CHAPTER 6.3

Trigonometric Graphs

Multiple-Choice Old Exam Questions

53 questions • 5 topics • options A–E • two questions per page

Topic 1 | Amplitude, Period, Phase Shift and Range

Reading the amplitude, period, phase shift and range of sine and cosine functions, and finding constants from them • Questions 1–12

Q **1**

If $y = -2 - 3\sin\left(2x + \frac{2\pi}{3}\right)$, M is the maximum, P the period and S the phase shift, then $M + \frac{P+S}{\pi}$ is equal to

A) $\frac{7}{3}$

B) $-\frac{1}{3}$

C) $\frac{4}{3}$

D) $\frac{17}{3}$

E) $\frac{5}{3}$

Q **2**

The range of the function $f(x) = 1 + \sqrt{4 - 4\sin^2 x}$ is

A) $[1, 5]$

B) $[0, 2]$

C) $[-1, 3]$

D) $[1, 3]$

E) $[-3, 5]$

Q
3

If the range of the function $y = K - 5\sin\left(\frac{\pi}{2}x - \frac{\pi}{2}\right)$ is $[-7, 3]$, then $K =$

A) -2

B) $\pi + 2$

C) 0

D) 4

E) $2 - \pi$

Q
4

The range of the function $y = 2 - |3\cos(3x - \pi)|$ is

A) $[-1, 2]$

B) $[-3, 0]$

C) $(-\infty, -3] \cup [0, \infty)$

D) $[1, 4]$

E) $(-\infty, 1] \cup [4, \infty)$

Q
5

The range of the function $f(x) = 3 - |\cos(x - \pi)|$ is

A) $[2, 3]$

B) $[2, 4]$

C) $[-3, 3]$

D) $(2, 4)$

E) $(2, 3)$

Q
6

If A is the amplitude, P is the period and F is the phase shift of the graph of the function $f(x) = -3\cos\left(\frac{\pi x}{5} - 2\pi\right)$, then $\frac{-2A+P-F}{2} =$

A) $-3 - 10\pi$

B) -3

C) 3

D) $3 + 10\pi$

E) $-3 + 10\pi$

Q
7

The range R and the period P of the function $y = -\left|3\sin\frac{x}{2}\right|$ are given by

A) $R = [-3, 0],\ P = 2\pi$

B) $R = [-3, 3],\ P = 2\pi$

C) $R = [-3, 0],\ P = 4\pi$

D) $R = [-3, 0],\ P = \pi$

E) $R = [-3, 0],\ P = \frac{\pi}{2}$

Q
8

Let $f(x) = -\frac{1}{3}\cos(2\pi\ x)$, and let A be its amplitude, P be its period and $(a,\ b)$ be the highest point of the function in the interval $[0,\ 1]$. Then $A + P + a - b =$

A) $\frac{3}{2}$

B) $\frac{5}{2}$

C) $\frac{3\pi}{2}$

D) $1 + \frac{3\pi}{2}$

E) $\frac{5\pi-1}{2}$

Q
9

The range of the function $f(x) = -\left|3\sin\frac{2x}{3}\right|$ is

A) $[-3, 0]$

B) $[0, 3]$

C) $[-3, 3]$

D) $[-1, 0]$

E) $[-1, 1]$

Q
10

The function $y = -2 + 5\cos(2x + 3\pi)$ has

A) range $= [-7, 3]$, phase shift $= \frac{3\pi}{2}$ units to the left

B) range $= [-5, 5]$, phase shift $= 3\pi$ units to the left

C) range $= [-7, 3]$, phase shift $= \frac{3\pi}{2}$ units to the right

D) range $= [-2, 2]$, phase shift $= 3\pi$ units to the right

E) range $= [-7, 7]$, phase shift $= \frac{3\pi}{2}$ units to the left

Q
11

The range of the function $f(x) = 2 - \left|\cos\left(-\frac{\pi x}{4}\right)\right|$ is equal to:

A) $[1, 2]$

B) $[0, 1]$

C) $[2, 3]$

D) $[-1, 0]$

E) $[-2, 0]$

Q
12

If $f(x) = a \sin b\,x$, $b > 0$ has a period of $\frac{2\pi}{3}$ and $f\left(\frac{\pi}{2}\right) = 2$, then a is:

