BLACK Worksheet 1

EQUIVALENT FRACTIONS

Find 3 equivalent fractions for each of the following:

1. $\frac{1}{4}$	**6.** $\frac{3}{7}$
2. $\frac{1}{3}$	**7.** $\frac{4}{9}$
3. $\frac{1}{5}$	**8.** $\frac{5}{8}$
4. $\frac{2}{3}$	**9.** $\frac{5}{7}$
5. $\frac{3}{4}$	**10.** $\frac{5}{6}$

SMALLEST TO BIGGEST

Group these numbers from smallest to largest:

1. 1.01, 1.1, 1.101

2. 2.43, 2.34, 2.034

3. 34.16, 34.016, 34.61

4. 21.27, 21.72, 21.072

5. 13.75, 1.375, 137.6

6. 141.2, 14.12, 14.21

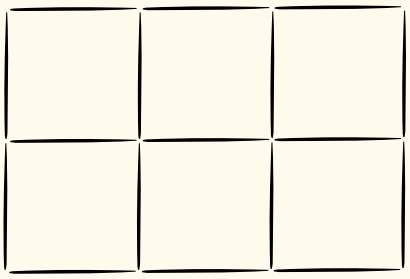
7. 20.71, 207.1, 201.7

8. 0.456, 0.465, 0.645

9. 0.017, 0.0099, 0.071

10. 1.008, 1.010, 1.001

PUZZLE



The arrangement above is made of 17 sticks.

Remove 5 sticks to leave 3 squares the same size as the original.

NUMERACY STRATEGIES (ADDITION)

Add by breaking down into powers of 10.

e.g. 38 + 73 = 30 + 8 + 70 + 3
= 100 + 11
= 111

1. 51 + 19

2. 23 + 85

3. 121 + 73

4. 173 + 24

5. 135 + 48

6. 214 + 135

7. 156 + 281

8. 1321 + 1525

9. 2715 + 1272

10. 1731 + 2256

5 QUICK QUESTIONS

Use any strategy but not a calculator.

1. 143 + 215

2. 67 - 34

3. 31 × 4

4. 48 ÷ 6

5. Round 3.926 to 1 decimal place.

NUMERACY STRATEGIES (MULTIPLICATION)

Multiply by breaking down into easier parts. e.g. 7 × 14 = 7 × (10 + 4)
= 7 × 10 + 7 × 4
= 70 + 28
= 98

1. 8 × 13

2. 5 × 14

3. 7 × 19

4. 6 × 35

5. 7 × 45

6. 7 × 13

7. 3 × 1421

8. 5 × 1213

9. 6 × 1314

10. 9 × 333

5 QUICK QUESTIONS

Use any strategy but not a calculator.

1. -2 + -3

2. -2 × -3

3. $\frac{2}{5} + \frac{1}{5}$

4. $\frac{2}{3} \times \frac{1}{5}$

5. $\frac{2}{3} \div \frac{1}{5}$

REMEMBER LAST YEAR'S WORK

Which is the most sensible statement? Choose from the 4 alternatives.

1. Keith's 20 year old brother is (1.2), (1.8), (2.6) or (6) metres tall.

_____

2. Samantha's baby sister weighs (30 gms), (300 gms), (3 kg) or (30 kg)?
Her older sister weighs (30 gms), (300 gms), (3 kg) or (30 kg)?

_____

3. Wayne's car averages 9.5 litres of fuel for every 100 km travelled. On his holiday he expects to drive 700 km and estimates he will need about ($30), ($60), ($90), ($120) for petrol which costs $1.80 per litre.

_____

Calculate the answers to the following:

4. George sets off on a training ride at 1.50pm and cycles for 4½ hours. What time did he stop?

_____

5. A plane is due to leave Wellington Airport at 20:50 and arrive at its destination at 03:05 the next day. It actually arrives 45 minutes early.
At what time does it arrive?

_____

NUMBER APPLICATIONS

1. A team in the Australian soccer league has 17 points. They have played 15 games. For a win there is 3 points, for a draw there is 1 point.

What are the various combinations (of Win, Draw or Lose) that would have summed to 17?

_____

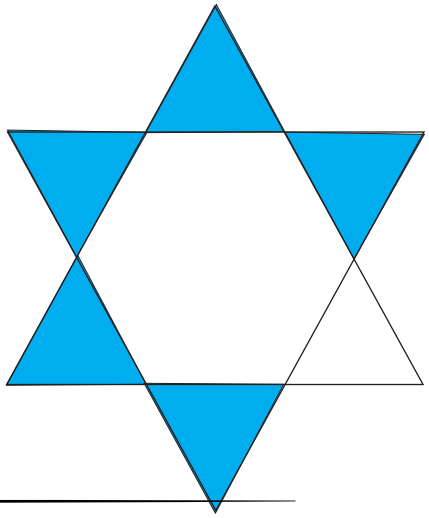
_____

_____

_____

_____

BLACK Worksheet 2



INVESTIGATION
The shape on the right is made from two same sized equilateral triangles. What fraction is shaded?

ESTIMATION
Estimate the answers to the following. No calculators.

1. 2.1 × 7

2. 14.9 × 10

3. 294 × 3

4. 13.9 × 5

5. 1.93 × 1.1

6. 2.73 × 3.9

7. 699 ÷ 6.8

8. 15.31 ÷ 4.9

9. 19973 ÷ 5.3

10. 15.2 ÷ 5.3

FRACTIONS

Add and subtract the following fractions.

1. $\frac{1}{7} + \frac{3}{7}$ _____

2. $\frac{4}{11} - \frac{2}{11}$ _____

3. $\frac{2}{3} + \frac{4}{5}$ _____

4. $\frac{5}{7} - \frac{2}{6}$ _____

5. $\frac{3}{5} - \frac{1}{3}$ _____

6. $\frac{15}{6} - 1$ _____

7. $2\frac{1}{4} + \frac{1}{3}$ _____

8. $1\frac{3}{4} + 1\frac{1}{5}$ _____

9. $\frac{1}{2} - \frac{2}{5}$ _____

10. $\frac{2}{5} + \frac{1}{7}$ _____

NUMERACY STRATEGIES

Division by multiplication. Solve these by rewriting as multiplication.

e.g. $45 \div 9 \longrightarrow 9 \times \boxed{5} = 45$

1. $32 \div 8$ _____

2. $63 \div 7$ _____

3. $120 \div 12$ _____

4. $84 \div 4$ _____

5. $96 \div 8$ _____

6. $112 \div 4$ _____

7. $144 \div 4$ _____

8. $92 \div 4$ _____

9. $315 \div 5$ _____

10. $159 \div 3$ _____

2.00	0.25	1.50
	2.25	

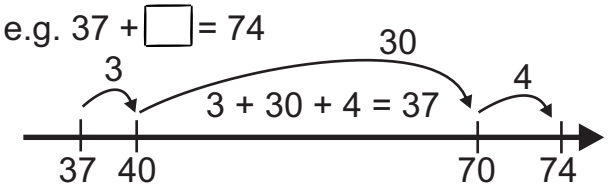
PUZZLE - MAGIC SQUARE

A magic square has all columns, rows and diagonals that sum to the same number.

Find the missing numbers to make a magic square.

NUMERACY STRATEGIES

Addition by use of a number line.



1. 17 + ☐ = 52

2. 25 + ☐ = 81

3. 37 + ☐ = 93

4. 42 + ☐ = 111

5. 53 + ☐ = 131

6. 42 + ☐ = 181

7. 121 + ☐ = 163

8. 117 + ☐ = 141

9. 121 + ☐ = 176

10. 119 + ☐ = 157

QUICK QUESTIONS

Use any strategy but do not use a calculator.

1. 179 + 93 = _____

2. 179 - 93 = _____

3. 312 × 7 = _____

4. Convert 0.17 to a percentage.

_____

5. What is 10% of 80?

_____

6. -2 + 5 = _____

7. -2 × 5 = _____

8. $1\frac{1}{4} + 2\frac{1}{2}$ = _____

9. $\frac{3}{7} + \frac{4}{10}$ = _____

10. 31.5 × 10 = _____

TESTING TIMES

Two companies offer Brad a job. Both offer $40,000 starting salary. For the first two years, Company 1 will give him a pay rise of $6000 at the end of each year. For the first two years, Company 2 will give him a rise of $1500 every six months. Which deal is the best?

NUMBER SKILLS

Work out the answers.

1. 40 × 50 = _____

2. 0.8 × 0.9 = _____

3. 30 × 0.7 = _____

4. 0.6 × 4 = _____

5. 4.2 ÷ 0.7 = _____

6. Divide 1720 by 8 _____

7. Divide 1720 by 0.8 _____

8. What is the square root of 0.25? _____

9. Simplify 0.1 × 0.2 × 0.2 _____

10. Write $\frac{5}{8}$ as a decimal. _____

11. 123 + ☐ = 978

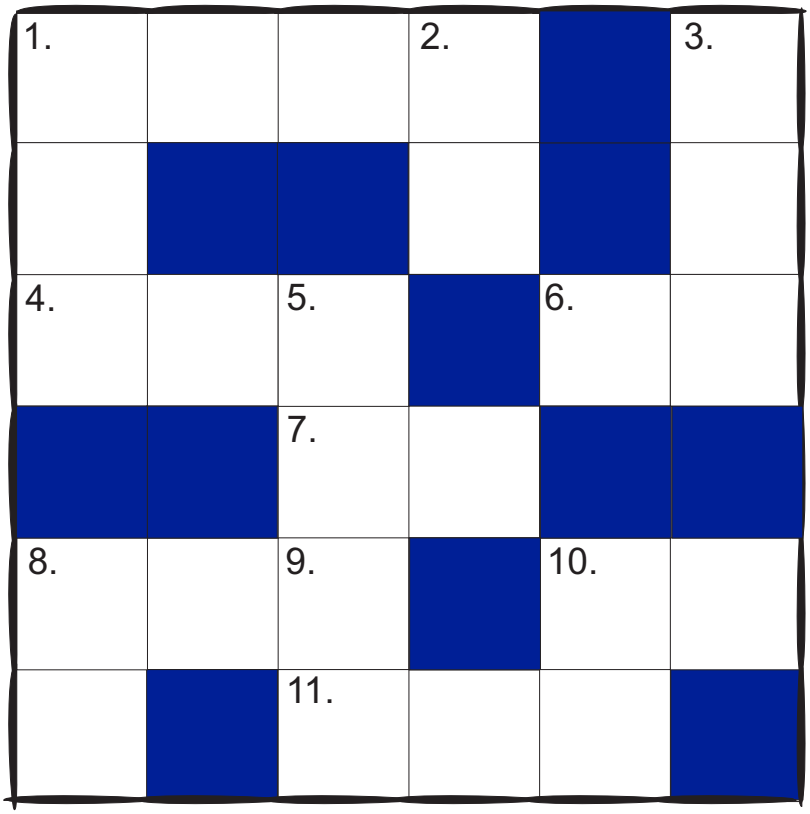
12. ☐ × 26 = 442

13. ☐ - 184 = 2965

14. ☐ ÷ 35 = 1999

15. 50 × 50 + ☐ = 2550

CROSS NUMBER



Across

1. $\frac{2}{5}$ of 3845

4. 118 × 2.5

6. $\frac{3}{7}$ of 210

7. $4\frac{1}{2} \times 3\frac{1}{3}$

8. $\frac{3}{4}$ of 284

10. Write $\frac{21}{30}$ as a %

11. $\frac{4}{7}$ of 301

Down

1. 80% of 240

2. Convert $\frac{4}{5}$ to a percent

3. 2310 ÷ 3

5. Convert 5.131×10^3 to ordinary form

8. Increase 15 by 40%

9. $\frac{1}{3}$ of 93

10. Reduce 80 by 10%

BLACK Worksheet 3

APPLICATION

John pays one third of his salary to his parents for board. Mary gives three eighths of her salary for board. Who pays the most board if John earns $1230 a week and Mary earns $1120 a week?

FRACTION PROBLEMS

1. $\frac{1}{2} \times 5 =$ _____

2. $\frac{2}{3} \times 6 =$ _____

3. $\frac{1}{3} \times \frac{1}{4} =$ _____

4. $\frac{2}{3} \times \frac{2}{5} =$ _____

5. $21 \times \frac{1}{3} =$ _____

6. $\frac{2}{3} \times \frac{4}{5} =$ _____

7. $\frac{1}{5} \times \frac{2}{7} =$ _____

8. $1\frac{1}{2} \times 3\frac{1}{4} =$ _____

9. $1\frac{1}{5} \times 1\frac{1}{5} =$ _____

10. $\frac{3}{7} \times \frac{7}{3} =$ _____

11. $8 \div \frac{1}{2} =$ _____

12. $8 \div \frac{1}{4} =$ _____

13. $8 \div \frac{1}{1000} =$ _____

14. $8 \div 0 =$ _____

15. $\frac{1}{2} \div \frac{1}{4} =$ _____

16. $\frac{2}{3} \div \frac{4}{5} =$ _____

17. $\frac{7}{11} \div 2 =$ _____

18. $1\frac{1}{4} \div 2\frac{1}{2} =$ _____

19. $2\frac{3}{5} \div 1\frac{1}{4} =$ _____

20. $6\frac{1}{3} \div 3\frac{1}{6} =$ _____

PUZZLE

Chloe left a large sum of money in her will to her family. Jim received one half of the total sum, Joan received one third of what was left and Mary received one quarter of what was left after that. There was then $5 000 left over which was split amongst the remaining family members. What was the original sum of money left in Chloe's will?

NUMERACY STRATEGIES (SUBTRACTION)

Subtraction sums can be rewritten as addition: e.g. 73 - 29

This can be rewritten to: 29 + $\boxed{44}$ = 73

Rewrite these as addition sums.

1. 47 - 9

2. 38 - 15

3. 73 - 25

4. 93 - 47

5. 88 - 59

6. 111 - 93

7. 125 - 89

8. 136 - 73

9. 152 - 118

10. 167 - 139

NUMERACY STRATEGIES (MULTIPLICATION)

To make it easier multiplying you can halve one number and double the other.

e.g. 6×22 —› $3 \times 44 = 132$

or $12 \times 11 = 132$

You could also treble one number and find one third of the other

e.g. 1.5×6 —› $4.5 \times 2 = 9$

or $0.5 \times 18 = 9$

Use a strategy to calculate these products. Show your working

1. 3×16

2. 28×2

3. 4.6×4

4. 1.6×4

5. 1.3×4

6. 2.7×2

7. 1.2×3

8. 2.4×3

9. 0.9×2

10. 1.5×4

TEN QUICK QUESTIONS

Use any strategy but not a calculator.

1. 223 + 89 = _____

2. 221 - 195 = _____

3. List the first 6 multiples of 3.

_____

4. What are the factors of 32?

_____

5. -2 - (-3) = _____

6. -312 + (-123) = _____

7. -3 + -2 × -4 = _____

8. $(-3)^2$ = _____

9. 2.31 × 100 = _____

10. 7.2 × 0.7 = _____

NUMBER SKILLS

Find the values of:

1. 2^4 = _____

2. 8^3 = _____

3. 10^5 = _____

4. $2^3 \times 3^2$ = _____

5. $2^2 \times 5$ = _____

6. $\sqrt{121}$ = _____

7. $\sqrt{64}$ = _____

Write in index form:

8. $3^2 \times 3$ = _____

9. $2^{10} \div 2^5$ = _____

10. $(2^2)^2$ = _____

PERCENTAGES

1. Express 36% as a fraction.	**6.** Express $5\frac{1}{2}$ % as a fraction.
2. Express 22.5% as a decimal.	**7.** Express $12\frac{1}{4}$ % as a decimal.
3. Find 48% of 3 metres	**8.** Write $\frac{5}{8}$ as a percentage.
4. Increase $20 by 15%	**9.** Increase 300 by 5%
5. Decrease $80 by 45%	**10.** Decrease $120 by 12.5%

BLACK Worksheet 4

APPLICATION
A block of gold that weighs 45 kg is cut into 4 pieces. Each piece is twice as heavy as the preceding one. How much does each of the four pieces weigh?

_____

_____

FRACTIONS AND DECIMALS
Convert these fractions to their simplest form.

1. 0.2 = _____

2. 0.5 = _____

3. 0.05 = _____

4. 0.005 = _____

5. 0.15 = _____

6. 0.35 = _____

7. 0.176 = _____

8. 0.319 = _____

9. 0.42 = _____

10. 0.120 = _____

DECIMALS
Add and subtract the following:

1. 4.25 + 1.11 = _____

2. 3.72 + 2.61 = _____

3. 4.18 + 2.97 = _____

4. 1.43 + 1.39 = _____

5. 0.176 + 0.188 = _____

6. 4.25 - 1.11 = _____

7. 3.72 - 2.16 = _____

8. 4.18 - 2.97 = _____

9. 0.188 - 0.176 = _____

10. 1.43 - 1.39 = _____

APPLICATION

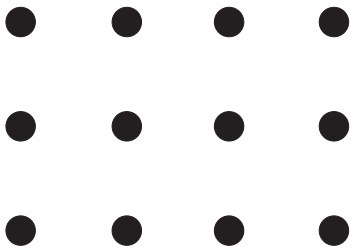
If John takes one third of a cake and Mary takes two fifths of what is left, how much is left for Michael?

_____

_____

PUZZLES

How many rectangles can be formed within these dots so that the vertices of each rectangle are 4 of the dots?



_____

_____

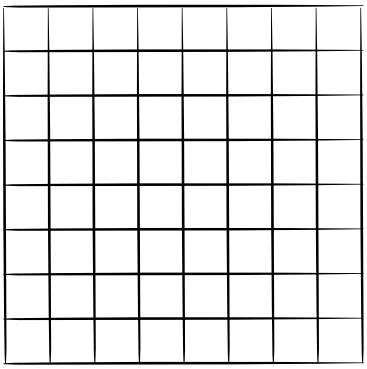
_____

The diagram below shows an 8 × 8 square grid
How many squares of any size are there?

_____

_____

_____



QUICK QUESTIONS

Use any strategy but not a calculator.

1. 149 + 53 = _____

2. 173 - 89 = _____

3. Simplify $\frac{8}{12}$ _____

4. $\frac{2}{3} \times \frac{4}{7}$ = _____

5. $\frac{2}{3} \div 4$ = _____

6. $\frac{11}{17} - \frac{3}{17}$ = _____

7. $\frac{3}{5} - \frac{1}{4}$ = _____

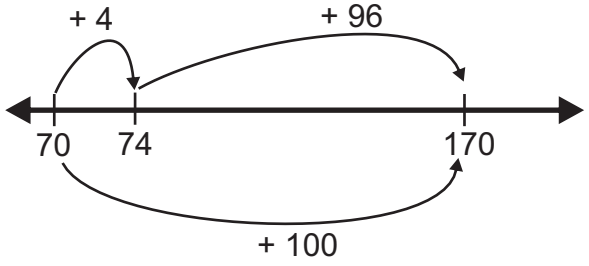
8. -2^2 = _____

9. 1.69 × 10 = _____

10. 3.6 × 0.4 = _____

NUMERACY STRATEGIES
Additions to a power of 10.

e.g. 74 + 96
- 4 + 4
70 + 100 = 170



1. 73 + 94 = _____

2. 15 + 89 = _____

3. 131 + 93 = _____

4. 155 + 49 = _____

5. 169 + 87 = _____

6. 63 + 97 = _____

7. 77 + 98 = _____

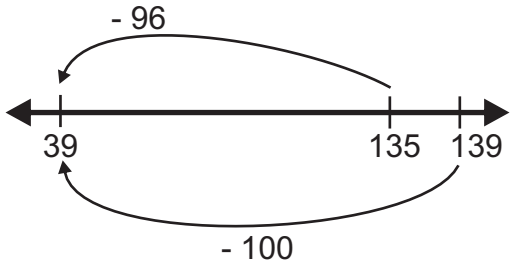
8. 123 + 97 = _____

9. 243 + 197 = _____

10. 345 + 293 = _____

NUMERACY STRATEGIES
Subtracting to a power of 10.

e.g. 135 - 96
+ 4 + 4
139 - 100 = 39



1. 127 - 97 = _____

2. 235 - 193 = _____

3. 175 - 89 = _____

4. 253 - 96 = _____

5. 262 - 49 = _____

6. 111 - 96 = _____

7. 176 - 88 = _____

8. 183 - 89 = _____

9. 539 - 97 = _____

10. 1126 - 997 = _____

WHAT IS FAT?

a. Calculate the answer and find it below.

b. When completed, cross out all those fractions that were not used.

c. Starting from the top line, write all the letters that remain to answer the question.

1. $\frac{5}{8} - \frac{1}{4}$ _____

2. $\frac{5}{6} + \frac{1}{3}$ _____

3. $\frac{3}{4} - \frac{1}{3}$ _____

4. $\frac{2}{3} + \frac{3}{5}$ _____

5. $\frac{4}{5} - \frac{1}{4}$ _____

6. $\frac{1}{3} + \frac{3}{8}$ _____

7. $\frac{5}{6} - \frac{1}{4}$ _____

8. $\frac{3}{10} + \frac{3}{4}$ _____

9. $\frac{1}{5} + \frac{5}{6}$ _____

10. $\frac{7}{9} - \frac{1}{6}$ _____

$\frac{3}{7}$	$\frac{3}{4}$	$1\frac{1}{30}$	$\frac{5}{6}$	$1\frac{2}{40}$	$1\frac{1}{6}$	$\frac{3}{8}$	$\frac{13}{16}$	$\frac{7}{10}$	$\frac{3}{7}$
F	C	S	H	I	T	O	P	J	F
$\frac{6}{13}$	$\frac{17}{24}$	$\frac{7}{10}$	$1\frac{1}{20}$	$\frac{5}{6}$	$1\frac{4}{15}$	$\frac{35}{54}$	$1\frac{1}{20}$	$1\frac{1}{5}$	$\frac{15}{24}$
W	R	J	E	H	D	U	E	Q	X
$\frac{7}{12}$	$\frac{7}{9}$	$\frac{7}{13}$	$1\frac{1}{20}$	$\frac{1}{8}$	$\frac{35}{54}$	$\frac{33}{54}$	$\frac{5}{12}$	$\frac{5}{6}$	$\frac{11}{20}$
N	V	K	E	B	U	R	G	H	Y

SEQUENCES

Look at the sequence on the right: **2 5 10 17 26**

Find the difference between consecutive terms: 3 5 7 9

Find the difference between these numbers. 2 2 2

Assume that the 3rd row continues as a row of 2s. You can then calculate write the 2nd and top rows. Use this method to continue the sequences below:

1. 1, 3, 7, 13, 21, ... , ... , ...

2. 2, 7, 13, 20, 28, ... , ... , ...

3. 5, 10, 20, 35, 55, ... , ... , ...

BLACK Worksheet 5

APPLICATION

Mary receives a rise and her salary increases from $35,000 to $37,500.
John receives a rise and her salary increases from $34,000 to $36,500.
Who has received the biggest percentage increase?

NUMERACY STRATEGIES

Multiplication and division by using knowledge of place value.

e.g. 2.4×6 $= 2 \times 6 + 0.4 \times 6$
$= 12 + 2.4$
$= 14.4$

$3.6 \div 2$ $= 3 \div 2 + 0.6 \div 2$
$= 1.5 + 0.3$
$= 1.8$

1. $2.2 \times 2 =$

2. $3.5 \times 4 =$

3. $5 \times 3.4 =$

4. $23 \times 0.4 =$

5. $2.16 \times 3 =$

6. $7.5 \div 3 =$

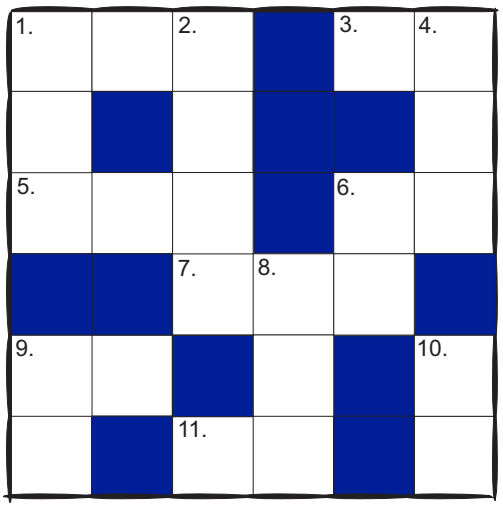
7. $12.6 \div 7 =$

8. $10.2 \div 2 =$

9. $2.68 \div 2 =$

10. $3.04 \div 0.04 =$

CROSS NUMBER



Across

1. Increase 320 by 20%

3. Convert $\frac{7}{20}$ to a percentage.

5. Find 60% of 420

6. Increase 50 by 12%

7. Find 75% of 580

9. Find 65% of 80

11. Find 60% of 40

Down

1. Find 40% of 955

2. Increase 3840 by 10%

4. Increase 440 by 15%

6. Find 250% of 22

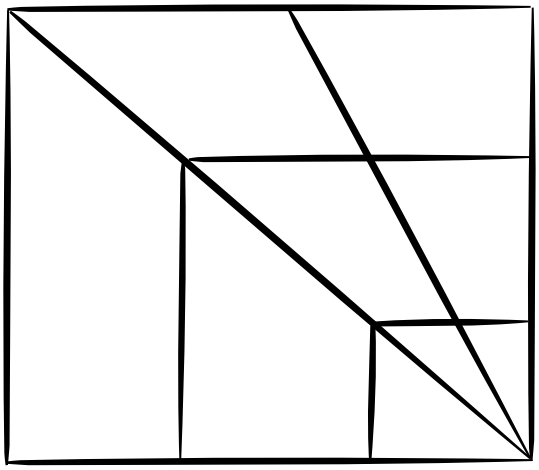
8. Reduce 380 by 20%

9. Reduce 70 by 20%

10. Find 60% of 75

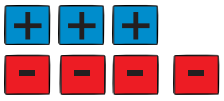
PUZZLE

How many triangles can you see in the large square?



NUMERACY STRATEGIES

Integer addition: $3 + {}^{-}4$ =



= -1

$^{-}2 + {}^{-}3$ =

= -5

1. 2 + -3 = _____

2. 5 + -2 = _____

3. 9 + -3 = _____

4. 21 + -8 = _____

5. 48 + -21 = _____

6. -3 + -2 = _____

7. -5 + -3 = _____

8. -11 + -3 = _____

9. -21 + -7 = _____

10. -31 + -22 = _____

DECIMALS

Multiply and divide the following decimals:

1. $2.1 \times 3 =$ _____

2. $1.4 \div 7 =$ _____

3. $1.5 \times 12 =$ _____

4. $1.52 \times 0.4 =$ _____

5. $1.52 \div 0.04 =$ _____

6. $1.52 \times 0.14 =$ _____

7. $6.42 \times 0.01 =$ _____

8. $6.42 \div 0.0001 =$ _____

9. $84.35 \times 0.01 =$ _____

10. $84.35 \div 0.0001 =$ _____

INDICES

Simplify the following and leave in index form:

1. $2^3 \times 2^5 =$ _____

2. $5^4 \times 5^3 =$ _____

3. $13^1 \times 13^2 =$ _____

4. $14^3 \times 14^2 =$ _____

5. $2^3 \times 2^4 \times 2^7 =$ _____

6. $2^6 \times 2^7 =$ _____

7. $8^7 \div 8^3 =$ _____

8. $2^7 \div 2^3 =$ _____

9. $2^{13} \div (2^8 \times 2^2) =$ _____

10. $2^6 \times 2^4 \div 2^3 =$ _____

NUMERACY STRATEGIES - STANDARD FORM

Write these numbers in scientific form:

1. 300 = _____

2. 215 = _____

3. 0.05 = _____

4. 0.0013 = _____

5. 0.0000715 = _____

Write these numbers in ordinary form:

1. $3.1 \times 10^2 =$ _____

2. $1.65 \times 10^3 =$ _____

3. $5 \times 10^6 =$ _____

4. $2.3 \times 10^{-3} =$ _____

5. $2.0 \times 10^{-4} =$ _____

27	17	21	30
28	18	22	31
15	5	9	18
16	6	10	19

MAGIC MATRIX

Choose any 4 numbers such that exactly one number is selected from each row and exactly one number is selected from each column. Sum together your chosen numbers and check the result.

_____ + _____ + _____ + _____ = 73

TWENTY QUICK QUESTIONS

Use any strategy but not a calculator.

1. $24 \times 3 =$ _____

2. $128 \div 4 =$ _____

3. $-4 \times -3 =$ _____

4. $-18 - 22 =$ _____

5. $\frac{3}{4} \times \frac{4}{5} =$ _____

6. $\frac{3}{4} \div \frac{4}{5} =$ _____

7. $\frac{3}{4} + \frac{4}{5} =$ _____

8. $1.93 \times 100 =$ _____

9. Convert $\frac{3}{8}$ to a percentage _____

10. Calculate 75% of $530 _____

11. $82 \times 5 =$ _____

12. $4321 \times 3 =$ _____

13. $-5 \times 6 =$ _____

14. $-2 + -3 + -4 =$ _____

15. $29.17 \div 10 =$ _____

16. $\frac{2}{3} \times \frac{7}{8} =$ _____

17. Convert 0.03 to a percentage _____

18. Calculate 20% of $170 _____

19. Increase 350 by 15% _____

20. Reduce $120 by 15% _____

Two MAGIC MATRIX

Choose any 4 numbers such that exactly one number is selected from each row and exactly one number is selected from each column. Sum together your chosen numbers and check the result.

17	13	25	20
8	4	16	11
27	23	35	30
12	8	20	15

\+ ☐ ☐ ☐ ☐

71

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

\+ ☐ ☐ ☐ ☐

34

BLACK Worksheet 6

APPLICATION
Brad scored 63 out of 90 in Test 1
He then scored 57 out of 80 in Test 2.
Did he improve? Calculate the percentage result in both.

_____

_____

STANDARD FORM (1)
Convert the following into standard form.

1. 21.3 _____
2. 0.214 _____
3. 0.0056 _____
4. 234.1 _____
5. 0.00073 _____

STANDARD FORM (2)
Convert the following from standard form to ordinary numbers:

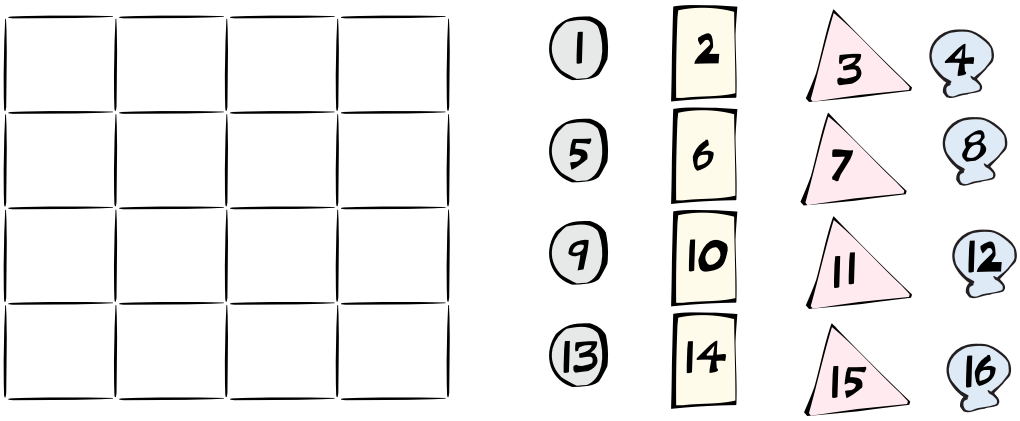
1. 1.73×10^{1} _____
2. 2.03×10^{-3} _____
3. 1.75×10^{2} _____
4. 2.829×10^{-3} _____
5. 1.83×10^{3} _____

INTEGERS
Evaluate the following integer problems.

1. $(+2) + (+3) =$ _____
2. $(+2) - (-3) =$ _____
3. $(-2) - (-3) =$ _____
4. $(-2) \times (-3) =$ _____
5. $(-2) \times (+3) =$ _____
6. $(-20) \div 5 =$ _____
7. $(-24) \div (-4) =$ _____
8. $(-2) + 6 \div (-2) + 3 =$ _____
9. $5 - (-3) \times (-2) - (-5) =$ _____
10. $5 \times [2 \times (-3) + (-1)] =$ _____

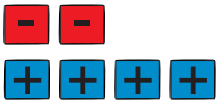
PUZZLE

There are 16 numbers each within a certain shape. Place them in the grid so that each line of 4 has 4 different numbers and shapes.



NUMERACY STRATEGIES - INTEGERS

Subtraction -3 - -2 = -1 

-2 + +4 = 2 

-2 - +4 = -6 

1. -2 - -1 = _____

2. -2 - -3 = _____

3. -7 - -3 = _____

4. -2 - +3 = _____

5. -5 - +7 = _____

6. -3 - -5 = _____

7. -11 - +3 = _____

8. -17 - -6 = _____

9. -17 - +8 = _____

10. -21 - +25 = _____

NUMERACY PRACTICE

Put a +, -, × or ÷ sign into each box to make the equations correct.

1. 5 ☐ (3 + 5) = 13

2. 9^2 - 9^2 = 8 ☐ 8

3. $\sqrt{100}$ ☐ (2 × 5) = 1

4. 2^4 + 2^3 = 8 ☐ 3

5. 36 ☐ (16 × 3) = 84

NUMERACY STRATEGIES - HIGHEST COMMON FACTORS

The largest common factor of two or more numbers is called the highest common factor. e.g Find the highest common factor of 24 and 30.

24 = 6 × 4
= 3 × 2 × 2 × 2
= 3 × 4 × 2
= 3 × 2 × 2 × 2

30 = 3 × 10
= 3 × 2 × 5
= 6 × 5

Factors of 24 are 2, 3, 4, 6, 8
Factors of 30 are: 2, 3, 5, 6, 10

Common factors are: 2, 3, 6

Highest Common Factor = 6

Find the highest common factors of the following pairs of numbers:

1. 30, 40

2. 56, 64

3. 72, 40

4. 84, 46

5. 112, 140

6. 325, 245

7. 300, 280

8. 110, 160

9. 320, 180

10. 64, 84

QUICK QUESTIONS

Use any strategy but not a calculator

1. 179
+ 81
_____

_____

2. 312
× 7
_____

_____

3. -3 × -4 = _____

4. -2 - (-3) - (-4) = _____

5. Convert $\frac{5}{8}$ to a percentage _____

FIFTEEN QUICK QUESTIONS

Use any strategy but not a calculator.

1. $3 \times 4 - (-2) \times 3 =$ _____

2. $1\frac{1}{4} + 2\frac{3}{8} =$ _____

3. $29.15 \times 10 =$ _____

4. Round 31.65 to 1 decimal place _____

5. Convert 36% to a decimal _____

6. Find 22% of $620 _____

7. Find 30% of $315 _____

8. Decrease $400 by 12.5% _____

9. Decrease $410 by 70% _____

10. Simplify the ratio 30:45 _____

11. Simplify 3km : 2500m _____

12. Split 350 into a ratio of 2:3 _____

13. Bill earns $67.50 in 3 hours.
How much does he earn in 40 hours?

_____

14. $\sqrt{400}$ _____

15. Simplify $\frac{140}{180}$ _____

Two MAGIC MATRIX

Choose any 4 numbers such that exactly one number is selected from each row and exactly one number is selected from each column. Sum together your chosen numbers and check the result.

27	17	21	30
28	18	22	31
15	5	9	18
16	6	10	19

\+ _____

73

4	5	6	7
8	9	10	11
12	13	14	15
16	17	18	19

ESTIMATING AND ROUNDING OFF

Round the numbers on the number line below to the nearest 100.

1. 120 is approximately _____

2. 260 is approximately _____

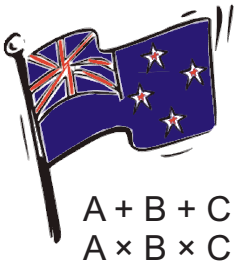
3. 350 is approximately _____

\+ _____

46

BLACK Worksheet 7

PUZZLE



$A + B + C = 15$
$A \times B \times C = 120$

Find the value of A, B, C.

SUBSTITUTION (1)

Evaluate the following expressions by substituting the following values:
$a = 6, b = 3, c = -2$

1. $3a$ _____

2. $5b$ _____

3. $2a - 2b$ _____

4. $3c - b$ _____

5. $2(a + b)$ _____

6. $\frac{a + b}{c}$ _____

7. $-3(a - b)$ _____

8. $\frac{3ab}{c}$ _____

9. $2(a + b) - c$ _____

10. $\frac{c}{a + b}$ _____

SUBSTITUTION (2)

Evaluate the following expressions by substituting the following values:
$x = 3, y = -5$

1. $x + y$ _____

2. $3x - 2y$ _____

3. $4(x - y)$ _____

4. $\frac{5x}{y}$ _____

5. $2xy - x^2$ _____

6. $9x + y$ _____

7. $x(x + y)$ _____

8. $y^2 - x^2$ _____

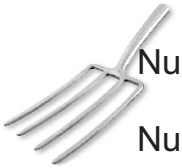
9. $7xy$ _____

10. y^2 _____

SEQUENCES AND PATTERNS

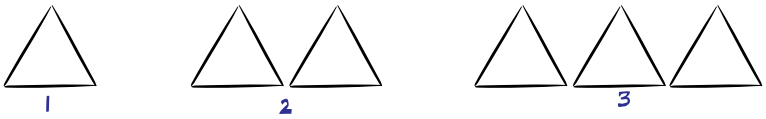
Complete the tables for each pattern and try and establish the rule.

1.



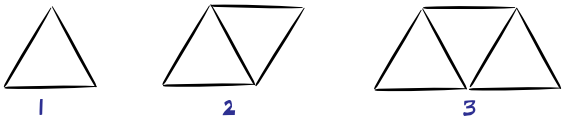
	1	2	3	4			n
Number of forks							
Number of prongs					32	40	4n

2.



	1	2	3	4			n
Number of triangles							
Perimeter					39	87	3n

3.

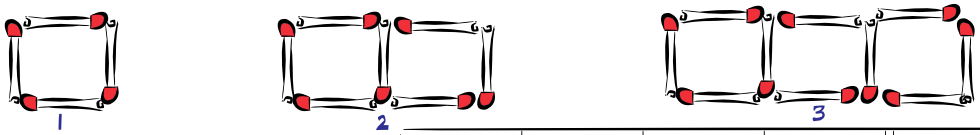


	1	2	3	4			n
Pattern number							
Perimeter					22	57	n + 2

4.

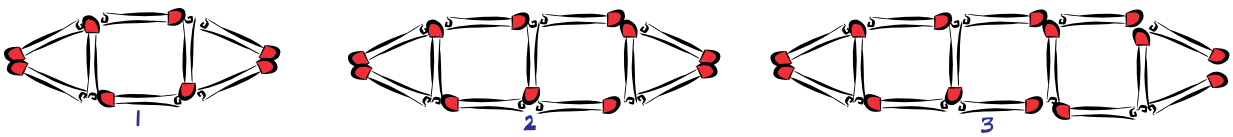
	1	2	3	4			n
Pattern number							
Perimeter					18	62	2n + 2

5.



	1	2	3	4			n
Pattern number							
Number of matchsticks					25	31	3n + 1

6.



	1	2	3	4			n
Pattern number							
Number of matchsticks					26	50	3n + 5

TEN QUICK QUESTIONS

1. Simplify $2a + 3a + 4a$ _____

2. Simplify $4a + 5b + 2a - 3b$ _____

3. Simplify $x^7 \times x^4 \times x^2$ _____

4. Simplify $\frac{x^9}{x^7}$ _____

5. Work $3a^2$ when $a = 3$

_____

6. Expand $2(x + 3)$

_____

7. Expand and simplify

$3(x + 2) + 2(x - 4)$

_____

8. What is the value of $2a + 3b$ when $a = 2$ and $b = 4$

_____

9. What is the value of x^2 when $x = -2$

_____

10. Find 3 consecutive numbers that sum to 45

_____

INVESTIGATION

Complete the next 3 numbers in each. sequence.

1. 4, 7, 10 ____ , ____ , ____

2. 1, 4, 9 ____ , ____ , ____

3. $\frac{7}{8}$ $\frac{11}{8}$ $\frac{15}{8}$ ____ , ____ , ____

4. 16, 8, 4 ____ , ____ , ____

5. 5, 10, 20 ____ , ____ , ____

Write down the first 5 terms of these sequences. In each one, the first term is 1.

6. Add 5 each time.

____ , ____ , ____ , ____ , ____ , ____

7. Subtract 3 each time.

____ , ____ , ____ , ____ , ____ , ____

8. Multiply by 2 each time.

____ , ____ , ____ , ____ , ____ , ____

9. Divide by 2 each time.

____ , ____ , ____ , ____ , ____ , ____

10. Add 1 then 2, 3, 4, ...

____ , ____ , ____ , ____ , ____ , ____

MISCELLANEOUS PRACTICE

1. What is the smallest number that 5, 6 and 10 all divide exactly? _____

2. If 5 similar books weigh 4.5 kg, what will 3 books weigh? _____

3. The area of a triangle is 36 cm^2. If the base is 9 cm what is the height? _____

4. If a car costing $5000 is sold for $4000 what was the percentage loss? _____

5. What is the approximate value of the square root of $(7^2 + 7^2)$ _____

WHAT'S THE DIFFERENCE BETWEEN PLANTS AND ANIMALS?

a. Factorise the following expressions.
b. Find the correct letter in the table.
c. Put the letter in the table above the question number for that letter.

