 \times 171 = (2 \times 2 \times 19) \times (3 \times 3 \times 19)$ **[1]**

$= 2^2 \times 3^2 \times 19^2$

$= (2 \times 3 \times 19)^2$ **[1]**

$\therefore$ 76×171 is a perfect square.

(b) For $171k$ to be a perfect cube,

smallest positive integer value of $k = 3 \times 19^2$ **[1]**

$= \mathbf{1083}$. **[1]**

13. (a) $AE = \frac{3}{2}(12)$ cm

$= 18$ cm **[1]**

Area of trapezium $ABDE = \frac{1}{2} \times (24 + 18) \times 8$ cm^2 **[1]**

$= \mathbf{168\ cm^2}$ **[1]**

(b) $168\ \text{cm}^2 = \frac{168}{100 \times 100}\ \text{m}^2$

$= \mathbf{0.0168\ m^2}$ **[1]**

Section B

14. (i) $\angle BAY = \frac{(5-2) \times 180°}{5}$ **[1]**

$= \mathbf{108°}$ **[1]**

(ii) $\angle WXY = 360° - 108° - 92°$ ($\angle$s at a pt.)

$= 160°$ **[1]**

Ext. angle of the second polygon $= 180° - 160°$

$= 20°$ **[1]**

$\therefore$ Number of sides in the second polygon $= \frac{360°}{20°}$

$= \mathbf{18}$ **[1]**

15. (a) (i) Time she spends doing stretching exercises

$= \left(\frac{4}{2+4+9} \times 1\frac{3}{4}\right)$ h **[1]**

$= \mathbf{\frac{7}{15}\ h}$ **[1]**

(ii) Percentage of the time she spends running

$= \frac{9}{2+4+9} \times 100\%$ **[1]**

$= \mathbf{60\%}$ **[1]**

(b) (i) Speed $= \frac{2400\ \text{m}}{10\ \text{min}\ 30\ \text{s}}$ **[1]**

$= \frac{(2400 \div 1000)\ \text{km}}{(10.5 \div 60)\ \text{h}}$

$= \mathbf{13.7\ km/h}$ (to 3 s.f.) **[1]**

(ii) Best time in 2022 = 10.5 min

Best time in 2023 $= \frac{90}{100} \times 10.5$ min **[1]**

$= 9.45$ min

$= \mathbf{9\ min\ 27\ s}$ (to the nearest second) **[1]**

(iii) Best time in 2021 $= \frac{100}{95} \times 10.5$ **[1]**

$= 11.1$ min

$= \mathbf{11\ min\ 3\ s}$ (to the nearest second) **[1]**

16. (i) 7.75 kr = \$1

1320 kr $= \$\left(\frac{1320}{7.75}\right)$

$= \$170.32$ (to 2 d.p.)

€1 = \$1.42

€132 $= \$(132 \times 1.42)$

$= \$187.44$

$\therefore$ The hotel in Helsinki costs more per night than the hotel in Stockholm. **[1]**

(ii) Total amount paid

$= \frac{102.5}{100} \times \$(4 \times 170.3226 + 3 \times 187.44)$ **[3]**

$= \mathbf{\$1275}$ (to the nearest \$) **[1]**

(iii) Price of the watch in Stockholm $= \$\left(\frac{3410}{7.75}\right)$

$= \$440$

Price of the watch in Helsinki $= \$(314 \times 1.42)$

$= \$445.88$ **[1]**

$\therefore$ Jason should buy the watch in **Stockholm**. **[1]**

(iv) (a) Additional cost = 120 kr – 45 kr

$= \mathbf{75\ kr}$ **[1]**

(b) Jason spent 15 kr on standard mail and 120 kr on express mail. **[1]**

$\therefore$ Maximum total weight = 50 g + 250 g

$= \mathbf{300\ g}$ **[1]**

End-of-year Checkpoint B

Section A

1. $\mathbf{0.667}, \frac{2}{3}, \frac{1}{2}, \left(\frac{2}{3}\right)^2$ [1]