A) -2

B) 2

C) 2π

D) $-\pi$

E) π

Topic 2 | Intersections, Intercepts and Extreme Values

Counting intersections with a line and x-intercepts, and locating maximum and minimum values • Questions 13–22

Q **13**

For $-\frac{\pi}{2} \leq x \leq \frac{9\pi}{2}$, the graph of the function $f(x) = 2\cos\left(\frac{x}{2} - \frac{\pi}{4}\right)$ intersects the line $y = 1$ at

A) three points

B) two points

C) four points

D) one point

E) no point

Q **14**

The number of x-intercepts of the graph of $y = -2\cos \pi\ x, -\frac{3}{2} \leq x < \frac{5}{2}$, is

A) 5

B) 1

C) 3

D) 4

E) 2

Q
15

The graph of the function $f(x) = 3\cos(2\pi\, x)$ over $[-1,\, 1]$ intersects the line $y = -2$ at

A) 5 points

B) 7 points

C) 8 points

D) 3 points

E) 4 points

Q
16

The graph of the function $f(x) = -2\sin(3x)$ over $[0,\, 2\pi]$ intersects the line $y = \frac{3}{2}$ at

A) 3 points.

B) 7 points.

C) 6 points.

D) 2 points.

E) 5 points

Q
17

The graph of $y = -\frac{1}{2}\sin \pi\ x$

A) has a maximum of $\frac{1}{2}$ in the interval $[3,\ 4]$

B) is decreasing on the interval $[1,\ 2]$

C) is increasing on the interval $[0,\ 1]$

D) has a minimum of $-\frac{1}{2}$ in the interval $[-1,\ 0]$

E) has a minimum of $-\frac{1}{2}$ in the interval $[1,\ 2]$

Q
18

The number of points of intersection of $y = 1$ and $y = -2\sin\frac{\pi\ x}{3}$ in the interval $[-3,\ 9]$ is

A) 2

B) 4

C) 5

D) 3

E) 6

Q
19

The function $y = \cos\left(\frac{x}{3} - \frac{\pi}{3}\right)$, for $-\frac{13\pi}{2} \leq x \leq \frac{17\pi}{2}$, has

A) three maximum values

B) two maximum values

C) four maximum values

D) five maximum values

E) six maximum values

Q
20

The graph of $y = -|\sin \pi\ x|$ over the interval $\left[\frac{1}{2}, \frac{3}{2}\right]$ intersects the line $y = -\frac{1}{2}$ at:

A) 2 points

B) 1 point

C) 3 points

D) 4 points

E) no point

Q
21

The graph of the function $y = 2\sin\left(\frac{1}{4}x\right)$, for $-8\pi \leq x \leq 8\pi$, has

A) two maximum values and five x-intercepts

B) three maximum values and four x-intercepts

C) four maximum values and three x-intercepts

D) five maximum values and two x-intercepts

E) three maximum values and three x-intercepts

Q
22

The graph of the function $y = 3\cos\left(\frac{1}{2}x - \frac{\pi}{4}\right)$, on the interval $\left[-\frac{7\pi}{2}, \frac{9\pi}{2}\right]$, intersects the line $y = 2$ at

A) four points

B) six points

C) three points

D) five points

E) no points

Topic 3 | Increasing, Decreasing and Sign of a Graph

Finding where a sine or cosine graph is increasing, decreasing, above or below the x-axis • Questions 23–32

Q **23**

The graph of $y = -\sin(\pi x + \pi)$, $-1 \leq x \leq 1$, is increasing on the interval:

A) $\left(-\frac{1}{2}, \frac{1}{2}\right)$

B) $\left(-1, \frac{1}{2}\right)$

C) $\left(-\frac{1}{2}, 1\right)$

D) $(0, 1)$

E) $\left(\frac{1}{2}, 1\right)$

Q **24**

The graph of the function $f(x) = -3\sin\left(\frac{1}{3}x\right)$, with $0 \leq x \leq 6\pi$, lies completely below the x-axis on the interval

A) $(0, 3\pi)$

B) $(0, 6\pi)$

C) $(3\pi, 6\pi)$

D) $(4\pi, 6\pi)$

E) $(\pi, 6\pi)$

Q
25

The graph of the function $y = 3\sin|x|$, $-\pi \leq x \leq \frac{\pi}{2}$, is decreasing on the interval

