National 4 Homework – Expressions and Formulae – Unit 1

Simplifying an expression, multiplying brackets and factorising

Simplifying

1. Simplify:

(a) $2x - 3x + 5x$ **(b)** $8y - 5y - 3y$ **(c)** $2s + 3t - s + 5t$

(d) $x + x + x + x + x$ **(e)** $k + 3k + 4k$ **(f)** $12m + 9m - 2m$

(g) $4p + 2q + 3q$ **(h)** $5x - 5x$ **(i)** $3a + 5b - b - 2a$

[1, 1, 2, 1, 1, 1, 2, 1, 2]

[12 marks]

Multiplying Brackets

2. Multiply out the brackets:

(a) $3(x + 5)$ **(b)** $4(a - 9)$ **(c)** $x(x + 2)$ **(d)** $y(b - 5)$

[2, 2, 2, 2]

3. Multiply out the brackets:

(a) $5(3x + 4)$ **(b)** $6(2b + c)$ **(c)** $10(4 - 5d)$ **(d)** $8(7y - 6)$

[2, 2, 2, 2]

4. Multiply out the brackets and simplify:

(a) $3(x + 7) + 2x$ **(b)** $5(2y + 3) - 6y$ **(c)** $7(s - 4) + 13$

[3, 3, 3]

5. Multiply out the brackets and simplify

(a) $-2(b + 4)$ **(b)** $2(a + 2d) - 3(d - 2a)$ [2, 3]

[30 marks]

Factorising

6. Factorise: **(a)** $3x + 9$ **(b)** $8x - 12$ [2, 2]

7. Factorise:

(a) $12b + 8$ **(b)** $x^2 + 5x$ **(c)** $ab + ac$

(d) $6b - 9c$ **(e)** $2y^2 - 4y$ **(f)** $4ab^2 - 6abc$ [2, 2, 2, 2, 2, 2]

[16 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Evaluating an expression or formulae which has more than one variable

1. If $x = 5$ and $y = 3$, find the value of

(a) $x + y$ **(b)** $2x - 4$ **(c)** $x^2 + 6y$ [2, 2, 2]

2. **(a)** $s = u + at$. Find s when $u = 3$, $a = 5$ and $t = 6$

(b) $E = mc^2$ Find E when $m = 7$ and $c = 5$

(c) $b = \sqrt{\frac{c}{d}}$ Find b when $c = 100$ and $d = 4$ [2, 2, 2]

3. The cost of using a photocopier is £2 plus 5 pence for each copy printed.

The cost £C of printing n copies is given by the formula

$$C = 2 + 0{\cdot}05n$$

(a) Find the cost of printing a class set of 30 worksheets.

(b) Peter was charged £4.75 for a number of copies.

How many copies did he have made? [2, 2]

4. $W = \sqrt{\frac{V}{h}}$. Calculate W when $V = 81$ and $h = 9$. [3]

5. Using the formula $F = \frac{\sqrt{E}}{g\,h^2}$, calculate F when $E = 3600$, $g = 3$ and $h = 2$. [3]

6. The formula to calculate acceleration is given as

$$a = \frac{2d}{t^2}$$

Where$a$ is the acceleration, d is the total distance and t is the time.
Calculate the acceleration when the distance is 100 metres and the time is 8 seconds.
Give your answer correct to 1 decimal place. [3]

[25 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Extending a pattern and determining its formula

1. For their barbeque Mr and Mrs Goldie allowed 2 burgers for each person attending and an extra 8 to be on the safe side.

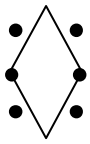
(a) Complete this table for the numbers of burgers they would need: [4]

Number of people attending (n)	1	2	3	4	5	6	10	15	20
Number of burgers required (b)									

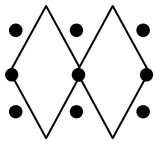
(b) Find a formula for the number of burgers for 'n' people attending the barbeque. [2]

(c) How many burgers would be needed for a barbeque with 23 people attending? [2]

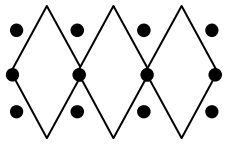
2. A pattern is built up as shown in this diagram:



