/17K	/21A	/4C	/10T	Total	/52

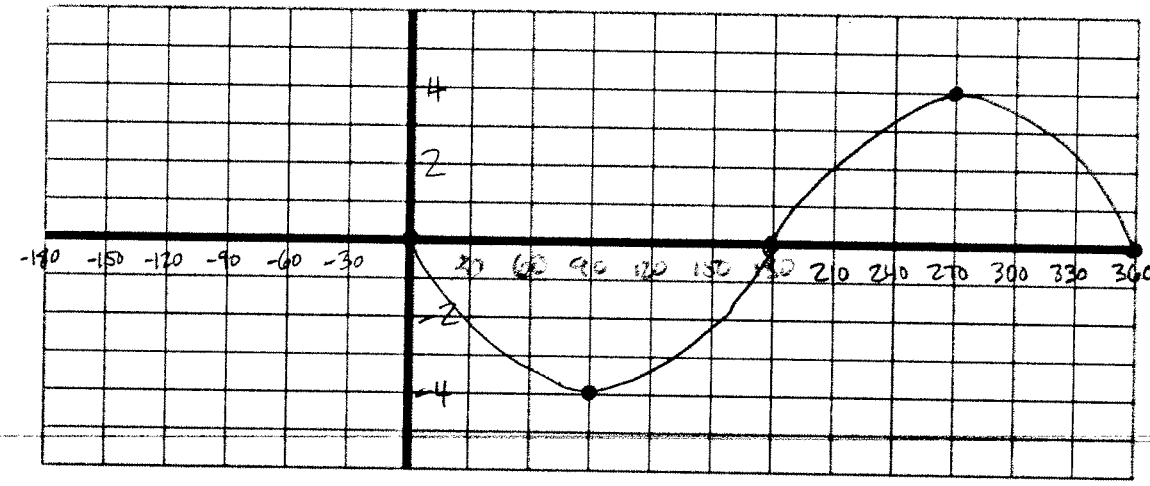
Name: Answers Date: _____

MCR3U

Test: Trigonometric functions

/3 K

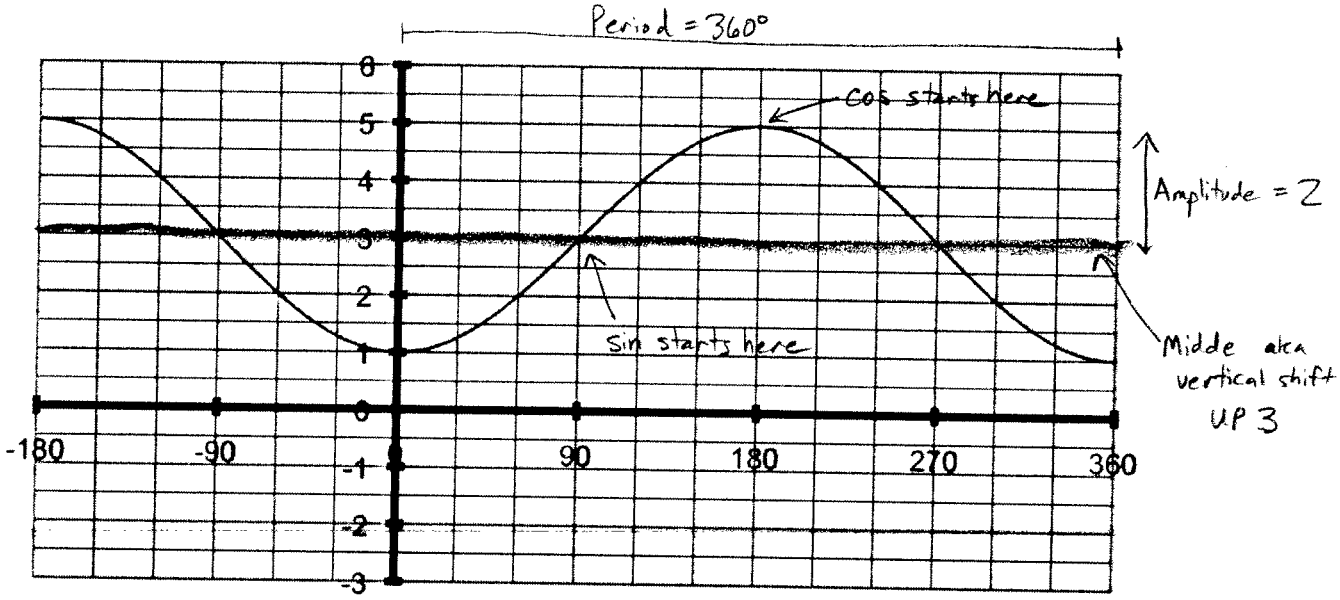
1. Sketch one cycle of the graph of $y = -4\sin x$. Include an appropriate scale on each axis.