A) $(-\pi, 0)$

B) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

C) $\left(-\frac{\pi}{2}, 0\right)$

D) $\left(-\pi, -\frac{\pi}{2}\right)$

E) $\left(0, \frac{\pi}{2}\right)$

Q
26

The graph of the function $f(x) = -3\sin\left(\frac{\pi}{2} - 2x\right)$, $\frac{\pi}{4} \leq x \leq \frac{5\pi}{4}$, is below the x-axis on

A) $\left(\frac{3\pi}{4}, \frac{5\pi}{4}\right)$

B) $\left(\frac{\pi}{2}, \pi\right)$

C) $\left(\frac{\pi}{2}, \frac{3\pi}{4}\right)$

D) $\left(\frac{\pi}{4}, \pi\right)$

E) $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

Q
27

The graph of $y = 3\sin|\pi\, x|$, with $-1 \leq\ x \leq 1$, is increasing on the interval

A) $\left(-1, -\frac{1}{2}\right) \cup \left(0, \frac{1}{2}\right)$

B) $\left(-\frac{1}{2}, 0\right) \cup \left(\frac{1}{2}, 1\right)$

C) $\left(-1, \frac{1}{2}\right)$

D) $\left(-\frac{1}{2}, \frac{1}{2}\right)$

E) $\left(-\frac{1}{2}, 1\right)$

Q
28

The graph of the function $f(x) = -2\cos\left(\frac{\pi}{4}x - \frac{\pi}{2}\right)$, $0 \leq\ x \leq 10$, is increasing on the interval

A) $[2, 6]$

B) $[0, 4]$

C) $[0, 4] \cup [8, 10]$

D) $[8, 10]$

E) $[3, 4] \cup [9, 10]$

Q
29

The graph of the function $y = \frac{1}{2}\cos\left(\frac{\pi}{2}x\right)$ increases over the interval

A) $(2, 4)$

B) $(0, 2)$

C) $(3, 5)$

D) $(1, 3)$

E) $(2, 5)$

Q
30

Over the interval $\left[-\frac{\pi}{4}, \frac{15\pi}{4}\right]$, the function $y = -\sin\left(\frac{x}{2} + \frac{\pi}{8}\right)$ is decreasing on the interval(s)

A) $\left[-\frac{\pi}{4}, \frac{3\pi}{4}\right]$ and $\left[\frac{11\pi}{4}, \frac{15\pi}{4}\right]$

B) $\left[\frac{3\pi}{4}, \frac{11\pi}{4}\right]$

C) $\left[-\frac{\pi}{4}, \frac{5\pi}{4}\right]$ and $\left[\frac{11\pi}{4}, \frac{15\pi}{4}\right]$

D) $\left[0, \frac{3\pi}{4}\right]$ and $\left[\frac{5\pi}{4}, \frac{11\pi}{4}\right]$

E) $\left[-\frac{\pi}{4}, \frac{3\pi}{4}\right]$ and $\left[\frac{7\pi}{4}, \frac{11\pi}{4}\right]$

Q
31

For $-8 \leq x \leq 8$, the graph of the function $y = -\frac{3}{2}\sin\left(\frac{\pi}{4}x\right)$ lies below the x-axis in the interval(s) (Hint: sketch the graph)

A) $(-8, -4)$ and $(0, 4)$

B) $(-4, 0)$ and $(4, 8)$

C) $(-6, -2)$ and $(2, 6)$

D) $(-4, 0)$ and $(0, 4)$

E) $(-4, 4)$

Q
32

The graph of $y = -4\sin(2x - \pi)$ is below the x-axis on the interval:

A) $\left(\frac{\pi}{2}, \pi\right)$

B) $(0, \pi)$

C) $\left(-\pi, -\frac{\pi}{2}\right)$

D) $\left(0, \frac{\pi}{2}\right)$

E) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

Topic 4 | True and False Statements

Deciding which statement about a sine or cosine graph, or about parity and periods, is true or false • Questions 33–40

Q **33**

The graph of $y = -\frac{2}{3}\sin\left(\frac{\pi}{4}x\right)$, with $-8 \leq x \leq 0$,

A) is above the x-axis on the interval $(-4, 0)$

B) intersects the x-axis at two points

C) has maximum value of $\frac{2}{3}$ in the interval $[-8, -4]$

D) is increasing on the intervals $(-8, -6)$ and $(-2, 0)$

E) is decreasing on the interval $(-6, -2)$

Q **34**

Which one of the following statements is FALSE?

A) $f(x) = x + \cos x \sin x$ is an odd function.

