Dunoon Grammar School

Mathematics Department

National 4 Mathematics

Expressions & Formulae

Revision Worksheets

Skills and Knowledge covered in this Unit

1.1 Algebra skills to manipulating expressions and working with formulae

- Collecting like terms (page 2)
- Multiplying out brackets (page 3)
- Factorising an expression with a numerical common factor (page 5)
- Evaluating an expression or formulae which has more than one variable (page 6)
- Extending a straightforward number or diagrammatic pattern and determining its formula (page 9)
- Calculating the gradient of a straight line from horizontal and vertical distances (page 16)

1.2 Applying geometric skills to circumference, area and volume

- Calculating the circumference of a circle (page 22)
- Calculating the area of a circle (page 23)
- Calculating the area of a parallelogram, kite and trapezium (page 25)
- Calculating the surface area of a prism (page 30)
- Calculating the volume of a prism (page 31)
- Using rotational symmetry (page 35)

1.3 Statistics, analysing data and probability

- Constructing a frequency table with class intervals (page 42)
- Determining mean, median, mode and range of a data set (page 43)
- Interpreting calculated statistics to compare data (page 44)
- Representing data in a pie chart (page 46)
- Using probability (page 48)

Collecting Like terms

1. Write each of the following in a shorter form:

(a)	$3x + 2x$	**(b)**	$4p + 2p + 6p$	**(c)**	$8a - 3$
(d)	$5m + 3m - 2m$	**(e)**	$3v + v$	**(f)**	$4y + 6y - y$
(g)	$5a + 4a + 6$	**(h)**	$9f - 4f + 6$	**(i)**	$8x + 3 + 2x$
(j)	$4c + 6 + 3$	**(k)**	$5m + 3 + 4m$	**(l)**	$4y + 5 + 2y$
(m)	$8 + 3x - 4$	**(n)**	$7d + 6 - 3d$	**(o)**	$5y + 6z + y$
(p)	$6a + 5b - 2a$	**(q)**	$12 + 7x - 7$	**(r)**	$5g + 6h + 4g$
(s)	$5r + 8 - 2$	**(t)**	$6x + 3 + 3x$	**(u)**	$8y - 4 + y$

2. Write each of the following in a shorter form:

(a)	$3x + 4x + 3y + 4y$	**(b)**	$4a + 5b + 6c + 7c$
(c)	$4a + 3a + 4b + 2b$	**(d)**	$2g + 4g + 3k + 2k$
(e)	$3m + 4m + 2p + 8p$	**(f)**	$7q + 3q + 2r + 4r$
(g)	$3x + 2 - 8x$	**(h)**	$2a + 4 - a + 4$
(i)	$7k - 3k - 4p - 2p$	**(j)**	$9n - 4n + 3p - p$
(k)	$15t + 16b - 5t - 4b$	**(l)**	$20r + 18r + 5r - 9s$
(m)	$24r + 17w - 16r - 2w$	**(n)**	$6x + 3 - 3x - 5x$

3. Simplify the following expressions:

(a)	$0{\cdot}3x + 0{\cdot}2x$	**(b)**	$1{\cdot}4p + 1{\cdot}2p + 1{\cdot}6p$	**(c)**	$5{\cdot}4a - 3a$
(d)	$2{\cdot}5m + 3{\cdot}3m - 2{\cdot}7m$	**(e)**	$3{\cdot}2v - 2{\cdot}9v$	**(f)**	$2{\cdot}4y + 6g - 1{\cdot}1y$
(g)	$\frac{1}{2}a + \frac{1}{2}a + 6\ a$	**(h)**	$\frac{2}{3}f - \frac{1}{3}f + 6$	**(i)**	$\frac{3}{5}x + 3 + \frac{2}{5}x$
(j)	$\frac{3}{4}c + \frac{1}{2}c + 3c$	**(k)**	$\frac{5}{8}m + 3 + \frac{7}{8}m$	**(l)**	$\frac{2}{3}y + 5 + \frac{2}{3}y$
(m)	$1\frac{2}{3}x + \frac{1}{2}x - \frac{2}{3}x$	**(n)**	$2\frac{4}{7}d + \frac{2}{7}d - 2d$	**(o)**	$3\frac{2}{3}y + \frac{5}{6}z + \frac{1}{3}y$

Multiplying out Brackets

1. Remove the brackets:

(a)	$4(c + 2)$	**(b)**	$2(e + 4)$	**(c)**	$5(f + 6)$	**(d)**	$3(t + 8)$
(e)	$7(g + 3)$	**(f)**	$9(w + 1)$	**(g)**	$6(h + 6)$	**(h)**	$8(p + 2)$
(i)	$3(2 + y)$	**(j)**	$7(1 + k)$	**(k)**	$5(5 + z)$	**(l)**	$3(2 + y)$
(m)	$9(1 + e)$	**(n)**	$3(2 + w)$	**(o)**	$8(12 + r)$	**(p)**	$10(7 + m)$

2. Multiply out the brackets:

(a)	$2(x + 5)$	**(b)**	$5(y + 7)$	**(c)**	$3(a + 6)$	**(d)**	$6(x + 4)$
(e)	$4(x + 9)$	**(f)**	$3(c + 8)$	**(g)**	$7(d + 3)$	**(h)**	$5(m + 5)$
(i)	$2(y + 14)$	**(j)**	$6(a + 3)$	**(k)**	$8(q + 5)$	**(l)**	$7(a + 7)$
(m)	$9(b + 2)$	**(n)**	$4(x + 8)$	**(o)**	$5(p + 10)$	**(p)**	$3(w + 11)$

3. Multiply out the brackets:

(a)	$2(a - 7)$	**(b)**	$3(x - 5)$	**(c)**	$6(q - 3)$	**(d)**	$4(y - 4)$
(e)	$5(b - 4)$	**(f)**	$4(p - 7)$	**(g)**	$8(y - 2)$	**(h)**	$3(w - 7)$
(i)	$8(c - 4)$	**(j)**	$7(d - 6)$	**(k)**	$5(s - 8)$	**(i)**	$2(x - 15)$
(m)	$10(w - 2)$	**(n)**	$5(c - 5)$	**(o)**	$3(a - 10)$	**(p)**	$7(q - 5)$

4. Multiply out the brackets:

(a)	$3(x - 5)$	**(b)**	$5(y + 7)$	**(c)**	$8(a + 6)$	**(d)**	$6(3 + t)$
(e)	$6(x + 9)$	**(f)**	$9(3 - y)$	**(g)**	$7(b - 4)$	**(h)**	$4(5 + p)$
(i)	$2(b + c)$	**(j)**	$8(x - y)$	**(k)**	$5(q - r)$	**(l)**	$3(a + x)$
(m)	$5(b - c)$	**(n)**	$3(x - z)$	**(o)**	$6(a - m)$	**(p)**	$10(p - q)$

5. Expand the brackets:

(a)	$4(2a + 5)$	**(b)**	$7(3y + 4)$	**(c)**	$2(12x + 11)$	**(d)**	$9(4c + 7)$
(e)	$2(3a + 4)$	**(f)**	$5(2x + 7)$	**(g)**	$10(3 + 2y)$	**(h)**	$3(5t + 6)$
(i)	$3(2x + 9)$	**(j)**	$2(7 + 5y)$	**(k)**	$4(3b + 8)$	**(l)**	$5(5x + 4)$

6. Expand the brackets:

(a)	$2(4a - 3)$	**(b)**	$6(4y - 3)$	**(c)**	$3(2x - 5)$	**(d)**	$4(5c - 6)$
(e)	$7(2a - 1)$	**(f)**	$2(8x - 3)$	**(g)**	$5(6 - 7y)$	**(h)**	$3(8t - 5)$

7. Remove the brackets:

(a)	$5(2c + 5)$	**(b)**	$2(2e + 4)$	**(c)**	$6(4f - 6)$	**(d)**	$3(2t + 8)$
(e)	$2(8g - 2)$	**(f)**	$6(4w + 1)$	**(g)**	$7(5h - 6)$	**(h)**	$8(3p - 2)$
(i)	$3(3 - 2y)$	**(j)**	$7(1 + 9k)$	**(k)**	$5(5 - 10z)$	**(l)**	$4(6 - 7u)$
(m)	$9(1 + 3e)$	**(n)**	$3(2 - 6w)$	**(o)**	$3(12 + 2r)$	**(p)**	$4(7 + 5m)$

8. Remove the brackets and simplify where possible:

(a)	$3(c + 2) + 7$	**(b)**	$2(e + 4) - 7$	**(c)**	$6(f + 4) - 7f$
(d)	$4(t + 8) - 7$	**(e)**	$7(g - 3) + 5g$	**(f)**	$8(w - 1) - 3w$
(g)	$6(h + 2) + 9$	**(h)**	$9(p + 3) + 5p$	**(i)**	$3(2 + f) - 4$
(j)	$4(7 - u) - 15$	**(k)**	$5(5 + p) - 2p$	**(l)**	$4(7 - u) - 15$
(m)	$6(1 + e) + e$	**(n)**	$3(6 + w) + w$	**(o)**	$8(11 + q) - 4q$
(p)	$6(3g + 2) + 7$	**(q)**	$2(2e + 4) - 3$	**(r)**	$7(4c + 5) - 20c$
(s)	$3(2t + 8) - t$	**(t)**	$3(8f + 3) - 4$	**(u)**	$3(4a + 1) - 4$
(v)	$5(2 + 2t) + 3t$	**(w)**	$4(1 + 9u) + 2u$	**(x)**	$(6 + 5x) - x$
(y)	$3(10 + 2d) - 5d$	**(z)**	$5(4 + 7u) - 28$		

9. Expand and simplify:

(a)	$2a + 3(a + 5)$	**(b)**	$3x + 2(x + 3)$	**(c)**	$4b + 8(b + 2)$
(d)	$5h + 4(2h + 1)$	**(e)**	$11x + 5(3x + 4)$	**(f)**	$10c + 3(2c + 1)$
(g)	$2(4t + 3) + 10t$	**(h)**	$3(5p + 4) + 7p$	**(i)**	$7(1 + 3c) + 10$

10. Expand and simplify:

(a)	$3(3a - 1) + 2a$	**(b)**	$2(5x + 3) - 3x$	**(c)**	$8(b + 2) - 9$
(d)	$4(2h - 1) + 7$	**(e)**	$5(3 - 4x) + 11x$	**(f)**	$3(2c + 1) - 8$
(g)	$2(4t + 3) - 10t$	**(h)**	$8(2p + 3) - 3p$	**(i)**	$7(1 - 3c) + 10$
(j)	$3 + 2(2x + 5)$	**(k)**	$7a + 3(2a - 3)$	**(l)**	$5 + 2(2x - 7)$
(m)	$6 + 5(3y - 2)$	**(n)**	$9b + 2(4b - 1)$	**(o)**	$8 + 3(5x + 7)$

Factorising an expression with a numerical common factor

1. Copy and complete each of the following:

(a) $2x + 6 = 2(x + \ )$ **(b)** $5a + 20 = 5(a + \ )$

(c) $4m - 24 = 4(\ - \ )$ **(d)** $3f - 6 = 3(\ - \ )$

(e) $5x + 5y = 5(\ + \ )$ **(f)** $6p - 12q = 6(\ - \ )$

(g) $3d - 12e = 3(\ - \ )$ **(h)** $14 + 7k = 7(\ + \ )$

(i) $35 - 42b = 7(\ - \ )$ **(j)** $24a + 36b = 12(\ + \ )$

2. Factorise:

(a) $2x + 2y$ **(b)** $3c + 3d$ **(c)** $6s + 6t$ **(d)** $12x + 12y$

(e) $9a + 9b$ **(f)** $8b + 8c$ **(g)** $5p + 5q$ **(h)** $7g + 7h$

(i) $4m + 4n$ **(j)** $9e + 9f$ **(k)** $13j + 13k$ **(l)** $14v + 14w$

3. Factorise:

(a) $2x + 8$ **(b)** $3m + 12$ **(c)** $4y - 4$

(d) $5p + 5$ **(e)** $8w - 16$ **(f)** $7u + 21$

(g) $10z - 20$ **(h)** $6h + 24$ **(i)** $2d - 12$

(j) $5r + 5s$ **(k)** $3k - 3l$ **(l)** $7w + 7x$

(m) $4u + 8v$ **(n)** $6r - 18s$ **(o)** $2e + 20f$

4. Factorise:

(a) $4x + 10$ **(b)** $6g - 15$ **(c)** $4f + 2$

(d) $8y - 4$ **(e)** $12e + 8$ **(f)** $6m + 21$

(g) $10a - 6$ **(h)** $9h + 12$ **(i)** $6r - 14$

(j) $10r + 5s$ **(k)** $12k - 3l$ **(l)** $7w + 21x$

(m) $4q + 8$ **(n)** $6 + 18g$ **(o)** $12m - 9$

5. Factorise:

(a) $2x + 4$ **(b)** $3d + 9$ **(c)** $6s + 3$ **(d)** $12x + 4$

(e) $6 + 9a$ **(f)** $2b + 8$ **(g)** $5y + 10$ **(h)** $10 + 15c$

(i) $12x + 16$ **(j)** $18m + 24$ **(k)** $30 + 36a$ **(l)** $14y + 21$

6. Factorise:

(a)	$3x - 6$	**(b)**	$4y - 8$	**(c)**	$16 - 8a$	**(d)**	$10c - 15$
(e)	$9s - 12$	**(f)**	$2b - 14$	**(g)**	$12x - 100$	**(h)**	$22m - 33$

7. Factorise:

(a)	$2a + 4b$	**(b)**	$10x - 12y$	**(c)**	$18m + 24n$	**(d)**	$10c + 15d$
(e)	$6a - 9x$	**(f)**	$18s - 12t$	**(g)**	$12x + 15y$	**(h)**	$14a - 7b$
(i)	$25c + 10d$	**(j)**	$9b - 15y$	**(k)**	$18x + 24y$	**(l)**	$6a + 28b$

Evaluating an expression or formulae which has more than one variable

1. If $x = 10$ and $y = 4$, calculate

(a)	$x + y$	**(b)**	$x - y$	**(c)**	$2x$	**(d)**	xy
(e)	$5y$	**(f)**	$x + 7$	**(g)**	$x - 3$	**(h)**	$y + 15$

2. If $a = 8$, $b = 5$ and $c = 2$, calculate

(a)	$a + b$	**(b)**	$a - b$	**(c)**	$b + c$	**(d)**	$a + 10$
(e)	$a - c$	**(f)**	$3a - 6$	**(g)**	$2a + 3c$	**(h)**	$8c - 3b$
(i)	$a + b + c$	**(j)**	$a + c - b$	**(k)**	$a - b - c$	**(l)**	$2a + 3b + 4c$

3. If $p = 3$, $q = 4$ and $r = 2$, calculate

(a)	$p + q$	**(b)**	$q - p$	**(c)**	$2q + r$	**(d)**	$pq + 10$
(e)	$pr + q$	**(f)**	$2p + 3r$	**(g)**	$3q - 4p$	**(h)**	$pq - pr$
(i)	$3p + 2q + 4r$	**(j)**	$p + 2q - 5r$	**(k)**	$20p - 10q$	**(l)**	$100r - 50p$

4. Given that $a = b + d$, find a when

(a)	$b = 7$ and $d = 9$	**(b)**	$b = 14$ and $d = 15$	**(c)**	$b = 18$ and $d = 5$
(d)	$b = 33$ and $d = 12$	**(e)**	$b = 24$ and $d = 17$	**(f)**	$b = 190$ and $d = 40$
(g)	$b = 51$ and $d = 16$	**(h)**	$b = 68$ and $d = 28$	**(i)**	$b = 121$ and $d = 38$

5. Given that $X = 3Y - Z$, find X when

(a)	$Y = 4$ and $Z = 5$	**(b)**	$Y = 10$ and $Z = 15$	**(c)**	$Y = 20$ and $Z = 10$
(d)	$Y = 12$ and $Z = 8$	**(e)**	$Y = 15$ and $Z = 5$	**(f)**	$Y = 100$ and $Z = 80$
(g)	$Y = 50$ and $Z = 23$	**(h)**	$Y = 17$ and $Z = 4$	**(i)**	$Y = 11$ and $Z = 32$

6. **(a)** If $p = r - q$, find p when $r = 42$ and $q = 17$

(b) If $y = 4x - 9$, find y when $x = 7$

(c) If $A = 7B + C$, find A when $B = 9$ and $C = 8$

(d) If $R = S + 5T$, find R when $S = 22$ and $T = 6$

(e) If $H = G - 2F$, find H when $G = 50$ and $F = 15$

(f) If $k = 2m + 3n$, find k when $m = 12$ and $n = 3$

(g) If $c = 4d - 5e$, find c when $d = 11$ and $e = 8$

(h) If $P = 2Q + 10R$, find P when $Q = 10$ and $R = 2$

(i) If $g = 5e - 2f$, find g when $e = 7$ and $f = 17$

(j) If $M = 9C + 8D$, find M when $C = 8$ and $D = 7$

7. The formula for distance is **D = S × T**, where D is the distance in kilometres, S is the speed in km/h and T is the time in hours. Find D when

(a) S = 30 km/h and T = 2 h **(b)** S = 50 km/h and T = 3 h

(c) S = 60 km/h and T = 5 h **(d)** S = 80 km/h and T = 4 h

(e) S = 55 km/h and T = 3 h **(f)** S = 70 km/h and T = 3½ h

(g) S = 68 km/h and T = 2½ h **(h)** S = 54 km/h and T = 4½ h

8. The formula **V = IR** is used in electrical calculations. Use the formula to find V when

(a) I = 18 and R = 5 **(b)** I = 5 and R = 20 **(c)** I = 2·6 and R = 4·5

(d) I = 4·1 and R = 10 **(e)** I = 3·5 and R = 12 **(f)** I = 7 and R = 9·2

9. A formula is given as $T = e^2 + 6$. Find the value of T when

(a) $e = 3$ **(b)** $e = 4$ **(c)** $e = 8$ **(d)** $e = 2$

10. A formula is given as $Q = 36 - r^2$. Find the value of Q when

(a) $r = 3$ **(b)** $r = 4$ **(c)** $r = 6$ **(d)** $r = 1$

11. A formula is given as $G = 45 - h^2$. Find the value of G when

(a) $h = 4$ **(b)** $h = 6$ **(c)** $h = 2$ **(d)** $h = 7$

12. A formula is given as $T = 2(s)^2 + 4$. Find the value of T when

(a) $s = 3$ **(b)** $s = 5$ **(c)** $s = 10$ **(d)** $s = 1$

13. A formula is given as $W = 25 + 3(x)^2$. Find the value of W when

(a) $x = 2$ **(b)** $x = 6$ **(c)** $x = 8$ **(d)** $x = 7$

14. A formula is given as $L = 2p^2 - 6$. Find the value of L when

(a) $p = 2$ **(b)** $p = 3$ **(c)** $p = 5$ **(d)** $p = 10$.