2. **(i)** $\angle ABC = 360° - 96° - 110° - 110°$ ($\angle$ sum of quadrilateral)
$= \mathbf{44°}$ [1]

(ii) The length of AC is **less than 7 cm** because the side opposite the smallest angle ($\angle ABC$) in the triangle ($\triangle ABC$) is the shortest. [1]

3. **(a)** Estimated distance $= 60 \times 3$
$= \mathbf{180\ km}$ [1]

(b) In part **(a)**, both the actual speed (56.8 km/h) and the actual time taken (2.74 h) are less than the values correct to 1 significant figure. Since distance travelled = speed × time, then the actual distance travelled by the motorist is less than 180 km. [1]

4. When $x = \frac{1}{2}$, $y = -\frac{3}{4}$,

$\frac{1}{2}a + b = -\frac{3}{4}$ [1]

$\therefore$ An example of the values is $\boldsymbol{a = 2}$ **and** $\boldsymbol{b = -1\frac{3}{4}}$. [1]

5. $\frac{4x-y}{8} - \frac{3(y+x)}{4} = \frac{4x-y}{8} - \frac{6(y+x)}{8}$

$= \frac{4x-y-6(y+x)}{8}$ [1]

$= \frac{4x-y-6y-6x}{8}$ [1]

$= -\frac{-2x-7y}{8}$

$= -\frac{\mathbf{2x+7y}}{\mathbf{8}}$ [1]

6. Value of car at the end of the 1st year $= \frac{90}{100} \times \$87\,500$
$= \$78\,750$

Value of car at the end of the 2nd year $= \frac{90}{100} \times \$78\,750$
$= \$70\,875$

Value of car at the end of the 3rd year $= \frac{90}{100} \times \$70\,875$
$= \$63\,787.50$ [1]

Overall percentage reduction $= \frac{\$87\,500 - \$63\,787.50}{\$87\,500} \times 100\%$ [1]

$= \mathbf{27.1\%}$ (to 3 s.f.) [1]

7. Circumference of circle $= 2\pi(4r)$ cm
$= 8\pi r$ cm

Length of side of square $= \sqrt{25r^2}$ cm
$= 5r$ cm

Perimeter of square $= (4 \times 5r)$ cm
$= 20r$ cm

Difference between the circumference of circle and perimeter of square
$= (8\pi r - 20r)$ cm [1]
$= \mathbf{4r(2\pi - 5)\ cm}$ [1]

8. Use a pair of compasses to construct an equilateral triangle with sides 6 cm.
From one side of this triangle, construct another equilateral with sides 6 cm.
Continue until there are a total of 6 equilateral triangles which make a regular hexagon. [2]

9. Consider the case where $PQ = QR$.
$\angle R = 50°$ [1]
Consider the case where $PQ = PR$.
$\angle R = \frac{180° - 50°}{2}$
$= 65°$ [1]
Consider the case where $PR = QR$.
$\angle R = 180° - 50° - 50°$
$= 80°$ [1]
$\therefore \angle R$ can be $\mathbf{50°}$, $\mathbf{65°}$ **or** $\mathbf{80°}$.

10. Let the additional number of children that would need to join the club be x.

$\frac{84+x}{96+84+x} = \frac{60}{100}$ [1]

$\frac{84+x}{180+x} = \frac{3}{5}$

$5(84 + x) = 3(180 + x)$

$420 + 5x = 540 + 3x$ [1]

$2x = 120$

$x = 60$

$\therefore$ The smallest number of children that would need to join the club is **60**. [1]

11. **(a)** Time taken if he arrives on time $= (t - 2)$ min
Time taken on Sunday $= (t - 2 - 4)$ min
$= \mathbf{(t - 6)\ min}$ [1]

(b) Since the distance travelled on both days is the same,

$30 \times \frac{t}{60} = 36 \times \frac{t-6}{60}$ [1]

$30t = 36(t - 6)$

$= 36t - 216$

$6t = 216$

$t = 36$

$\therefore$ Corey took **36 min** on Saturday. [1]