Amp: 4
Period: 360°
Middle: no shift
Phase shift: none

/3

2. Write an equation to represent the sinusoidal function in the following graph.



$y = -2\cos x + 3$

or $y = 2\sin(x - 90°) + 3$

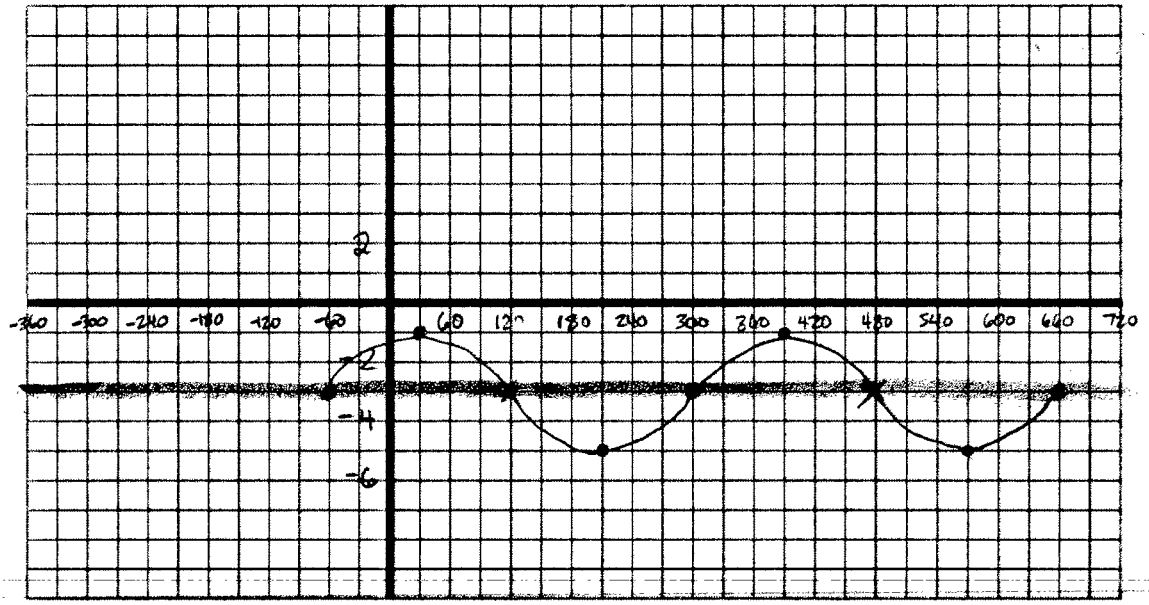
or $y = 2\cos(x - 180°) + 3$ ← most common

/5
K

3. Sketch two cycles of the graph of $y = 2\sin(x + 60^\circ) - 3$. Include an appropriate scale on each axis.

Period = 360° ↓ Middle is 3 down ↙

Amplitude ↗ ↑ Starts 60° left



/1
C

4. The equation of a cosine function is $y = 2\cos(5x - 150^\circ)$. Explain why the phase shift is not 150°.

$= 2\cos[5(x - 30^\circ)]$

must be factored out first!