Pattern 1
1 Diamond
6 Beads



Pattern 2
2 Diamonds
9 Beads



Pattern 3
3 Diamonds
12 Beads

(a) Complete the table for the number of diamonds and number of beads in other patterns. [2]

Number of Diamonds	1	2	3	4	5		12
Number of Beads	6	9	12				

(b) Write down a rule, in symbols, for finding the number of beads needed for any number of diamonds. [2]

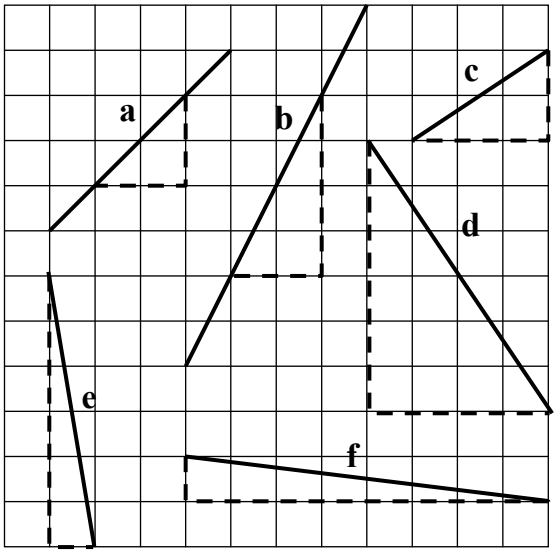
(c) Jasper has 57 beads, how many diamonds would he need to use up all of the beads? [2]

[14 marks]

National 4 Homework – Expressions and Formulae – Unit 1

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

1. Find the **gradients** of the lines shown in the diagram below



[6]

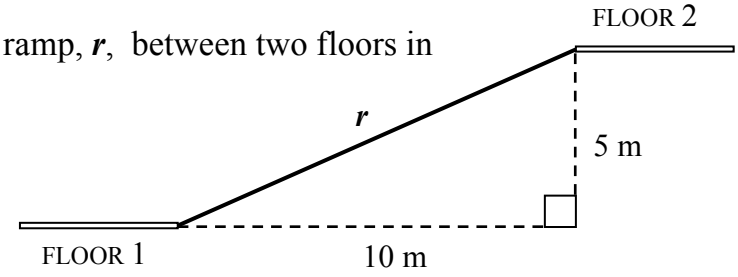
2. **(a)** Draw a coordinate diagram and plot the following pairs of points.

(i) A(3, 8) and B(7, 10) **(ii)** C(–8, 2) and D(3, –4) [2]

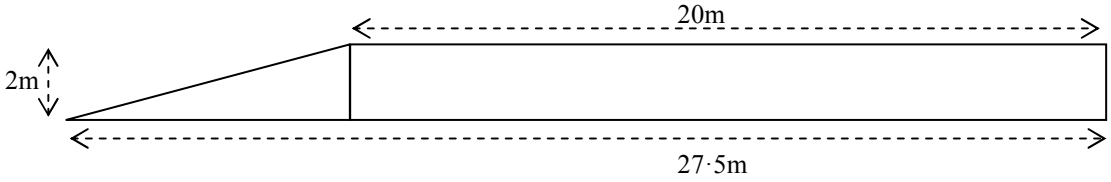
(b) Calculate the gradient of the lines AB and CD. [2]

3. The diagram shows a moving ramp, ***r***, between two floors in a shopping centre.

Find the gradient of the ramp. [2]



4. A special stage is being built for an outdoor concert. It has to be 20 metres wide, 2 metres high and have a ramp on one side.



To be safe the gradient of the ramp should be between 0·25 and 0·3.

Is this ramp safe? Show all your working and give a reason for your answer. [4]

[16 marks]

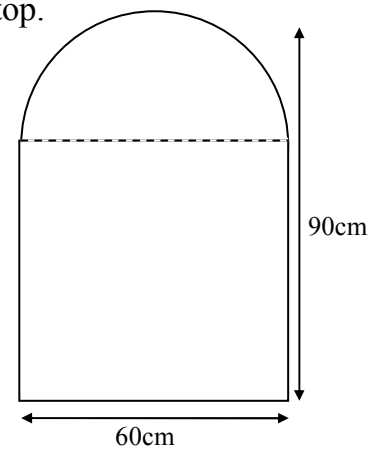
National 4 Homework – Expressions and Formulae – Unit 1

Calculating the circumference and area of a circle

- **In this exercise, answers should be given correct to one decimal place where necessary.**
- **Use $\pi = 3{\cdot}14$ in all calculations.**

1. Find the circumference of a circle with a diameter of 24cm. [2]

2. A window is in the shape of a rectangle with a semi-circle on top. The total height of the window is 90cm and the total width is 60cm.