12. **(i)** $AX = \frac{5}{13} \times 65\ \text{cm} = 25\ \text{cm}$

$DX = \frac{12}{13} \times 65\ \text{cm} = 60\ \text{cm}$

$\therefore$ Area of quadrilateral $= \left(4 \times \frac{1}{2} \times 60 \times 25\right)\ \text{cm}^2$ [1]

$= \mathbf{3000\ cm^2}$ [1]

(ii) Let the shortest distance from C to AB be h cm.
$AB \times h\ \text{cm} = 3000\ \text{cm}^2$
$65 \times h = 3000$ [1]
$h = 46.2$ (to 3 s.f.)
$\therefore$ The shortest distance from C to AB is **46.2 cm**. [1]

13. **(a)** **(i)** $270 = \mathbf{2 \times 3^3 \times 5}$ [1]

(ii) $18 = 2 \times 3^2$
$270 = 2 \times 3^3 \times 5$
$54 = 2 \times 3^3$
$90 = 2 \times 3^2 \times 5$ [1]
HCF of 54 and 90 $= 2 \times 3^2 = 18$
LCM of 54 and 90 $= 2 \times 3^3 \times 5 = 270$
$\therefore$ The two numbers are **54** and **90**. [1]

(b) For $1936 \div \frac{p}{q}$ to be a perfect cube, $1936 \times \frac{q}{p}$ is a perfect cube.

$\therefore$ $\boldsymbol{p = 2, q = 11}$ **[2]**

Section B

14. (a) Males in age group 21–24 years use the most mobile data in both years. **[1]**

(b) **Yes**, because the bars corresponding to the females are taller than those corresponding to the males. **[2]**

(c) **Yes**, because angle of sector corresponding to age group 21–24 years

$= \frac{12}{3 + 9 + 12 + 10 + 6} \times 360°$ **[1]**

$= 108°$ **[1]**

15. (a) (i) Number of passengers handled in 2017

$= \frac{100}{105.5} \times 65.6$ million **[1]**

$=$ **62.2 million** (to 3 s.f.) **[1]**

(ii) Percentage of passengers that passed through the airport

$= \frac{221\,155}{65\,600\,000} \times 100\%$ **[1]**

$=$ **0.337%** (to 3 s.f.) **[1]**

(b) Time required $= \frac{100}{79} \times 5.5$ h **[1]**

$= 6.9620$ h (to 5 s.f.)

$=$ **6 h 58 min** (to the nearest min) **[1]**

(c) (i) Amount he has to pay from 9.30 p.m. to 11 p.m.

$= (90 \times 4)$ cents

$= 360$ cents

$= \$3.60$ **[1]**

Amount he has to pay from 11 p.m. to 1 a.m.

$= \$(5 \times 4)$

$= \$20$ **[1]**

$\therefore$ Total amount he has to pay $= \$3.60 + \$20$

$=$ **\$23.60** **[1]**

(ii) OPEN The top two levels may offer more convenient access to the arrival and departure halls, hence they might be targeted at those who go to the airport to pick up or send off people, i.e. short-term parking. **[1]**

16. (a) (i) Each interior angle of polygon Q

$= \frac{360° - 90°}{2}$ **[1]**

$= 135°$ **[1]**

Each exterior angle of polygon $Q = 180° - 135°$

$=$ **45°** **[1]**

(ii) Number of sides in polygon R

$=$ Number of sides in polygon Q

$= \frac{360°}{45°}$

$=$ **8** **[1]**

(b) OPEN

(i) Each interior angle of polygon Q and of polygon R could be **150° and 120°** respectively. **[2]**

(ii) Each exterior angle of polygon $Q = 180° - 150°$

$= 30°$ **[1]**

Number of sides in polygon $Q = \frac{360°}{30°}$

$=$ **12** **[1]**

Each exterior angle of polygon $R = 180° - 120°$

$= 60°$ **[1]**

Number of sides in polygon $R = \frac{360°}{60°}$

$=$ **6** **[1]**