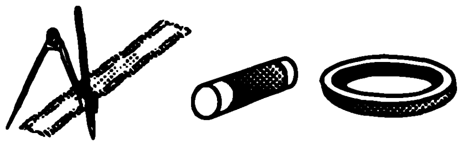
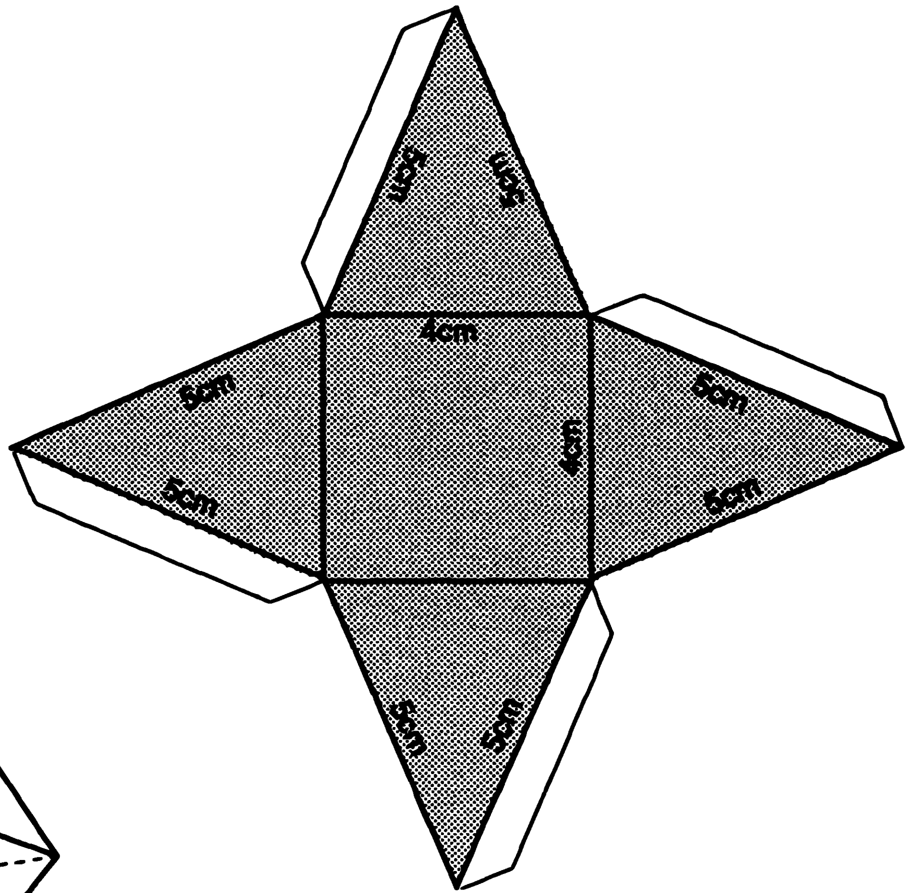
Nets of pyramids

You will need compasses, ruler, card, a sharp pencil and sellotape or glue.

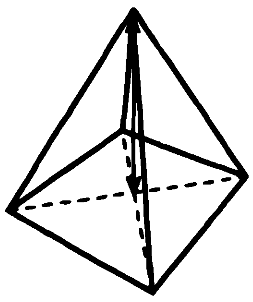


1. Draw this net of a pyramid using a ruler, pencil and compasses only.



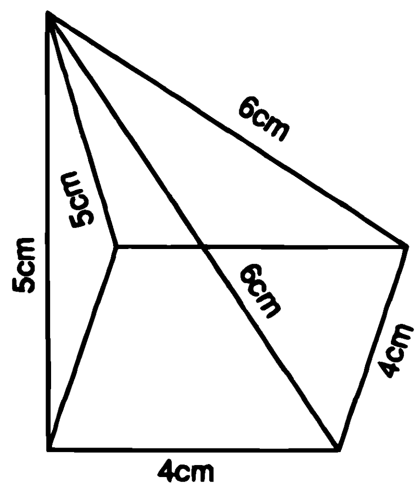
- First draw the square.
- Then use compasses to draw the triangles accurately.
- Add flaps to every other side.
- Cut the net out and fold it to make a square based pyramid.

You should find that for this pyramid, the top is directly above the centre of the square base. It is called a **right pyramid**.

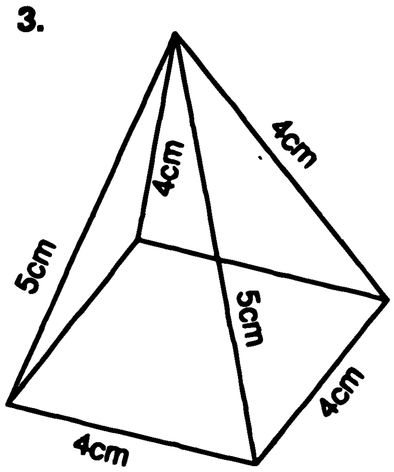


The pyramids below all have square bases but they are not right pyramids.
They are not drawn to scale.

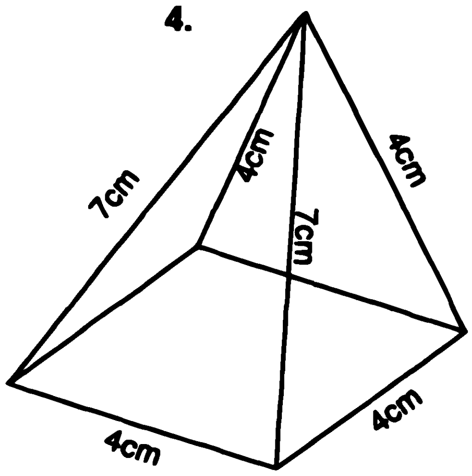
2.



3.



4.



- Draw sketches of their nets.
- Mark the measurements on the sketches.
- When you are convinced that the sketches are correct, draw the nets accurately.
- Add flaps.
- Check by cutting, folding and sticking.

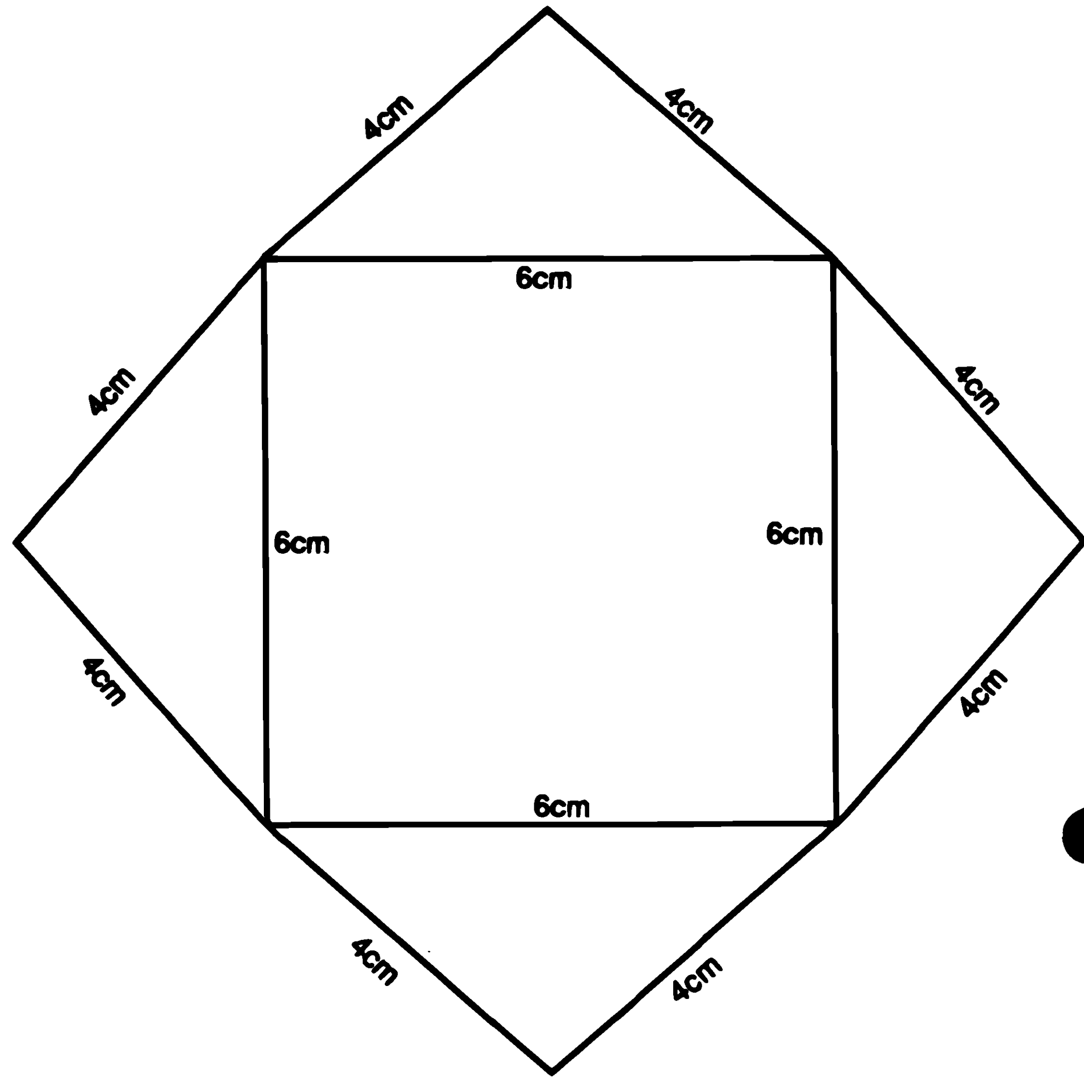
Turn over.

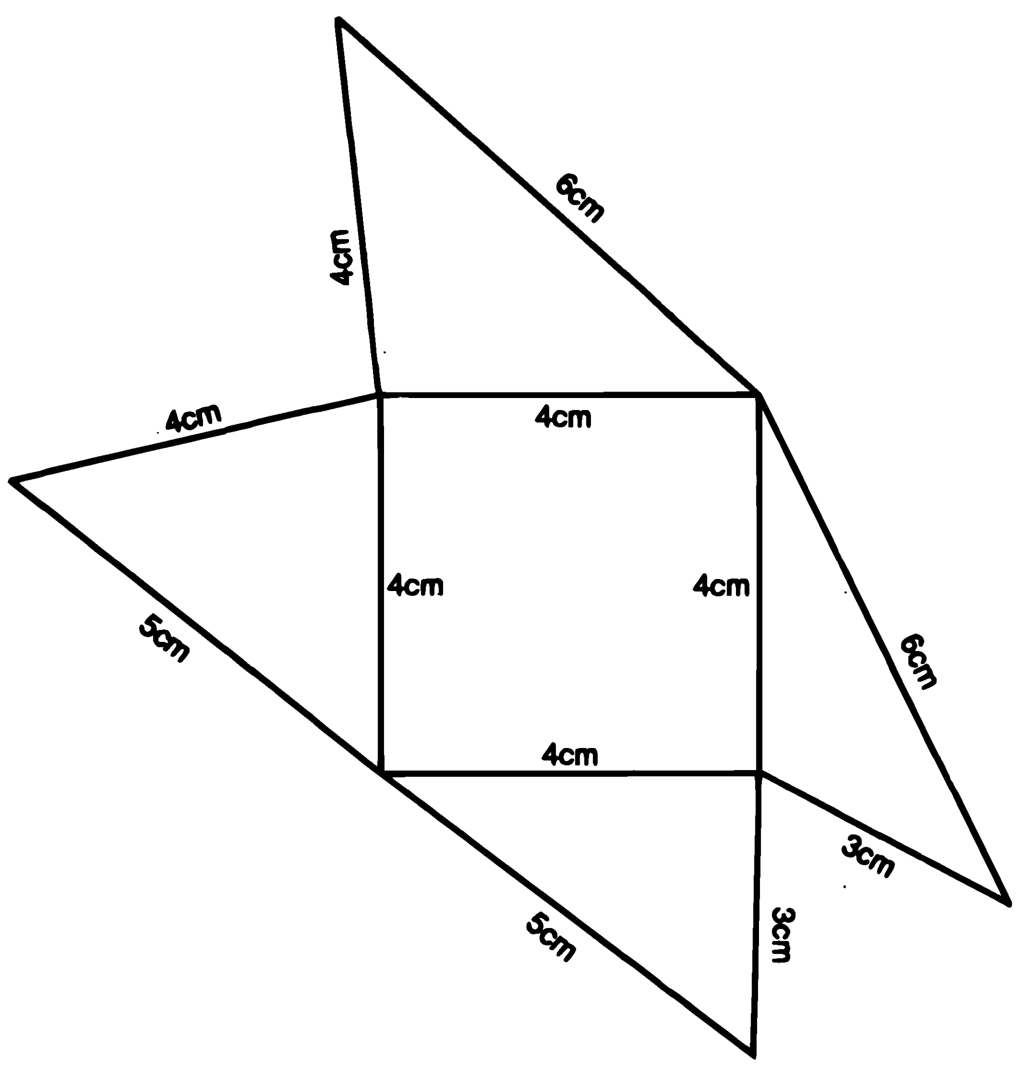
5. Draw these nets accurately.

Cut and fold.

What happens?

Why?

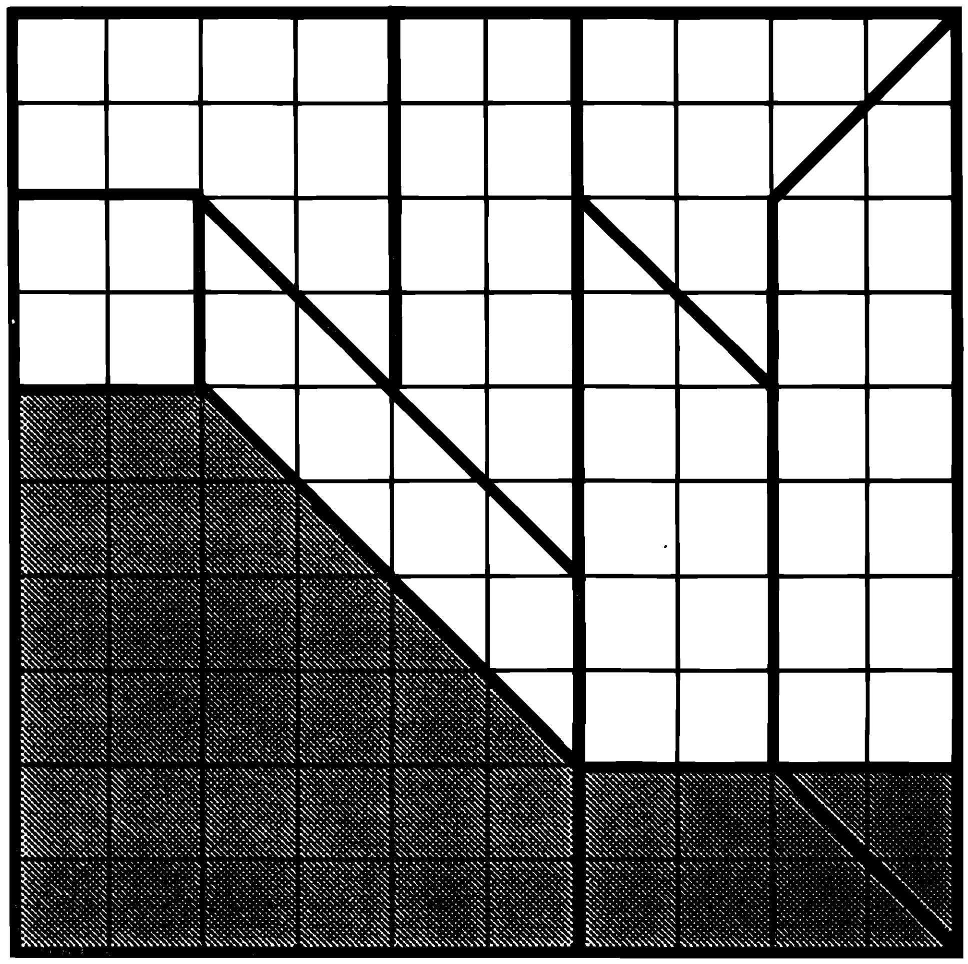




Squares Tangram

You will need cm squared paper, scissors, coloured pencils and glue.

1. Draw this pattern carefully on cm squared paper.
2. Colour the 3 shaded pieces.
3. Cut out the 10 pieces.



4. This is a **6**cm square.

   - Fit the 3 shaded pieces together to cover this square.
   - Stick the square you have made into your book.

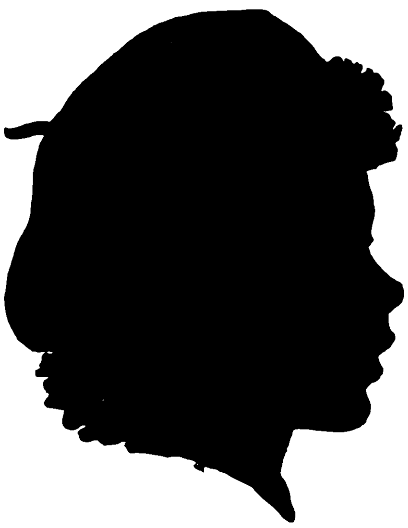
5. This is an **8**cm square.

   - Fit the other 7 pieces together to cover this square. (You may turn pieces over).
   - Stick the square you have made into your book.

6. What was the area of the square you started with?
7. What are the areas of the other 2 squares?
8. Copy and complete:

$$10^2 = \blacksquare^2 + \blacksquare^2$$
$$100 = \blacksquare + \blacksquare$$

PROVE IT!



Think of a whole number.
Square it.
Divide by 4.

Try several numbers.
What do you notice ?

I've found a result but does it always work ?

Of course it does.

Prove it !

Well, an even number must be twice some other number; ... call it 2n.

An odd number is alw... one less than an even... I'll call the odd ... 2n−1.

If you squar... you would... and th... then... w...

What is the rule and how was it proved?