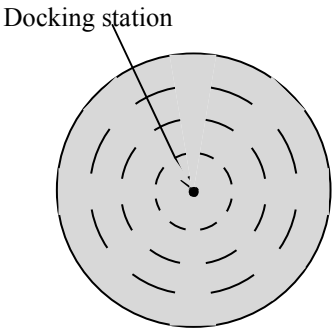


(a) Calculate the area of glass needed to glaze the window. [5]

A rubber gasket forms a seal between the glass and the window frame.

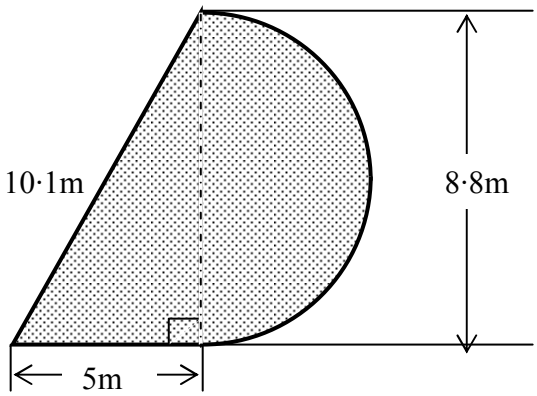
(b) Calculate the length of the gasket. [3]

3. A wireless telephone has a range of 50m. This means that it can receive and transmit calls up to 50m from its docking station.



Calculate the area in which it can receive and transmit calls. [2]

4. The patio area of my garden is shaped as shown in the diagram. It is in the shape of a semi – circle and a right angled triangle.



(a) Calculate the area of the patio. [5]

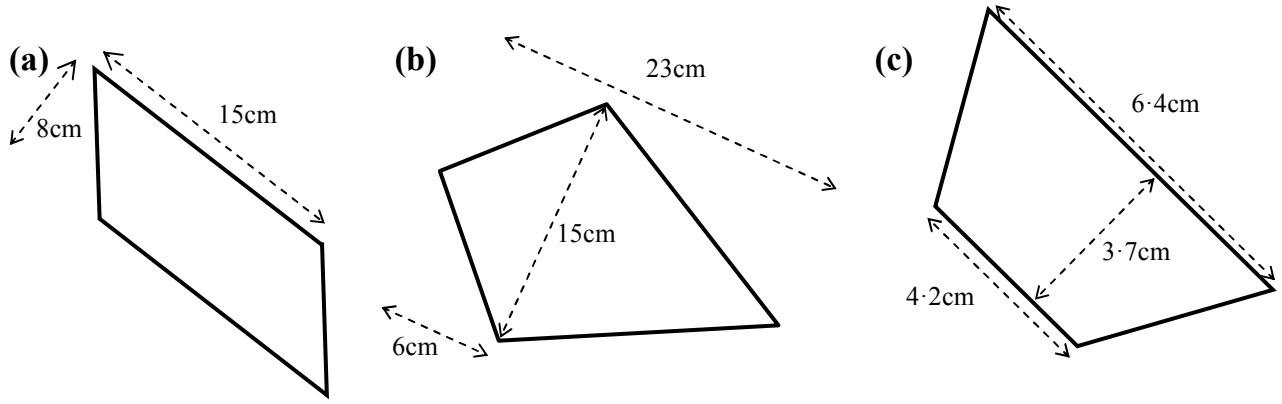
(b) Calculate the perimeter of the patio. [4]

[21 marks]