15. A formula is given as $H = t^2 + 2t + 1$. Find the value of H when

(a) $t = 2$ **(b)** $t = 4$ **(c)** $t = 3$ **(d)** $t = 10$.

16. A formula is given as $T = k^2 + 3k - 6$. Find the value of T when

(a) $k = 3$ **(b)** $k = 6$ **(c)** $k = 2$ **(d)** $k = 12$

EXAM QUESTIONS

1. Find the value of $3a - 2b$ when $a = -4$ and $b = 2$.

2. Evaluate the formula $W = \dfrac{10\sqrt{P}}{4d}$ when $P = 2{\cdot}56$ and $d = 0{\cdot}4$.

3. The force, F, needed to stop a train traveling at a speed, v m/s, within a stopping distance, s m, is given by the formula:

$$F = \frac{120v^2}{s}$$

Find the force that would stop a train travelling at 24 m/s in 400 m.

4. A formulae used in Electricity is

$$I = \sqrt{\frac{P}{R}}$$

where I is the current, P is the power and R is the resistance in a circuit.

Find the current (I) when there is a power of 100 and a resistance of 12.

5. The period of the swing of a pendulum is given as $T = 2\pi\sqrt{\dfrac{l}{g}}$.

Calculate T when $l = 75$ and $g = 10$. [π = 3·14]

Extending a straightforward number pattern

1. Find the next three terms in each of these number patterns:

(a) 1, 3, 5, 7, 9..... **(b)** 3, 6, 9, 12 .....

(c) 10, 16, 22, 28..... **(d)** 100, 96, 92, 88 .....

(e) 1, 5, 9, 13, ... **(f)** 30, 25, 20, ...

2. Find the next two terms in each of these number patterns:

(a) 1, 2, 4, 8, 16 ..... . **(b)** 243, 81, 27, ...

(c) 1, 2, 4, 7, 11 ..... **(d)** 20, 19, 17, 14.....

(e) 2, 4, 8, 14, 22 ..... **(f)** 400, 200, 100 .....

Extending a straightforward number or diagrammatic pattern and determining its formula.

One step patterns

1.

(a) Copy this table and complete it using the information above.

Number of bunches	1	2	3	4	5	6
Number of bananas						

(b) For every extra bunch of bananas, how many bananas are added?

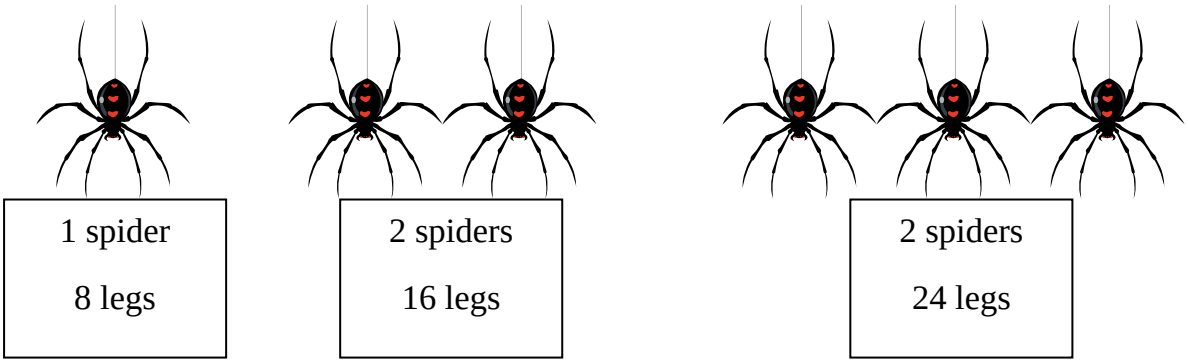
(c) Write down a formula (rule) for finding the total number of bananas (N) if you know the number of bunches (B) :-

Number of bananas = × number of bunches

(d) Write this rule in symbols.

(e) How many bunches of bananas would I have if I had 48 bananas altogether?

2.



(a) Copy this table and complete it using the information above:

Number of spiders	1	2	3	4	5	6
Number of legs						

(b) For every extra spider, how many legs are added?

(c) Write down a formula (rule) for finding the total number of legs (L) if we know the number of spiders (S) :-

Number of legs = × number of spiders

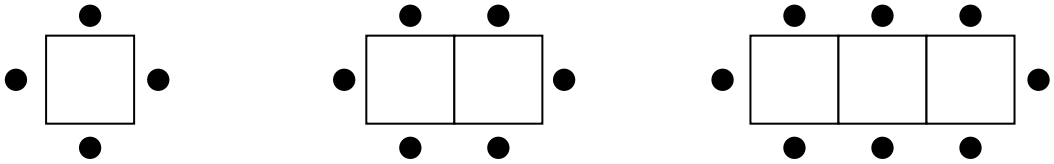
(d) Write this formula in symbols.

(e) How many spiders would there be if there were 80 legs?

Extending a straightforward number or diagrammatic pattern and determining its formula.

Two step patterns

1. The squares in the diagram represent tables and the dots represent people sitting at them.



(a) Draw diagrams to show the number of people who could sit at 4 tables and 5 tables.

(b) Copy and complete this table for the number of tables and the number of people.

Number of tables	1	2	3	4	5		10	14
Number of people								

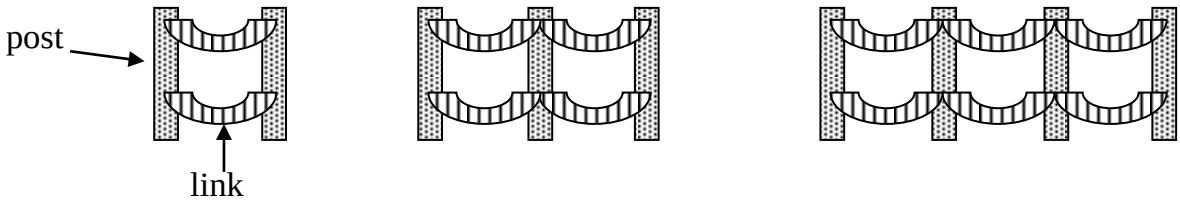
(c) Write down a rule in words for the finding the number of people if you know how many tables there are.

(d) Write the formula in symbols using T for the number of tables and P for the number of people.

(d) Use your formula to find how many people would be able to sit at 20 tables.

(e) There are 44 people at a gathering. How many tables would be needed to seat them?

2. Mr Wright wants to build a fence round his garden and draws some diagrams so that he can work out how many posts and how many link pieces he will need.



(a) Draw diagrams with 5 and 6 posts.

(b) Copy and complete this table to show the number of posts and the number of links required for different lengths of fencing.

Number of posts	1	2	3	4	5		20	25
Number of links								

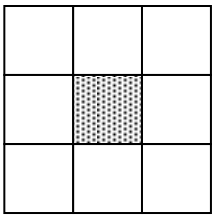
(c) Write down a rule in words for the finding the number of links needed if you know how many posts there are.

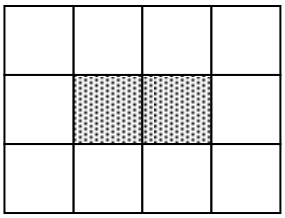
(d) Write the formula in symbols using L for the number of links and P for the number of posts.

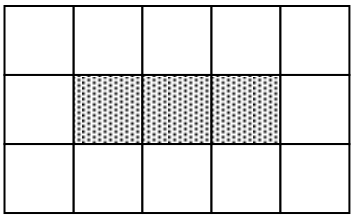
(e) Use your formula to find how many links would be needed for 50 posts.

(f) Mr Wright has 100 links. How many posts would he need to use them all up?

3. Plain and patterned tiles are laid in a strip.







(a) Draw the next two patterns of tiles.

(b) How many plain tiles would there be in a strip with 7 patterned tiles?

(c) If there are 9 patterned tiles, how many plain tiles will these be?

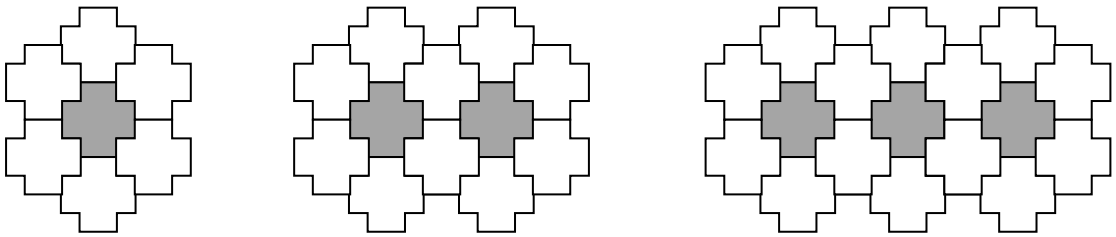
(d) Copy and complete the following table:

Number of patterned tiles	4	5	6	7	8	9	10		20
Number of plain tiles									

(e) Write down a formula for finding the number of plain tiles (P) when you know the number of patterned tiles (R).

(f) If there are 152 plain tiles, how many patterned tiles would there be?

4. **(a)** Complete the table below for this tile pattern made from coloured and white tiles.



Number of coloured tiles	1	2	3	4		10	20		50
Number of white tiles									

(b) Write down a formula for finding the number of white tiles (W) when you know the number of coloured tiles (C).

(c) If there are 86 white tiles, how many coloured tiles would there be?

5. For their barbeque Mr and Mrs Goldie allowed 3 burgers for each person attending and an extra 10 to be on the safe side.

(a) Complete this table for the numbers of burgers they would need:

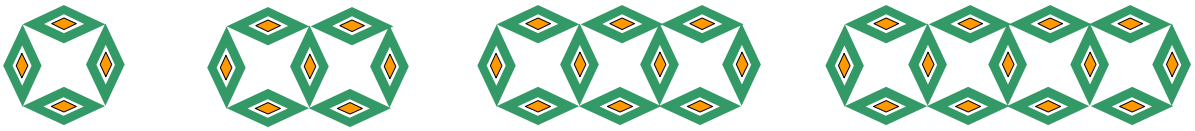
Number of people	1	2	3	4	5	6
Number of burgers						

(b) Find a formula for the number of burgers needed when you know the number of people.

(c) Use your formula to find out how many burgers would be needed for 18 people.

(d) If you have 100 burgers how many people could you invite to the barbeque?

6. These patterns are made up from a number of rhombuses.



(a) Complete the table to show the number of rhombuses used in each.

Pattern number	1	2	3	4	5	6
Number of rhombuses						

(b) How many rhombuses would be needed for the 10^{th} pattern?

(c) How many rhombuses would be in the 24^{th} pattern?

(d) Write down a rule for finding the number of rhombuses (R) in any pattern number (P).

(e) What pattern number would have 34 rhombuses in it?

(f) What pattern number would have 46 rhombuses in it?

7. **(i)** Find a formula for each of the following.

(a)

P	1	2	3	4	5	6		12		
Q	3	6	9	12	15	18			48	90

(b)

M	1	2	3	4	5	6		11		
N	3	5	7	9	11	13			33	57

(c)

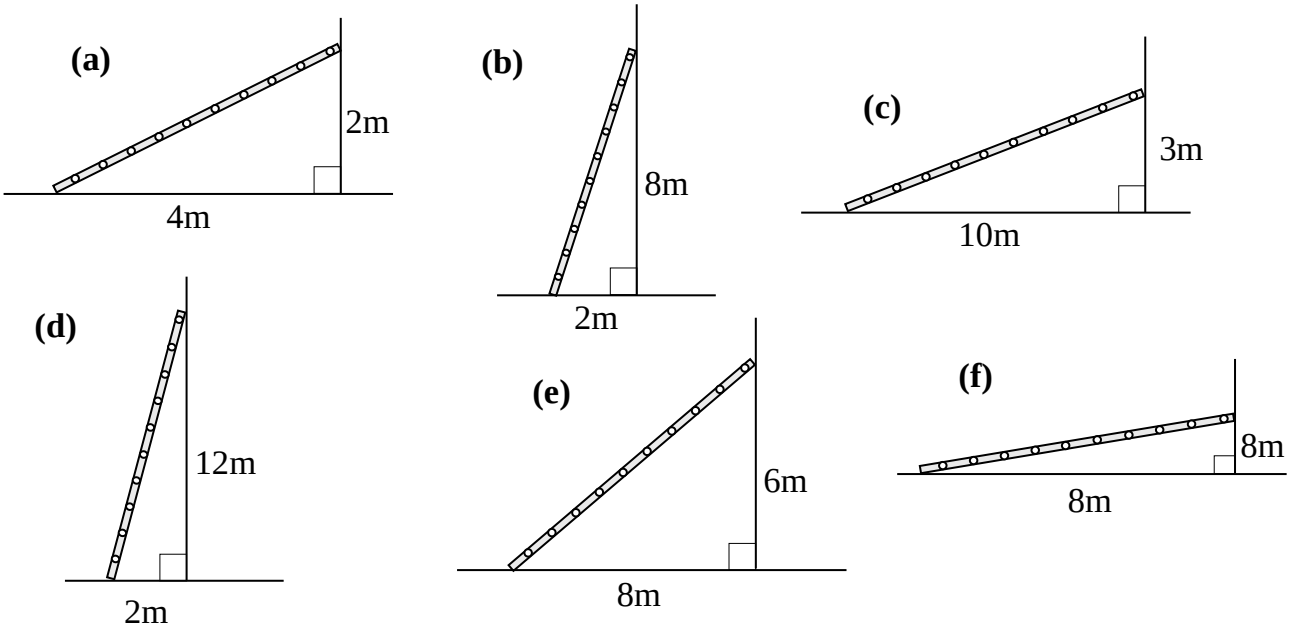
R	1	2	3	4	5	6		14		
T	2	5	8	11	14	17			26	47

(d)

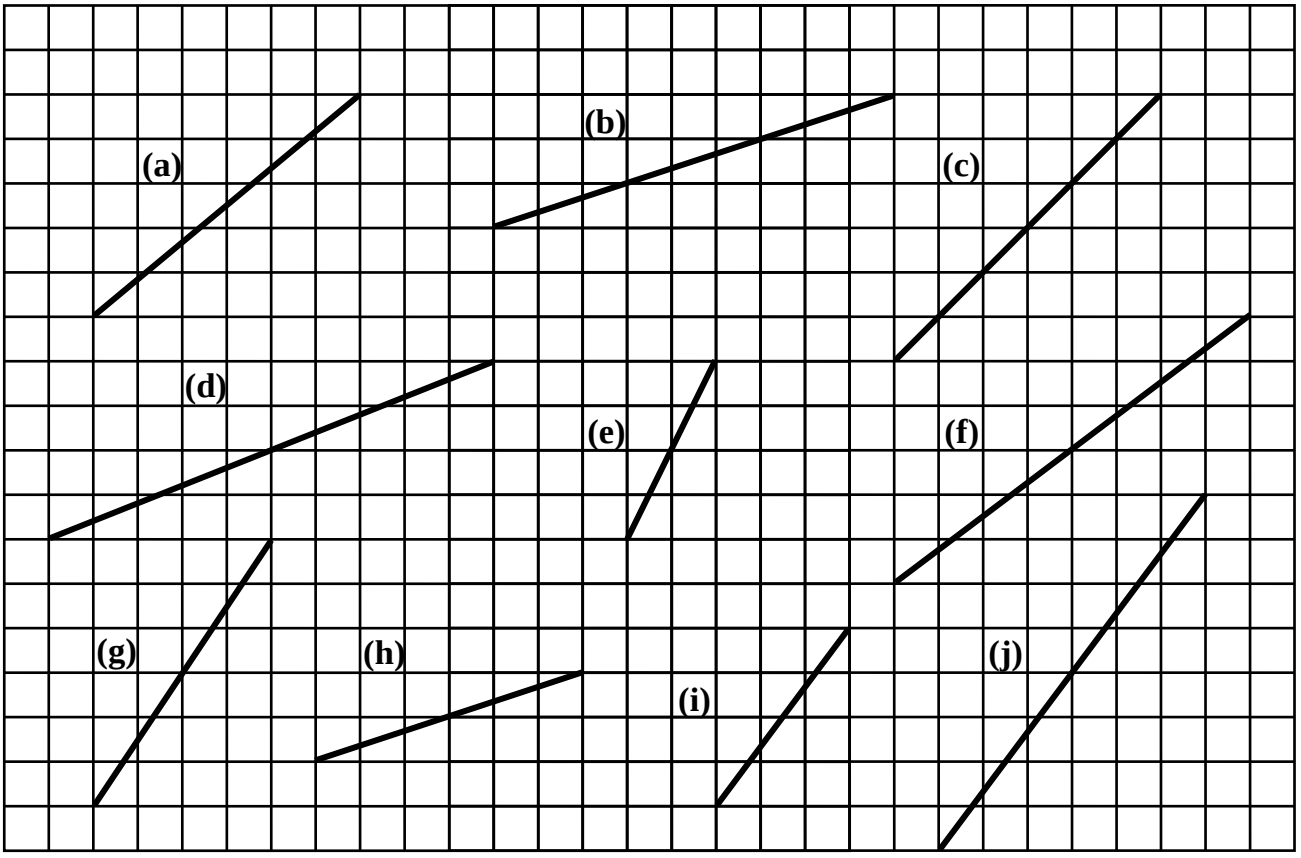
D	5	6	7	8	9	10		20		
K	4	5	6	7	8	9			31	68