Smile Worksheet **0725**

Race Track

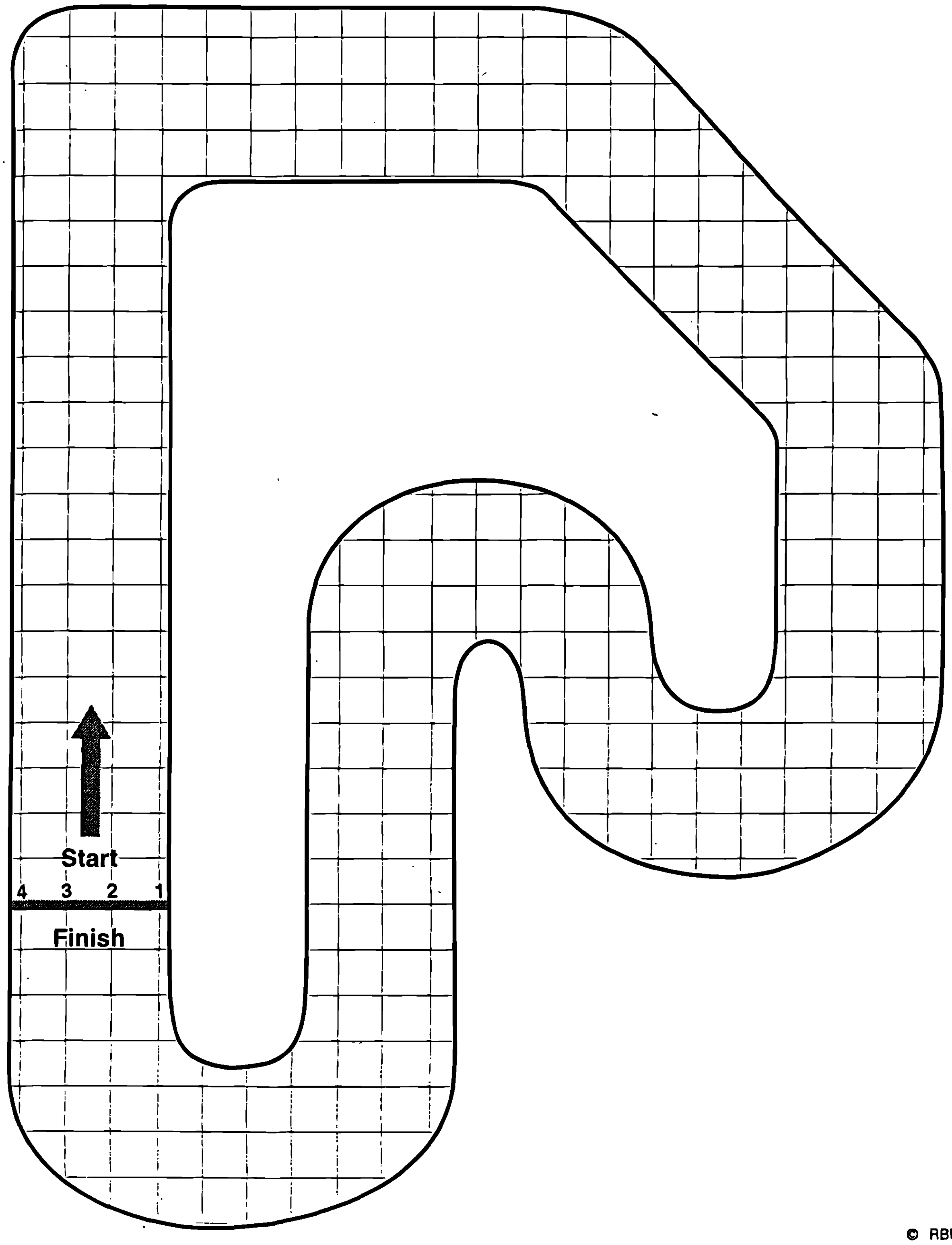
This is a game for 2 to 4 players that simulates cars racing around a track.
Each player moves in turn and the moves must be written as vectors.

Rules

- Each player starts off from rest, i.e. with the vector $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$.
- To move, each component of the previous move may be changed by 1 or left alone.

For example after a move of $\begin{pmatrix} -1 \\ 3 \end{pmatrix}$ any of the following moves are possible:

$$\begin{pmatrix} -1 \\ 3 \end{pmatrix} \begin{pmatrix} 0 \\ 3 \end{pmatrix} \begin{pmatrix} -2 \\ 3 \end{pmatrix} \begin{pmatrix} -1 \\ 2 \end{pmatrix} \begin{pmatrix} 0 \\ 2 \end{pmatrix} \begin{pmatrix} -2 \\ 2 \end{pmatrix} \begin{pmatrix} -1 \\ 4 \end{pmatrix} \begin{pmatrix} 0 \\ 4 \end{pmatrix} \begin{pmatrix} -2 \\ 4 \end{pmatrix}$$



Who's Who?

Bill **always** tells the truth but Phil and Will sometimes lie.

1. Which one is Bill?

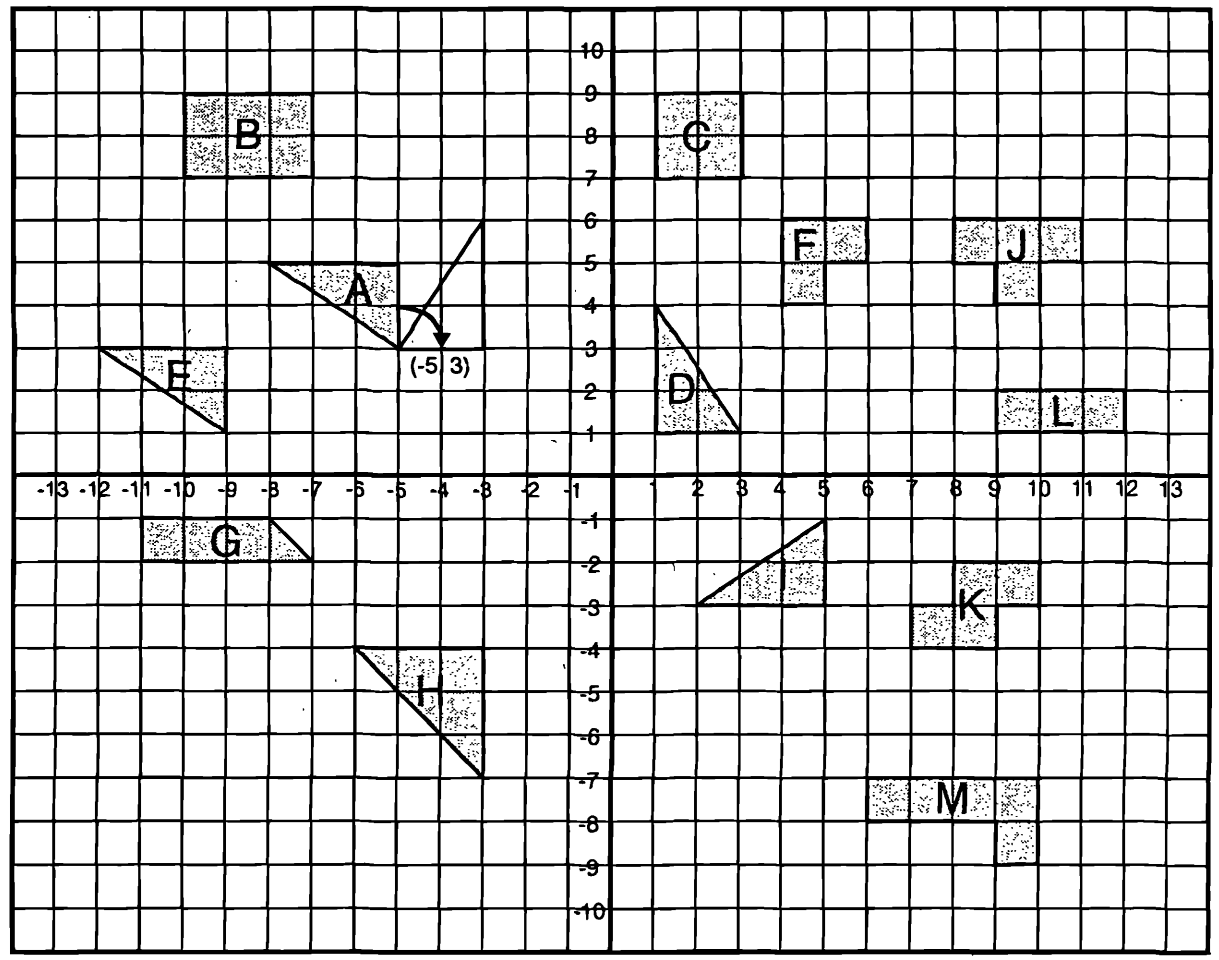
2. Where are Will and Phil?

Explain all your answers.

Rotations

Rotate the shapes as instructed below.
Tracing paper might help.
Shape **A** has been done for you.

Shape	Centre of Rotation	Turn	Direction
A	(-5, 3)	$\frac{1}{4}$	clockwise
B	(-7, 7)	$\frac{1}{4}$	clockwise
C	(3, 9)	$\frac{1}{4}$	anti-clockwise
D	(1, 1)	$\frac{1}{2}$	anti-clockwise
E	(-12, 3)	$\frac{1}{4}$	anti-clockwise
F	(5, 4)	$\frac{1}{2}$	clockwise
G	(-7, -2)	$\frac{1}{4}$	anti-clockwise
H	(-3, -4)	$\frac{3}{4}$	anti-clockwise
I	(2, -3)	$\frac{1}{4}$	clockwise
J	(11, 6)	$\frac{1}{2}$	
K	(7, -4)	$\frac{1}{4}$	anti-clockwise
L	(11, 1)	$\frac{1}{2}$	
M	(10, -7)	$\frac{1}{2}$	



Regular Polygons

n	=	number of sides
V	=	angle at each vertex
A	=	angle at centre

Is there a connection between V and A?

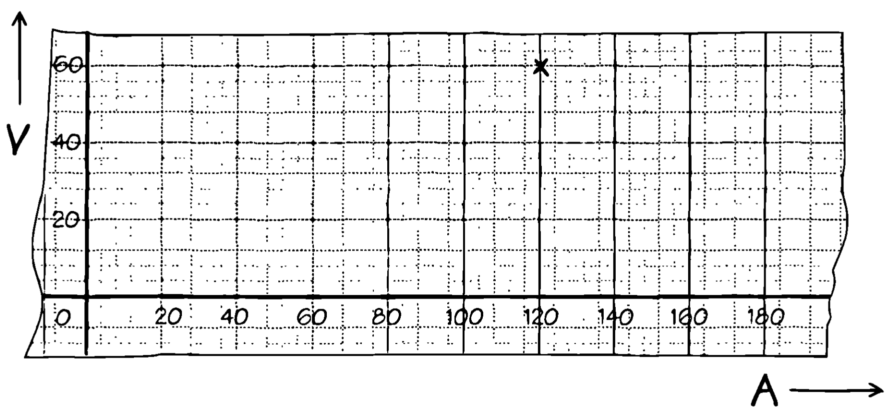
1. **Measure** angles **V** and **A** for the different regular polygons on the inside pages.

2. **Record** your results in a table.

June 9th   Smile 0731   Regular Polygons

Polygon	n	V	A
Triangle	3	60°	120°
Square	4	90°	

3. **On a graph** plot **V** against **A**.

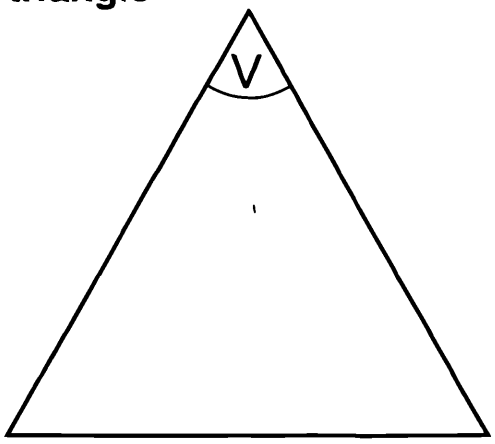


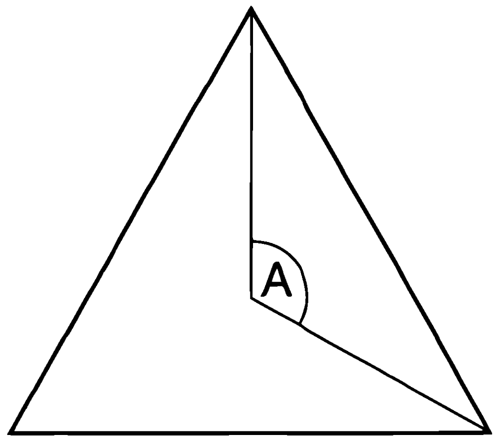
4. Why should you *not* join the points on this graph?

5. What do your table and graph suggest about a connection between **V** and **A**?

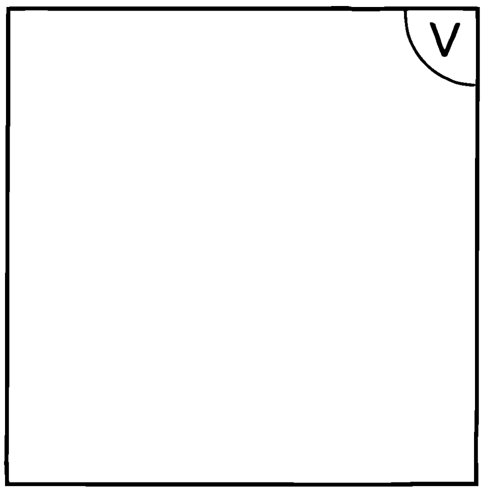
Now turn to the back page.

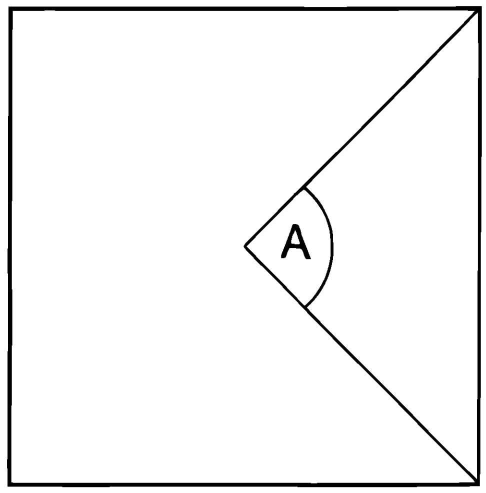
Equilateral triangle



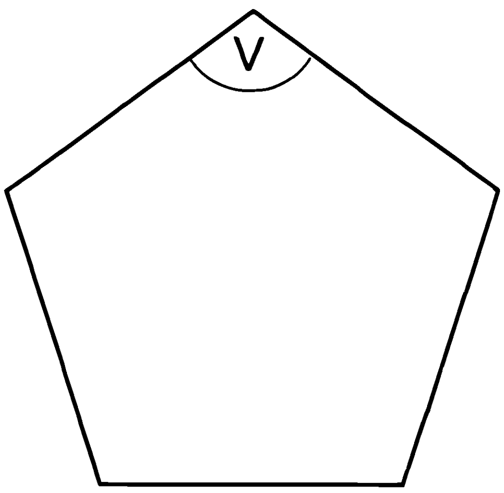


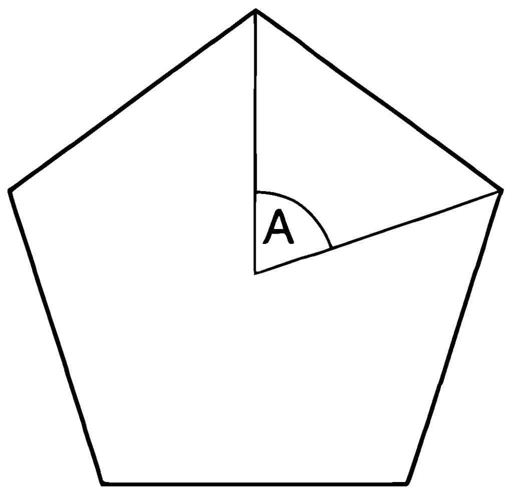
Regular Quadrilateral (Square)



