6. For the sawtooth function:

(a) period $T = 2$

Let x represent time for this one...

(b) General form for $\phi_n(x) = \sin\left(\dfrac{2\pi n x}{2}\right) = \sin(\pi n x)$

(c) Fourier coefficients:

$$\frac{\displaystyle\int_{-1}^{1} -x \sin(\pi n x)\, dx}{\displaystyle\int_{-1}^{1} \sin^2(\pi n x)\, dx} = A_n = \frac{\left(\dfrac{x \cos(n x \pi)}{\pi n} - \dfrac{\sin(\pi n x)}{\pi^2 n^2}\right)\Big|_{-1}^{1} \quad \text{for } n \neq 0}{\dfrac{\pi n - \sin(\pi n)}{\pi n}}$$

$$\Rightarrow A_n \overset{n \neq 0}{=} \frac{\left(2\pi n \cos(\pi n) - 2\sin(\pi n)\right)}{\pi^2 n^2} \cdot \frac{\pi n}{\pi n - \sin(\pi n)}$$

$$A_n = \frac{2\pi n \cos(\pi n) - 2\sin(\pi n)}{\pi n\,(\pi n - \sin(\pi n))} \quad \text{for } n \neq 0$$

$$f \sim \sum_{n=1}^{\infty} \frac{2\pi n \cos(\pi n) - 2\sin(\pi n)}{\pi n\,(\pi n - \sin(\pi n))} \cdot \sin(\pi n x)$$