Calculating the gradient of a straight line from horizontal and vertical distances

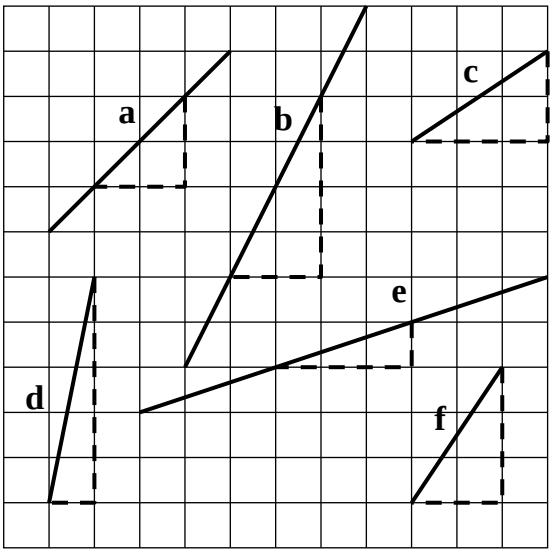
1. Calculate the gradient of each ladder below:

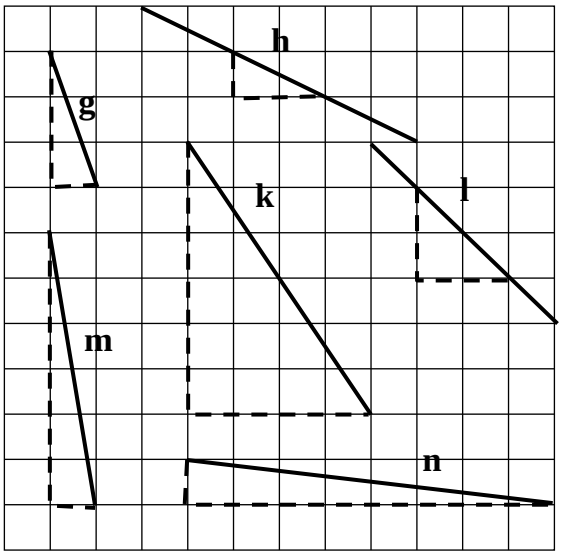


2. Calculate the gradient of each line below, leaving your answer as a fraction in its simplest form where necessary.

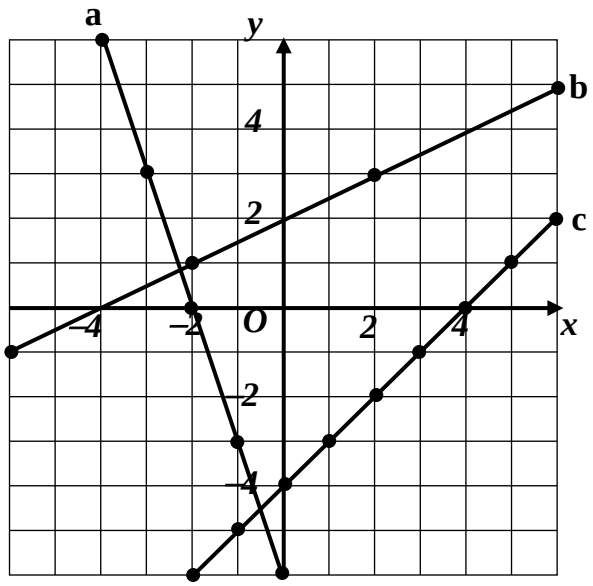


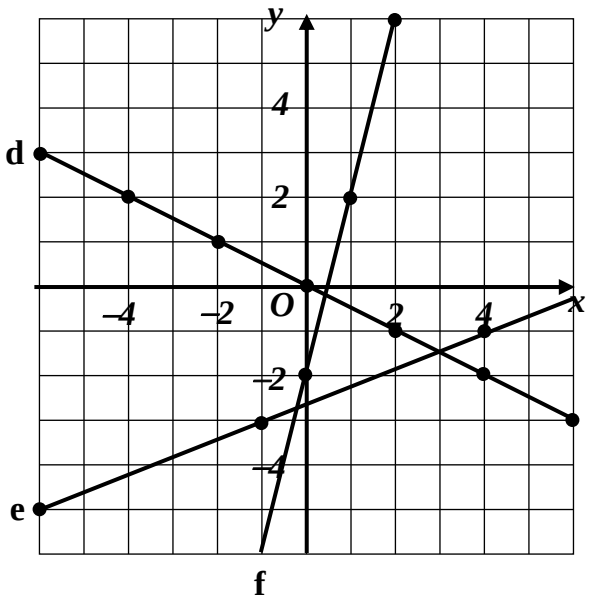
3. Find the **gradients** of the lines shown in each of the diagrams below





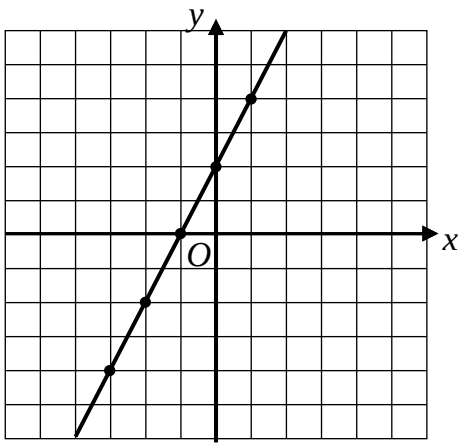
4. Find the **gradients** of the lines below



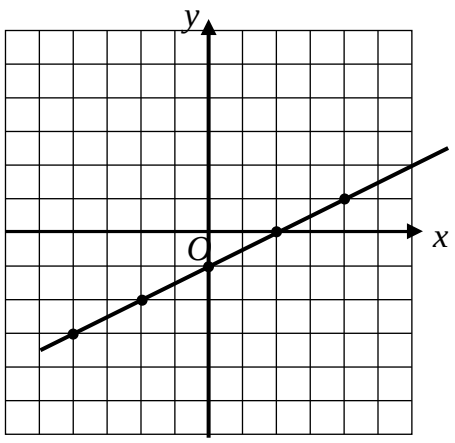


5. Write down the gradient of the lines drawn in the diagrams below.

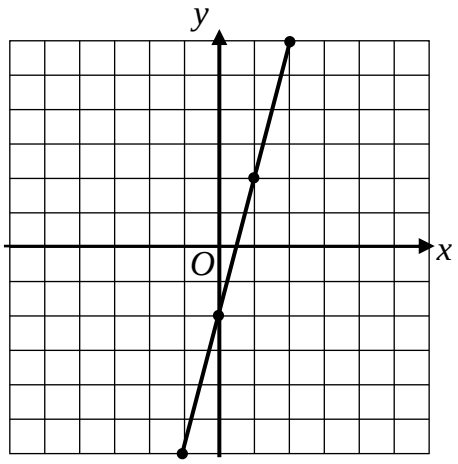
(a)



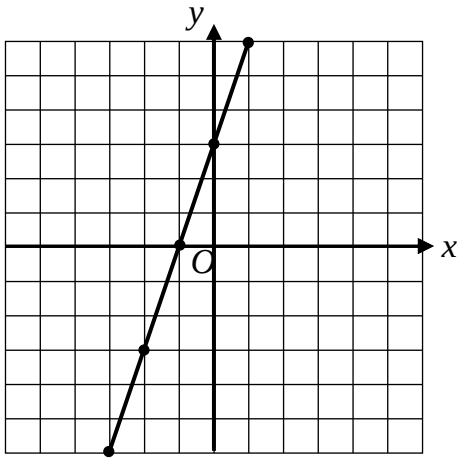
(b)



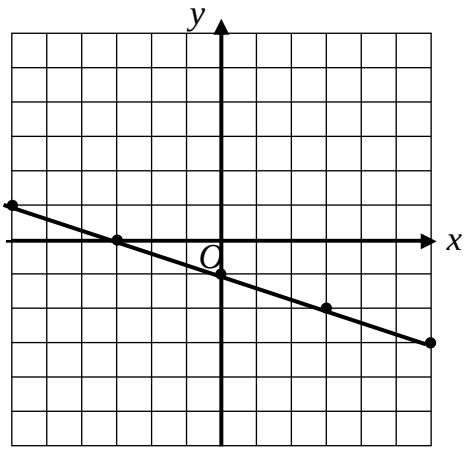
(c)



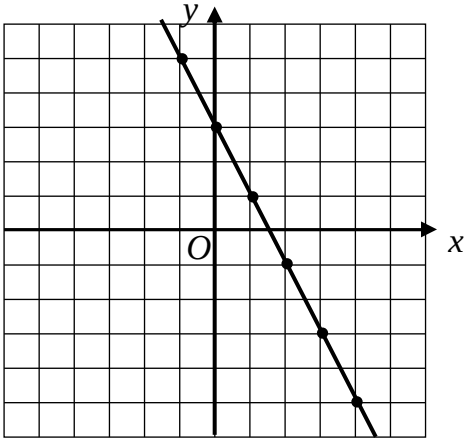
(d)



(e)



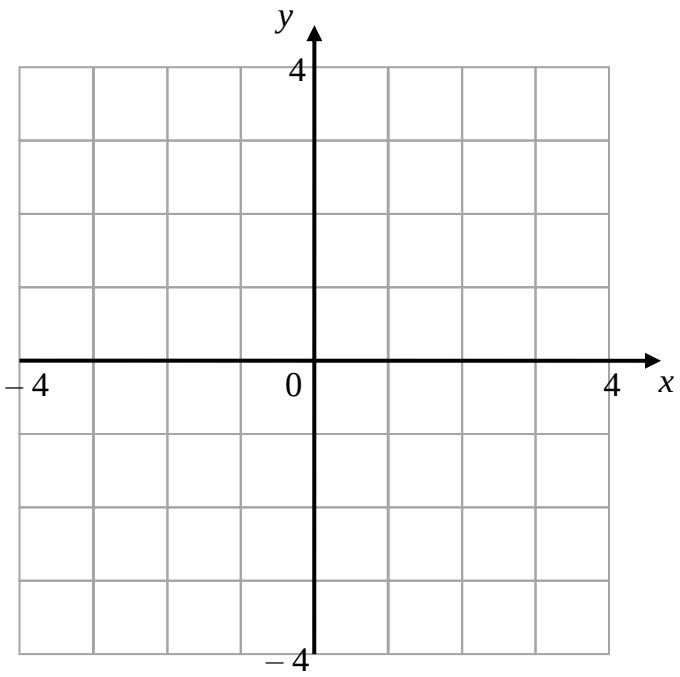
(f)



Calculating the gradient of a straight line from horizontal and vertical distances

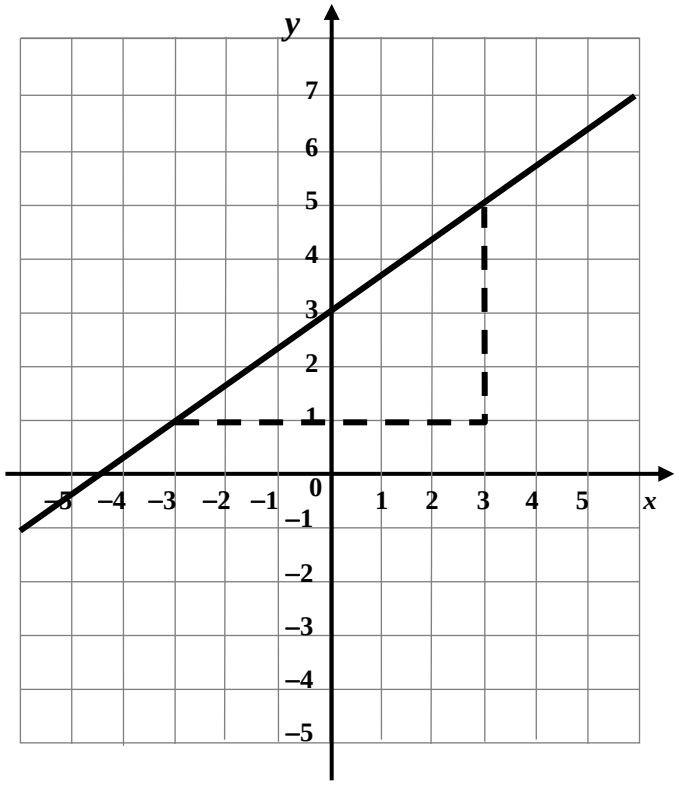
EXAM QUESTIONS

1. **(a)** Copy the grid shown below plot the points A(– 1, 0) and B(3, – 3).

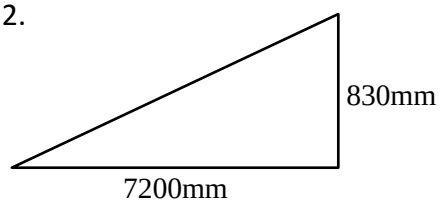


(b) Find the gradient of the line AB

2. Find the gradient of the line shown in the diagram below.



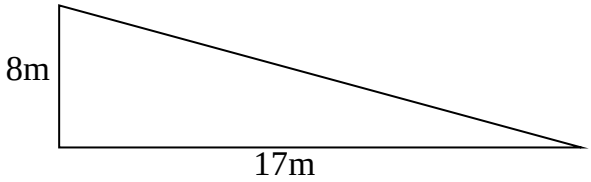
3. The manufacturer of a ramp for a shop entrance states that to be suitable for a wheelchair user the gradient of the ramp must be between 0·1 and 0·2.



Is this ramp suitable for wheelchair users?

You must show working and give a reason for your answer.

4. A skateboard ramp has been designed to have the dimensions shown in the diagram.



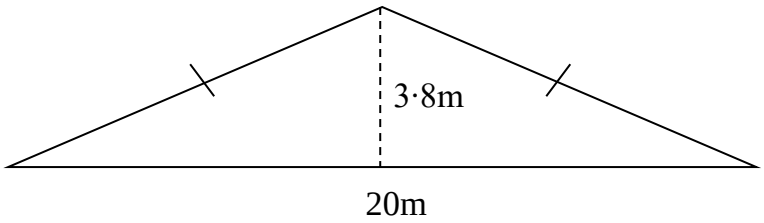
Safety regulations state that the gradient of the ramp should be a **maximum** of 0·5.

Does this ramp meet safety regulations? **You must show working and give a reason for your answer.**

5. A builder wants to find the gradient of the slope of a roof.

The length of the attic floor is 20 metres long and the height at the centre is 3·8m.

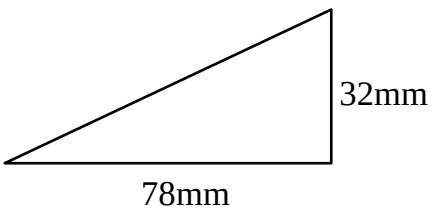
Calculate the gradient of the slope of the roof



6. A door wedge is in the shape of a triangle.

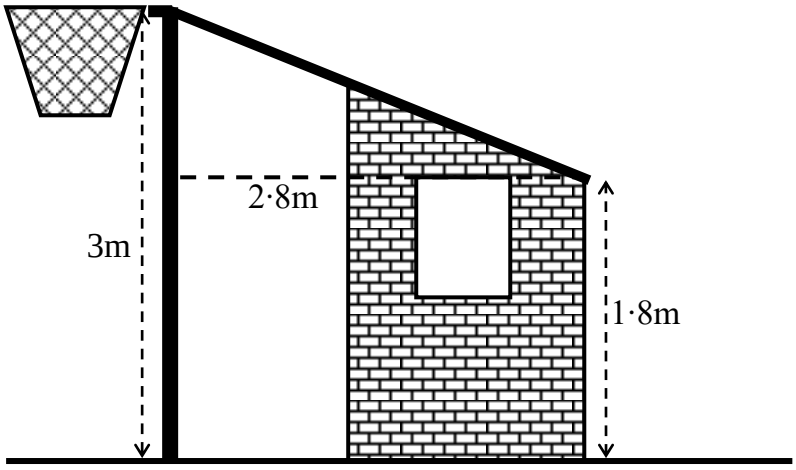
It has a height of 32mm and a base of 78mm.

Calculate the gradient of the sloping edge.



7. Colin has put a basketball net on a pole in his garden. He has fixed it to his garden shed using a baton which he has nailed over the roof of the shed.

The horizontal distance is 2·8 metres and the basketball pole is 3 metres high.



Calculate the gradient of the slope of the roof.

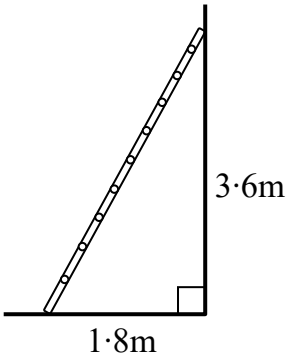
8. A ladder resting against a wall reaches 3·6 metres up a wall.

The foot of the ladder is 1·8 metres from the wall.

For the ladder to be used safely the gradient of the ladder must lie between 1·8 and 2.

Is this ladder being used safely?

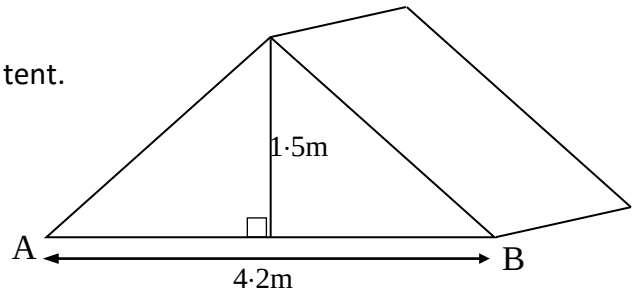
You must show working and give a reason for your answer.