1. $2x + 2$

2. $2x^2 - 6x$

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

4. $x^2 - x - 12$

5. $2x^2 - 18$

6. $8x - 10$

7. $10x^2 + 4x$

8. $x^2 - 16$

9. $x^2 + 3x - 10$

10. $2x^2 + 10x + 12$

11. $x^2 - 2x$

12. $x^2 + 5x + 6$

13. $x^2 - 16x$

14. $x^2 - 6x + 5$

$2(x + 2)(x + 3)$	C	$(x - 2)(x - 3)$	R
$4(2x - 5)$	N	$x(x - 16)$	F
$(x - 5)(x + 1)$	Y	$2x(x - 3)$	M
$(x - 4)(x + 4)$	E	$(x + 5)(x - 2)$	T
$2(x + 1)$	A	$(x - 4)(x + 3)$	O
$x(x - 2)$	I	$(x + 2)(x + 3)$	S
$2(x - 3)(x + 3)$	D	$2x(5x + 2)$	L

1	6	11	2	1	7	12	1	3	8	
13	4	4	9	7	4	4	12	8		
1	6	5	13	1	6	10	14	13	3	8	8

BLACK Worksheet 8

EQUATION SOLVING (1)

1. $2x + 3 = 7$

2. $2x - 3 = 11$

3. $5x - 2 = -12$

4. $-3x - 2 = 7$

5. $5 - 2x = 9$

6. $\frac{x}{3} - 1 = 2$

7. $\frac{x}{2} + 3 = 9$

8. $\frac{x}{5} - 1 = -3$

9. $4 - \frac{x}{3} = 2$

10. $3 - \frac{x}{5} = -4$

EQUATION SOLVING (2)

1. $2(x + 1) = 12$

2. $3(x - 2) = 9$

3. $4(x - 3) = -12$

4. $2(3 - x) = 6$

5. $2(x - 1) - x = 5$

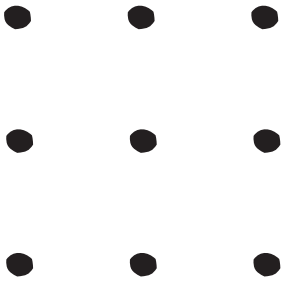
6. $(x + 2) + (x + 3) = 15$

7. $(x - 1) + (x - 5) = 18$

8. $2(x - 2) + 3(x - 1) = 3$

9. $5(x - 1) + 2(x + 1) = 18$

10. $3(x - 1) = x + 17$



PUZZLE
Draw four straight lines without taking your pen off the paper. Your finished shape should go through all 9 dots.

FIVE QUICK QUESTIONS

1. Find the value of A when $A = \frac{1}{2}bh$ and b = 4, h = 8

2. Simplify 3a - 2b - a - 5b

3. Simplify 2a × 3b × -4c

4. Simplify $3x^2 - 2x + 4x^2$

5. Write a rule for the following pattern 2, 4, 6, 8 . . . .

MAGIC SQUARE
The magic square below uses the numbers 1 to 16.

All the rows, columns and main diagonals add up to 34.

Complete the missing numbers.

16		3	13
	7		12
	14	15	1

INVESTIGATION
A man has a bundle of $10 notes in his pocket.

The notes are numbered consecutively from 442426 to 442450.

What is the total value?

SEQUENCES AND PATTERNS

Establish a rule for the following patterns.

e.g. 4, 7, 10 If n is the number of the term then n = 1 is the first term.
The rule is: nth term = 3n + 1.

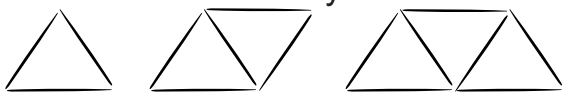
1. 2, 4, 6, 8 _____

2. 3, 5, 7, 9 _____

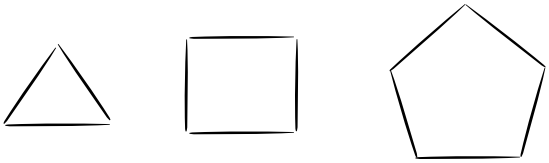
3. 1, 4, 16, 25 _____

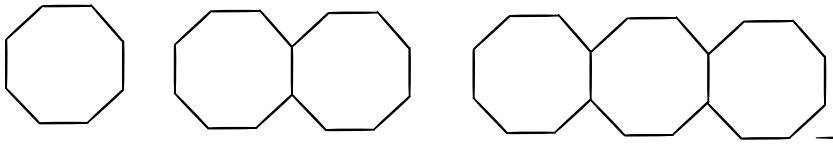
4. 2, 5, 17, 26 _____

Each of the following shapes can be made from sticks. Give the rule for the pattern number and the number of sticks needed to form that shape.
The first one is done for you.

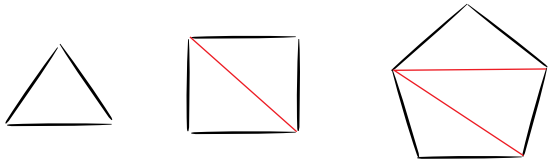
5.  *number of sticks for the nth pattern = 2n + 1*

6.  _____

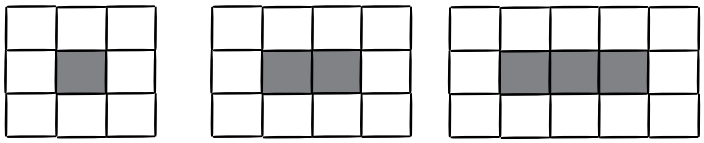
7.  _____

8.  _____

9. For the sequence below, give the rule for the number of diagonals.

 _____

10. For the sequence below, give the rule for the number of white squares across the length.

 _____

ALGEBRA SKILLS

Simplify the following algebraic expressions.

1. $3c \times 5f$

2. $3x \times -2f =$

3. $-2x \times 3y \times 4r$

4. $y + 7y \times -4y$

5. $5x - 4y + 2x - 6y$

6. $4x \times 2x$

7. $(5x)^2$

8. $(3x^2y^3)^2$

9. $\frac{16x^2y^4}{10xy^2}$

10. $\sqrt{64y^{10}}$

FIVE QUICK QUESTIONS

1. Write a rule for the following pattern: 3, 5, 7, 9 . . . .

2. Simplify $x^4 \times x^2 \times x^3$

3. Simplify $6x^4 \times 3x^2$

4. Simplify $\frac{x^8}{x^4}$

5. Simplify $\frac{8x^{11}}{x^4}$

PUZZLE

If 1 m^3 of earth weighs 1600 kg, then how much earth would there be in a hole 50 cm × 50 cm × 50 cm?

BLACK Worksheet 9

ALGEBRA SKILLS
Expand and simplify:

1. 5(x + y)

2. x(x + 5)

3. x(5 - y)

4. 8 + 2(3 - 2x)

5. 6 - 4(3x - 2)

6. 5(x - 2) + 3(x - 5)

7. 4(x + 1) + 2(x + 3)

8. 3(x - 1) - 2(x + 1)

9. 5(x + 3) - 3(x - 1)

10. 4x + 3(2 - x)

ALGEBRA SKILLS (2)
Factorise the following:

1. 3x + 3y

2. 8x + 20y

3. 4x + 10y - 6r

4. ax + ay

5. 10xyz + 22xyr

6. 2x - 2y

7. 5x - 15y

8. 2x + 6y + 8z

9. bx - by

10. 17xy - 14xyz

EQUATION SOLVING
Write an equation for each problem then solve it.

1. A number is doubled, then 3 is subtracted from it to give an answer of 7. What was the original number?

2. A number is divided by 3 then has 4 subtracted from it to give an answer of 8. What was the original number?

3. 4 less than 5 times a number is 11. What is the number?

4. 5 is added to a number then multiplied by 7 to give an answer of 56. What was the original number?

5. Four consecutive numbers add up to 74. What are the numbers?

6. The length of a rectangle is 3 metres more than the width. If the perimeter is 22 metres, find the length and the width.

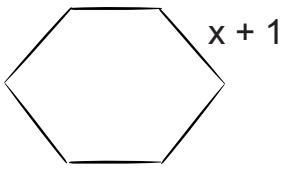
EQUATION SOLVING (continued)
Write an equation for each problem then solve it.

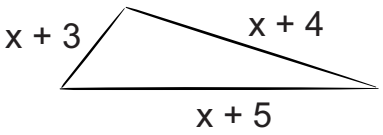
7. A laptop computer costing $1430 is paid by providing a deposit of $470 and the rest is paid over 12 equal monthly installments.

8. In a fundraising event participants are given money for each kilometre walked. Jane, Peter and Fred all walk in the event and their total distance walked is 48km. Jane walks 5km more than Peter and Fred walks 5km more than Jane. How much does each person walk?

9. Peter is three times as old as Michael and the difference of their ages is 48. What are their ages?

10. Pictured below are two shapes. One is a regular hexagon of side length x + 1 metres and the other a triangle of irregular lengths. Find the value of x if both perimeters are the same.





SUDOKU

7				9			8	3
		6				5		
3	1			7	8		9	
		5	9		7			
		8				6		
	7		6		5	3		
	8		1	4			2	5
		9				4		
5		7						1

ALGEBRA SKILLS

Factorise the following

1. $2x + 6$

2. $10x - 15$

3. $x^2 - 4x$

4. $2x^2 - 8x$

5. $x^2 + 5x + 6$

6. $x^2 - 5x + 6$

7. $x^2 - x - 12$

8. $x^2 - 8x + 7$

9. $x^2 - 8x + 12$

10. $x^2 - 2x - 15$

QUICK QUESTIONS

1. Find the value of T when a = 4, b = 8 and $T = 2(a + b)$.

2. Simplify $6a - 5b - 3a + 3b$

3. Simplify $3a \times 4b \times 5c$

4. Simplify $5x - 3x^2 - 2x$

5. Write a rule for the pattern 2, 4, 6, 8, ...

6. Write a rule for the pattern 3, 5, 7, 9, ...

7. Simplify $x^7 \times x^2 \times x^{-1}$

8. Simplify $5x^2 \times 6x^3$

9. Simplify $\frac{x^{12}}{x^3}$

10. Simplify $\frac{2x^{12}}{x^3}$

BLACK Worksheet 10

ALGEBRA SKILLS
Expand and simplify:

1. x(x +2)

2. (x + 1)(x + 2)

3. (x + 2)(x - 2)

4. (x + 2)(x + 2)

5. (x - 3)(x + 4)

6. (x - 3)(x - 3)

7. (2x + 1) (3x + 3)

8. (2x - 1) (3x - 3)

9. (5x + 2) (4x - 3)

10. (4x - 2)(3x - 2)

ALGEBRA SKILLS (2)
Simplify the following:

1. 2a + 3a

2. 2a + 3a - 4a

3. 5a + 3b + 2a + 4b

4. $5a^2 + 2a + 3a^2 + 4a$

5. 2a + 7b - a + 3b

6. 2a - 3b - a - 5b

7. $3a^2 - a - 2a^2$

8. 2xy + 4yx

9. $3x^2y - 2yx^2 + x^2y - 3yx^2$

10. $4x^2y - 2yx^2$

SOLVING EQUATIONS

Solve the following equations:

1. $x - 3 = 7$

2. $x + 6 = -11$

3. $3x = -15$

4. $-11x = 33$

5. $\frac{x}{7} = 5$

6. $3x - 1 = 8$

7. $16 - 2x = 19 - 5x$

8. $8(x - 2) = 24$

9. $3(x + 2) = 2(x - 5)$

10. $\frac{3(x - 1)}{2} = -6$

ALGEBRA SKILLS

Expand and simplify:

1. $x(x + 3) + 2(x - 4)$

2. $x(x - 3) - 2(x + 3)$

3. $x(x - 2) + 3(x - 5)$

4. $x(x - 2) + 5(x - 1)$

5. $x(x + 7) + 2(x - 1)$

6. $2x + 3(x + 1)$

7. $7x + x(x - 3)$

8. $8x - 2(x + 3)$

9. $9x - x(x - 4)$

10. $5x + x(3 - x)$

ARE GENIUSES PERFECT?

Expand and simplify the following expressions.
Write the letter above the answer in the table below.

1.	**A**	3(x + y)
2.	**P**	6(x - y)
3.	**E**	-2(x + y)
4.	**R**	-3(x - y)
5.	**S**	3(x - 3)
6.	**O**	-2(x + 4)
7.	**W**	x(3 + x)
8.	**H**	x(x - 2)
9.	**C**	-x(x - 3)
10.	**N**	2x(x + 4)
11.	**T**	-3x(x - 2)
12.	**M**	-2x(3x - 5)
13.	**K**	2(x + y) + (x - y)
14.	**I**	3(x + y) + (x + 2y)
15.	**Y**	4(2x - 3) - 2(x + 4)
16.	**G**	3(3x + 2) - 2(x - 4)

$3x + 3y$	$6x - 6y$	$-2x - 2y$	$-3x + 3y$	$3x - 9$	$-2x - 8$	$2x^2 + 8x$	,
$3x + x^2$	$x^2 - 2x$	$-2x - 8$		$-x^2 + 3x$	$3x + 3y$	$2x^2 + 8x$	$-3x^2 + 6x$
$-6x^2 + 10x$	$3x + 3y$	$3x + y$	$-2x - 2y$		$3x + 3y$		
$-6x^2 + 10x$	$4x + 5y$	$3x - 9$	$-3x^2 + 6x$	$3x + 3y$	$3x + y$	$-2x - 2y$	
$-x^2 + 3x$	$3x + 3y$	$2x^2 + 8x$	$-3x^2 + 6x$	,	$-6x^2 + 10x$	$3x + 3y$	$3x + y$	$-2x - 2y$
$3x + 3y$	$2x^2 + 8x$	$6x - 20$	$-3x^2 + 6x$	$x^2 - 2x$	$4x + 5y$	$2x^2 + 8x$	$7x + 14$

QUICK QUESTIONS

1. Find the value of C when F = 67 and $C = \frac{2}{5}(F - 32)$

2. Simplify $-2a + 5b + 5a - 7b$

3. Simplify $5a \times 2b \times c$

4. Simplify $5x^2 - 5x - 6 + 8x$

5. Write a rule for the pattern 3, 6, 9, 12, ...

6. Write a rule for the pattern 2, 5, 8, 11, ...

7. Simplify $x^7 \times x^3 \times x^2$

8. Simplify $4x^2 \times 6x^3$

9. Simplify $\frac{x^{10}}{x^3}$

10. Simplify $\frac{8x^{10}}{4x^3}$

PUZZLE

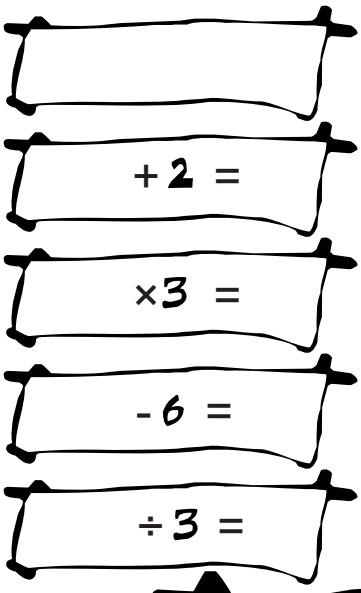
1. Start with a number.

2. Add 2.

3. Multiply this by 3.

4. Subtract 6 from the total.

5. Divide by 3.



6. What is the number that was left? Explain why

BLACK Worksheet 11

Factorials are useful in working out the number of ways things can be selected or arranged. For example, 3 people can be arranged in a line 3! or 6 different ways.

1 Write the first seven factorials:

0! = _____

1! = _____

2! = _____

3! = _____

4! = _____

5! = _____

6! = _____

2 Explain why 6 × 5! gives the same answer as 6!

_____

_____

_____

3 If 8! = 40 320 calculate 9!

_____

4 (0! + 0! + 0! + 0! + 0!)! = _____

5 Simplify $\frac{7!}{5!} = \frac{7 \times 6 \times 5!}{5!}$

$= $ _____

BEDMAS

1. 4 + 3 × 2 = _____

2. 5 + 7 × 8 = _____

3. 9 × 9 - 5 × 8 = _____

4. 36 ÷ 4 + 15 = _____

5. 4 × (8 + 7) = _____

6. $(2 \times 5^2) - 4 \times 5 =$ _____

7. (8 + 7) × (12 - 9) = _____

8. $(7 + 4)^2 - 6 \times 8 =$ _____

9. $3^2 \times 7 - 5 \times 5 =$ _____

10. 3! × (15 - 9) ÷ 2 = _____

11. $[(3! + 2)^2 - 40] \times 2 =$ _____

12. 3! × (15 - 9) ÷ 3 = _____

THE RESTLESS SEA

A tsunami is an ocean wave that occurs after an earthquake (or some other eruption or explosion) takes place in or near the sea. The wave moves very fast in deep water and can have speeds of over 900 km/hour. The wave slows as it reaches shallow water and the energy of the wave's speed is then transformed to increased height and force. As it slows it rises to a great height and can cause enormous destruction.

An undersea earthquake in the Indian Ocean on 26th December 2004 produced a tsunami that killed over 200,000 people. The earthquake took place at about 8am (local time) in the Indian Ocean off the western coast of northern Sumatra and the resultant tsunami hit the coast of Somalia (4500 km away) around 7 hours later.

1. What was the speed (in metres per second)?

2. Convert this figure to kilometres per hour.

3. The speed of the tsunami (in metres per second) is related to the depth of the water by the equation $s^2 = 9.81d$ where s = speed and d = depth of the water. Suppose an earthquake at sea produces a tsunami in water 700 metres deep. Determine the speed of the tsunami wave traveling through this area.

4. Fill in the missing word:
"As ocean depth increases the speed of the tsunami _____ "

5. Why would determining a tsunami's speed be a useful skill?

METHODS OF MULTIPLICATION

The Lattice Method Of Multiplication

1. Draw a rectangle and divide it into squares.
Draw a diagonal in each square. Write the first number at the top.
Write the second number on the right hand side.

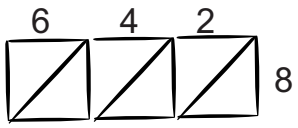
2. Multiply each digit. Write the product in each half of the square.

3. Add the numbers diagonally.

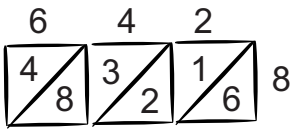
Look at these examples:

642 × 8

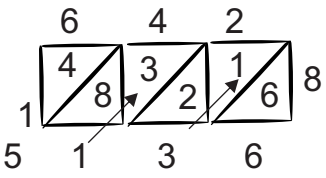
Step 1



Step 2

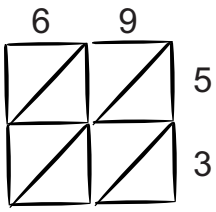


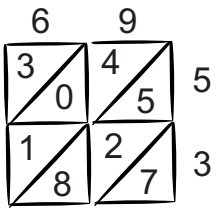
Step 3

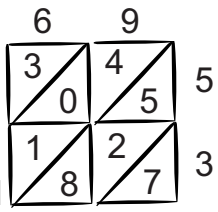


= 5136

69 × 53



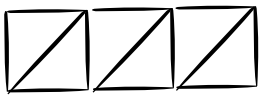




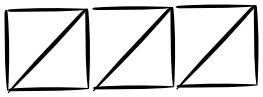
= 3657

Use the Lattice Method of Multiplication for each of the following:

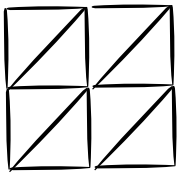
1. 583 × 7



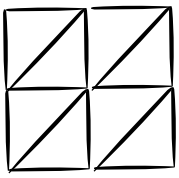
2. 678 × 5



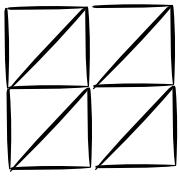
3. 46 × 82



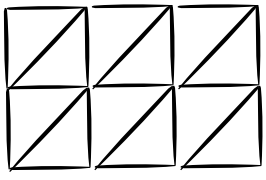
4. 27 × 42



5. 58 × 39



6. 967 × 25



MATHS IN ACTION

1. A company has an advertising budget of $25,000. It plans to produce and air a radio commercial to promote its products. It will cost $5000 to produce the commercial and an additional $250 each time the commercial is aired on the radio breakfast show. How many days can the company afford to run the commercial if it is aired once a day?

2. A bread-making machine costs $599. The ingredients to make a 1 kg loaf of bread are milk powder $4.50 (1 packet makes 15 loaves), yeast $5 (makes 5 loaves), flour $4.50 (makes 6 loaves), packet of salt $3 (contains enough for 150 loaves). At a supermarket you pay $4.50 for the same size loaf of bread. How many whole loaves of bread will you have to make in order for the cost of the machine and ingredients to be less than the cost of buying an equivalent amount of bread at the store?

3. Patrick has 50 millilitres of a 30% solution of copper sulfate and a further bottle of 20% solution. For his chemistry experiment, he needs a 22% solution of copper solution. He makes the following table to calculate the amount that he needs to mix to get a 22% solution.

	Amount of Solution (mL)	Amount of Copper Sulphate
30% solution	50	0.30(50)
20% solution	x	0.20x
22% solution	50 + x	0.22(50 + x)

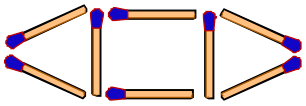
He then forms an equation to solve: $0.30(50) + 0.20x = 0.22(50 + x)$
Solve the equation and find how much of the 20% solution should be added.

BLACK Worksheet 12

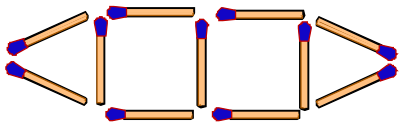
Complete the missing numbers from the cross number.

		60	÷	10	=								÷	2^3	=	$\sqrt{81}$				
		÷		×		×							÷		×			÷		
		15	÷	5	=					÷	7	=	9		3!	÷	3	=	2	
		=		=		=				×		=			=		=			
	÷		=				÷		=				2^3			-		=		
							×		=										÷	
	÷	8	=	3!			3^2		42	÷	$\sqrt{36}$	=	7						3^2	
÷		×					=												=	
4	×	7	=					+	$\sqrt{25}$	=					2^3	-	3	=		
=		=									÷						÷			
		-	4	=			96	÷	2^3	=							3			
				÷			÷		=		-						=			
			92	÷	4	=	6	+		=										
		4!		=			=				=									
		÷			+	$\sqrt{9}$	=						5!	÷	2	=				
	+		=	43			÷				÷						÷			
		=		-			5!	÷	$\sqrt{16}$	=					3!	+	$\sqrt{25}$	=		
		2^2	+		=	22	=				=						=			
			=											×		=				
				-	4!	=														

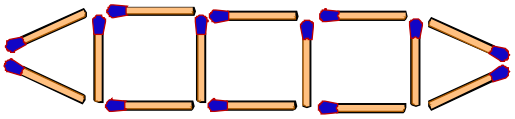
LINEAR PATTERNS



Pattern 1



Pattern 2



Pattern 3

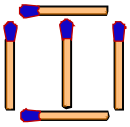
1. Complete the table below to show the number of match sticks used for each pattern.

Pattern number (n)	1	2	3	4	5	6
Matchsticks (m)	8	11				

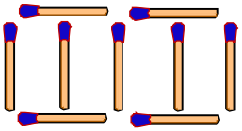
2. Julia says “Because you add three to get the next number in the sequence, the rule should be 3 times the pattern number, then add 5."

Write Julia’s rule as an equation. _____

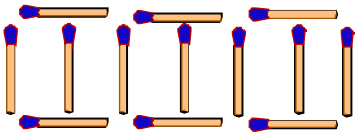
Another matchstick pattern is drawn below.



Pattern 1

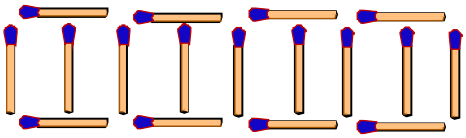


Pattern 2



Pattern 3

3. Draw a diagram of pattern number 4 in the space below.



4. Complete the table to show the number of matchsticks needed for pattern numbers 3, 4 and 5.

Pattern number (n)	1	2	3	4	5	6
Matchsticks (m)	5	9				

5. Which pattern number needs exactly 41 matchsticks? _____

6. How many matchsticks are needed for pattern 50? _____

7. Julia says “Because you add four to get the next number in the sequence, the rule should be 4 times the pattern number, then add 1.”

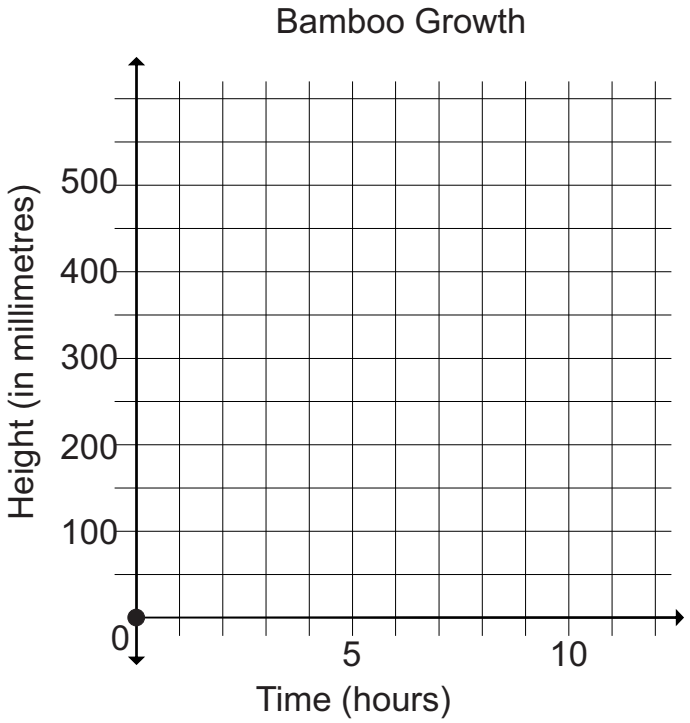
Write Julia’s rule as an equation: _____

WRITING AN EQUATION FROM A TABLE

Bamboo is one of the fastest growing plants on earth. In some countries it can grow over 1 metre per day. The table below shows a bamboo plant's observed growth over an 8 hour period.

1. Graph the observations and show that the table represents a linear function (i.e. draws a straight line graph).

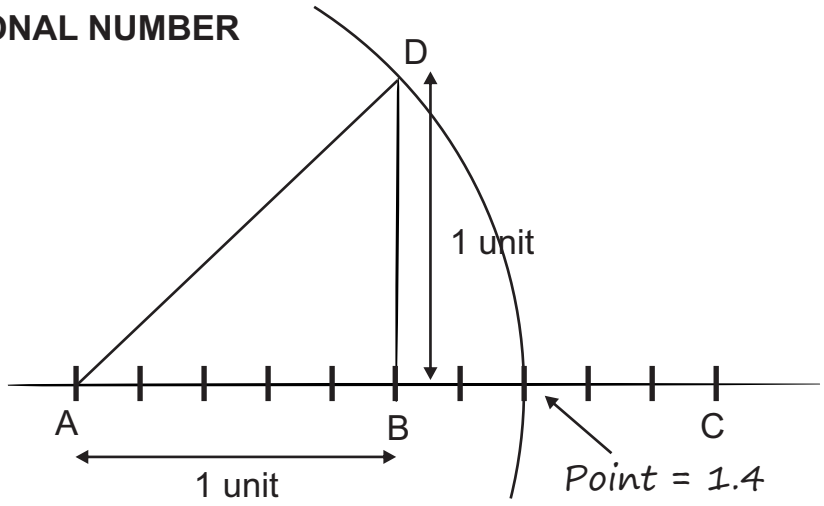
Time (hours), x	0	2	4	6	8
Height (mm), y	150	250	350	450	550



2. Write an equation for the function so that the height of the bamboo could be calculated given any time in hours.

3. Use your equation to calculate how many hours it would take before this particular bamboo plant grows 1 metre tall (assuming that growth continues at the same rate).

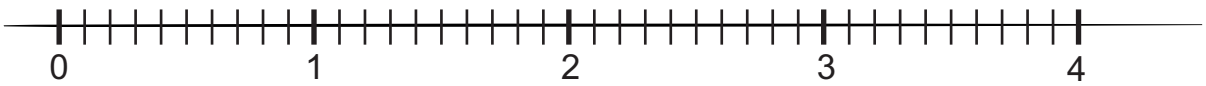
GRAPHING AN IRRATIONAL NUMBER



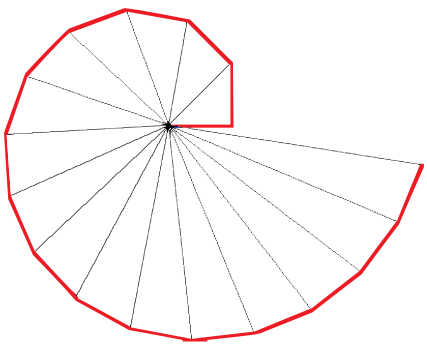
1. The diagram above shows a triangle with two sides each with a length of 1 unit. It has an arc with radius AD. Line AC is divided into 10 equal parts. Prove that the triangle is a right angled triangle.

2. What is an irrational number?

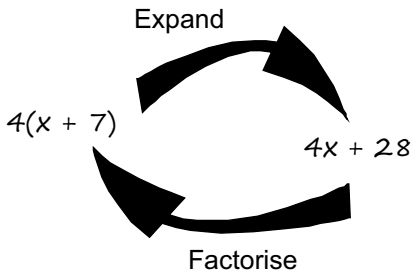
Indicate on the number line below the approximate position of each of the following: $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, $\sqrt{6}$, $\sqrt{7}$, $\sqrt{8}$, $\sqrt{10}$



You are going to draw the "Wheel of Theodorus as shown below. Start near the centre of a large piece of paper. Draw a right angled triangle with sides 1 unit in length. Next, using the hypotenuse as the base, draw another right angled triangle with the outside leg as 1 unit. Repeat this process to draw at least 20 right angled triangles. Colour your "Wheel of Theodorus". What are the lengths of each hypothenuse? Use mathematics to calculate the first 3 hypotenuse lengths



BLACK Worksheet 13



EXPANDING AND FACTORISING

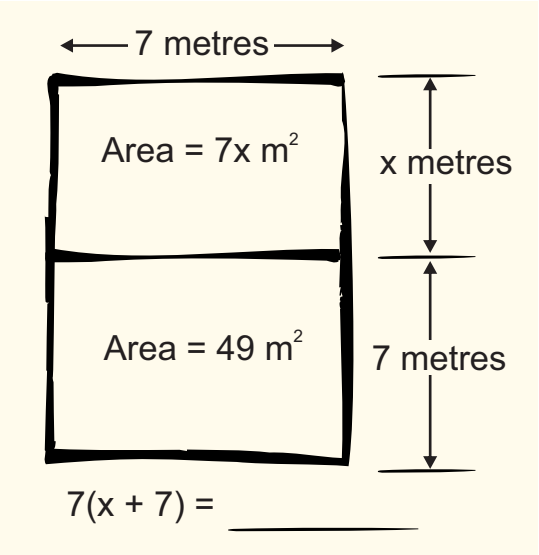
1. Why do we need to factorise?
   Why do we need to expand?

_____

_____

2. Complete this table of expressions in factorised and expanded form.

Factorised Form		*Expanded Form*
3(x + 9)	↔	_____
_____	↔	10x + 15
x(7 - y)	↔	_____
_____	↔	2ab - 16a

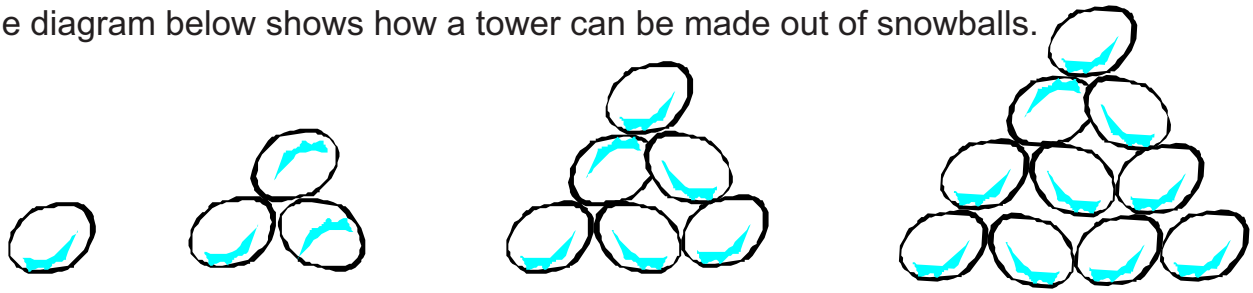


3. Expand the expressions below

3(x + 7)	= _____	4(x + 5)	= _____
x(2x + 7)	= _____	2x(3x + 9y)	= _____
4(x - 2)	= _____	3(x - 8)	= _____
x(3x - 17)	= _____	3x(3x - y)	= _____
3(2x + 2)	= _____	2(5x + 6)	= _____
4(3x - 2)	= _____	7(4x - 3)	= _____
-4(1 + 2x)	= _____	-1 (3 - x)	= _____
2x(x + 4)	= _____	-x(1 + x)	= _____

TRIANGULAR NUMBERS

The diagram below shows how a tower can be made out of snowballs.



1. Draw the next tower in the pattern (above), then complete the table below.

Tower Number (n)	1	2	3	4	5	6
Snowballs (s)	1					

2. The number of balls needed to build each tower forms a sequence called triangular numbers.

The formula for calculating the nth term of a triangular number is: $\frac{n^2 + n}{2}$

Use the formula to calculate how many snowballs would be needed for Tower 10.

3. If you had 120 snow balls, what would be the Tower Number?

4. Here are the first five terms of a number sequence: 5, 8, 11, 14, 17.

Circle the correct expression for the nth term of the sequence.

5n $\quad$ $n^2 + 4$ $\quad$ $n + 4$ $\quad$ $3n + 2$

5. Look at the three sequences of numbers below:

Sequence p: 4, 6, 8, 10, 12, . . .
Sequence q: 3, 8, 15, 24, 35, . . .
Sequence r: 5, 10, 17, 26, 37, . . .

Sequence r is obtained from p and q by the following formula: $r = \sqrt{p^2 + q^2}$

Calculate the sixth term of each of the sequences p, q and r.

PERCENTAGES

1. Elizabeth sees an advertisement for a new stereo. She can purchase the stereo on "time payment" with a deposit of 25% and then 18 monthly installments of $45.Complete the calculations in the table below to calculate how much extra Elizabeth will eventually pay by buying the stereo on time payment.

25% Deposit
Total Cost of 18 monthly payments @ $45
Total cost Elizabeth will pay
Advertised Cost of the Stereo
Extra amount Elizabeth has to pay

2. Elizabeth is looking to purchase a new shirt and jeans. She could either buy them ready made or decide to save money and make them herself.
. The cost of a new shirt and jeans is below. Find the total cost.

Shirt $59.95, Jeans $99.99, Total Cost $ _____

Elizabeth decides to save money by making the shirt herself. She calculates that she will need two metres of material. This material usually costs $18.45 per metre, however at sale price she can save 10%. Elizabeth also need to purchase a shirt pattern ($15.95), 6 buttons (1.55 cents each) and a reel of cotton ($3.30). How much does Elizabeth save by making her own shirt?

2 metres of material @ $18.45 = _____
10 % discount = _____
Sale Price = _____
Shirt Pattern @ $15.95 = _____
6 buttons @ $1.55 = _____
Cotton @ $3.30 = _____
Total Cost = _____
Saving = _____

Comment on the savings.

_____

_____

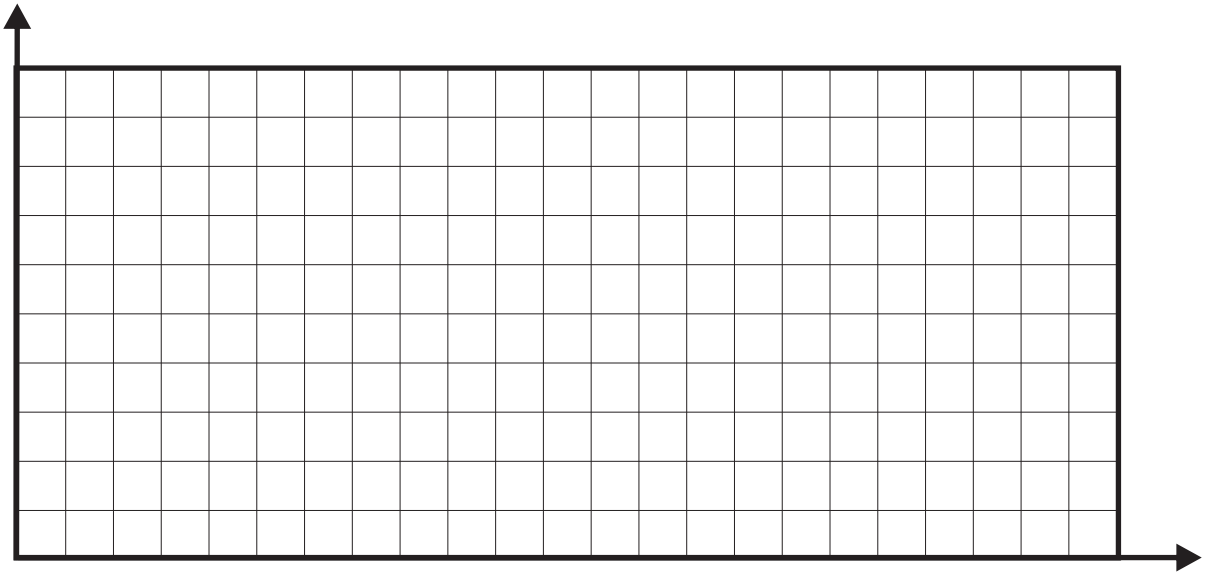
CORN CALCULATIONS

Two farmers each harvest 50 hectares of corn per day from their fields. The area of one farmer's field is 1000 hectares, and the area of the other farmer's field is 600 hectares.

1. The equation y = 1000 - 50x gives the unharvested area (y) of the larger field (in hectares) after x days. Write an equation giving the unharvested area y of the smaller field (in hectares) after x days.

_____

2. Graph the two equations from 1. on the grid below.



3. Identify the slope and y-intercept of each graph.

_____

_____

_____

4. What is the geometric relationship between the two line graphs? How do you know?

_____

_____

5. How long does it take for the farmers to harvest the corn in both fields?

_____

_____

BLACK Worksheet 14

QUICK QUESTIONS

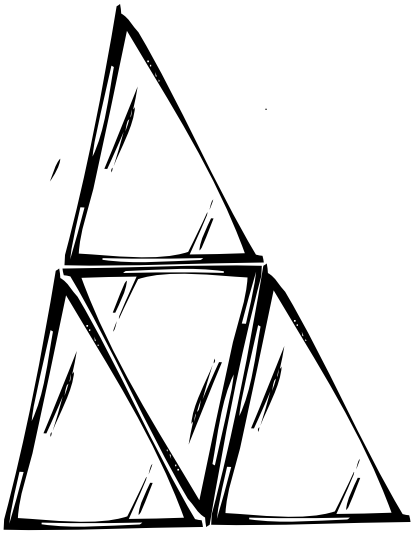
1. $3 + 6 \times 4 + 5$

2. $15 \div 3 \times 6 - 4^2$

3. $2(10) + 3(4 + 8)$

4. $2[\,5 + (45 \div 9)^2]$

5. $\dfrac{5 + 4^2}{3^2 \times 4}$



The above large triangle is made of identical smaller triangles each with a base of 2.6 cm and vertical height of 3.4 cm.

Calculate the area of the large triangle.

6. If a = 7, b = 3 and c = 5 then evaluate $a^2 - (b^3 - 5c)$.

7. If m = 10, n = 5, p = 2 then evaluate $m^3 + n + p^3$.

8. If r = 9, s = 12, t = 15 then evaluate $3rs - t^2$.

9. If g = 4, h = 6, j = 8 and k = 12 then evaluate $2k^2 + \dfrac{2g(h - g)}{gh - j}$

10. If x = 12, y = 4, z = 3 then evaluate $\dfrac{xy^2 - 3z}{3}$

TAKING A BREAK

Edith and John travel to Hawaii for 5 day's holiday. Airfares cost $1200 + GST each (GST is charged at 15%). Together, their accommodation costs are $1500.
Airport tax is $25 each. Travel insurance is $60 each. They have also budgeted for $300 per day (each) for meals and other purchases (per diem).

1. What is the total cost?

Airfares _____

GST _____

Accommodation _____

Airport Tax _____

Travel Insurance _____

Per Diem _____

Total _____

2. The travel agency arranged a 20% discount on their travel insurance.
If they each paid $60, how much was the cost of their original policies?

