A Level Maths at UTC

- UTC will offer you the highest quality A Level maths experience with experienced teachers.
- UTC will have small A Level class sizes, so you can get individualised support every lesson.
- UTC will use technology such as graphical calculators and laptops throughout the course to help you to achieve your potential.
- UTC will reinforce industry links throughout the course so you know how the maths you are doing is linked to the real world.
- UTC will offer enrichment opportunities such as the UKMT mentoring programme and support for Oxbridge application, to give you loads to talk about at university interviews!

Design, optimisation, rates of change

A Level Mathematics – for students who got Level 6 or above at GCSE.

Paper 1: Pure Mathematics 1 (*Paper code: 9MA0/01)

Paper 2: Pure Mathematics 2 (*Paper code: 9MA0/02)

Each paper is:

2-hour written examination

33.33% of the qualification

100 marks

Content overview

- Topic 1 – Proof
- Topic 2 – Algebra and functions
- Topic 3 – Coordinate geometry in the (x, y) plane
- Topic 4 – Sequences and series
- Topic 5 – Trigonometry
- Topic 6 – Exponentials and logarithms
- Topic 7 – Differentiation
- Topic 8 – Integration
- Topic 9 – Numerical methods
- Topic 10 – Vectors

Paper 3: Statistics and Mechanics (*Paper code: 9MA0/03)

2-hour written examination

33.33% of the qualification

100 marks

Content overview

Section A: Statistics

- Topic 1 – Statistical sampling
- Topic 2 – Data presentation and interpretation
- Topic 3 – Probability
- Topic 4 – Statistical distributions
- Topic 5 – Statistical hypothesis testing

Section B: Mechanics

- Topic 6 – Quantities and units in mechanics
- Topic 7 – Kinematics
- Topic 8 – Forces and Newton's laws
- Topic 9 – Moments

Design, optimisation, rates of change

A Level Further Mathematics – for students who got level 7+ at GCSE and want some extra challenge.

Paper 1: Core Pure Mathematics 1 (*Paper code: 9FM0/01) **Paper 2: Core Pure Mathematics 2 (*Paper code: 9FM0/02)**
Each paper is: ***1 hour and 30 minutes written examination*** ***25% of the qualification*** ***75 marks***
Content overview Proof, Complex numbers, Matrices, Further algebra and functions, Further calculus, Further vectors, Polar coordinates, Hyperbolic functions, Differential equations

- Paper 3 & 4 – choice of Further Statistics, Further Mechanics or Further Decision. We will decide on which of these modules to do during the course.

Design, optimisation, rates of change

How do I design a box with maximum volume?

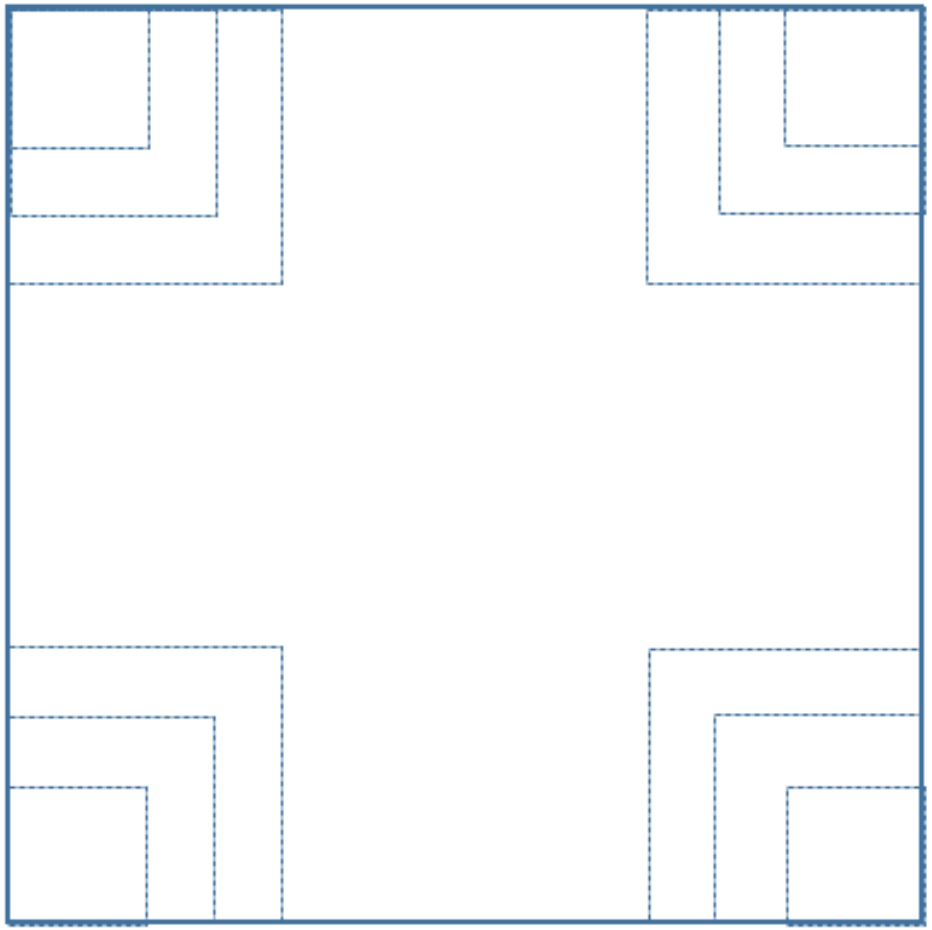
Consider a box cut out of a piece of paper 20cm x 20cm.