9. The distance between the tent pegs at A and B is 4·2m and the height at the centre is.1·5m.

The sloping sides are the same length.

Calculate the gradient of the sloping side of the tent.

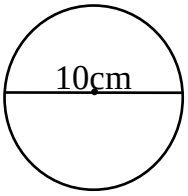


Calculating the circumference of a circle

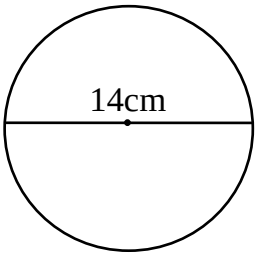
Use π = 3·14 in all questions

1. Calculate the circumference of the circles below:

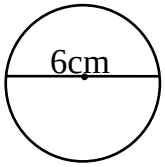
(a)



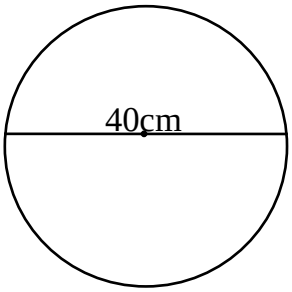
(b)



(c)



(d)



2. Calculate the circumference of circles with **diameter**:

(a)	10cm	**(b)**	20cm	**(c)**	100mm	**(d)**	8cm
(e)	25mm	**(f)**	30cm	**(g)**	500mm	**(h)**	60m
(i)	16mm	**(j)**	15cm	**(k)**	50cm	**(l)**	200cm

3. Write down the **diameter** of circles with **radius**:

(a)	4cm	**(b)**	5cm	**(c)**	15cm	**(d)**	9mm
(e)	10m	**(f)**	14cm	**(g)**	3m	**(h)**	12mm
(i)	8cm	**(j)**	25mm	**(k)**	1·5m	**(l)**	24cm

4. Calculate the circumference of circles with **radius**:

(a)	10cm	**(b)**	15cm	**(c)**	50cm	**(d)**	30mm
(e)	3m	**(f)**	5m	**(g)**	4m	**(h)**	20cm
(i)	2m	**(j)**	12cm	**(k)**	25cm	**(l)**	100cm

5. Patricia wants to put a decorative edge round the top and bottom of the wastepaper bin in her bedroom.

The top of the bin has a diameter of 25cm and the bottom has a diameter of 20cm.

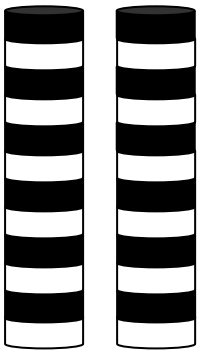
What length of edging will she need to buy?

6. Martin has to replace the circular seal in the door of his washing machine.

The radius of the door is 12cm.

What is the circumference of the door seal?

7. A florist is decorating her shop and wants to put pieces of coloured ribbon round white poles to create a striped effect like this:



The pole has a radius of 12cm. Calculate how much ribbon she will need to decorate the two poles.

Answer correct to the nearest necessary metre.

8. Linzi's Mum buys a frill of length 78cm to fit round her birthday cake.

Find out the biggest diameter that the cake can have so that the frill fits.

Calculating the area of a circle

1. Calculate the area of circles with **radius**:

(a)	10cm	**(b)**	20cm	**(c)**	100 mm	**(d)**	8 cm
(e)	25mm	**(f)**	30cm	**(g)**	500 mm	**(h)**	60 m
(i)	16mm	**(j)**	15cm	**(k)**	50 cm	**(l)**	200 cm

2. Write down the **radius** of circles with **diameter**:

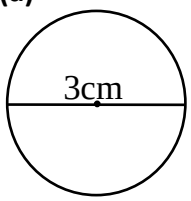
(a)	4 cm	**(b)**	5 cm	**(c)**	15cm	**(d)**	9mm
(e)	10 m	**(f)**	14 cm	**(g)**	3m	**(h)**	12mm
(i)	8 cm	**(j)**	0·5 mm	**(k)**	1·6m	**(l)**	2·5cm

3. Calculate the area of circles with **diameter**:

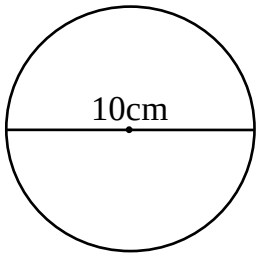
(a)	10cm	**(b)**	16cm	**(c)**	50cm	**(d)**	30mm
(e)	2m	**(f)**	12m	**(g)**	4m	**(h)**	20cm
(i)	3m	**(j)**	5cm	**(k)**	25cm	**(l)**	100cm

4. Calculate the area of the circles below :

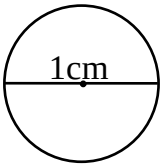
(a)



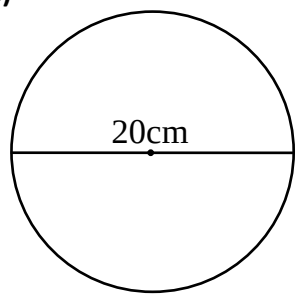
(b)



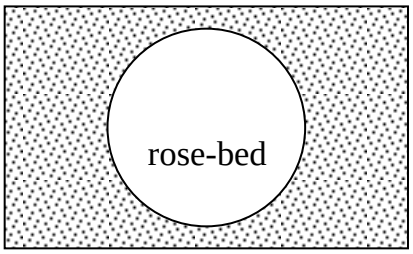
(c)



(d)



5.



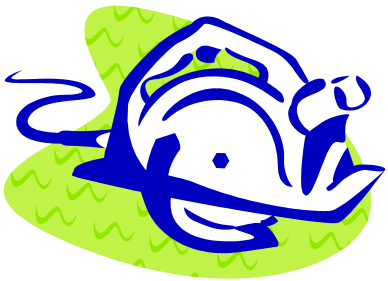
Simon is cutting a circular area from his lawn to plant a rose-bed.

If the diameter of the rose-bed is 1m, what area of lawn will he need to remove?

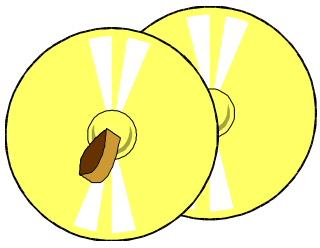
6. Santino has a circular power saw.

The radius of the blade is 10cm.

What is the area of the blade?

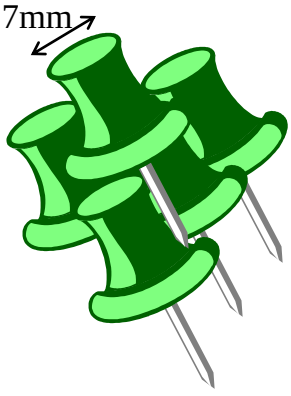


7. The radius of a cymbal is 18cm. Calculate the area of one of them.



8. The diameter of the top of a pin is 7mm.

Calculate the total area of the tops of 5 of them.

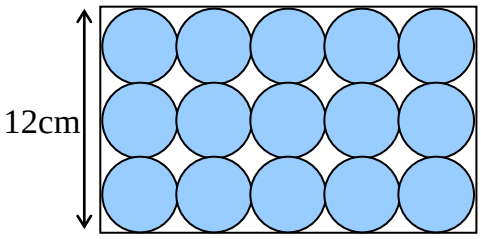


9. Tea-light candles have to be packed into a box like this:

(a) What is the area of 1 tea light?

(b) Calculate the total area taken up by the 15 tea lights on the tray.

(c) What is the area of the top of the tray?

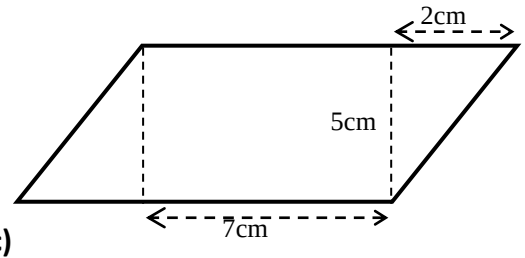


(d) How much space on the tray is **NOT** taken up by the tea lights?

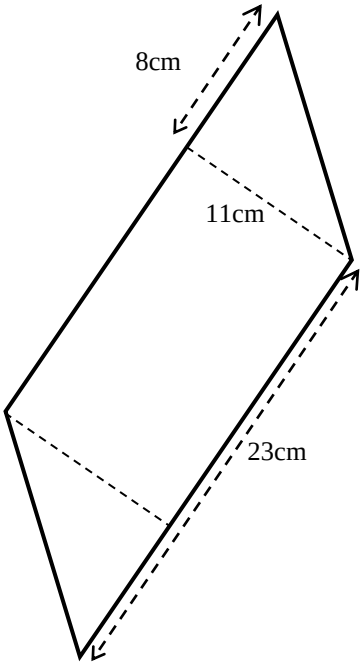
Calculating the area of a parallelogram, kite and trapezium

1. Calculate the area of these parallelograms by splitting them into triangles and rectangles:

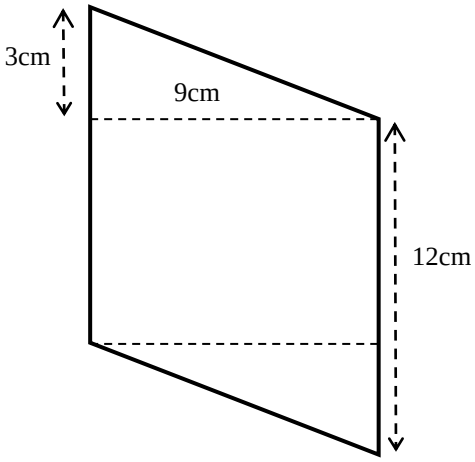
(a)



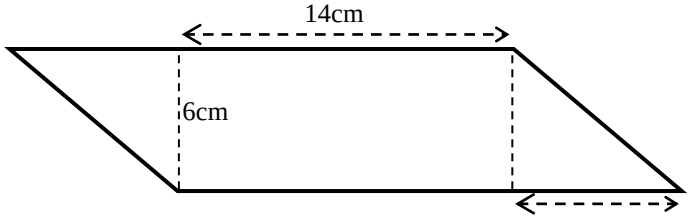
(b)



(c)

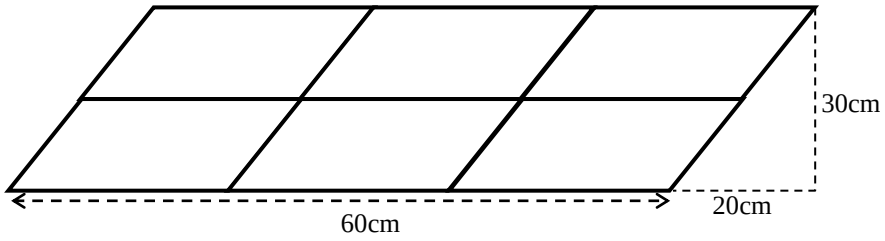


(d)



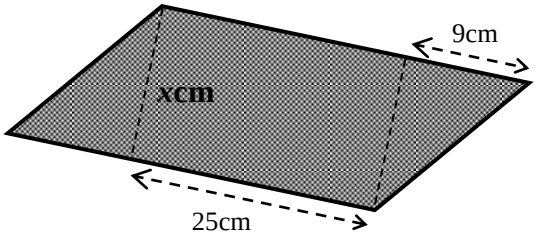
6cm

2. Calculate the area of one of the parallelograms in this diagram:



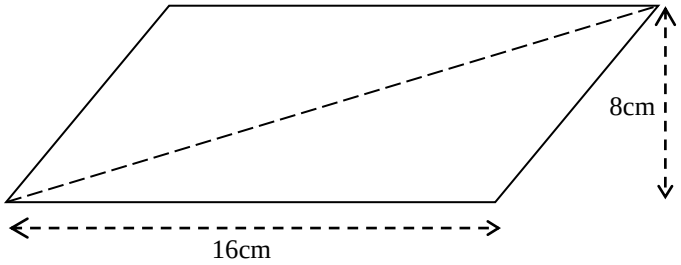
3. The area of this parallelogram is 340cm².

Calculate the value of *x*.

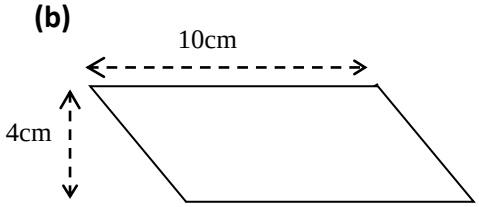


4. Calculate the areas of these parallelograms by splitting them into triangles:

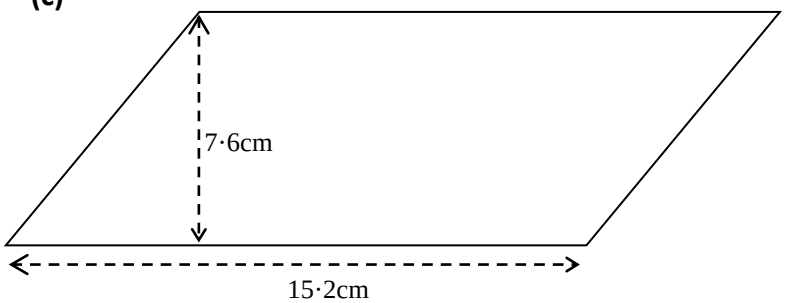
(a)



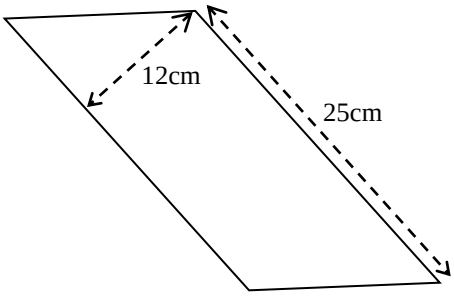
(b)



(c)

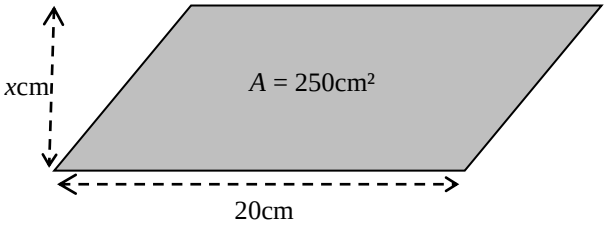


(d)

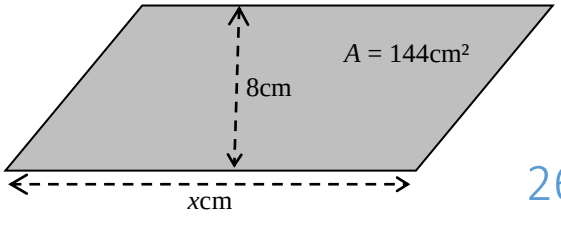


5. Calculate the length marked *x* in these parallelograms given their areas:

(a)

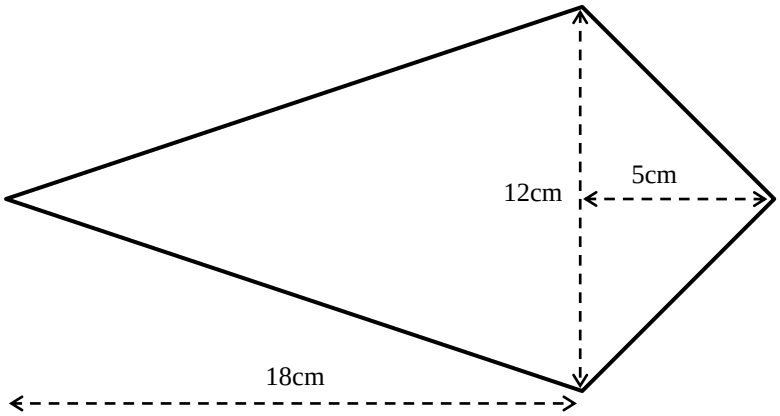


(b)

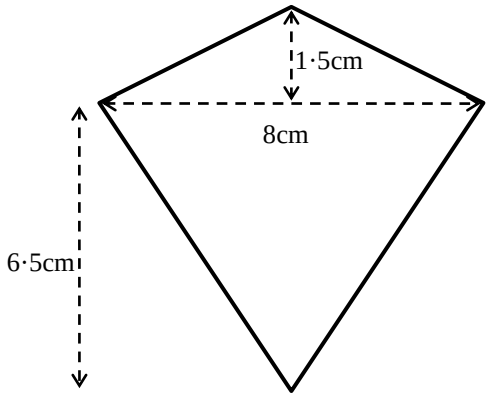


6. Calculate the areas of these kites:

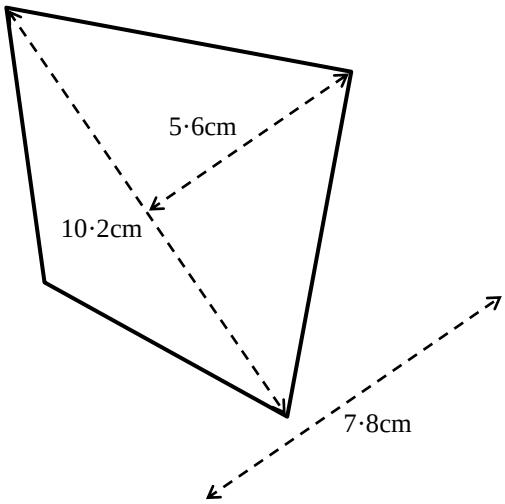
(a)



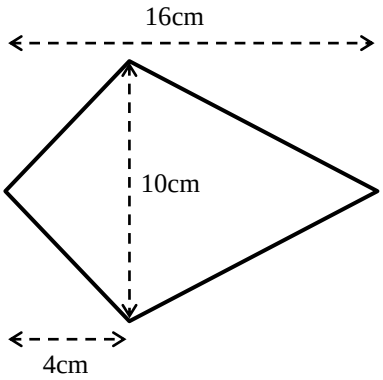
(b)