B) If $\frac{\pi}{2} < x < \pi$, then $\sin x - \cos x > 0$.

C) $f(x) = \cos x \sin^2 x$ is an odd function.

D) $f(x) = 3 + \cos x$ is an even function.

E) The period of the function $f(x) = -\sin(2\pi x)$ is 1.

Q
35

Which one of the following statements is FALSE about the graph of the function $f(x) = -\frac{1}{2}\sin\left(\frac{\pi x}{2}\right), -2 \leq x \leq 2$? The graph

A) is increasing on the interval $(-1, 1)$.

B) has three x-intercepts.

C) lies above the x-axis on the interval $(-2, 0)$.

D) lies below the x-axis on the interval $(0, 2)$.

E) passes through the origin.

Q
36

The graph of the function $f(x) = 2\sin(4x + \pi)$, where $-\frac{\pi}{4} \leq x \leq \frac{\pi}{4}$,

A) has three x-intercepts

B) has no y-intercept

C) is increasing on the interval $\left(-\frac{\pi}{8}, \frac{\pi}{8}\right)$

D) is below the x-axis in the interval $\left(-\frac{\pi}{4}, 0\right)$

E) is above the x-axis in the interval $\left(0, \frac{\pi}{4}\right)$

Q
37

Which one of the following statements is TRUE about the function $f(x) = -1 + \frac{1}{2}\sin(2x - 3\pi)$?

A) The range of the function is $\left[-\frac{3}{2}, -\frac{1}{2}\right]$

B) The vertical translation of the graph of the function is $\frac{1}{2}$ unit up

C) The period of the function is 2π

D) The phase shift of the function is 3π units to the right

E) The amplitude of the function is $\frac{3}{2}$

Q
38

The graph of $y = \frac{5}{2} - \cos\left(3\left(x - \frac{\pi}{6}\right)\right)$ has:

A) range $\left[\frac{3}{2}, \frac{7}{2}\right]$

B) period π

C) phase shift $\frac{\pi}{2}$ to the left

D) amplitude 3

E) y-intercept $-\frac{5}{2}$

Q
39

Which one of the following statements is FALSE about the function $f(x) = 5\cos\left(3x - \frac{\pi}{4}\right)$?

A) The graph of $f(x)$ has y-intercept at $y = -1$

B) The range of $f(x)$ is $[-5, 5]$

C) The horizontal shift of the graph of $f(x)$ is $\frac{\pi}{12}$ units to the right

D) The amplitude of the graph of $f(x)$ is 5

E) The period of $f(x)$ is $\frac{2\pi}{3}$

Q
40

Which one of the following statements is TRUE?

A) The equation $\sin x = 2$ has no solution in the interval $\frac{\pi}{2} \leq x \leq \frac{3\pi}{2}$.

B) The domain of $y = \sin(x + \pi)$ is $[-\pi, \infty)$.

C) The period of the graph of $y = \sin\big(\pi(2x - 1)\big)$ is π.

D) The range of the function $y = 2\sin(x - \pi) - 1$ is $[-2, 2]$.

E) $(\sec x)(\sin x) = 1$.

Topic 5 | Constants and Equations from Graphs

Finding the constants or the equation of a sine or cosine function from its graph • Questions 41–53

Q **41**

If the adjacent figure represents the graph of $y = -2\cos(bx + c)$, then

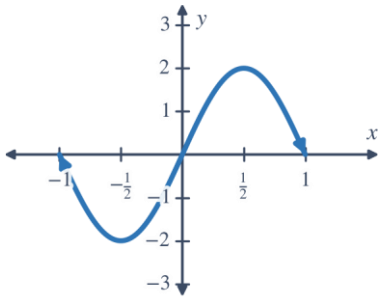
A) $b = \pi$ and $c = \frac{\pi}{2}$

B) $b = \pi$ and $c = -\frac{\pi}{2}$

C) $b = 2\pi$ and $c = -\frac{\pi}{4}$

D) $b = 2\pi$ and $c = \frac{\pi}{4}$

E) $b = \pi$ and $c = \frac{\pi}{4}$



Q **42**

If the adjacent figure represents the graph of the function $y = a\cos(kx + b)$, then $a + k + \frac{b}{\pi} =$

