

STEP III, 2014, Q6

6 Starting from the result that

$$h(t) > 0 \text{ for } 0 < t < x \implies \int_0^x h(t) dt > 0,$$

show that, if $f''(t) > 0$ for $0 < t < x_0$ and $f(0) = f'(0) = 0$, then $f(t) > 0$ for $0 < t < x_0$.

(i) Show that, for $0 < x < \frac{1}{2}\pi$,

$$\cos x \cosh x < 1.$$

(ii) Show that, for $0 < x < \frac{1}{2}\pi$,

$$\frac{1}{\cosh x} < \frac{\sin x}{x} < \frac{x}{\sinh x}.$$



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