F.IF.B.4 Graphing Trigonometric Functions

1. The maximum value of the function \( y = 3 \sin 2x \) is:
   1) \( \pi \)
   2) 2
   3) 3
   4) \( 2\pi \)

2. What is the minimum value of \( f(\theta) \) in the equation \( f(\theta) = 3 \sin 4\theta \)?
   1) \(-1\)
   2) \(-2\)
   3) \(-3\)
   4) \(-4\)

3. What is the maximum value for the function \( y = \frac{1}{3} \sin 5x \) is:
   1) \( \frac{1}{3} \)
   2) \( \frac{1}{3} \)
   3) \( \frac{1}{5} \)
   4) \(-5\)

4. If \( f(x) = 2 \sin 3x + C \), then the maximum value of \( f(x) \) is:
   1) \( C \)
   2) \( C + 2 \)
   3) \( C + 3 \)
   4) \( C + 6 \)

5. What is the maximum value of \( y \) for the equation \( y = 1 + 3 \sin x \)?
   1) 1
   2) 2
   3) 3
   4) 4

6. The path traveled by a roller coaster is modeled by the equation \( y = 27 \sin 13x + 30 \). What is the maximum altitude of the roller coaster?
   1) 13
   2) 27
   3) 30
   4) 57

7. The Ferris wheel at the landmark Navy Pier in Chicago takes 7 minutes to make one full rotation. The height, \( H \), in feet, above the ground of one of the six-person cars can be modeled by
   \[ H(t) = 70 \sin \left( \frac{2\pi}{7} (t - 1.75) \right) + 80, \] where \( t \) is time, in minutes. Using \( H(t) \) for one full rotation, this car's minimum height, in feet, is
   1) 150
   2) 70
   3) 10
   4) 0

8. Which function's graph has a period of 8 and reaches a maximum height of 1 if at least one full period is graphed?
   1) \( y = -4 \cos \left( \frac{\pi}{4} x \right) - 3 \)
   2) \( y = -4 \cos \left( \frac{\pi}{4} x \right) + 5 \)
   3) \( y = -4 \cos(8x) - 3 \)
   4) \( y = -4 \cos(8x) + 5 \)
9 Based on climate data that have been collected in Bar Harbor, Maine, the average monthly temperature, in degrees F, can be modeled by the equation \( B(x) = 23.914 \sin(0.508x - 2.116) + 55.300 \). The same governmental agency collected average monthly temperature data for Phoenix, Arizona, and found the temperatures could be modeled by the equation \( P(x) = 20.238 \sin(0.525x - 2.148) + 86.729 \). Which statement cannot be concluded based on the average monthly temperature models \( x \) months after starting data collection?

1) The average monthly temperature variation is more in Bar Harbor than in Phoenix.
2) The midline average monthly temperature for Bar Harbor is lower than the midline temperature for Phoenix.
3) The maximum average monthly temperature for Bar Harbor is 79° F, to the nearest degree.
4) The minimum average monthly temperature for Phoenix is 20° F, to the nearest degree.

10 Relative to the graph of \( y = 3 \sin x \), what is the shift of the graph of \( y = 3 \sin \left( x + \frac{\pi}{3} \right) \)?

1) \( \frac{\pi}{3} \) right
2) \( \frac{\pi}{3} \) left
3) \( \frac{\pi}{3} \) up
4) \( \frac{\pi}{3} \) down

11 Given the parent function \( p(x) = \cos x \), which phrase best describes the transformation used to obtain the graph of \( g(x) = \cos(x + a) - b \), if \( a \) and \( b \) are positive constants?

1) right \( a \) units, up \( b \) units
2) right \( a \) units, down \( b \) units
3) left \( a \) units, up \( b \) units
4) left \( a \) units, down \( b \) units

12 Which transformation could be used to make the graph of the equation \( y = \sin x \) coincide with the graph of the equation \( y = \cos x \)?

1) translation
2) rotation
3) dilation
4) point reflection

13 The graph of the equation \( y = |\sin x| \) will contain no points in Quadrants

1) I and II
2) II and III
3) III and IV
4) I and IV

14 Which type of symmetry does the equation \( y = \cos x \) have?

1) line symmetry with respect to the \( x \)-axis
2) line symmetry with respect to \( y = x \)
3) point symmetry with respect to the origin
4) point symmetry with respect to \( \left( \frac{\pi}{2}, 0 \right) \)

15 The graph of which equation is symmetric with respect to the origin?

1) \( y = -3 \)
2) \( x = 2 \)
3) \( y = \sin x \)
4) \( y = \cos x \)

