

Section 2: Trigonometric equations

Solutions to Exercise level 1

1. (i) $\sin x = 0.3$
Roots are in the first and second quadrants
 $x = 17.5^\circ$ or $180^\circ - 17.5^\circ$
 $x = 17.5^\circ$ or 162.5°
- (ii) $\tan x = 1.5$
Roots are in the first and third quadrants
 $x = 56.3^\circ$ or $180^\circ + 56.3^\circ$
 $x = 56.3^\circ$ or 236.3°
- (iii) $\cos x = -0.7$
Roots are in the second and third quadrant
 $x = 180^\circ - 45.6^\circ$ or $180^\circ + 45.6^\circ$
 $x = 134.4^\circ$ or 225.6°
- (iv) $\sin x = -0.6$
Roots are in the third and fourth quadrant
 $x = 180^\circ + 36.9^\circ$ or $360^\circ - 36.9^\circ$
 $x = 216.9^\circ$ or 323.1°
2. (i) $\sin x = 0.6$
Roots are in the first and second quadrants
 $x = 36.9^\circ$ or $180^\circ - 36.9^\circ$
 $x = 36.9^\circ$ or 143.1°
- (ii) $\cos x = 0.8$
Roots are in the first and fourth quadrants
 $x = 36.9^\circ$ or -36.9°
- (iii) $\tan x = -0.6$
Roots are in the second and fourth quadrants
 $x = 180^\circ - 31.0^\circ$ or -31.0°
 $x = 149.0^\circ$ or -31.0°
- (iv) $\cos x = -0.3$
Roots are in the second and third quadrants
 $x = 180^\circ - 72.5^\circ$ or $-(180^\circ - 72.5^\circ)$
 $x = 107.5^\circ$ or -107.5°

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3. (i) $\sin x = \frac{1}{\sqrt{2}}$
 $\sin 45^\circ = \frac{1}{\sqrt{2}}$, and roots are in the first and second quadrants
so $x = 45^\circ$ or $180^\circ - 45^\circ$
 $x = 45^\circ$ or 135°

(ii) $\sin x = -\frac{1}{2}$
 $\sin 30^\circ = \frac{1}{2}$, and roots are in the third and fourth quadrants
so $x = 180^\circ + 30^\circ$ or $360^\circ - 30^\circ$
 $x = 210^\circ$ or 330°

(iii) $\cos x = \frac{\sqrt{3}}{2}$
 $\cos 30^\circ = \frac{\sqrt{3}}{2}$, and roots are in the first and fourth quadrants
so $x = 30^\circ$ or $360^\circ - 30^\circ$
 $x = 30^\circ$ or 330°

(iv) $\cos x = -\frac{1}{\sqrt{2}}$
 $\cos 45^\circ = \frac{1}{\sqrt{2}}$, and roots are in the second and third quadrants
so $x = 180^\circ - 45^\circ$ or $180^\circ + 45^\circ$
 $x = 135^\circ$ or 225°

4. (i) $\cos x + \frac{3}{2} = 2$
 $\Rightarrow \cos x = \frac{1}{2} = \cos 60^\circ$
 $\Rightarrow x = 60^\circ, 300^\circ$

(ii) $\tan^2 x = 3$
 $\Rightarrow \tan x = \sqrt{3}$ or $\tan x = -\sqrt{3}$
 $\quad = \tan 60^\circ \quad \quad = \tan(-60^\circ)$
 $\Rightarrow x = 60^\circ, 120^\circ, 240^\circ, 300^\circ$

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$$\begin{aligned} \text{(iii)} \quad \sin^2 x - \cos^2 x &= \frac{1}{2} \\ \Rightarrow \sin^2 x - (1 - \sin^2 x) &= \frac{1}{2} \\ \Rightarrow 2\sin^2 x - 1 &= \frac{1}{2} \\ \Rightarrow \sin^2 x &= \frac{3}{4} \\ \Rightarrow \sin x &= \frac{\sqrt{3}}{2} \quad \text{or} \quad \sin x = -\frac{\sqrt{3}}{2} \\ &= \sin 60^\circ \qquad \qquad = \sin(-60^\circ) \\ \Rightarrow x &= 60^\circ, 120^\circ, 240^\circ, 300^\circ \end{aligned}$$

$$\begin{aligned} \text{(iv)} \quad \cos^2 x + 2 &= \frac{5}{4} \\ \Rightarrow \cos^2 x &= -\frac{3}{4} \\ \text{so there are no real roots} \end{aligned}$$