

Practise, Apply, Solve 5.4, page 442

1. (a) $\pi, 180^\circ$ (b) $\frac{\pi}{2}, 90^\circ$ (c) $-\pi, -180^\circ$
 (d) $\frac{-3\pi}{2}, -270^\circ$ (e) $-2\pi, -360^\circ$ (f) $\frac{3\pi}{2}, 270^\circ$
 (g) $\frac{-4\pi}{3}, -240^\circ$ (h) $\frac{3\pi}{4}, 135^\circ$
2. For each diagram, extend the terminal arm so that it intersects with the circle. Then, highlight the circle from 0 to this intersection point.
 (a) Highlight unit circle from 0 to π (180°).
 (b) terminal arm at 60° counterclockwise
 (c) terminal arm at 120° counterclockwise
 (d) terminal arm at 240° counterclockwise
 (e) terminal arm at 300° counterclockwise
 (f) terminal arm at 180° clockwise
 (g) terminal arm at 90° clockwise
 (h) terminal arm at 45° clockwise
3. (a) 120° (b) -300° (c) 45°
 (d) -135° (e) 210° (f) -270°
 (g) 330° (h) -810°
4. (a) rotate counterclockwise to 9 o'clock
 (b) rotate counterclockwise to 11 o'clock
 (c) rotate counterclockwise to 12 o'clock
 (d) rotate counterclockwise to 7 o'clock
 (e) rotate clockwise to between 1 and 2 o'clock
5. (a) $\frac{\pi}{2}$ (b) $\frac{3\pi}{2}$ (c) $-\pi$ (d) $\frac{\pi}{4}$
 (e) $\frac{-3\pi}{4}$ (f) $\frac{\pi}{3}$ (g) $\frac{4\pi}{3}$ (h) $\frac{-2\pi}{3}$
6. (a) terminal arm rotated counterclockwise in 1st quadrant, $\frac{\pi}{4}$
 (b) terminal arm rotated counterclockwise in 2nd quadrant, $\frac{\pi}{3}$
 (c) terminal arm rotated counterclockwise in 4th quadrant, $\frac{\pi}{6}$
 (d) terminal arm rotated clockwise to positive y-axis, no related acute angle
 (e) terminal arm rotated counterclockwise in 3rd quadrant, $\frac{\pi}{4}$
 (f) terminal arm rotated counterclockwise in 4th quadrant, $\frac{\pi}{3}$
7. (a) Graph points $(\theta, f(\theta)) = (-2\pi, 0), \left(\frac{-11\pi}{6}, 0.5\right), \left(\frac{-5\pi}{3}, 0.87\right), \left(\frac{-3\pi}{2}, 1\right), \left(\frac{-4\pi}{3}, 0.87\right), \left(\frac{-7\pi}{6}, 0.5\right), (-\pi, 0), \left(\frac{-5\pi}{6}, -0.5\right), \left(\frac{-2\pi}{3}, -0.87\right), \left(\frac{-\pi}{2}, -1\right), \left(\frac{-\pi}{3}, -0.87\right), \left(\frac{-\pi}{6}, -0.5\right), (0, 0), \left(\frac{\pi}{6}, 0.5\right), \left(\frac{\pi}{3}, 0.87\right), \left(\frac{\pi}{2}, 1\right), \left(\frac{2\pi}{3}, 0.87\right), \left(\frac{5\pi}{6}, 0.5\right), (\pi, 0), \left(\frac{7\pi}{6}, -0.5\right), \left(\frac{4\pi}{3}, -0.87\right), \left(\frac{3\pi}{2}, -1\right), \left(\frac{5\pi}{3}, -0.87\right), \left(\frac{11\pi}{6}, -0.5\right), (2\pi, 0)$
 (b) maximum: $\left(\frac{-3\pi}{2}, 1\right), \left(\frac{\pi}{2}, 1\right)$; minimum: $\left(\frac{-\pi}{2}, -1\right), \left(\frac{3\pi}{2}, -1\right)$
 (c) $\theta = -2\pi, -\pi, 0, \pi, 2\pi$
8. (a) Graph points $(\theta, f(\theta)) = (-2\pi, 0), \left(\frac{-11\pi}{6}, 0.6\right), \left(\frac{-5\pi}{3}, 1.7\right), \left(\frac{-3\pi}{2}, -\right), \left(\frac{-4\pi}{3}, -1.7\right), \left(\frac{-7\pi}{6}, -0.6\right), (-\pi, 0), \left(\frac{-5\pi}{6}, 0.6\right), \left(\frac{-2\pi}{3}, 1.7\right), \left(\frac{-\pi}{2}, -\right), \left(\frac{-\pi}{3}, -1.7\right), \left(\frac{-\pi}{6}, -0.6\right), (0, 0), \left(\frac{\pi}{6}, 0.6\right), \left(\frac{\pi}{3}, 1.7\right), \left(\frac{\pi}{2}, -\right), \left(\frac{2\pi}{3}, -1.7\right), \left(\frac{5\pi}{6}, -0.6\right), (\pi, 0), \left(\frac{7\pi}{6}, 0.6\right), \left(\frac{4\pi}{3}, 1.7\right), \left(\frac{3\pi}{2}, -\right), \left(\frac{5\pi}{3}, -1.7\right), \left(\frac{11\pi}{6}, -0.6\right), (2\pi, 0)$