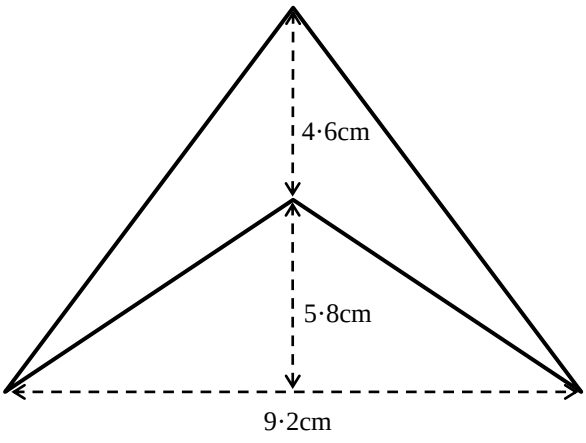


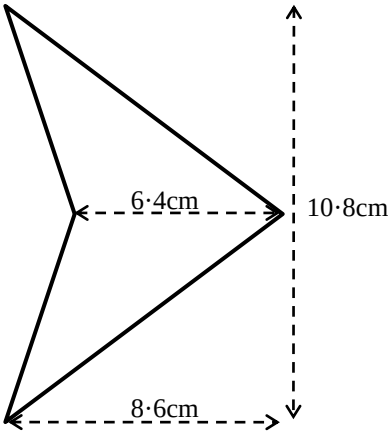
(c)



(d)

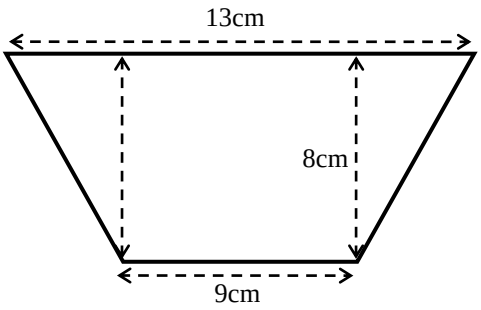




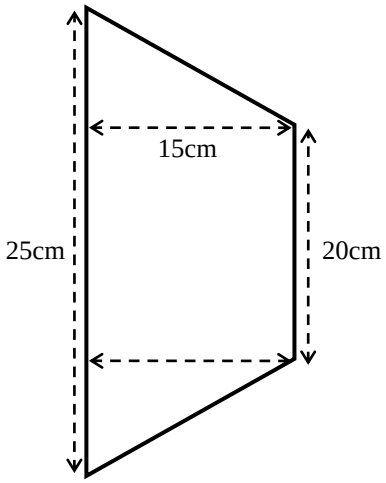


7. Calculate the area of each trapezium by dividing them into rectangles and triangles:

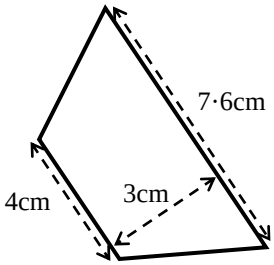
(a)



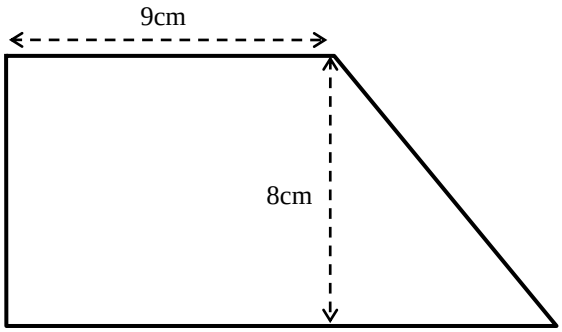
(b)



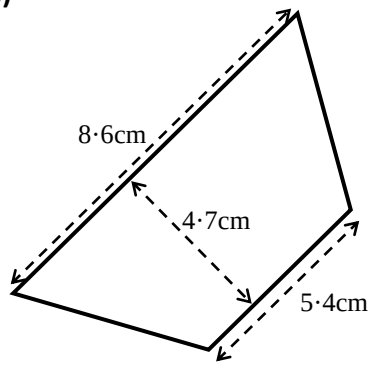
(c)



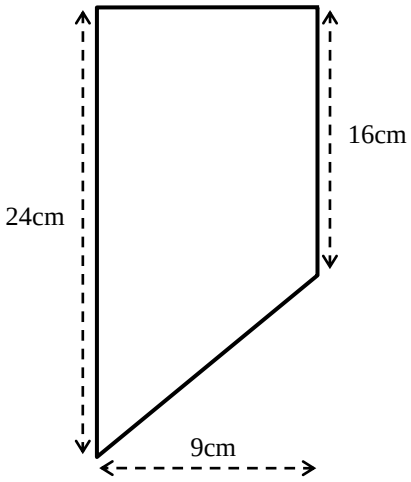
(d)



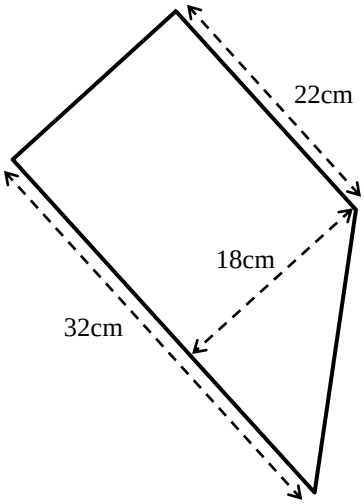
(e)



(f)

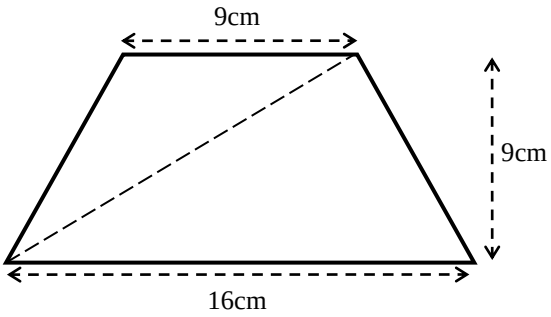


(g)

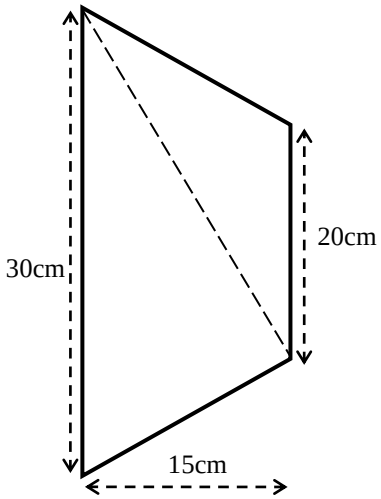


8. Calculate the area of each trapezium by dividing them into triangles:

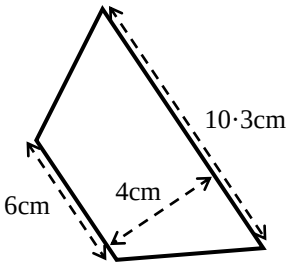
(a)



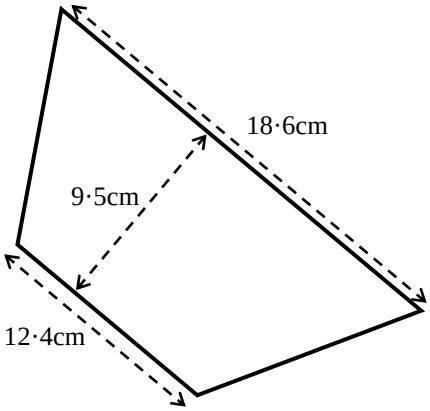
(b)



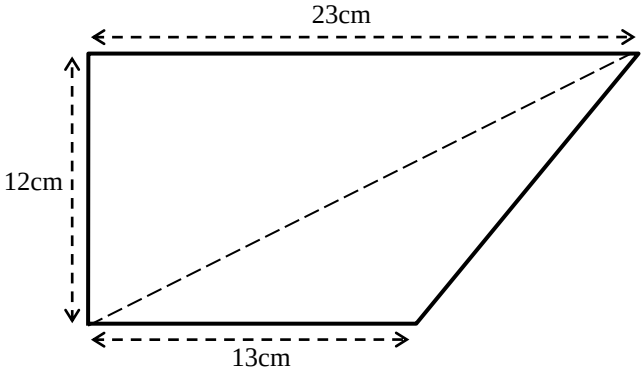
(c)



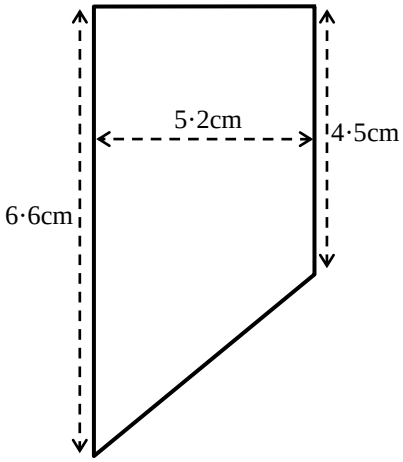
(d)



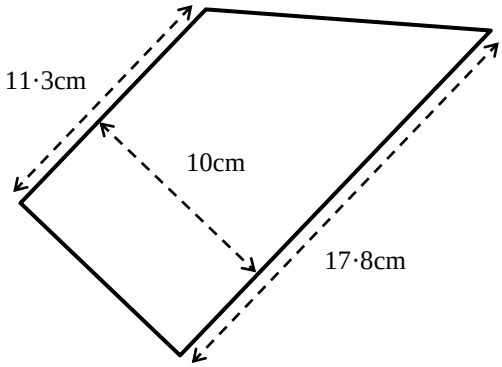
(e)



(f)



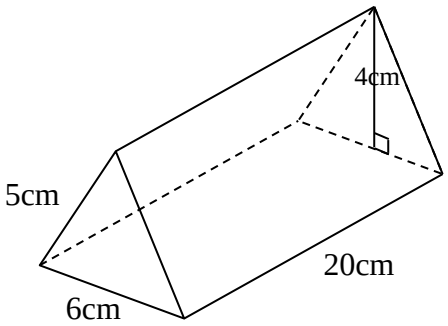
(g)



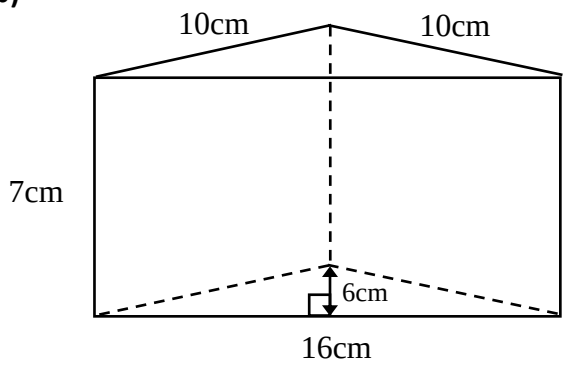
Calculating the surface area of a prism

1. For each shape below, sketch the net and calculate the surface area.

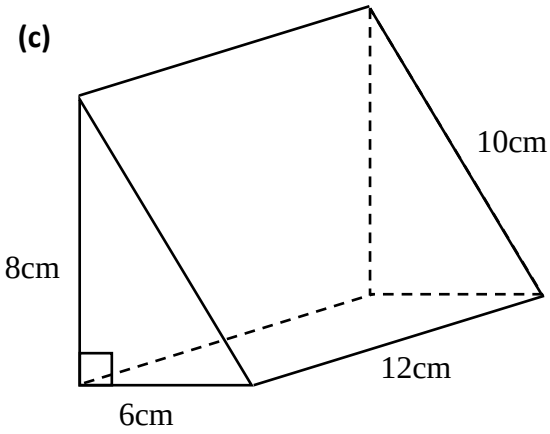
(a)



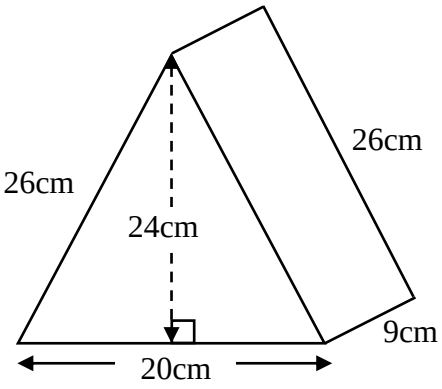
(b)



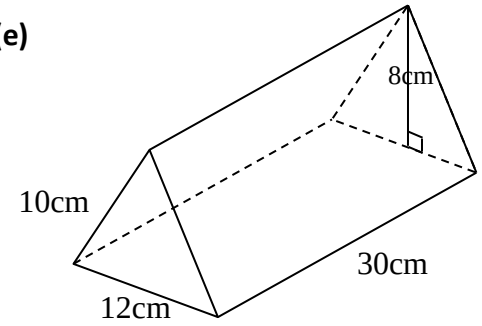
(c)



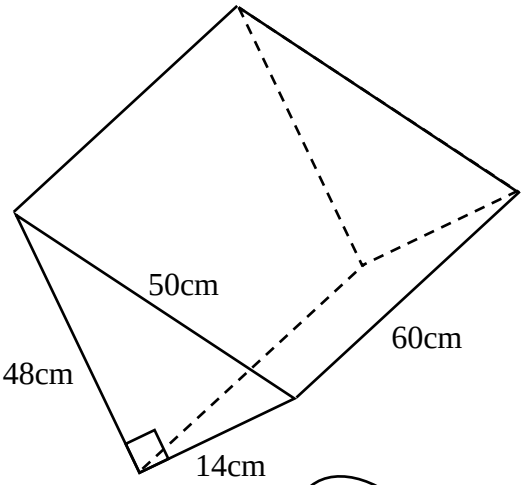
(d)



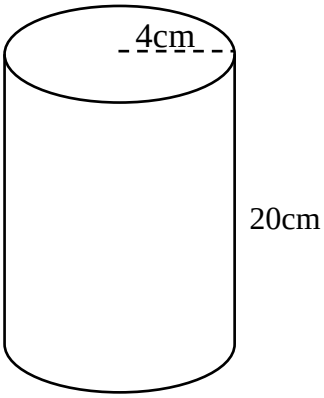
(e)



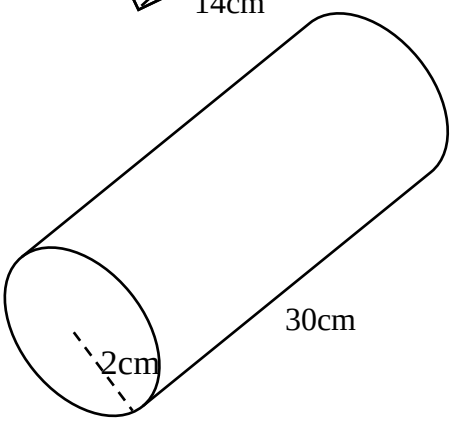
(f)



(g)



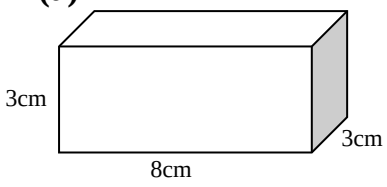
(h)



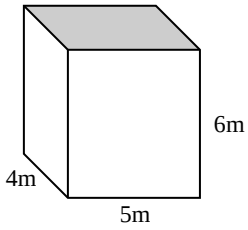
Calculating the volume of a prism

1. Calculate the volume of each of the cuboids below:

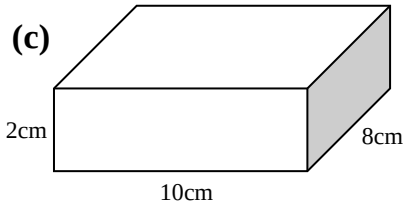
(a)



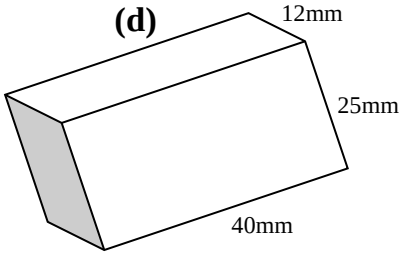
(b)



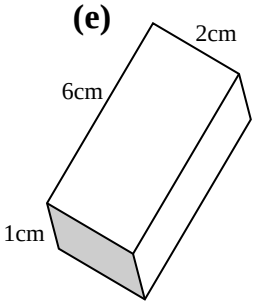
(c)



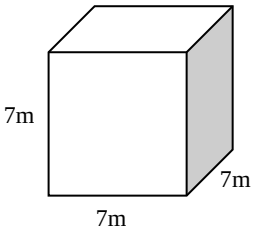
(d)



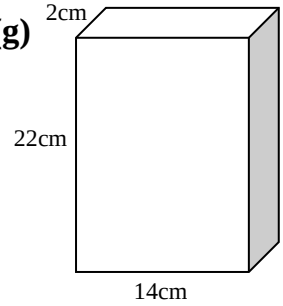
(e)



(f)



(g)



2. Calculate the volumes of the cuboids measuring:

(a) 12cm by 8cm by 9cm **(b)** 18mm by 12mm by 3mm

(c) 50cm by 20cm by 5cm **(d)** 15m by 7m by 8m

(e) 11mm by 9mm by 2mm **(f)** 4·3cm by 2·2cm by 10cm

3. Calculate the volumes of the cubes of side:

(a) 6cm **(b)** 4mm **(c)** 14cm **(d)** 23mm

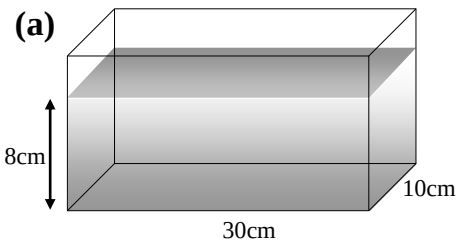
4. Convert each of the following volumes in *cubic centimetres* into *litres*:

(a) $3000cm^3$ **(b)** $2400cm^3$ **(c)** $12600cm^3$ **(d)** $600cm^3$

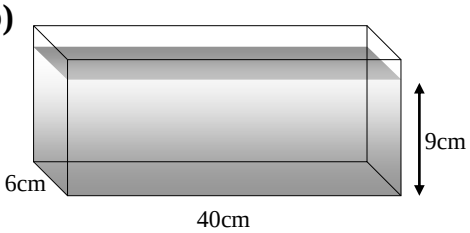
(e) $1460cm^3$ **(f)** $480cm^3$ **(g)** $320000cm^3$ **(h)** $2565cm^3$

5. Calculate the volume of water in each fish tank below, giving your answer in *litres* :

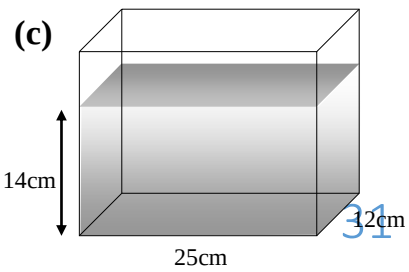
(a)



(b)



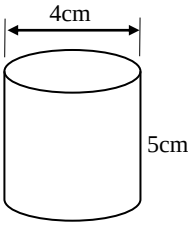
(c)



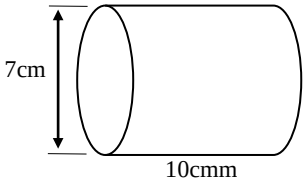
Calculating the volume of a cylinder

1. Calculate the volume of each cylinder below:

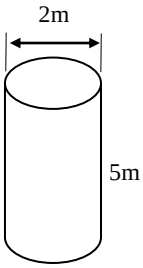
(a)



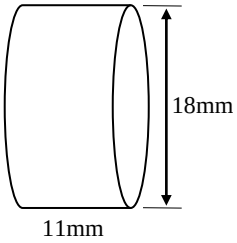
(b)



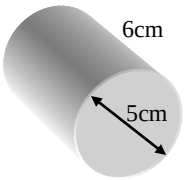
(c)

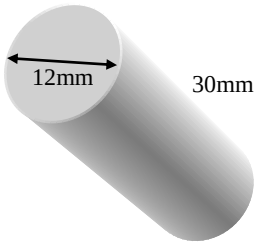


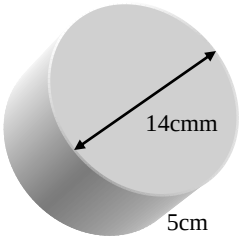
(d)

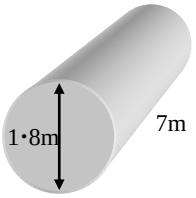


2. Calculate the volume of each cylinder below :

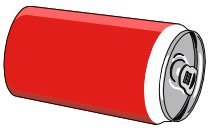








3. The drinks can opposite is cylindrical in shape.



Calculate its volume (in ml) if it has a diameter of 6cm and a length of 11·68cm . Give your answer to the nearest millilitre.