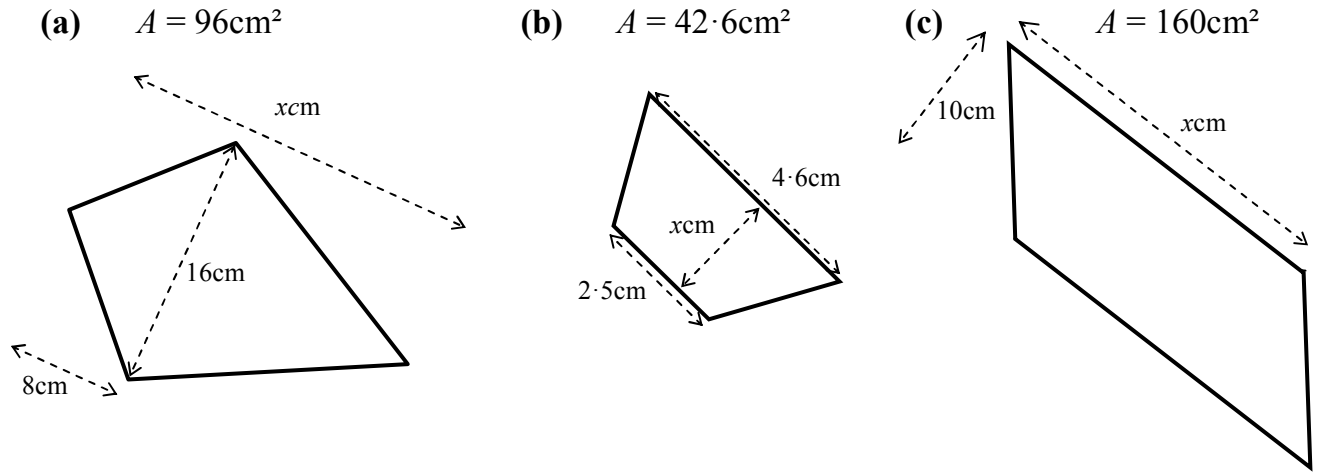
National 4 Homework – Expressions and Formulae – Unit 1

Calculating the area of a parallelogram, kite and trapezium

1. Calculate the areas of these shapes: [2, 2, 2]

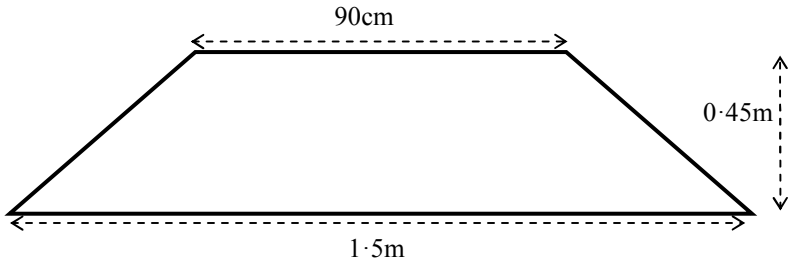


2. The areas of these shapes have been given. Calculate the value of x in each one. [2, 2, 2]



3. A window ledge is shaped like a trapezium with dimensions as shown in the diagram.

It is to be tiled with tiles which cost £12.40 per square metre.



Calculate the cost of tiling the window ledge. [4]

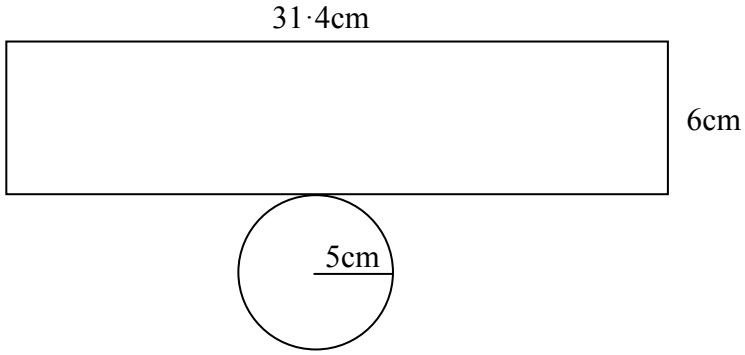
[16 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Investigating the surface of a prism

- **In this exercise, answers should be given correct to one decimal place where necessary.**
- **Use $\pi = 3{\cdot}14$ in all calculations.**