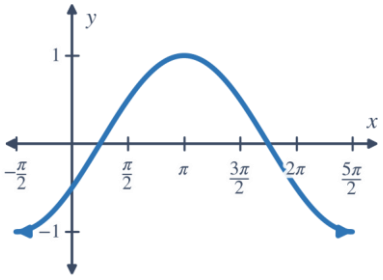
A) 0

B) 1

C) -1

D) $\frac{\pi-1}{2}$

E) $\frac{\pi^2-1}{2}$



Q
43

If the adjacent figure represents the graph of $y = a\cos(bx) + 1$, then $2b - \pi\, a =$

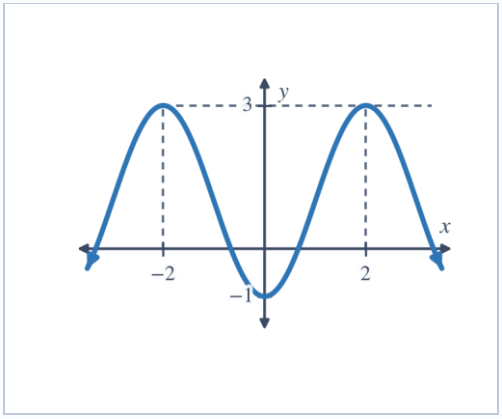
A) 3π

B) 2π

C) -2π

D) -3π

E) π



Q
44

If the graph of the function $f(x) = 2\cos(bx + c)$, $b > 0$ and $-\frac{\pi}{2} \leq c \leq \frac{\pi}{2}$, has period $\frac{2\pi}{3}$ and passes through the point $(0, 2)$, then $b + c =$

A) 3

B) 0

C) 4

D) 5

E) 2

Q
45

The equation of the function whose part of its graph is drawn below is

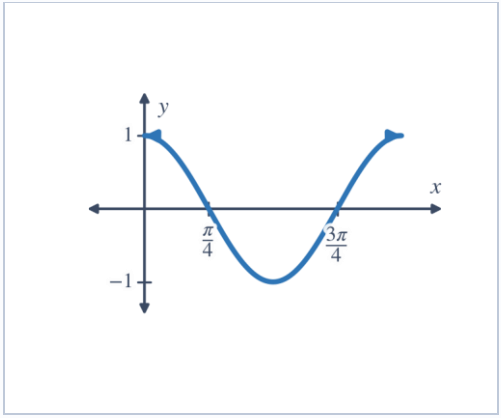
A) $y = -\cos 4x$

B) $y = -\sin 3x$

C) $y = -\sin 2x$

D) $y = \cos 2x$

E) $y = -\cos 2x$



Q
46

If the adjacent figure represents the graph of the function $y = a\sin(bx + c), -\frac{3\pi}{2} \leq x \leq \frac{5\pi}{2}$, then

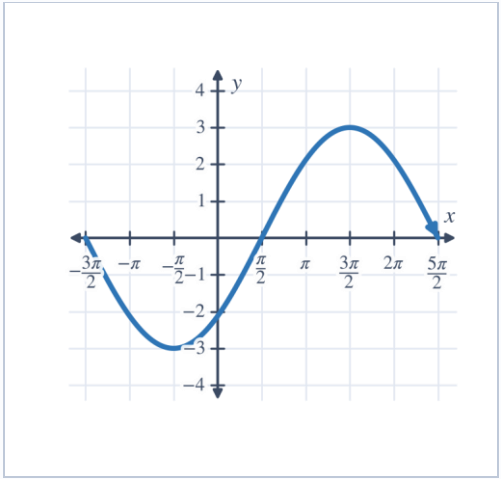
A) $a = -3,\ b = \frac{1}{2},\ c = \frac{3\pi}{4}$

B) $a = -3,\ b = 2,\ c = -\frac{3\pi}{2}$

C) $a = 3,\ b = \frac{1}{2},\ c = -\frac{3\pi}{4}$

D) $a = 3,\ b = 4,\ c = 3\pi$

E) $a = -3,\ b = \frac{1}{4},\ c = \frac{3\pi}{8}$



Q
47

The adjacent figure represents part of the graph of

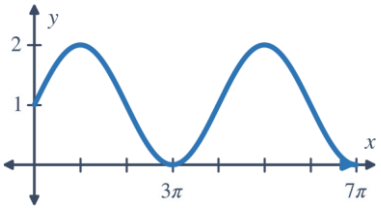
A) $y = \sin\left(\frac{1}{2}x\right) + 1$