_____

3. While in Hawaii, Edith and John hire a car to travel around the island.
Hire charges are $40 per day with an extra charge of 16 cents per kilometre.
They keep the car for 4 days and travel a total of 935 km.
How much does it cost them for the car hire?

_____

4. During one drive to a surf beach, they travel at an average speed of 90 km/h for 3 hours. On the drive back they average 60 km/hr.

How far is it to the surf beach? _____

How long did it take them to drive back? _____

5. The car uses 40 litres of petrol for the trip to the beach and back. Petrol costs $1.70 cents per litre. Calculate the average fuel consumption per 100 kilometre and calculate much John and Edith would have paid for petrol.

_____

_____

_____

6. For their flight home, the plane is due to leave for New Zealand at 22:15. It is delayed for 2½ hours. What time will they leave?

_____

_____

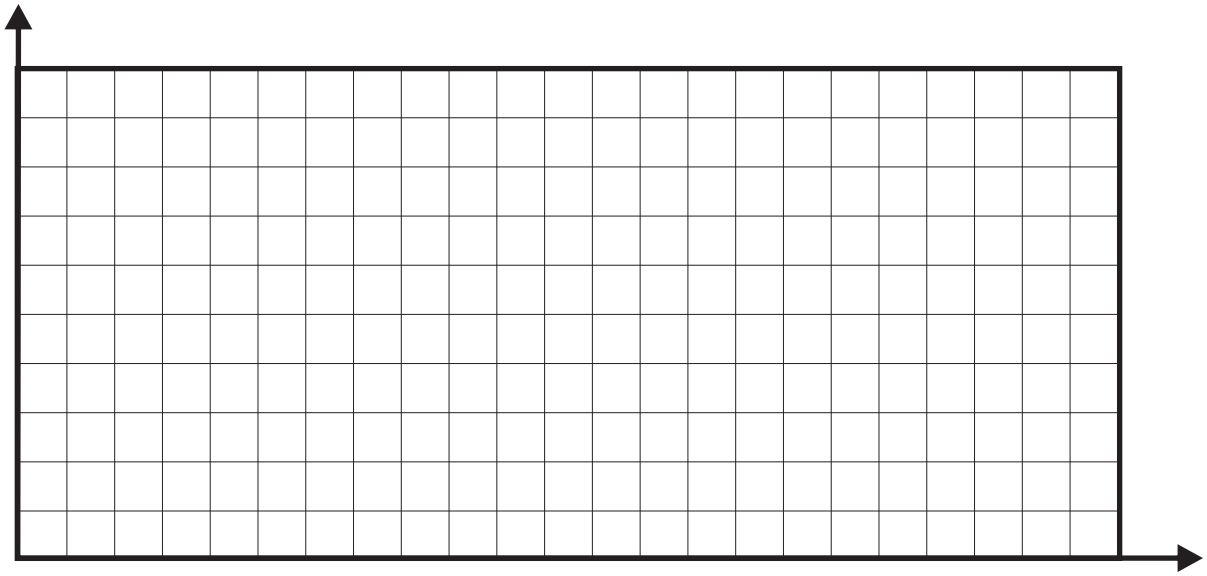
WILL YOU SPONSOR ME?

Delmaine participates in a walk-a-thon. Donors can pledge money for each kilometre that she walks and / or a fixed amount that doesn't depend on how far she walks. The table gives the amounts pledged by four donors.

Donor	Amount per km (x)	Fixed amount	Equation
Praveen	None	$50	
Sanjit	$2	$20	
Salil	$5	None	
Peyton	$3	$40	

1. For each person, write an equation giving the amount of money **(**y**)** that person will donate if Delmaine walks x kilometres.

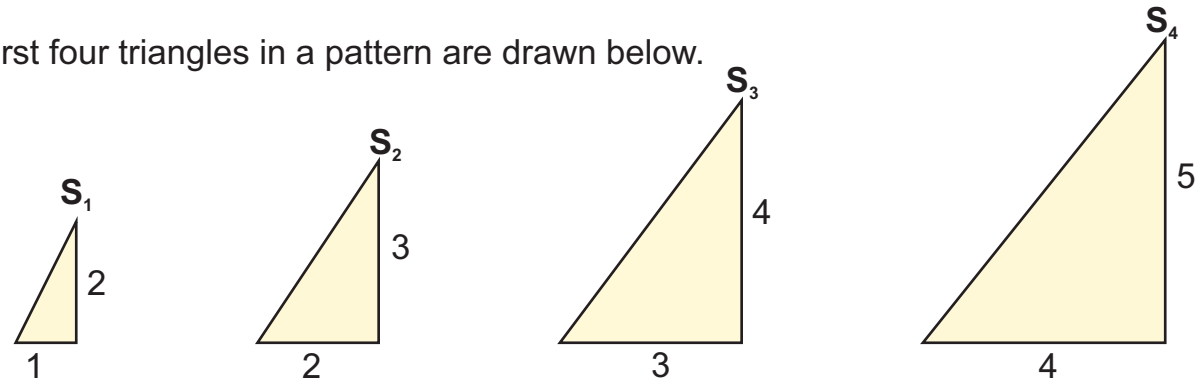
2. Graph your equations on the grid below.



3. Consider the equations you have written. Which donor will potentially give the most money? Explain why this is so.

MATHS CHALLENGE

The first four triangles in a pattern are drawn below.



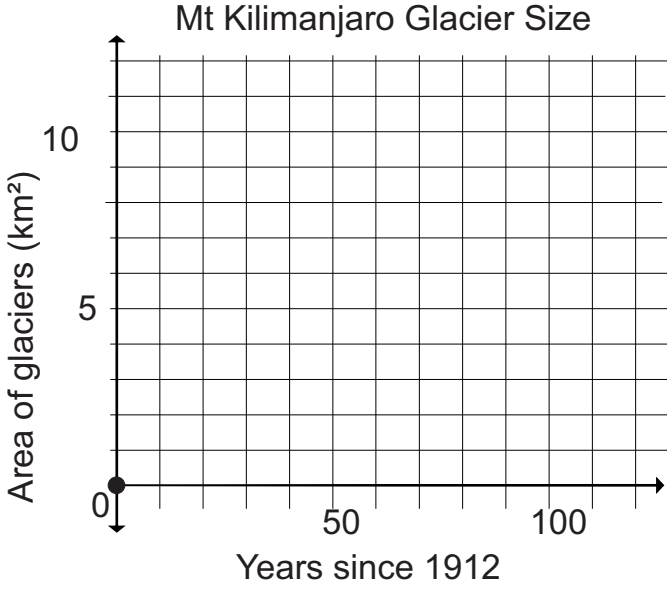
What would be the area size of the nth triangle (S_n)

MATHEMATICAL PROBLEM SOLVING

Since 1912, scientists have been mapping the glaciers of Mount Kilimanjaro in Africa. Their data suggests that the glaciers are shrinking in overall area.
Below is a table of their results to date:

Year	1912	1953	1976	1989	2000	2006
Glacier Area (km²)	12.1	6.7	4.2	3.3	2.2	2.0

Let x be the number of years since 1912 and let y be the area of the glaciers (in square kilometres). Make a scatter plot of the data pairs and draw a line of best fit through the data points. Predict the year when the glaciers will disappear.



BLACK Worksheet 15

EQUATION SOLVING

1. $8x - 1 = 10x - 2$

2. $7x + 10 = 8x - 32$

3. $4x + 14 = 10(x - 7) - 3x$

4. $2(x - 3) = 3(x - 1)$

5. $5x = 2x - 18$

A BAFFLING BIRTHDAY

Cheyenne is having an end of year party. There is something baffling about the date of her birthday in that two days before the party she was 15 years old but at the same time next year she will be 17 years old. How can this be true?

A CORD OF WOOD

A cord is a unit of measure of dry wood. It is defined as 128 cubic feet (or 3.62 m^3). If you were designing a trailer to fit a cord of wood, what would be a possible dimension of the trailer?

Let n = 3, a = 5000 and b = $-\frac{1}{25}$

Write the value of $(ab)^n$ in words.

Calculate $\frac{1500 \times 15}{25 \times 60}$

DEALING WITH DAIRY DATA

The table below shows Dairy Production for the last 10 years at one central North Island factory.

CENTRAL DAIRY PRODUCTION
Dairy Products (thousand tonnes)

Year Ended 31 March	Butter	Cheese	Powdered Milk	Casein
2000	247	102	197	45
2001	240	101	188	48
2002	241	88	192	50
2003	244	88	264	45
2004	265	109	206	47
2005	277	85	203	82
2006	243	78	174	81
2007	252	92	176	80
2008	261	107	176	85
2009	266	88	188	87
2010	251	115	119	87

1. In which year did Central Dairy Production produce the most Butter?

Year = _____

2. Write Casein as a fraction and a percentage of total Dairy Production for 2007.

Fraction = _____

Percentage = _____

3. Which product had the biggest increase in production over the ten years?

Casein production has nearly doubled since 2000

Product = _____

4. Calculate the total amount (in tonnes) of Dairy Products that were produced in the year ending March 31, 2010. Give your answer to two significant figures.

Total = _____

5. Percentage increase is defined as the increased amount divided by the original amount. Use this information to give the percentage increase or decrease of cheese and of powdered milk in the 11 years from 2000 to 2010.

	Cheese	Powdered Milk
2000 figure	_____	
2010 figure	_____	
Increase or decrease amount	_____	
Percentage increase or decrease	_____	

CLIMATE CALCULATIONS

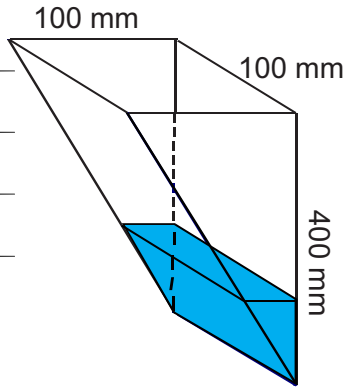
1. In Auckland, 1445 mm of rain fell during 2010.

Write 1445 mm in metres. _____

2. During 2010, there was four times more rain in winter than the rest of the year.

Calculate how much rain fell in the winter. _____

3. Rainfall is measured in a rain gauge. One type of rain gauge is shown below.
Calculate the total volume of water that the gauge could hold.
HINT: (Volume = Cross Sectional Area × Length)



4. If full, how many litres of water would the gauge hold?

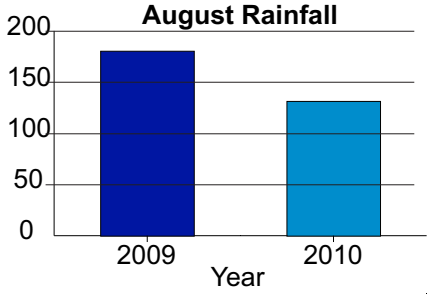
This table gives the amount of rainfall, for two years in Auckland, during Aug and Sep.

	2009	***2010***
August	180 mm	131 mm
September	195 mm	156 mm

5. What is the total amount of rainfall for August and September 2010?

6. The rainfall in October 2010 was 121 mm. This was 10% more than October 2009. Calculate the amount of rainfall in October 2009

7. Edith draws a graph (below) based on the results in the table. In her project, Edith states "There was a 49% difference in the amount of rainfall for August 2009 & August 2010". Explain why Edith is wrong.



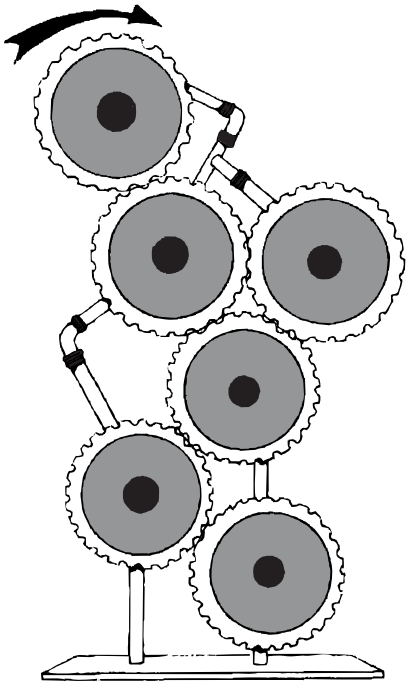
Factorise the following

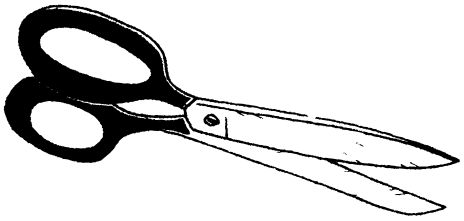
$x^2 + 10x + 24$	$x^2 + 9x + 8$	$x^2 + 13x + 30$
$x^2 + 2x - 48$	$x^2 + 6x - 40$	$x^2 + 4x - 5$
$x^2 - 8x + 15$	$x^2 - 9x + 14$	$x^2 - 22x + 120$
$x^2 - 2x - 35$	$x^2 - x - 72$	$x^2 - 11x - 12$
$x^2 - 10x + 25$	$x^2 + 20x + 100$	$x^2 - 100$

Factorise the following expression

$x^2 - y^2$

Use your answer above, to work out the exact value of: $123456789^2 - 123456788^2$





Some non-mathematicians have come up with two inventions - the Gear Wheel Machine and some new scissors. However each has a problem.

What is the problem with the Gear Wheel Machine?

What is the problem with the scissors?

BLACK Worksheet 16

EQUATION SOLVING

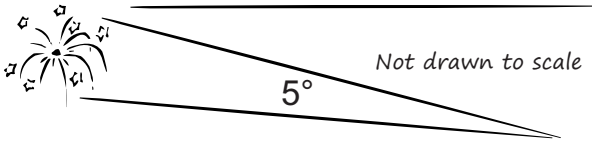
1. $6x + 7 = 8x - 13$

2. $5(x - 2) = 30$

3. $8x - 3 = 5(2x + 2)$

4. $2(3x + 1) + 2x = 12x$

5. $4(x - 2) = 8x + 2$



PERCENTAGE DISTRIBUTION

Leaving a “tip” originated in 18th century English coffee houses. It meant “To Insure Promptness”. In some countries a tip of 15% is expected when you eat at a restaurant or have room service in a hotel.

Five parties eat at a restaurant. The total amount (without tip) for each account is listed below:

Party 1: $195.50
Party 2: $240.20
Party 3: $180.80
Party 4: $255.60
Party 5: $160.40

The waitress expects to make a 20% tip on each of the totals. To calculate the tip should she multiply each amount by 0.2 and then add to find the total amount or add all the total amounts together and then multiply that total by 0.2? Use your method to find the total tip amount.,

To estimate the width of a firework burst, use the formula $w = 5.7At$
A is the estimated viewing angle of the display, t is the time (in seconds) from the instant you see light until you hear the sound and w is the width (in metres). James is 2 km from a fireworks display and counts 5 seconds between seeing the light and hearing the explosion sound of the fireworks. He estimate the viewing angle at 5°. Use this information to estimate the width of the firework’s burst.

1 Put a +, -, ×, or ÷ sign into each ☐ to make the equations correct.

$5 \square (3 + 5) = 13$

$9^2 - 9^2 = 8 \square 8$

$\sqrt{100} \square (2 \times 5) = 1$

$2^4 + 2^3 = 8 \square 3$

$36 \square (\sqrt{16} \times 3) = 48$

$5! \square 3 = 40$

$4! \square (12 - 3!) = 144$

$3 \times \sqrt{100} = 3! \square \sqrt{25}$

$$\frac{200}{4 \square 2} = 25$$

$$\frac{27 \square 33}{22 \square 18} = 15$$

2 Reynolds has 4 class tests in one week. He receives the following marks:
17 out of 25 for Science,
29 out of 40 for English,
10 out of 15 for History
and 25 out of 30 for Maths.

Write all these marks as percentages and rank her 4 marks from highest down to the lowest.

Rank		Percentage
_____	Science	_____
_____	English	_____
_____	History	_____
_____	Maths	_____

3 Evaluate the expressions when x = 20, y = 5

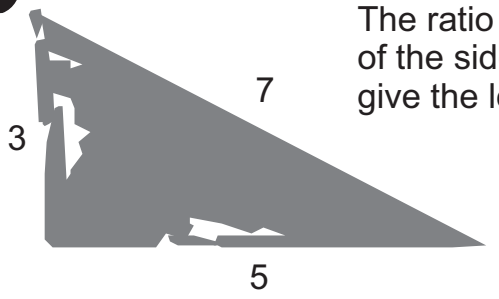
$0.5x + y =$ _____

$\frac{x + 5}{y} =$ _____

$0.3(x - y) =$ _____

$y^2 - 2x =$ _____

4



The ratio of the sides of the triangle are written beside each of the sides. If the perimeter of the triangle is 60 cm then give the length of each side.

_____

_____

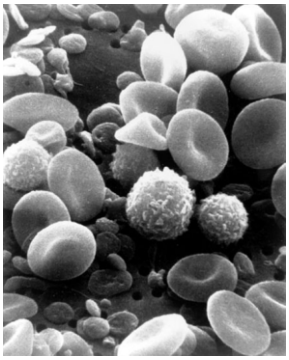
_____

5 A bakery sells 1 dozen croissants for $5.40, How much would it cost for 15 croissants?

_____

_____

BLOODY MATHEMATICS!

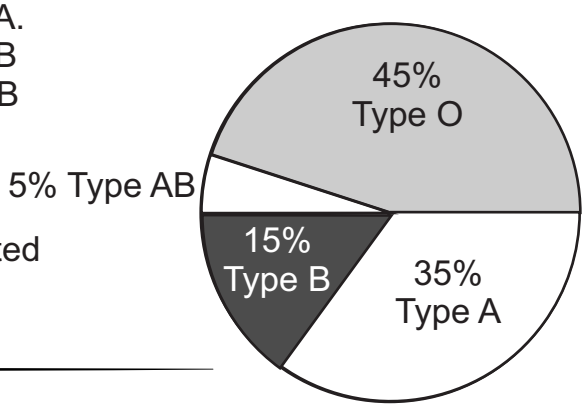


1. The picture shows blood through a microscope.
Red blood cells have a diameter of 7.0×10^{-6} m.
White blood cells have a diameter of 1.2×10^{-5} m.
How many times wider are white blood cells than red blood cells?

_____

_____

The diagram below shows the blood types of donors going to a blood bank.
45% of the people going to give blood are Type O.
35% of the people going to give blood are Type A.
15% of the people going to give blood are Type B
5% of the people going to give blood are Type AB



2. Patients with Type A blood can also accept Type O blood in a transfusion. Give the probability that a randomly selected donor will be either Type A or Type O.

_____

3. Patients with Type B blood can also accept Type O blood in a transfusion. Give the probability that a randomly selected donor will be either Type B or Type O.

_____

4. What is the probability that a randomly selected donor does not have Type O blood?

_____

5. What is the probability that a randomly selected donor does not have Type A or Type B blood.

_____

6. Two donors come into the centre at the same time. What is the probability that both are blood Type O?

_____

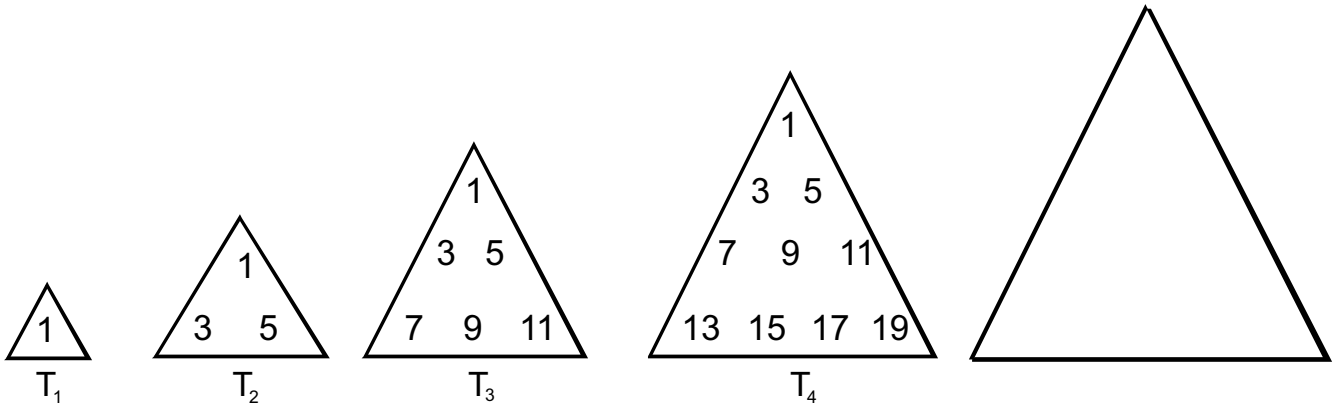
_____

7. There are 400 donors who go to the blood bank in a week. Each donate 470 ml of blood. How much of the blood type AB would you expect in 1 week.

_____

_____

TRIANGLES FULL OF ODD NUMBERS



In the diagram above, the set of odd numbers, starting at 1, are placed into triangles of different sizes. The first 4 triangles are shown.

1. In the unmarked triangle above, draw T5, the 5th triangle of odd numbers.

2. The table below gives the sum of the numbers in the bottom row of each triangle. The variable n gives the triangle number. Complete the table

Triangle	T1	T2	T3	T4	T5	Tn
Sum of bottom row	1	8				

3. What would the sum of the numbers in the bottom row of the 100th triangle equal?

_____

4. The sum of the numbers in the bottom row of the nth triangle of odd numbers is 1 728. Find the value of n.

_____

5. Calculate the triangle number whose bottom numbers sum close to 3300.

_____

_____

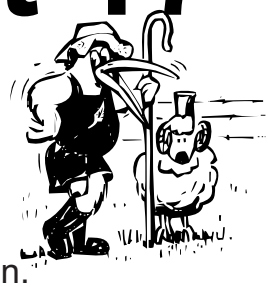
6. Claudia has come up with an expression to calculate the sum of all the numbers in each of the triangles. Her expression is: sum = $\left(\frac{n}{2} + \frac{n^2}{2}\right)^2$

Use her rule to complete the table below. Does the rule seem correct?

Triangle	T1	T2	T3	T4	T5
Sum of bottom row	1	9			

_____

BLACK Worksheet 17



A ROYAL DILEMMA

The Queen wants to divide 11 horses in her stable amongst her 3 children.

The oldest child is to receive $\frac{1}{2}$ of the horses, the second child is to receive $\frac{1}{4}$ of the horses and the youngest is to receive $\frac{1}{6}$ of the horses.

The lawyers are at the stables but cannot think of a way to do this. The Queen then rides up on her horse and says “I have arrived and I have a solution to the problem.” What could his solution possibly be?

FACTORISING TRINOMIALS

Solve each equation by factorising

1. $x^2 + 12x + 35 = 0$

2. $x^2 - x - 20 = 0$

3. $x^2 + 9x - 22 = 0$

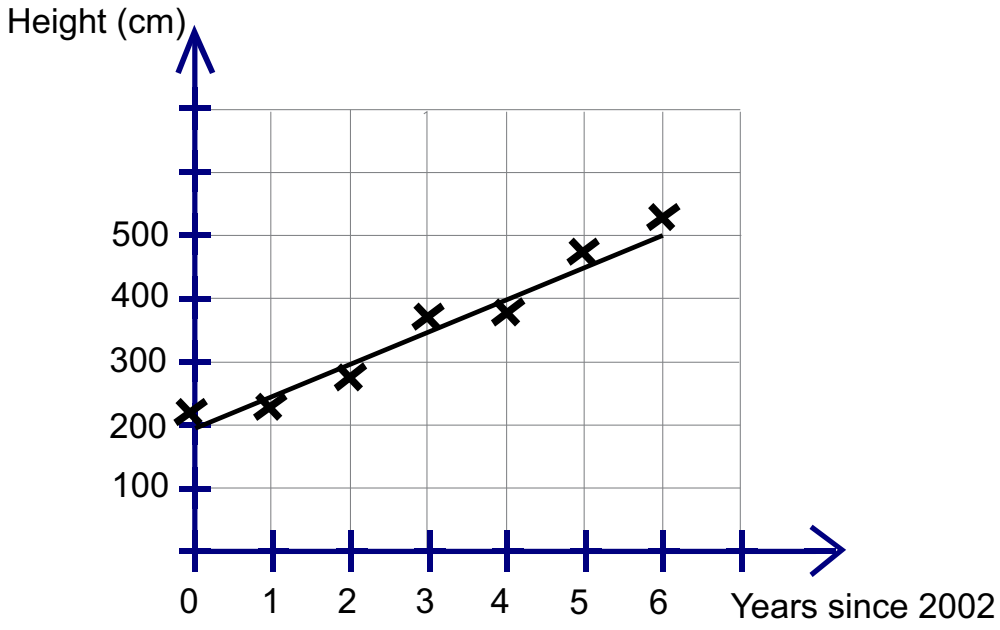
4. $x^2 - 18x + 80 = 0$

5. $x^2 + 15x = -50$

6. $x^2 - 5x = 24$

A GROWING TREND

Flora is a botanist and she has been studying the rare Carpen Tree. She found her first Carpen Tree in 2002. The graph below shows the height of this tree, measured annually since 2002. A growth trend has been added to the graph.



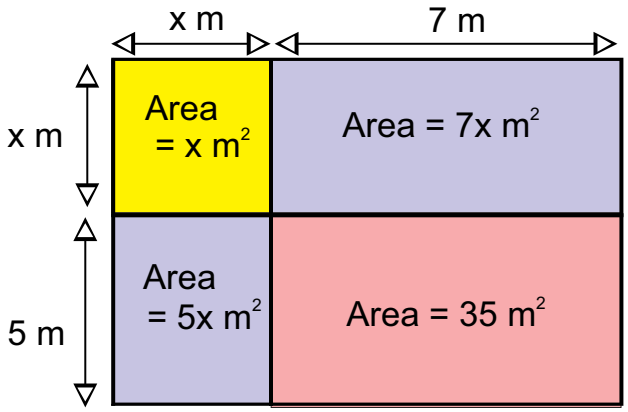
1. Find the equation of the growth trend where: y = the height of the tree, in cm and x = the number of years since 2002.

2. What does the gradient of the trend line show about how this tree is growing?

3. Flora estimates that the tree was about 4 years old when she found it. Why is this a reasonable estimate?

4. In what year do you estimate that the tree will first reach 10 metres tall?

EXPANDING



multiplying (x + 7) (x + 5)

$= x^2 + 5x + 7x + 35$

$= x^2 + 12x + 35$

Expand and simplify.

(x + 3) (x + 4)

$= x^2 + 4x + 3x + 12$

=

(x + 4) (x + 2)

$= x^2 + 2x + 4x + 8$

=

(x + 5) (x + 3)

(x + 6) (x - 2)

(x + 7) (x - 3)

(x + 4) (x - 5)

(x - 6)(x - 4)

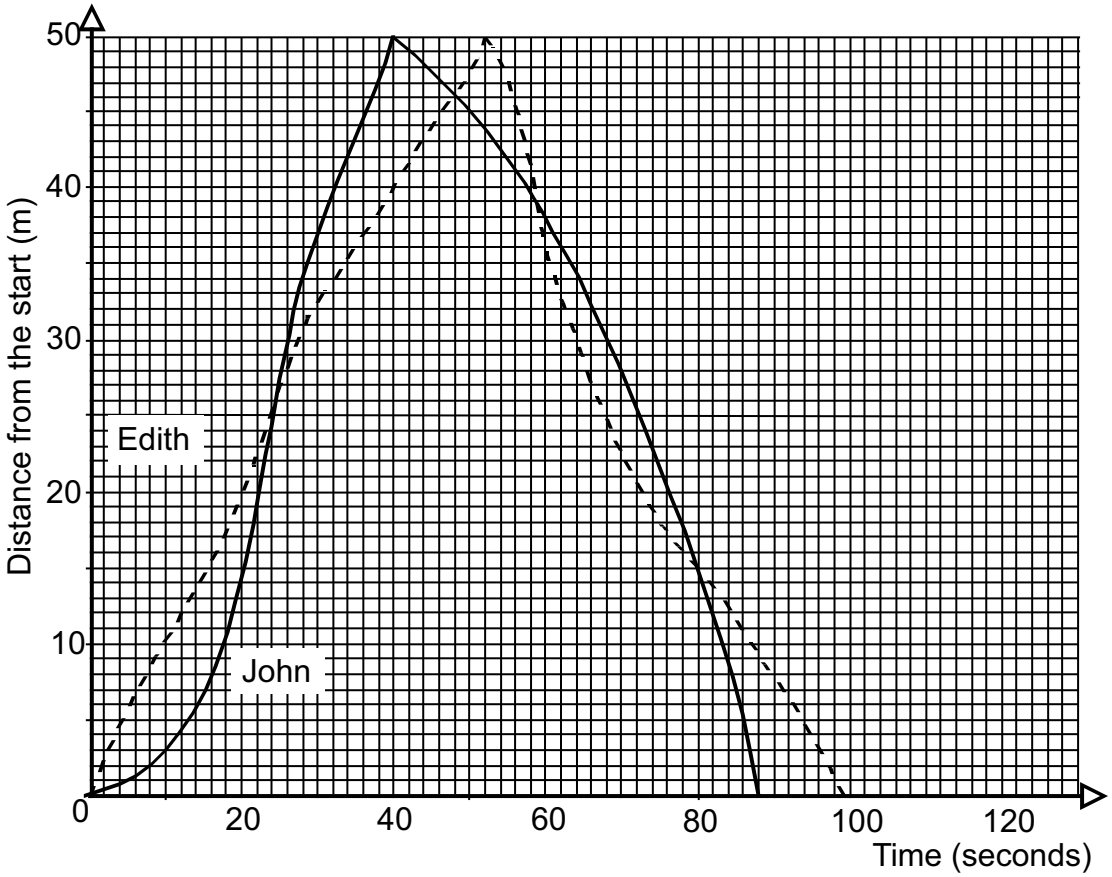
(x - 9) (x - 2)

(x - 7)(x + 3)

(x - 4) (x + 1)

WET MATHEMATICS

The graph below represents a swimming race between Edith and John.



1. At what time did John overtake Edith for the second time?

_____

2. Give the maximum distance between the swimmers during the race

_____

3. Who was swimming faster at 56 seconds? How can you tell?

_____

THE UPS AND DOWNS OF MATH

1. An amusement park roller coaster ride includes a free fall drop of 90 metres. Engineers use the equation $d = 5t^2$ to determine the time (t seconds) that it takes the roller coaster car to travel a distance of d metres. How long will it take to travel the 90 metres?

_____

_____

_____

_____

BLACK Worksheet 18

PERCENTAGE APPLICATIONS

The Prime Minister has just called you on the phone. Apparently GDP (Gross Domestic Product) rose 5% last month but fell 30% this month. He wants to know what the overall percentage change is over the last two months. Calculate the answer for him.

NUMBER PRACTICE

1. $2(6^2 - 9) =$

2. $\frac{1}{3}(7^2 - 4) =$

3. $[38 - (8 + 3)] \div 3 =$

4. $\frac{1}{2}[28 + 5(-2)] =$

5. $2 + 8(5) \div 2 + 3 =$

Let $w = 6$, $x = 0.4$, $y = \frac{1}{2}$ and $z = -2$

Evaluate each expression

6. $w \times x \times z$

7. $w + 20 \div y$

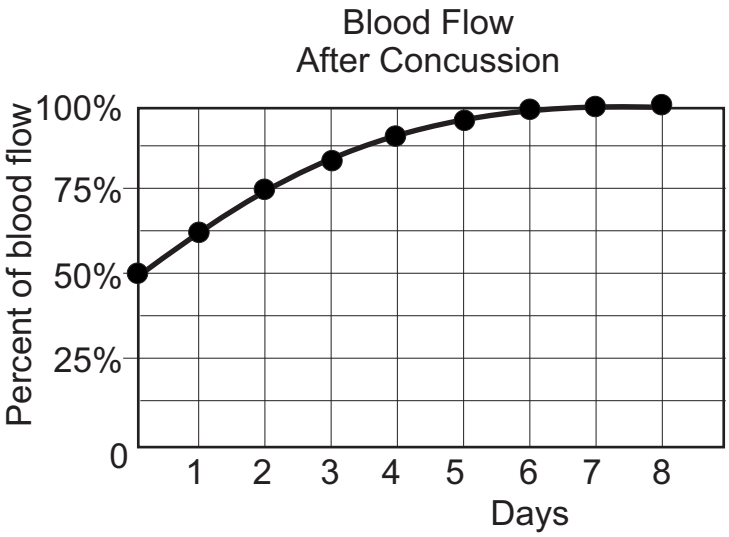
8. $y^2 + w$

9. $\frac{-2z - 15x}{3y}$

10. $(x - y)^2$

REAL LIFE SITUATIONS

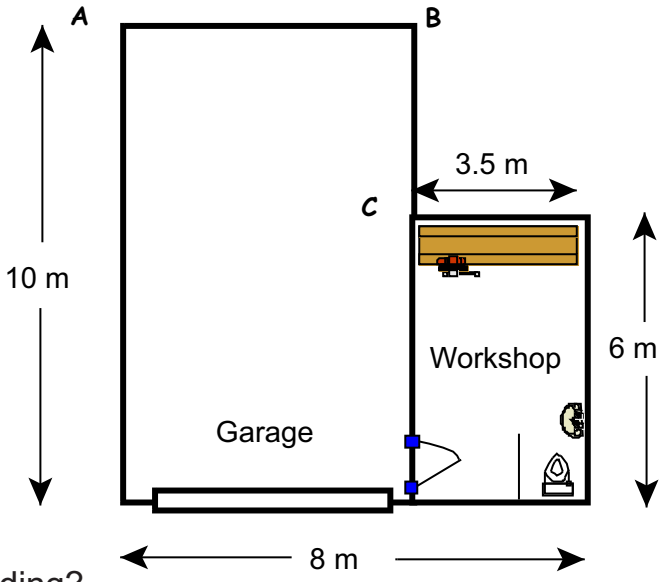
Many athletes suffer concussion as a result of a sports collision or injury. The graph below shows the relationship between blood flow to the brain and the number of days after the concussion.



Describe the graph and comment on the statement “Athletes should have two weeks rest after a concussion.”

BUILDING WITH MATHEMATICS

This diagram is a plan view of a garage and workshop.
All dimensions are in metres.



1. Calculate the missing dimensions.

AB = _____ m

BC = _____ m

2. What is the total perimeter of the building?

_____

_____

3. What is the total area of the building?

_____

_____

The diagram below shows the front view of the garage and the workshop.
The roof forms an isosceles triangle with the rest of the building.

4. What is the area of the isosceles triangle that is formed (DEF)?

_____

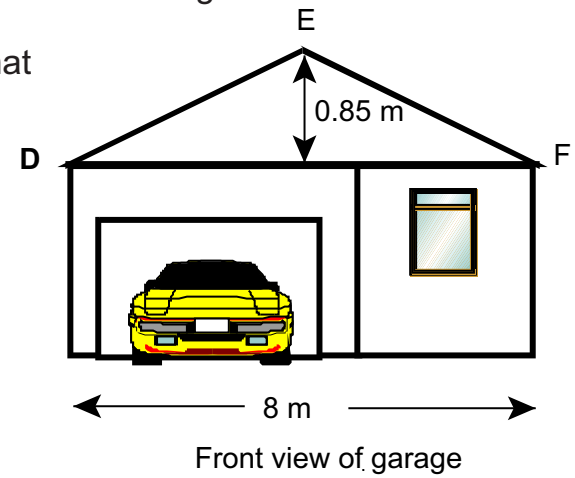
_____

5. What is the length of the roof marked DE?

_____

_____

_____



Front view of garage

6. What is the angle of slant on the roof (EDF and EFD)?

_____

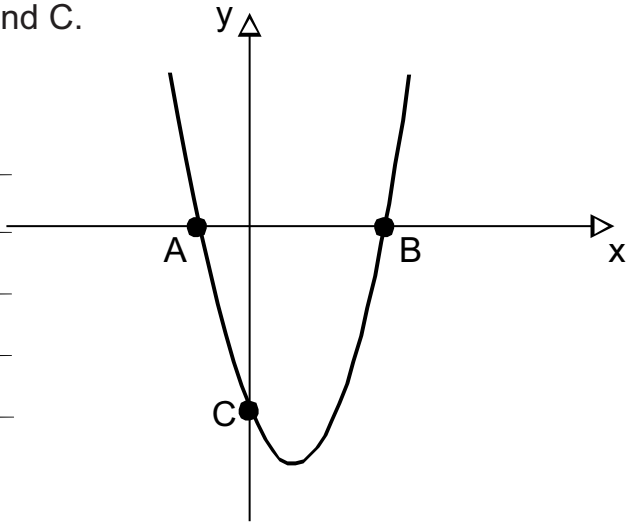
_____

PLOTTING PARABOLAS

1. Factorise $x^2 - 5x - 24$

2. Solve the equation $x^2 - 5x - 24 = 0$

3. The sketch below shows the graph of $y = x^2 - 5x - 24$. The curve forms a parabola and cuts the x axis at the points A and B. The curve also cuts the y axis at point C. Write down the co-ordinates of A, B and C.

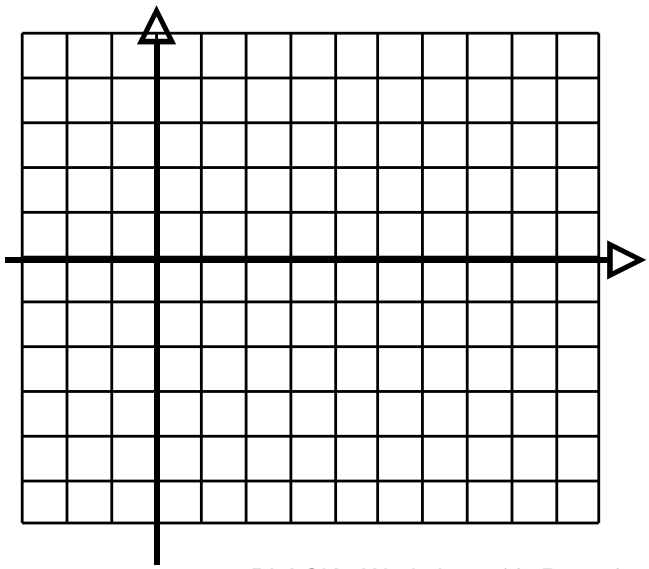


4. The graph of the equation $y = x^2 - 4x - 1$ forms a curve called a parabola.
Complete the table of values below.
Use these values to sketch the graph of $y = x^2 - 4x - 1$ on the grid below.

x	-1	0	1	2	3	4	5
x^2							
$- 4x$							
$- 1$							
y							

5. Draw the straight line represented by $y = 2x - 6$. Write the intersection points of the parabola with this equation

6. The two graphs intersect where
$x^2 - 4x - 1 = 2x - 6$.
Solve the equation to see if your answer to 5. (above) is correct.



EXPANDING

Expand and simplify the following

$(x + 7)(x + 3)$	$(x + 6)(x + 4)$	$(x + 6)(x + 2)$
$(x + 5)(x + 3)$	$(x + 3)(x - 2)$	$(x + 4)(x - 1)$
$(x + 9)(x - 3)$	$(x + 7)(x - 6)$	$(x - 5)(x + 3)$
$(x - 8)(x + 5)$	$(x - 10)(x + 6)$	$(x - 9)(x + 2)$
$(x - 4)(x - 3)$	$(x - 5)(x - 2)$	$(x - 8)(x - 4)$
$(x - 4)(x - 2)$	$(x + 4)(x - 4)$	$(x + 10)(x - 10)$
$(x + 5)^2$	$(x + 8)^2$	$(x - 7)^2$

BLACK Worksheet 19

NUMBER CALCULATIONS

1. John invests $610 into a bank account paying compound interest at a rate of 6.5% per annum. By completing the spaces below, calculate the total amount in John's account after 2 years. Round your final answer to 2 decimal places.

Starting Amount: $ _____ × _____ = Year 1 Total Amount: $_____

Year 1 Amount: $ _____ × _____ = Year 2 Total Amount: $_____

The heat setting of a gas oven is called its Gas Mark. A Gas Mark, G, can be converted to a temperature, C° by using the formula: C = 15G + 120

2. Factorise the expression 15G + 120.

_____

3. Make G the subject of the formula C = 15G + 120.

_____

_____

The distance from the Earth to the Moon is 400 000 kilometres.

4. Write the number 400 000 in standard form.

_____

5. The distance from the Earth to the Sun is 1.5×10^8 kilometres.

Calculate the value of the expression: $\frac{\text{distance from the Earth to the Moon}}{\text{distance from the Earth to the Sun}}$

Give your answer in standard form.

_____

_____

_____

MEDICAL MATH

Chemists studying the use of aspirin have found that the amount of aspirin (in milligrams) in your bloodstream after t hours is given by the function $y = A(0.7)^t$ where A is the initial amount of aspirin in a given dose.

1. A doctor prescribes 2 aspirin tablets every 4 hours. Each tablet has 200 mg of aspirin. How much aspirin will still be in the bloodstream after 8 hours?