/2
K

5. Determine the period of the function $y = 3\sin\left[\frac{2}{5}(x - 45^\circ)\right] + 7$.

$\text{Period} = \frac{360^\circ}{(2/5)} = \frac{360^\circ}{0.4} = 900^\circ$

/3 K

6. Describe the transformations that must be applied to the graph of $f(x) = \sin x$ to obtain the graph of $g(x) = -\sin[2(x + 30°)]$.

Vertical flip

Horizontally compressed to ½ its width (Period = 180°)

Shifted 30° left (phase shift)

/4 T

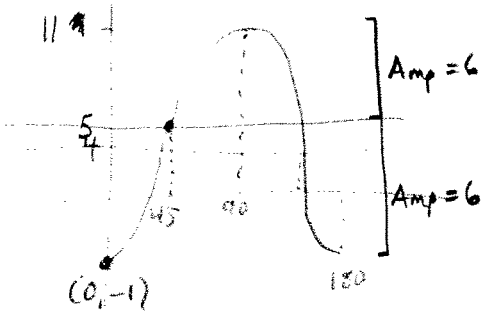
7. A sinusoidal function has an amplitude of 6 units, a period of 180°, and a minimum at (0, –1). Represent the function with an equation using a sine or cosine function.

$y = -6\cos[2x] + 5$

or $y = 6\cos[2(x - 90°)] + 5$

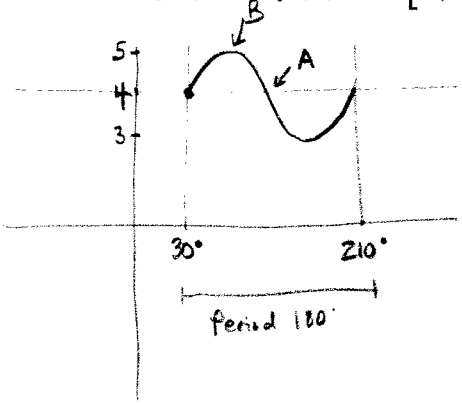
or $y = 6\sin[2(x - 45°)] + 5$

or $y = -6\sin[2(x - 135°)] + 5$



/2 T

8. Represent the graph of $f(x) = \sin[2(x - 30°)] + 4$ with an equation using a cosine function.



∴ Point A is at 120° (midway between 30° and 210°)

∴ Point B is at 75° (midway between 30° and A)

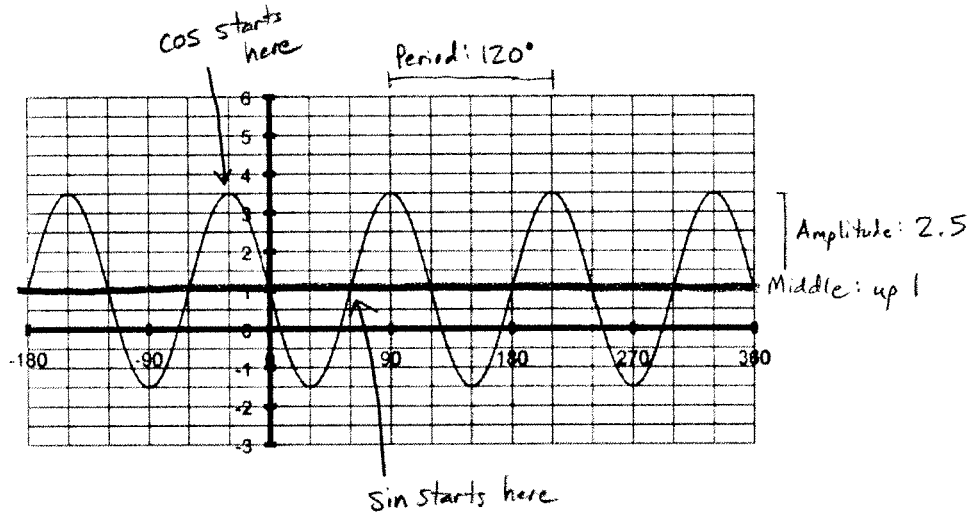
∴ $y = \cos[2(x - 75°)] + 4$

/4 K

/4 A

9. Determine equations to model each of the following sinusoidal functions.

a)