B) $y = \cos\left(\frac{1}{2}x\right) + 1$

C) $y = 2\sin(x) + 1$

D) $y = 2\cos(x) + 1$

E) $y = \sin(2x) + 1$



Q
48

If the adjacent figure represents the graph of the function $y = a\cos(bx + c)$, $-\frac{2\pi}{3} \leq x \leq \frac{2\pi}{3}$, then

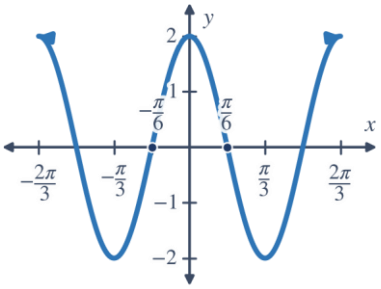
A) $a = -2,\ b = 3,\ c = \pi$

B) $a = 2,\ b = \frac{1}{3},\ c = \pi$

C) $a = -2,\ b = 3,\ c = -\frac{2\pi}{3}$

D) $a = -2,\ b = \frac{2}{3},\ c = \frac{2\pi}{3}$

E) $a = 2,\ b = \frac{2}{3},\ c = \frac{\pi}{3}$



Q
49

If the adjacent figure represents the graph of $y = -2\cos(bx + c)$, then

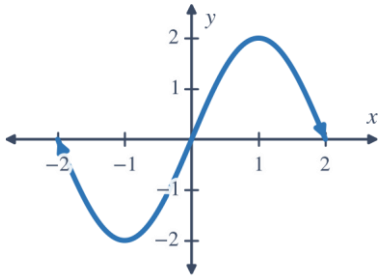
A) $b = \frac{\pi}{2}$ and $c = \frac{\pi}{2}$

B) $b = \frac{\pi}{2}$ and $c = \frac{\pi}{4}$

C) $b = \pi$ and $c = \frac{\pi}{2}$

D) $b = 2\pi$ and $c = -\frac{\pi}{4}$

E) $b = 2\pi$ and $c = -\pi$



Q
50

If the adjacent figure represents the graph of $y = \frac{1}{2}\cos(bx + c)$, $\frac{\pi}{2} \leq x \leq \frac{9\pi}{2}$, then

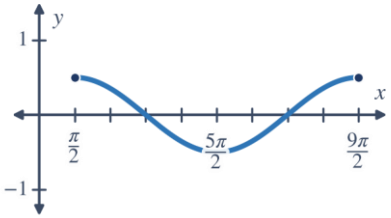
A) $b = \frac{1}{2},\ c = -\frac{\pi}{4}$

B) $b = \frac{1}{2},\ c = -\frac{\pi}{2}$

C) $b = 2,\ c = -\frac{\pi}{2}$

D) $b = \frac{1}{4},\ c = \frac{\pi}{2}$

E) $b = \frac{1}{4},\ c = \frac{\pi}{4}$



Q
51

If the adjacent figure represents the graph of $y = -2\cos(bx + c)$, $-\frac{2\pi}{3} \leq x \leq \frac{2\pi}{3}$ and $b > 0$, then

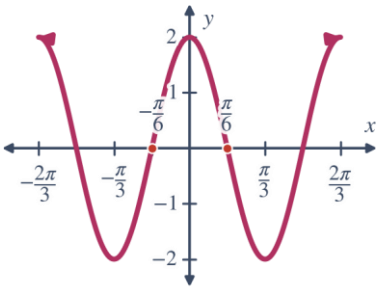
A) $b = 3,\ c = \pi$

B) $b = \frac{1}{3},\ c = \pi$

C) $b = 3,\ c = -\frac{2\pi}{3}$

D) $b = \frac{2}{3},\ c = \frac{2\pi}{3}$

E) $b = \frac{2}{3},\ c = \frac{\pi}{3}$



Q
52

If the adjacent figure represents the graph of $y = a\cos(bx + c)$ over one period, where $0 < c \leq 2\pi$ and $a < 0$, then $8a + b + c =$