A car and an ambulance are traveling towards each other. They are 1 km (1000 metres) apart. The car is traveling at a speed of 50 km / hr (13.9 metres / second). The ambulance is traveling faster at 80 km / hr (22.2 metres / second). The ambulance is racing to an accident and has its siren on. In ideal conditions, the siren can be heard from 400 m.

2. If the conditions are ideal, in how many seconds will the driver of the car first hear the siren?

MATHS IN SPACE

The book “Rocket Boys” was made into a movie called “October Sky”. It is based on the true story of a coal miner’s son who takes up rocketry and eventually becomes a NASA scientist. In the story he experiments with different rocket designs.

He uses a formula $R = \frac{S + F + P}{S + P}$

R is the mass ratio of a rocket.
S is the mass of the structure.
F is the mass of the fuel.
P is the mass of the payload (that part of the rocket such as satellites etc that are being carried for a fee into space).

A more efficient rocket design requires less propellant to achieve a given goal, and would therefore have a lower mass ratio. A higher mass ratio permits the rocket to achieve a higher velocity. Typical rockets have mass ratios in the range from 8 to 20. The Space Shuttle, for example, has a mass ratio of 16.

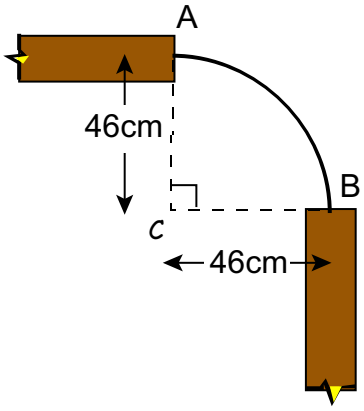
A small rocket is designed with a mass structure of 900 grams and a payload of 1500 grams. How much fuel (in kilograms) should be loaded into the rocket if it is to have a mass ratio of 8?

SICK MATHEMATICS

A nurse dispensing medication has to take into account the weight of the patient. In one particular instant, a patient is taking 150 milligram blood pressure tablets. The dosage is 5 milligrams per kilogram of body weight and the tablets should be taken 3 times a day (every 8 hours). If the patient weighs 120 kg, how many tablets would be needed for a 30 day supply?

MATHEMATICS IN DESIGN

The diagram represents the plan view of the corner of a display cabinet. The corner is fitted with a concave piece of glass (represented by the arc AB).



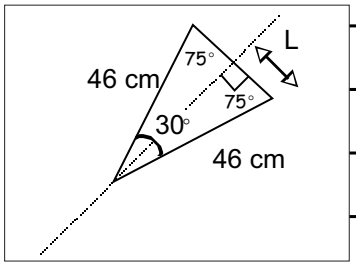
Note: diagram is not drawn to scale

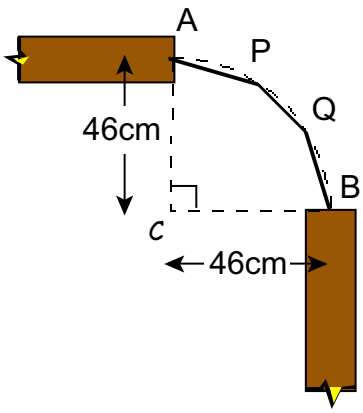
The arc AB is a quarter of a circle with the centre of the circle at C. The circle radius is 46cm.

1. Calculate the length of the arc AB.
Give your answer correct to 3 significant figures.

In another design, the concave window in part 1. is replaced by 3 identical glass panels. These panels are all straight and are represented in the diagram below by the lines AP, PQ and QB.

2. Calculate the length of each panel
(i.e. calculate the lengths of one of AP, PQ or QB).
Give your answer correct to 3 significant figures.





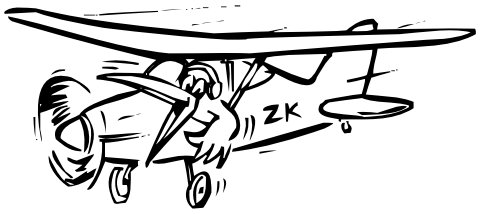
Note: diagram is not drawn to scale

6. The Pyramid Arena is a sports stadium in Memphis, USA. It is the 6th largest pyramid in the world.

It has a 183 metre square base and is 98 metres tall.

What is the volume of this pyramid?

BLACK Worksheet 20



MATHEMATICAL APPLICATIONS

1. On July 20, 1969, Neil Armstrong stepped onto the surface of the moon. On the moon his space suit and life support packs weighed only 15 kg. However the weight of anything on the moon is only one sixth the weight on earth. What would be the weight of his space suit and life support packs on earth?

2. A flock of snow geese was tracked on one particular migration flight. The geese managed to fly 600 km in 7.5 hours. Write an equation so that the distance flown can be worked out for any given time.

3. The intensity of sound can be measured in watts per square metre. The table below gives watts per square metre for some common sounds.

10^{2}	jet plane engine(30 metres away)
10^{1}	pain level
10^{0}	amplified rock music (2 metres away)
10^{-2}	a noisy kitchen / classroom
10^{-3}	heavy traffic
10^{-6}	normal conversation
10^{-7}	average home
10^{-9}	whisper
10^{-12}	barely audible sound

How does the intensity of a whisper compare to that of a normal conversation?

THE PERCENTAGE GAME

1. A concert ticket costs $154. GST of 15% is added to this. What is the total price for 4 tickets?

2. A shirt is on sale for 35% off the original price. If the original price was $79 what is the discounted price?

3. According to the figures released by a job website, the average starting income of a university graduate is $49 478. The average starting income of a person with just a NCEA qualification is $24 395. Calculate the percentage increase in the starting income for a person who leaves school with NCEA and another who goes and earns a University degree.

4. In Chemistry class, Rebecca boiled 120 millilitres of solution for 10 minutes. Afterwards, only 111 millilitres remained due to evaporation. What was the percentage of decrease in the amount of liquid?

5. Fuji wants to gain weight for wrestling. At present he is 90 kg but to wrestle in the heavy-weight class he wants to be 105 kg. What is the percentage of weight that Fuji needs to gain?

6. Last year the Mahobe share price rose 32% in the first half of the year and then it rose a further 10% in the second half of the year. What was the overall percentage change?

APPLYING MATHEMAICS

Pressure is commonly measured in “pounds per square inch” (PSI).

The formula $P = \frac{1.2W}{H^2}$ represents the amount of pressure exerted on the floor by the heel of a shoe.

P represents the pressure in pounds per square inch (PSI)
W represents the weight of a person wearing the shoe (in pounds)
H represents the width of the heel of the shoe (in inches)

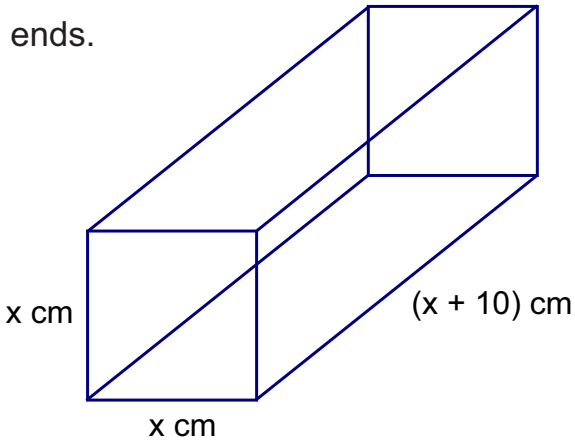
1. Find the weight of the person (in kg) if the heel is 75 mm wide and the pressure exerted is 25 pounds per square inch. Note - you need to convert mm to inches (25 mm = 1 inch) and investigate how many pounds in a kilogram.

2. When exercising, a person’s pulse should not exceed a certain limit depending on that person’s age. The maximum rate is represented by the expression: $P = 0.8(220 - a)$ where a is the age in years. Tim is advised by his trainer that his maximum pulse rate should not exceed 152. What is Tim’s age?

3. Exercise physiologists have found that the formula $L = 0.0625s^2$ can approximately determine the maximum running speeds (in metres per second) that a person with leg length L (in metres) can sustain. Find the maximum running speed of a person with leg length 0.68 metres.

USING ALGEBRA AND MEASUREMENTS

The diagram shows a wire box frame with square ends.
The frame is made using 100 cm of wire.



1. Form an equation, then find the value of x.

2. Calculate the volume of the box.

3. A 900 gram block of Edam cheese measures 18 cm × 9 cm × 5 cm.
Calculate the volume of the block of cheese.

4. How many 900 gram blocks of cheese will fit in the carton shown? Most freight companies require the mass of a full carton to be under 25 kg. This make it easier to handle. Could the full carton of cheese meet this requirement?

5. Edam cheese has 20% fat and Cheddar cheese has 35% fat. If 900 grams of Edam and 500 grams of Cheddar are blended together, what is the final percentage of fat in the final blended cheese?

BLACK Worksheet 21

If a = 48, b = 12, c = 7 and d = 4, calculate:

1. $\sqrt{a - b}$

2. $\sqrt{a + b + d}$

3. $-(c + d) + \sqrt{ab}$

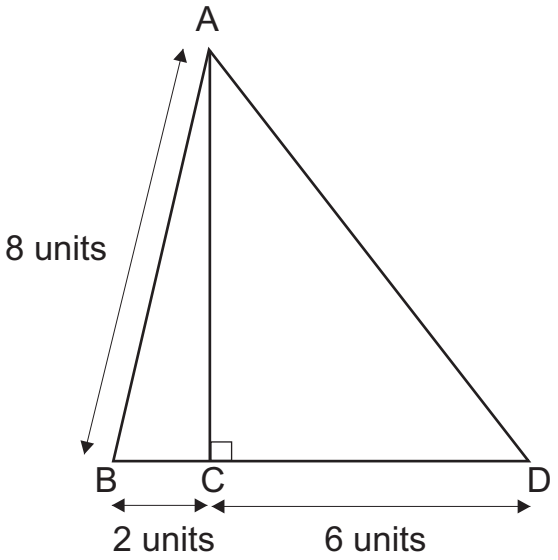
4. $\sqrt{b^2 - (a + c + 2d)}$

5. $\sqrt{(a^2 + b^2 + c^2 + 3)}$

CHALLENGES

1. What is $\sqrt{500}$ to the nearest integer?

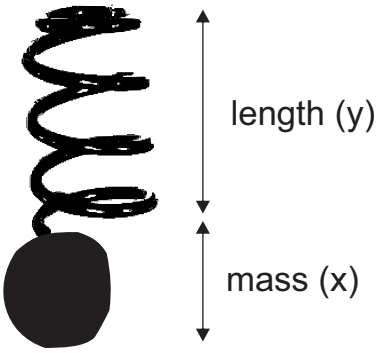
2. Solve $(x - 2)^2 + 1 = 37$



3. Find area of triangle ACD.

HANGING OUT

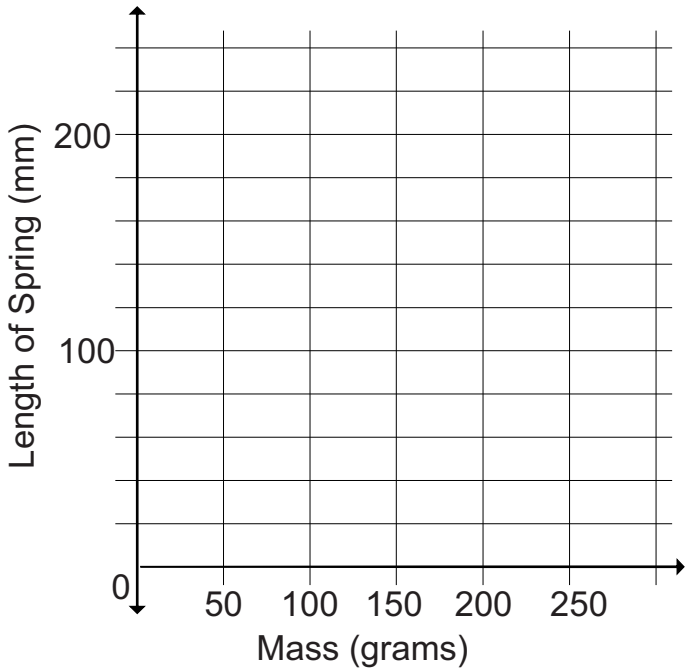
The table below gives the length of a spring when different masses are suspended from it.



Mass (grams), x	0	50	100	150	200
Length (mm), y	80	120	160	200	240

1. Draw the graph of the table.

Length of Spring
when different sized masses are attached



2. Does the graph represent a linear function?

3. Write an equation for the line you have drawn.

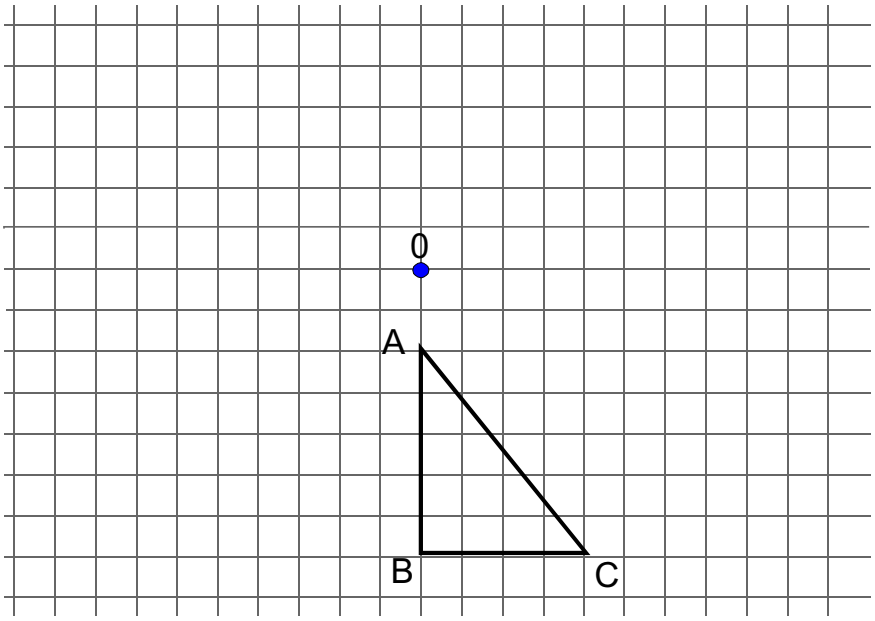
4. If 500 grams was attached to the spring, what would be the length of the spring?

WHAT A WASTE!

For Waikato counties with a population, p, the equation W = 0.798p - 3785 approximates the amount of solid waste, W, (in tonnes) that was disposed during 2010.

1. The population of Hamilton is 140 700. To the nearest thousand tonnes, find how much solid waste was disposed of in Hamilton during 2010.

ROTATION, VECTORS and REFLECTION

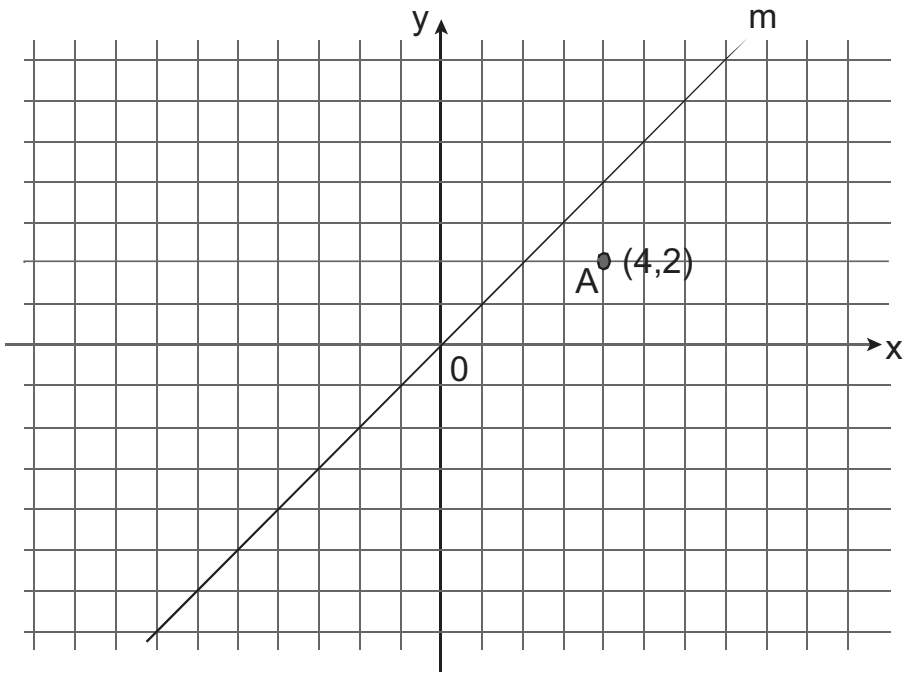


1. On the diagram above, draw the image of the triangle ABC after an anticlockwise rotation of 90° around point O.

2. Label your new image A'B'C'.

The image triangle A'B'C' is then translated by $\begin{pmatrix} 10 \\ 5 \end{pmatrix}$

3. Draw and label the resultant triangle A" B" C".



4. The graph shows the point A(4,2) and the line m (y=x). A → B under a reflection in the line m. Draw and label the point B on the graph.

5. B → C under a rotation of 90° anticlockwise, centre 0.
Write the co-ordinates of C beside your point.

6. Write the column vector for the translation B to C. $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$

MONEY MATTERS

Edith is planning to go to university for 3 years. Each university semester is 20 weeks long and there are two semesters per year. To work out the costs over the 3 years she used a spreadsheet on her computer. She began to set up the table shown below.

	A	B	C	D
1	Study Costs Year 1	$4 500		3 year costs
2	Year 2	$5 000		
3	Year 3	$8 000	Total study costs	$17 500
4	Personal Costs (per year)	$6 000	Total personal costs	$18 000
5	Accommodation Costs (per week)	$ 190	Total accommodation costs	$22 800
6			Total cost over 3 years	

1. Write the formulas that Edith would use to calculate the values in Cells D3, D4 and D5 and D6.

2. When Edith finishes her spreadsheet, what value should appear in Cell D6?

When Edith turned 10, her grandparents invested $15 000 in a bank savings account. After tax, the money has earned 4.5% compound interest per annum. Edith now uses a spreadsheet to calculate how much money is in the bank at the beginning of each year and the final amount that will be in the account when she turns 18.

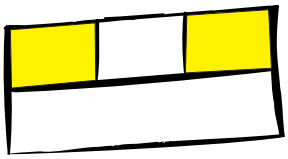
	A	B	C
	Age (yrs)	Amount in the bank	Yearly Interest earned
1	10	$15 000.00	$675.00
2	11	$15 675.00	$705.38
3	12	$16 380.38	$737.12
4	13	$17 117.50	$770.29
5	14	$17 887.79	$804.95
6	15	$18 692.74	$841.17
7	16	$19 533.91	$879.03
8	17	$20 412.94	
9	18		

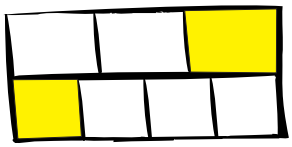
3. Calculate the values for Cells C8 and B9

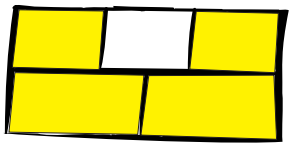
BLACK Worksheet 22

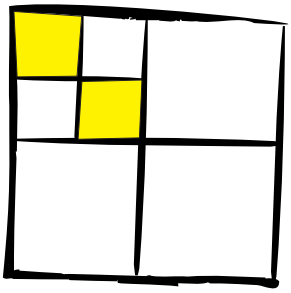
FRACTIONS

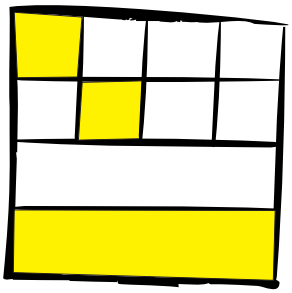
1. What fraction of each shape is shaded?

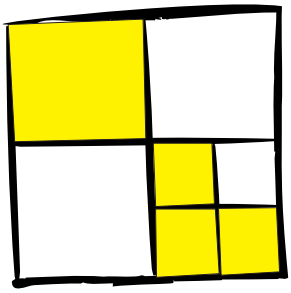












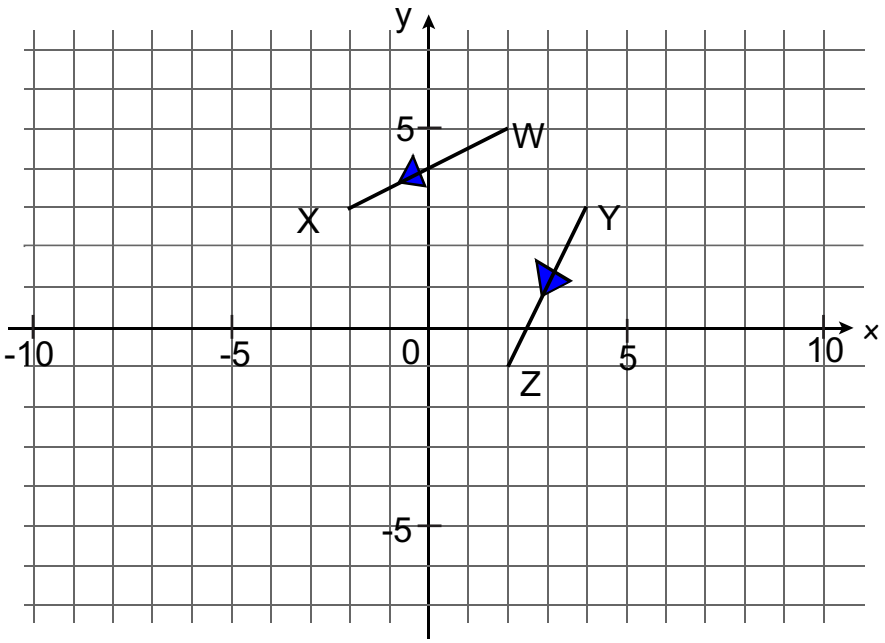
2. Look a the fraction division below and find the values for a and b.

$$\frac{19}{23} \div \frac{a}{b} = \frac{187\ 644}{28\ 382}$$

3. While using a calculator you press the add (+) button and add 36.5 instead of pressing the subtract (-) button and subtracting. Your incorrect answer is 118.25. What should the correct answer have been?

TRANSFORMING

The diagram shows the vectors WX and YZ .



1. Write WX as a column vector. $\begin{pmatrix} \quad \\ \quad \end{pmatrix}$

2. WX is reflected in the y axis. Draw the resulting vector.

3. WX can be mapped on to YZ by a rotation.
Write the co-ordinates of the centre of rotation.

4. WX can also be mapped onto YZ by a reflection.
Draw a dotted line on the diagram to indicate the mirror line.

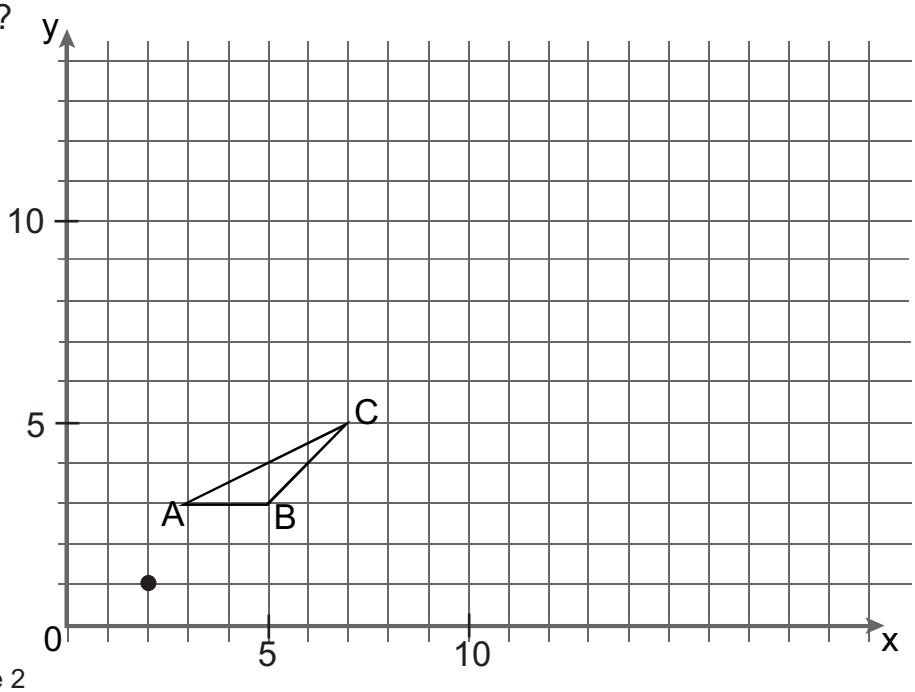
Triangle ABC (see below) has vertices at points (3,3), (5,3) and (7,5).

5. If the centre of enlargement is point (2,1) and the scale factor for enlargement is 3, sketch and label the new triangle A'B'C'.

6. Write the co-ordinates of the new triangle: _____

7. If the area of triangle ABC is 8 cm^2, what is the area of A'B'C'? _____

8. If Triangle ABC is enlarged with scale factor of -1, what is the area of the new triangle?



FACTORISING

Find the missing terms to complete each factorisation

$x^2 + 5x + 6$

$(x + 3)(x + \quad)$

$x^2 + 4x + 3$

$(x \quad\quad)(x + 1)$

$x^2 + 7x + 12$

$(x + 4)(x \quad\quad)$

$x^2 + 6x + 8$

$(x \quad\quad)(x + 2)$

$x^2 + 5x - 14$

$(x + 7)(x - \quad)$

$x^2 + 3x - 28$

$(x \quad\quad)(x - 4)$

$x^2 + x - 20$

$(x + 5)(x \quad\quad)$

$x^2 + 4x - 45$

$(x \quad\quad)(x - 5)$

$x^2 - 7x + 12$

$(x - 4)(x \quad\quad)$

$x^2 - 8x + 16$

$(x \quad\quad)(x - 4)$

$x^2 - 10x + 24$

$(x - 6)(x \quad\quad)$

$x^2 - 13x + 30$

$(x \quad\quad)(x - 3)$

$x^2 - x - 12$

$(x - 4)(x \quad\quad)$

$x^2 - 4x - 21$

$(x \quad\quad)(x + 3)$

$x^2 - 4x - 5$

$(x - 5)(x + 1)$

$x^2 - 3x - 40$

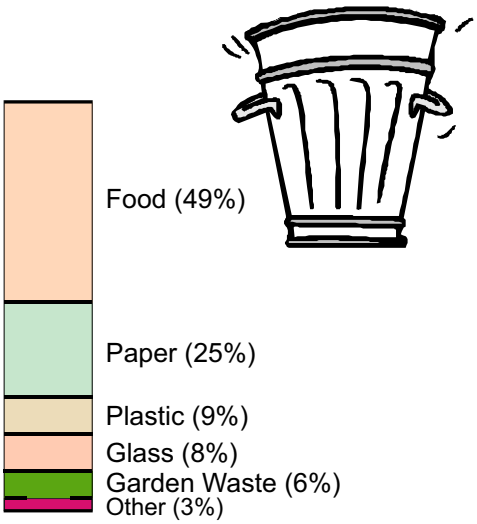
$(x \quad\quad)(x + 5)$

$x^2 + 12x + 36$

$(x + \quad\quad)(x \quad\quad)$

$x^2 - 25$

$(x \quad\quad)(x \quad\quad)$



The Martin's family garbage weighs 38 kg.

Use the diagram above to calculate the amount of food refuse that is in the tin.

Food _____

Paper _____

Glass _____

Plastic _____

Garden Waste _____

Other _____

Quadratic Trinomials.

A quadratic expression has the form $ax^2 + bx + c$, where $a \neq 0$. Sometimes there will be no "bx" part and sometimes no "c" part (if $b = 0$ or $c = 0$). A quadratic trinomial has all 3 parts - the x^2 part, the bx part and a number, c. Sometimes you will be given a quadratic trinomial and be asked to factorise it. This means that you have to find an expression with two sets of brackets that expand into the quadratic.

CREDIT CRUNCH

Alicia receives an offer for a credit card in the mail. The bank offers “A Great Deal”. If she signs up for their credit card they will give her a $500 limit with minimum monthly payments of $20 and interest of 21%

The offer sounds too good to be true so Alicia signs up and immediately goes out and purchases a new cell phone for $500.

1. Estimate how long will it take Alicia to pay off the $500 by making the minimum $20 payment each month. You may wish to use a spreadsheet with headings similar to below.

Statement	Amount Due	Payment	Balance	Interest 21% ÷ 12 = 1.75%	Balance Due
1	$500	$20	$480	$8.40	$488.40
2	$488.40	$20	$468.40	$8.20	$476.60
3	$476.40				

2. What will be the total amount paid to the credit card company and what will be the actual interest paid?

A SOUND INVESTMENT?

1. The value of a car decreases over time. Suppose you purchase a car for $10 000. The cars value t years after purchase can be approximated by the function: $V = 10\,000(0.8)^t$. Complete the table below and find out after how many years the car will be worth less than $5000.

Year (t)	0	1	2	3	4	5
Car Value $V = 10\,000(0.8)^t$	$10 000					

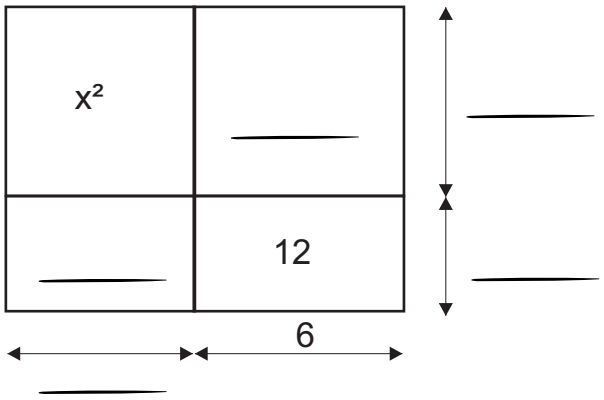
BLACK Worksheet 23

FACTORS, SUMS and AREAS

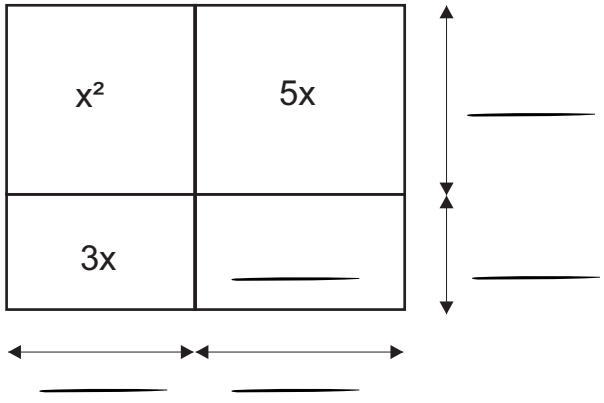
1. Each of the top numbers in the table below can be factored as a product of two numbers whose sum is the bottom number in the column. Fill in all the missing numbers.

Product	36	56	63	72	96	___	___	___	168	432
Factor	18	___	___	___	12	9	15	21	8	___
Factor	2	___	___	___	___	10	12	___	___	18
Sum	20	15	16	38	___	___	___	24	___	___

2. Write the missing products and dimensions of each quadrilateral.
Write an expression that gives the area of the figure.
The figures are not drawn to scale.



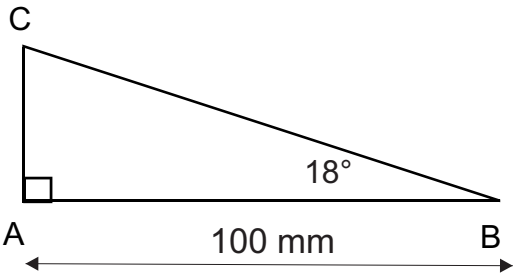
Area = _____



Area = _____

CONSTRUCTIONS

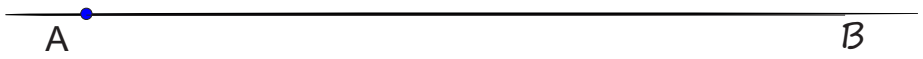
You are going to construct a triangle similar to the one below.



1. Construct a line through A, perpendicular to AB.

2. Use your protractor to draw ABC = 18º and complete the triangle ABC.

3. Using the diagram you have drawn, measure the length of BC to the nearest millimetre.

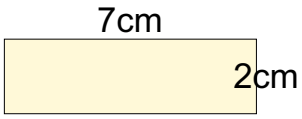


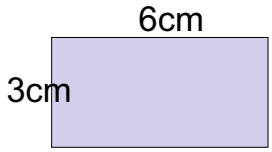
4. Use Trigonometry to verify your BC length answer.

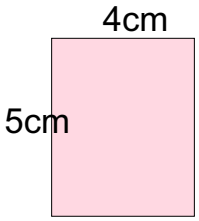
5. Measure the length of AC then use either Trigonometry or Pythagorus to verify your answer. Explain one reason why the answers could be different.

GRAPHING AREAS

The diagram shows three rectangles.
Their base and height measurements add up to 9 cm.





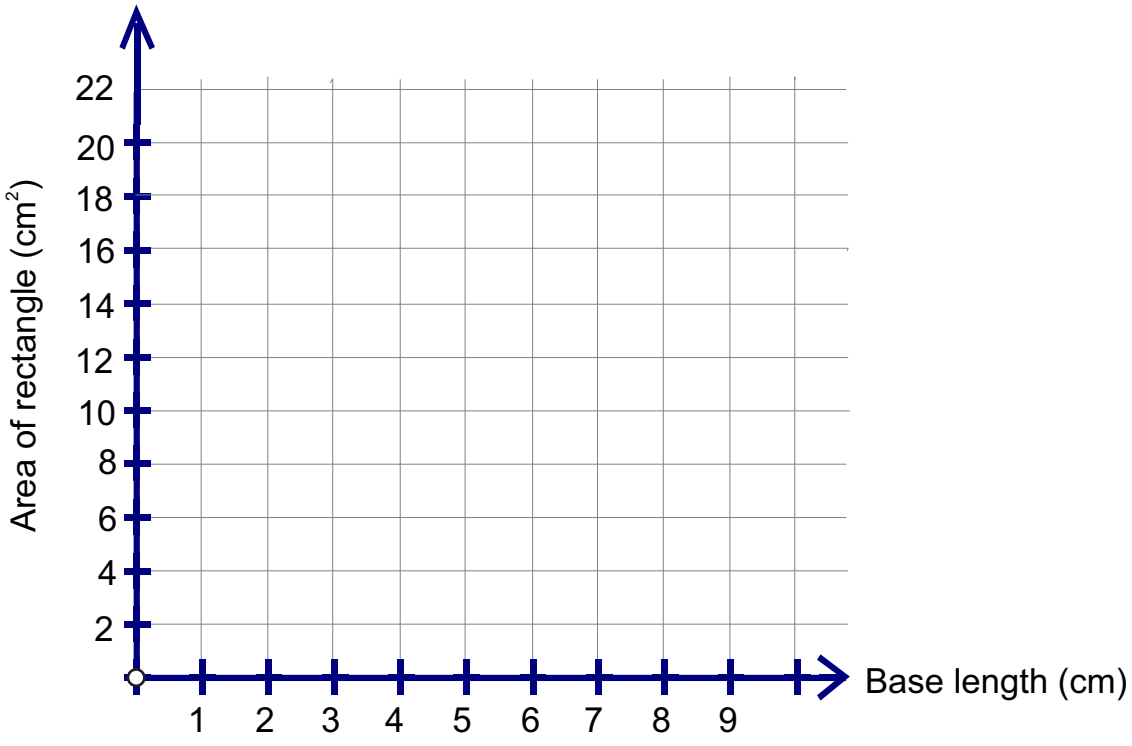


The table below shows the area of rectangles with base and height adding to 9 cm.

1. Complete the table then use the table reults to draw complete the graph below.

Base of Rectangle	Height of Rectangle	Area of Rectangle
8 cm		
7 cm	2 cm	
6 cm	3 cm	
5 cm	4 cm	
4 cm		
3 cm		
2 cm		
1 cm		

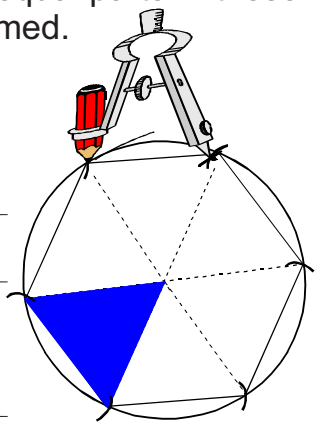
.



2. What is the largest area for a rectangle whose base and height add up to 9 cm?

CIRCULAR MATHEMATICS

Stepping the radius around the circumference of a circle, gives six equal parts. If these points are then joined to the centre of the circle, 6 triangles are formed.



1. What sort of triangles are formed from this process?
Give a reason for your answer.

_____

_____

2. What is the size of each angle in the triangles?

_____

3. If the radius of the circle is 5 cm calculate the area of the triangle that is shaded.

_____

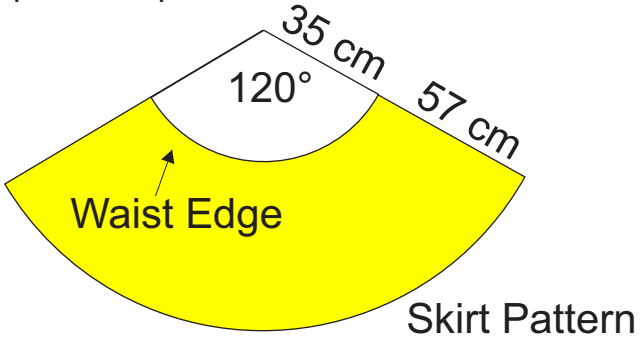
_____

_____

Edith decides to make a skirt. The pattern's shape forms part of a sector of a circle.

4. What fraction of a circle is this sector?

_____



Skirt Pattern

5. The circumference of a circle is measured by the formula _____

6. Use your formula to calculate the length of the waist edge on the pattern to the nearest whole number.

_____

_____

_____

7. How many square metres of material is being used in the dress?

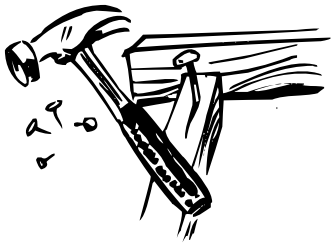
_____

_____

_____

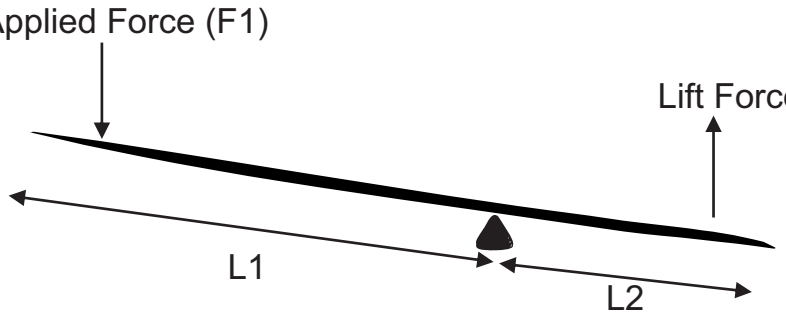
_____

BLACK Worksheet 24



MATHEMATICS IN TECHNOLOGY

Forces and lever arm distances obey an “inverse proportion”.



$$\frac{F1}{F2} = \frac{L2}{L1}$$

1. A 100 kg weight is applied to one end of a leaver 2.2 metres long. The leaver is pivoted 0.2 metres from its end. What lift force is exerted?

2. Pulleys transfer power in much the same way as a gear. Different speeds can be obtained by changing the sizes of the pulley diameters and the speed of the driving pulley. For the pulley system shown below, the speed of the pulley is inversely proportional to its diameter. If Pulley A has a diameter of twice that of Pulley B then when Pulley A makes one turn, Pulley B will make 2 turns (assuming there is no slippage in the belt).

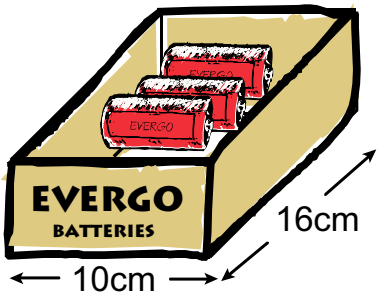
Pulley A Pulley B

$$\frac{\text{Speed of Pulley A}}{\text{Speed of Pulley B}} = \frac{\text{Diameter of Pulley B}}{\text{Diameter of Pulley A}}$$

If Pulley B is 10 cm and is rotating at 240 rpm (revolutions per minute) then calculate the speed of Pulley A if its diameter is 25 cm.

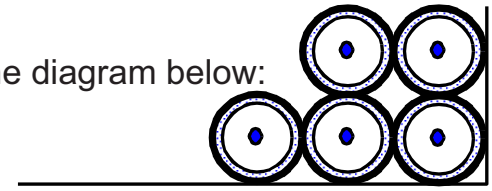
MATHEMATICS AND PACKAGING APPLICATIONS

Evergo batteries are shaped and packed as in the diagram. Batteries are 2 cm in diameter and 5 cm long. Batteries are packed in rectangular boxes which are 16 cm long and 10 cm wide.



