1. [4 *points*]

(a) Write $\sin x - \sqrt{3}\cos x$ in the form $R\sin(x-\alpha)$, where R and α are to be found with $R > 0$ and $0 < \alpha < \frac{\pi}{2}$.

(b) Hence solve the equation:

$$\sin x - \sqrt{3}\cos x = \sqrt{3}$$

for $0 \leqslant x \leqslant 2\pi$.

2. [4 *points*]

Solve the equation:

$$\cos 2x + \cos 4x = 0$$

for $-\pi \leqslant x \leqslant \pi$.

3. [6 *points*]

(a) Show that:

$$\sin(2\arctan x) = \frac{ax}{b+x^2}$$

where a and b are constants to be found.

(b) Hence solve the equation:

$$2\arctan x = \arcsin\left(\frac{4}{5}\right)$$

4. [6 *points*]

Given that $\sec\alpha = 2$ and $\cot\beta = -3$ with $0 < \beta < \pi < \alpha < 2\pi$, find the exact value of $\sin(\alpha + 2\beta)$.