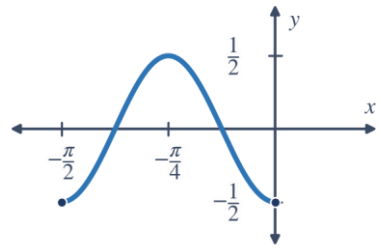
A) 2π

B) -2π

C) $\frac{\pi}{2}$

D) $-\pi$

E) π



Q
53

The adjacent graph represents a part of the graph of

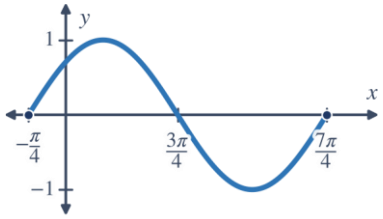
A) $y = \sin\left(x + \frac{\pi}{4}\right)$

B) $y = \sin\left(x - \frac{\pi}{4}\right)$

C) $y = \cos\left(x + \frac{\pi}{4}\right)$

D) $y = 1 - \cos\left(x - \frac{\pi}{4}\right)$

E) $y = -1 - \sin\left(x - \frac{\pi}{4}\right)$



Answer Key

"Original" shows the question number in the source worksheet.

Q	Original	Ans.	Value
1	1	**E**	$\frac{5}{3}$
2	9	**D**	$[1, 3]$
3	10	**A**	-2
4	17	**A**	$[-1, 2]$
5	24	**A**	$[2, 3]$
6	28	**B**	-3
7	29	**A**	$R = [-3, 0],\ P = 2\pi$
8	32	**A**	$\frac{3}{2}$
9	33	**A**	$[-3, 0]$
10	41	**A**	range $= [-7, 3]$, phase shift $= \frac{3\pi}{2}$ units to the left
11	54	**A**	$[1, 2]$
12	52	**A**	-2
13	2	**A**	three points
14	16	**D**	4
15	19	**E**	4 points
16	26	**C**	6 points.
17	30	**A**	has a maximum of $\frac{1}{2}$ in the interval $[3, 4]$
18	31	**B**	4
19	34	**A**	three maximum values
20	38	**A**	2 points
21	45	**A**	two maximum values and five x-intercepts
22	47	**A**	four points
23	3	**A**	$\left(-\frac{1}{2}, \frac{1}{2}\right)$
24	5	**A**	$(0, 3\pi)$
25	7	**C**	$\left(-\frac{\pi}{2}, 0\right)$
26	8	**A**	$\left(\frac{3\pi}{4}, \frac{5\pi}{4}\right)$
27	11	**A**	$\left(-1, -\frac{1}{2}\right) \cup \left(0, \frac{1}{2}\right)$
28	20	**A**	$[2, 6]$
29	36	**A**	$(2, 4)$
30	40	**A**	$\left[-\frac{\pi}{4}, \frac{3\pi}{4}\right]$ and $\left[\frac{11\pi}{4}, \frac{15\pi}{4}\right]$
31	46	**A**	$(-8, -4)$ and $(0, 4)$
32	50	**A**	$\left(\frac{\pi}{2}, \pi\right)$
33	4	**A**	is above the x-axis on the interval $(-4, 0)$
34	6	**C**	$f(x) = \cos x \sin^2 x$ is an odd function.

Q	Original	Ans.	Value
35	12	**A**	is increasing on the interval $(-1,\ 1)$.
36	13	**A**	has three x-intercepts
37	14	**A**	The range of the function is $\left[-\frac{3}{2}, -\frac{1}{2}\right]$
38	15	**A**	range $\left[\frac{3}{2}, \frac{7}{2}\right]$
39	25	**A**	The graph of $f(x)$ has y-intercept at $y = -1$
40	43	**A**	The equation $\sin x = 2$ has no solution in the interval $\frac{\pi}{2} \leq\ x \leq \frac{3\pi}{2}$.
41	18	**A**	$b = \pi$ and $c = \frac{\pi}{2}$
42	21	**A**	0
43	22	**A**	3π
44	23	**A**	3
45	27	**D**	$y = \cos 2\,x$
46	35	**A**	$a = -3,\ b = \frac{1}{2},\ c = \frac{3\pi}{4}$
47	37	**A**	$y = \sin\left(\frac{1}{2}x\right) + 1$
48	39	**A**	$a = -2,\ b = 3,\ c = \pi$
49	42	**A**	$b = \frac{\pi}{2}$ and $c = \frac{\pi}{2}$
50	44	**A**	$b = \frac{1}{2},\ c = -\frac{\pi}{4}$
51	48	**A**	$b = 3,\ c = \pi$
52	49	**A**	2π
53	51	**A**	$y = \sin\left(x + \frac{\pi}{4}\right)$