

MAT 120 — Homework 4 — Fall 2020

Due date: Thursday, November 12

Note: A sinusoid function $y = A \sin(Bx)$ has period $2\pi/B$ and frequency $B/2\pi$.

1. Find the following special values as exact expressions, no decimals.

- (a) $\sin(-7\pi/6)$
- (b) $\cos(-13\pi/4)$
- (c) $\sin(13\pi/3)$
- (d) $\cos(12\pi/4)$

2. Sketch a graph of the following functions. Plot at least 5 points on each graph.

- (a) $y = 3^x$
- (b) $y = \log_3 x$
- (c) $y = 2x - 1$
- (d) $y = -3x + 7$
- (e) $y = 2 \sin(\pi x)$
- (f) $y = 3 \sin(\frac{3\pi}{2}x)$

$$(g) f(t) = \begin{cases} t, & 0 \leq t < 1 \\ 2 - t, & 1 \leq t < 3 \\ t - 4, & 3 \leq t \leq 4 \end{cases}$$

$$(h) f(t) = \begin{cases} 4t, & 0 \leq t < 1 \\ -2t + 6, & 1 \leq t < 2 \\ 2, & 2 \leq t < 5 \\ -\frac{2}{3}t + \frac{16}{3}, & 5 \leq t \leq 8 \end{cases}$$

- 3. (a) Find the piecewise form, and sketch a graph, of the ADSR envelope function which connects the points: $(0, 0)$, $(100, 0.8)$, $(200, 0.4)$, $(1200, 0.4)$ and $(2400, 0)$. (Assume the t axis is in milliseconds.)
- (b) Find the slope of each part of this function (A, D, S, and R).
- 4. (a) Write a sinusoid function which has amplitude 10 and frequency 10.
- (b) Graph the above sinusoid with an envelope given by an ADSR function that lasts for one second and has the same length of time in each of the two parts A, D, and the same length of time in each of the two parts S, and R. Further, make the AD part last half as long as the SR part, and make the highest value 1.0 and the sustain value 0.4.
- (c) Write the ADSR function from the previous part as a piecewise function.
- 5. A Fourier series for a harmonic tone is a sum of terms $A_n \sin(B_n t)$, for $n = 1, 2, 3, \dots$. Write the first five terms of a Fourier series for a harmonic tone which has fundamental frequency 440 Hz, and has amplitude $1/n$ for the n^{th} partial.