What size square should I cut out of the corners to give me a box with maximum possible volume?

Design, optimisation, rates of change

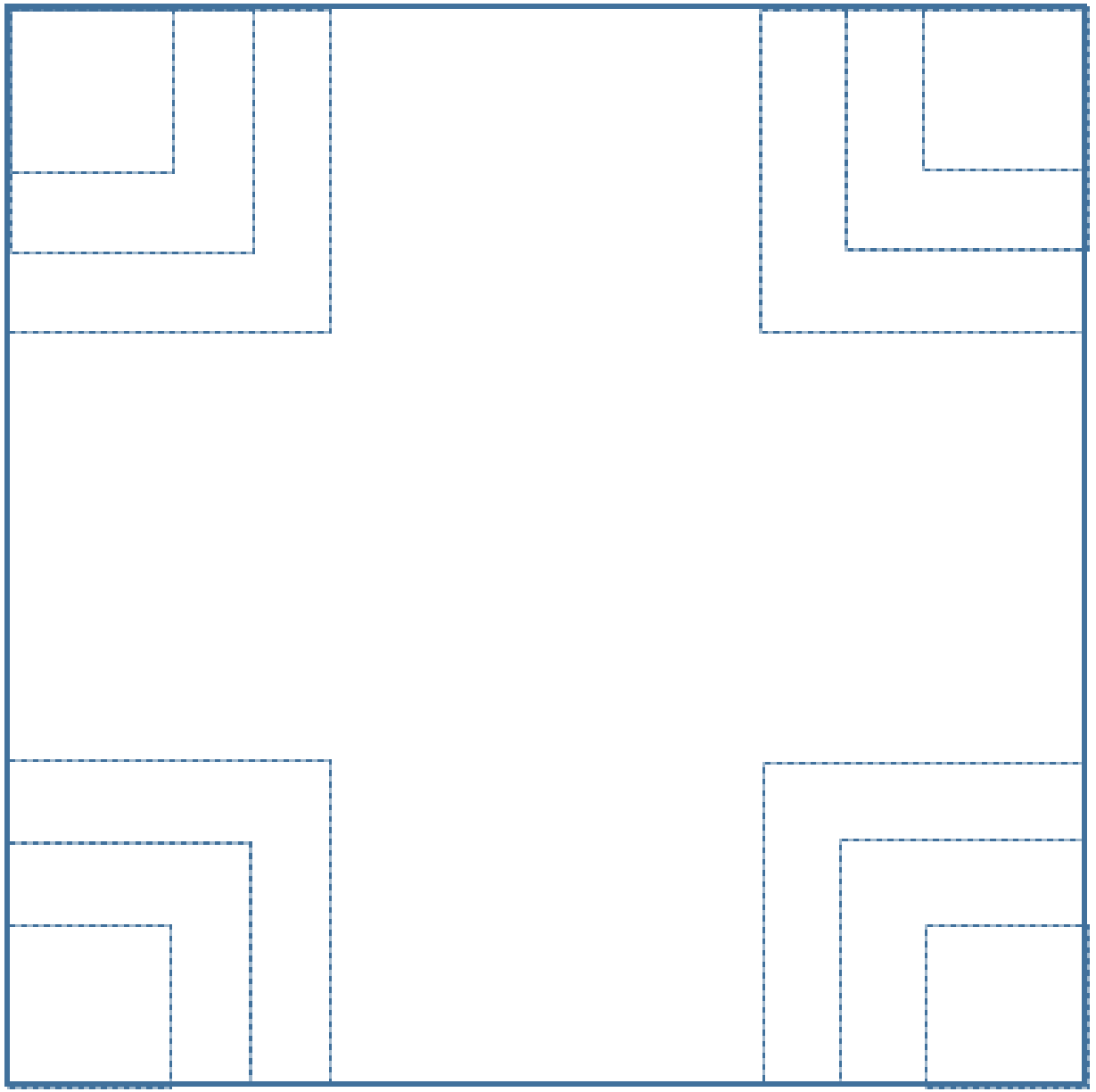
Design approach 1 – inspection.

