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Calculus

Calculus – Introduction

This is the first lesson in a series of lessons on the branch of Mathematics called Calculus. Calculus was invented to describe mathematically some situations in the real world – it was invented as a tool for Mathematical Modelling.

Lesson Outcomes

By the end of this lesson, you should be able to:

- explain why calculus was developed as a branch of mathematics.

Curriculum Links

LO 2: Functions and Algebra

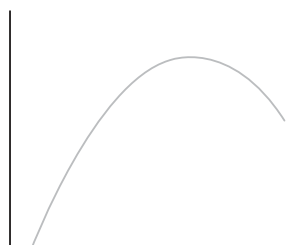
12.2.7 (a) Investigate and use instantaneous rate of change of a variable when interpreting models of situations:

- demonstrating an intuitive understanding of the limit concept in the context of approximating the rate of change or gradient of a function at point; (Linked to task)

Lesson Notes

Here is an example of a problem that stimulated the invention of Calculus.

Problem: Determine the area under the curve of the graph below:



There wasn't a formula to do this so the mathematicians started off by drawing a shape that they knew they could find the area of – a rectangle.

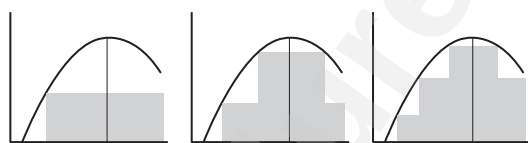


Fig. 1

Fig. 2

Fig. 3

(see *fig. 1*). The area, however, of this rectangle was much less than the area under the curve so they drew more rectangles and found the sum of the area of the rectangles (see *fig. 2*). This estimation was better but still not good enough. The mathematicians then realised that the more rectangles they used, the better the sum of the areas of the rectangles would approximate the area under the curve (see *fig. 3*).

The above example is the idea at the heart of one of the branches of Calculus called Integral Calculus. **Integral Calculus** provides a technique for determining the areas under curves and the volumes of solids.

At school level we study the other branch of calculus: namely Differential Calculus. It also deals with the challenge of calculating – more accurately approximating – something for which there is no formula. We will describe this branch of Calculus by looking at the following example.

Problem: Given a piece of square cardboard 20cm × 20cm, cut out a square from each corner and fold up to make a box with the greatest possible volume.

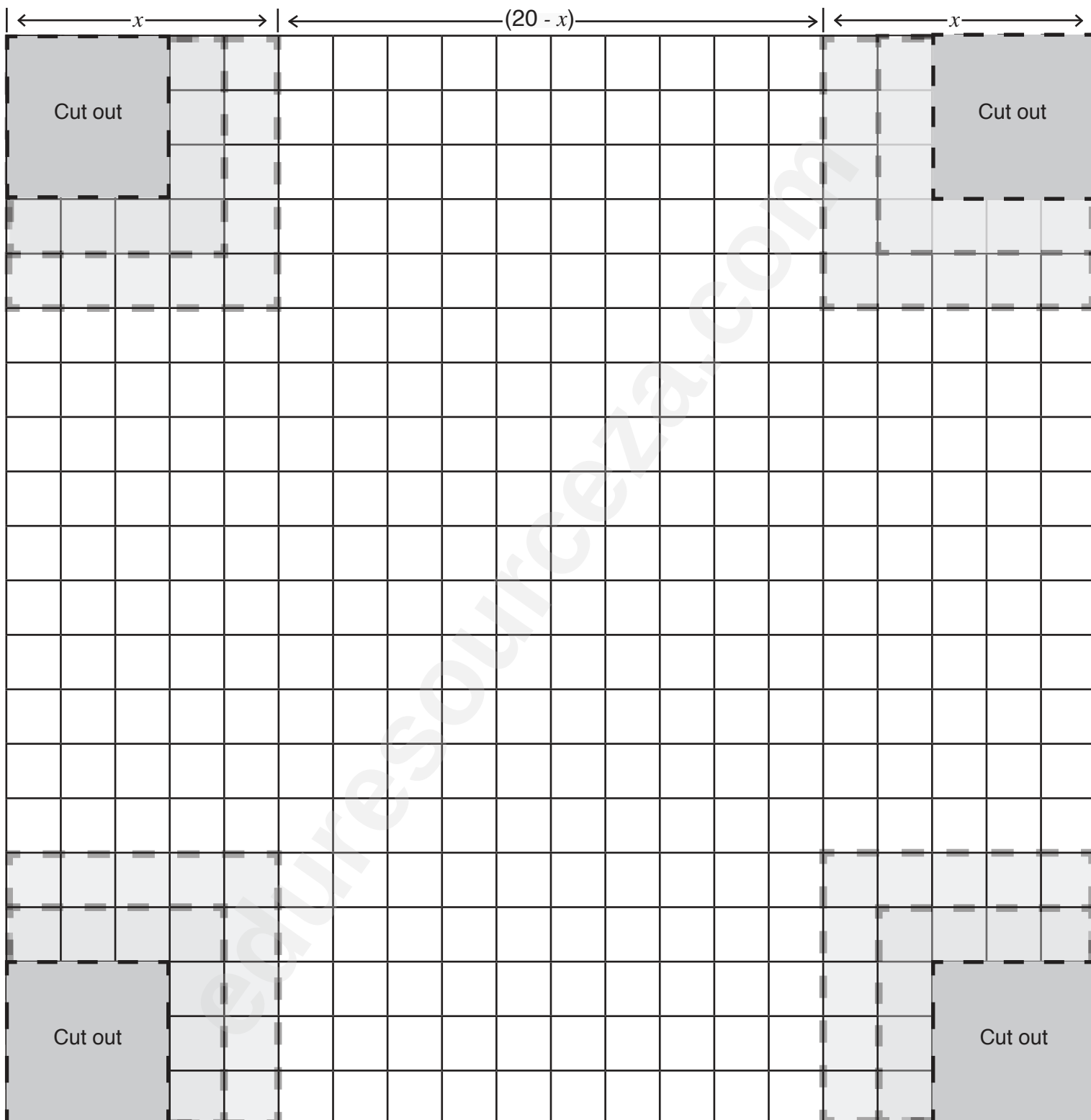
(see diagram sheet on the next page)

One way of tackling this problem, would be to make a number of boxes by changing the size of the square that is cut out of the corners and then to calculate the volume of each box.

The table below gives the volume of the boxes with different sized squares cut out of the corners. A graph of the situation would give you a better idea of the trend in the volume.

Length of side of square in cm	Volume of box in cm ³
1	324
2	512
3	588
4	576
5	500
6	384
7	252
8	128
9	36

Calculus



Box template

1 block $\approx$ 1cm



Task

Check the volumes that were calculated in the lesson above and draw a graph of the length of the side of cut-out square verses volume of the box.

