Let $f(\theta) = \sin 2\theta$ and $g(\theta) = \cot \theta (1 - \cos 2\theta)$. Use the function to answer the following questions.

a. For what exact value(s) of θ is $f(\theta) = \sin \theta$ on the interval $\frac{\pi}{2} < \theta \leq \pi$. Show your work.

b. For what exact value(s) of θ is $2f(\theta) = -\sqrt{3}$ on the interval $0 < \theta \leq 2\pi$. Show your work.

c. Using trigonometric identities, analytically show that $f(\theta) = g(\theta)$ for all values of θ.

Consider the functions $f(\theta) = \cos 2\theta$ and $g(\theta) = (\cos\theta + \sin\theta)(\cos\theta - \sin\theta)$.

a. Find the exact value(s) on the interval $0 < \theta \le 2\pi$ for which $2f(\theta) + 1 = 0$. Show your work.

b. Find the exact value(s) on the interval $\frac{\pi}{2} < \theta < \pi$ for which $f(\theta) = \sin\theta$. Show your work.

c. To three decimal places, find the values of $f\left(\frac{\pi}{8}\right)$ and $g\left(\frac{\pi}{8}\right)$.

d. Would your results from part c) hold true for all values of θ. Justify your answer.