- Cut out the large square, and choose the size of square you are going to cut out of the corners.
- You can choose a 3cm square, 4.5cm square, 6cm square or whatever size you like!



Design, optimisation, rates of change

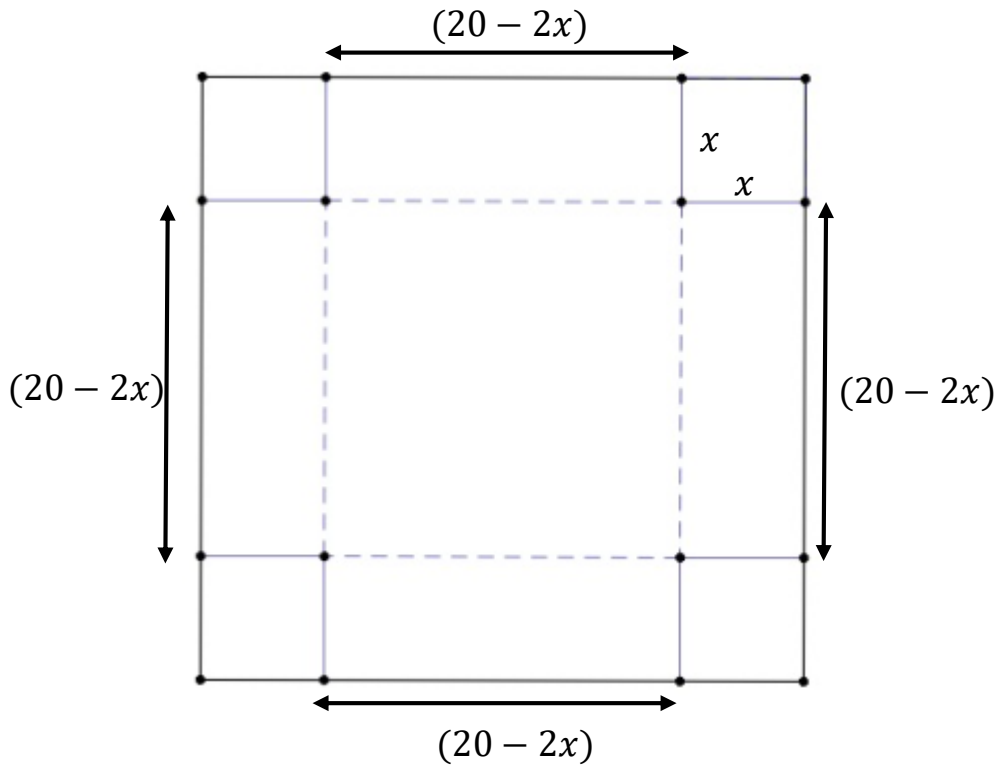
- Fold up the sides to make a box.
- Record your results on worksheet 1.
- Discuss your results with others – who has got the maximum box volume?



Design, optimisation, rates of change

Design approach 2 – graphical

- Look at the representation of your box on the right.
- What does the value of x represent?
- How can you use this to get an expression for the volume of your box in terms of x?



Expanding your expression for volume.

