Lesson 5: Representing Functions with Equations (Day 2)

For graphs of sinusoidal functions, we are often interested in obtaining the ***simplest*** equation. This means: ideally $d=0$

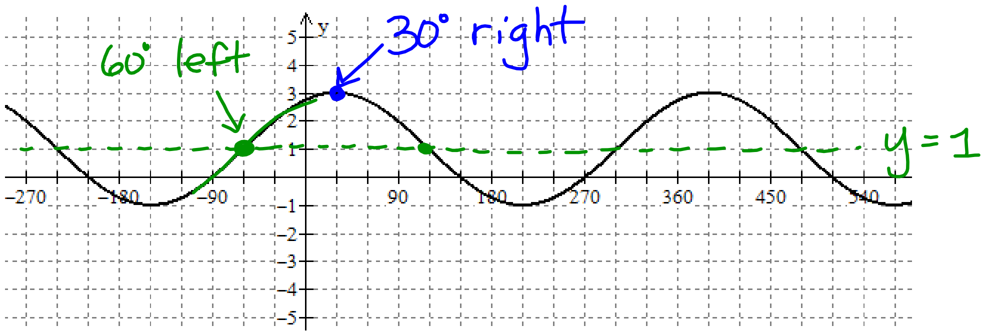
- Avoid phase shifts (horizontal translations), if possible
  - Sometimes you can use a reflection in the x-axis instead of a phase shift
  - If possible, choose a base curve (sine or cosine) that avoids a phase shift
- Avoid using reflections in the y-axis

From the graph, it is easiest to identify its properties, and then use those properties to determine the transformations and the equation.

Parameter	Property	How to determine/calculate
a	Amplitude	$\lvert a\rvert = \frac{\max - \min}{2}$ $a<0$ if a reflection is needed to avoid a phase shift
k	# of cycles in the domain of the base curve	$k = \frac{360°}{period}$
d	Phase shift	Sine as base curve • Locate the equation of the axis. • Find the **POI** between the **curve** and the **equation of the axis** closest to the y-axis where the graph is ***increasing***. • The θ-value of this point is the phase shift. Cosine as base curve • Go to the ***maximum*** closest to the y-axis • The θ-value of this point is the phase shift.
c	Vertical displacement, also the y-intercept of the equation of the axis	$c = \frac{\max + \min}{2}$

Apr 25-12:34 PM

Ex 7) Determine the (simplest) **phase shift** for the following function using:



a) sine as the base curve

$d = -60°$

$(x+60°)$

b) cosine as the base curve

$d = +30°$

$(x-30°)$

Apr 25-1:42 PM

Ex 8) Determine the simplest sinusoidal equation for the following function, using:

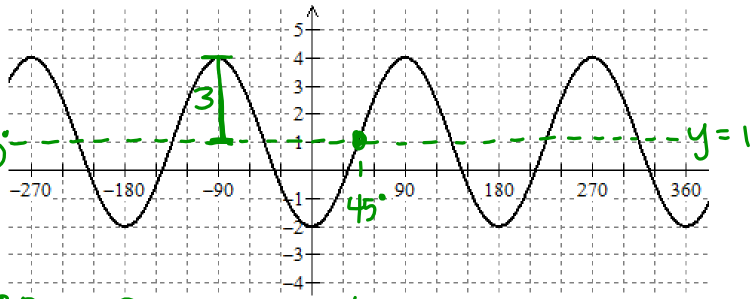
$C = +1$

$a = 3$

period $= 180°$

$K = \frac{360°}{\text{period}}$

$K = 360° \div 180 = 2$



a) sine as the base curve

$d = +45°$

$\boxed{g(x) = 3\sin[2(x - 45°)] + 1}$

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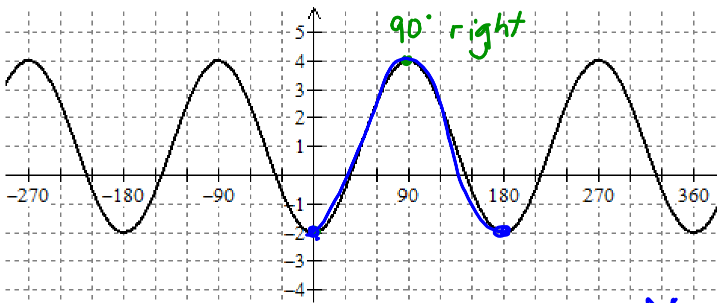


$a = 3$
$C = +1$
$K = 2$
same as above

$d = 90°$

★ or $d = 0$ if we RITXA

b) cosine as the base curve

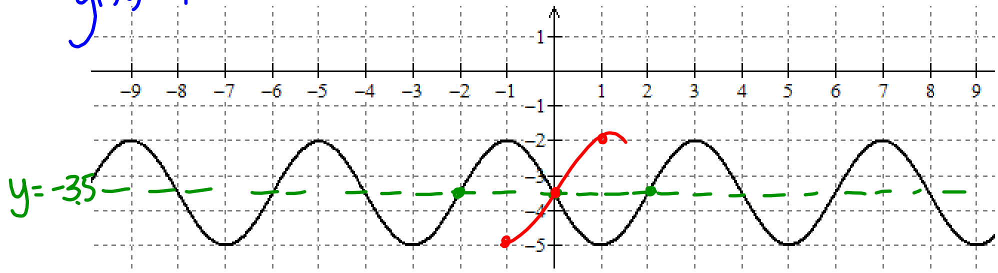
$\boxed{g(x) = 3\cos[2(x - 90°)] + 1}$ ← correct, but not ideal.