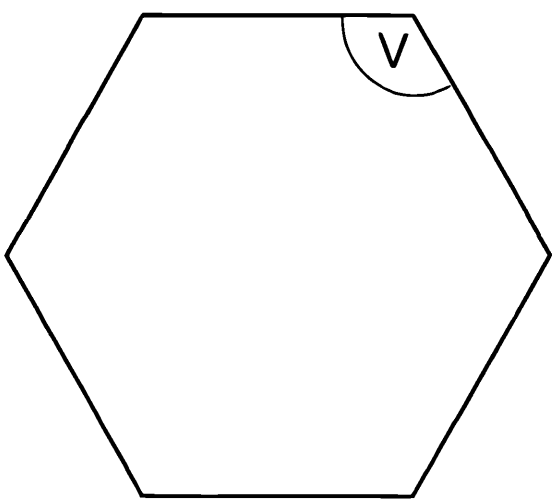


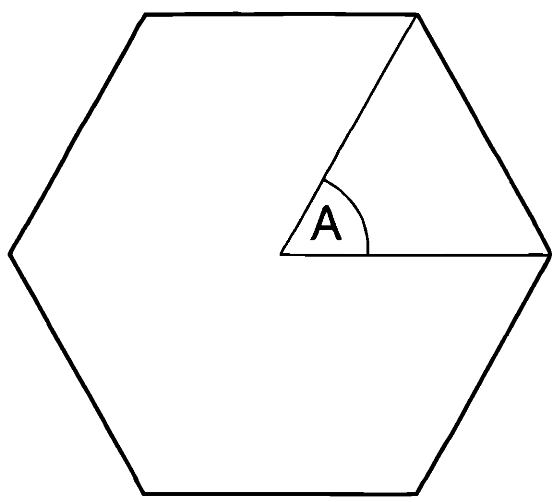
Regular Pentagon



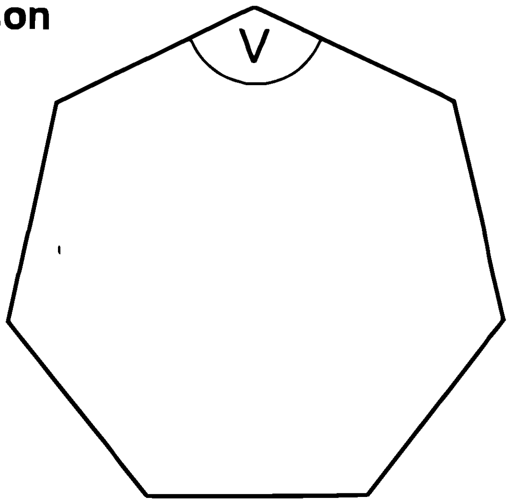


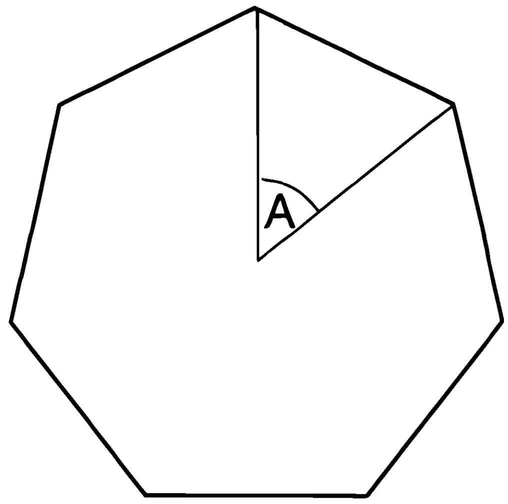
Regular Hexagon



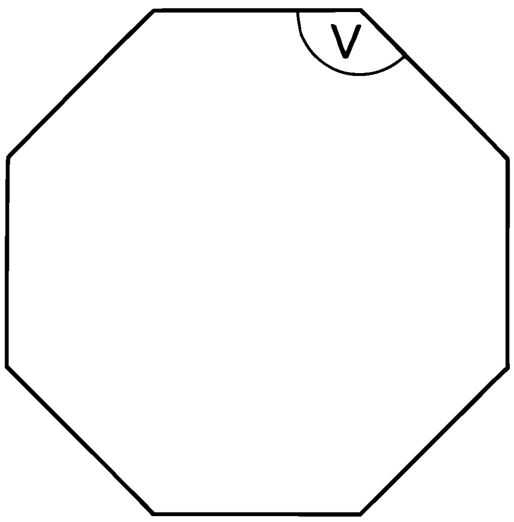


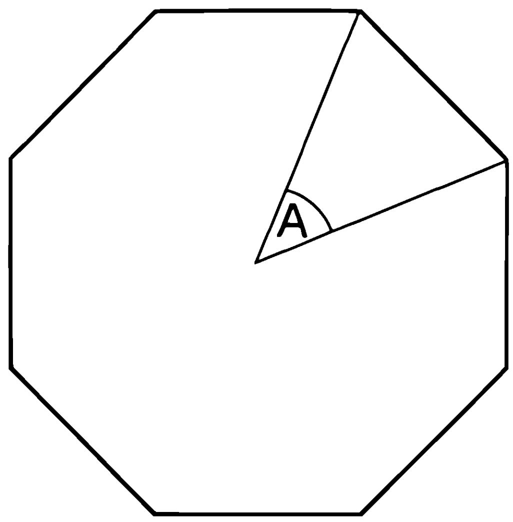
Regular Heptagon



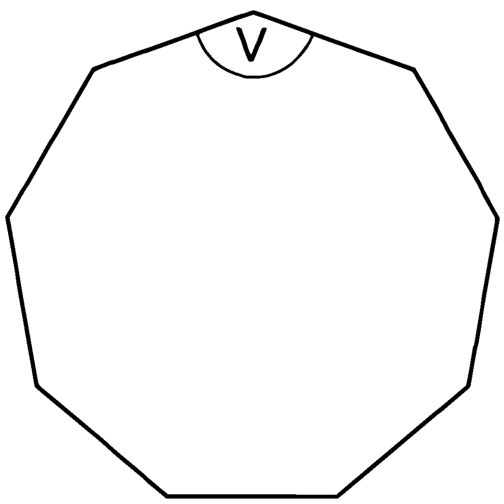


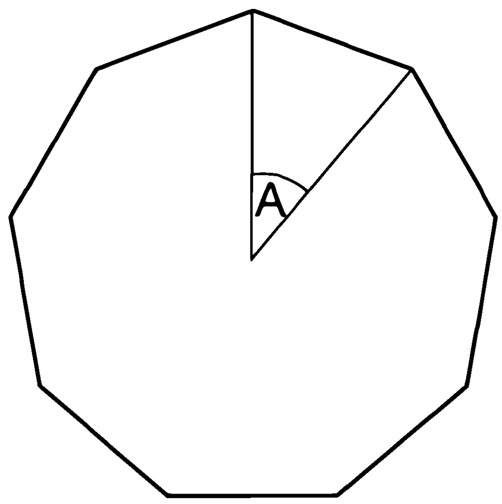
Regular Octagon



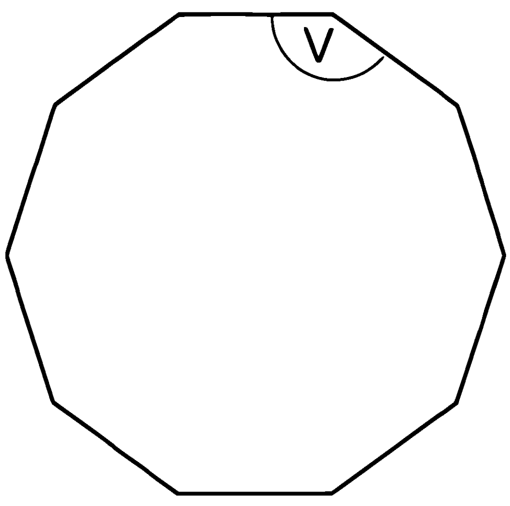


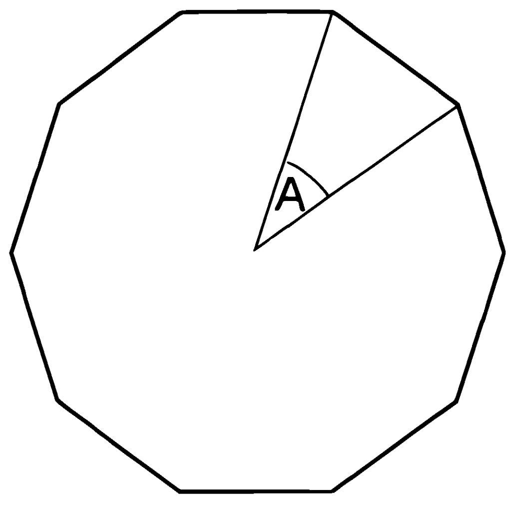
Regular Nonagon

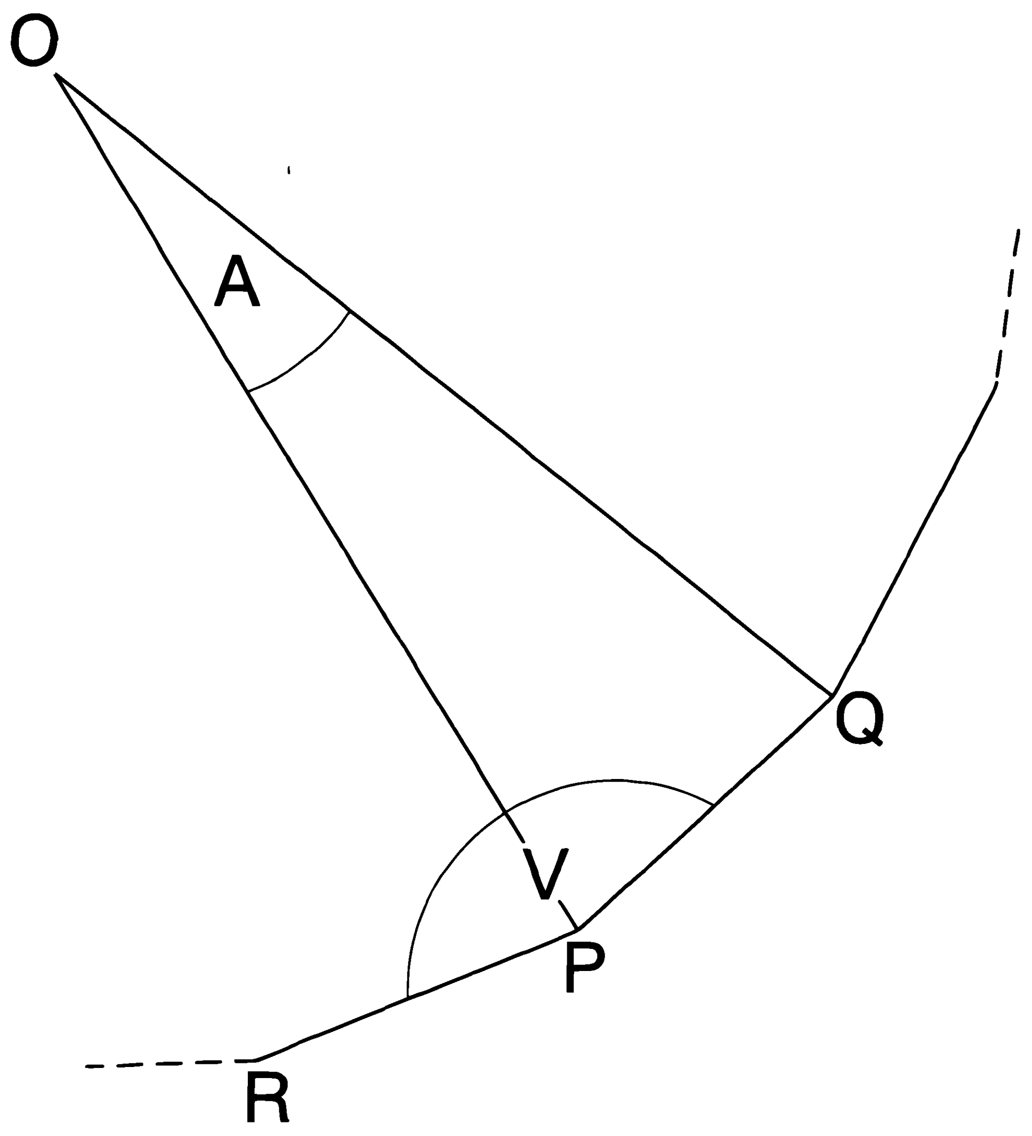




Regular Decagon







Consider any regular polygon with its centre **O** *and one side* **PQ**.

6. What type of triangle is **OPQ**?

7. What can you say about the line **OP** and the angle **V**?

8. ∠**RPQ** = **V**; what is ∠**OPQ**?

9. What is ∠**PQO**?

10. Use the sum of the angles of a triangle to write an equation connecting **V** and **A**.

11. Your answer to question 5 should have *suggested* the connection between **V** and **A**.
Your answer to question 10 should have *proved* the connection between **V** and **A**.

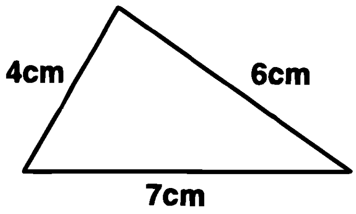
What do you think is the difference between these two approaches?

Ruler, Pencil, Compass

These drawings are not to scale.

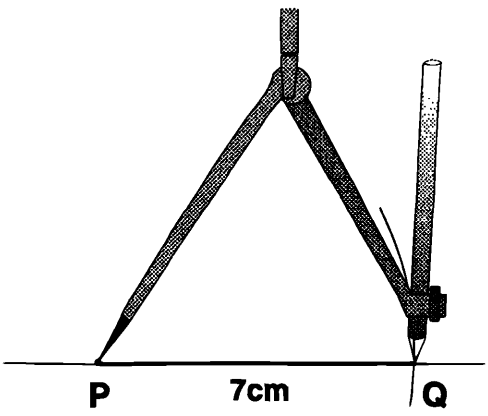
Can you draw this triangle accurately using only:

- a ruler
- a sharp pencil and
- a compass?

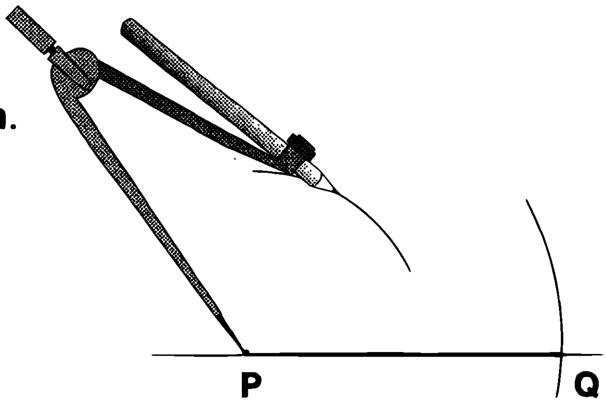


Here's how!

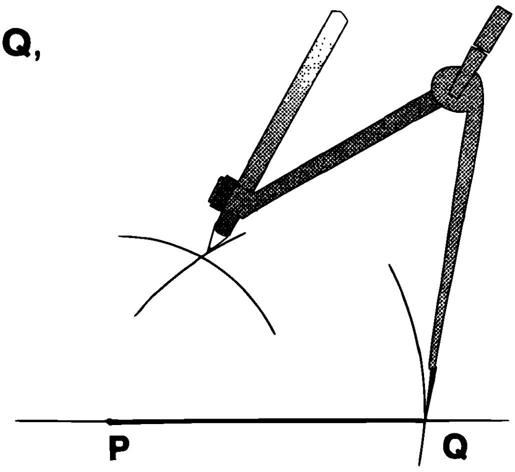
- Mark off **7cm** on a line.



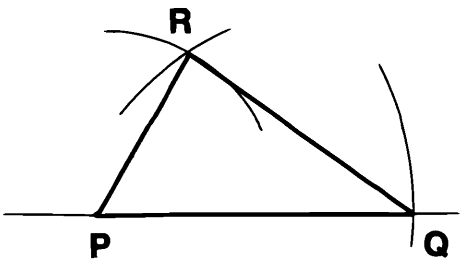
- Draw an arc centre **P**, radius **4cm**.



- Draw another arc; centre **Q**, radius **6cm**.



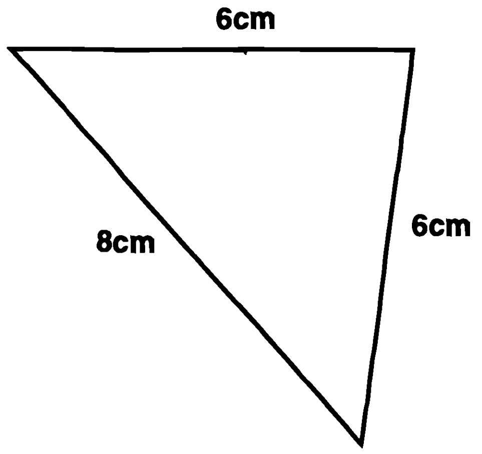
- Draw the triangle **PQR**.
- Check the measurements.



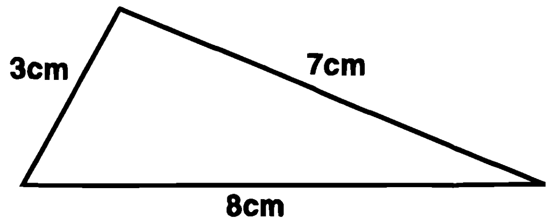
Turn over

Draw these triangles accurately, using only a ruler, a sharp pencil and a compass.

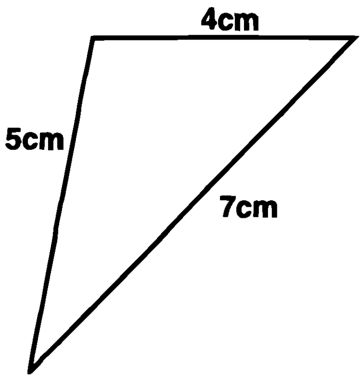
1)



2)



3)



Try to draw these triangles accurately, some are impossible.

4) 5cm, 5cm, 9cm.

5) 15cm, 8cm, 7cm.

6) 8cm, 8cm, 8cm.

7) 4cm, 7cm, 11cm

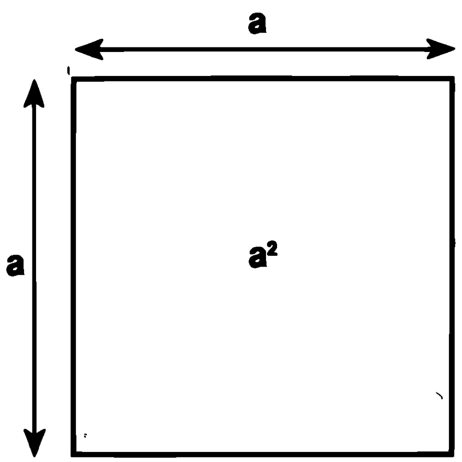
8) Which triangles are impossible to draw? Explain why.

9) Look at the triangles you have drawn.

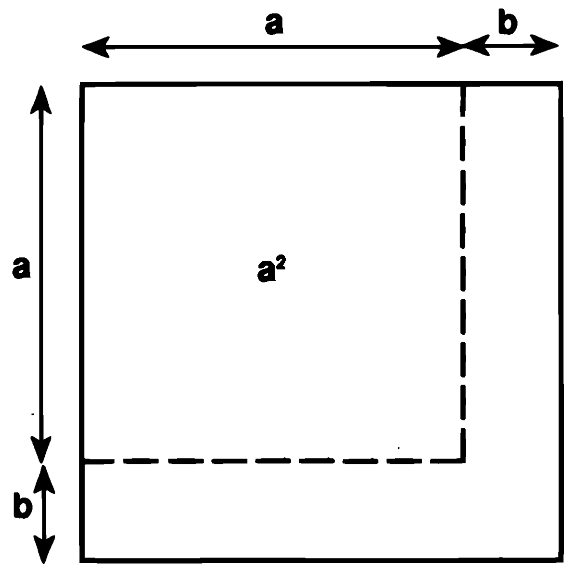
- Which ones are isosceles?
- Which one is equilateral?

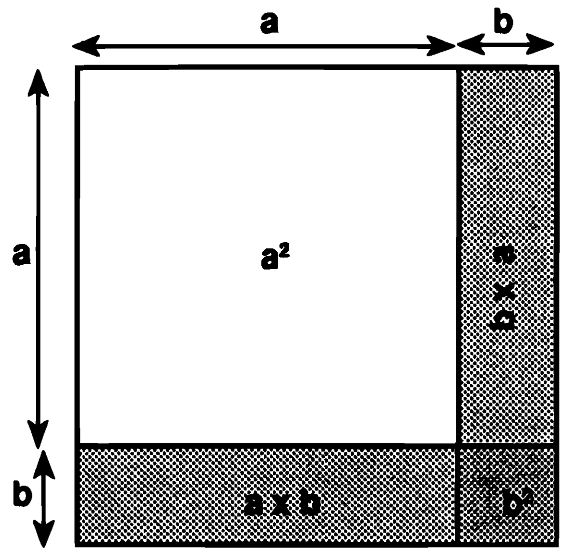
Start with a^2

Start with a^2, a square of side length a . . .



increase the length by b.