$y = 2.5\sin[3(x-60°)]+1$

$y = 2.5\cos[3(x+30°)]+1$

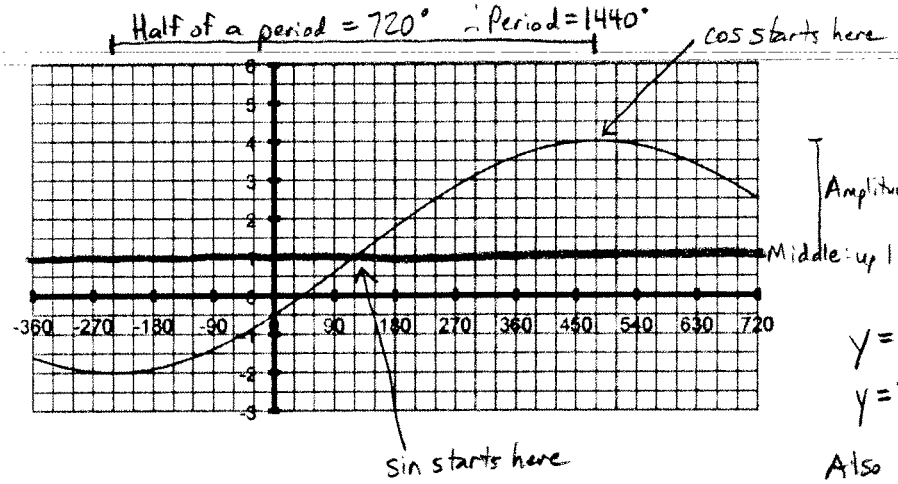
Also accept

$y = -2.5\cos[2(x-30°)]+1$

$y = -2.5\sin[2(x)]+1$

$y = 2.5\cos[2(x-90°)]+1$

b)



$y = 3\sin\left[\frac{1}{4}(x-120°)\right]+1$

$y = 3\cos\left[\frac{1}{4}(x-480°)\right]+1$

Also accept

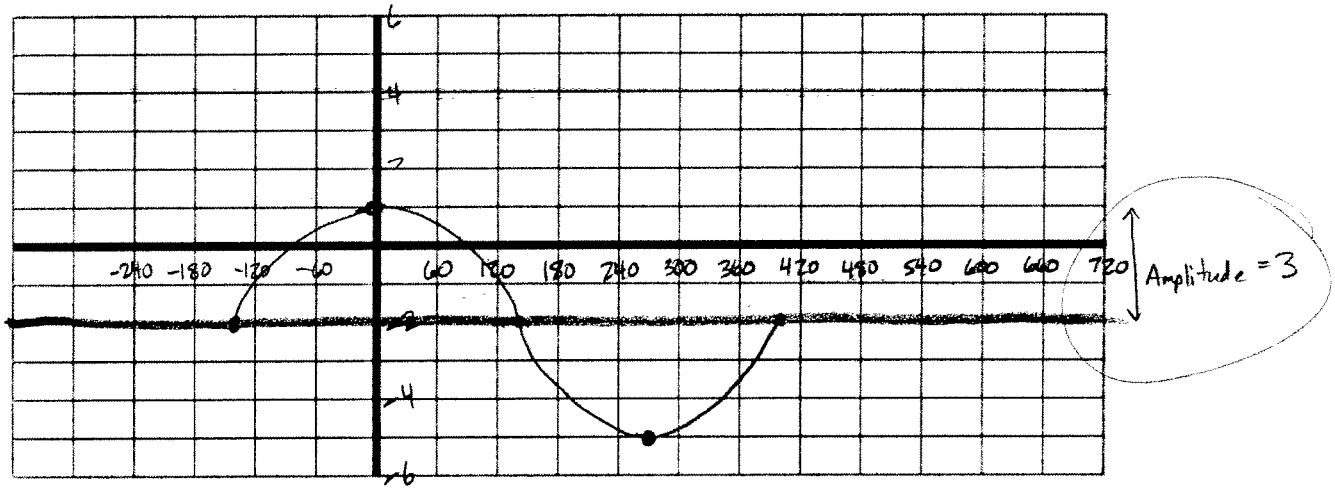
$y = -3\cos\left[\frac{1}{4}(x+240°)\right]+1$

