# Section 2: Further trigonometric equations

## Solutions to Exercise level 1

1. (i) $3\sin(\theta + 20°) = 2$

$\sin(\theta + 20°) = \frac{2}{3}$

$\theta + 20° = 41.8 \text{ or } 138.2°$

$\theta = 21.8 \text{ or } 118.2°$

(ii) $4\cos(\theta + 50°) = 1$

$\cos(\theta + 50°) = \frac{1}{4}$

$\theta + 50° = 75.5° - 284.5°$

$\theta = 25.5° \text{ or } 234.5°$

(iii) $7\sin(\theta - 35°) = 5$

$\sin(\theta - 35°) = \frac{5}{7}$

$\theta - 35° = 45.6° \text{ or } 134.4°$

$\theta = 80.6° \text{ or } 169.4°$

(iv) $5\cos(\theta - 62°) = 3$

$\cos(\theta - 62°) = \frac{3}{5}$

$\theta - 62° = -53.1° \text{ or } 53.1°$

$\theta = 8.9° \text{ or } 115.1°$

2. (i) $2\sin\theta + 3\cos\theta = R\sin(\theta + \alpha)$

$= R\sin\theta\cos\alpha + R\cos\theta\sin\alpha$

Comparing coefficients of $\sin\theta$ gives $2 = R\cos\alpha$

Comparing coefficients of $\cos\theta$ gives $3 = R\sin\alpha$

(ii) $R^2\cos^2\alpha = 4$

$R^2\sin^2\alpha = 9$

$R^2 = 13$

$R = \sqrt{13}$

$\frac{R\sin\alpha}{R\cos\alpha} = \frac{3}{2}$

$\tan\alpha = \frac{3}{2}$

$\alpha = 56.3°$ (1 d.p.)

3. (i) $\sin\theta - 4\cos\theta = R\sin(\theta - \alpha)$

$= R\sin\theta\cos\alpha - R\cos\theta\sin\alpha$

Comparing coefficients of $\sin\theta$ gives $1 = R\cos\alpha$

Comparing coefficients of $\cos\theta$ gives $4 = R\sin\alpha$

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(ii) $R^2\cos^2\alpha = 1$

$R^2\sin^2\alpha = 16$

$R^2 = 17$

$R = \sqrt{17}$

$\dfrac{R\sin\alpha}{R\cos\alpha} = \dfrac{4}{1}$

$\tan\alpha = 4$

$\alpha = 76.0°$ (1 d.p.)

4\. (i) $4\sin\theta - 5\cos\theta = R\cos(\theta+\alpha)$

$= R\cos\theta\cos\alpha - R\sin\theta\sin\alpha$

Comparing coefficients of $\cos\theta$ gives $4 = R\cos\alpha$

Comparing coefficients of $\sin\theta$ gives $5 = R\sin\alpha$

(ii) $R^2\cos^2\alpha = 16$

$R^2\sin^2\alpha = 25$

$R^2 = 41$

$R = \sqrt{41}$

$\dfrac{R\sin\alpha}{R\cos\alpha} = \dfrac{5}{4}$

$\tan\alpha = 1.25$

$\alpha = 51.3°$ (1 d.p.)

5\. (i) $3\sin\theta + \cos\theta = R\cos(\theta-\alpha)$

$= R\cos\theta\cos\alpha + R\sin\theta\sin\alpha$

Comparing coefficients of $\cos\theta$ gives $1 = R\cos\alpha$

Comparing coefficients of $\sin\theta$ gives $3 = R\sin\alpha$

(ii) $R^2\cos^2\alpha = 1$

$R^2\sin^2\alpha = 9$

$R^2 = 10$

$R = \sqrt{10}$

$\dfrac{R\sin\alpha}{R\cos\alpha} = \dfrac{3}{1}$

$\tan\alpha = 3$

$\alpha = 71.6°$ (1 d.p.)