1. How much bigger is the (a + b) square than the (a) square?
This diagram will help.

The increase in size $= (a \times b) + (b \times a) + b^2$
$= 2ab + b^2$

2. Copy and complete:
$(a + b)^2 = a^2 +$ [redacted] $+$ [redacted]

3. Substitute the values a = 5 and b = 3, to check that your identity works.

4. Use your identity to calculate $(102)^2$.

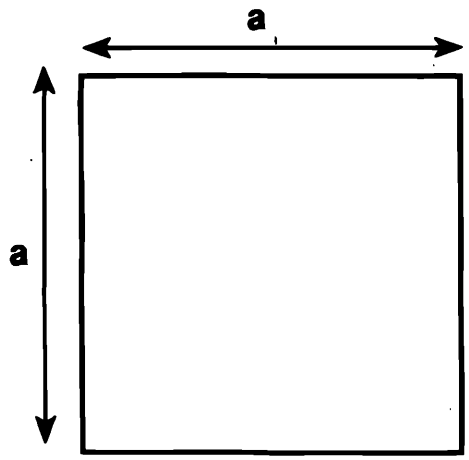
5. If b = a, verify that $(2a)^2 = 4a^2$.

6. What is the difference between $(a + b)^2$ and $a^2 + b^2$.

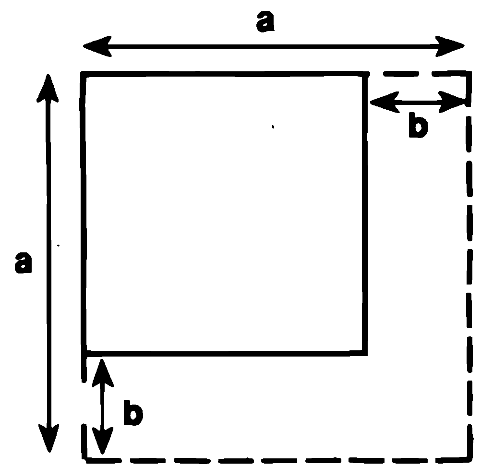
7. Substitute the value b = - 4 to calculate $(96)^2$.

8 Put b = - c and rewrite your identity $(a - c)^2 =$ [redacted]

Start with a^2, a square of side length **a** . . .

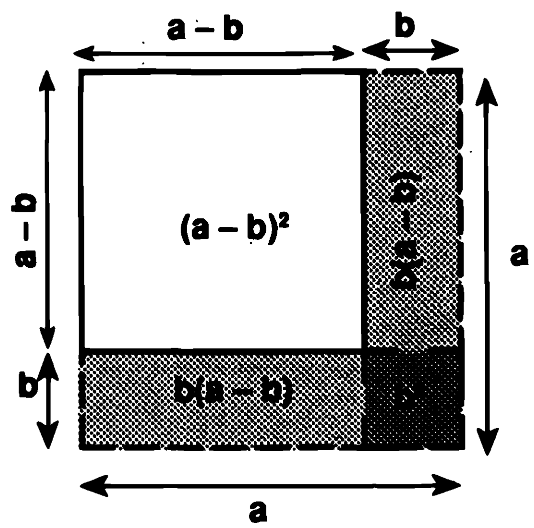


reduce the length by **b**.



9. How much smaller is the (a – b) square than the (a) square?

This diagram will help.



The decrease in size $= b(a - b) + b(a - b) + b^2$

$= ba - b^2 + ba - b^2 + b^2$

$= 2ab - b^2$

Copy and complete:

$(a - b)^2 = a^2 - (2ab - b^2)$

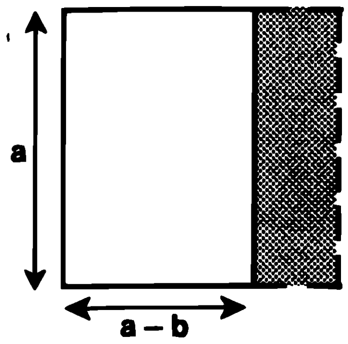
$= a^2 - \blacksquare + \blacksquare$

On the opposite page there are two other methods of finding the area. Check the result with your answer to questions **8** and **9**.

Here are two ways of working out $(a - b)^2$.

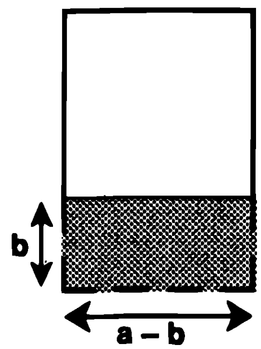
Start with a^2

Remove right-hand rectangle



Left-hand rectangle $= a^2 - ab$

Remove bottom rectangle



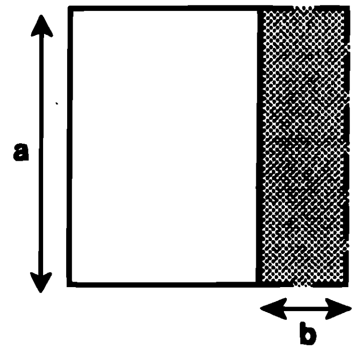
Bottom rectangle $= b(a - b)$
$= ba - b^2$

Therefore the *unshaded* square

$$(a - b)^2 = (a^2 - ab) - (ba - b^2)$$
$$= a^2 - ab - ba + b^2$$
$$= \mathbf{a^2 - 2ab + b^2}$$

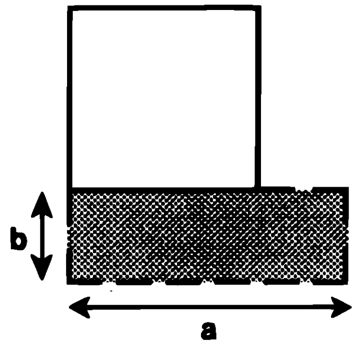
Start with a^2

Remove ab from the right



Remainder $= a^2 - ab$

Remove ab from the bottom



Remainder $= (a^2 - ab) - ab$
$= a^2 - 2ab$

This has taken away the bottom right-hand square twice, so add it back once:

$$(a - b)^2 = \mathbf{a^2 - 2ab + b^2}$$

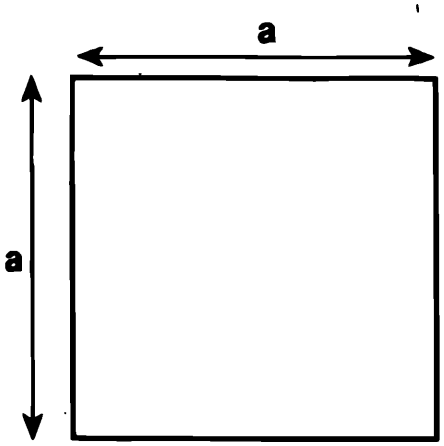
10. Substitute the values $a = 7$ and $b = 4$ to check the identity $(a - b)^2 = a^2 - 2ab + b^2$.

11. Use the identity to calculate 99^2.

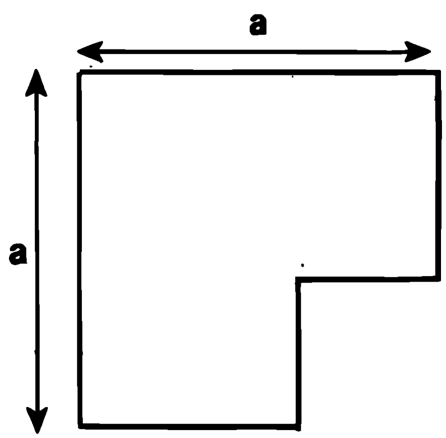
12. What is the difference between $(a - b)^2$ and $a^2 - b^2$?

13. What is the difference between $(a + b)^2$ and $(a - b)^2$?

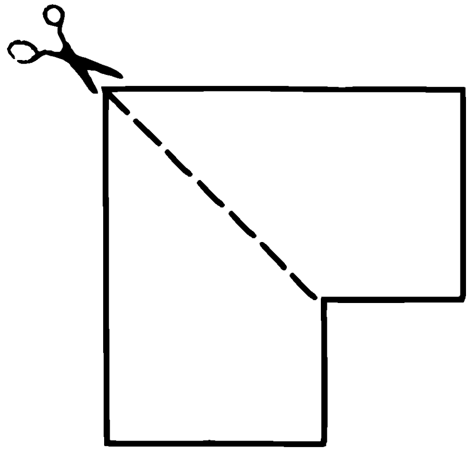
Start with a^2, a square of side length **a** . . .



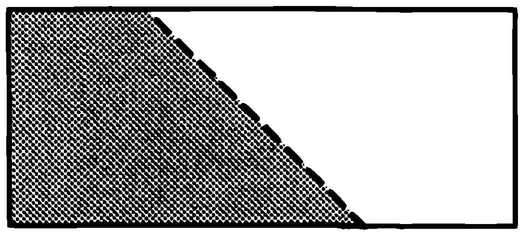
remove b^2, a square of side length **b** . . .



cut along the dotted line.



Turn one piece over and re-fit to create this rectangle.



14. What are the length and width of the rectangle?

15. Copy and complete: $(a + b)(a - b) = ■ - ■$

16. Substitute the values $a = 10$ and $b = 1$ to check that your identity works.

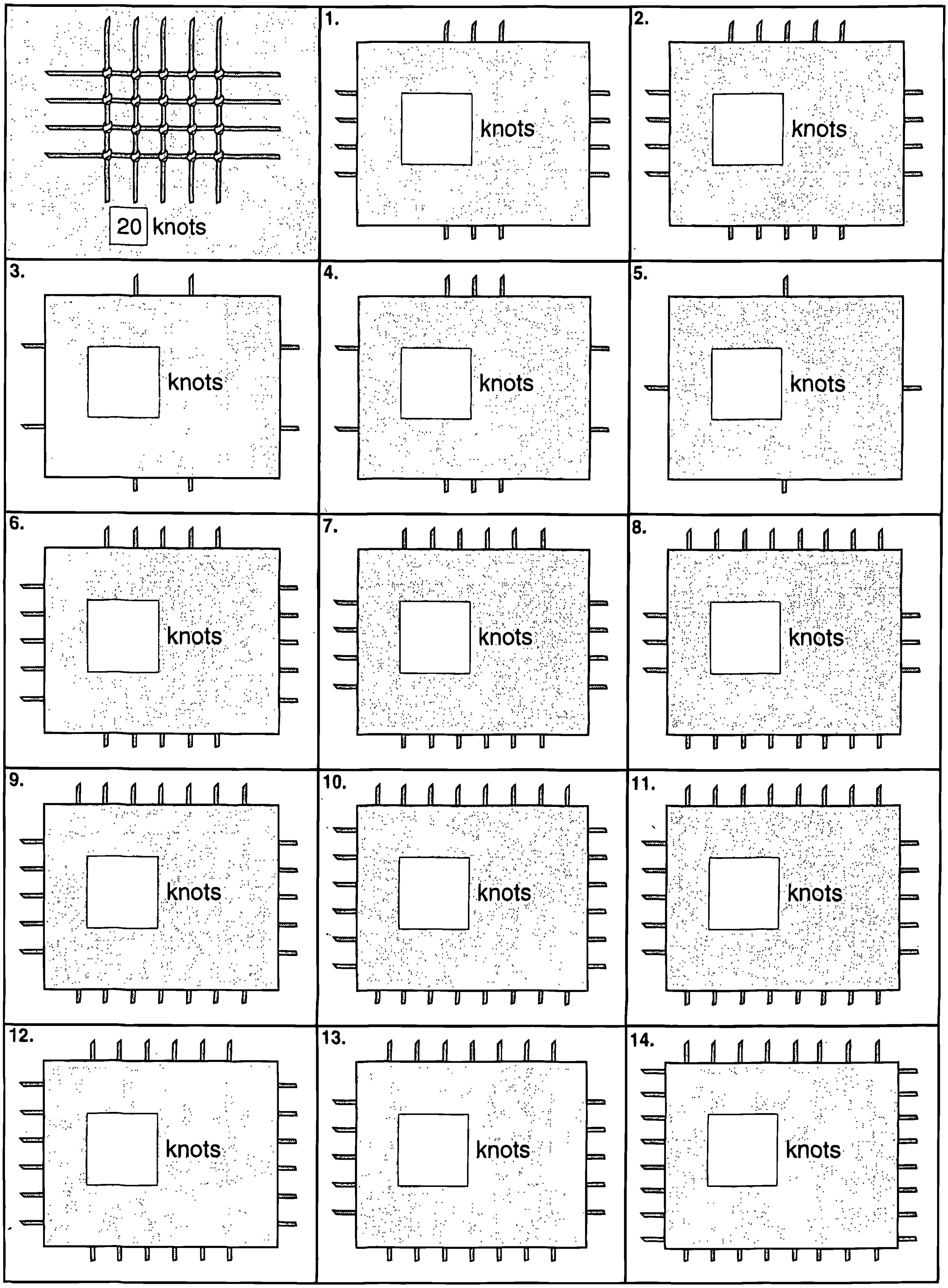
17. Use your identity to calculate 103 x 97.

18. If $x = (a + b)$ and $y = (a - b)$ use the identities you have found to simplify

a) $x^2 + 2xy + y^2$

b) $(x + y)^2$

Knots

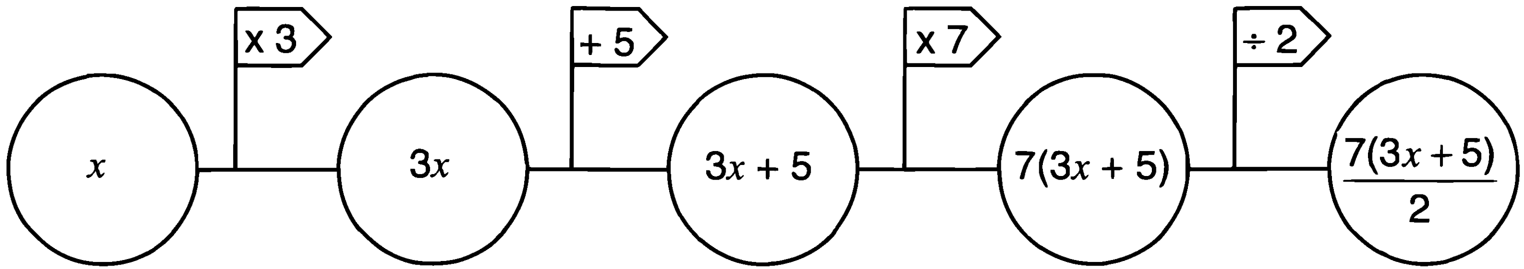

20 knots
1. knots
2. knots
3. knots
4. knots
5. knots
6. knots
7. knots
8. knots
9. knots
10. knots
11. knots
12. knots
13. knots
14. knots

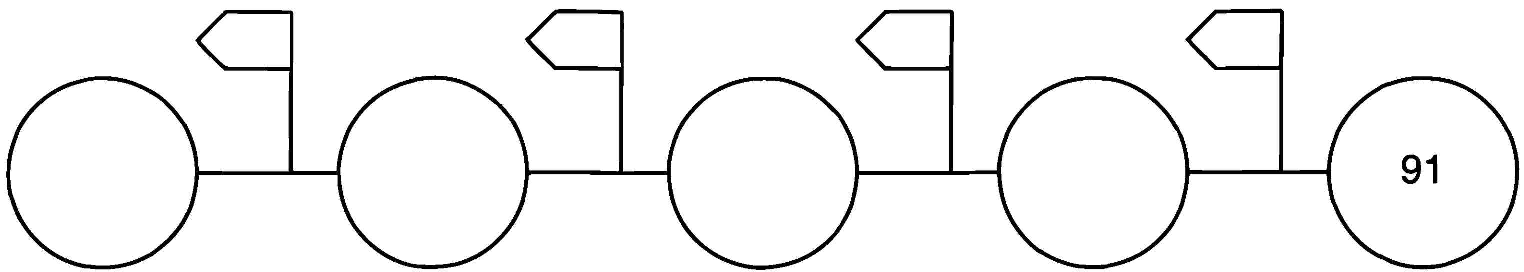
Solving equations

$$\frac{7(3x+5)}{2} = 91$$

Can you solve this equation and find the value of x?

$$\frac{7(3x+5)}{2} = 91$$

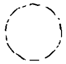




Undo the operations, one at a time, by turning over the pages.

x 2

182



÷ 7

26

– 5

$\div 3$

7

So $x = 7$

Now solve these.

1. $\frac{x+5}{2} = 12$

2. $4b - 7 = 7$

3. $5(4d - 3) = 125$

4. $\frac{5y+17}{3} = 24$

5. $2(9* - 3) - 20 = 10$

6. $\frac{3(2x-5)}{7} = 9$

7. $4(3x + 5) + 3 = 53$

8. $\frac{3(5m+1)}{2} + 17 = 20$

What chance?

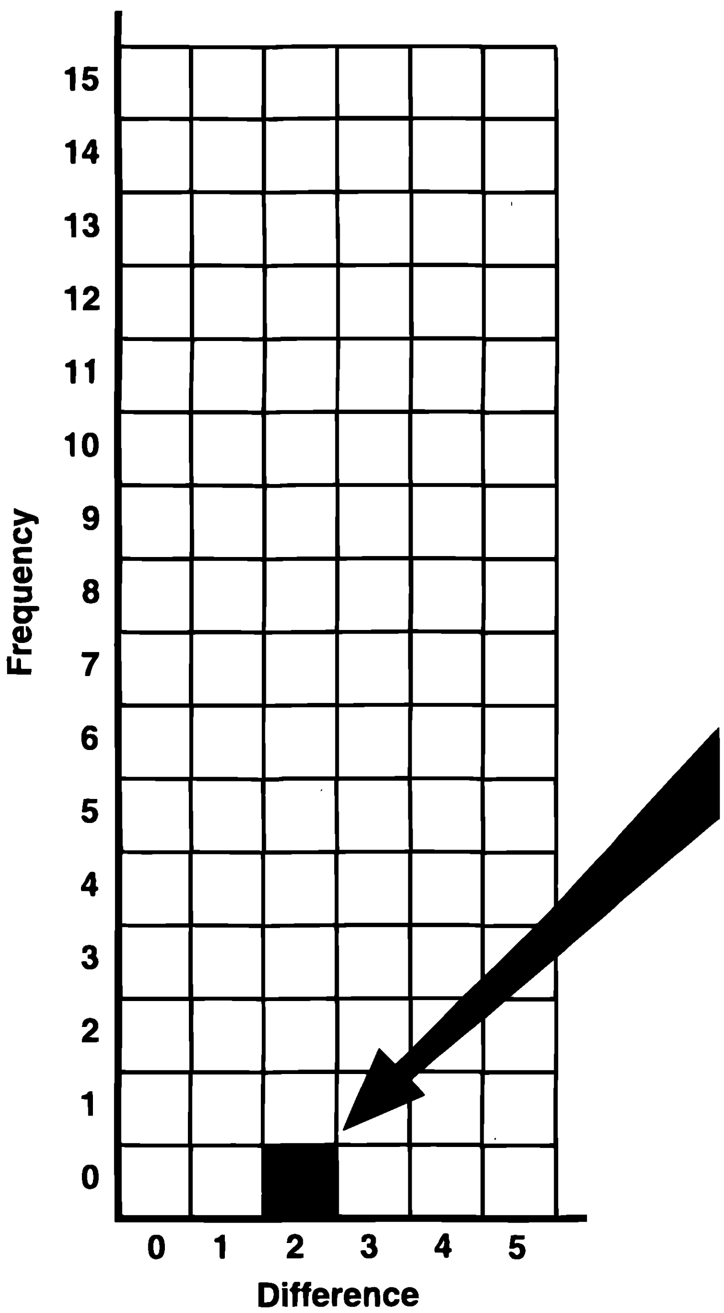
You will need : 2 dice and squared paper.