1. A container designed to hold mustard is open ended and has the net shown in the diagram below

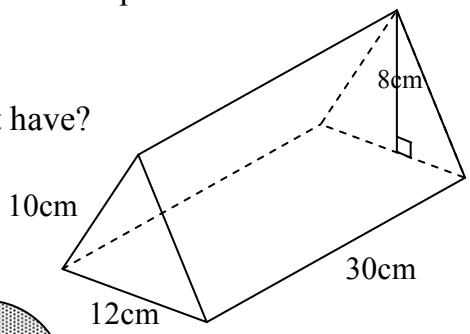


Calculate the area of this net. [5]

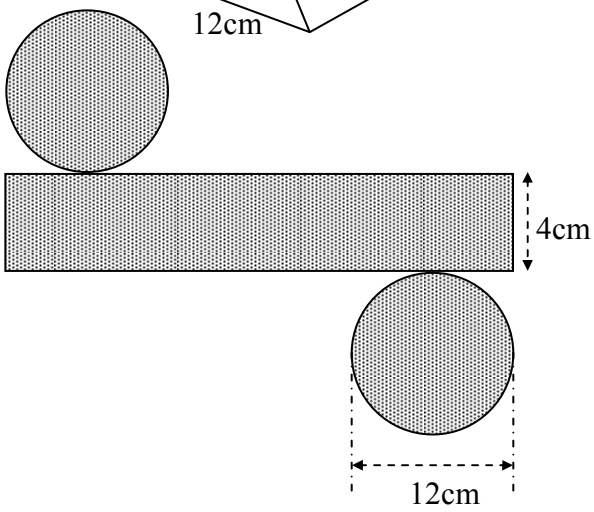
2. **(a)** What is the mathematical name given to this 3D shape? [1]

(b) How many faces, edges and vertices does it have? [3]

(c) Calculate the surface area of it. [4]



3. A gift box is made up from the net shown in the diagram.



(a) What is the mathematical name given to the 3D shape made from this net? [1]

(b) Given that the circles in the net have diameter 12cm and the height of the 3D shape is 4cm, calculate the curved surface area of the shape. [4]

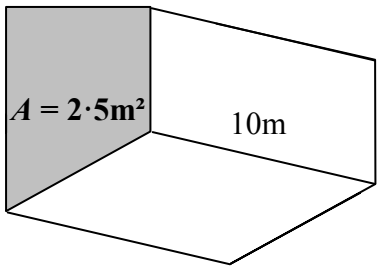
[18 marks]

National 4 Homework – Expressions and Formulae – Unit 1

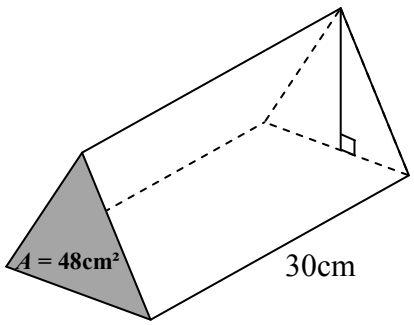
Calculating the volume of a prism

1. Calculate the volumes of these prisms.

(a)



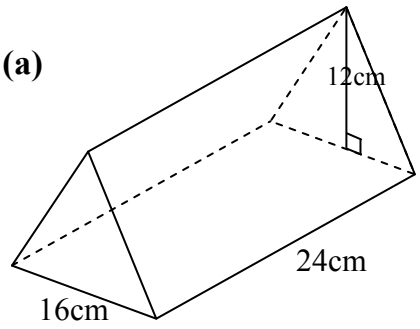
(b)



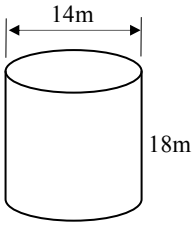
[2, 2]

2. Calculate the volumes of these prisms:

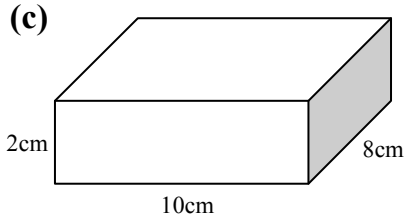
(a)



(b)

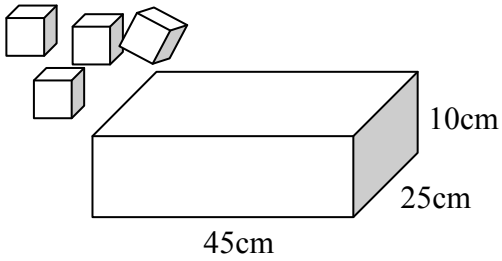


(c)



