

# MA 140 - Calculus

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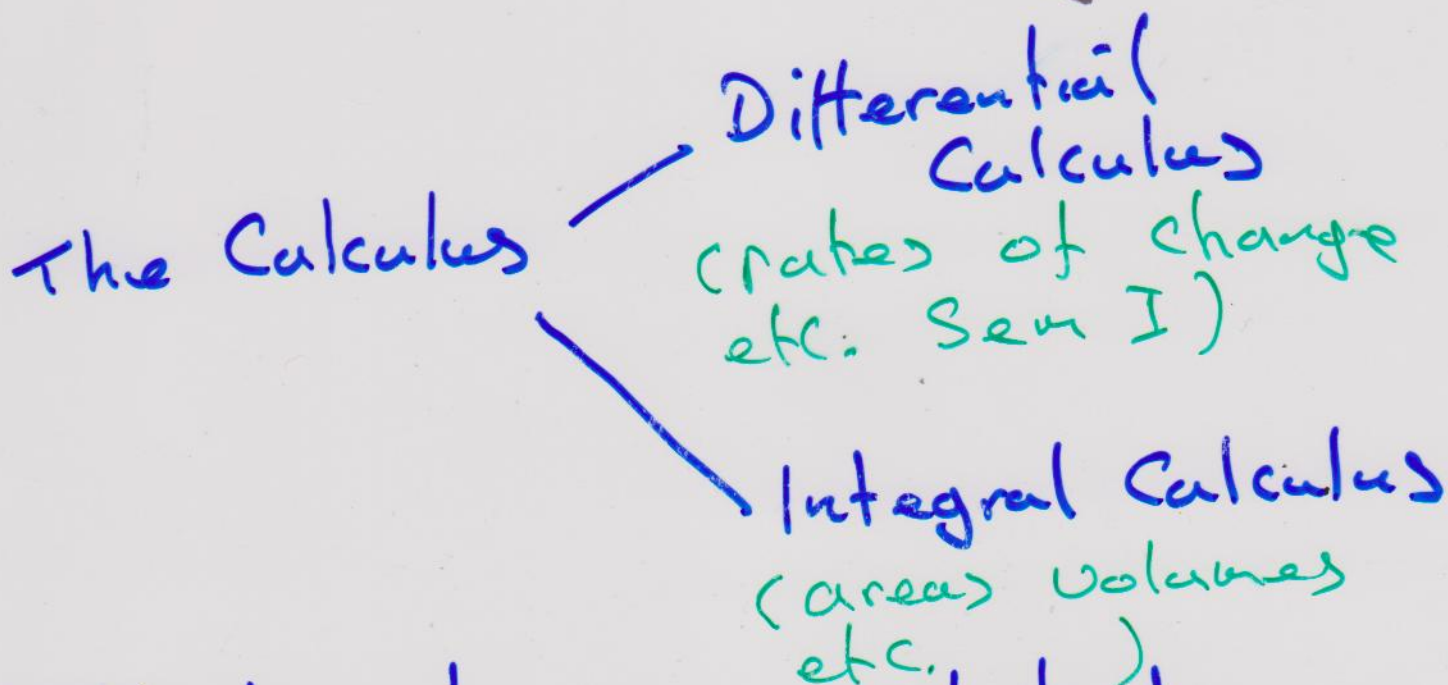
Text: Engineering Mathematics

by

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cost: about €80 for two volumes

A Calculus ~ a theory for  
calculating.



Both branches are related.

Both branches involve limiting  
processes

Today & tomorrow:

Two examples: first a rate of change; second an area.

### Example 1



stone falls  $y$  metres  
in  $t$  seconds.

Experience suggests

$$y = 4.9 t^2$$

Question: What is the average  
Speed between  $t=2$  and  
 $t=3$  seconds?

$$\text{Average speed} = \frac{\text{distance travelled}}{\text{time}}$$

$$= \frac{4.9(3)^2 - 4.9(2)^2}{1}$$

$$= 4.9(9 - 4)$$

$$= 24.5 \text{ m/s}$$

Let

$v(t)$  = speed of stone at time  $t$ .

Question: What is the speed of the stone at time  $t=2$ ?

$$v(2) = \lim_{h \rightarrow 0} \frac{y(2+h) - y(2)}{h}$$



$$= \lim_{h \rightarrow 0} \frac{4.9(2+h)^2 - 4.9(2)^2}{h}$$

$$= \lim_{h \rightarrow 0} \frac{4.9 \{ (2+h)^2 - 2^2 \}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{4.9 \{ \cancel{2^2} + h^2 + 4h - \cancel{2^2} \}}{h}$$

$$= \lim_{h \rightarrow 0} \frac{4.9 \cancel{h} (h+4)}{\cancel{h}}$$

$$= \lim_{h \rightarrow 0} 4.9(h+4)$$

$$= 4.9 \times 4 = 19.6 \text{ m/s}.$$