1. If you throw two dice and find the difference between the two numbers

   a) What is the largest difference you can get?

   b) What is the smallest difference you can get?

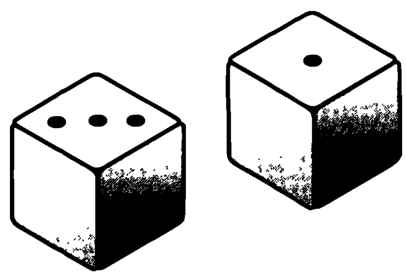
2. Draw a graph like this:



Throw two dice on the table and record the difference between the two numbers by shading a square in the correct column.

For example:

if you threw



you would shade the first square in the 2 column.

Carry on until *one* of the columns reaches the top.

   a) What column won?

   b) Can you think of a reason why?

   c) How many times did you throw the two dice?

turn over

3. Now copy and complete this table to show all the possible differences.

a) Write down anything you notice about your completed table.

b) How many different ways of getting a difference are there altogether?

Second Dice

First Dice	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0				
3						
4						
5						
6						

4. a) Shade all the **0**'s in your table. How many are there?

The probability of scoring **0** is $\frac{6}{36}$. Why?

b) Shade all the **1**'s. How many are there?

The probability of scoring **1** is $\frac{10}{36}$.

c) Copy and complete this table to show all the probabilities.

Difference	**0**	**1**	**2**	**3**	**4**	**5**
Probability	$\frac{6}{36}$	$\frac{10}{36}$				

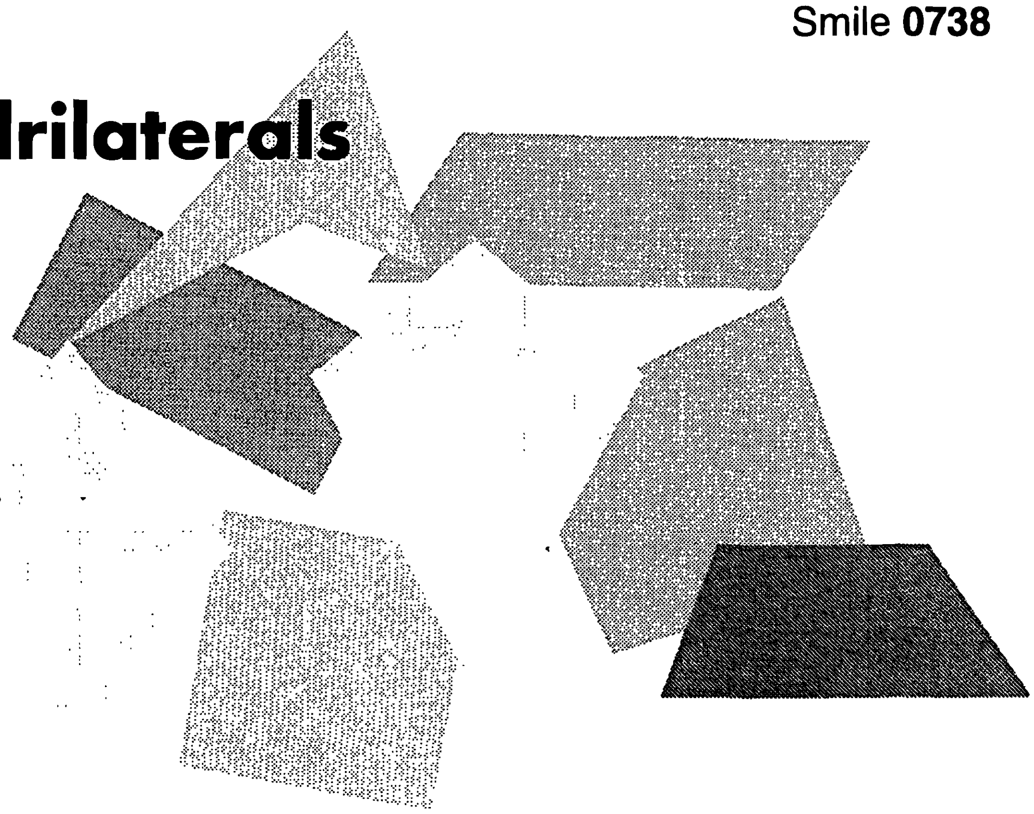
d) Add up all the probability fractions - what do you notice?

5. Problem

If you win 1p each time you throw a difference of 1, 2, 3 or 4 and you lose 4p each time you throw a difference of 0 or 5, are you likely to have more or less money after 36 throws?

Try to explain your answer.

The Family of Quadrilaterals



You will need Smile Worksheet **0738a**.

You may like to use Smile **2163** *Geometry Facts*.

1. What is the definition of a kite?

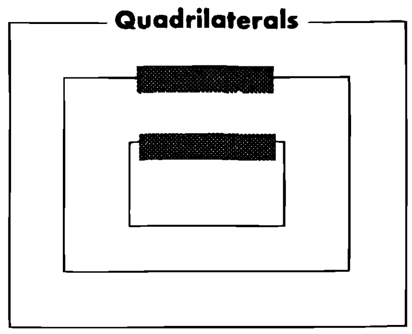
2. What is the definition of a rhombus?

3. Is it possible to draw:
a) a kite that does not fit the description of a rhombus
b) a rhombus that does not fit the description of a kite?

4. Complete these sentences and the labels on the Venn diagram with the words *'rhombuses'* and *'kites'*.

"All [redacted] are [redacted] ".

" [redacted] are special cases of [redacted] ".



5. There are other quadrilaterals that are special cases of each other.

Compare the following pairs of quadrilaterals, use their definitions to decide if one is a 'special case' of the other. You make like to draw Venn diagrams.

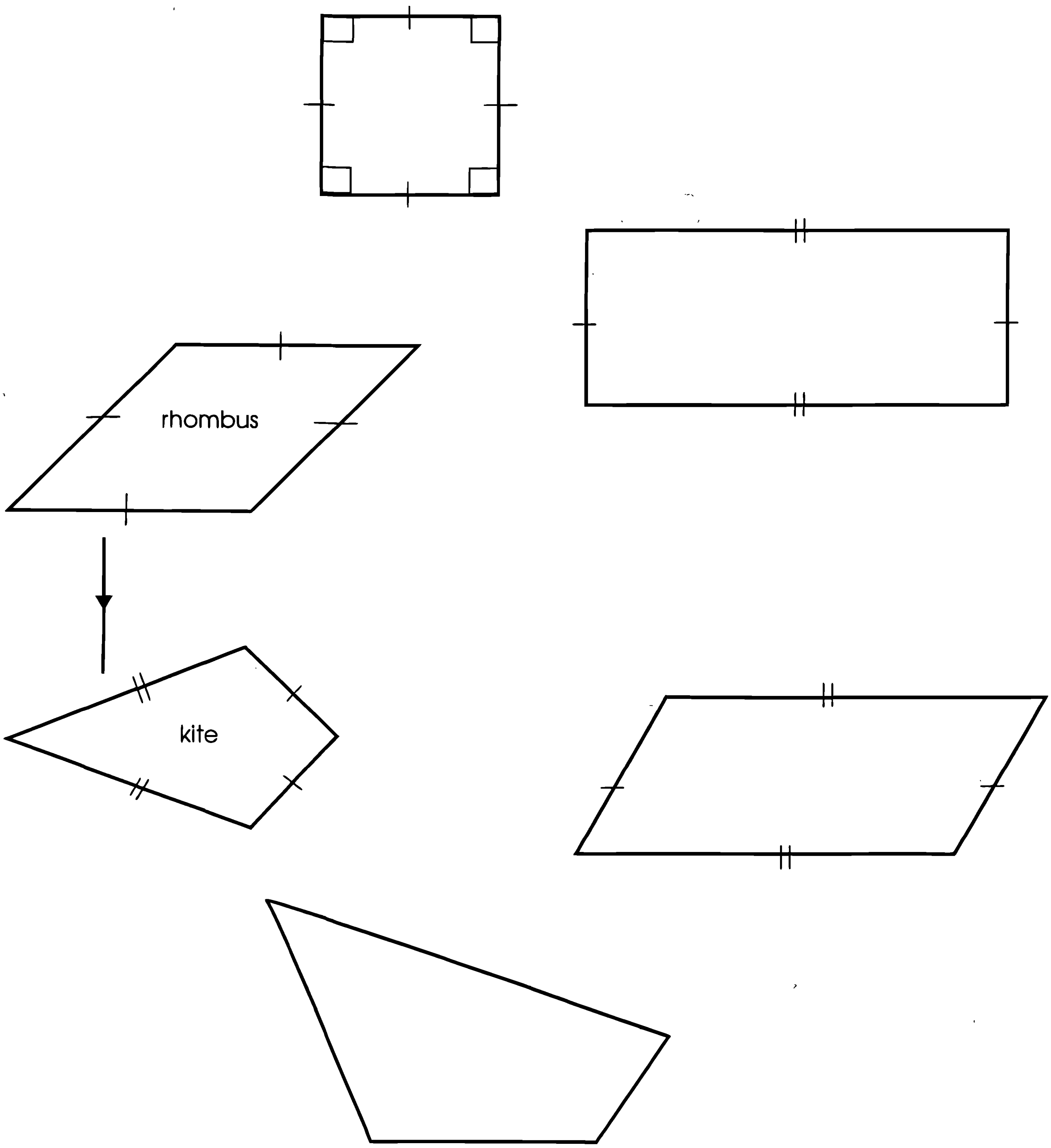
a) **Rhombuses** and **squares**
b) **Squares** and **rectangles**
c) **Rhombuses** and **parallelograms**
d) **Rectangles** and **parallelograms**
e) **Kites** and **parallelograms**
f) **Trapeziums** and **parallelograms**
g) **Trapeziums** and **kites**
h) **Rhombuses** and **rectangles**
i) **Kites** and **quadrilaterals**
j) **Trapeziums** and **quadrilaterals**

6. On *Quadrilaterals Worksheet* **0738a** fill in the arrows on the 'is a special case of' diagram.

Challenge On the back of the worksheet is the outline of a Venn diagram that can be used to display all the 'special cases of' relationships between quadrilaterals. Label each section of the diagram.

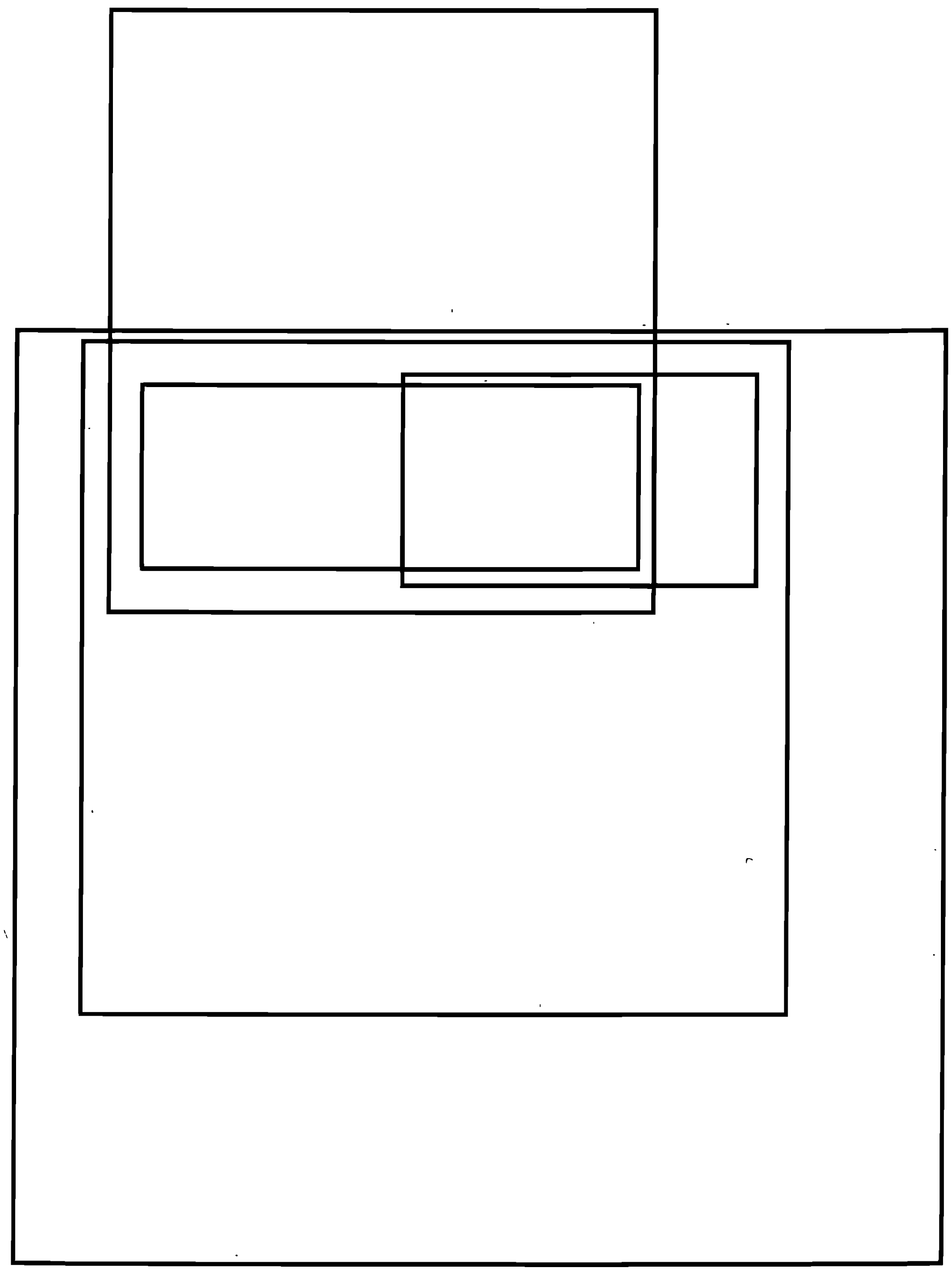
The Family of Quadrilaterals

Show the relationship **'is a special case of'** by adding arrows in the diagram below.



A ——— **B** means "A is a special case of B".

turn over

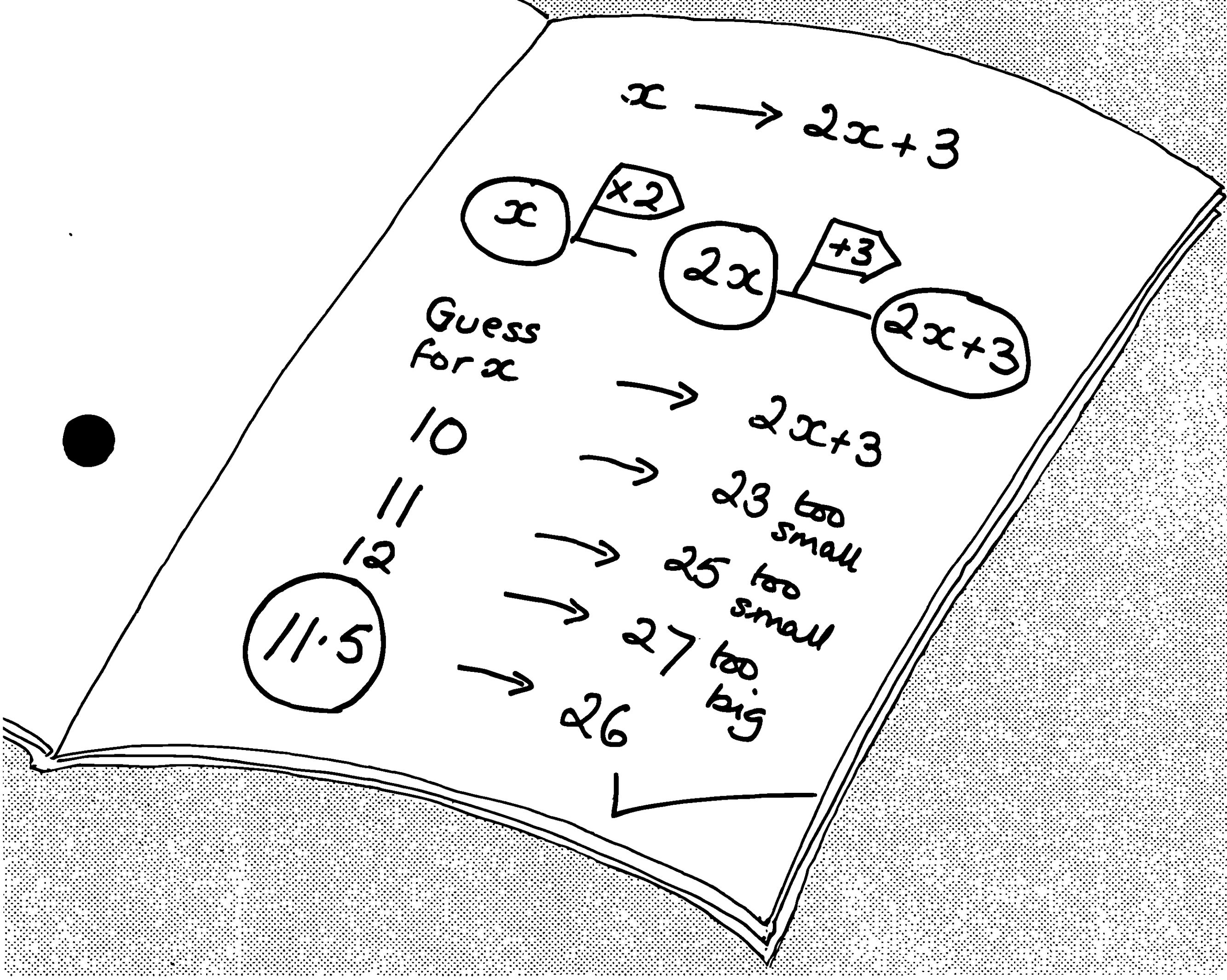


Smile **0740**

SOLVE IT!

A calculator may help.

