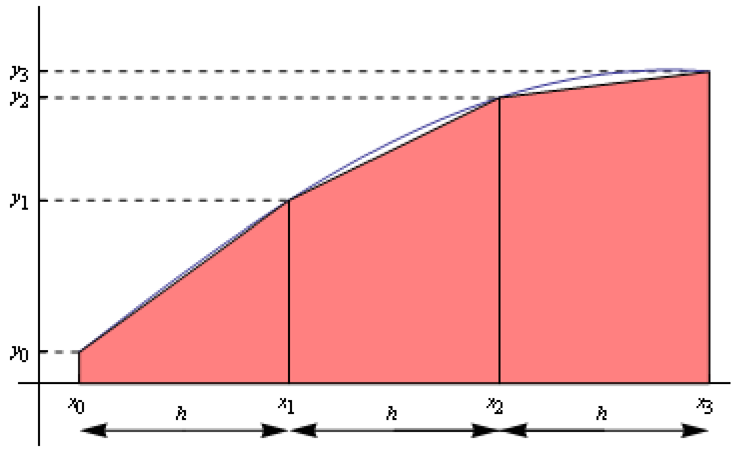
CJ - Numerical methods

<table>
<tr><td colspan="2">All of this is in the formula book.</td></tr>
<tr><td>What is an ordinate? (with example)</td><td>

- A y-value.
- The following has 4 ordinates (y-values) starting from y_0 to y_3.



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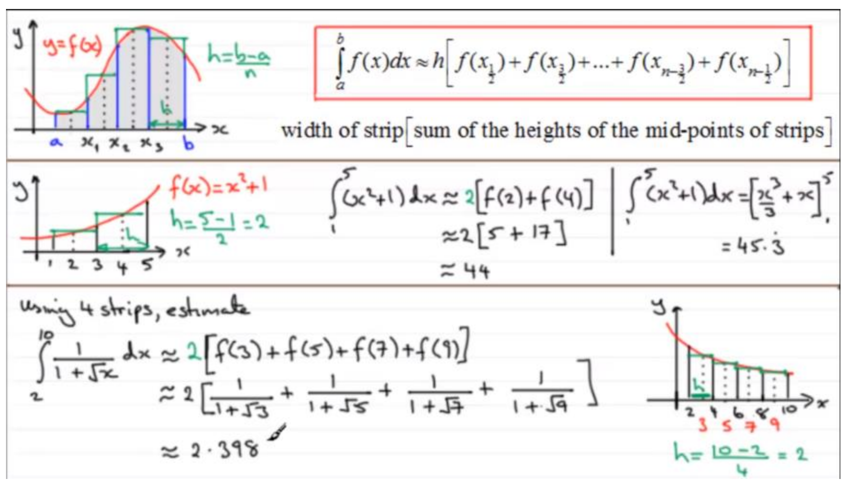
<tr><td>How does the mid-ordinate rule work?</td><td>



This comes from the formula:

$$\int_a^b y\,\mathrm{d}x \approx h\left(y_{\frac{1}{2}} + y_{\frac{3}{2}} + \ldots + y_{n-\frac{3}{2}} + y_{n-\frac{1}{2}}\right), \text{ where } h = \frac{b-a}{n}$$
</td></tr>
<tr><td>How is Simpson's Rule better than the Midordatine rule?</td><td>By minimising the differences at the top and bottom of each rectangle by replacing the mid ordinates with a quadratic curve.</td></tr>
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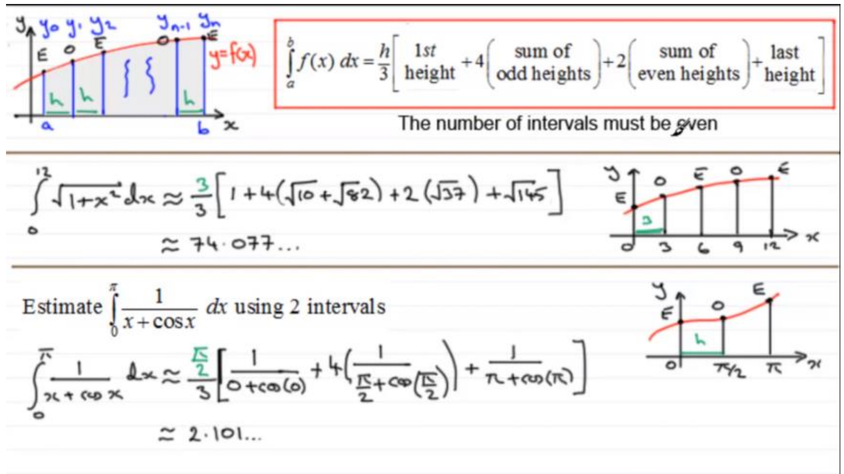
<tr>
<td>How does Simpson’s rule work?</td>
<td>



If the area required is divided into n strips of equal thickness, **where n is even,** **Key point**

then $\int_{x_0}^{x_n} f(x)\,dx \simeq \frac{d}{3}[(y_0+y_n)+4(y_1+y_3+y_5+\cdots+y_{n-1})+2(y_2+y_4+y_5+\cdots+y_{n-2})]$

This means you require 5 ordinates.

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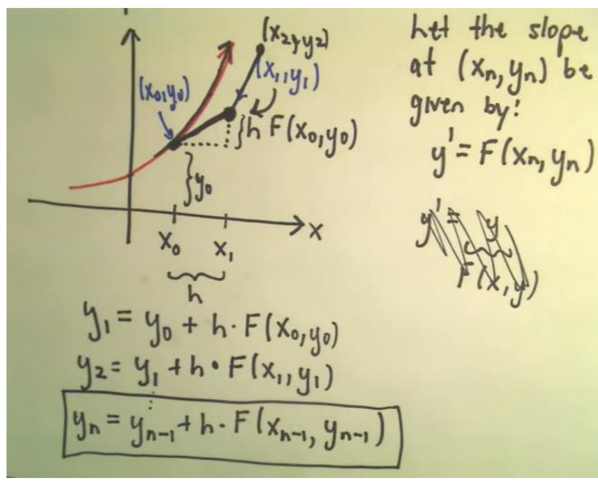
<td>When is Euler’s Method usually used? How does it work geometrically? What should you note?</td>
<td>

- To solve nonlinear differential equations (eg, $dy/dx = x^2 + y^2$).



- As shown, reducing step size increases accuracy.

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<td>When will Euler’s Method be an underestimate or an overestimate?</td>
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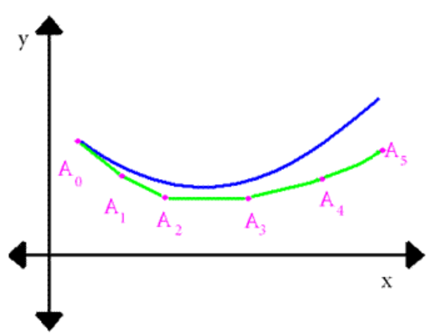
Underestimate when convex:



Underestimate when concave:

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	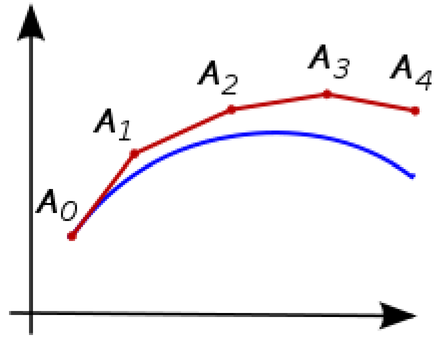

A_0
A_1
A_2
A_3
A_4