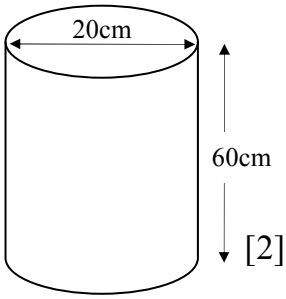
[3, 2, 2]

3. Jake has 100 cube shaped building blocks of side 5 centimetres which he is trying to pack into a box measuring 45cm by 25cm by 10cm. [4]



Will all the blocks fit in the box? If not, how many will he be left with?

4. A water container in the shape of a cylinder with diameter 20 centimetres and height 60 centimetres is shown below.
[diagrams are not drawn to scale]

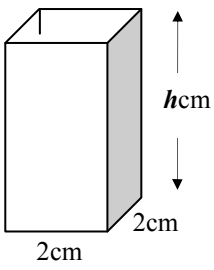


(a) Calculate the volume of the cylinder, in cm^3. [take $\pi = 3 \cdot 14$] [2]

(b) The cylinder is full of water. The water is then poured from the cylinder into 1000 small cuboid-shaped containers which will be frozen to produce small ice blocks.

The water in the cylinder **exactly fills** the 1000 containers.

Each cuboid has a square base of side 2cm and a height of ***h***cm.
Calculate the height (***h***) of each small container. [3]



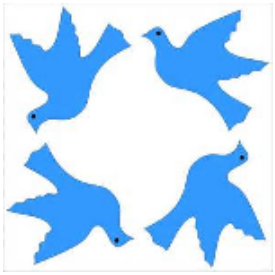
[20 marks]

National 4 Homework – Expressions and Formulae – Unit 1

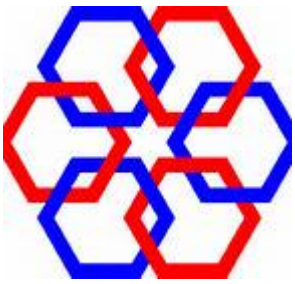
Using rotational symmetry

1. Write down the order of rotational symmetry of these shapes:

(a)

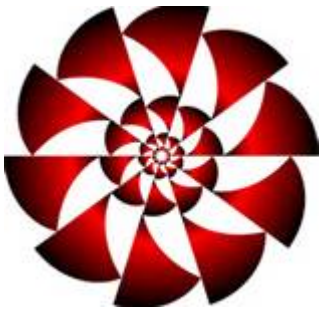


(b)



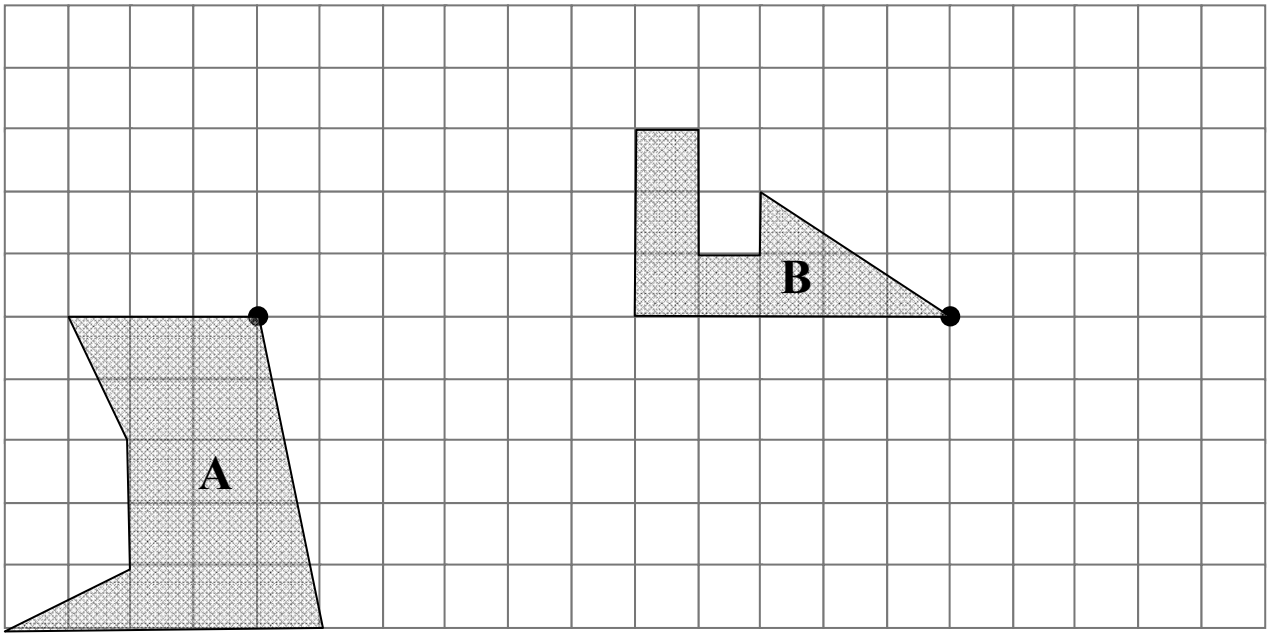
(c)