1. If batteries are packed as in the diagram, how many will fit on the bottom layer of the cardboard box?

2. The batteries are packed in two layers, as in the diagram below:
The batteries are sold for 75 cents each.
What is the cost of a box of batteries?



3. Some shops give a 10% discount if customers purchase a box of batteries. How much would a box of batteries cost if a 10% discount was given?

MATHEMATICS AND SCIENCE APPLICATIONS

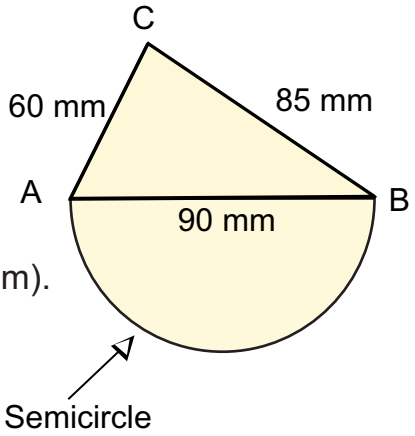
1. Adele has 20 milliliters of a 30% solution of Sulphuric Acid. She needs a 25% solution for a class experiment. She also has a bottle of 15% solution of Sulphuric Acid. She needs to calculate how many milliliters of the 15% solution she should add to obtain the required 25% solution. She draws up the following table:

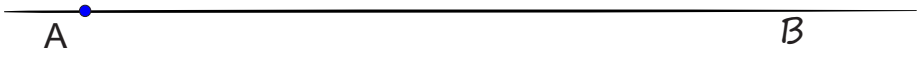
	Amount of Solution (mL)	Amount of Sulphuric Acid
30% solution	20	0.30(20)
15% solution	x	0.15x
25% solution	20 + x	0.25(20 + x)

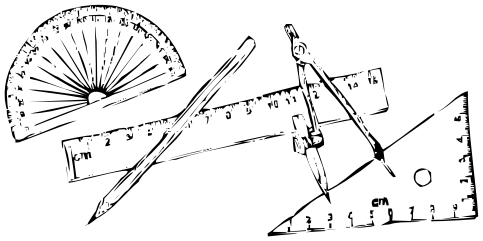
She then forms an equation to solve: $0.30(20) + 0.15x = 0.25(20 + x)$.
Solve the equation and find how much of the 20% solution should be added.

CONSTRUCTIONS

1. Draw an accurate pattern of the shape shown.
You need to:
i. Use a compass and ruler to find point B.
ii. Construct a perpendicular bisector of AB.
iii. Draw the semicircle with AB as diameter.
iv. Find point C (Length AC = 60 mm, Length BC = 85 mm).





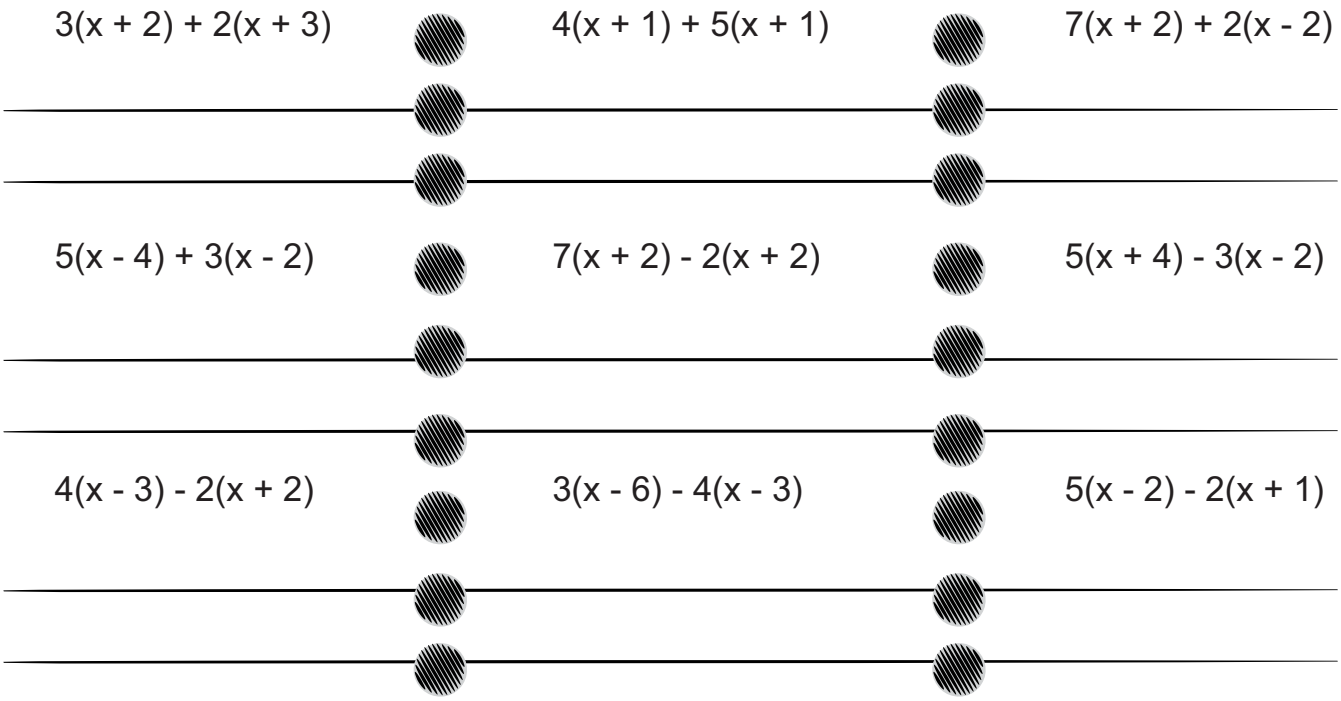


2. Calculate the area of the shape you have drawn.

Did you know that you can check your answer by using the online calculators at the mathscentre website? Just use the triangle and the sector calculators to work out each separate area. The add together the two areas

ALGEBRA

1. Expand and simplify each expression



2. Factorise the following expressions by completing.

12x + 6 = 6( )

16x - 12 = 4( )

6x + 18 = (x)

24 - 20x = (5x)

12x - 9 = (4x)

2x + 4y = 2( )

3. Factorise the following:

10 - 2a = _____

12b - 9 = _____

8g + 20 = _____

16y + 12 = _____

6x - 20 = _____

9 - 24d = _____

x^2 + 7x = _____

a^2 - a = _____

a^2p + a^2 = _____

$10b^2$ - b = _____

4. Factorise the following:

2x + 2y + ax + ay = _____

= _____

3x + 12 + xy + 4y = _____

= _____

BLACK Worksheet 25

PERCENTAGES FOR TRADESMAN

1. A mechanic buys an air filter for $47.98. His mark up is 140%. What does he charge a customer for the airfilter?

2. The electricity line voltage is 225 volts. During a system malfunction the voltage drops 5.5%. What is the reduced voltage?

3. Due to a change in specifications the cost of a new kitchen increases by 25%. If the original cost was $16 750, what will be the new cost?

4. By using an automatic welding machine the time taken to weld a new tank can be reduced by 40%. Originally it was budgeted to take 30 hours. How long will it take with the machine?

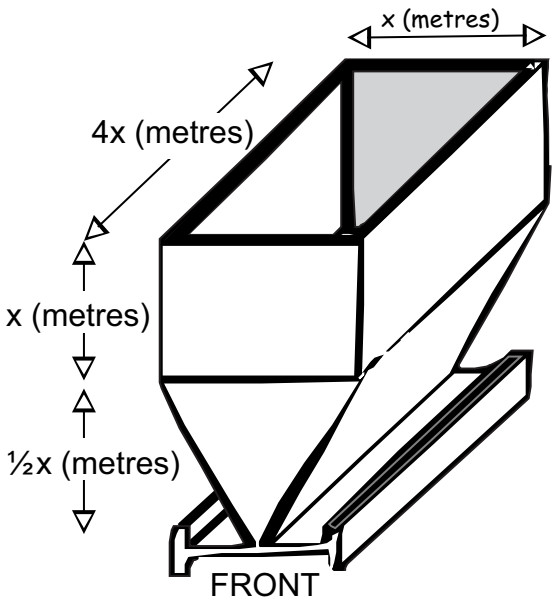
5. Air-conditioning engineers reduce a heating duct from 1.1 metres to 0.96 metres. What was the percentage decrease in length?

6. The reading on a pressure valve increases from 35 psi to 42 psi. What is the percentage increase?

7. A car's water pump costs $82.20. The pump is sold to a customer for $205.50. What is the percentage markup?

THE RIGHT DIMENSION

The diagram represents a grain hopper. The hopper has a length of 4x metres and has a constant cross-sectional area comprising of a square of side length x metres and a triangle with a perpendicular height of ½ x metres.



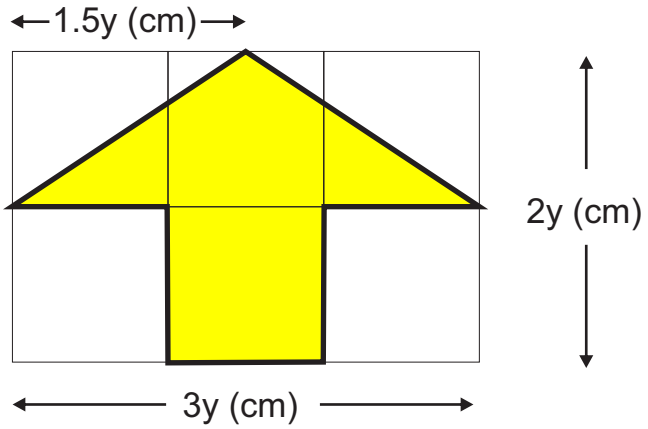
1. Find in terms of x, the area of the cross-section (of the front) of the hopper.

Cross sectional area
= Area Square + Area triangle

2. What is the volume of the hopper?

3. The hopper can hold 40 m^3 of grain.
Calculate the size of x.

4. Find the area of the arrow shown below.



5. If 2x + y = 10 cm, what is the value of 4x?

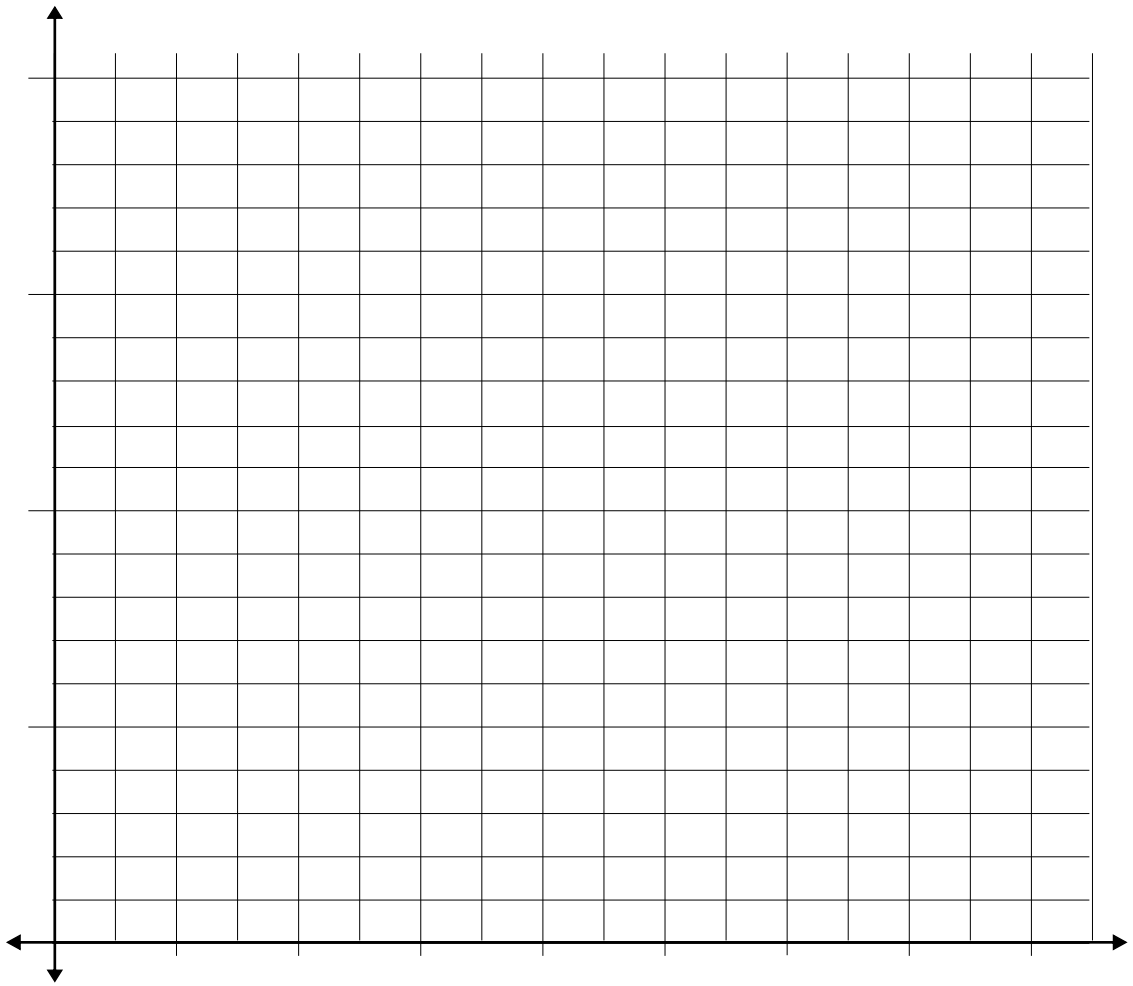
LINEAR GRAPHS AND REAL LIFE APPLICATIONS - DIVING

Quite often, diving books work in imperial measurements. This means that depths are given in feet and inches and pressure in terms of psi (pounds per square inch). Most diving manuals state that underwater pressure increases by 4.3 pounds per square inch (psi) for every 10 feet you descend.

This can be expressed by the equation $p = 0.43d + 14.7$

p = the pressure in pounds per square inch
d = the depth of the dive in feet

i. Draw a graph of this equation.
ii. Use your graph to estimate the depth where you would reach 150 psi.



DIVE DEPTH	50	100	150	200	250	300	350	400
PRESSURE								

ALGEBRA WORKOUT

Expand and simplify:

$-5(x - 5y)$

$5x + 2(x + 6)$

$(x + 6)(x + 5)$

$(x + 4)(x - 4)$

$(x + 3)(2x - 5)$

$(x - 7)(x - 6)$

$(x - 10)^2$

$\frac{x^2 - 9}{x^2 - 4x + 3}$

$(2x + 7)(3x - 6)$

Factorise:

$3a^2 - ab$

$4x^2 - 16$

$1 - x^2$

$3x^2 - 12$

$x^2 - 4x + 4$

$x^2 + 6x - 16$

$x^2 - 5x - 6$

$x^2 + 12x + 36$

$2x^2 + 14x + 20$

Solve:

$40x = 10$

$x^2 = 4x + 60$

$\sqrt{16x^2} = 20$

BLACK Worksheet 26

MATHEMATICS AND NUTRITION

Most foods are required by law to show factual information regarding nutrition. Below is the information taken from a label on Puffed Wheat Breakfast Cereal. The '% Daily Intake' figures are based on a 2000 calorie diet. For breakfast, you like to eat 2 cups of Puffed Wheat with 1 cup of skim milk.

Nutrition Facts

Serving Size: 1 cup (30 grams)
Servings per container: 18

Amount per serving	**Puffed Wheat**	**With ½ cup skim milk**
Calories	120	160
Calories from fat	10	10
	% Daily Intake	
Total Fat	1%	2%
Cholesterol 0 mg	0%	1%
Sodium 220 mg	9%	12%
Potassium	3%	9%
Total Carbohydrates 24g	8%	10%
Dietary Fibre 3g	12%	12%
Sugars 4g		
Vitamin A	10%	15%
Vitamin C	10%	10%
Calcium	0%	15%
Iron	45%	45%
Vitamin D	10%	25%
Thiamin	50%	50%
Riboflavin	50%	60%
Vitamin B6	50%	50%
Folic Acid	50%	50%
Phosphorus	10%	20%
Magnesium	8%	10%
Zinc	50%	50%
Copper	4%	4%

1. How many calories are consumed with your breakfast cereal?

2. What percent of the daily intake of fat do you consume?

3. You increase the milk on your cereal to 1½ cups. How many extra calories will you consume?

4. Nutritionalists recommend that you eat a breakfast food that provides at least 10% of daily Vitamin C intake. Do you get this with your bowl of Puffed Wheat?

5. Nutritionalists recommend that 20% of your daily calories come from breakfast. You are told that you need at 2500 calories during the day. Are you getting the right amount of calories with your breakfast of Puffed Wheat with milk?

USING MATHEMATICS AT THE POOL

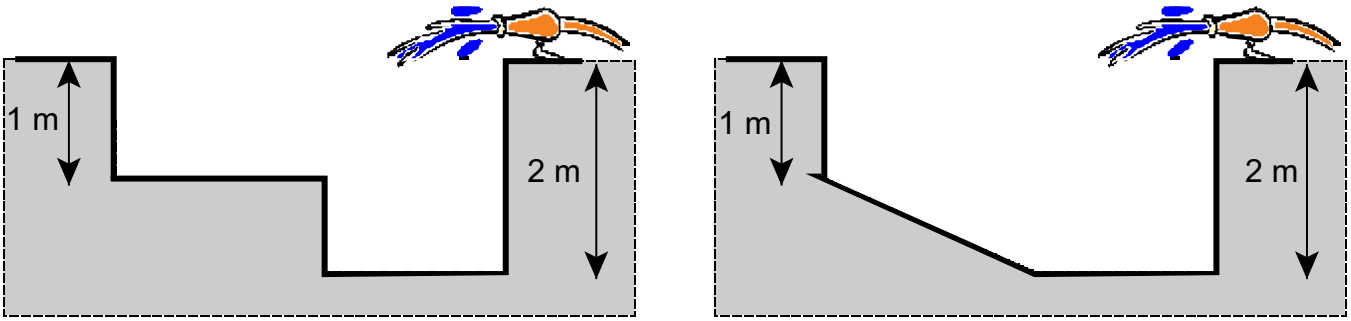
1. A rectangular shaped swimming pool is used at Mahobe College for interschool swimming competitions. It is 50 metres long, 32 metres wide and 2.4 metres deep. Once a year the pool is drained for service. There are two drains, one at each end of the pool. Drain 1 empties the pool at 4.5 cubic metres of water per minute. Drain 2 empties the pool at a rate of 5.5 cubic metres of water per minute. If both drains are opened at 9 am, when will the pool be empty?

2. After servicing, the caretaker fills the pool using 3 hoses.
Hose 1 fills at a rate of 2.25 m^3 of water per minute.
Hose 2 fills at a rate of 1.5m^3 of water per minute.
Hose 3 fills at a rate of 2 m^3 of water per minute.

If the hoses are turned on at 6 am, will the pool be ready for afternoon swimming lessons?

3. Sports scientists have calculated that swimmers burn approximately 10.5 calories per minute. The equation C = 10.5t represents C (the number of calories burnt) and t (the time in minutes spent swimming). If one particular swimmer wanted to burn 400 calories, for how long should they swim?

MATHEMATICAL GRAPHS



Two swimming pools are filled using a hose which pours water at a constant rate.
The cross sections of both pools are drawn below.

1. Describe in words how the depth of the water in the deep end of each pool varies with time from the moment that the pools first begin to fill.

Pool A: _____

_____

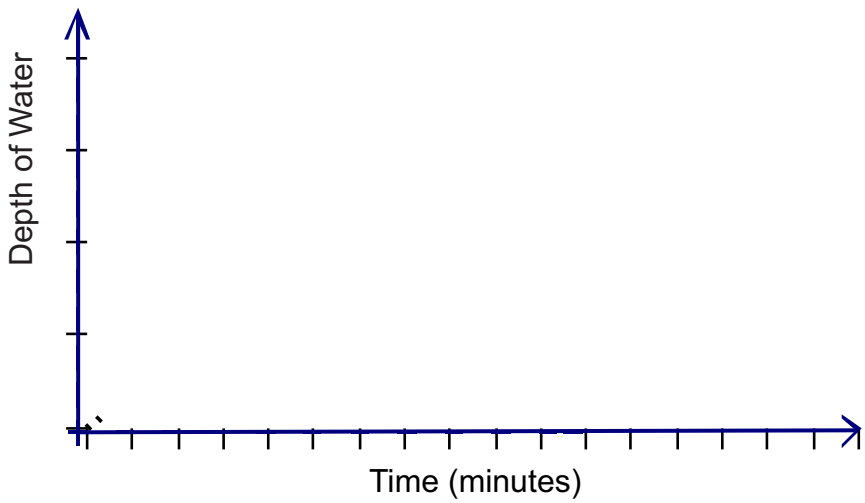
_____

Pool B: _____

_____

_____

2. Sketch a graph showing how the depth of water in the deep end varies with time. Clearly label your graph Pool A and Pool B.



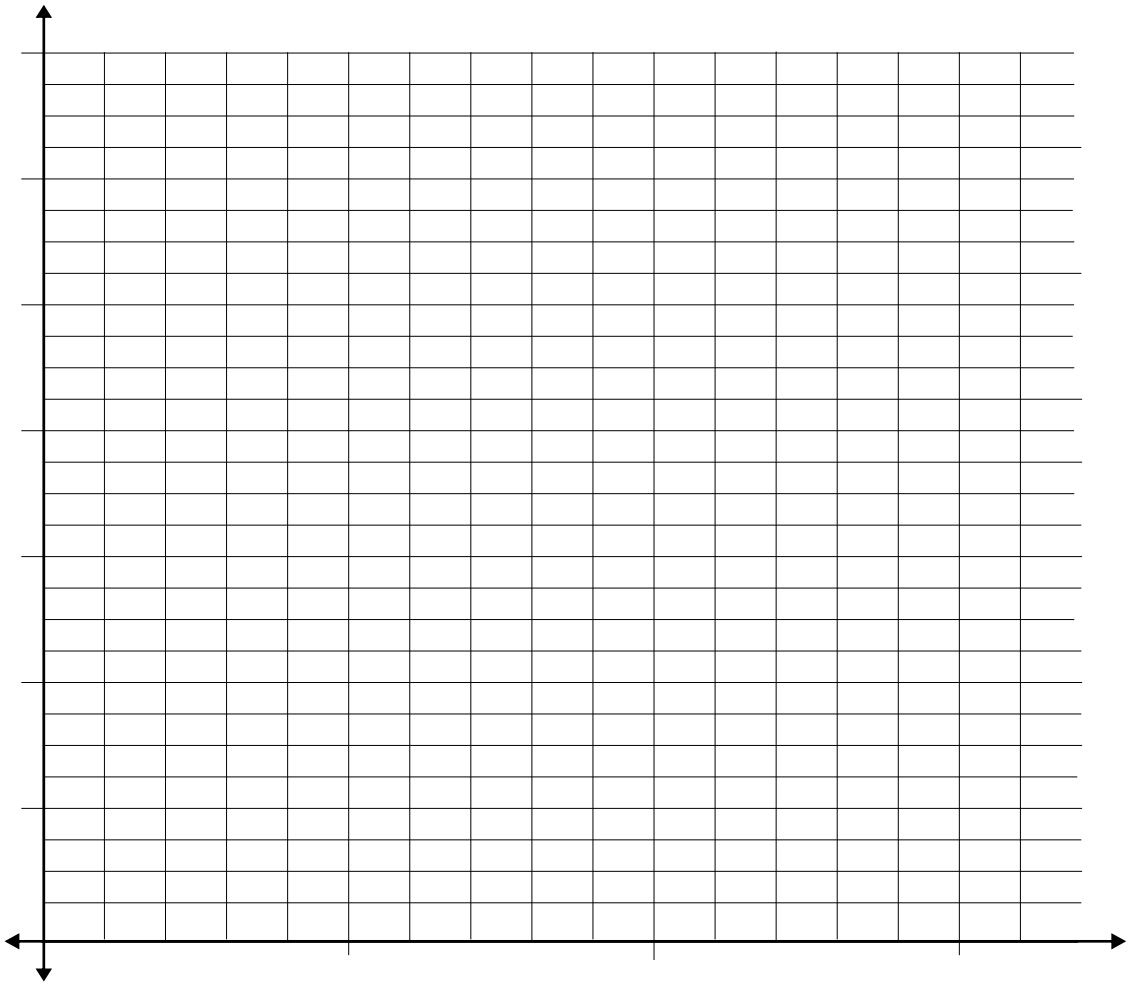
LINEAR GRAPHS AND HUMAN BIOLOGY

The amount of blood in a body can be approximately calculated by using the equation:

$$A = \frac{w}{14}$$

A = the amount of blood in litres
w = the weight of the person in kilograms.

Graph the equation and predict the weight of a person who has 6.5 litres of blood.



WEIGHT (KG)	20	40	60	80	100
BLOOD VOLUME					

BLACK Worksheet 27

SOLVING APPLIED PROBLEMS

Then number of diagonals (d) of a polygon with n sides is given by the formula below:

$$d = \frac{n^2 - 3n}{2}$$

1. Use the formula to find how many diagonals an octagon has.

2. When the adult dosage is known, nurses use "Young's Rule" to determine the amount of medicine to give a child under the age of 12.

$$C = \frac{AD}{A + 12}$$

C = Child's dose
A = Age of child
D = Dose normally given to an adult

Amoxicillin is a powerful antibiotic given for serious infections. The recommended adult dosage is 250 mg every 8 hours. Using Young's Rule, what would be the recommended dosage for a 12 year old child?

3. When several electrical appliances are used at home the total current being drawn is the sum of all the individual currents drawn by each appliance. If two appliances W1 and W2 are being used at the same time, the current flow, I (amps), can be expressed by the formula below. Note - New Zealand voltage (V) is a constant 230 volts.

$$I = \frac{W1}{V} + \frac{W2}{V}$$

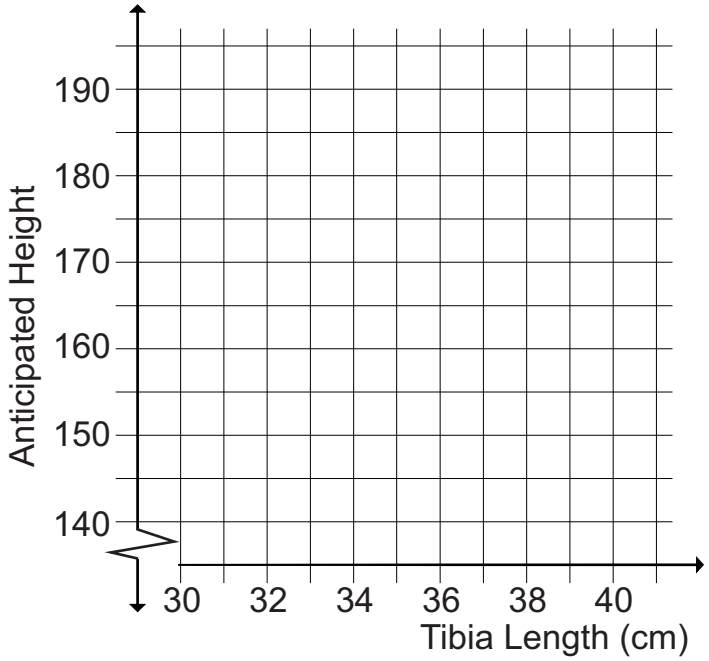
W = Power in watts
V = Voltage (V)

Sally is drying her hair with a hair dryer that is rated at 1600 watts. Her TV is also playing in the room. What power would the TV be rated at if the total current flow is 7.2 amps?

MORE MATHEMATICS

1. A Forensic Anthropologist can determine age, sex and stature of a body by examining teeth and bones. When remains of ancient people have been found, anthropologists can determine their height by using the formula H = 82 + 2.5T (for males) or H = 73 + 2.5T (for females). H represents the height of the person (in cm) and T is the length of the body's tibia bone found.
Complete the table, then graph the resultant pairs of numbers.

MALE		FEMALE	
tibia length (cm)	Height	tibia length (cm)	Height
30		30	
34		34	
38		38	



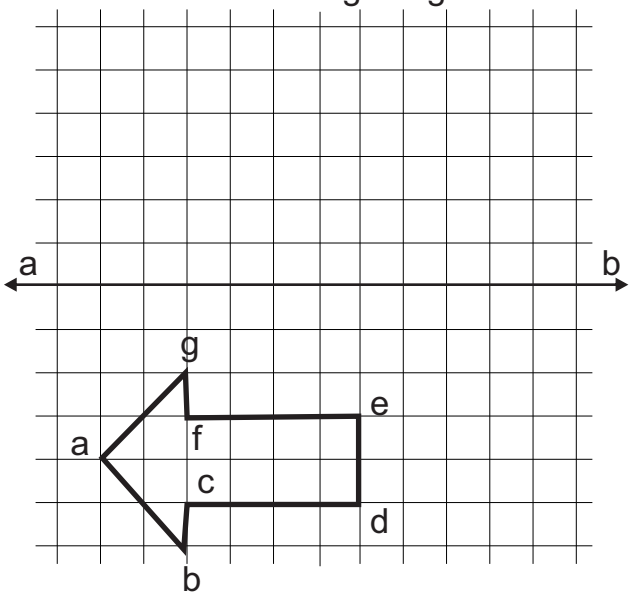
2. If bones are found and you are told that the original body was a 1.74 m male. How long (approximately) should the tibia bone be?

_____

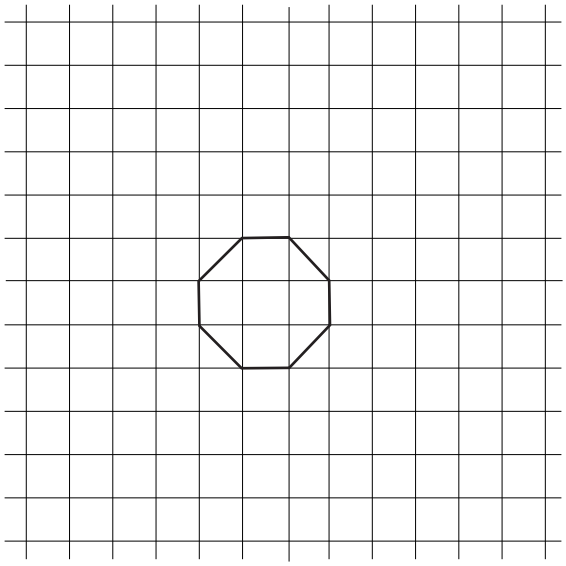
_____

3. An animator draws an arrow head on a grid. She then move the arrow head 4 units right, 2 units up and reflects it in the line ab.

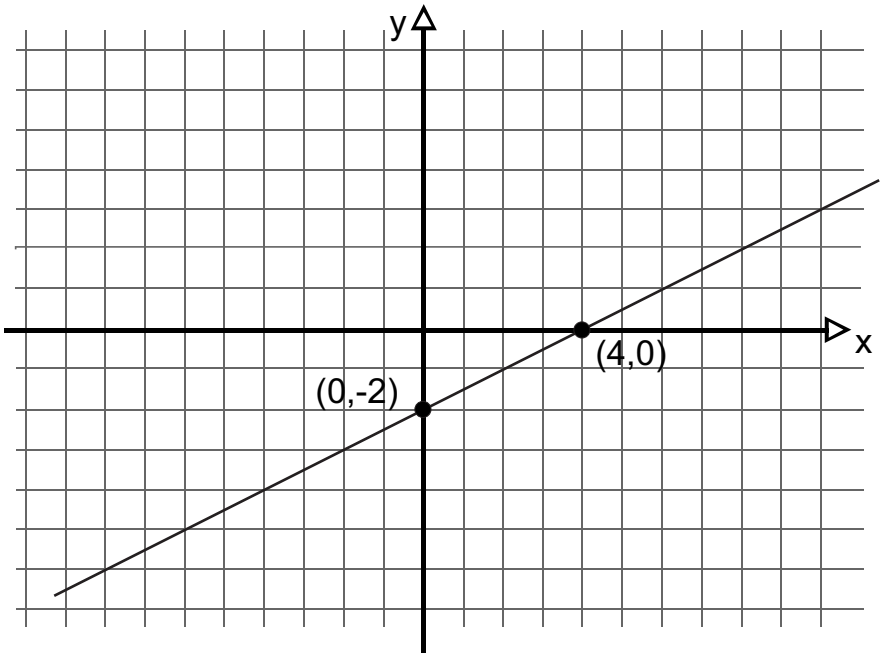
Draw the resulting image



4. Reflect the octagon over each of its sides.



LINEAR LINE GRAPHS



The diagram above shows the graph of $y = \frac{1}{2}x - 2$.

1. What is the gradient of this line? _____

2. On the diagram, draw the graph of $y = -2x + 3$.

3. Using the graph, estimate the point of intersection of the lines: $y = \frac{1}{2}x - 2$ and $y = -2x + 3$.

_____

4. Write an equation of any line that is parallel to $y = \frac{1}{2}x - 3$.

_____

5. The line $y = -2x + 3$ is reflected in the y axis.
What is the equation of the new line?

_____

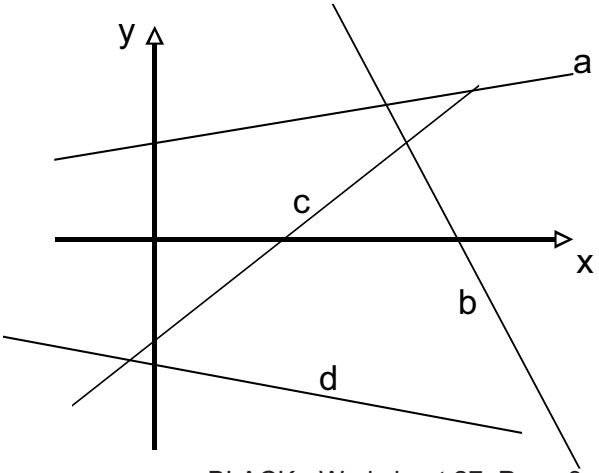
6. In the figure shown, choose any line which has:

a positive gradient

_____

a negative y intercept

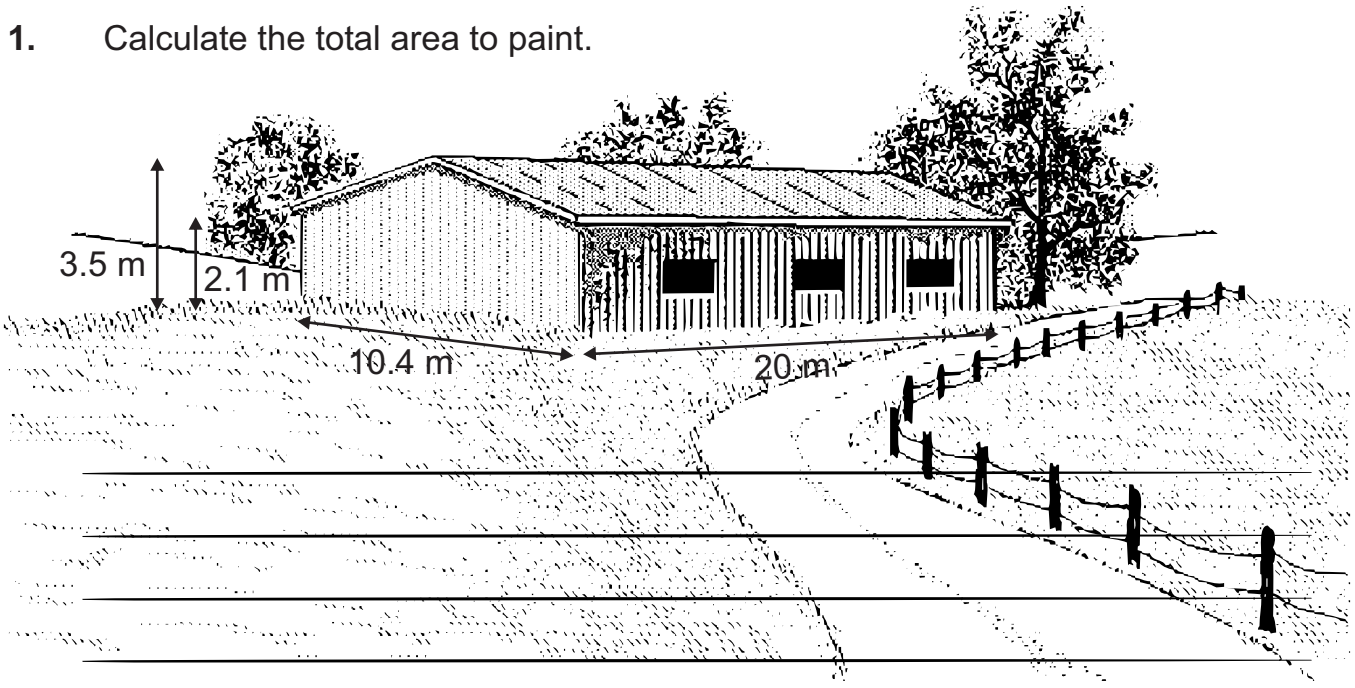
_____



PAINTING BY NUMBERS

You are are given the task of painting the walls and door of a barn.
The diagram shows the barn. The front and back walls are the same shape.
The two sides are the same rectangular shape and each have 3 windows with dimensions 2 m × 1 m.

1. Calculate the total area to paint.



2. A litre of paint covers 13 m^2. How many litres of paint are required for the job? (Assume that they only give the barn one coat of paint.)

3. A litre of paint costs $39. The shop gives a 15% discount if 10 litres or more paint is purchased. How much will the paint cost?

4. You are paid $1000 to complete the painting job and you decide to enlist the help of 2 friends. You need to also purchase 3 paint brushes at $17.75 each. The job takes the three of you 2 whole days of working 8 hours per day to complete. Calculate your hourly rate (after paying for the paint and brushes).

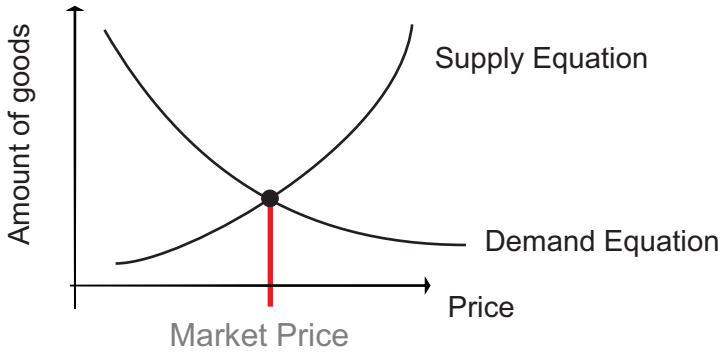
BLACK Worksheet 28

AN ECONOMICAL USE OF MATHS

The supply equation in economics is used to specify the amount of a particular commodity that sellers are willing to offer the market. The demand equation specifies the amount of a commodity that buyers are willing to purchase. An increase in price (p) usually causes an increase in the supply and a decrease in the demand. A decrease in price brings a decrease in supply and increase in demand.

Market price is defined as the price at which supply and demand are equal. Some supply and demand equations are straight lines while others are curved (similar to the illustration below).

Supply and Demand Equations

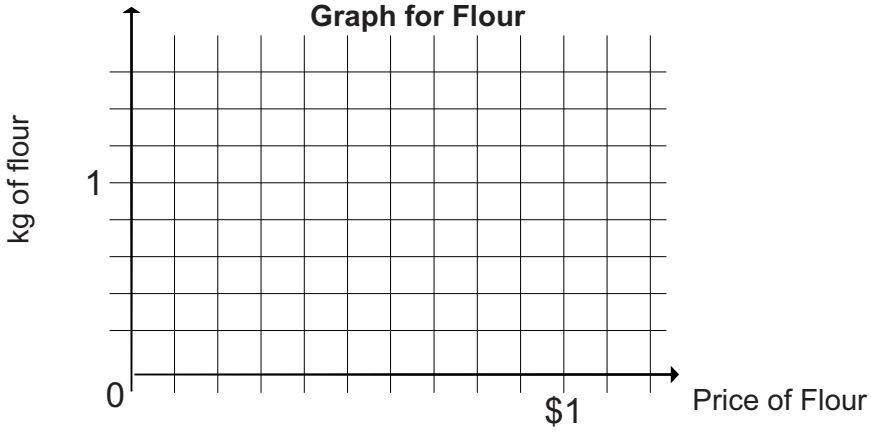


The supply and demand equations for flour has been estimated by economists to be given by the equations below. The variable p is measured in dollars ($) and S and D are measured in kg of flour.

