



AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE (AIMSSEC)

AIMING HIGH

WORKSHEET

THE ANSWER IS 2024, BUT WHAT IS THE QUESTION?

You can be a creative mathematician; you can be someone who has your own mathematical ideas. Find your own interesting facts about 2024 and calculations that have the answer 2024.



1. What different questions can you find with 2024 as the answer?

Perhaps you can make up an easy question, a harder one and one that is very hard. Compare your questions with other people's. For example you might ask: 'What is $(20 + 24) + (20+24)(20+24) + (20 + 24)?$ '

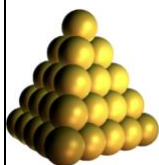
You might like to investigate powers of whole numbers. For example you might ask:

'What is: $2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3$?'

What interesting facts can you find about the year that you were born?

Is it correct to say "twenty twenty-four" or should we say "two thousand and twenty-four" or are both correct? Why?

People say "twenty twenty four" so do the 2 twenties mean – 20 thousands, 20 hundreds, 20 tens or 20 units?



2. The number **2024 is a tetrahedral number**, that is a number that can be represented by a tetrahedral stack like the one shown for the tetrahedral number 35 which has 35 spheres in 5 triangular layers.

The numbers of spheres in each layer are triangle numbers. For a total of 2024 spheres 22 layers are needed. In the picture, the bottom layer has 15 spheres in it $(1 + 2 + 3 + 4 + 5)$, the second layer has 10 spheres, the 3rd has 6, the 4th has 3 and to top layer has only 1. Why is it useful to know how to stack objects like this?

Write down the first 22 triangle numbers that give the number in each layer and the first 22 tetrahedral numbers giving the total number of spheres in each stack.

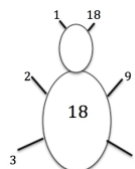
The number 2024 is very special because it is over 250 years since the year was a tetrahedral number and it will be over 300 years until the next one.

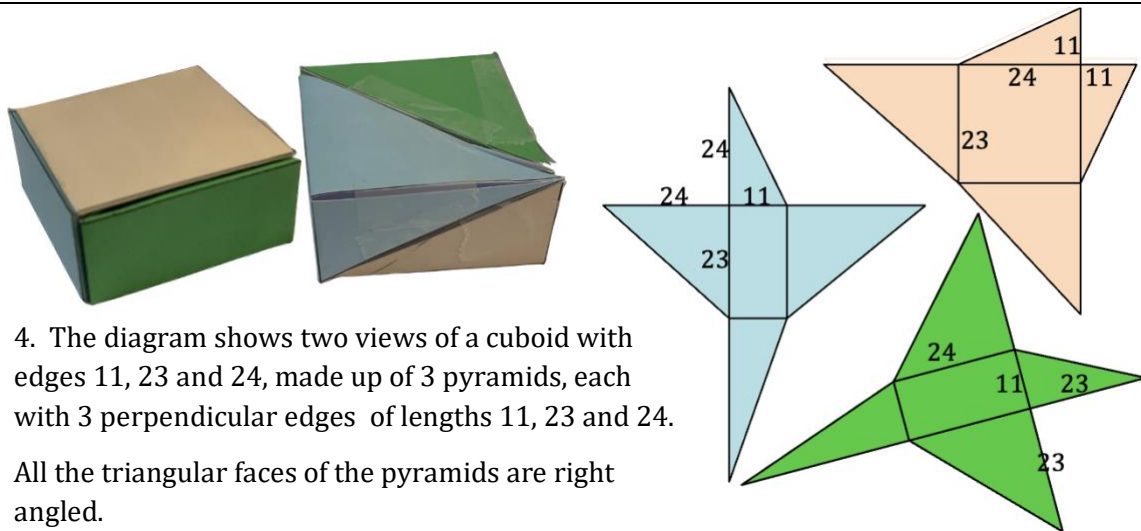
3. Find the prime factors of 2024 and write 2024 as a product of its prime factors. Draw the factor bug for 2024. How many legs does it have?

Here is the factor bug for 18. The antennae show $1 \times 18 = 18$.

The pairs of legs show and $2 \times 9 = 18$ and $3 \times 6 = 18$.

Factor bugs for other numbers can have more legs.





4. The diagram shows two views of a cuboid with edges 11, 23 and 24, made up of 3 pyramids, each with 3 perpendicular edges of lengths 11, 23 and 24.

All the triangular faces of the pyramids are right angled.

Use the nets on pages 3, 4 and 5 to make 3 pyramids like the ones shown and fit them together to make a cuboid.

What does this tell you about the volume of each pyramid?

What does it tell you about the number 2024?

HELP

How old are you? If you are 9 years old then write down some interesting calculations that have the answer 9 (or whatever your age is, do the same for your age).

For example all these have the answer 9:

3×3 ; half of 18 ; $10 - 1$; $20 - 11$; $16 - 7$; 3^2 ; square root of 81 etc.

See the problem 'I'm Eight'

<https://aiminghigh.aimssec.ac.za/years-3-10-i-am-eight/>

NEXT

5. How many ways can you arrange the digits 2, 2, 0 and 4 to get different numbers?
What is the sum of those numbers?

6. Explore Wild and Wonderful Number Patterns, see <http://nrich.maths.org/33>

Make up some of your own number patterns.

You've probably come across number patterns before, ones like :-

2 4 6 8 10 12...

512 256 128 64 32...

220 210 200 190 180 170...

11 14 17 20 23 26...

Work out the rules that produced each of the patterns.

What is the reason for the series of dots appearing after each one?

Now make up some of your own number patterns.

NETS OF PYRAMIDS

1. To make the models, either add tables to the edges of the net, or use sticky tape, or use glue.
2. Print the 3 nets given on card if possible, or print on paper and stick the paper onto scrap card.
3. Cut out the 3 nets and make 3 pyramids.
4. Fit the pyramids together to form a cuboid.
5. Work out the volumes of the pyramids and the cuboid.