If $2x + 3 = 26$ then $x = ?$



Use intelligent guess work to solve these.
The information opposite may help you.

1. $2x + 3 = 39$

2. $2x + 3 = 145$

3. $2x + 3 = 3.4$

4. $2x + 3 = 17.5$

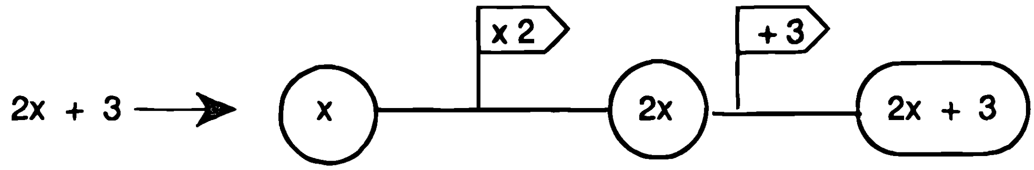
5. $6(p - 4) = 36$

6. $\frac{x + 3}{2} = 6$

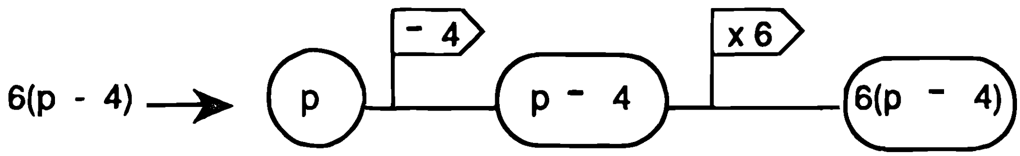
7. $\frac{y}{2} - 10 = 13$

8. $\frac{5(t + 4)}{6} = 7.5$

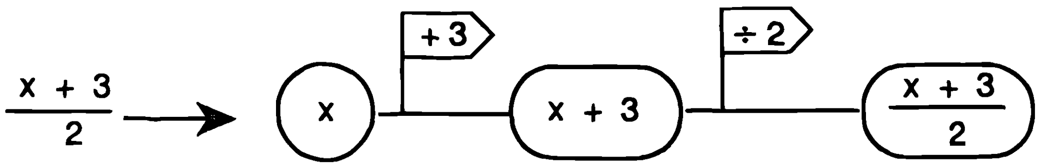
9. $3(a + 4) - 7 = 5.6$



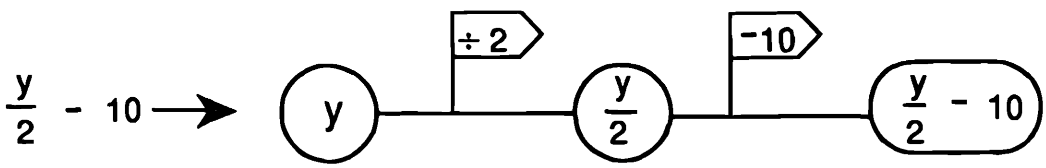
Multiply by 2 and then add 3



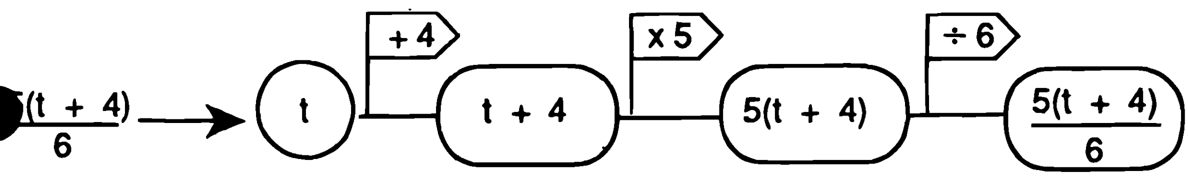
Subtract 4 then multiply by 6



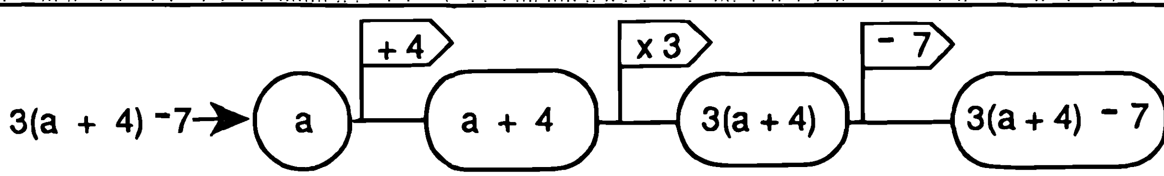
Add 3 then divide by 2



Divide by 2 then subtract 10



Add 4 then multiply by 5 then divide by 6



Add 4 then multiply by 3 then subtract 7

Turn over

Some of these may have negative answers.

10. $\frac{9(p+5)}{2} = 18$

11. $\frac{\phi}{7} + 21 = 23$

12. $2(3x + 25) = 20$

13. $\frac{\theta + 17}{13} = 2$

14. $\frac{7(\beta + 9)}{3} = 14$

15. $3(\Omega - 2) + 15 = 30$

β is Beta
Ω is Omega
θ is Theta
ϕ is Phi

These are letters from the Ancient Greek alphabet. They are often used as symbols in mathematical problems.

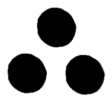
AT2 Alg Level 9

Smile **0741**

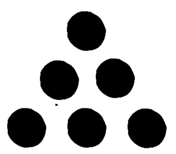
The Thirty Eighth Triangle Number

1.

$T_1 = 1$



$T_2 = 3$



$T_3 = 6$

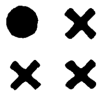
and so on . . .

Make a table of **n** and T_n
for **n = 1, 2, 3, . . . 6**

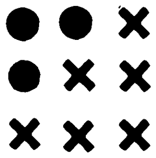
Draw a suitable grid and
plot T_n against **n**.

Why would it not be sensible to join the points on this graph ?

2.



$T_1 + T_2 = 2^2$



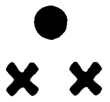
$T_2 + T_3 = 3^2$

and so on . . .

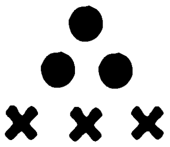
Generalise this pattern for

$$T_{n-1} + T_n = \square$$

3.



$T_1 + 2 = T_2$



$T_2 + 3 = T_3$

and so on . . .

Generalise this pattern for

$$T_{n-1} + \square = \square$$

4.

Both your generalisations use

T_{n-1} and T_n

Re - arrange the first so that it becomes

$T_{n-1} =$

Re - arrange the second so that it too becomes

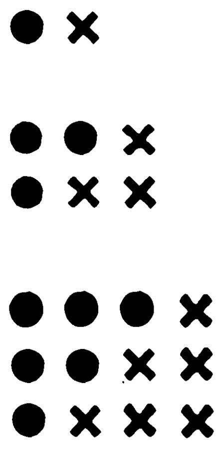
$T_{n-1} =$

You now have two expressions for T_{n-1} so

=

Re - arrange this to write a formula for T_n in terms of **n**.

Test your result.



Does this number pattern confirm your formula for T_n?

Turn over

How does the formula for T_n explain the shape of your graph ?

Find

a) T_{100}

b) The thirty eighth triangle number.

Solving by graphs

● You will need graph paper.

$2x - 3 = 11$ so $x = ?$

1. Draw a mapping diagram of $x \rightarrow 2x - 3$

x		$2x - 3$
-2	→	-7
-1	→	■
0	→	■
4	→	5
6	→	■

2. Write the mappings as co-ordinates:

(-2, -7)

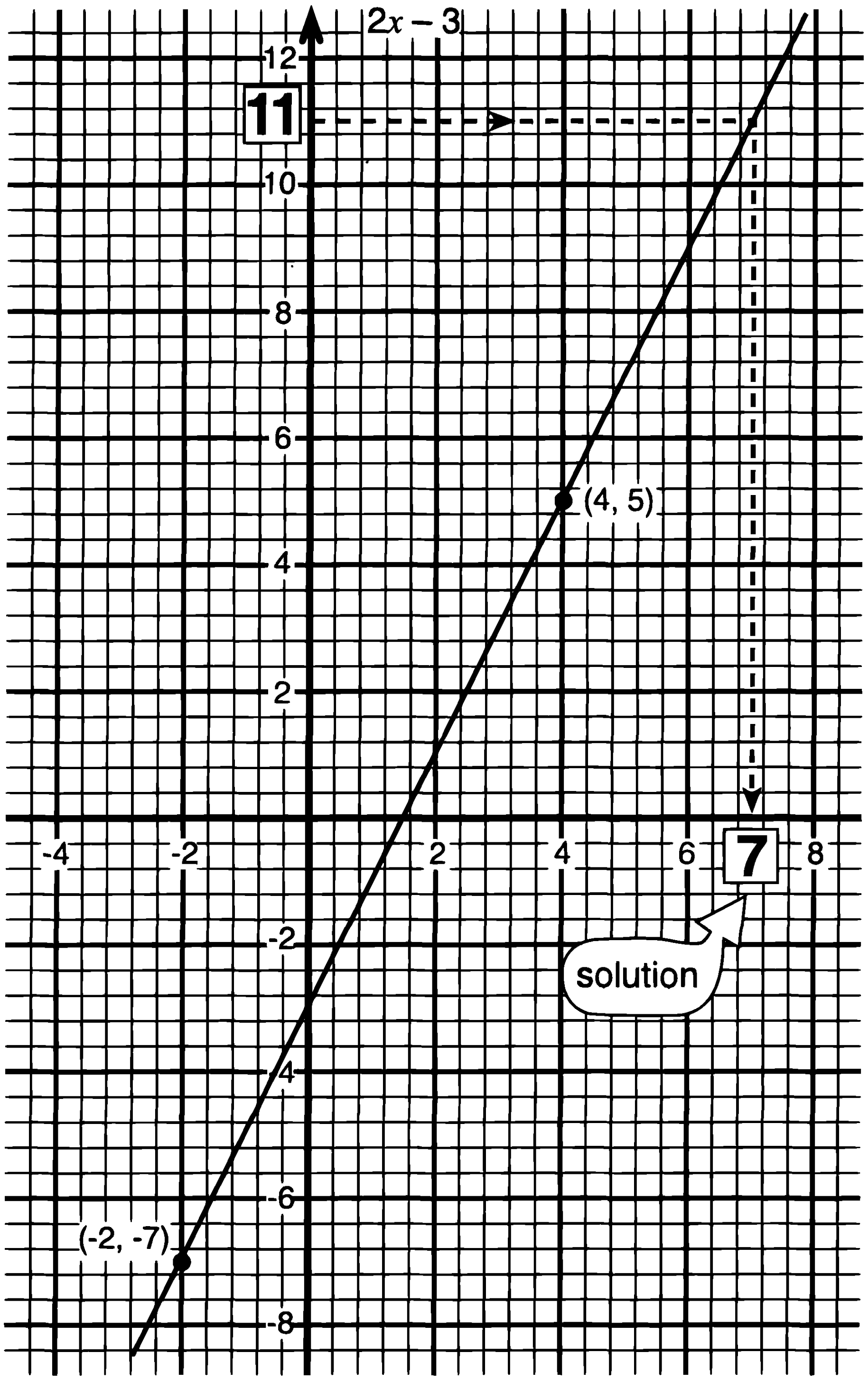
(-1, ■)

(0, ■)

(4, 5)

(6, ■)

3. Draw the graph by plotting the co-ordinates and joining with a straight line.



4. Read off the solution:

$x = 7$

5. Check the solution.

x —(× 2)→ $2x$ —(− 3)→ $2x - 3$

7 —(× 2)→ 14 —(− 3)→ 11

turn over

6. Use your graph to read off the solutions for:

a) $2x - 3 = 3$

b) $2x - 3 = -5$

c) $2x - 3 = 7$

d) $2x - 3 = 0$

Remember to check your solutions!

7. Draw the graph of the mapping $x \longrightarrow 3(x + 4)$
Use it to solve:

a) $3(x + 4) = 15$

b) $3(x + 4) = -7.5$

c) $3(x + 4) = 10$

Check your solutions.

8. Draw one graph to solve all these:

a) $\frac{x + 5}{2} = 2$

b) $\frac{x + 5}{2} = 6$

c) $\frac{x + 5}{2} = 3.2$

d) $\frac{x + 5}{2} = 0$

Equations and graphs

Can you solve this equation?

$$\frac{x+7}{2} = 2(x+4)$$

1. Try to guess a value of x which would make the equation true.

Turn over for a method.

Mapping diagrams will help:

$$\frac{x+7}{2} = 2(x+4)$$

$x \longrightarrow \frac{x+7}{2}$

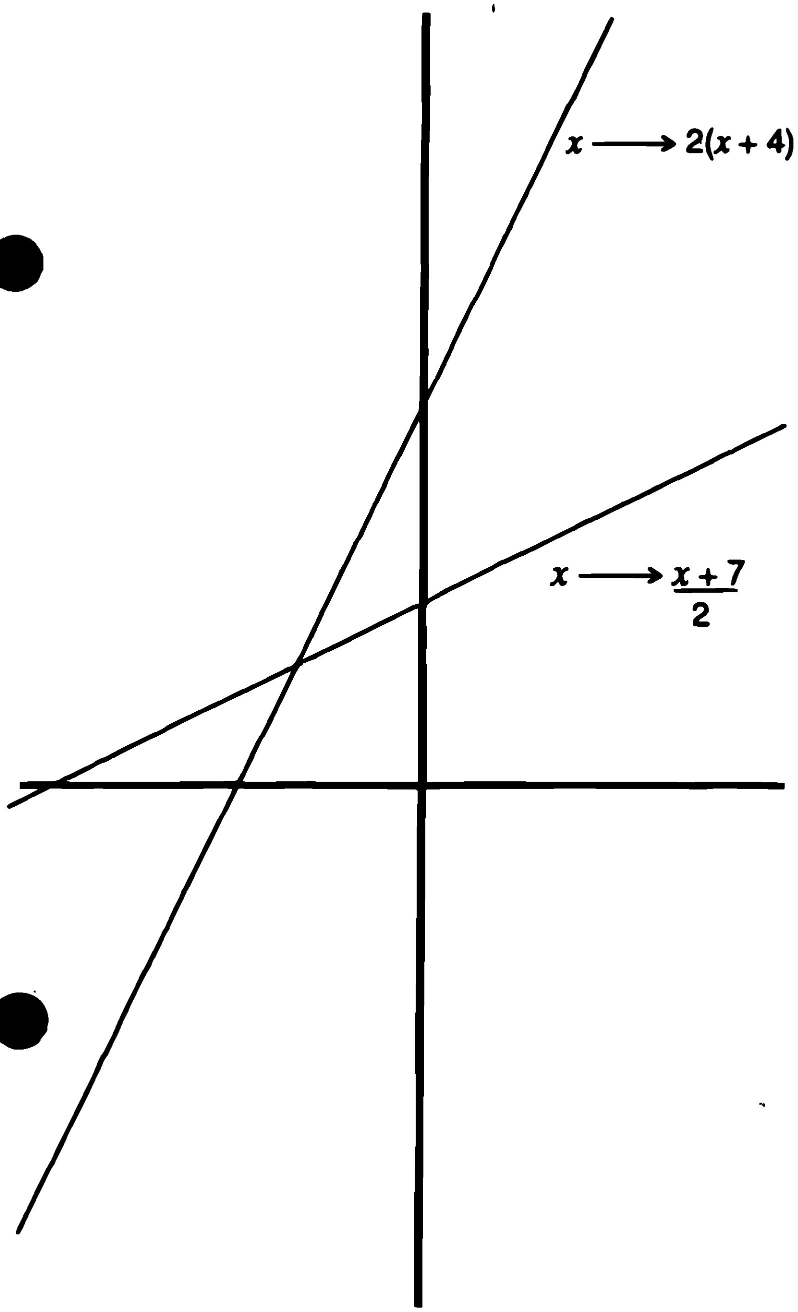
x	$\frac{x+7}{2}$
2	$4^1/_2$
0	$3^1/_2$
5	6
-1	3
.	.
.	.
.	.

$x \longrightarrow 2(x+4)$

x	$2(x+4)$
2	12
0	8
5	18
-1	6
.	.
.	.
.	.

2. Can you find a value of x which gives the same result for both mappings?

3. Draw the graphs of both mappings:

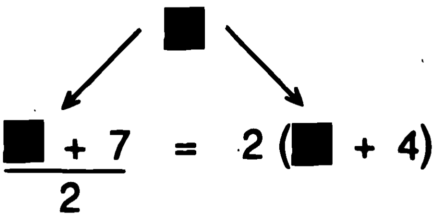


4. Which point lies on both lines?

5. So which number maps to the same result in both

$$x \longrightarrow \frac{x+7}{2} \quad \text{and} \quad x \longrightarrow 2(x+4)?$$

6. Check your solutions by substituting into the equation:



7. Use graphs to solve these:

a) $6 - x = \frac{x}{2} + 3$

b) $x^2 = x + 6$ (2 solutions)

and check your solutions.

Inverses

These mapping diagrams show that 'add 6' and 'subtract 6' are inverses of each other.

x	$\longrightarrow$	$x + 6$
5	$\longrightarrow$	11
$3\frac{1}{2}$	$\longrightarrow$	$9\frac{1}{2}$
28	$\longrightarrow$	34
-5	$\longrightarrow$	1

x	$\longrightarrow$	$x - 6$
11	$\longrightarrow$	5
$9\frac{1}{2}$	$\longrightarrow$	$3\frac{1}{2}$
34	$\longrightarrow$	28
1	$\longrightarrow$	-5

1 Draw mapping diagrams to show that the mappings $x \longrightarrow 2x$ and $x \longrightarrow \frac{1}{2}x$ are inverses of each other.

2 Draw mapping diagrams to find the inverses of

a) $x \longrightarrow x + 7$ b) $x \longrightarrow x$

c) $x \longrightarrow \frac{x}{6}$ d) $x \longrightarrow x - 2$

3 What is special about the mapping $x \longrightarrow x$?

4 Draw mapping diagrams to find the inverses of

a) $x \longrightarrow 3 - x$ b) $x \longrightarrow \frac{4}{x}$

c) $x \longrightarrow 10 - x$ d) $x \longrightarrow \frac{10}{x}$

Explain why these mappings are called 'self-inverse mappings'.

5 Find some other self-inverse mappings.

Pascal's Triangle

An activity for a small group.

Contents:

- Share out the work between you.

When you have finished answer these questions.

