Year 11 Mathematics Advanced

Topic: Trigonometric Identities and Equations (3 of 3)
Review Questions (Worked Solutions): Mixed one-off exam questions
Term 3, 2026

Mixed one-off exam questions

Q1 North Sydney Boys 2024 Trial Q29(i) · **1 mark**

Solve $\sin(x + 15^\circ) = \cos 24^\circ$.

Criteria	Marks
Converts $\cos 24^\circ$ to $\sin 66^\circ$ (complementary angle) and solves for x	1

Solution.

Use the complementary relationship $\cos\theta = \sin(90^\circ - \theta)$:

$$\cos 24^\circ = \sin(90^\circ - 24^\circ) = \sin 66^\circ.$$

The equation becomes $\sin(x + 15^\circ) = \sin 66^\circ$, so equating the angles,

$$x + 15^\circ = 66^\circ \implies x = 51^\circ.$$

Q2 Caringbah 2020 Trial Q17 · **2 marks**

Solve $\left|2\cos x - 1\right| = 1$ for $0 \le x \le \pi$.

Criteria	Marks
Splits into the two cases $2\cos x - 1 = 1$ and $2\cos x - 1 = -1$	1
Both solutions $x = 0,\ \dfrac{\pi}{2}$	1

Solution.

Removing the absolute value gives two cases.

Case 1: $2\cos x - 1 = 1 \implies \cos x = 1$. On $[0, \pi]$ this gives $x = 0$.

Case 2: $2\cos x - 1 = -1 \implies \cos x = 0$. On $[0, \pi]$ this gives $x = \dfrac{\pi}{2}$.

Hence $x = 0,\ \dfrac{\pi}{2}$.

Q3 Fort St 2025 Trial Q17 · **2 marks**

Given $\sin x = \dfrac{\sqrt{5}}{5}$ with $0 < x < \dfrac{\pi}{2}$, find $\sin^4 x - \cos^4 x$.

Criteria	**Marks**
Factors as $(\sin^2 x - \cos^2 x)(\sin^2 x + \cos^2 x) = \sin^2 x - \cos^2 x$	1
Evaluates to $-\dfrac{3}{5}$	1

Solution.

From $\sin x = \dfrac{\sqrt{5}}{5}$,

$$\sin^2 x = \left(\frac{\sqrt{5}}{5}\right)^2 = \frac{5}{25} = \frac{1}{5}, \qquad \cos^2 x = 1 - \sin^2 x = \frac{4}{5}.$$

Factor as a difference of two squares and use $\sin^2 x + \cos^2 x = 1$:

$$\sin^4 x - \cos^4 x = (\sin^2 x - \cos^2 x)(\sin^2 x + \cos^2 x) = \sin^2 x - \cos^2 x.$$

Therefore

$$\sin^4 x - \cos^4 x = \frac{1}{5} - \frac{4}{5} = -\frac{3}{5}.$$

Q4 Hurlstone 2023 Trial Q40 · **2 marks**

A water balloon travels $d = \dfrac{1}{32}v^2 \sin 2\theta$ metres when launched at angle θ and speed v m/s. With $v = 12$ and $d = 3$, find the angle(s) θ to the nearest degree, for $0° \leq \theta \leq 90°$.

Criteria	Marks
Substitutes $v = 12$, $d = 3$ to obtain $\sin 2\theta = \dfrac{2}{3}$	1
Both angles $\theta \approx 21°,\ 69°$	1

Solution.

Substitute $v = 12$ and $d = 3$:

$$3 = \frac{1}{32}(12)^2 \sin 2\theta = \frac{144}{32}\sin 2\theta = \frac{9}{2}\sin 2\theta \implies \sin 2\theta = \frac{2}{3}.$$

Since $0° \leq \theta \leq 90°$, we have $0° \leq 2\theta \leq 180°$, so $\sin 2\theta > 0$ gives two values in the first and second quadrants. The related angle is $\sin^{-1}\left(\frac{2}{3}\right) \approx 41.81°$, so

$$2\theta \approx 41.81° \quad \text{or} \quad 2\theta \approx 180° - 41.81° = 138.19°.$$

Hence

$$\theta \approx 20.9° \quad \text{or} \quad \theta \approx 69.1°,$$

i.e. $\theta \approx 21°$ or $\theta \approx 69°$ to the nearest degree.

Q5 Gosford 2020 Trial Q15 · **3 marks**

Solve $\left|1 - 2\cos^2 x\right| = 1$ for $0 \leq x \leq 2\pi$.

Criteria	Marks
Splits into the two cases $1 - 2\cos^2 x = 1$ and $1 - 2\cos^2 x = -1$	1
Solves $\cos^2 x = 0$ giving $x = \dfrac{\pi}{2},\ \dfrac{3\pi}{2}$	1
Solves $\cos^2 x = 1$ giving $x = 0,\ \pi,\ 2\pi$	1

Solution.

Removing the absolute value gives two cases.

Case 1: $1 - 2\cos^2 x = 1 \implies \cos^2 x = 0 \implies \cos x = 0$. On $[0, 2\pi]$ this gives $x = \dfrac{\pi}{2},\ \dfrac{3\pi}{2}$.

Case 2: $1 - 2\cos^2 x = -1 \implies \cos^2 x = 1 \implies \cos x = \pm 1$. On $[0, 2\pi]$ this gives $x = 0,\ \pi,\ 2\pi$.

Collecting all solutions,

$$x = 0,\ \frac{\pi}{2},\ \pi,\ \frac{3\pi}{2},\ 2\pi.$$