

STEP III, 2003 Q1

- 1 Given that $x + a > 0$ and $x + b > 0$, and that $b > a$, show that

$$\frac{d}{dx} \arcsin \left(\frac{x+a}{x+b} \right) = \frac{\sqrt{b-a}}{(x+b)\sqrt{a+b+2x}}$$

and find $\frac{d}{dx} \operatorname{arcosh} \left(\frac{x+b}{x+a} \right)$.

Hence, or otherwise, integrate, for $x > -1$,

(i) $\int \frac{1}{(x+1)\sqrt{x+3}} dx$,

(ii) $\int \frac{1}{(x+3)\sqrt{x+1}} dx$.

[You may use the results $\frac{d}{dx} \arcsin x = \frac{1}{\sqrt{1-x^2}}$ and $\frac{d}{dx} \operatorname{arcosh} x = \frac{1}{\sqrt{x^2-1}}$.]



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