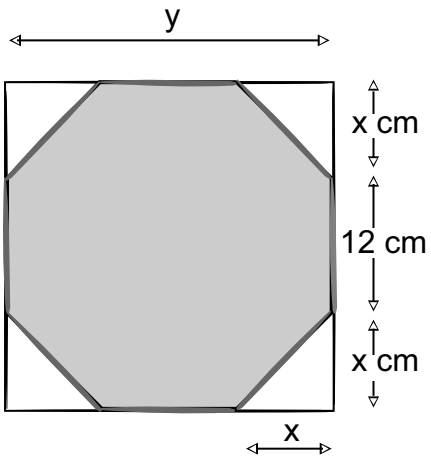
Supply	S = 0.8p + 0.5
Demand	D = -0.3p + 1.5

1. Find the market price of the supply and demand equations by graphing them on the grid below.

Supply and Demand Graph for Flour



AREA OF AN OCTAGON



Georgia wants to make a regular octagon.
Each side of the octagon will be 12 cm in length.

She finds a square piece of card and forms the octagon by cutting off the four corners.

1. Write down an expression for the shaded octagon shown in terms of x and y.

2. Use Pythagoras's Theorem to find the value of x.

3. Calculate the area of the octagon.

REAL LIFE APPLICATION - RIVER SPEED

Surveyors measured the speed of a current below the dam at Lake Karapiro. Based on their data the speed (S) in metres per second can be approximated by the formula:
$S = -0.03d + 0.46$, where d is the depth (in metres) of the water.

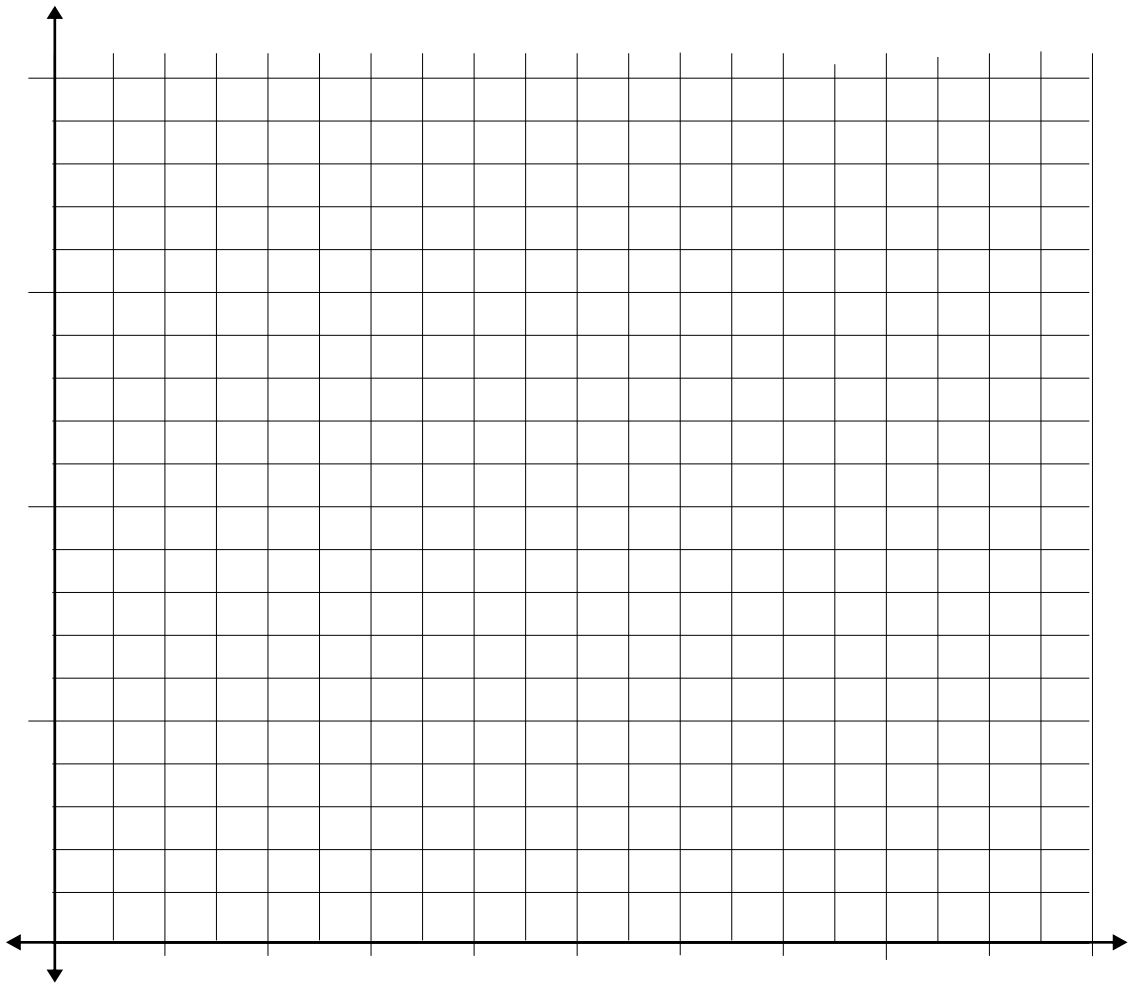
1. Describe what happens to the speed of the current as the depth of the water increases.

LINEAR GRAPHS - HEIGHTS

The World Almanac has a section that deals with ideal height and weights for adults with a medium build. A person with height of 1.5 metres should have a weight of 51 kg. A person with height of 1.7 m should have a weight of 62 kg.

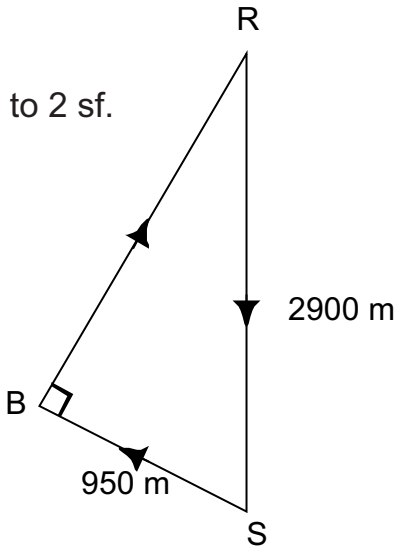
i. Graph the figures and write a linear equation to estimate the weight of a person of any height.

ii. Use your graph to estimate the ideal weight of a person who is 1.8 metres tall.



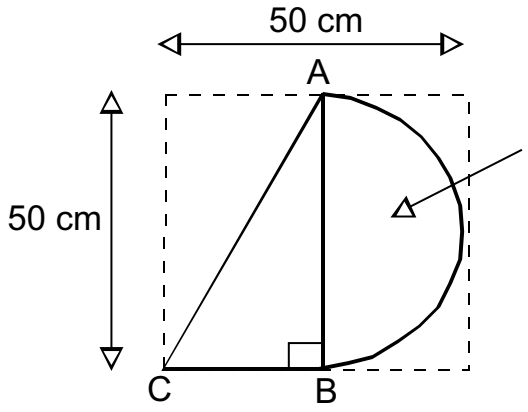
MEASUREMENT APPLICATIONS

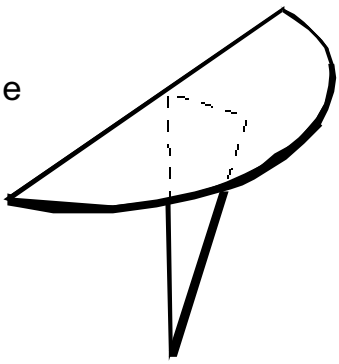
A yacht is to follow a triangular course from the start S, around a buoy B, then a rock outcrop R, and back to S. The buoy is placed 950 m from S so that angle SBR is a right angle. The rock outcrop is 2900 m from the start.



1. Calculate the total distance around the course, rounded to 2 sf.

A kitchen shelf is made from a 50 cm square piece of wood. The horizontal base of the shelf is a semicircle and it is fixed to the wall by a support cut from the same piece of wood and shaped as a right angled triangle. The two diagrams below show the original drawings on the wood to be cut and the final shelf.



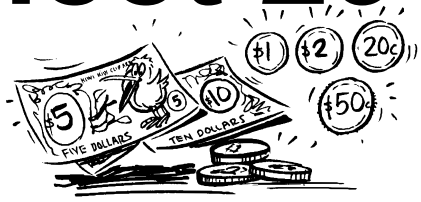


2. Use the plan to calculate the horizontal shelf area.

3. Use the plan to calculate the total area of wood used (i.e. the vertical support area + the horizontal shelf area).

4. Calculate the hypotenuse length of the vertical support (AC).

BLACK Worksheet 29



MATHEMATICS AND THE VALUE OF MONEY

To find the interest amount paid on borrowed money you use the formula I = PRT where I is the interest, P is the principal amount borrowed ($), R is the interest rate (%) and T is the time (years) of the loan.

1. Lauren borrows $5000 for 12 months at 6% per annum.
How much interest does she pay?

2. James borrows $8000 for 5 months at 6.5% per annum.
How much interest does he pay?

If a principal amount (P$) is borrowed at an interest rate (R%) for T (years) the future value of the loan (FV) can be calculated by the formula below.

$$FV = P(1 + RT)$$

3. Mika takes out a loan for $2000 to purchase a computer. The annual interest rate is 7% and she must repay the interest after 1 year. Find the future value of the loan after 1 year.

4. Mika decides to repay the above loan after 9 months. Find the future value of the loan that she will need to repay.

HOW TO MEASURE TALL STRUCTURES

The tallest man-made structure is the Burj Khalifa, in Dubai that is 828 m in height. The CN Tower in Toronto, Canada, (553.3 m) was formerly the world's tallest (1976 - 2007). The Petronius Platform stands 610 m off the sea floor leading some to claim it as the tallest freestanding structure in the world. Taipei 101 in Taipei, Taiwan, is 509.2 m and the Shanghai World Financial Center is 487 m in height. By comparison, the Sky Tower in, Auckland is 328 metres high. There is discussion over how to measure the tallest structures as some figures include tall radio masts on the top of the buildings.

Burj Khalifa

CN Tower

Petronius Platform

Taipei 101

In this exercise you are going to measure the height of a tall building or structure. It may be a two or three storey building at school, a building in your town or a tall tree.

BUILDING AND USING A CLINOMETER

1. On the next page is an outline for a clinometer.
You need to print 2 copies of this and glue it to two sides of card.

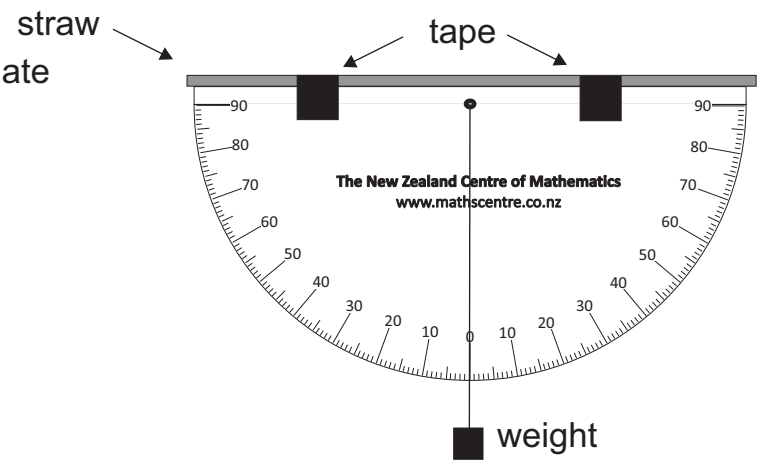
2. Tape a straw to the top of the card.

3. Thread some string through the middle and hang a weight from the string.

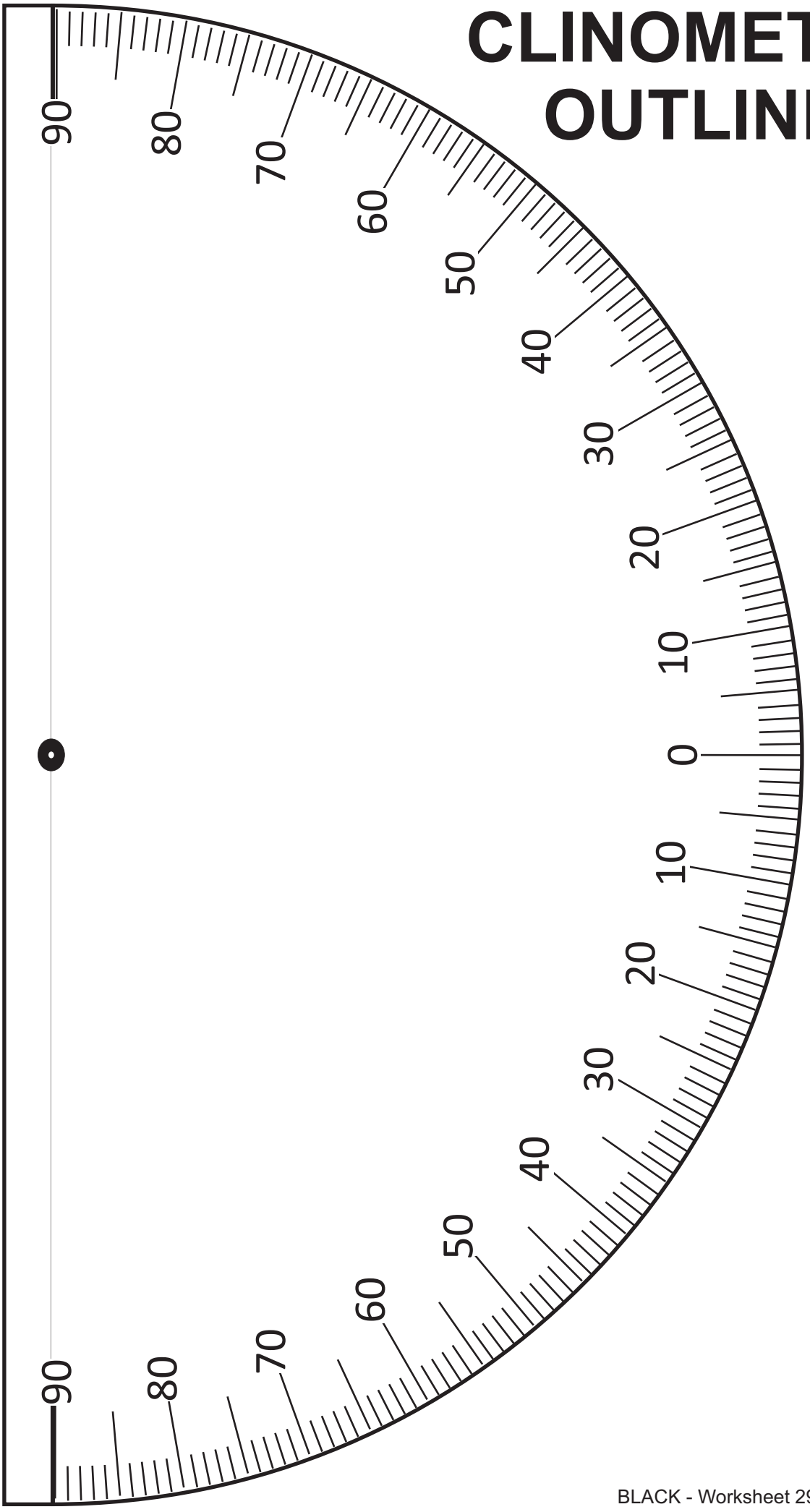
4. Work with a partner. Stand 10 metres from the base of the structure that you are measuring and sight the top of the structure through the straw. Do this 3 times with your partner measuring the angle on the clinometer each time.

5. Take another 3 set of measurements at 20 metres and 30 metres from the base of the structure.

6. Now use trigonometry to calculate the height of your structure.



CLINOMETER OUTLINE



MEASURING EXERCISE - How Tall Is _____ ?

1st measurement 10 metres	2nd Measurement 20 metres	3rd Measurement 30 metres
Angle 1		
Angle 2		
Angle 3		
Average		

Eye Level Height _____

Tan _____ × 10 = _____

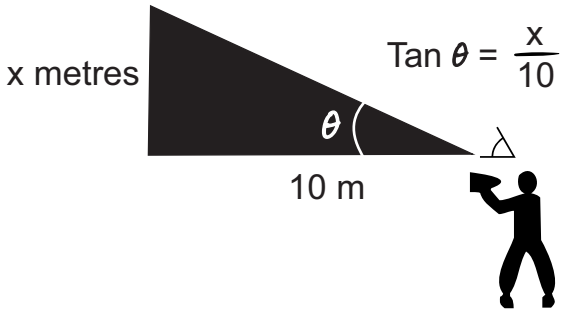
Tan _____ × 20 = _____

Tan _____ × 30 = _____

Total = _____

Average = _____

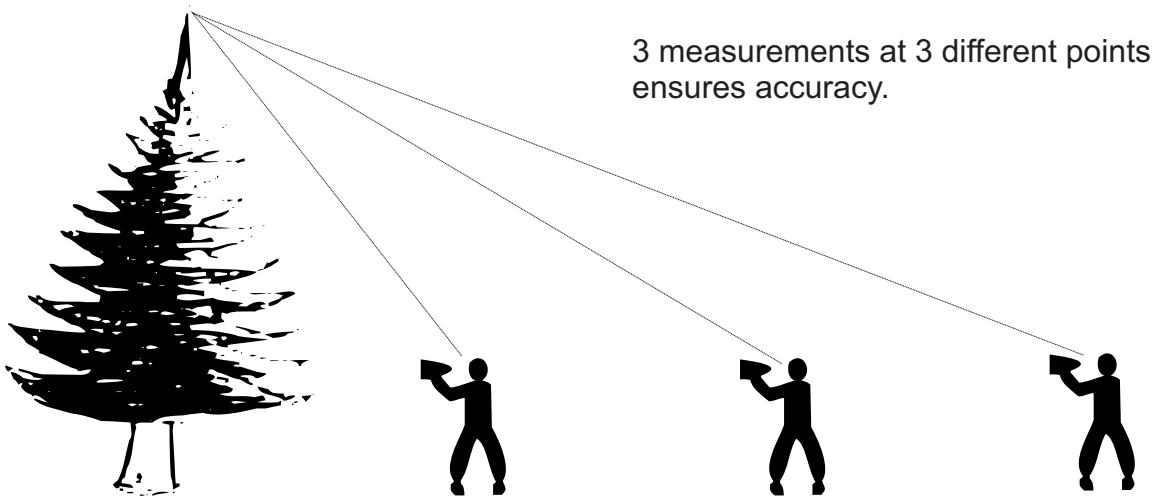
+ Eye Level Height _____



Stand 10 metres from the base of the structure that you are measuring and sight the top of the structure through the straw. Do this 3 times with your partner measuring the angle on the clinometer each time.

Take another 3 set of measurements at 20 metres and 30 metres from the base of the structure.

3 measurements at 3 different points ensures accuracy.



BLACK Worksheet 30

USING YOUR CALCULATOR

1. $6.5^2 - 3.5^2$ = _____

2. $\frac{216 \times 0.015}{0.04}$ = _____

3. $\frac{30}{3.5} + \frac{8}{1.6}$ = _____

4. $\frac{3}{4}$ of 40 + $\frac{1}{4}$ of 60 = _____

5. $(20 \times 15.5) - (16 \times 20.25)$ = _____

6. $\frac{35.72 + 61.8}{21.2}$ = _____

7. $(5.5 \times 6.8)^2$ = _____

8. $\sqrt{4.84 \times 10^6}$ = _____

9. $(6.5 \times 10^{-3}) \div (7 \times 10^{-4})$ = _____

10. $\sqrt[3]{\frac{360}{0.0748 \times 65.25^2}}$ = _____

CALCULATOR CHALLENGES

1. $A = \sqrt{x(x - a)(x - b)(x - c)}$

a = 3.7
b = 4.4
c = 5.1

x = ½(a + b + c)

Find A (accurate to 1 DP)

_____

_____

_____

_____

_____

2. $V^3 = \frac{64P}{wA}$

P = 2450
w = 65.2
A = 0.0205

Find V (accurate to 1 DP)

_____

_____

A DILEMMA THAT URGENTLY NEEDS TO BE CALCULATED

When Kate and Graeme were married they didn't have much money. On their first wedding anniversary Graeme was unable to give Kate a present. Instead he gave her 10 cents and promised to double the amount each year. Kate is looking forward to her silver wedding anniversary when they have been married for 25 years. However Graeme is not so enthusiastic. Why?

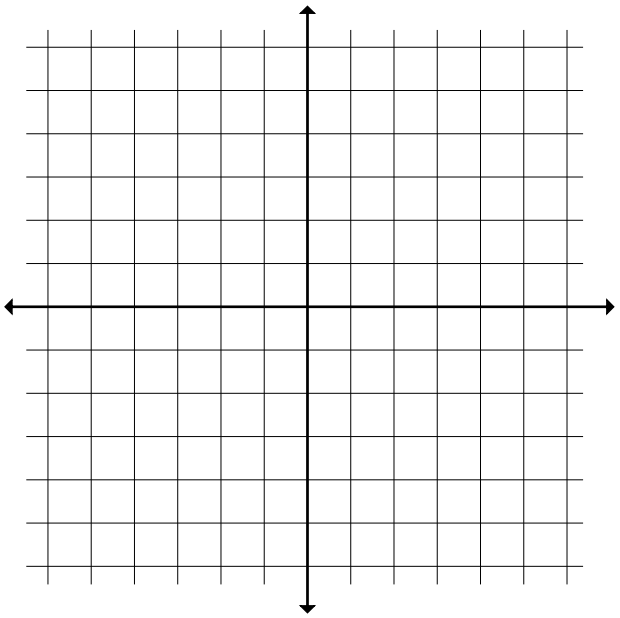
_____

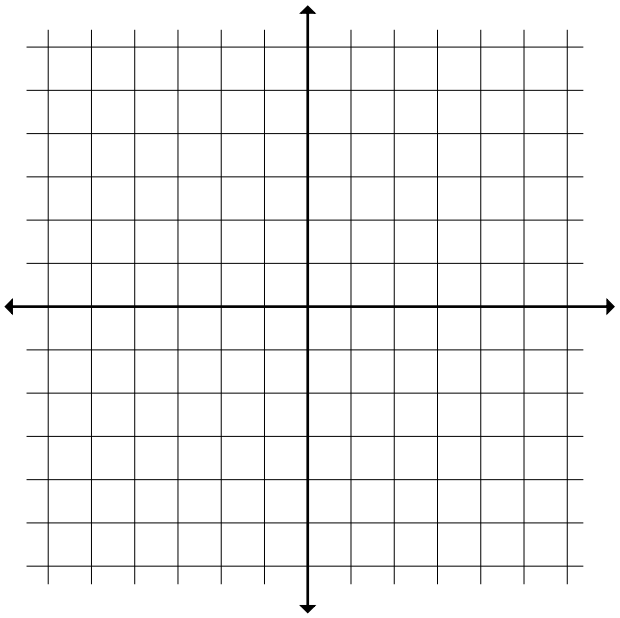
TRANSFORMATIONS

Draw the following figures and their images.

1. Draw triangle ABC.
A(4, -3), B(-2,-1), C(-2, -5)

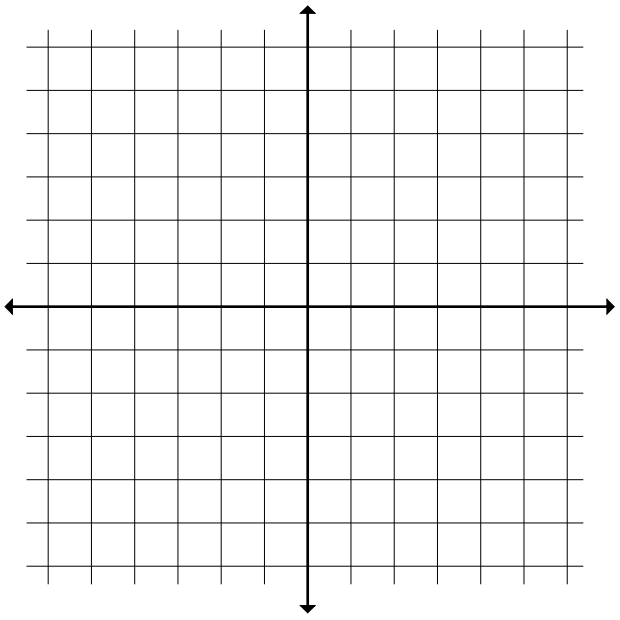
Reflect ABC in the x - axis.
Draw the image as A´B´C´





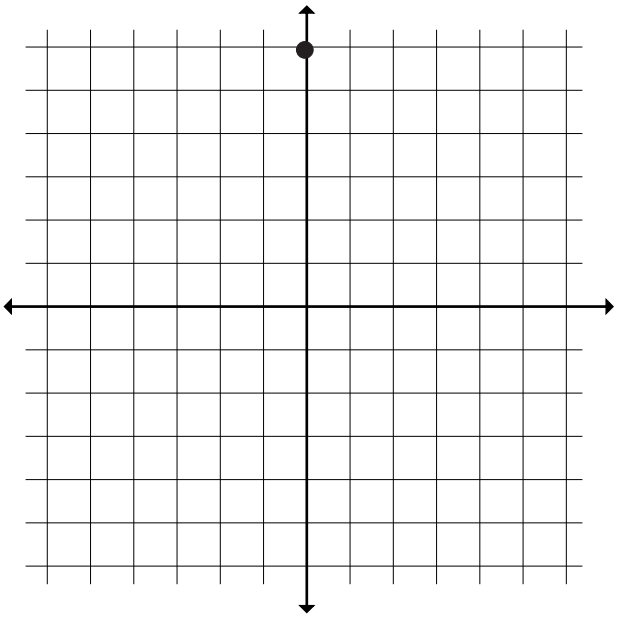
2. Draw trapezoid CDEF.
C(1, 4), D(3, 4), E(6, -1), F(0, -1)

Reflect CDEF in the y axis
Draw the image as C´D´E´F´.



3. Draw quadrilateral EFGH.
E(-5,5), F(-1, 6), G(-2, -3), H(-6, -1)

Translate EFGH 6 units right.
Draw the image as E´F´G´H´.



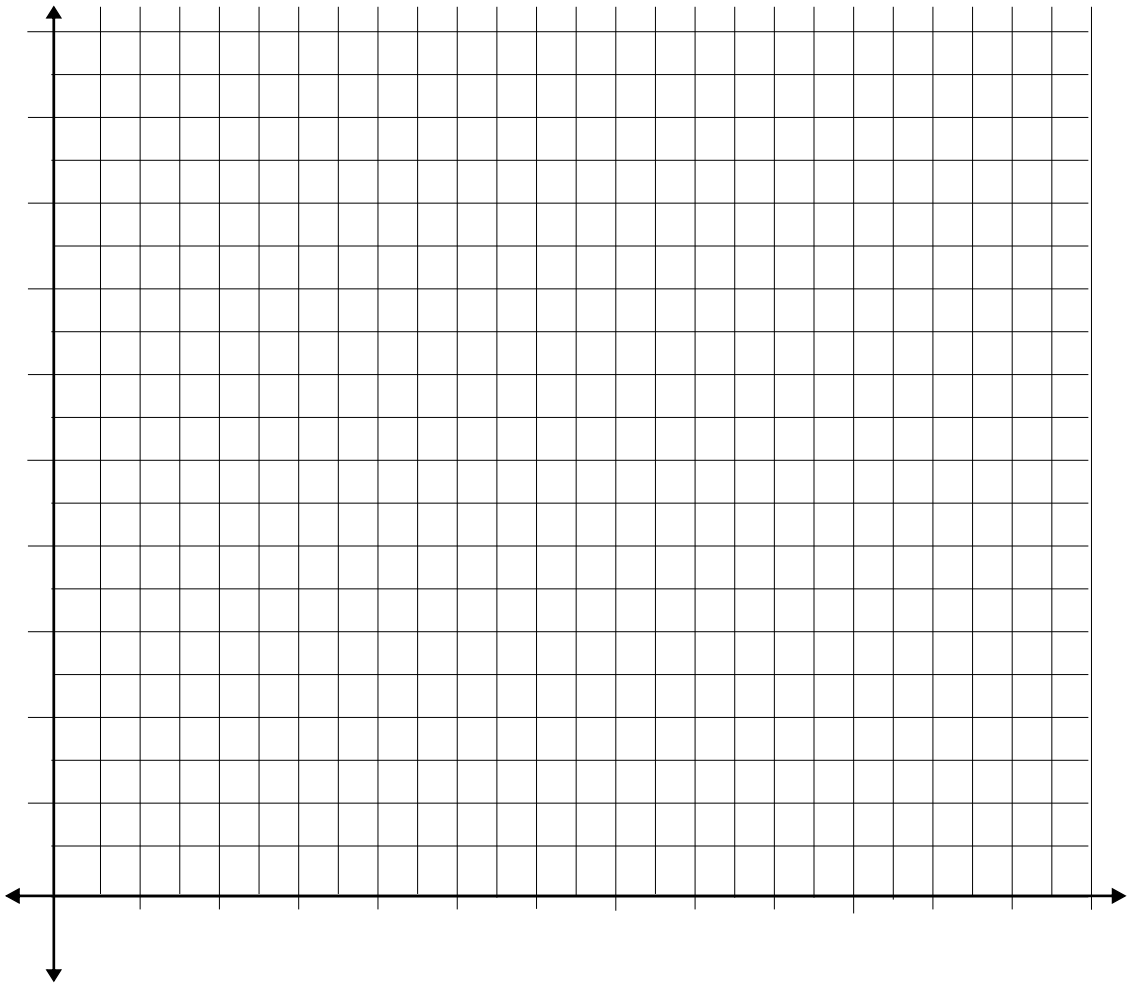
4. Draw square JKLM
J(1,4), K(-1, 4), L(-1, 2), M(1, 2)

Enlarge JKLM by scale factor 3
Use centre of enlargement (0,6)
Draw the image as J´K´L´M´.

LINEAR GRAPHS - METEOROLOGY

In a thunderstorm you normally see lightening, then after a short time you hear the thunder. The distance d in kilometres that sound travels can be expressed by the equation d = 0.34t (t is in seconds).

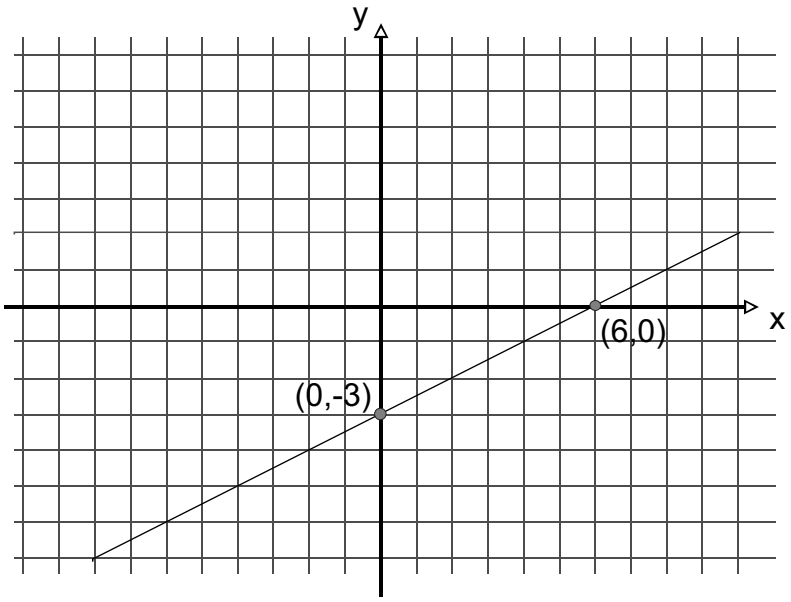
1. Graph the equation then use your graph to estimate how long it would take to hear the thunder from storms that are 5 km and 8 km away.



TIME (SEC)	0	5	10	15	20	25
DISTANCE (KM)						

GET THE POINT

The diagram below shows the graph of $y = \frac{1}{2}x - 3$.



1. What is the gradient of this line? _____

2. On the diagram, draw the graph of $y = -2x + 2$.

3. Using the graph, estimate the point of intersection of the lines:

$y = \frac{1}{2}x - 3$ and $y = -2x + 2$ _____

4. Simplify **i.** $\frac{3x^6}{x^2}$ = _____

ii. $5x + 2 - (5 - 6x)$ = _____

5. Expand and simplify $(x + 2)(x - 7)$ = _____

= _____

6. Completely factorise $3x^2 - 9x$ = _____

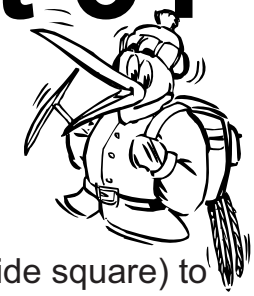
7. Solve the equations: i. $6x + 5 = 50$ _____

_____

ii. $x^2 + 14x + 48 = 0$ _____

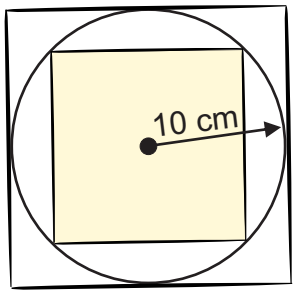
_____

BLACK Worksheet 31

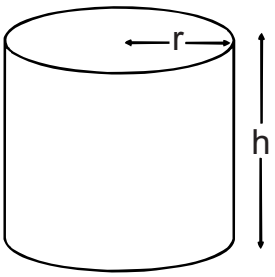


PROBLEM SOLVING

1. What is the ratio of the area of the circumscribed square (the outside square) to that of the inscribed square (the shaded square inside)?

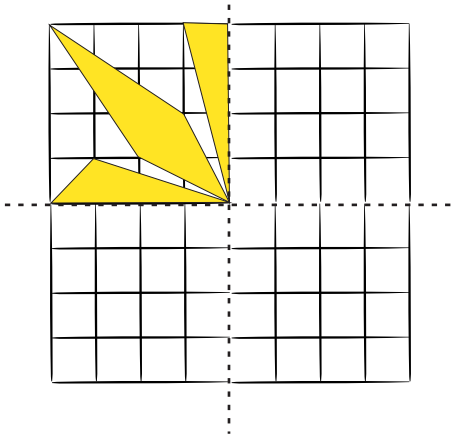


2. The volume of a cylinder is shown below. If the height of the cylinder is halved and the diameter is doubled, how will the volume be changed?



$$V = \pi r^2 h$$

3.



The shape pictured is one quarter of a symmetrical pattern. The dotted lines are the axes of symmetry.

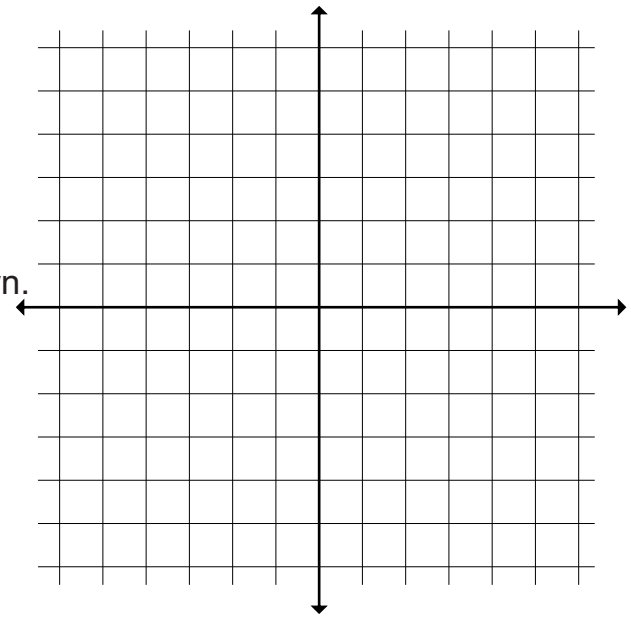
Complete the shape.

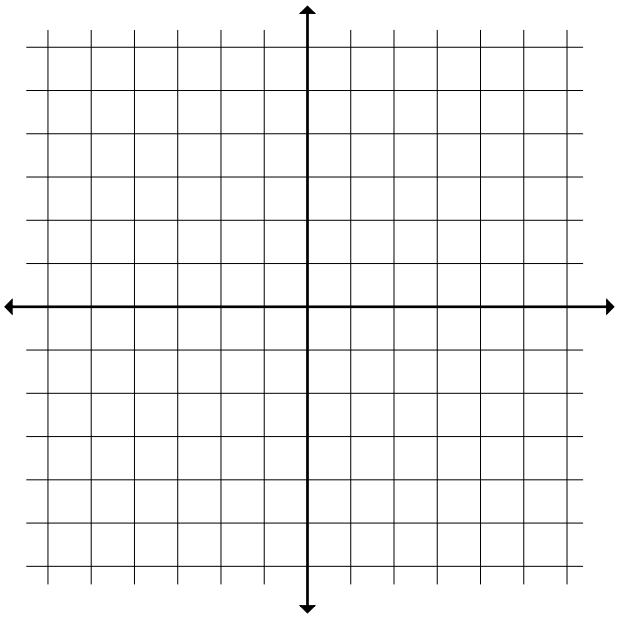
TRANSFORMATIONS

Draw the following figures and their images.

1. Draw parallelogram MNOP.
M(-5, 3), N(-1, 3), O(-2, 1), P(-6, 1)

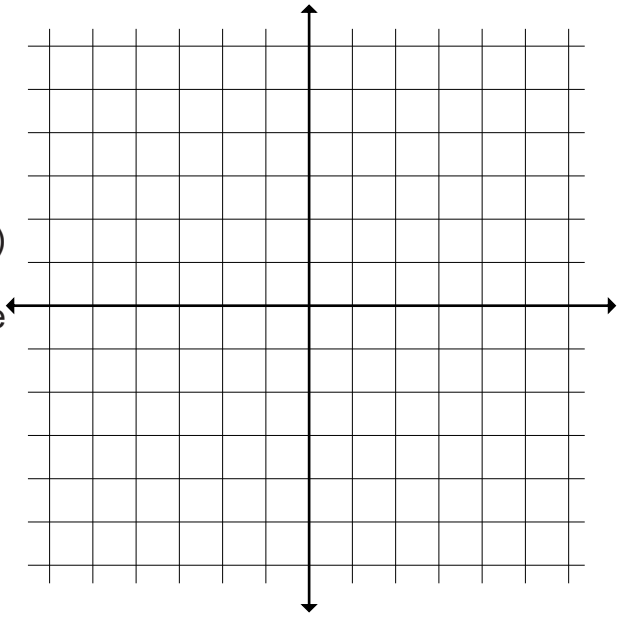
Translate MNOP 3 units right, 4 units down.
Draw the image as M´N´O´P´.





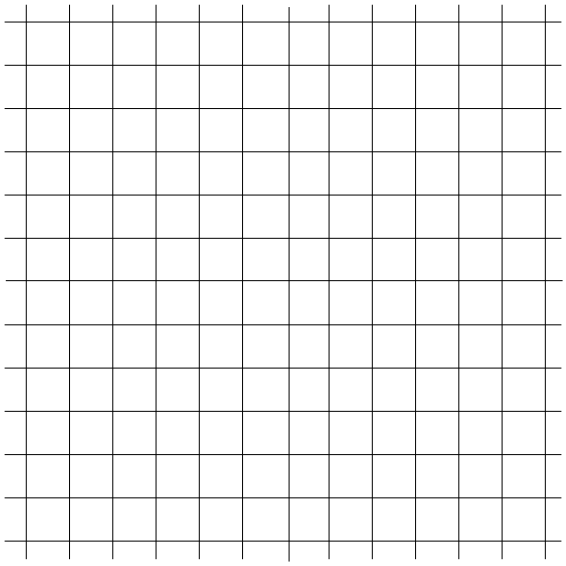
2. Draw triangle PQR.
P(0, 0), Q(-1, 4), R(-4, 4).

Rotate PQR 90° clockwise around the point (0, 0)
Draw the image as P´Q´R´.



3. Draw pentagon RSTUV
R(-5, 3), S(-3,4), T(-1, 3), U(-2, 1), V(-4, 1)

Reflect RSTUV in the x axis then translate the pentagon 2 units up and 1 to the right.



4. A ship is blown off course by a storm. After the storm it is 10 km west and 4 km south of its original location. Use the grid to show where it is in relation to where it was before the storm.

ANALYSING STATISTICAL DATA

John is surveying the smoking habits of the students in his year level. He can use one of two methods to gather the information he needs.

Method 1: *Ask students the questions face to face.*
Method 2: *Give students a form to fill out. The form does not ask for names.*

1. Which method is the best to use? Give a reason.

One of the questions that John asks in his survey is "How many cigarettes did you smoke last Wednesday?" Here is his table of results:

Number of cigarettes	0	1	2	3	4	5	6	7	8	9	10
Number of students	25	3	4	5	4	2	0	0	0	2	0

2. How many students did John survey?

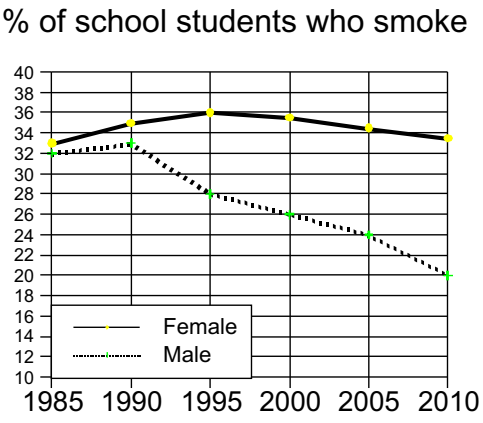
3. What was the mean and median number of cigarettes smoked last Wednesday?

