Math 30-1 - Sinusoidal Curves Assignment

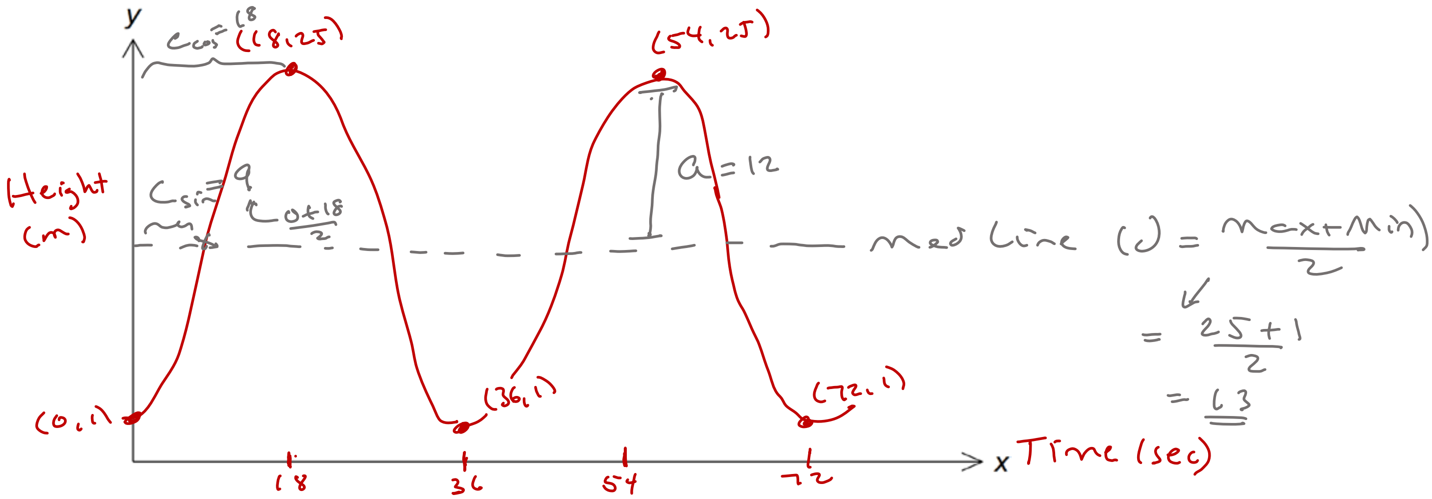
PART A – Riding the Wheel

Refer to PRACTICE QUESTION #8 from your Trig I class handout, on the height of a Ferris Wheel.
(I have uploaded a complete solution to the question, a link is on D2L right where you found the link to this assignment)

1. Before starting here - **complete the question** in your own notes / the Trig handout Topic 5 Practice Question 8. (Again, use solution posted online for reference, do the work in your booklet)

2. In the space provided below, sketch the resulting function if the following changes are made
   - The maximum height of the Ferris Wheel is 25m. (the min height is still 1m)
   - The Ferris Wheel completes a rotation every 36s. (instead of 30s)

   ***Be sure to fully label each axis and provide a scale.**



3. Determine an equation of the function you graphed, in the form $y = a\sin[b(x-c)] + d$ **and** $y = a\cos[b(x-c)] + d$. Show all steps / reasoning.

$$y = 12\sin\left[\frac{\pi}{18}(x-9)\right] + 13$$

$$\frac{2\pi}{36}$$

$$y = 12\cos\left[\frac{\pi}{18}(x-18)\right] + 13$$

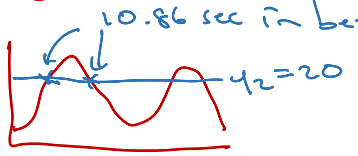
4. Use your equation to predict the height after 15 seconds.

$$h = 12\sin\left[\frac{\pi}{18}(15-9)\right] + 13 \Rightarrow = \boxed{23.4\text{m}}$$

5. Use your graphing calculator to predict the percentage of time that a person's height on the Ferris wheel would be 20m or more. Explain your process.

$y_1 = 12\sin(\pi/18(x-9))+13$ } intersect (twice!)
$y_2 = 20$

10.86 sec in between these two



$$\frac{10.86}{36} = \boxed{30\%}$$

PART B – Winnipeg Temperatures

For this part of the assignment, you will determine the values of a, b, c and d for both a sine and cosine equation to model the following data. (Assume 365 days in a year) You will start by scaling the graph below, labeling each axis, and **plotting all of the points** represented by the data.