4. Six cola-cans each with a diameter of 6·8cm and a height of 9·183cm are sold together in an economy pack.

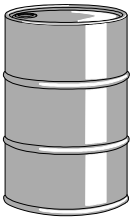
Calculate the total volume of cola in the six-pack.

Answer to the nearest millilitre.

5. A container for holding coffee is cylindrical in shape.

Given that it has a diameter of 8cm and a height of 15cm calculate its volume in cubic centimetres.

6. An oil drum has a diameter of 66cm and a height of 105.3cm.

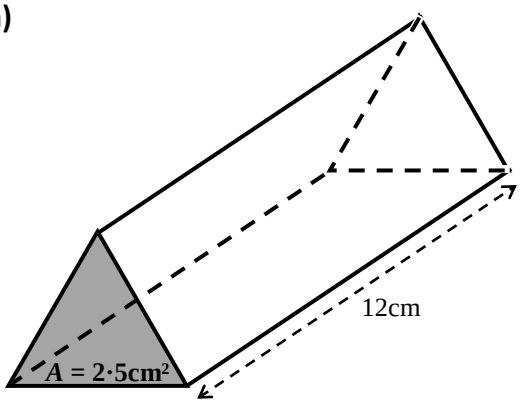


Calculate the capacity of the drum to the nearest litre.

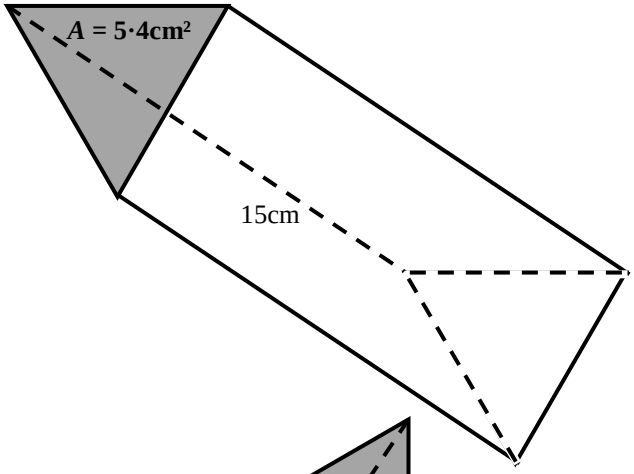
Calculating the volume of a triangular prism

1. Calculate the volumes of these triangular prisms

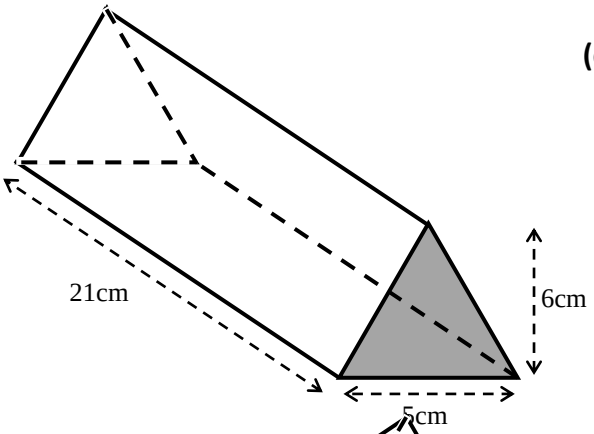
(a)



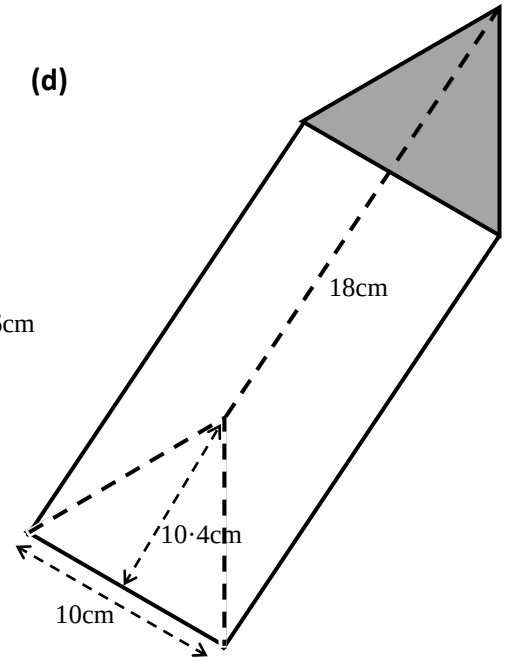
(b)



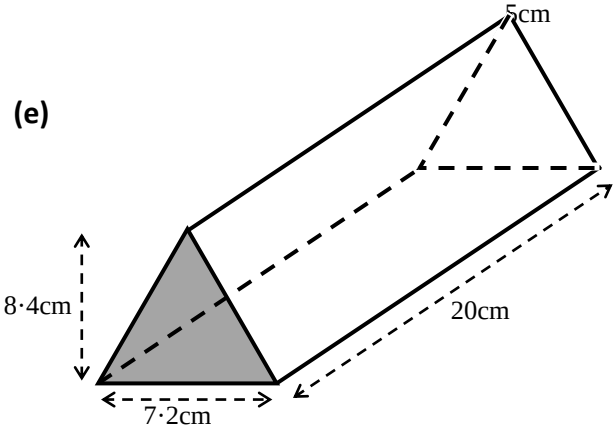
(c)



(d)

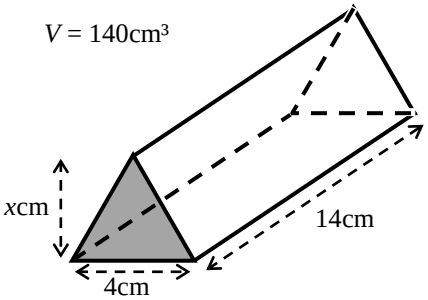


(e)

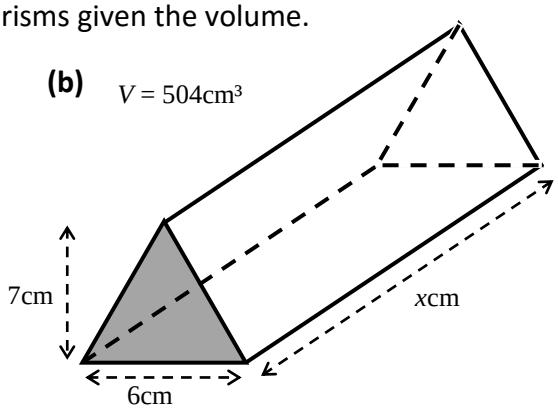


2. Calculate the side marked x in these triangular prisms given the volume.

(a) $V = 140\text{cm}^3$



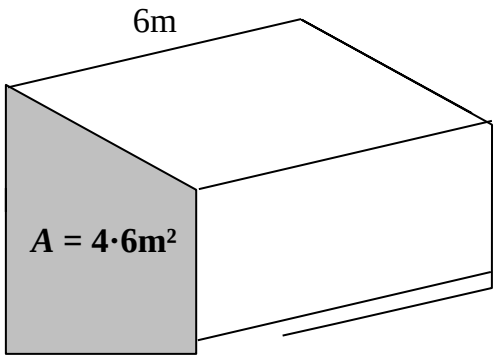
(b) $V = 504\text{cm}^3$



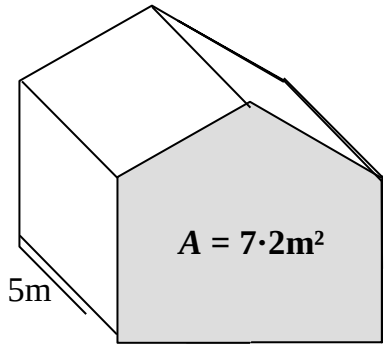
Calculating the volume of other prisms

The area of the base of these prisms is given. Calculate the volume of the prisms.

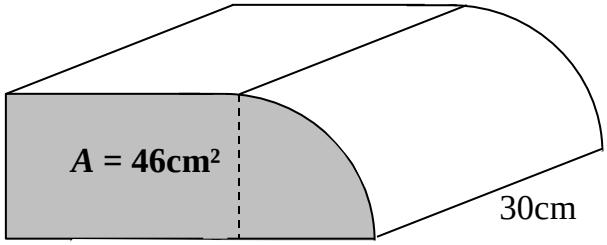
(a)



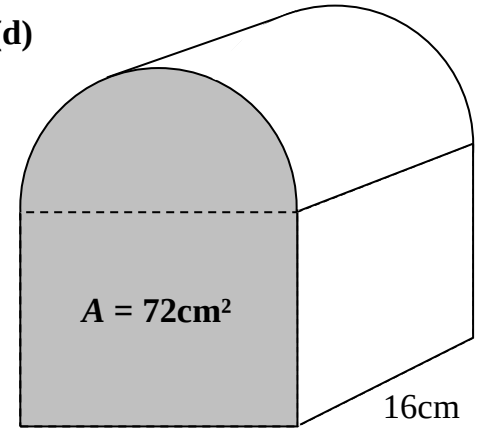
(b)



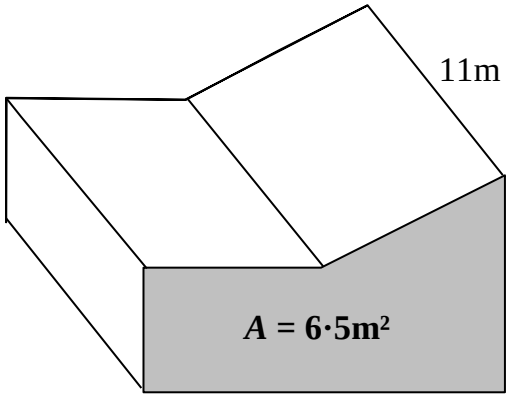
(c)



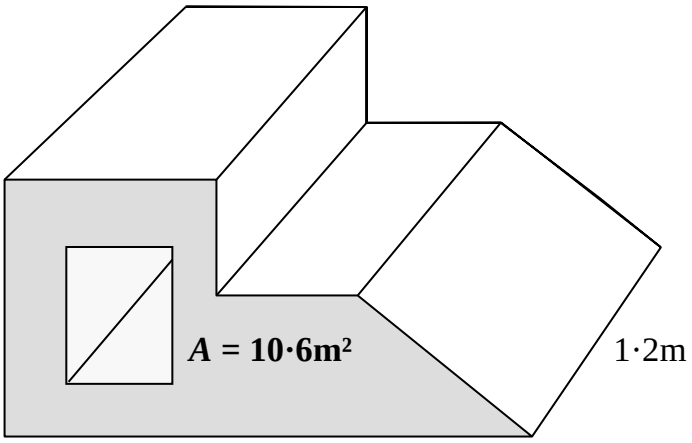
(d)



(e)



(f)

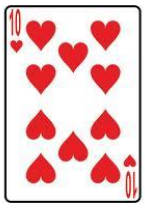


Using rotational symmetry

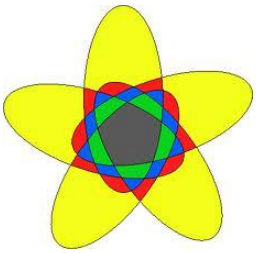
Exercise 1

1. State the order of rotational symmetry for each of these patterns and objects.

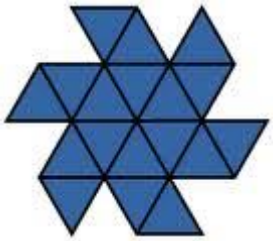
(a)



(b)



(c)



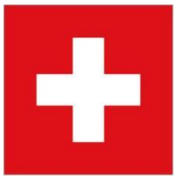
(d)

(e)

4

(f)

(g)



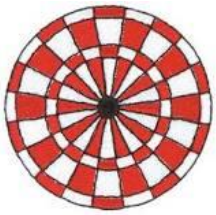
(h)

(i)

(j)

(k)

(l)



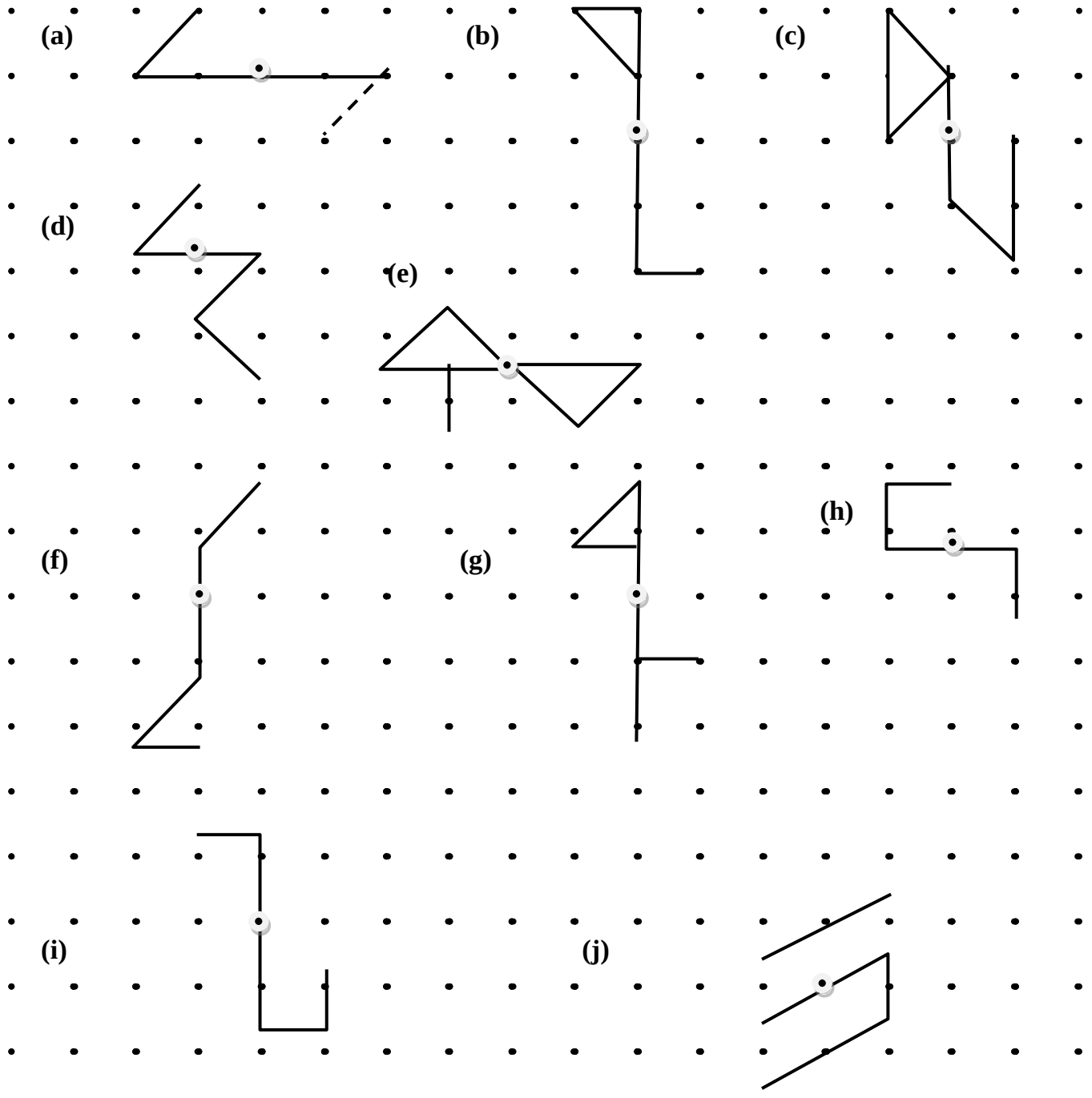
(m)