4. If a student is chosen at random, what is the probability that he/she will smoke at least 4 cigarettes.

5. If you were to draw a pie chart which shows the percentage of smokers and non smokers then what would be the angle for each?

John finds some interesting data on young people and smoking habits. The graph of his data is below.

6. Using the graph, write your conclusions about smoking trends.



Knowing Number . . . . . complete these sentences.

1. BEDMAS means _____

_____

_____

2. On a number line, positive numbers are on the _____ of the zero, while negative numbers are on the left of the zero. The bigger the digit of the negative number, the _____ the number.

3. 6^5 means 6 × 6 _____

$\left(\frac{2}{3}\right)^3$ means _____

4. Equivalent Fractions are fractions which _____

5. To add or subtract fractions, the denominators must be _____

6. To multiply fractions, multiply both numerators and denominators and then

_____

7. To divide fractions, reverse the divisor fraction and _____

8. To write a fraction as a decimal, divide the numerator by the _____

To write a fraction as a percentage, _____

To write a percentage as a fraction, _____

9. Numbers that are very small (e.g. 0.0065) or very big (e.g. 1 957 000 000) are written in _____ (i.e. 6.5×10^{-3} and 1.957×10^{9})

10. When rounding numbers, if the following digit in the series is ≥ 5 then you add _____ to the last significant digit.

ASTRONOMY APPLICATION

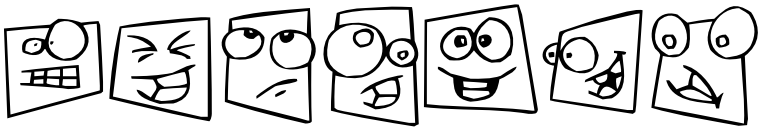
1. The Sun burns approximately 4.4×10^6 tons of hydrogen per second. Using this information, how much hydrogen would the Sun burn in one year?

_____

_____

_____

BLACK Worksheet 32



SEQUENCES OF NUMBERS

Complete the sequences:

1. 2, 5, 10, 17, 26, _____, _____, _____, _____

2. 1, 5, 11, 19, 29, _____, _____, _____, _____

3. 2, 7, 13, 20, 28, _____, _____, _____, _____

4. 1, 3, 9, 27, 81, _____, _____, _____, _____

5. 1, 2, 6, 24, 120, _____, _____, _____, _____

Find the values of:

6. $\sqrt{25 \times 144}$ $\sqrt{25} \times \sqrt{144}$ $\sqrt{25 + 144}$ $\sqrt{25} + \sqrt{144}$

7. Extend these number patterns:

5^2, 0 × 10 + 25 = 25
15^2, 10 × 20 + 25 = 225
25^2, 20 × 30 + 25 = 625

3 × 37 = 111
6 × 37 = 222
9 × 37 = 333

8. What is the value of x in the equation: $2^3 \times 3^x \times 5 = 1080$?

Knowing Measurement, Shape & Space . . . . . complete these sentences.

Measurement: The most common unit for length is the _____

For smaller lengths use _____

For accurate small measures, use _____

10 mm = _____ cm 100 cm = _____ m 1000 m = _____ km.

The standard unit for mass is the _____ For small measures, use _____ and for larger measures use _____

Capacity of an object describes how much air or liquid an object can hold. The basic unit for capacity is the _____ smaller measures (e.g. medicine) are measured in _____ Volume of an object is found by calculating the area of the object's main face and then multiplying by its _____

Remember these measures: $1000cm^3$ = _____ litre, a bucket contains approximately _____ litres, and a milk carton contains _____.

The basic unit for temperature is _____ Water freezes at _____ °C and boils at _____ °C .

In the 24 hour clock system, the numbers are numbered from 0 to _____ The first two numbers give the hours after _____ the second two numbers give the _____

Give the formulae for area and perimeter of a quadrilateral, a triangle and a circle.

_____

_____

_____

_____

Pythagoras' Theorem states that _____

_____

To help remember trig ratios, we learn the word _____

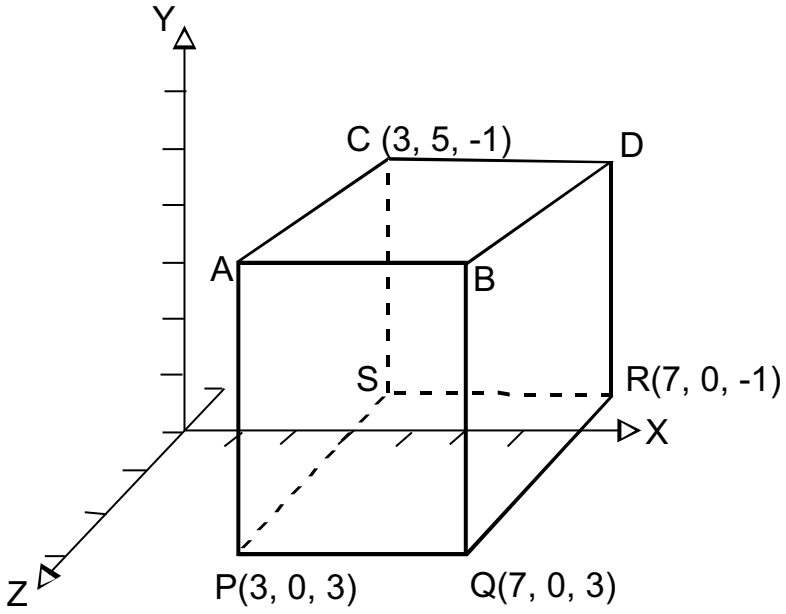
Sine = Cosine = Tangent =

THE MATHEMATICS OF SHAPE AND SPACE

The diagram shows a cuboid drawn on a set of 3D axes.

The axes have an x, y and a z axis. Co-ordinates are given as (x, y, z).

The coordinates of P are (3, 0, 3)
The coordinates of Q are (7, 0, 3)
The coordinates of R are (7, 0, -1)
The coordinates of C are (3, 5, -1)



1. Write down the (x, y, z) coordinates.

of A ( ) and of D ( )

2. Write down the lengths of the following:

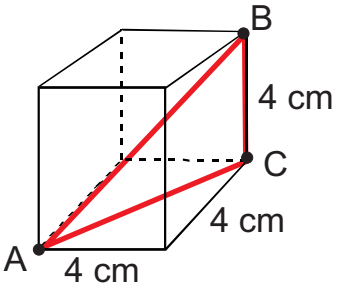
PQ

QR

PR

3. Calculate the total surface area of the cuboid.

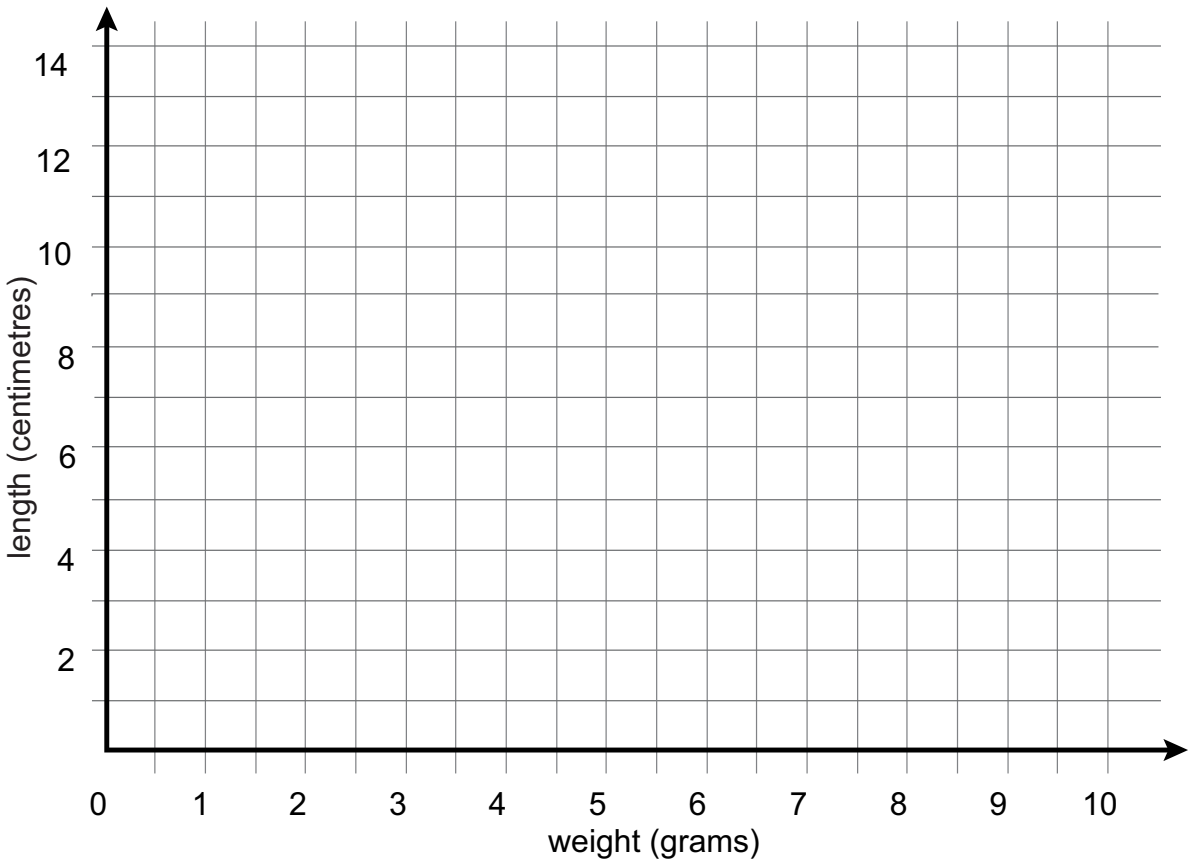
4. The figure below shows a cube with sides of 4 cm. A right angled triangle (ABC) is drawn fitted within the cube. Find the length of AB.



ELASTIC STRETCH AND LINEAR GRAPHS

Class 10FR hang different weights from an elastic band. The length that the band stretches is then measured. After weighing a range of objects, they discover that the weight of the object (x gm) is related to the stretch of the band (y cm) by the equation $y = 3 + 2x$.

1. On the graph below, show how x and y are related.



2. Find the length of the elastic band when:

i. there is no weight. _____

ii. 5.5 grams are hung from it. _____

3. Make x the subject of the formula $y = 3 + 2x$.

_____

Another elastic band is tried with the same weights. With the second band, the weight is related to the stretch by the formula $y = 2 + 4x$.

4. Find x and y when the lengths of the two elastic bands are the same.

_____

_____

BLACK Worksheet 33

QUICK CALCULATIONS

1. 18 ÷ 24 =

2. 3 ÷ 1½ =

3. 0.4 ÷ 0.2 =

4. 72 ÷ (6 × 2) =

5. 8808 ÷ 12 =

6. 5 ÷ ½ =

7. 9.45 ÷ 100 =

8. 45 ÷ 0.9 =

9. 100^2 ÷ 10 =

10. 1000 ÷ 10 ÷ 5 =

EQUATIONS TO SOLVE

1. 5x = 1.5, x =

2. 2y + 8 = 14, y =

3. 6z - 1 = 5z + 9, z =

4. 4(j - 2) = 20, j =

5. k + 0.8 = 2.2, k =

6. m^2 = 6.25, m =

7. 10p = 1, p =

8. 7 + r × 2 = 17, r =

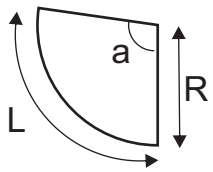
9. 9600 ÷ s = 240, s =

10. 4u - 18 = 26, u =

TRADE MATHEMATICS

The length of the arc of a sector of a circle can be found by using the formula:

$$L = \frac{2\P Ra}{360}$$



L = length of the arc
¶ = pi (3.14)
R = radius length
a = angle

1. A sheet metal worker has to design a cone which has a circular base. The radius (R) is 5 metres and the angle (a) is 30°. What will be the diameter of the base of the cone? (You also need to know the formula for the circumference of a circle.)

2. The cost of the material is based on the area of the metal used. Area of a sector is:

$$A = \frac{\P R^2 a}{360}$$

Calculate the area of the sector above.

Knowing Probability and Statistics . . . . . complete these sentences.

Probability measures the likelihood of an event happening.
It is expressed as a fraction, decimal or percentage and will always be between _____ and _____ .
A probability of 0 means the event will _____ happen and a probability of 1 means the event is _____ to occur.

Tree diagrams can help illustrate probabilities. Each branch of the tree shows the _____ of the event and each set of branches must always add up to _____

Averages give a central value that is representative of a given set of numbers.
The three most common averages are _____ , _____ , _____
The mean is the sum of all the values _____ by the amount of values in the group. The median is the _____number when they have all been placed in numerical order. The mode is the value that occurs the _____

As well as averages, numeric data can be analysed by calculating the measures of spread such as _____ and _____ The range is found by taking the _____ from the _____ Quartiles divide the group of numbers into _____ equal parts. To illustrate measures of spread, or to compare data from two or three sources, draw a _____ and _____ graph.

Time Series data is collected over a _____ period of time. It is then analysed in an attempt to find any _____ so that we can make predictions.

MATHS WHILE EATING OUT

At a restaurant you can choose a first course, main course and dessert. You can choose soup or shrimp cocktail for the first course, steak, chicken, fish or vegetarian lasagne for the main course and chocolate mousse or fruit. Give the number of possible meals that can be chosen.

_____

_____

_____

ICECREAM STATISTICS

The Creamy Ice Company sells various sorts of ice cream.
Here are the sales figures for one week in November:

	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Iceberger	13	15	12	16	15	37	41
Triple Tub	12	17	15	15	12	42	45
Cee Ice	25	20	24	20	24	58	55
Creamy Choc	17	16	15	20	19	33	37

1. Which is the most popular ice cream? _____

2. Which is the most popular day for people to buy ice creams? _____

Last year, the Creamy Ice Company recorded the following sales:

Season	Autumn	Winter	Spring	Summer
Sales (thousands)	8.4	6.2	7.9	18.1

3. What were the total sales for the year? _____

4. If this information was drawn on a pie chart, what would the angle of the Winter section be?

_____

So far, the Creamy Ice Company has recorded the following sales this year:

Season	Autumn	Winter	Spring	Summer
Sales (thousands)	9.2	6.8	8.7	_____

5. If you had to predict sales for summer this year, based on last year's sales figures, how many sales would you predict? Explain your answer.

_____

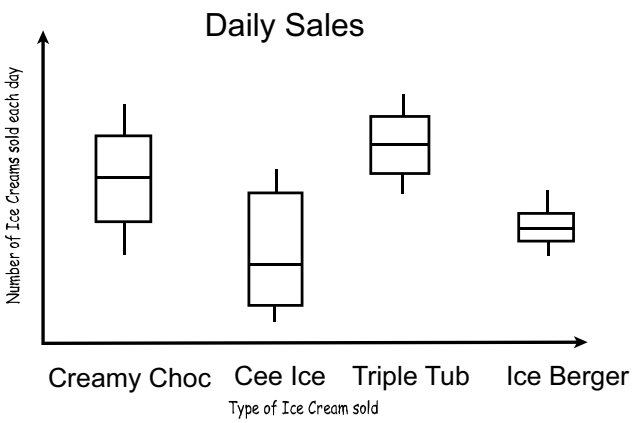
_____

The box and whisker graph shows an analysis of the daily sales of each of the different types of ice cream during last October.

6. Which ice cream had the largest range of sales?
Explain how you come to this answer.

_____

_____



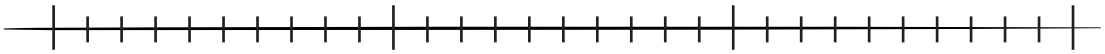
STATISTICAL APPLICATIONS

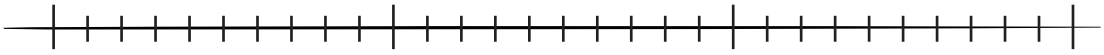
A consumer watch magazine has given you the task of evaluating two kinds of battery. You test a batch of each battery in a portable DVD player and note how long (in hours) each runs.

Battery Brand A - Eternal Life
27.5, 27.6, 27.8, 27.9, 27.9, 28.0, 28.0, 28.0, 28.0, 28.1, 28.1, 28.1

Battery Brand B - Super Cell
26.7, 26.9, 27.6, 27.7, 27.8, 27.9, 28.0, 28.1, 28.3, 28.8, 28.8, 28.9

1. Draw a dot plot, find the mean, median and write a statement that tells which you feel is the best battery.





2. The distances (in centimetres) of 11 jumps from the final round of a women's long jump competition are listed here: 703, 702, 685, 677, 689, 670, 665, 669, 645, 687, 674. Display the data on a Stem and Leaf Plot to show how the data is distributed and circle the median and quartile values.

Woman's Long Jump Results

Unordered Plot		Ordered Plot	
64	|	64	|
65	|	65	|
66	|	66	|
67	|	67	|
68	|	68	|
69	|	69	|
70	|	70	|

BLACK Worksheet 34

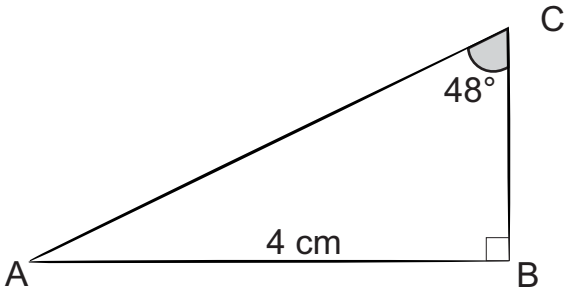
ROMAN NUMERALS

1. The Pantheon in Rome has been used in the past as a royal tomb and is still used today for church services. Inside the circular floor has an area of 1473 square metres. What is the diameter of the floor?

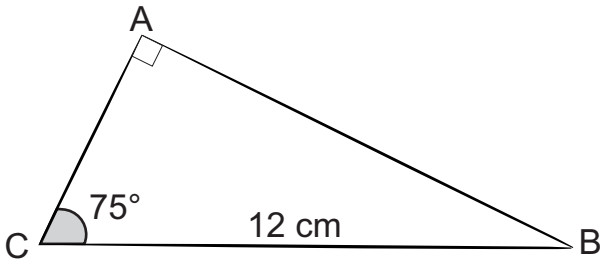
TRIGONOMETRY

Find each of the lengths AC.
Note that the triangles are not drawn to scale.

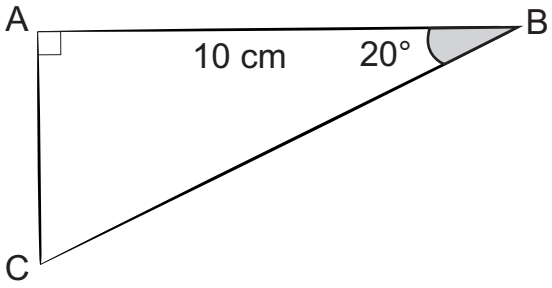
1.



2.



3.



Knowing Algebra . . . . . complete these sentences.

When adding or subtracting algebraic equations only combine _____ terms.
When multiplying or dividing, multiply or divide the numbers then the _____

When expanding algebraic equations, multiply any terms outside the brackets by those inside, then _____ by combining any like terms.

When factorising an expression, find a _____ factor, then rewrite the expression. Factorising quadratics usually involves some trial and _____

A formula is a general rule written as an _____. To substitute values, replace the variables with the given _____. Rearranging a formula usually involves changing the subject of an equation. The subject of an equation is a single variable that comes before the _____ sign.

When solving equations, you usually have to move variables or numbers from one side of the equation to the other. When doing this, change addition signs to _____ and multiplication signs to _____.

EQUATION SOLVING

Solve each equation.
The domain is {-3, -1, 2, 5}.

1. y = x - 10

2. y = 2x + 5

3. 2x - y = -3

4. 3x - ½y = 6

STATISTICAL ANALYSIS

Below are the lengths of leaves taken and measured from a Rooibos Tea Bush.

Length (cm)	4.0 - 4.4	4.5 - 4.9	5.0 - 5.4	5.4 - 5.9	6.0 - 6.4	6.5 - 6.9	7.0 - 7.4	7.4 - 7.9
Frequency (f)	2	10	25	15	8	5	4	1

Use the data collected to answer the following questions:

1. How many leaves were measured? _____

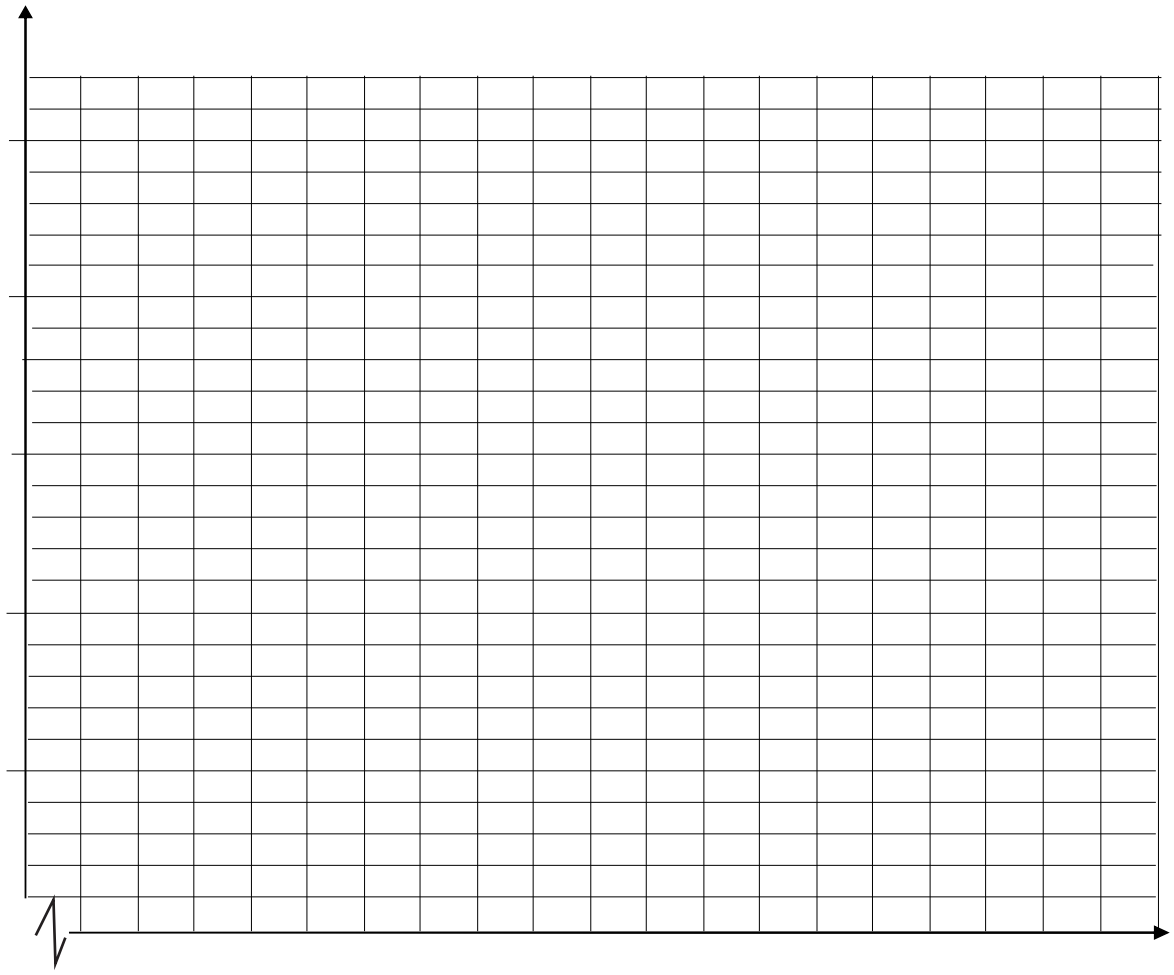
2. What is the mode of the data? _____

3. What is the median of the data? _____

_____

_____

4. Draw a histogram of the data.
Remember to give your histogram a title and label the axes.



MORE STATISTICAL ANALYSIS

The lengths of leaves taken and measured from a Rooibos Tea Bush are now rewritten in a different form.

Length (cm)	Frequency (f)	Interval Mid-Point (x)	f × x
4.0 - 4.4	2	4.2	8.4
4.5 - 4.9	10	4.7	_____
5.0 - 5.4	25	5.2	_____
5.4 - 5.9	15	5.7	_____
6.0 - 6.4	8	6.2	_____
6.5 - 6.9	5	6.7	_____
7.0 - 7.4	4	7.2	_____
7.4 - 7.9	1	7.7	_____
Total (f)	_____	**Total (f × x)**	_____

1. Calculate and write the missing data on the table.

2. What is the mean of the data? _____

_____

_____

MEDICAL MATTERS

A doctor tries to keep each consultation to 20 minutes. To test whether she is keeping to schedule she asks her receptionist to record the time taken for the next 100 patients. The results of the survey are below.

Time (minutes)	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Number of Patients	2	5	8	12	18	22	15	12	1	0	2	1	1	1

1. Give the range of times taken for consultations. _____

2. Find the mode time taken per patient. _____

3. Find the median time taken per patient. _____

4. Find the mean time taken per patient.

_____

_____

5. On average, is the doctor managing to keep to her 20 minutes per consultation? Explain your answer.

_____

BLACK Worksheet 35

STATISTICS

An ordered set of data values (golf scores) is listed below:

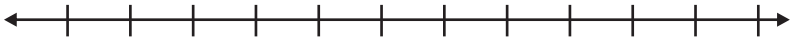
69 71 73 *a* 78 98 *b*

1. The data has a median of 74 and a mean of 82. What are the values of *a* and *b*?

2. In the case above, which would be the most reliable “average” of the numbers - the median or the mean. Give a reason for your answer.

3. Study the stem and leaf graph below and give the minimum, maximum, mode, lower quartile, median and upper quartile. Use these figures to draw a box and whisker plot.

2	3 3 4
2	6 7 8 9 9
3	0 1 1 2 3 3 3 4
3	5 6 7 8 8 8 9
4	1 2 2 4
4	5 7 9
5	2 4
5	8
6	0



Knowing Transformation Geometry . . . . . complete these sentences.

An axis of symmetry is a line through which one side of the figure can be _____ onto the other. The order of symmetry of a figure is the number of _____ that it has.

When reflected, a point and its image are _____ distances from the mirror line. Length, angle size, and area are _____ (stay the same), however sense can change (the way the figure looks).

In any transformation, the original points are given letter names e.g A, B and C while their images are indicated by _____ , _____ and _____

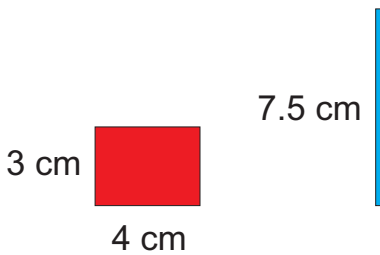
When a figure can be rotated onto itself one or more times during one complete turn it is said to have _____ To rotate a figure you must know the centre of rotation and the angle of rotation. Positive angles of rotation move a figure

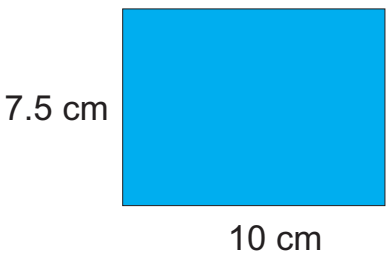
_____

When a figure is enlarged you must have the scale factor (k) and the centre of enlargement. If $k > 1$ then the figure is _____ than the original. If $0 < k < 1$ then the figure is _____ than the original. If k is negative, then the image is reversed to the opposite side of the centre. To find the centre of enlargement, join two or more related points of the original and image. The centre of enlargement is found where the lines _____ To find the scale factor of an enlargement, divide the length of an image line by the corresponding length of the original.

A translation is defined by a vector. All points of the original are moved according to the vector.

ENLARGEMENT BY RATIO





The two rectangles are similar.
What is the ratio of their measurements?

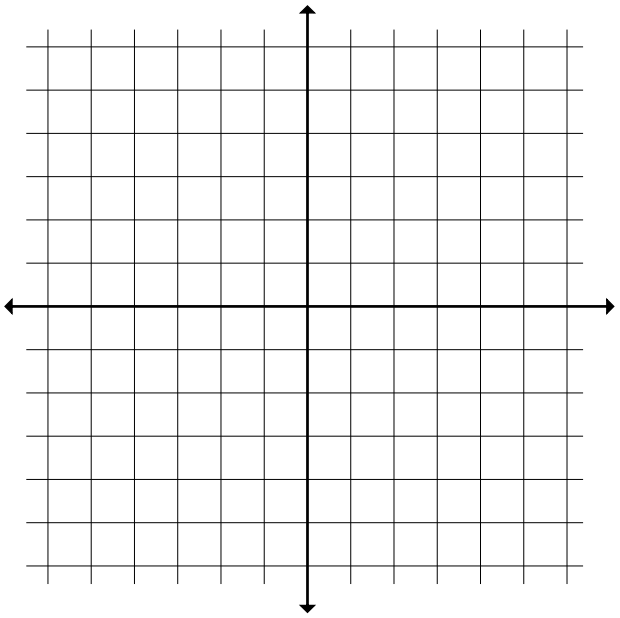
_____

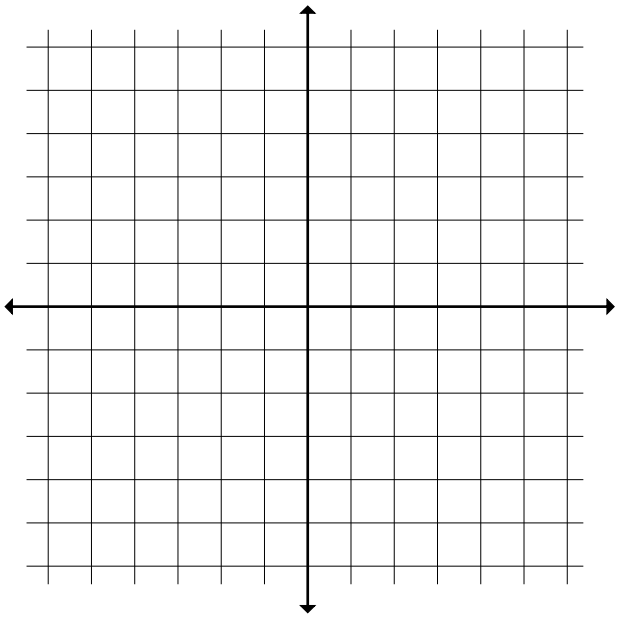
TRANSFORMATIONS

Draw the following figures and their images.

1. Draw trapeziod UVWX.
U(-2, 4), V(4, 4), W(-4, -4), X(-4, 2)

Enlarge UVWX by scale factor ½
Use centre of enlargement (0, 0).
Draw the image as U´V´W´X´



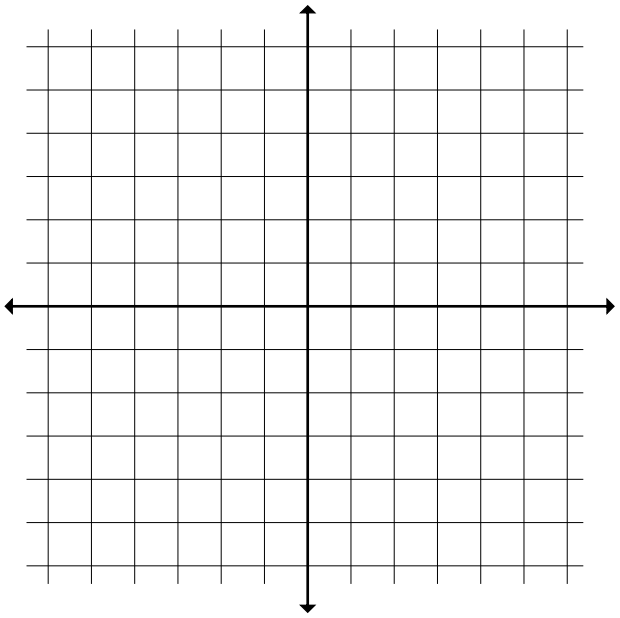


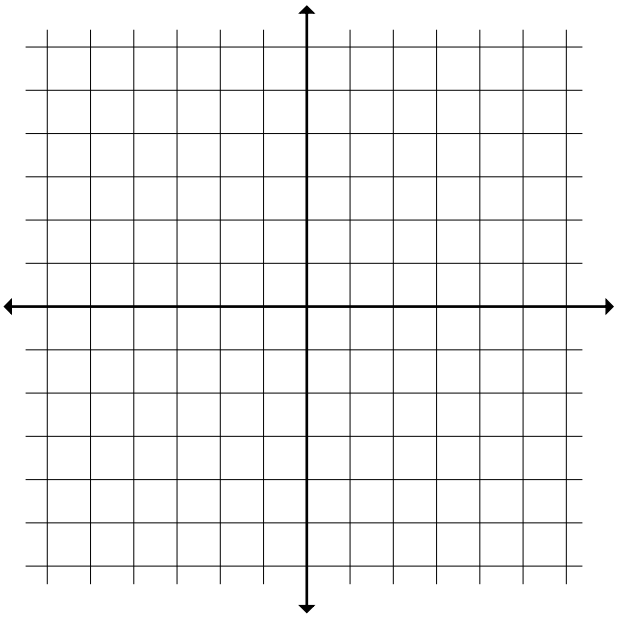
2. Draw triangle XYZ.
X(-4, 4), Y(6, 1), Z(3, 6)

Rotate XYZ 180° around (0, 0).

3. Draw parallelogram ABGH.
A(0, -1), B(4, -1), G(1, 3), H(-3, 3)

Reflect ABGH in the x axis.
Draw the image as A´B´G´H´.





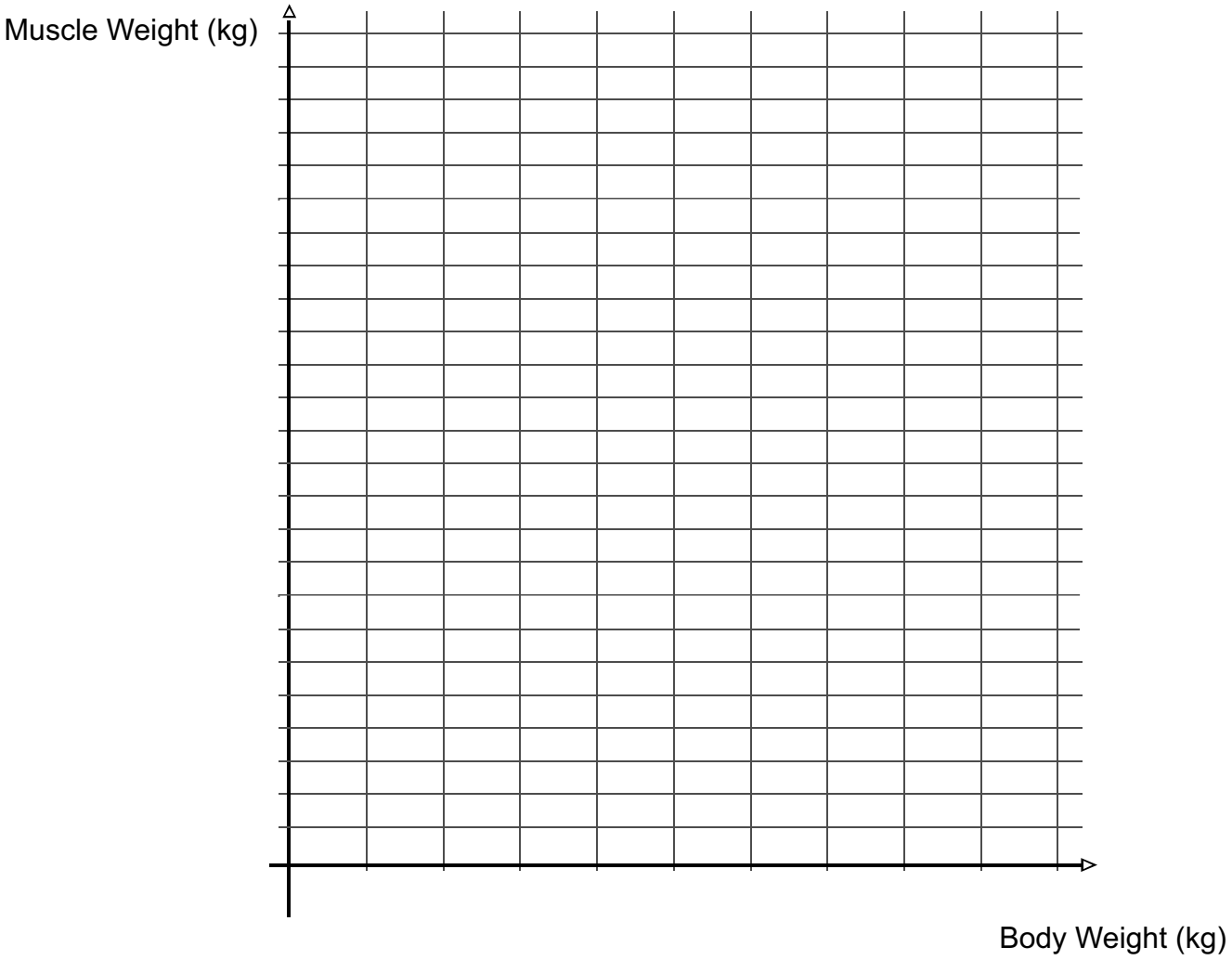
4. Draw square JKLM
J(5,-2), K(1, -2), L(1, -6), M(5, -6)

Enlarge JKLM by scale factor -½
Use centre of enlargement (0,0)

MATHEMATICS AND HEALTH APPLICATIONS

1. A normal person's body weight is approximately 2 kg of muscle for each 5 kg of body weight. Make a table to show the relationship between body and muscle weight for people weighing between 60 and 110kg. Graph your relationship.

Graph of Body Weight v Muscle Weight



2. Nurses setting up intravenous (IV) fluids must control the flow rate (F) in drops per minute. They use the formula: $F = \frac{Vd}{t}$ where V is the volume of the solution in millilitres, d is the drop factor in drops per millilitre, and d is the time in minutes. Write the equation and calculate the correct flow rate of 1200 milliltres of saline to be given over 8 hours using a drop factor of 10 drops per millilitre.

BLACK Worksheet 36

SEQUENCES

The nth term of some sequences are listed below.
Write the first five terms of each sequence.

1. $n(n + 2)$

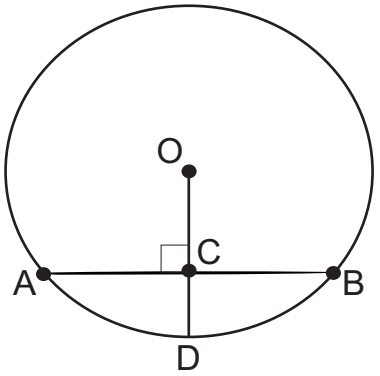
2. $100 - 10n$

3. $n^2 - 1$

4. $n^3 + 1$

5. $\frac{n}{n + 1}$

6. $\frac{n}{2n + 1}$



PROBLEM SOLVING

In the circle above:

AB = 24 cm
OD = 13 cm

What is the length of OC?

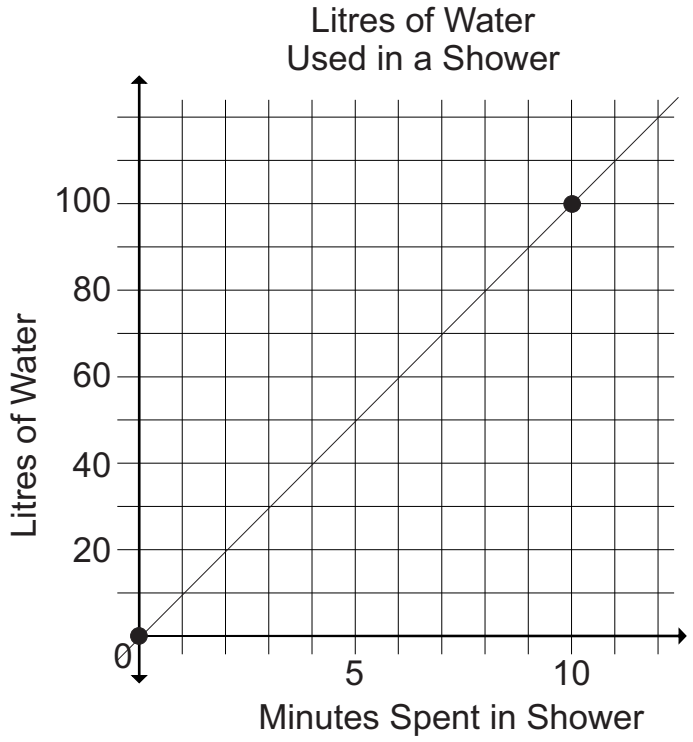
MELENCOLIA

The famous ingraving entitled Melencolia has many mathematical instruments featured, including a magic square. It was drawn by the German artist Albrecht Durer.