$\boxed{g(x) = -3\cos 2x + 1}$ ideal answer

May 3-10:53 AM

Ex 9) Determine the simplest sinusoidal equation for the following function, using:

$g(x) = 1.5\sin[90(x+2)] - 3.5$



a) sine as the base curve

$c = -3.5$

$a = 1.5$

$k = 90 \rightarrow \frac{360^\circ}{\text{period}} = \frac{360^\circ}{4}$

$d = 0$ if I RITXA

$\boxed{g(x) = -1.5\sin 90x - 3.5}$

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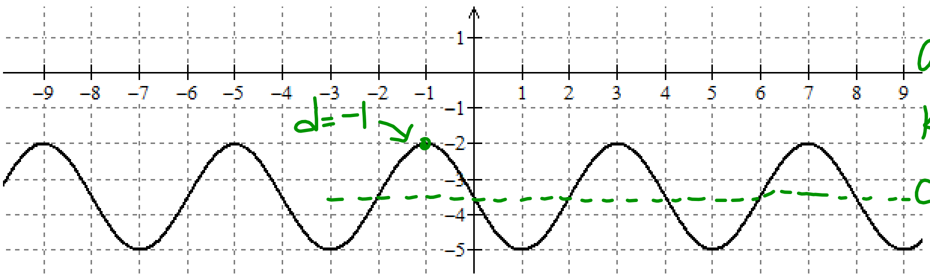


$a = 1.5$

$k = 90$

$c = -3.5$

same as before

$d =$

b) cosine as the base curve

$\boxed{g(x) = 1.5\cos[90(x+1)] - 3.5}$

May 3-10:54 AM

Ex 10) Determine a sinusoidal equation for a function with the following properties:
amplitude 3 units, minimum at (0, -4), period of 90°

a) using sine as the base curve

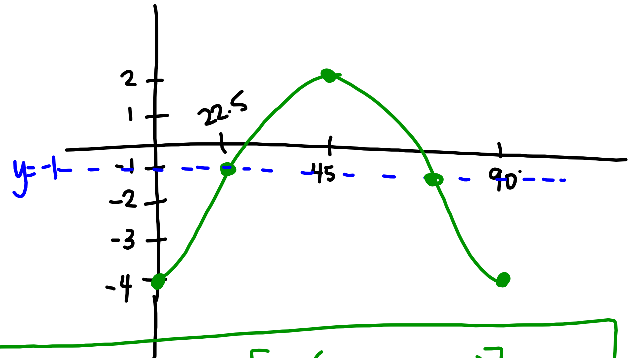
$a = 3$

$c = -1$

$k = \frac{360°}{90}$

$k = 4$

$d = +22.5$



$$\boxed{g(x) = 3\sin[4(x - 22.5)] - 1}$$

Apr 25-1:47 PM

Ex 10) Determine a sinusoidal equation for a function with the following properties:
amplitude 3 units, minimum at (0, -4), period of 90°

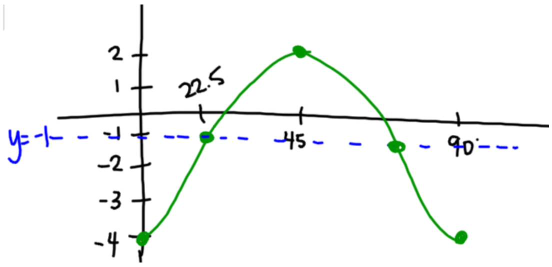
b) using cosine as the base curve

$a = 3$

$k = 4$

$c = -1$

$d = 0$ * if the graph is R ITXA



$$\boxed{g(x) = -3\cos 4x - 1}$$

May 3-10:55 AM

HW U4L5 Day 2:

1. Handout **there are a few typos in the answer key, so please refer to this to check your answers:*

1. $f(\theta) = -3\sin(4\theta) + 1$ 2. $f(\theta) = -\cos(\frac{1}{2}\theta) - 2$ 3. $f(\theta) = 8\cos[\frac{1}{3}(\theta - 30°)] + 3$ 4. $f(\theta) = 2\sin[6(\theta + 7.5°)] + 5$ or $f(\theta) = 2\cos[6(\theta + 7.5°)] + 5$
5. $f(\theta) = 4\sin\frac{3}{4}(\theta - 90°) - 1$ 6. $f(\theta) = 5\sin 3\,0\theta + 2$ 7. $f(\theta) = \frac{5}{2}\sin[15(\theta - 5°)] + \frac{7}{2}$ 8. $f(\theta) = 6\cos[3\,6(\theta + 1°)] - 3$
9. $f(\theta) = 4\sin(\frac{1}{2}\theta) + 2$ or $f(\theta) = 4\cos(\frac{1}{2}\theta) + 2$ 10. $f(\theta) = 6\sin(8\theta) - 2$ or $f(\theta) = 6\cos(8\theta) - 2$
11. $f(\theta) = 3\sin(\theta - 30°) + 9$ or $f(\theta) = 3\cos(\theta - 30°) + 9$ 12. $f(\theta) = 8\sin\theta + 5$ or $f(\theta) = 8\cos(\theta - 90°) + 5$
13. $f(\theta) = 2\sin[\frac{1}{2}(\theta + 180°)] + 1$ or $f(\theta) = 2\cos\frac{1}{2}\theta + 1$ 14. $f(\theta) = 4\sin 3(\theta - 30°) + 10$ or $f(\theta) = -4\cos 3\theta + 10$
15. $f(\theta) = 6\sin 2(\theta + 45°) - 5$ or $f(\theta) = 6\cos 2\theta - 5$

2. p.383 #5

3. p. 391 #1, 3, 4, 6, 7 *Correction: 1b. cos(x-90)+2*

4. Sign and correct transformation quizzes