/4 A

/1 T

10. Graph the sinusoidal function $y = 3\sin\left[\frac{2}{3}(x+135°)\right]-2$. Label the amplitude on the graph.

Period $= \frac{360°}{0.67} = 540°$



/5 A

/1 C

11. The following table lists average monthly high temperatures (°C) in St. John's NF for one year.

1	2	3	4	5	6	7	8	9	10	11	12
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	1	5	10	16	20	20	16	11	6	2

a) Determine a sinusoidal equation to model this data.

Amplitude: $\frac{max-min}{2} = \frac{20-0}{2} = 10$

Middle: $\frac{max+min}{2} = \frac{20+0}{2} = 10$

Period: 12 months so $k = \frac{360°}{12} = 30$

Phase shift: sin: 5 right

cos: 7.5 right

$y = 10 \sin[30(x-5)] + 10$

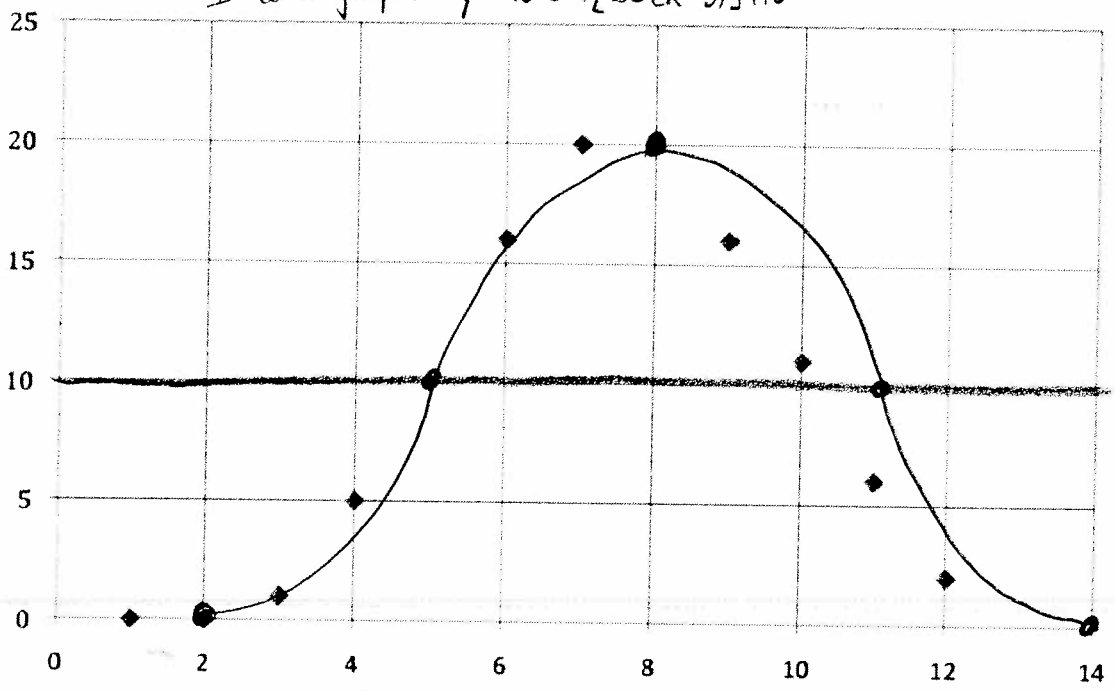
$y = 10 \cos[30(x-7.5)] + 10$

Also accept

$y = -10 \cos[30(x-1)] + 10$

b) Graph the equation below AND describe any discrepancies between the equation and data.