Investigate the engraving on the internet, show where it is on the picture and write the numbers from the magic square in the grid below. Circle the numbers on the magic square which indicate the year in which the engraving was produced and write why it is a magic square.

Knowing Graphs . . . . . complete these sentences.

A linear graph is a straight line graph. Co-ordinates are number pairs that indicate points on the graph. The first number of the pair gives the horizontal _____ while the second number gives the vertical y value. Intercepts are where the line intersects the x axis _____ (x intercept) or the y axis (_____). The equation of any straight line can be written in the form y = mx + c, where m defines the _____ of the line and c is the



The number of litres of water used in a shower depends on the amount of time spent in the shower.

Look at the graph on the left and write a sentence that defines the equation of the graph.

Mark the following aspects onto the graph shown on the right.

Positive gradient

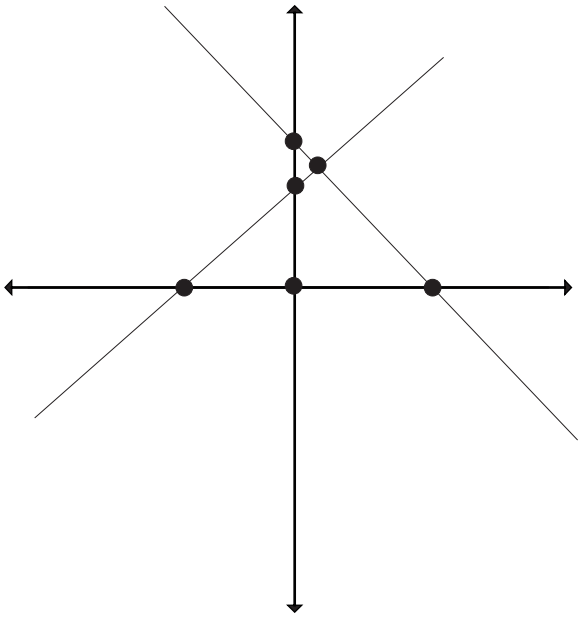
Negative gradient

Origin

y intercept

x intercept

Intersection of two line graphs.



STRIKING STATISTICS

Edith and John decide to join their local Ten Pin Bowling Club. In his first 12 games, John's scores are:

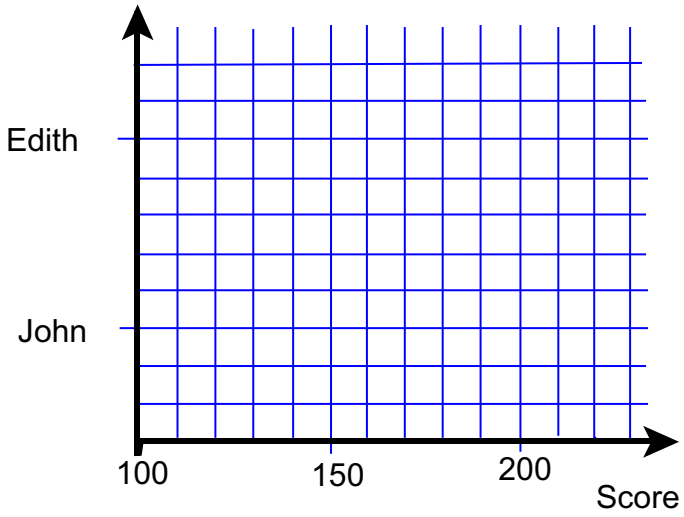
160, 150, 141, 144, 138, 148, 140, 160, 158, 144, 141, and 140

The statistics for these twelve games are: Mean Score, 147; Median Score, 144; Upper Quartile Score, 158; Lower Quartile Score, 140; Range, 22.

Edith's scores for her first twelve games are: 210, 215, 180, 131, 157, 147, 105, 112, 210, 205, 112 and 100

1. Summarise Edith's results in the table below.

Mean Score	_____
Median Score	_____
Upper Quartile Score	_____
Lower Quartile Score	_____
Range	_____



2. On the grid above, draw two box and whisker graphs: one that shows John's statistics and the other that shows Edith's statistics.

3. There is a ten pin bowling doubles competition in the next few weeks. If you were to enter and needed a partner, would you choose Edith or John? Write an explanation below about why you would choose that particular person.

_____

_____

_____

_____

4. In his next game, John increases his mean score to 148. How many points did he score in the game to achieve this result?

_____

_____

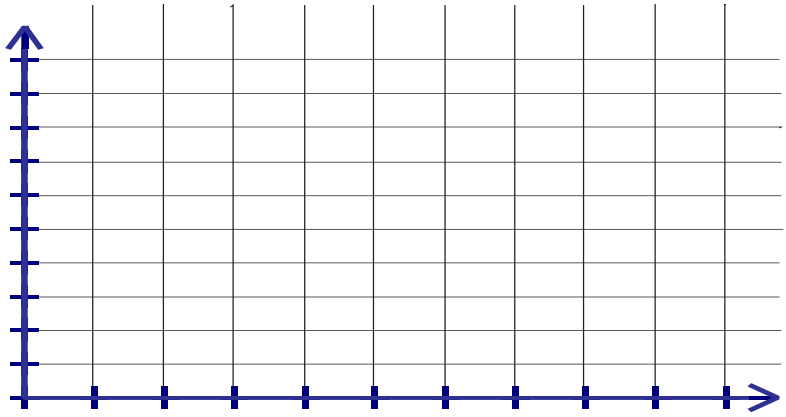
_____

MATERNITY MATHEMATICS

At Mahobe Maternity Hospital, babies are born each day. The table below shows how many babies were born over a particular 5 day period.

	Day 1	Day 2	Day 3	Day 4	Day 5
Number of babies born	2	5	4	7	4

1. Draw and label a bar graph of the number of babies born each day:



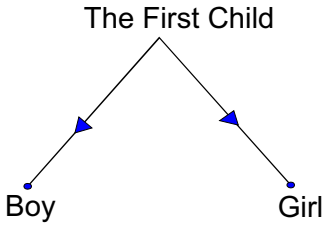
2. On how many days were there more than 3 babies born? _____

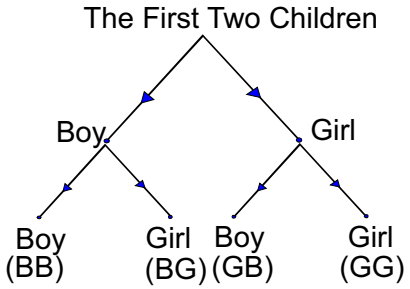
3. How many babies were born over the 5 day period? _____

4. Calculate the mean number of babies born per day. _____

5. What was the most common number of babies born per day (the mode)? _____

This next two diagrams show the probability of a couple's first child being a boy or a girl and the probabilities for the first two children.





6. What is the probability of a family of two children being 2 boys?

_____

7. What is the probability of a family of two children being a boy and a girl?

_____

8. What is the probability of a family of three children being 2 girls and 1 boy?

_____

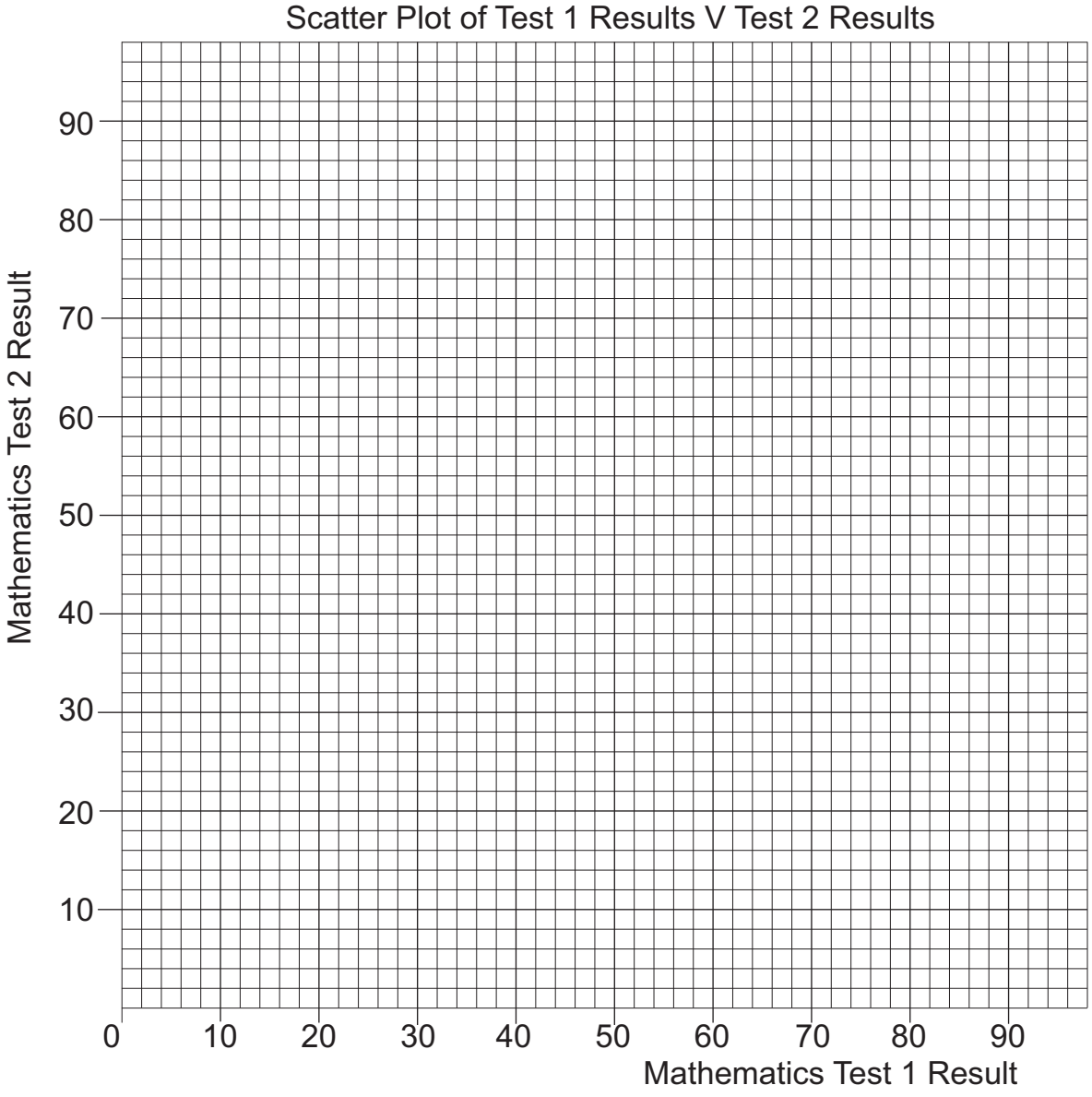
BLACK Worksheet 37

PREDICTING EXAMINATION MARKS

Teachers quite often need to predict marks when students are absent on the day of test. They do this by looking at results from previous tests. The table below gives ten marks from students who have both sat the same two Mathematics tests.

Result 1	47	74	69	79	64	37	63	89	53	45
Result 2	35	53	50	59	48	26	44	65	38	32

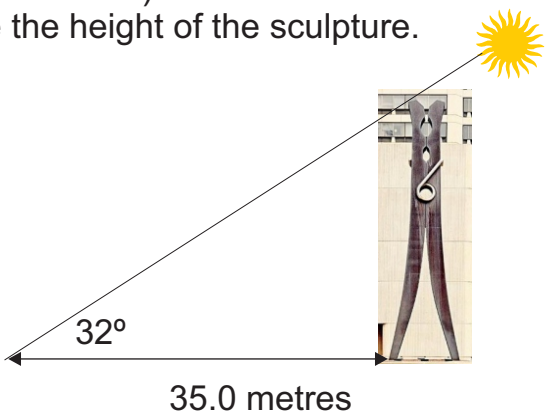
1. Plot these results on a scatter diagram and draw a line of best fit.



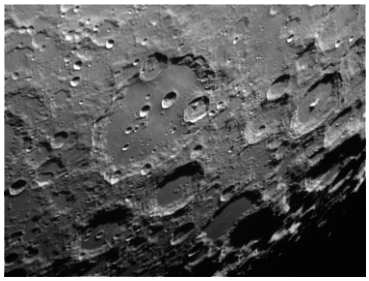
2. Three students missed Test 2. Their marks for Test 1 were 60, 85 and 20. What would be a good estimate of these three students marks for Test 2?

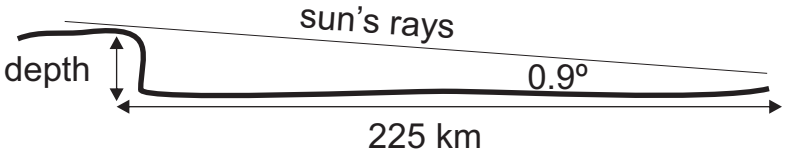
TANGENT TRIGONOMETRY

1. Clothespin is a famous stainless steel sculpture found in Centre Plaza Philadelphia, USA. At a certain time of the day you measure the shadow at 35.0 metres from the base and an angle of 32º (see the diagram below). Use these measurements to calculate the height of the sculpture.



2. Clavius is one of the largest crater formations on the Moon (see the photo below). Astronomers have calculated that when the sun's rays strike the moon's surface at an angle of 0.9º, the edge of the lunar crater casts a shadow along the whole length of the crater. They know that the Clavius crater is 225 km wide, but what is its depth?





3. A water tower in Stanton, Iowa is recognised as the world's "largest coffeepot". Two angle measurements are taken 15 metres from the base of the structure. The angle of elevation from the ground to the top of the pot is 68º, the angle of elevation from the ground to the bottom of the pot is 61º. How tall is the actual coffee pot?

EXTENDED PROBLEM SOLVING

For the period 2000 - 2010 the consumption of bottled water in New Zealand has been approximated by $y = 0.1x^2 + 0.1x + 6$ where y is the volume of water in litres per person and x is the number of years since 2000.

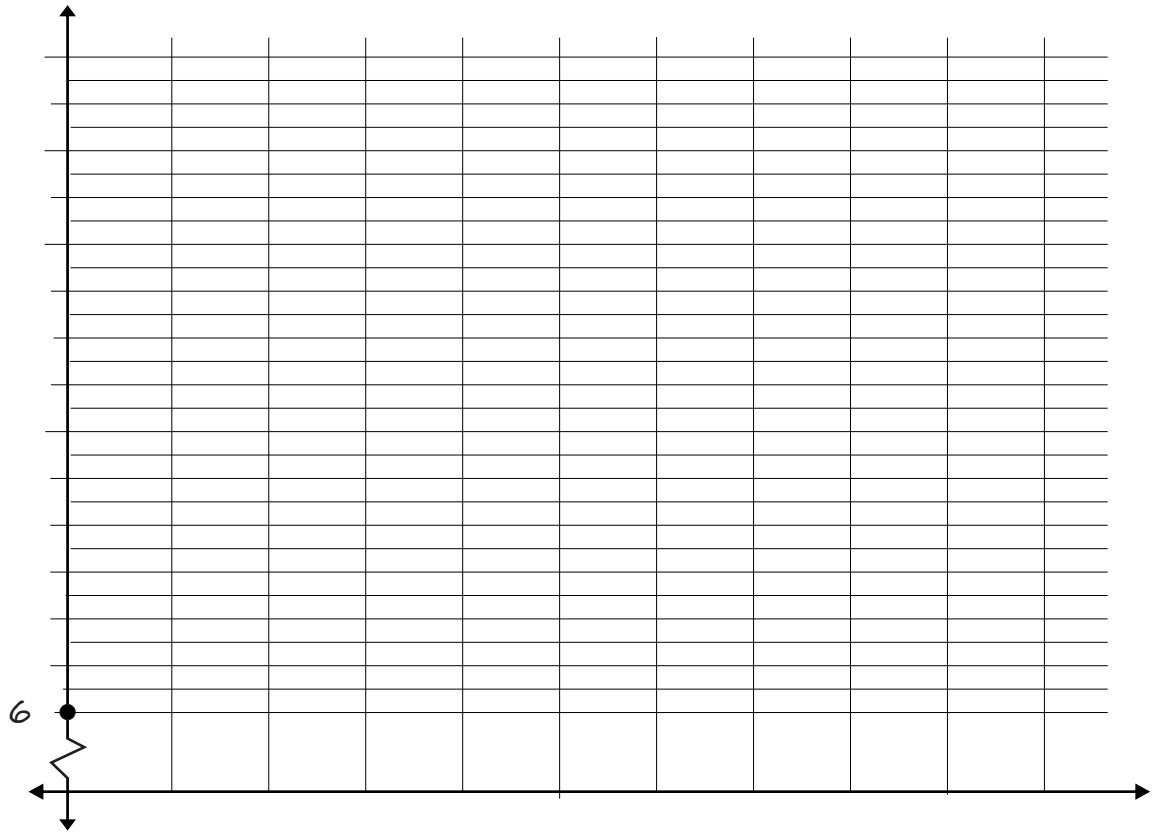
1. Either use a spreadsheet or a calculator to find the values and fill in the table.

Year (x)	1	2	3	4	5	6	7	8	9	10
$0.1x^2 + 0.1x + 6$	6.2	6.6								

2. What was the first year when consumption of bottled water went over an average of 10 litres per person?

_____

3. Graph the results below. Between which years did the annual water consumption start to increase the most dramatically from the previous year?
Explain how you used the graph to find this.

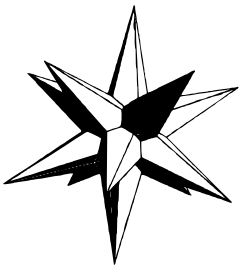


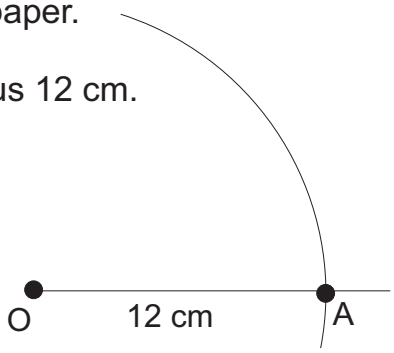
_____

THE NINTH STELLATION OF THE ICOSAHEDRON

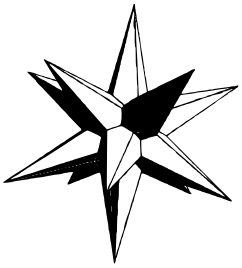
This is a solid figure made from 12 star points. To make each start point you need to draw the pattern below on 12 pieces of stiff card or paper.

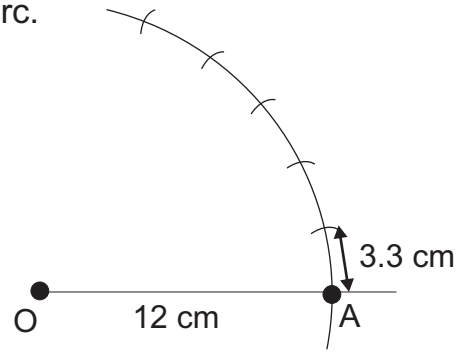
Step 1: With centre O, draw an arc with radius 12 cm.



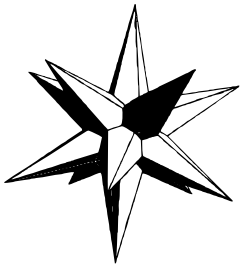


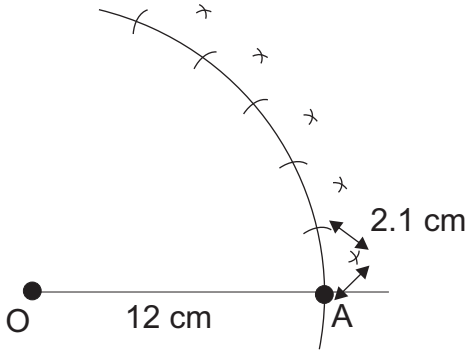
Step 2: Beginning at point A draw an arc with radius 3.3 cm. Continue until you have 5 points on your arc.



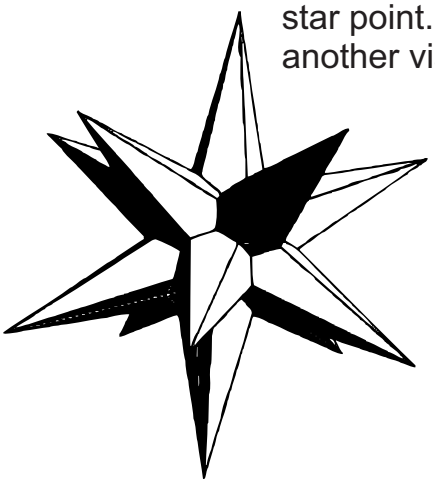


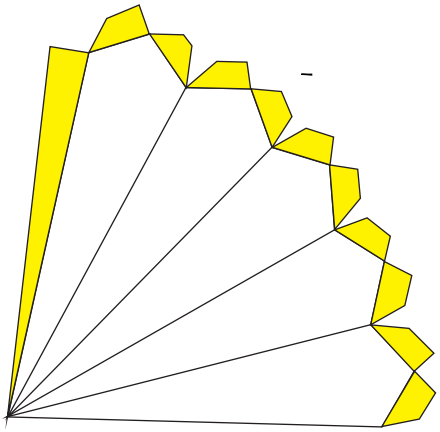
Step 3: Using A and the other points on the arc mark off the points at 2.1 cm





Step 4: Draw all the lines and add tabs as shown. Score along the lines and fold. Glue the longest tab to the opposite face and you should have a star point. Remember you need 12 of these. Each star point is glued to another via two of the small outside tabs





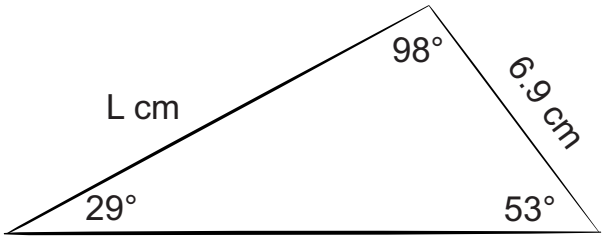
ISBN: 9781877489150

BLACK Worksheet 38

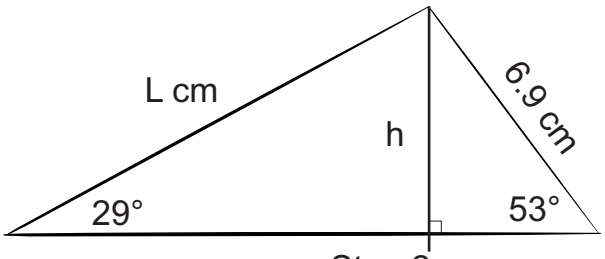
ADVANCED TRIGONOMETRY

Trigonometry can be used to work out the angles and sizes of right angle and non right angled triangles. The triangle below does not have a right angle however in the Step 2 illustration two right angled triangles are created.

1. Study the triangles below then complete the calculations that have been started to find the size of the triangle side labeled L cm.



Step 1



Step 2

$\frac{h}{L}$ = Sin 29

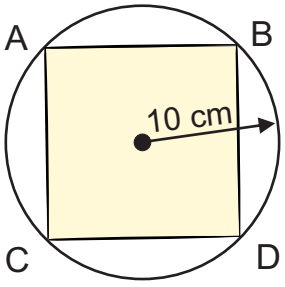
h = L × Sin 29

$\frac{h}{6.9}$ = Sin 53

h = 6.9 × Sin 53

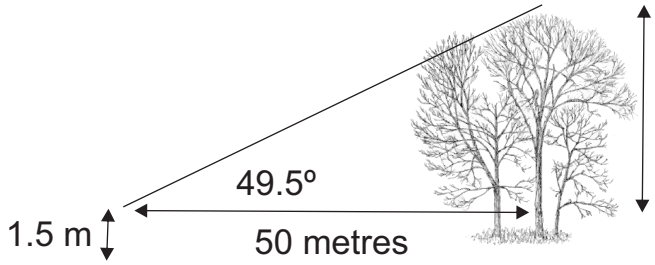
h = h

2. What is the perimeter of the square ABCD?



USING TRIGONOMETRY

1. A forester measures 50 meters from a group of trees and uses a clinometer to measures the angle of elevation from eye level to the top of the trees at 49.5°. The distance from the forester's eye level to the ground is 1.5 meters. Find the height of the tree to the nearest tenth of a meter.



2. The largest sundial in the world was built around 1720 at Jaipur, India. It is a right angled triangle shape and the shadow cast by the sun visibly moves 1mm every second.

If the hypotenuse length of the sundial is 60.35 metres and the angle of elevation is 27°, find the height of the sundial from the ground.

3. At the beginning of a Synchronized Swimming performance, two swimmers start at opposite corners of a rectangular pool that is 50 meters long and 25 meters wide. They swim toward each other along a diagonal and meet halfway. How far from their starting points do the swimmers meet?

4. A building's wheel chair access ramp cannot be over 5° in elevation. You are to build a ramp that is 4 metres long. How far away from the building should the ramp start?

The formula: $s = \frac{1}{6} n (n + 1)(2n + 1)$ gives the sum of the squares of the integers from 1 to n. For example, the sum of the squares of the integers from 1 to 4 ($1^2+2^2+3^2+4^2$) is

$$(4) \times (4 + 1) \times ((2\times4) + 1)$$
$$= \frac{1}{6} \times 4 \times 5 \times 9$$
$$= 30$$

Use the formula to find s when n = 10.

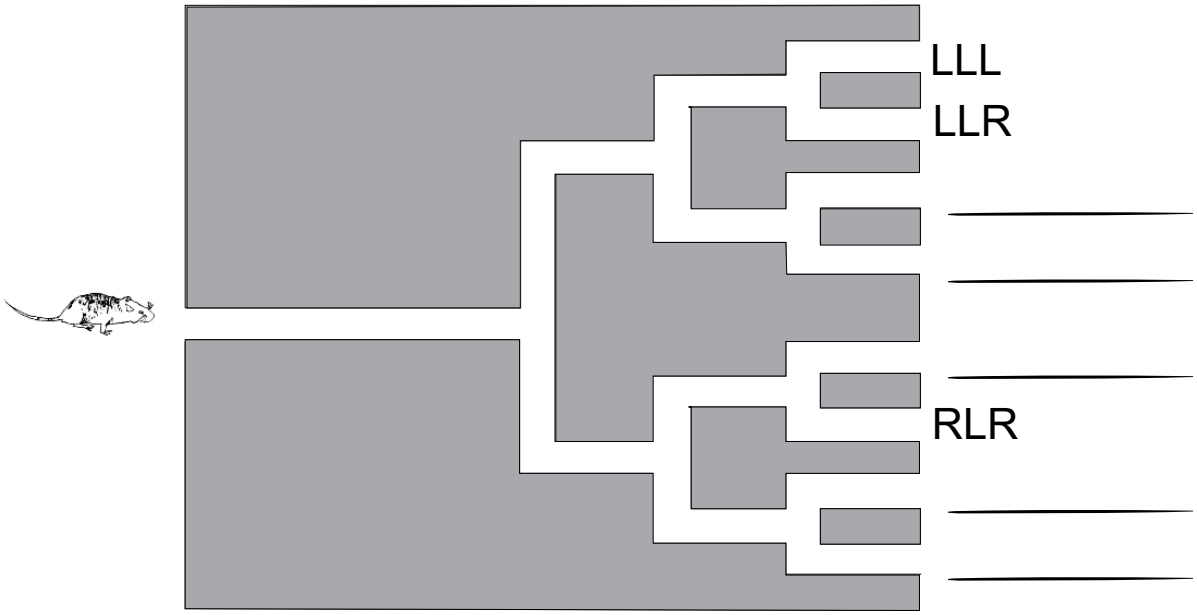
Police use the formula $S = \sqrt{204D}$ to estimate the speed (S) of a car in kilometers per hour by measuring the distance (D) that a car skids on a dry road.

On his way home from work, David skids while stopping to avoid a dog on the road and crashes into a parked car. He tells the police that before the accident he was only traveling at 50 km per hour. The police measure the skid at 13.3 metres. Should David be prosecuted for speeding if the road's speed limit was 50 km/hr?

The gold content of jewelry is measured in Karats (abbreviated to K or KT). A Karat is the unit of proportion based on a range of 1 to 24 parts, with 24 karat gold being 100% pure. However because pure gold is too soft for ordinary use it is typically alloyed with other metals such as copper, silver and nickel to increase the hardness.

This means 18 Karat gold is 75% pure gold ($\frac{18}{24}$).

How would you describe a piece of jewelry which is $\frac{2}{3}$ pure gold using the unit Karats?



The figure above shows the view looking down on a maze. Mice enter the maze from the left hand side and at each branch they can turn either right (R) or left (L).
Each exit can be labelled according to the number of left or right turns that were made. For example RLR means the mouse turned right at the first branch, left at the second branch and right at the third branch.

1. Label each of the unmarked exit points.

2. How many of the exits have exactly two L's in their label? _____

3. What fraction of the exits have only one L in their label? _____

4. 64 mice go through the maze.
How many would you expect to follow the path to the exit labelled LLL?

_____

INTERPRETING A MARGIN OF ERROR

It has been found that when you survey different samples from the same population you get can get different results. For example one survey held at your school might find that 68% of students have cell phones. Another survey might find that 72% have cell phones. This is because the surveys don't ask the whole school but might only take a sample of 100 students each time. Due to this variation a survey should include a "margin of error". This means a sample percent of 30% with a margin or error of ±5% means that the actual percent is most likely to be between 25% and 35%.

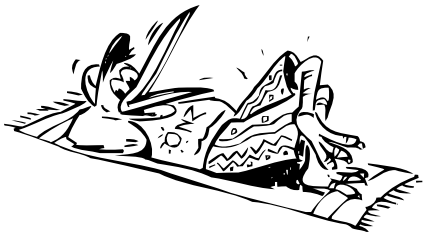
In an election a random sample predicts that Arnold will receive 52% of the votes and Xania will receive 48% of the votes. The margin of error is ±3%. Can you predict who will win the election?

_____

_____

_____

BLACK Worksheet 39



HOLIDAY PROBLEMS TO PONDER

1. Your neighbours tell you that they are going on holiday. They will be away for "43 meals". How many days is that?

2. Last Christmas, motorists in Germany were held up on the autobahn linking Frankfurt and Munich by heavy snow storms. The traffic jam was 170 km long. How many cars do you estimate were in the traffic jam? Write the assumptions you made with your estimate.

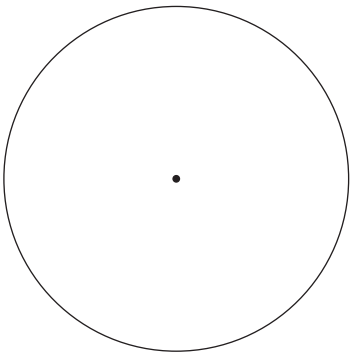
3. A report in the newspaper says that the average New Zealand male will change the TV channel at least 117,000 times in their lifetime. Is this a realistic figure?

GRAPHICAL REPRESENTATIONS

1. A soil sample was taken from a site in Newmarket, Auckland. The composition of the soil was as follows:

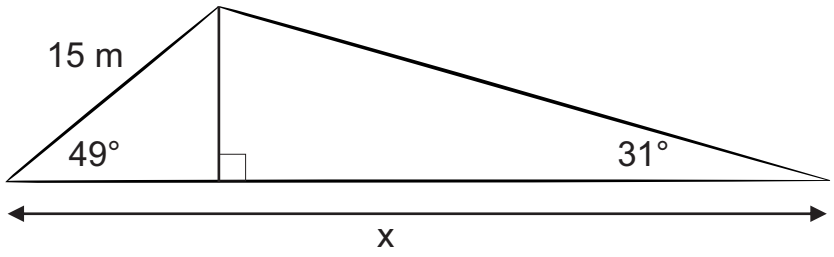
Air 25%
Water 20%
Minerals 45%
Organic Material 10%

Draw a pie chart to represent the figures.

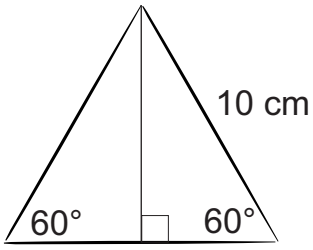


MATHEMATICAL CHALLENGES

1. Study the triangle below and calculate the distance x



2. Calculate the area of the equilateral triangle below.



3. A periscope is used in a submarine to view the surface of the ocean. The Naval Manual states that the periscope height, h, (in feet) above the surface and the distance, d, (in miles) that a sailor can see are related by the formula: $h = \frac{d^2}{1.4}$

If the periscope is raised to a distance of 3 feet above the ocean surface, how far (in kilometres) can the sailor see?

STATISTICS

The list below gives the number of hours that students in one particular class spent online last week.

14	7	6	10	5	12	1	6	5	5	1	3	11	7	4	7
4	13	13	9	14	1	0	12	4	1	9	3	11	0	10	10

1. Make a line plot of the data.

2. Which value occurs the most frequently?

_____

3. Would the mean, median or mode best represent this data.
Explain your answer.

_____

_____

Look at the data in the stem and leaf plot below.

STEM	LEAF	
9	3, 5	
10	2, 2, 5, 8, 9	
11	4, 5, 8, 8, 8, 8, 9, 9	
12	0, 1, 7, 7, 8, 9	9 | 3 = 9.3

4. What is the difference between the least and the greatest values?

_____

5. What is the mode of the numbers?

_____

6. What is the median of the numbers?

_____

7. Does the mean, median or mode best represent this set of numbers?

_____

_____

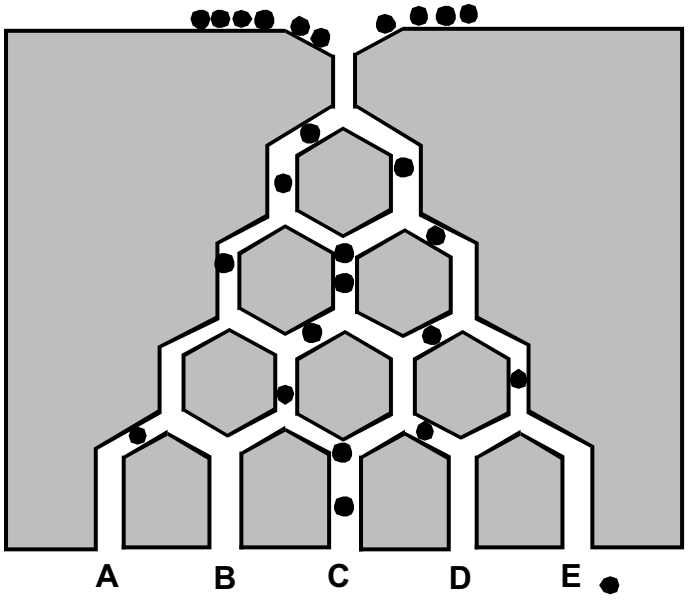
PROBABILITY EXPERIMENTS

Four groups of students each conduct an experiment with 100 marbles and the maze shown on the right.

The marbles are placed at the top entrance to the maze and allowed to travel downwards.

Their exit point is noted.

Each group's results are shown in the tables below.



Group 1

Exit	Number of marbles
A	10
B	26
C	35
D	24
E	5

Group 2

Exit	Number of marbles
A	5
B	27
C	37
D	20
E	11

Group 3

Exit	Number of marbles
A	6
B	25
C	40
D	22
E	7

Group 4

Exit	Number of marbles
A	4
B	24
C	38
D	28
E	6

1. Put together the results of each group and work out the probability of a marble arriving at each of the exits.

EXIT	A	B	C	D	E
Total number of marbles arriving at exit					
Probability of marbles arriving at exit					

2. At which exit or exits have the most marbles arrived?
Suggest a reason for this.

BLACK Worksheet 40

ALGEBRA ESSENTIALS

Simplify the following expressions:

1. 2 × 3x _____

2. 3x × 4y _____

3. 2x × 4y × 5 _____

4. 4x × -2y _____

5. -2x × -3y × -4a _____

6. -5 × 3x × 2y _____

7. -3x × 3x _____

8. $2x^2 \times 5x^3$ _____

9. $4x \times -2x^2$ _____

10. $-12x^3 \times -3x$ $36x^4$

Expand the following:

1. (x + 6)(x + 9) = _____

2. (x - 7)(x - 10) = _____

3. (x + 15)(x - 3) = _____

4. $(x - 4)^2$ = _____

5. (x - 12)(x + 8) = _____

6. $S = 4\P r^2$ and ¶ = 3.14 and S = 80
Calculate the value of r

_____

_____

_____

FACTORISE THESE EXPRESSIONS

1. $x^2 + 5x + 6$ $x^2 - 7x - 30$ $x^2 - 16$

_____

2. $x^2 + 7x$ $x^2 + 4x + 4$ $x^2 + 2 - 35$

_____

3. $x^2 - 14x + 48$ $2x^2 + 16x + 24$ $x^2 + 7x$

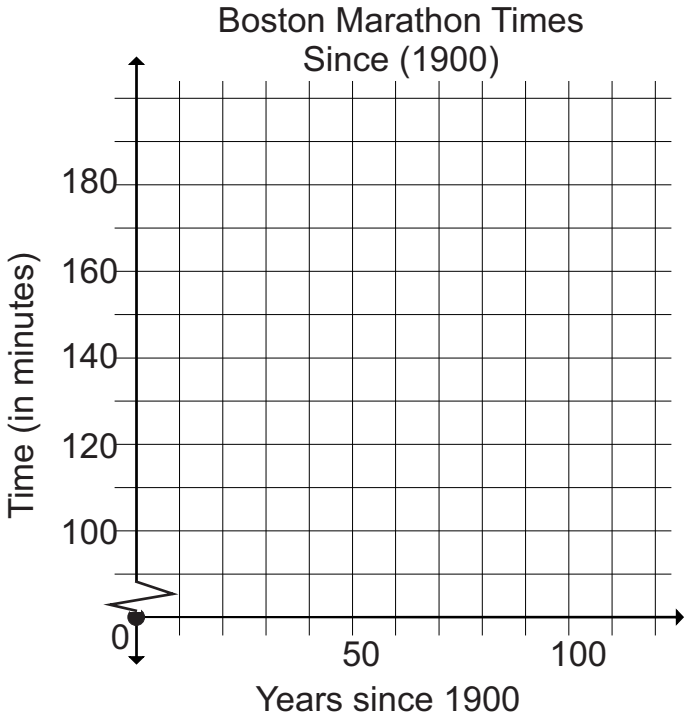
_____

STATISTICS AND REAL LIFE DATA

The table below gives the men's winning times in the Boston Marathon for every 10th year from 1900 to 2000. In the table the x value represents the number of years since 1900 and the y value represents the winning time (converted to the nearest minute)

x	0	10	20	30	40	50	60	70	80	90	100
y	160	149	150	155	148	153	141	131	132	128	130

1. Make a scatter plot of each (x, y) pair and draw a line that appears to best fit through the data.



2. Write an equation for your line.

3. Use your equation to predict the men's winning time (in minutes) for the Boston Marathon for 2010.

4. The actual winning time for the 2010 Boston Marathon was 2 hrs 5 min 52 sec (126 minutes.) Does the graph and resultant equation accurately predict winning times over each ten year block?

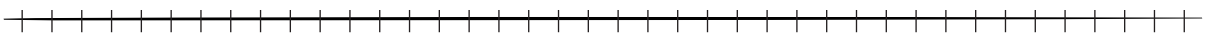
ANIMAL AGES

The table below shows the average natural life span of 20 well known animals.

Animal	Life Span(Years)
Baboon	20
Camel	12
Cow	15
Elephant	40
Fox	7
Gorilla	20
Hippopotamus	25
Kangaroo	7
Lion	15
Monkey	15

Animal	Life Span (Years)
Mouse	3
Opossum	1
Pig	10
Rabbit	5
Sea Lion	12
Sheep	12
Squirrel	10
Tiger	16
Wolf	5
Zebra	15

1. Make a line plot of the average life spans of the animals in the table.



2. Write a statement about the average life span of animals.

3. What is the most common life span for the animals in the table?

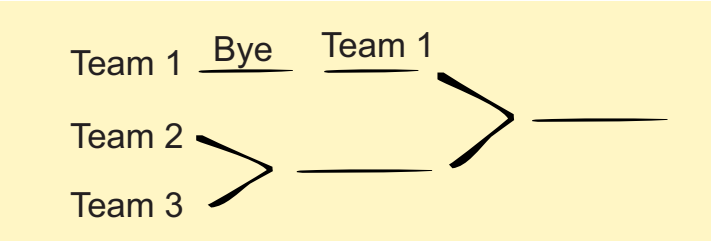
4. How many animals live at least 20 years?

5. Is this table a good representation of age spans of all animals?

THE TENNIS DRAW

Mahobe College is holding an interschool tennis tournament. There are 17 teams entered in the tournament. The organisers decide to have an elimination tournament with each team drawn out of a hat for the first round of games. How many games and how many “byes” must be scheduled for the tournament?

The example below shows the schedule arrangement if there were 3 teams. In this case shown there would be 2 games played.



1. Draw a chart to show all games that could be scheduled.

2. How many games will be played with a 17 team tournament?