16 As angle \( x \) increases from 180° to 270°, the value of \( \cos x \) will

1) increase from 0 to 1
2) increase from \(-1\) to 0
3) decrease from 0 to \(-1\)
4) decrease from 1 to 0
17. As $\theta$ increases from $-\frac{\pi}{2}$ to 0 radians, the value of $\cos \theta$ will
   1) decrease from 1 to 0
   2) decrease from 0 to $-1$
   3) increase from $-1$ to 0
   4) increase from 0 to 1

18. As $\theta$ increases from $\frac{\pi}{2}$ to $\frac{3\pi}{2}$, the value of $\cos \theta$
   1) decreases, only
   2) increases, only
   3) decreases and then increases
   4) increases and then decreases

19. As angle $\theta$ increases from $\pi$ radians to $2\pi$ radians, the cosine of $\theta$
   1) increases throughout the interval
   2) decreases throughout the interval
   3) increases, then decreases
   4) decreases, then increases

20. As angle $x$ increases from $\frac{\pi}{2}$ to $\pi$, the value of $\sin x$
    will
   1) increase from $-1$ to 0
   2) increase from 0 to 1
   3) decrease from 0 to $-1$
   4) decrease from 1 to 0

21. As $x$ increases from $\pi$ to $2\pi$, the value of $\sin x$
   1) increases, only
   2) decreases, only
   3) increases, then decreases
   4) decreases, then increases

22. As $\theta$ increases from $\pi$ to $\frac{3\pi}{2}$, which statement is true?
   1) $\sin \theta$ increases from $-1$ to 0.
   2) $\sin \theta$ decreases from 1 to 0.
   3) $\cos \theta$ decreases from 0 to $-1$.
   4) $\cos \theta$ increases from $-1$ to 0.

23. A sine function increasing through the origin can be used to model light waves. Violet light has a wavelength of 400 nanometers. Over which interval is the height of the wave decreasing, only?
   1) (0, 200)
   2) (100, 300)
   3) (200, 400)
   4) (300, 400)

24. As $x$ increases from 0 to $\frac{\pi}{2}$, the graph of the equation $y = 2\tan x$ will
   1) increase from 0 to 2
   2) decrease from 0 to $-2$
   3) increase without limit
   4) decrease without limit

25. A person’s lung capacity can be modeled by the function $C(t) = 250 \sin \left( \frac{2\pi}{5} t \right) + 2450$, where $C(t)$ represents the volume in mL present in the lungs after $t$ seconds. State the maximum value of this function over one full cycle, and explain what this value represents.

26. The height, $h(t)$ in cm, of a piston, is given by the equation $h(t) = 12 \cos \left( \frac{\pi}{3} t \right) + 8$, where $t$ represents the number of seconds since the measurements began. Determine the average rate of change, in cm/sec, of the piston’s height on the interval $1 \leq t \leq 2$. At what value(s) of $t$, to the nearest tenth of a second, does $h(t) = 0$ in the interval $1 \leq t \leq 5$? Justify your answer.
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Answer Section

1 ANS: 3  REF: 068125siii
2 ANS: 3  REF: 018935siii
3 ANS: 2  REF: 089420siii
4 ANS: 2
   The maximum of a sine wave is 1.  $2(1) + C = C + 2$.
   REF: fall9919b
5 ANS: 4  REF: 019033siii
6 ANS: 4
   The maximum of a sine wave is 1.  $27(1) + 30 = 57$.
   REF: 080419b
7 ANS: 3

$H(t)$ is at a minimum at $70(-1) + 80 = 10$

   REF: 061613aii
8 ANS: 1
   $-4(-1) - 3 = 1$  $8 = \frac{2\pi}{b}$

   $b = \frac{\pi}{4}$

   REF: 081820aii
9 ANS: 4

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Bar Harbor</th>
<th>Phoenix</th>
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</thead>
<tbody>
<tr>
<td>Midline</td>
<td>31.386</td>
<td>66.491</td>
</tr>
<tr>
<td>Maximum</td>
<td>55.3</td>
<td>86.729</td>
</tr>
<tr>
<td>Range</td>
<td>47.828</td>
<td>40.476</td>
</tr>
</tbody>
</table>

   REF: 061715aii
10 ANS: 2  REF: 011701aii
11 ANS: 4  REF: 061706aii
12 ANS: 1  REF: 010711b
13 ANS: 3  REF: 080903b
14 ANS: 4  REF: 010216b
15 ANS: 3  REF: 018929siii
16 ANS: 2  REF: 068121siii
25 ANS:  
250(1) + 2450 = 2700  The maximum lung capacity of a person is 2700 mL.

REF: 081928aii

26 ANS:  
\[
\frac{h(2) - h(1)}{2 - 1} = -12, \quad h(t) = 0 \text{ at } t \approx 2.2, 3.8, \text{ using a graphing calculator to find where } h(t) = 0.
\]

REF: 061836aii