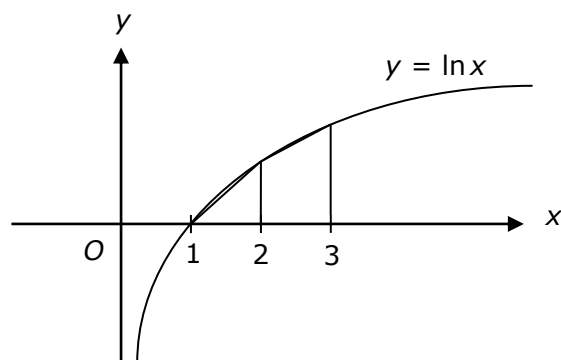




- MA 11** (a) Sketch the graph of $y = \ln x$ in the space provided. **1**
- SQ** (b) Use the trapezoidal rule with three function values to find an approximation to $\int_1^3 \ln x \, dx$. **2**
- (c) State whether the approximation found in part (b) is greater than or less than the exact value of $\int_1^3 \ln x \, dx$. Justify your answer. **1**

(a)



(b)

x	1	2	3
lnx	0	ln2	ln3

$$\begin{aligned} \int_1^3 \ln x \, dx &\approx \frac{b-a}{2n} \{f(a) + f(b) + 2[f(x_1) + \dots + f(x_{n-1})]\} \\ &= \frac{1}{2} \{0 + \ln 3 + 2 \ln 2\} \\ &= \frac{1}{2} (\ln 3 + 2 \ln 2) \\ &= 1.242453325\dots \\ &= 1.24 \text{ (2 dec pl)} \end{aligned}$$

(c) The approximation using the trapezoidal rule is less than the exact value because $y = \ln x$ is concave down and the trapezia are under the curve.

* These solutions have been provided by [projectmaths](http://projectmaths.com.au) and are not supplied or endorsed by NESA.

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