(n)

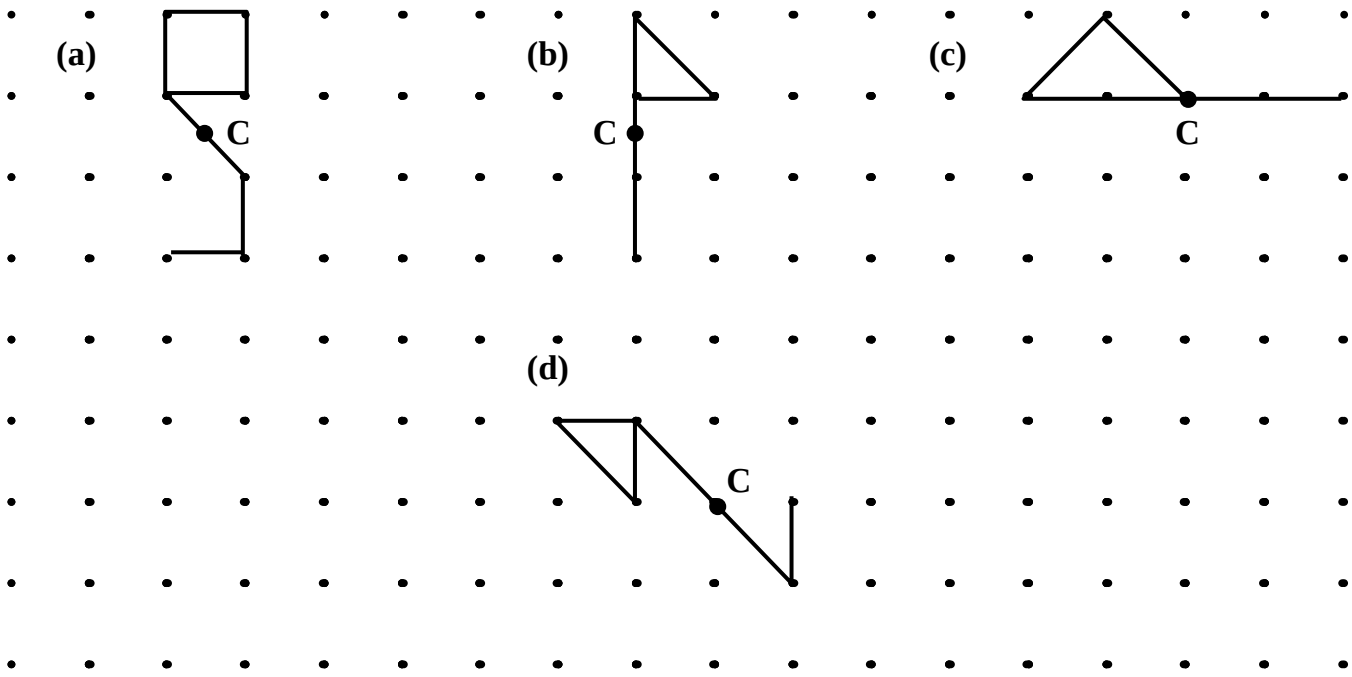
(o)

Exercise 2

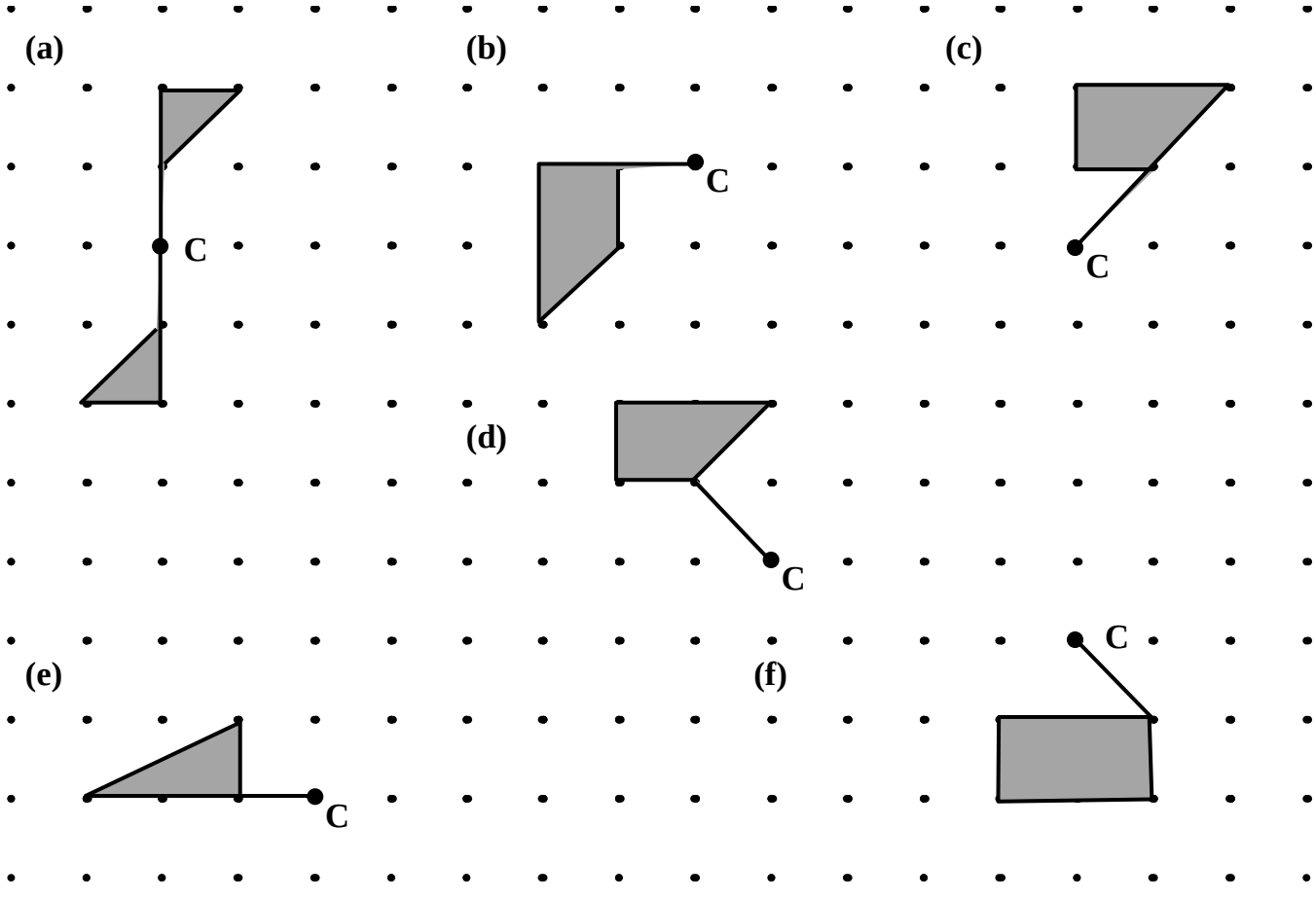
1. Copy these diagrams onto square dotty paper and add one line to each so that they have half – turn symmetry about the point marked . The first one has been done for you.



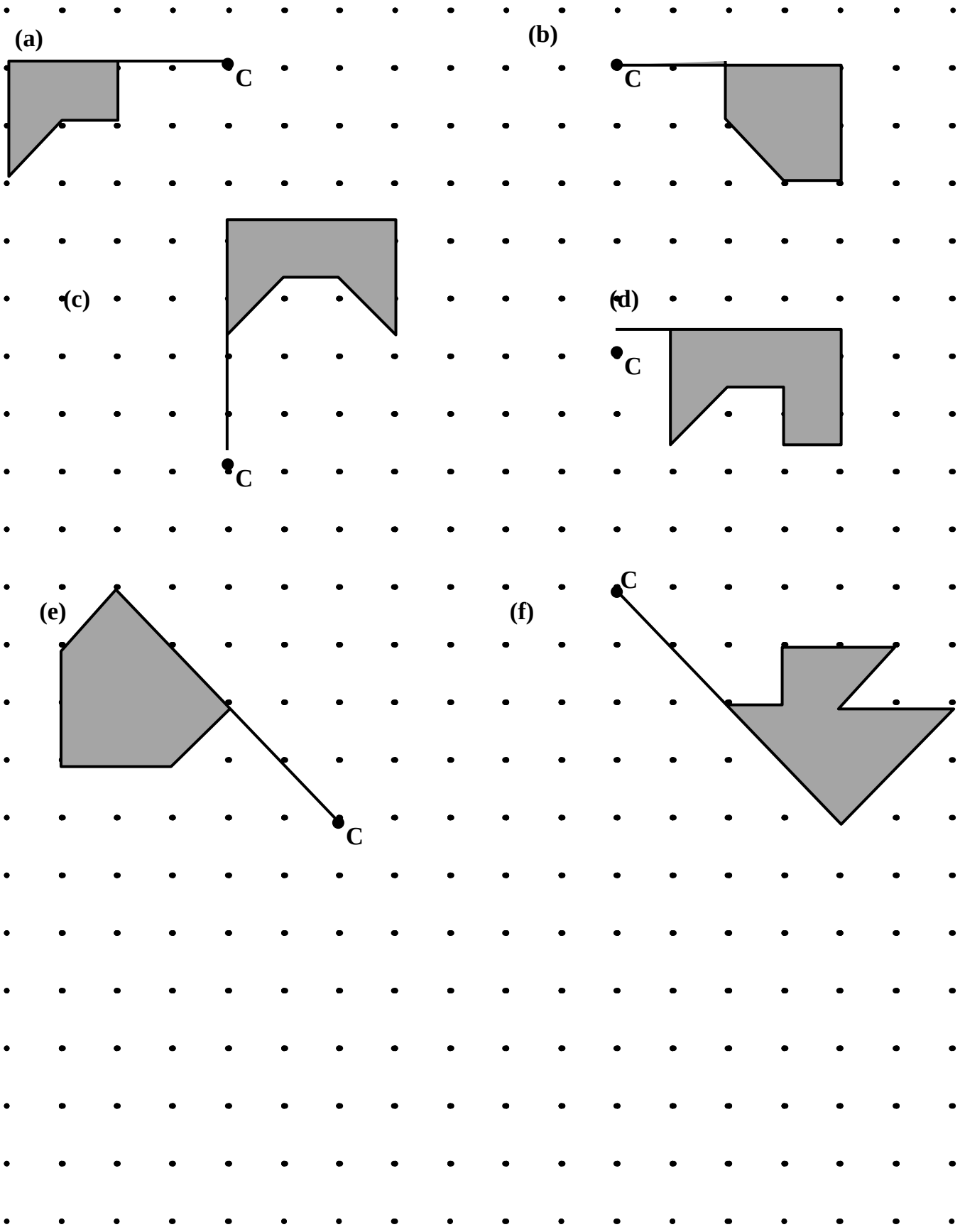
2. Copy these diagrams and add two lines so that the shapes have half turn symmetry about the point C.



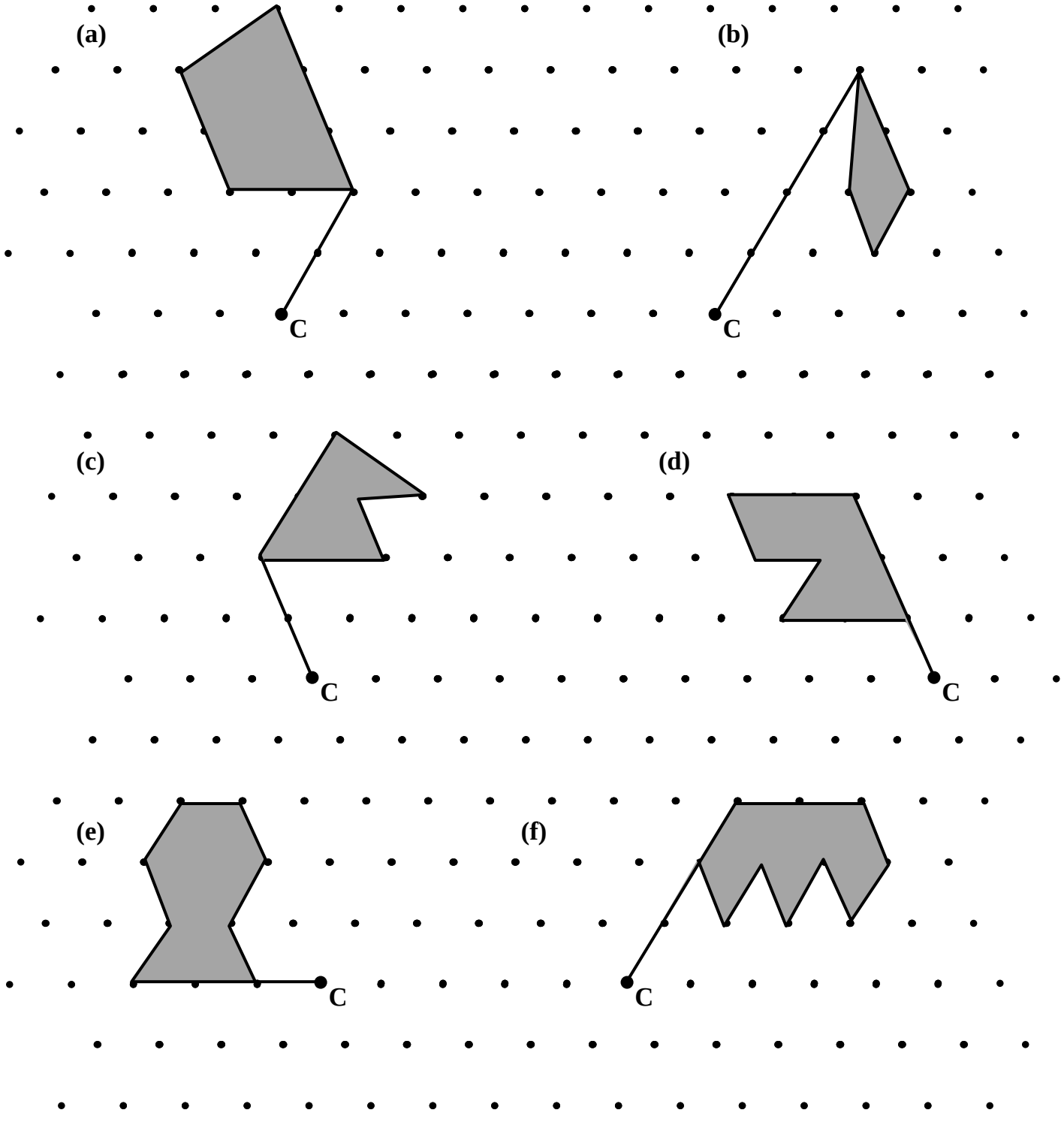
3. Copy and complete these diagrams so that the shapes have half – turn symmetry about the point marked C. The first one has been completed for you.



4. Copy and complete the following so that each finished diagram has half – turn symmetry about the point C.

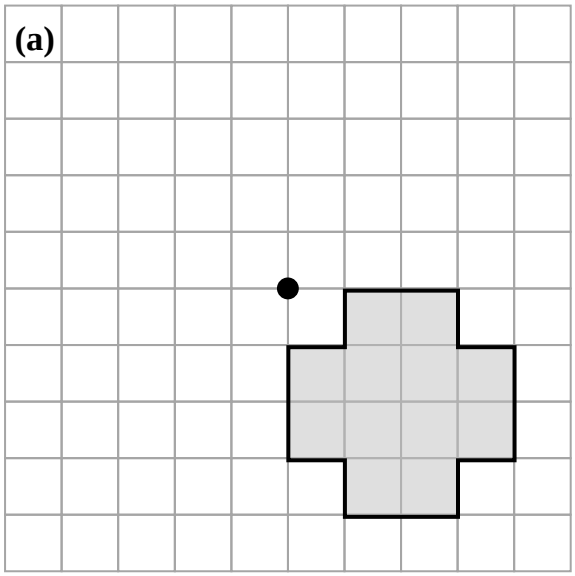


5. Copy and complete the following diagrams so that they have turn symmetry of order 3 about the point C.

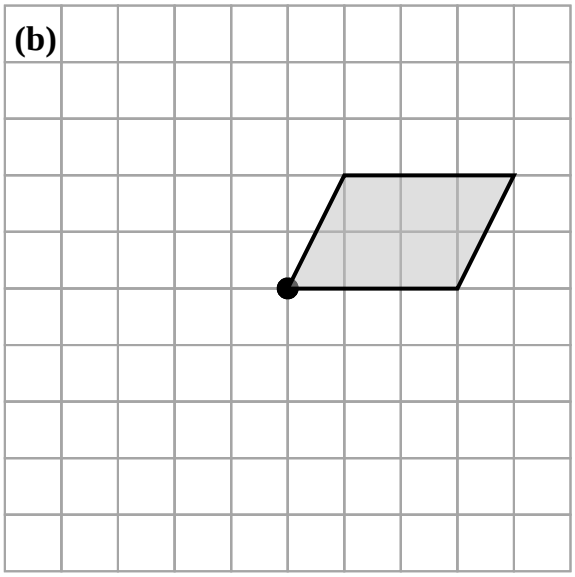


6. Copy and complete these patterns so that they have turn symmetry of order 4.

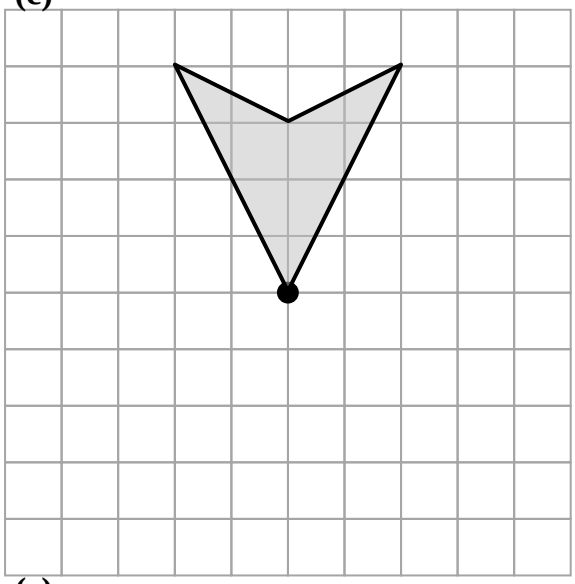
(a)