(d)



[4]

2. Complete shape **A** so that it has half turn symmetry and shape **B** so that it has turn symmetry of order 4 about the dot.



[2, 4]

[10 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Constructing a frequency table with class intervals from raw data

1. A class of second year pupils had a test recently and the following marks were obtained:

32 43 23 18 36 21 9 45 45 32 33 46

7 12 24 20 32 11 48 21 37 42 42 41

Copy and complete this tally table for the above data.

Mark	Tally Marks	Number
1–10		
11–		
–50		

[6]

2. A sample of 25 Christmas trees was selected and the heights of them measured. The results are shown here.
[Measurements are in metres.]

1·3 2·4 1·5 3·3 1·1

2·1 2·2 2·7 1·7 2·3

1·5 2·4 1·1 4·0 2·6

3·5 3·3 2·8 1·0 2·7

4·1 3·2 1·9 3·8 2·7

Height	Tally	Frequency
1·0 – 1·4		
2·5 –		
– 4·4		

Complete the table for the figures given. [8]

[14 marks]

National 4 Homework – Expressions and Formulae – Unit 1

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

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

19 23 30 24 19 25 31 27 28 30 19

Calculate the mean, median, mode and range for the above data. [7]

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

2·8	3·4	2·8	3·1	3·0	4·0	3·5	3·8	3·9	2·9
2·7	3·6	2·5	3·3	3·5	4·1	3·6	3·4	3·2	3·4

Find the **(a)** mean **(b)** median

(c) mode **(d)** range. [2, 2, 1, 2]

3. The weekly takings in small store, to the nearest £, for a week in December and March are shown below

December	2131	2893	2429	3519	4096	4810
March	1727	2148	1825	2397	2901	3114

(a) Calculate the mean takings for December and March. [4]

(b) Give a reason for the difference in the answers in part (a). [1]

4. A footballer scored the following numbers of goals for 9 matches.

1 0 3 3 2 4 1 4 3

After his tenth match his mean score was 2·6 goals per match.

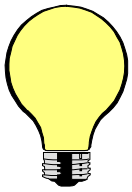
How many goals did he score in the tenth match? [3]

[22 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Interpreting calculated statistics to compare data

1. 20 light bulbs were tested to see how long they would last. The lifetimes of the bulbs are given below in hours.



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

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

Do you agree with their claim? [3]

2. The stem-and-leaf tables show the marks of a class of pupils in two maths tests.

paper 1

2	2					
3	0	3				
4	0	2	4			
5	1	1	1			
6	2	5	5	6		
7	0	0	1	5	5	
8	1	3	3	4	6	8
9	0	1	1	4	5	

paper 2

2	0	1	3				
3	0	2	3	4			
4	1	1	3	5	5		
5	2	4	5	5	8	8	9
6	0	1	4	5			
7	1	3	5				
8	3	7					
9	0						

$n = 29$; 2 | 2 represents 22

(a) For each paper, calculate the median and range. [4]

(b) In which paper did the pupils do better? [1]

3. Your parents tell you that they have been thinking about the amount of pocket money that they give you. They have been asking other parents and give you a list of the amounts of pocket money your friends receive.

£9 £11 £15 £13 £9 £20 £12 £18 £10

They ask you to say whether you would like to have the mean, the median or the mode of the above figures.