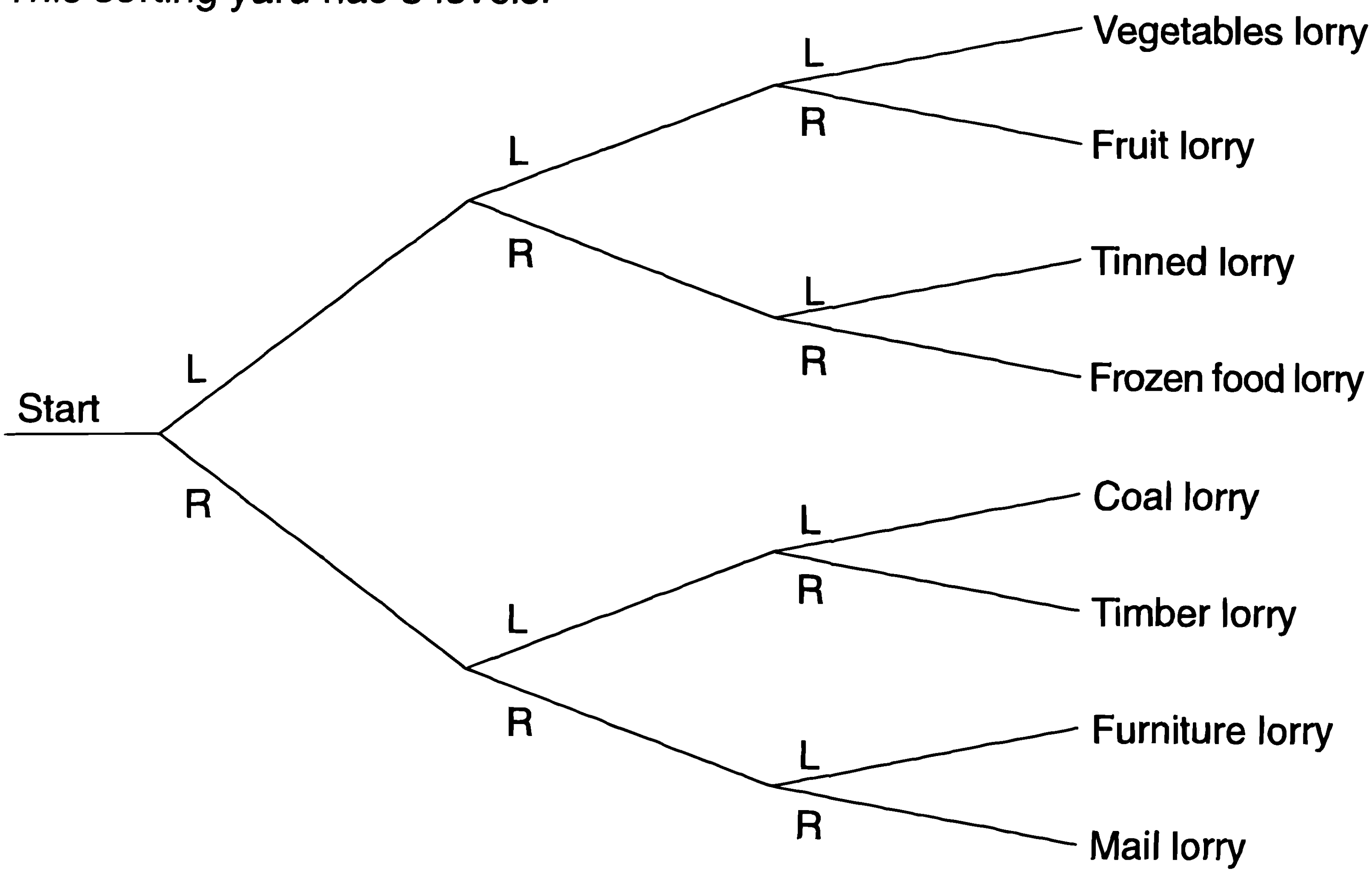
1. What similarities are there between the five pieces of work?

2. How do they compare with Pascal's Triangle?

Sorting Yard

Smile **0746A**

Lorries are sorted according to their contents.
This sorting yard has 3 levels.



A Coal lorry would have to be sent right, left and left again at each level to get to the correct bay. This can be coded RLL.

1. What is the code for sorting a Frozen food lorry?

2. How many different codes are there?

3. The code LRL and LLR both have two L's and one R.
   Are there any more with two L's and one R?
   Copy and complete this table:

Combinations	Path	Total number of paths
Three L's	LLL	1
Two L's and one R	LLR, LRL, RLL	3
Two R's and one L		
Three R's		

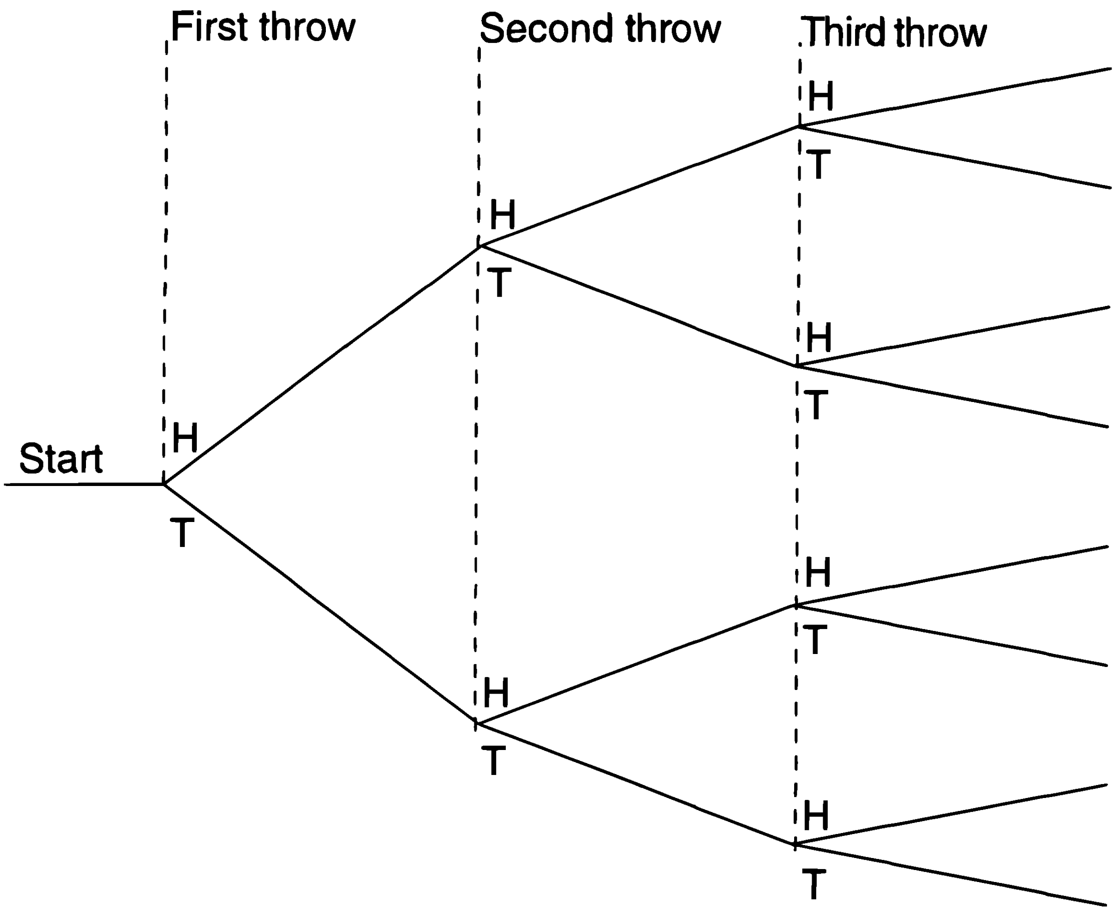
4. Investigate what happens if you have a sorting yard with four sorting levels.

Flipping Coins

Smile **0746B**

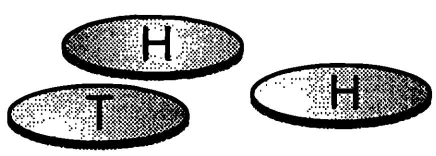
You will need 3 coins.

- Flip a coin 3 times and trace your path through the tree diagram.



1. How many different paths are there?

2. These 3 coins were flipped at the same time:



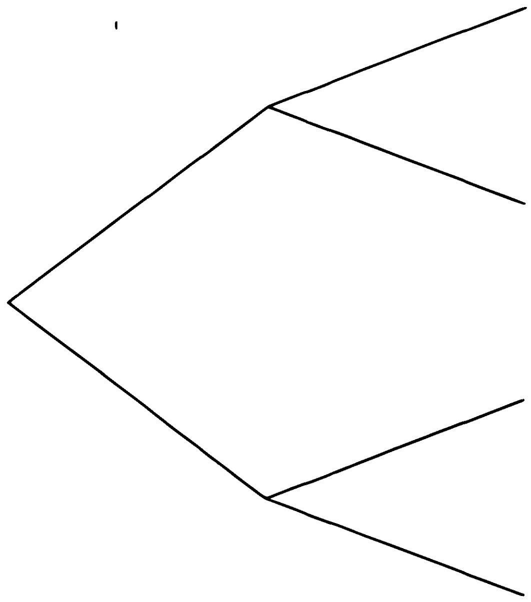
How many different ways could this result have occured?
Record them all.

3. Copy and complete the table below:

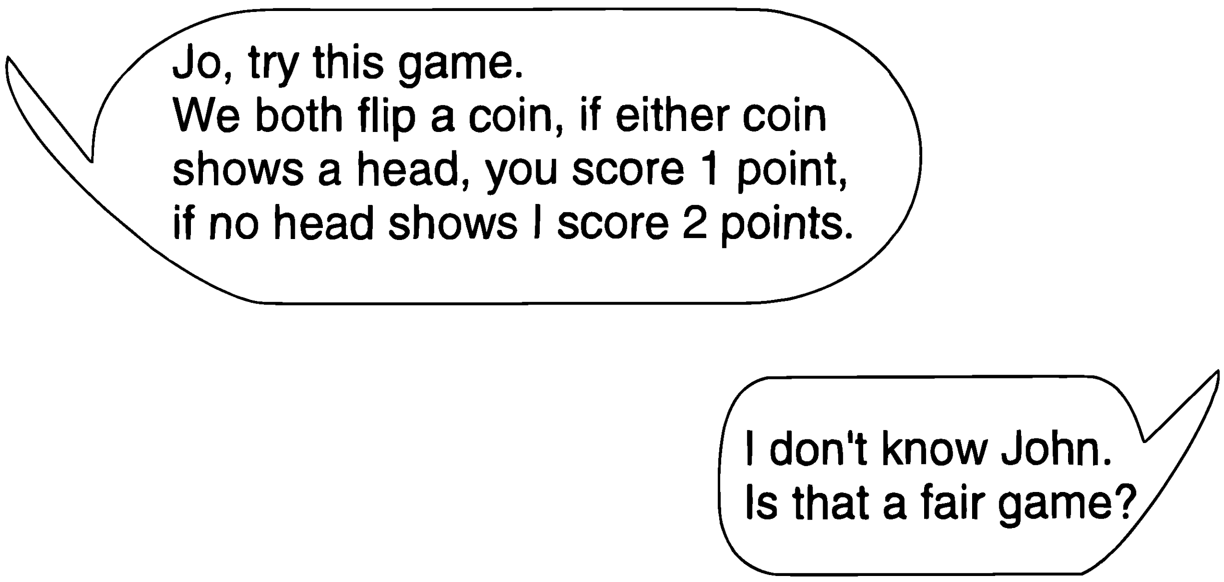
Combinations	**Path**	**Total number of paths**	**Probability**
3 Heads	HHH	1	$\frac{1}{8}$
2 Heads and 1 Tail	HHT, HTH, THH	3	$\frac{3}{8}$
2 Tails and 1 Head			
3 Tails			
		Total of probabilities	

Turn over

4. Investigate the probabilities if you flip 2 coins only.



5.



Is it a fair game?
Explain your answer.

6. If you flip 4 coins you can get five different combinations of heads and tails. They are :

4 Heads

3 Heads and 1 Tail

2 Heads and 2 Tails

1 Head and 3 Tails

4 Tails

Draw a tree diagram and use it to work out the probabilities for each of the five combinations.

Coin Game

Smile **0746C**

You will need: 16 counters each and 1 coin.

A game for 2 people.

Heads →

Tails ↓

Player 1 Start counter here					Home ***F*** Square
				Home ***E*** Square	
			Home ***D*** Square		
		Home ***C*** Square			
	Home ***B*** Square				
Home ***A*** Square					**Player 2** Start counter here

Tails ↑

← Heads

Rules:

- Each player places one counter on the starting square.
- Take it in turns to flip a coin and follow the rules below.

Player 1

If Heads	move counter one square to the right
If Tails	move counter one square down

Player 2

If Heads	move counter one square to the left
If Tails	move counter one square up

- As each counter reaches a Home Square, start another counter off.
- When all counters are on Home Squares, the winner is the one with the most counters on Home Squares A and F.
- Is there any pattern to the results?

Turn over

1. Player 2 needs 5 Heads in a row to get to Home Square A.
   Why?

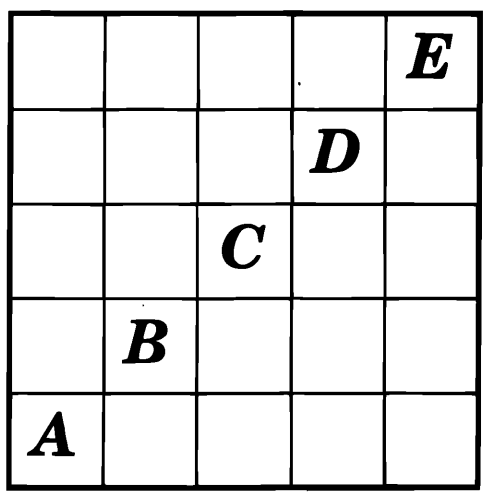
2. To get to Home Square B, Player 2 needs 4 Heads and 1 Tail.
   There are 5 possible paths.
   List them all.

3. Copy and complete this table of possible routes for Player 2.
   (Use a whole page)

Home Square	Path	Total number of paths
A	HHHHH	1
B	HHHHT HHHTH HHTHH HTHHH THHHH	5

4. How would Player's 1 table be different?

5. If you played the same game on a 5 x 5 board, how many possible paths would there be for Player 2 to get to Home Squares A, B, C, D and E?



What are the possibilities with a 4 x 4 board?
3 x 3 board?

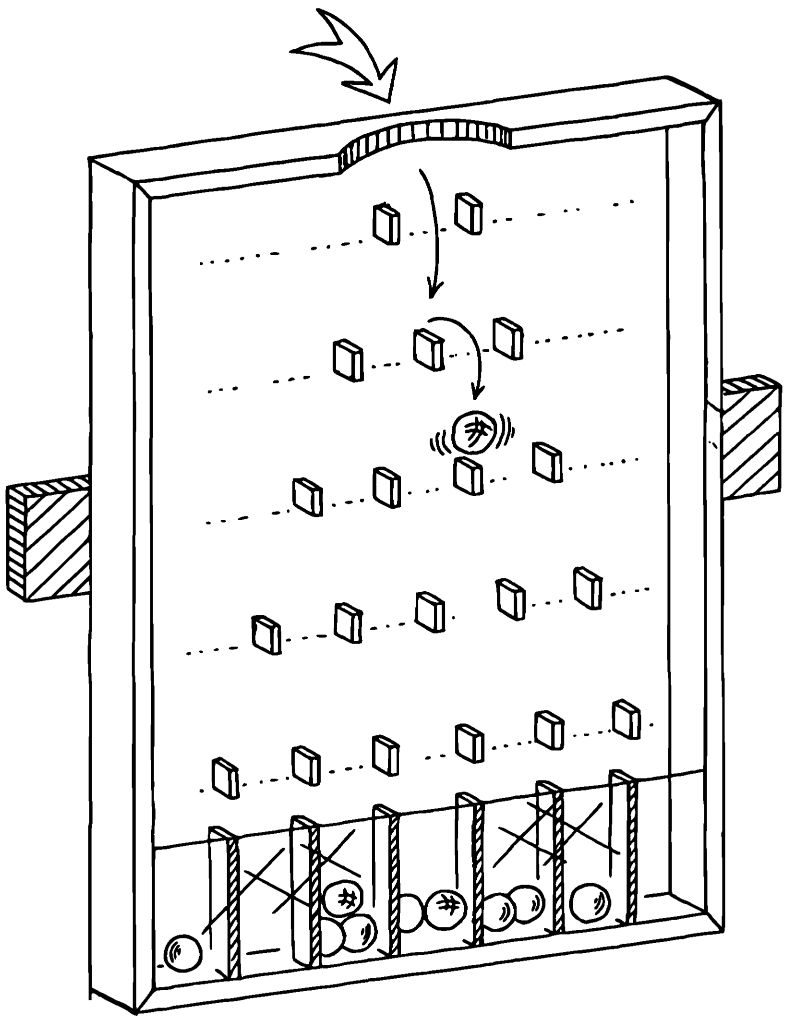
Is there a pattern to your results?

Can you use the pattern to find the number of paths to each Home Square on a 6 x 6 board ?
What about an 8 x 8 board?

Probability Maze

Smile **0746D**

You will need: a probability maze or MicroSMILE program *Pinball*



If you roll a ball through the maze several times, how often will it fall in each column?

You can answer by:

a) Guessing

b) Doing an experiment using the probability maze or MicroSMILE program *Pinball*

c) Working it out. See the hints on the back of this card.

- Compare your answers to b) and c).
- Explain any differences.

Turn over

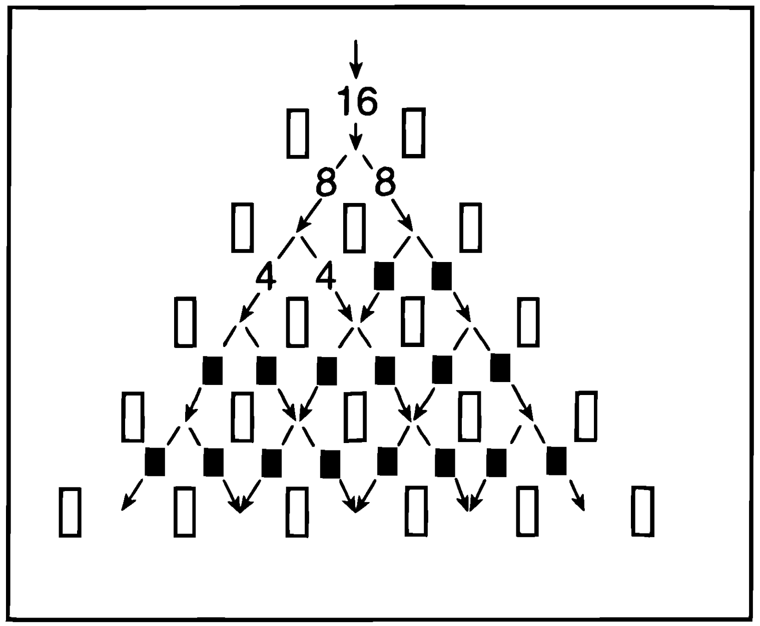
Hints for working out the probabilities.

