## Question 1 (6 marks)

(a) Use integration by parts to find $\int x \sin x \mathrm{~d} x$.

(3 marks)
Consider the image of a pearl shown in Figure 1.

This image has been removed for copyright reasons.

Figure 2 shows the graph of $y=\sqrt{x \sin x}$, for $0 \leq x \leq \pi$, which models the top half of the cross-section of this pearl, outlined in Figure 1.


Figure 2
(b) The shape of the pearl can be obtained by rotating the curve in Figure 2 about the $x$-axis for $0 \leq x \leq \pi$.
Show that, according to the model, the exact volume of the pearl is $\pi^{2}$ cubic units.

(3 marks)