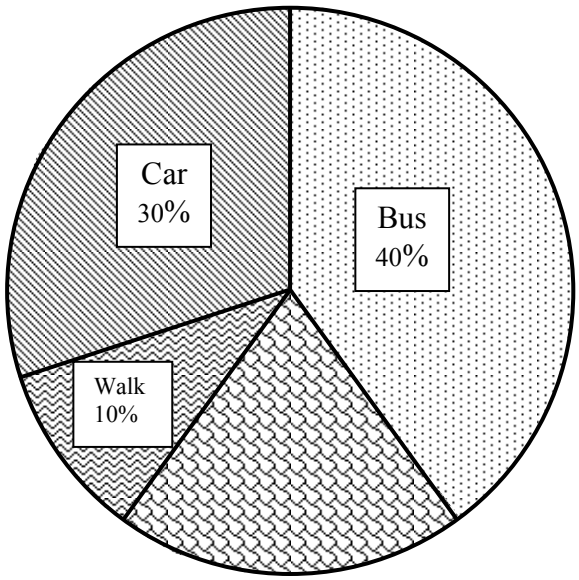
Which one would you choose and why? [4]

[12 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Representing raw data in a pie chart

1. A class of 30 pupils was asked about how they travelled to school and this pie chart drawn.



(a) How many
- **(i)** walked
- **(ii)** came by bus
- **(iii)** came by car
- **(iv)** cycled? [4]

(b) What was the least popular method of travel? [1]

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

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

Draw a pie-chart to show this information.

[5]

3. A group of pupils are asked their favourite type of music. The results are shown below.

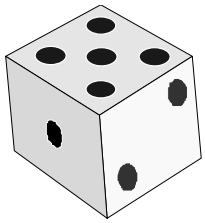
Type of Music	Number of Pupils
Pop	43
Rock	12
Hip-Hop	9
R and B	18
Disco	23
Rap	15

Show this information in a pie chart. [5]

[15 marks]

National 4 Homework – Expressions and Formulae – Unit 1

Using probability

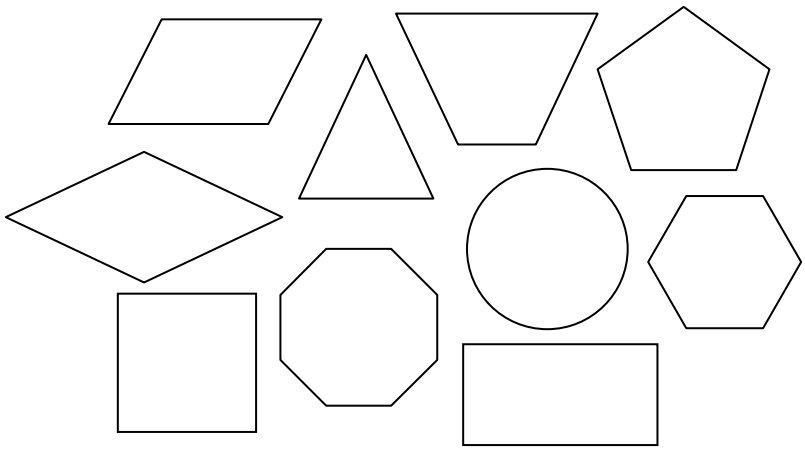


1. A die is rolled. Find the probability that it lands showing

(a) 1 **(b)** an odd number

(c) a prime number **(d)** a multiple of 3 **(e)** a number less than 3 [5]

2. If one of these geometric shapes is picked at random, what is the probability that it has



(a) 4 sides **(b)** a centre of symmetry **(c)** less than 3 sides [3]

3. Darren and his friend are playing with a pack of cards from which his maths teacher has confiscated the Ace of Spades and the King of Hearts.

What is the probability that the first card he deals is

(a) an Ace **(b)** a black card **(c)** a Queen **(d)** the 4 of clubs? [4]

4. A coin is tossed and a die thrown.

Copy and complete this table to show all the possible results: [2]

	1	2	3	4	5	6
Heads(H)		2H				
Tails(T)				4T		

What is the probability of getting: **(a)** Heads and an even number?

(b) Tails and a prime number? [2]

[16 marks]