 (b) maximum: $(-2\pi, 1), (0, 1), (2\pi, 1)$; minimum: $(-\pi, -1), (\pi, -1)$
 (c) $\theta = \frac{-3\pi}{2}, \frac{-\pi}{2}, \frac{\pi}{2}, \frac{3\pi}{2}$
9. (a) Graph points $(\theta, f(\theta)) = (-2\pi, 0), \left(\frac{-11\pi}{6}, 0.6\right), \left(\frac{-5\pi}{3}, 1.7\right), \left(\frac{-3\pi}{2}, -\right), \left(\frac{-4\pi}{3}, -1.7\right), \left(\frac{-7\pi}{6}, -0.6\right), (-\pi, 0), \left(\frac{-5\pi}{6}, 0.6\right), \left(\frac{-2\pi}{3}, 1.7\right), \left(\frac{-\pi}{2}, -\right), \left(\frac{-\pi}{3}, -1.7\right), \left(\frac{-\pi}{6}, -0.6\right), (0, 0), \left(\frac{\pi}{6}, 0.6\right), \left(\frac{\pi}{3}, 1.7\right), \left(\frac{\pi}{2}, -\right), \left(\frac{2\pi}{3}, -1.7\right), \left(\frac{5\pi}{6}, -0.6\right), (\pi, 0), \left(\frac{7\pi}{6}, 0.6\right), \left(\frac{4\pi}{3}, 1.7\right), \left(\frac{3\pi}{2}, -\right), \left(\frac{5\pi}{3}, -1.7\right), \left(\frac{11\pi}{6}, -0.6\right), (2\pi, 0)$
 (b) $\frac{\pi}{2} + \pi n, -2 \leq n \leq 1, n \in \mathbf{I}$
 (c) $-2\pi, -\pi, 0, \pi, 2\pi$
10. (a) Refer to Key Ideas 5.3 for graph of standard sine curve; extend domain from -2π to 2π .
 (b) Extend domain of sine curve from -180° to 540° .
11. (a) Refer to Key Ideas 5.3 for graph of standard cosine curve.
 (b) Extend domain of cosine curve from $-\pi$ to 3π .
12. (a) Refer to Key Ideas 5.3 for graph of standard tangent curve; extend domain from -180° to 180° .
 (b) Extend domain of tangent curve from $-\pi$ to $\frac{3\pi}{2}$.
13. (a) $-150^\circ, -30^\circ, 210^\circ, 330^\circ$
 (b) $-34^\circ, -326^\circ, 34^\circ, 326^\circ$
 (c) $-94^\circ, -274^\circ, 86^\circ, 266^\circ$
14. (a) 1.1, 2.1, 8.4, 7.3
 (b) $-2.1, 2.1, 4.2, 8.4$
 (c) $-1.3, 1.8, 4.9, 8.1$
15. (a)
- (b) $(\theta, f(\theta)) = \{(0, 0), \left(\frac{\pi}{6}, 0.5\right), \left(\frac{\pi}{3}, 0.87\right), \left(\frac{\pi}{2}, 1\right), \left(\frac{2\pi}{3}, 0.87\right), \left(\frac{5\pi}{6}, 0.5\right), (\pi, 0), \left(\frac{7\pi}{6}, -0.5\right), \left(\frac{4\pi}{3}, -0.87\right), \left(\frac{3\pi}{2}, -1\right), \left(\frac{5\pi}{3}, -0.87\right), \left(\frac{11\pi}{6}, -0.5\right), (2\pi, 0)\}$
 (c) Sketch the sine curve from 0 to 2π .
 (d) The graph is periodic and sinusoidal. $y = \sin \theta$
16. (a) zeros: 2.5, 7.5, 12.5, 17.5; min. (5, -1) and (15, -1); max. (0, 1), (10, 1), and (20, 1)
 (b) 10 s (c) -1 m (d) 4 s
17. (a) $(T, D) = (0, 0.5), (1, -0.2), (2, -0.3), (3, 0.5), (4, -0.1), (5, -0.4), (6, 0.4), (7, 0.1), (8, -0.5), (9, 0.3)$
 (b) Plot the points in (a).
 (c) The function repeats itself about every 3.1 s.
 (d) The amplitude and the displacement from rest are the same.
18. The interval over which periodic phenomena repeat themselves can be the number of degrees of rotation of a point around a circle or it can be measured in terms of the actual circumference of the circle, which is a real number.
19. (a) clockwise (b) 6 s
 (c) (time(s), small) = (0, 0), (0.5, 1), (1, 0), (1.5, -1), (2, 0), (2.5, 1), (3, 0), (3.5, -1), (4, 0), (4.5, 1), (5, 0), (5.5, -1), (6, 0), (6.5, 1), (7, 0), (7.5, -1), (8, 0), (8.5, 1), (9, 0), (9.5, -1), (10, 0), (10.5, 1), (11, 0), (11.5, 1), (12, 0)
 (time(s), large) = (0, 0), (1.5, 3), (3, 0), (4.5, -3), (6, 0), (7.5, 3), (9, 0), (10.5, -3), (12, 0)
 (d) 2.8 m (e) 0.8 m (f) 0 m