

STEP II, 2006, Q4

- 4 By making the substitution $x = \pi - t$, show that

$$\int_0^{\pi} xf(\sin x)dx = \frac{1}{2}\pi \int_0^{\pi} f(\sin x)dx ,$$

where $f(\sin x)$ is a given function of $\sin x$.

Evaluate the following integrals:

- (i) $\int_0^{\pi} \frac{x \sin x}{3 + \sin^2 x} dx ;$
- (ii) $\int_0^{2\pi} \frac{x \sin x}{3 + \sin^2 x} dx ;$
- (iii) $\int_0^{\pi} \frac{x |\sin 2x|}{3 + \sin^2 x} dx .$



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