I will graph $y = 10 \sin[30(x-5)] + 10$



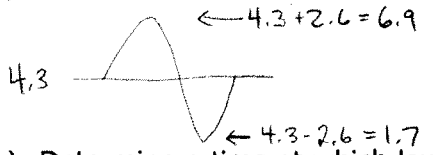
It seems to lag a little behind the data

eg. in months 9, 10, 11.

/5
A

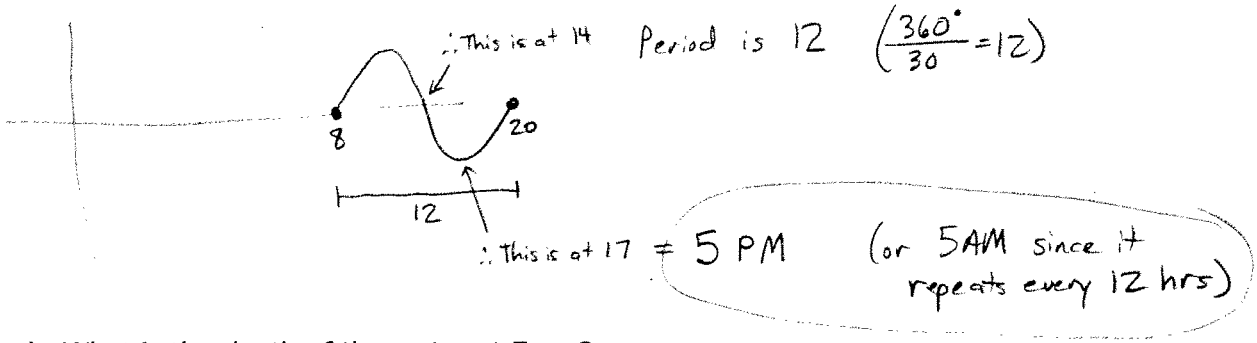
12. The height, h, in metres, of the tide in a given location on a given day at t hours after midnight can be modeled using the sinusoidal function $h(t) = 2.6\sin[30(t-8)] + 4.3$.

a) Determine the maximum depth, h, of the water.



Max depth is 6.9 m

b) Determine a time at which low tide occurs.



c) What is the depth of the water at 7 am?

$h(7) = 2.6\sin[30(7-8)] + 4.3$

$= 2.6\sin(-30) + 4.3$

$= 3$ m

/3
T

/2
C

13. The following table shows annual average sunspot activity from 1970 to 2006. Predict the next three occurrences of maximum sunspot activity after 2006. Explain your reasoning.

Maximums occur about every 10 years

∴ Next ones may occur in 2010, 2020, 2030

Year (since 1970)	Sunspots (Annual Average)	Year (since 1970)	Sunspots (Annual Average)
0	107.4	19	162.2 (1989)
1	66.5	20	145.1
2	67.3	21	144.3
3	36.7	22	93.5
4	32.3	23	54.5
5	14.4	24	31
6	11.6	25	18.2
7	26	26	8.4
8	86.9	27	20.3
9	145.8	28	61.6
(1980) 10	149.1	29	96.1
11	146.5	30	123.3 (2000)
12	114.8	31	123.3 (2001)
13	64.7	32	109.4
14	43.5	33	65.9
15	16.2	34	43.3
16	11	35	30.2
17	29	36	15.4
18	100.9		