PROOF OF FORMULA 3.662.2

$$\int_0^{\pi/2} (\operatorname{cosec}\, x - 1)^\mu \, \sin 2x \, dx = \frac{(1-\mu)\pi\mu}{\sin \pi\mu}$$

Write
$$\int_0^{\pi/2} (\operatorname{cosec}\, x - 1)^\mu \, \sin 2x \, dx = 2 \int_0^{\pi/2} (1 - \cos x)^\mu \sin x \cos^{1-\mu} x \, dx.$$

The change of variable $t = \cos x$ gives
$$\int_0^{\pi/2} (\operatorname{cosec}\, x - 1)^\mu \, \sin 2x \, dx = 2 \int_0^1 (1-t)^\mu t^{1-\mu} \, dt.$$

This last integral is
$$2B(1 + \mu, 2 - \mu) = \frac{2\Gamma(1+\mu)\Gamma(2-\mu)}{\Gamma(3)},$$

and this simplifies to the stated answer.