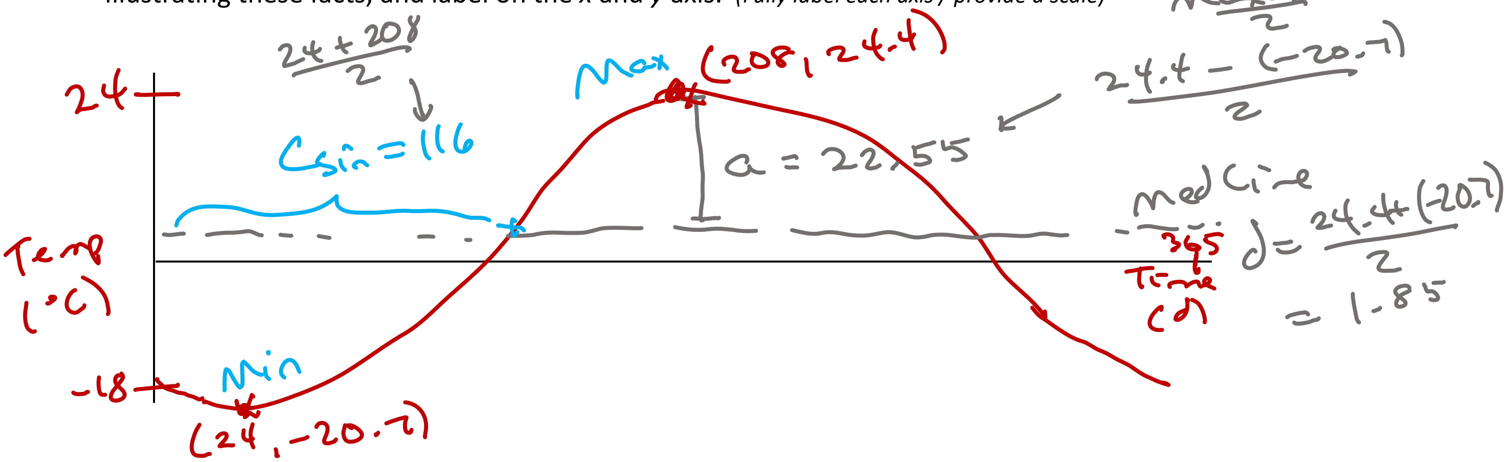
AVERAGE DAILY TEMPERATURE OF WINNIPEG THROUGHOUT THE YEAR

Date	Day #	Ave Temp	Date	Day #	Ave Temp	Date	Day #	Ave Temp
Jan 1	1	-14.3	May 9	129	11.5	Sept 15	258	12.9
Jan 24	24	-20.7	May 31	151	15.8	Oct 1	274	7.7
Feb 18	49	-16.8	June 11	162	18.5	Oct 17	290	5.0
Feb 27	58	-15.0	July 1	182	22.1	Nov 16	320	-7.6
March 11	70	-10.6	July 27	208	24.4	Nov 22	325	-12.2
March 30	89	-4.1	Aug 11	223	19.4	Dec 4	338	-15.8
April 14	104	3.4	Aug 28	240	17.6	Dec 25	359	-17.9
April 20	110	7.2						

min

max

1. In Winnipeg, the COLDEST day, on average, is January 24, with a temperature of -20.7 °C. The WARMEST day, on average, is July 27, with a temperature of 24.4 °C. Plot two points with an "x" on the graph below illustrating these facts, and label on the *x* and *y* axis. *(Fully label each axis / provide a scale)*



2. Plot the remaining points (use dots •, approximate their position) given by the data, and construct a smooth, sinusoidal curve that best represents the data. *(NOTE: Your curve will not contain all of the points. It is merely a "curve of best fit"!)*

3. Using the formulas and methods developed in class, determine the values of a, b, c and d for a sinusoidal equation in the form: $y = a\sin[b(x-c)]+d$ **and** $y = a\cos[b(x-c)]+d$.

   - *Note that you will using the max and min points (marked by an X) to determine these values.*
   - *Draw a pair of dashed horizontal lines representing the "c" values for sine and cosine.*

$a = \frac{max - min}{2}$

$b = \frac{2\pi}{365}$ ← period

$c_{sin} = \frac{24+208}{2} = 116$

$c_{cos} = 208$ $\quad d = 1.85$

$y = 22.55 \sin\left[\frac{2\pi}{365}(x-116)\right]+1.85$

$y = 22.55 \cos\left[\frac{2\pi}{365}(x-208)\right]+1.85$

4. Write both a sine and cosine equation that models the average daily temperature in Winnipeg, *T*, as a function of the day of the year, *n*.

