

Trigonometric Functions Review

Answer key Final answers only. Try first, then check.

CORE SKILLS

- K1**
- a) $\frac{7\pi}{6}; 315^\circ$
 - b) $-\frac{1}{2}; \frac{\sqrt{2}}{2}; -\sqrt{3}$
 - c) Principal angle $\frac{\pi}{4}$; e.g. $-\frac{7\pi}{4}$
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- K2**
- a) Period π ; $D = \{x \in \mathbb{R} \mid x \neq \frac{\pi}{2} + n\pi, n \in \mathbb{Z}\}$; asymptotes $x = \frac{\pi}{2} + n\pi, n \in \mathbb{Z}$
 - b) Zeros $\frac{\pi}{2}, \frac{3\pi}{2}$; maxima $(0, 1)$ and $(2\pi, 1)$; minimum $(\pi, -1)$
 - c) $d = \frac{\pi}{2}$
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- K3**
- a) $f(x) = -3 \sin\left(2\left(x - \frac{\pi}{6}\right)\right) + 1$; amplitude 3, period π , phase shift $\frac{\pi}{6}$ right, midline $y = 1$
 - b) $R = [-2, 4]; \left(\frac{11\pi}{12}, 4\right)$
 - c) $y = 2 \cos\left(\frac{\pi}{3}(x - 1)\right) - 1$
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- K4**
- a) $-\sqrt{2}; -2; \sqrt{3}$
 - b) $D = \{x \in \mathbb{R} \mid x \neq \frac{\pi}{2} + n\pi, n \in \mathbb{Z}\}$; $R = (-\infty, -1] \cup [1, \infty)$; period 2π
 - c) Period π ; asymptotes $x = \frac{n\pi}{2}, n \in \mathbb{Z}$
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- K5**
- a) $x = \frac{4\pi}{3}, \frac{5\pi}{3}$
 - b) $x = 0, \frac{2\pi}{3}, \frac{4\pi}{3}, 2\pi$
 - c) $x = \frac{7\pi}{6} + 2n\pi$ or $x = \frac{11\pi}{6} + 2n\pi, n \in \mathbb{Z}$

REAL WORLD

- A1**
- a) $D(t) = 6 \sin\left(\frac{\pi}{6}t\right) + 8$
 - b) From 7:00 a.m. to 11:00 a.m. ($D(t) < 5$ for $7 < t < 11$)
 - c) Never: $D(t) = 15$ needs $\sin\left(\frac{\pi}{6}t\right) = \frac{7}{6} > 1$. The model's maximum depth is 14 m, so the wharf does not flood.
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- A2**
- a) 5.86 m/min; 14.14 m/min
 - b) About 15.71 m/min
 - c) 0 m/min. No: the wheel keeps turning at the same speed. At the top (42 m) the rider moves horizontally, so only their height stops changing for an instant.
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- A3**
- a) 1000 m; $500\sqrt{2} \approx 707.1$ m
 - b) $t = \frac{10}{3} \approx 3.33$ s
 - c) L is undefined ($\sec \frac{\pi}{2}$ is a vertical asymptote): the beam is parallel to the shore and never reaches it. For $5 < t < 15$ the beam points away from shore ($L < 0$ has no meaning), so there is no lit spot.

THINK IT THROUGH

- T1**
- a) $\cos \frac{\pi}{2} = 0$, so both sides equal 0.
 - b) Dividing by $\cos x$ assumes $\cos x \neq 0$. Factor: $\cos x(2 \sin x - 1) = 0$, so $x = \frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}, \frac{3\pi}{2}$.
 - c) 8: both factors repeat every 2π , so each of the 4 solutions has one copy in $(2\pi, 4\pi]$, and 0, 2π , 4π are not solutions.
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- T2**
- a) e.g. $y = 4 \sin\left(2\left(x - \frac{\pi}{12}\right)\right) + 3$
 - b) e.g. $y = 4 \cos\left(2\left(x - \frac{\pi}{3}\right)\right) + 3$
 - c) e.g. $y = \cot(2x)$

BOSS LEVEL

- Boss**
- a) $x = \frac{\pi}{18}, \frac{5\pi}{18}, \frac{13\pi}{18}, \frac{17\pi}{18}, \frac{25\pi}{18}, \frac{29\pi}{18}$
 - b) 5π
 - c) $2k$ solutions; sum $(2k - 1)\pi$
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