Each time the ball drops onto a peg, it has an even chance of falling to the left or to the right.

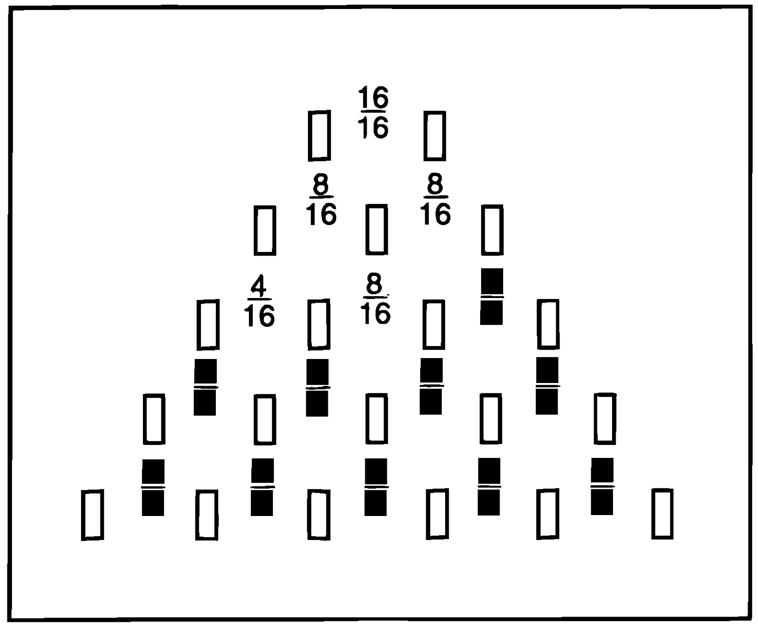
What would happen if a ball falls through the maze 16 times?

- Copy and complete the grids below to find the number of balls you could expect to land in each column.

a)



b)



What would happen if the maze had another row of pegs?

Investigate.

A boat for three

Davey, Hilary, Simon and Tim decided to hire out a boat.

1. How many ways could they choose **one person** to go to hire the boat?
   Write all these ways down.

2. They decided to send two people to go off to buy some food for the boat trip.
   How many different ways could they choose **two people** to go?
   Write them all down.

3. The boat only held three people.
   How many different ways could they choose **three people** to go in the boat?
   Write them all down.

The next day Ronnie came with them, so there were five people altogether.

4. How many ways could they choose **one person** to hire the boat?

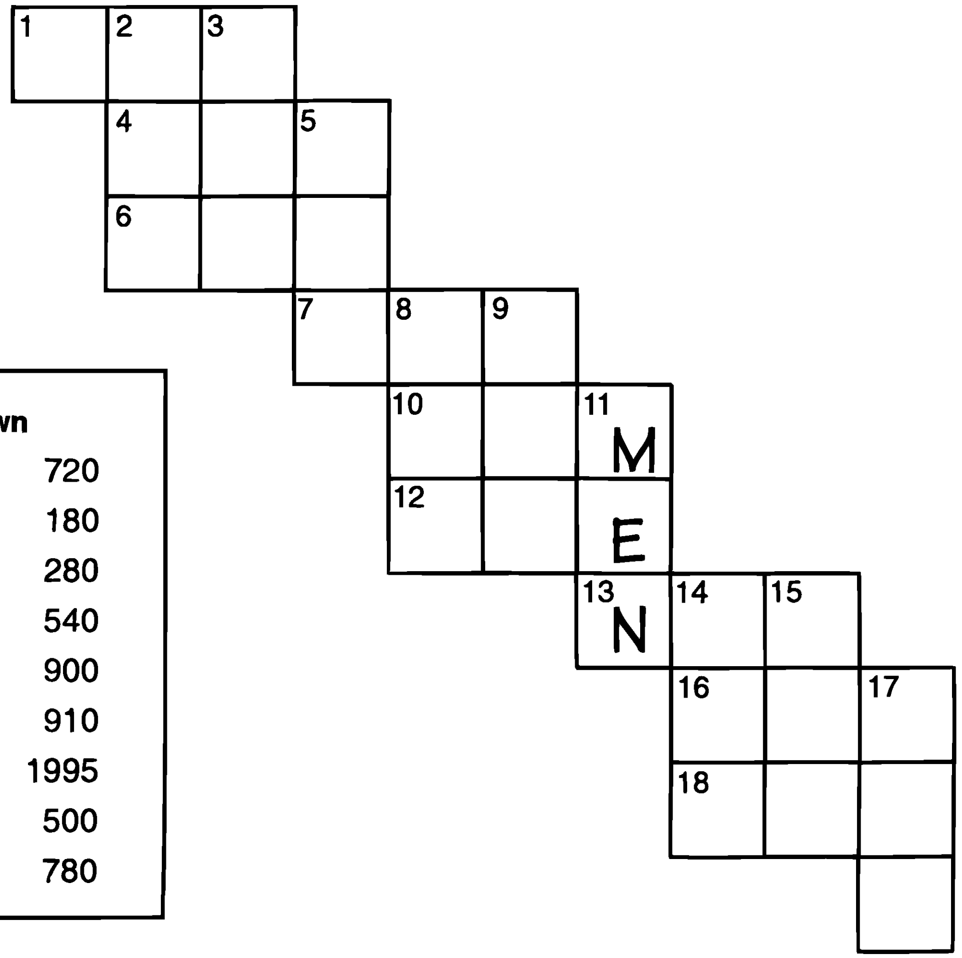
5. Write down all the ways they could choose **two people** to buy the food.

6. Write down all the ways they could pick **three people** to go out in the boat.

7. Four people were needed to carry all the equipment back to the boat house.
   How many ways could they choose **four people** to carry the equipment back?

The TIMES Crossword

Copy and complete this crossword.



Clues

Across		Down	
1.	180	**2.**	720
4.	540	**3.**	180
6.	280	**5.**	280
7.	1200	**8.**	540
10.	2106	**9.**	900
12.	50	**11.**	910
13.	5880	**14.**	1995
16.	475	**15.**	500
18.	300	**17.**	780

Code

1	2	3	4	5	6	7	8	9	10	11	12	13
A	B	C	D	E	F	G	H	I	J	K	L	M

14	15	16	17	18	19	20	21	22	23	24	25	26
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

How to solve the clues

All the answers are familiar three letter words.

The three letters are represented by factors of the number in the clue. Use the code to translate factors to letters.

Example Clue 11 Down is **910**.

Three factors of **910** are needed.

910 =	2	x	5	x	91	or
	2	x	7	x	65	or
	2	x	13	x	35	or
	5	x	7	x	26	or
	5	x	13	x	14	or
	7	x	10	x	13	

Hint:
Start with prime factors.
910 = 2 x 5 x 7 x 13

The highest number that can be used is 26.

These are all the possible answers.

5 x 7 x 26 translates to E G Z
5 x 13 x 14 translates to **E M N**
7 x 10 x 13 translates to G J M

Rearrange the letters.

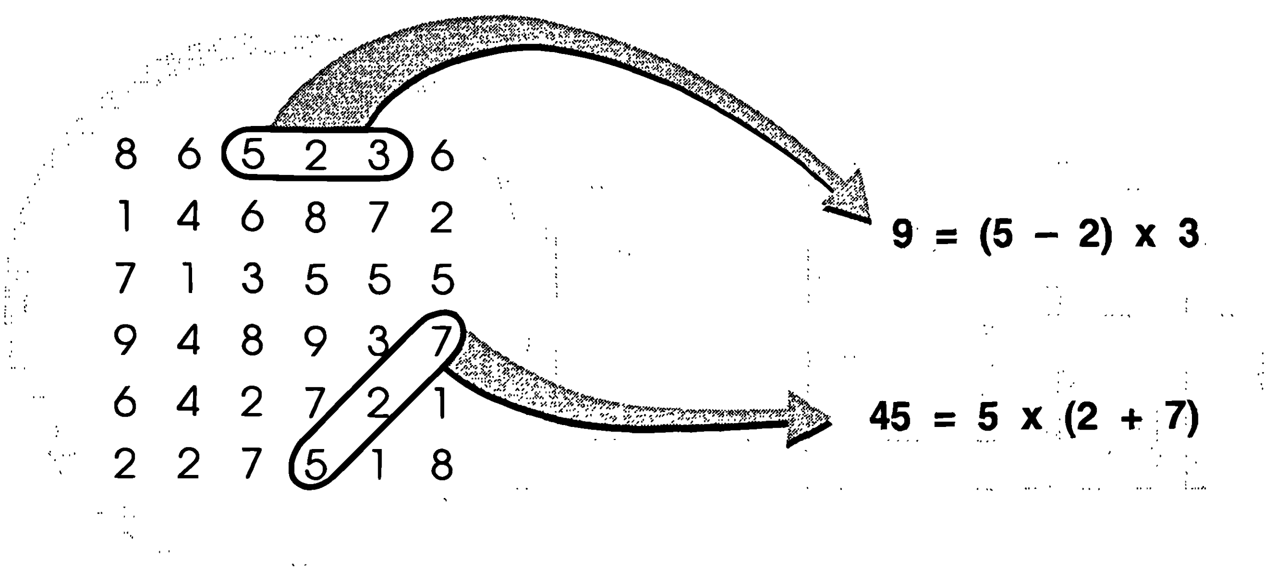
MEN is the only possible word.

Try 13 Across next.
You already have 'N'
so '14' must be one of
the factors.

Three Numbers

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

Choose any three numbers next to each other to make sentences with different answers.



1) Make sentences for these answers:

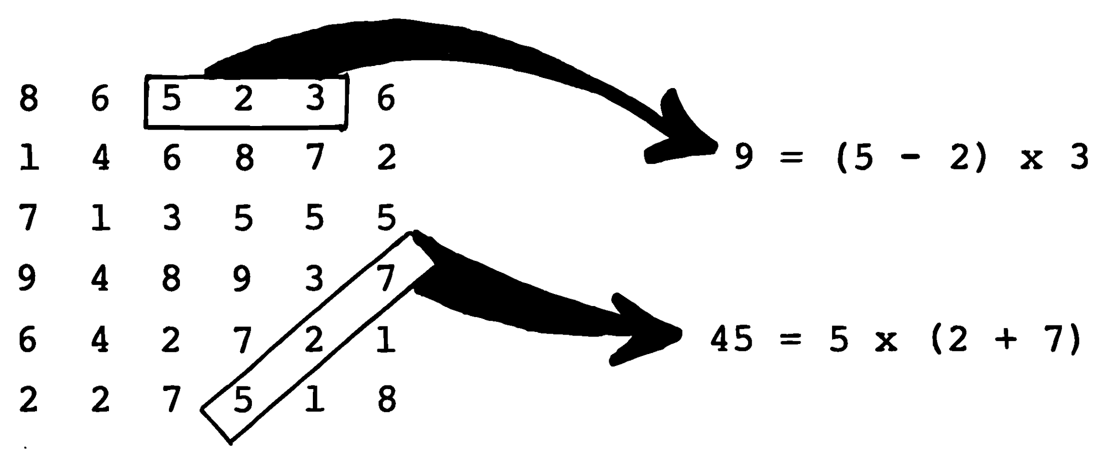
22 16 26 21 3

2) Challenge a friend! Take turns to set an answer and see who can find it first.

THREE NUMBERS

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

Choose any 3 numbers next to each other to make sentences with different answers.

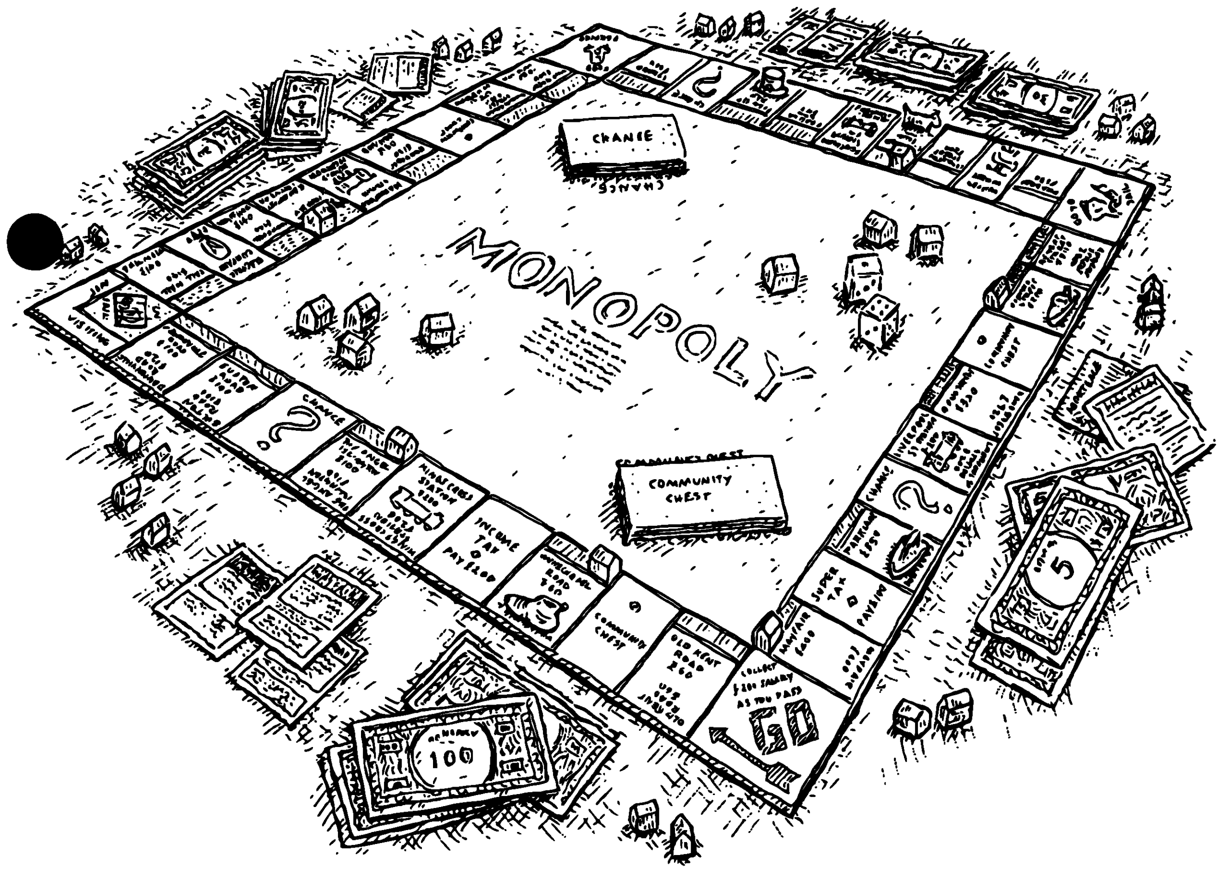


(1) Make sentences for these answers:

22 16 26 21 3

(2) Challenge a friend! Take turns to set an answer and see who can find it first.

Monopoly



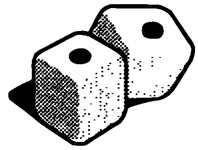
(1 You are **seven** squares away from **Mayfair** which is owned by your rival and has a hotel on it, which means that if you land there it will cost you **£2000** . . .

. . . It is your turn. Is it wise to spend money developing your own property before you throw the dice, or should you save it in case you have to pay ?

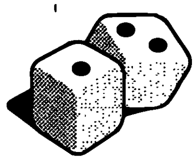
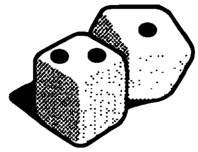
Give reasons for your decision.

Turn over

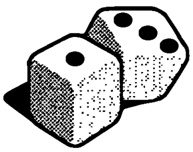
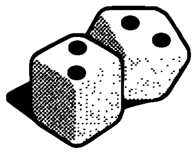
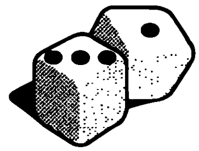
There is only **1** way of scoring **two** :



There are **2** ways of scoring **three** :

 or 

There are **3** ways of scoring **four** :

 or  or 

(2) Copy and complete this table for all the scores.
(Remember that 6 is the highest number on a dice.)

Score	2	3	4	5	6	7	
Ways of getting the score	1 + 1	1 + 2	1 + 3	1 + 4			
		2 + 1	2 + 2				
			3 + 1				
Total	1	2	3				

(3) How many ways are there of scoring **six** ?

(4) How many ways are there of scoring **ten** ?

(5) Are you more likely to score **six** or **ten** ? **Why** ?

(6) Are you more likely to score **five** or **nine** ? **Why** ?

(7) How many different ways are there of scoring altogether ?

(8) Why is **seven** away from **Mayfair** dangerous ?

Another way to list all the possible scores with two dice is to make a table.

(9) Copy and complete this table.

You should have **36** entries in the table.

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

(10) Now shade all the **sevens**. You should shade **6 sevens.**

This means that there are **6** ways out of **36** to score **seven** . . .

. . . so the probability of scoring **seven** is $\frac{6}{36}$

(11) Use the entries in your table to copy and complete the table below, which shows the probabilities for each score.

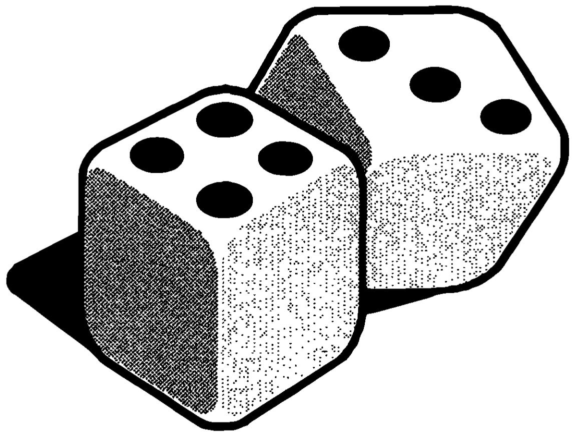
Score	2	3	4	5	6	7	8	9	10	11	12
Probability						$\frac{6}{36}$					

(12) **A problem:**

At a school fête two boys run a stall.

Competitors pay **1p** per go and throw **two** dice.

Competitors win
3p if they throw a **double**
2p if they throw a total of **seven**



Are the boys likely to make a profit ?

(13) Now make your final decision about question (1) and explain it.