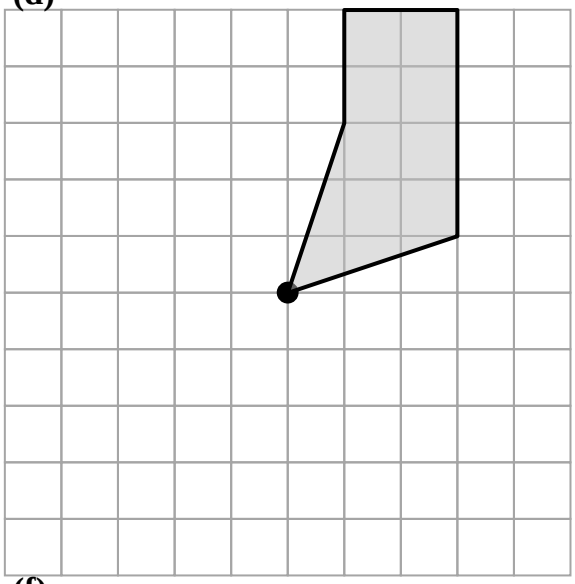
(b)



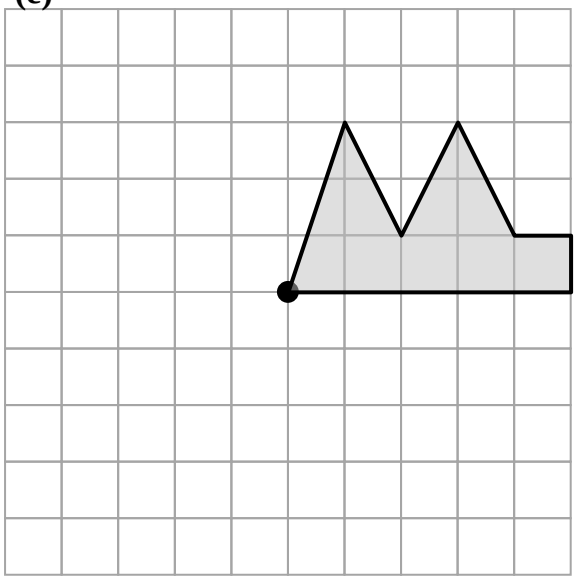
(c)



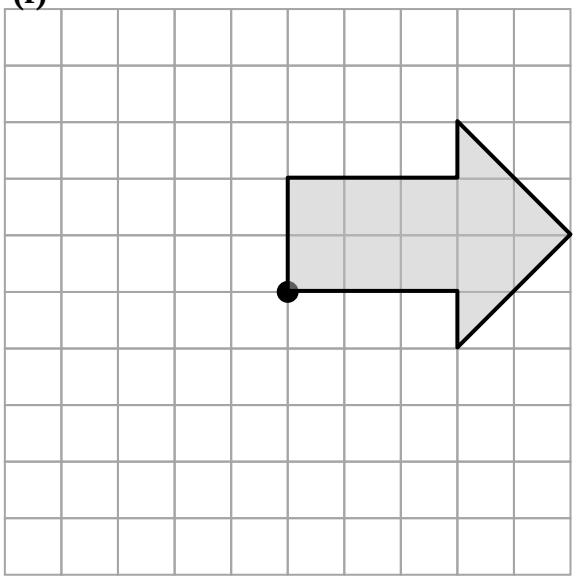
(d)



(e)

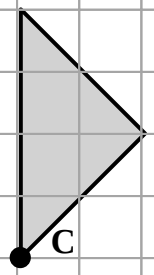


(f)

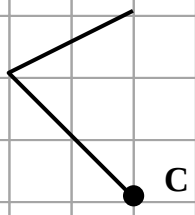


7. Copy and complete these diagrams so that they have turn symmetry of order 4 about C.

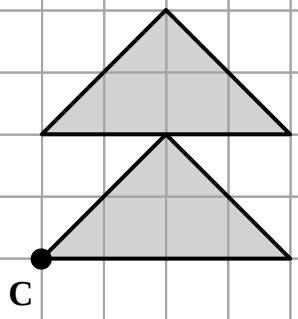
(a)



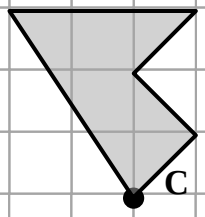
(b)



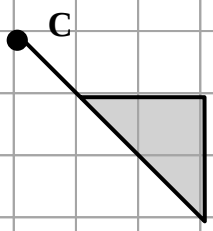
(c)



(d)



(e)



Constructing a frequency table with class intervals

1. A class sat a Maths test. Their results are shown below.

61	30	71	62	46	60	42	55	57	40
62	41	35	81	50	65	62	67	69	83
51	46	65	73	53	74	84	82	72	75

Draw a frequency table to show these results using class intervals of size 10 starting with 30 – 39.

2. The table shows the ages of people working in a factory.

24	41	30	50	43	32	31	42	23	30
37	20	46	35	52	26	40	21	48	26
34	25	37	45	27	31	33	39	27	36

Arrange this information in a frequency table using class intervals of size 5 starting with 20 – 24.

3. A group of darts players were asked what there highest ever score was with 3 darts.

The results are shown here.

115	113	131	142	164	134	132	120	111	108	121
155	119	151	145	164	135	175	150	146	155	167
121	133	112	105	140	179	176	147	129	110	115

Show these results in a frequency table using a suitable class interval.

4. A group of people were asked to say how many coins they had in their pocket.

12	0	3	19	14	1	20	12
9	7	1	9	16	7	21	10
4	15	11	12	15	27	6	11
2	0	9	31	15	18	3	4
22	15	16	26	25	17	13	3

Make a frequency table to show these results using a suitable class interval.

Determining mean, median, mode and range of a data set

1. Find the mean, median, mode and range for each of the following data sets.

(a) 7 8 9 10 12 12 12 13 13 13 13

(b) 50 51 51 51 51 52 52 53 53 53 53

(c) 0·4 2·1 3·6 4·8 5·3 5·3 5·5 5·7 6·0

(d) 7 9 10 11 12 14 14 15 16

(e) 6 8 11 12 14 15 15 17 21 22 24

(f) 8 10 11 12 14 14 15

(g) 0·31 0·34 0·35 0·38 0·40 0·42 0·43 0·43 0·45

(h) 2 3 3 3 5 5 5 5 6 6 7 7 8

2. Find the mean, median, mode and range for each of the following data sets. (Remember to write the numbers in order before finding the median)

(a) 7 6 3 11 8 7 10 4 7

(b) 1 3 11 4 9 15 7 2 6 3 5

(c) 2·0 2·5 3·3 1·7 2·2 2·7 1·9 2·2 2·9 1·5 2·4

(d) 85 81 80 89 88 81 85 86 81 90

(e) 4 2 3 1 2 4 3 2 1 2 2 3 2 4

(f) 1·2 0·8 2·0 0·9 0·8 0·6 1·1 2·2 1·2 0·8 0·9 1·9

(g) 332 308 340 325 336 341 319 324 317 306 308 320

(h) 8·8 12·4 15·2 10·3 11·9 9·7 20·0 16·9 9·7 17·1

3. Mr. Khan timed how long it took each of his class to complete an exercise. The times are in seconds.

300 480 216 311 419 333 281 295 308 276

402 343 398 290 364 378 399 294 401 300

Calculate the mean and the median.

4. The weights, in kilograms, of 20 new-born babies are shown below.

2·8 3·4 2·8 3·1 3·0 4·0 3·5 3·8 3·9 2·9

2·7 3·6 2·5 3·3 3·5 4·1 3·6 3·4 3·2 3·4

Find the median, mode and range.

Interpreting calculated statistics to compare data

1. Paul works in a shoe shop on a Saturday. The manager wants to make a special purchase of "Trainers". He asked Paul to do a tally of sizes of men's shoes sold that day.

Size	6	6½	7	7½	8	9	10
Pairs Sold	5	17	21	16	15	11	2

(a) Which size of shoe will the manager order most of?

(b) What do we call this measure in statistics?

2. The ***Lucky Strike Match Company*** advertises the *average* contents of its boxes as 48.

Here is a sample of the boxes contents :

45 47 46 50 48 51 46 47 49 51

Is the company correct in their advert? Give a reason for your answer.

3. The ages of the players in a local football team are given below :

19 23 25 24 19 25

31 27 29 30 34

(a) Calculate the mean, median and mode.

(b) Jake is 25 years old. Is he above or below the average age?

(c) The two oldest players leave and are replaced by two players aged 18 and 25.

Calculate the mean, median and modal age of the team now.

(d) How would you describe Jake's age now?

4. A small firm employs 10 people. The salaries of the employees are as follows :

£40 000, £18000, £15000, £9000, £15000, £15000, £13000, £15000, £15000, £15000.

(a) Calculate the mean, median and mode.

(b) Which of the three measures best describes the ***average*** salary in the company?

5. Diane does a lot of travelling in her job. She keeps a note of the miles she drove each week for the first 10 weeks.

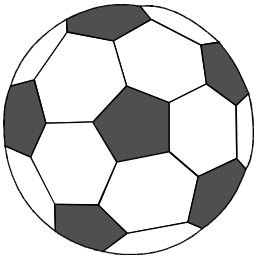
785 846 816 704 685 723 960 788 729 814

(a) Calculate the mean weekly mileage.

(b) If Diane's mean weekly mileage stays the same, how many miles would she expect to travel in a year? (She has 6 weeks holiday when she does no driving)

6. In a 5-a-side football competition, the average age of a team must not exceed 16.

Below are the ages of 2 groups of 10 players who want to enter 2 teams each.



A : 14 , 16 , 14 ,17 , 15 , 18 , 16 , 15 , 17 , 18

B : 14 , 15 , 16 , 17 , 15 , 16 , 14 , 16 , 18 , 14

(a) How would you arrange the teams ?

(b) Here are the ages of another team : 15, 17, 16, 17, 16

Will they be allowed to take part in the competition ?

7. In nine arithmetic tests during the term, Peter's scores were :

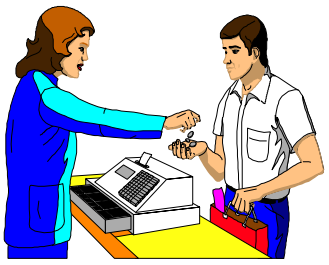
20 22 18 21 22 16 14 19 17

Which of the three averages - mean, median or mode - would he prefer to count as his '*mark*' ?

8. The first eight customers at a supermarket one Saturday spent the following amounts:

£25.10, £3.80, £20.50, £15.70,

£38.40, £9.60, £46.20, £10.46.



(a) Find the mean amount spent.

(b) I spend £11.53. Compare this to the average amount spent.

9. 20 lightbulbs were tested to see how long they would last. The lifetimes of the bulbs are given below in hours.

1503	1469	1511	1494	1634	1601	1625	1492	1495	1505
1487	1493	1006	1512	1510	1599	1501	1486	1471	1598

The manufacturing company claims that the ***average*** lifetime of a lightbulb is 1500 hours.

Do you agree with their claim?

Representing raw data in a pie chart

1. A survey was carried out in which 60 people were asked to name their favourite radio station. The results were

Clyde 1	24	**Clyde 2**	8	**Radio 1**	14
Radio 2	5	**Scot fm**	9		

(a) Copy and complete the table

(b) Draw the pie-chart.

Station	Number of people	Angle in piechart
Clyde 1	24	$\frac{24}{60}\times 360 = 144^o$
Clyde 2	8	$\frac{8}{60}\times 360 =$
Radio 1	14	$\frac{14}{60}\times 360 =$
Radio2	5	$\frac{5}{60}\times 360 =$
Scot fm	9	$\frac{9}{60}\times 360 =$

2. Draw a pie-chart for each of the data sets below.

(a) 90 people were surveyed to find the most popular flavour of crisps

Flavour	ready salted	cheese & onion	smoky bacon	salt & vinegar	prawn cocktail	roast chicken
Number of people	23	28	11	18	7	3

(b) 120 people were asked about the newspapers that they buy each day.

Newspaper	Daily News	The Moon	The Reporter	None
Number of people	35	42	26	17

(c) 240 pupils were asked to choose their favourite sport.

Sport	football	basketball	tennis	swimming	hockey
Number of pupils	80	64	32	48	16

(d) A professional photographer took 144 photographs of the types shown below

Type of photo	Baby	Wedding	Portrait	Adverts	News
Number of photographs	48	60	10	18	8

3. As people left a Sports Centre they were asked which sport they had taken part in. The table shows the results.

Sport	Number of people
Squash	4
Swimming	17
Badminton	8
Skating	11

Draw a pie chart to illustrate the results.

Using Probability

1. A die is rolled. Calculate the probability that the result will be

(a) a 2

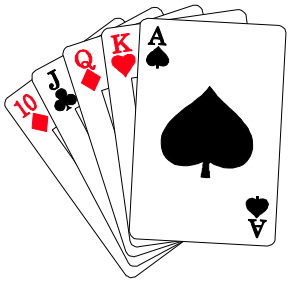
(b) a score greater than 3

(c) an odd number

2. A letter is chosen from the word INTERMEDIATE. Find the probability that it will be

(a) a vowel **(b)** a T **(c)** an E **(d)** an M

3. A card is drawn from a deck of 52 playing cards.



Find the probability that it will be

(a) a club **(b)** a red card

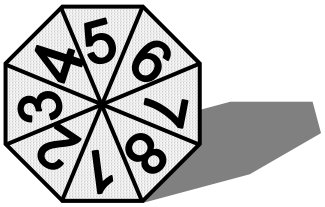
(c) an Ace **(d)** a face card

(e) 3 of spades **(f)** a black king

4. A bag contains 3 red discs, 5 blue discs and 2 green discs. A disc is chosen at random from the bag. Find the probability that it is

(a) blue **(b)** red **(c)** green **(d)** not red

5. This spinner is used in a game.



What is the probability of getting

(a) a 6 **(b)** an even number **(c)** a number greater than 5

(d) a multiple of 3 **(e)** a factor of 8 **(f)** a number less than 3?

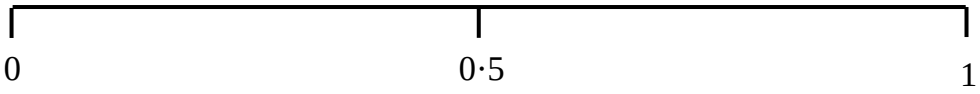
6. 20 tickets numbered 1 to 20 are placed in a bag and one is drawn out at random.

What is the probability that it will be

(a) number 17 **(b)** a multiple of 5 **(c)** an odd number

(d) greater than 12 **(e)** less than 6 **(f)** a factor of 16?

7. **(a)** Copy this probability line



(b) Mark with an arrow where you think the probability is that

(i) you will get a tail when you toss a coin

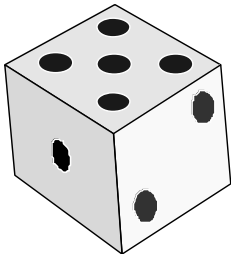
(ii) you will get a six when throwing a dice

(iii) a raw egg will break when you drop it

(iv) you will live forever

(v) you will leave school one day

8. A die is rolled. Find the probability that it lands with



(a) 5

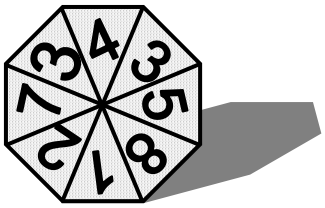
(b) an even number

(c) a prime number

(d) a multiple of 3

(e) a number greater than 4?

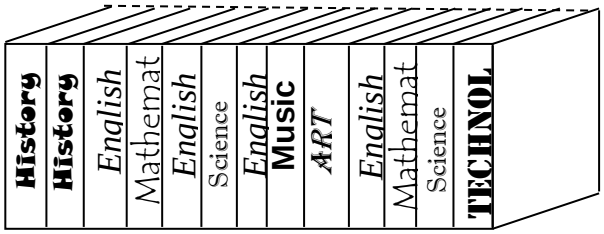
9. This spinner is used in a game.



What is the probability of getting

(a) 1 **(b)** an odd number **(c)** a number greater than 3 ?

10. Mario keeps his schoolbooks on a shelf.



If he closes his eyes and chooses a book ,

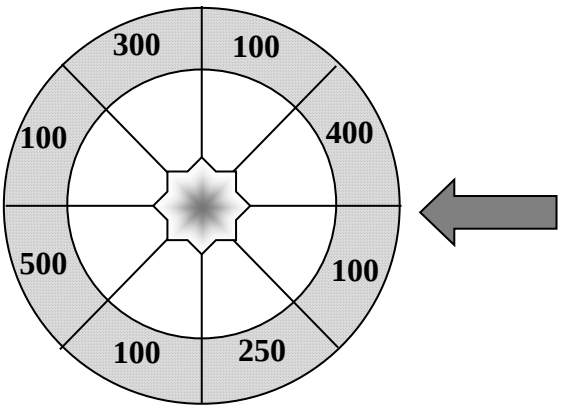
what is the probability that it is

(a) History **(b)** Maths **(c)** French **(d)** English ?

11. If you pick a letter at random from the word **MATHEMATICS**, what is the probability that it will be

(a) a vowel **(b)** a consonant **(c)** M ?

12. This "Wheel of Fortune" is used at a fundraising event.



What is the probability of winning

(a) £100

(b) £400

(c) more than £250