5. Use each equation to predict the average temperature in Winnipeg on April 1.

Sine Equation | *Cosine Equation*

Substitute Day #91 for both equations

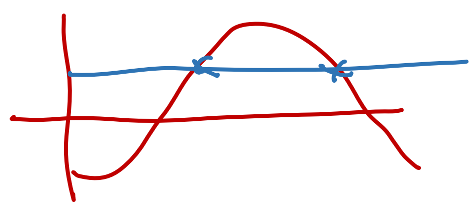
−7.55°C | −7.82°C

6. Use your sine equation and a graphing method to determine the approximate number of days the average temperature in Winnipeg should be above 15°C. Explain your process.

$$y_1 = 22.55 \sin\left[\frac{2\pi}{365}(x - 116)\right] + 1.85$$

$y_2 = 15$

Find two intersections



$y_2 = 15$

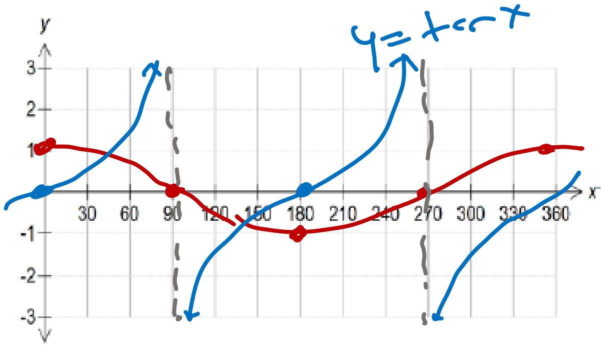
$\boxed{110 \text{ days}}$

7. Environmentalists predict that the average temperature in Winnipeg will increase by 2°C over the next 15 years. Assuming that increase is applicable throughout the year, which of the values of a, b, c, or d in your sinusoidal equations will change? Explain.

d increases by $\boxed{2}$

PART C – The TANGENT GRAPH

On your formula sheet it can be seen that $tan\theta = \frac{sin\theta}{cos\theta}$.



1. On the grid on the left, sketch the graph of ❶ $y = cosx$
2. Since $tanx = \frac{sinx}{cosx}$, the graph of $y = tanx$ will have a **vertical asymptote** wherever $cosx = 0$. On your graph draw dotted lines representing vertical asymptotes wherever the graph of $y = cosx$ is zero. *(That is, at any x-intercepts)*
3. Since $tanx = \frac{sinx}{cosx}$, the graph of $y = tanx$ will have an $\boldsymbol{x}$ **−intercept** wherever $sinx = 0$. On your graph plot points on the x-axis representing where $sinx$ (and therefore $cosx$) is equal to zero.
4. Use your graphing calculator (or an online tool like desmos) to complete the rest of your graph. Fill out the table below.

Angle Measure	0°	45°	90°	135°	180°	225°	270°	315°	360°
y-coordinate on Tangent Line	0	1	und	-1	0	1	und	-1	0

5. Examine your graph to state the following characteristics of the graph of $y = tanx$.

Domain: $x \neq 90 + 180n ; n \in I$
In degrees and radians

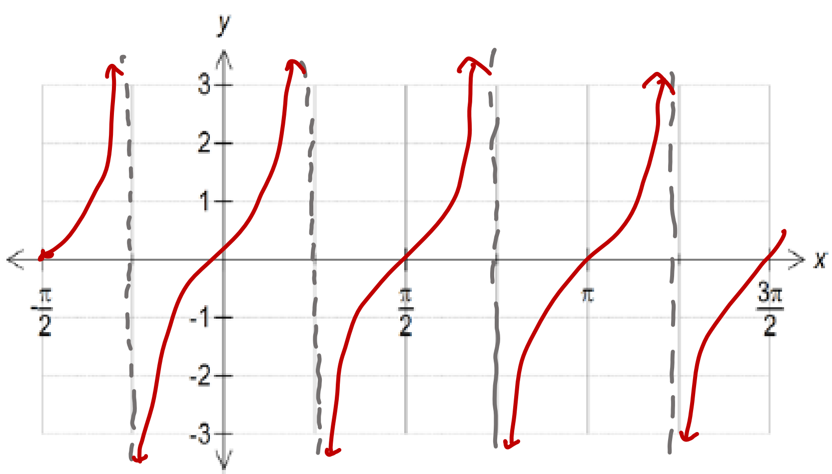
Range: $\mathbb{R}$

Amplitude: N/A

Period: 180° or π

x-intercepts: $x = 180n ; n \in I$ "every 180°"

6. Sketch the graph of $y = \tan 2x$, and describe the characteristics.



Domain: $x \neq \frac{\pi}{4} + \frac{\pi}{2}n$ $n \in I$

Range: $\mathbb{R}$

Amplitude: N/A

Period: $\frac{\pi}{2}$

x-intercepts: $x = \frac{\pi}{2}n$ $n \in I$