$$V = (20 - 2x)(20 - 2x)x$$

$V =$

$V =$

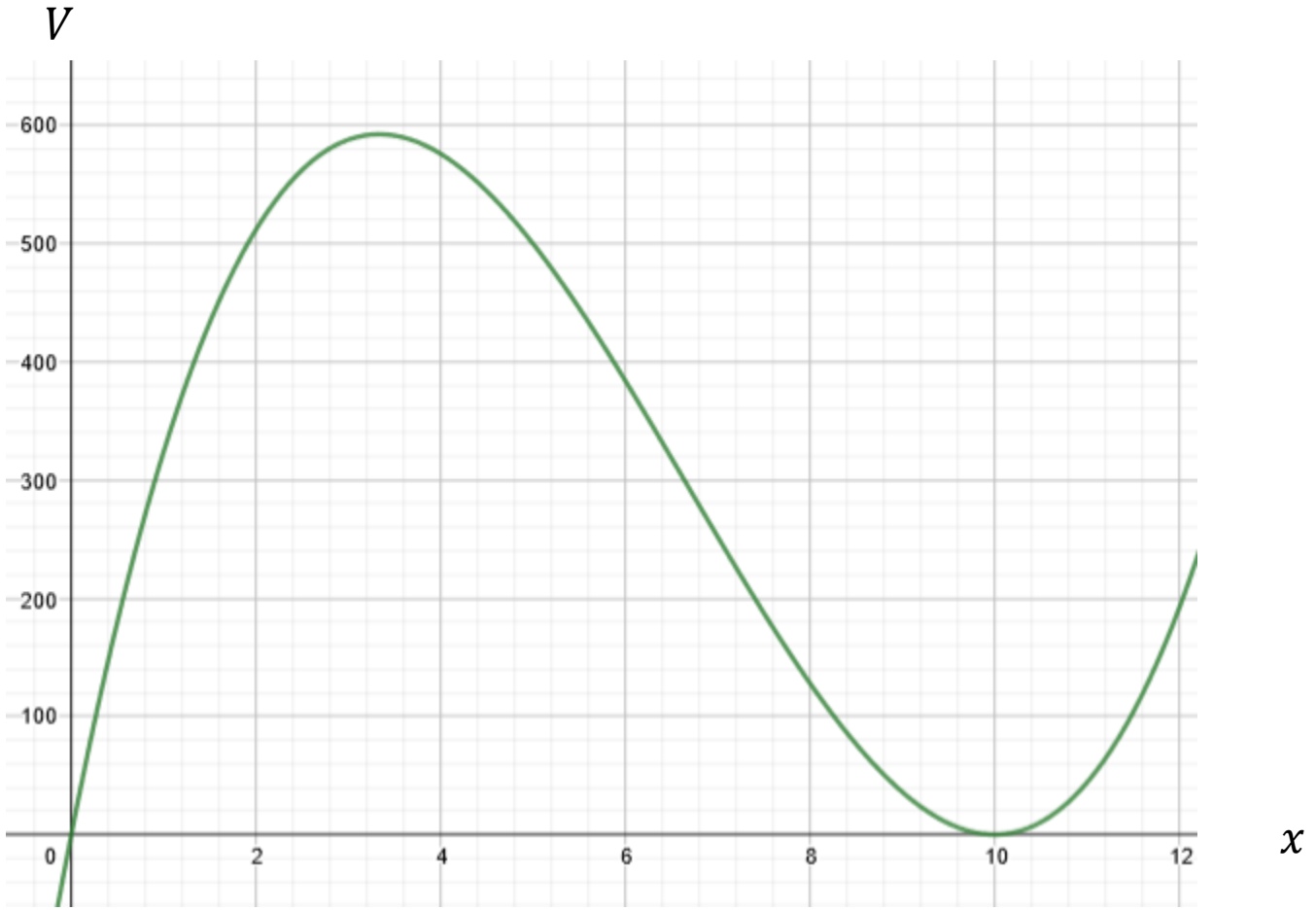
Graphing your function for volume.

- $V = 4x^3 - 80x^2 + 400x$

- Lets take a look at this function on geogebra.
- https://www.desmos.com/calculator/kojy1crrkv

- Which x value maximises volume?

- What is the maximum volume?



Design, optimisation, rates of change

Design approach 3 – calculus.

- We are going to look at how to use calculus to find the maximum box volume.

$$V = 4x^3 - 80x^2 + 400x$$

$$\frac{dV}{dx} =$$

$$\frac{dV}{dx} =$$

How to differentiate a polynomial function.

- Multiply each term by the power of x. For example, if the term is $3x^2$ you will multiply 3 by 2.
- Reduce the power on each term by 1. For example if the term is x^2 it will become x.
- Simplify each term.

Using $\frac{dV}{dx}$ to find the maximum box volume.

$$\frac{dV}{dx} = 12x^2 - 160x + 400$$

How to use the derivative to maximise a function.

- Set $\frac{dV}{dx}$ to equal zero.
- Solve the equation to find the x value.
- Substitute in to find the maximum volume.

- What x value gives the maximum volume?
- What is the maximum volume?
- Which of the three approaches was the best?

Further optimisation problem.

- A farmer has an an adjustable fence that is 100m long. He uses this fence to enclose a rectangular grazing area on three sides, the fourth side being the side of his barn.
- Find the maximum area he can enclose WITH HIS FENCE.
- Step 1 – sketch the problem and label the sides with information you have..

- Step 2 – find the area of the field in terms of x and simplify your expression.

- Step 3 – Differentiate the expression.

How to differentiate a polynomial function.

- Multiply each term by the power of x. For example, if the term is $3x^2$ you will multiply 3 by 2.
- Reduce the power on each term by 1. For example if the term is x^2 it will become x.
- Simplify each term.

- Step 4 – Set your derivative equal to zero and solve the equation.

- Step 5 – Find the maximum value of area using your value of x.