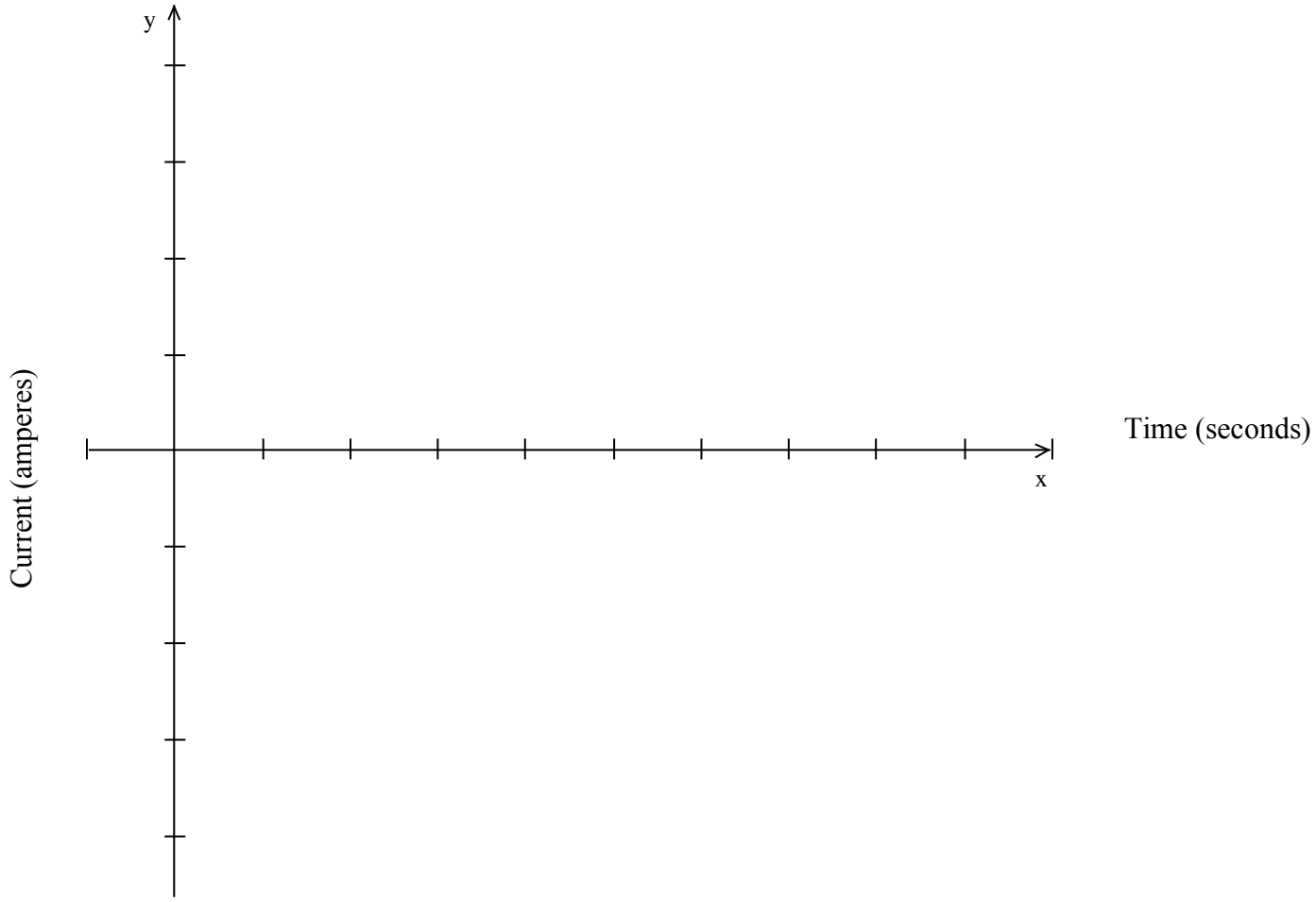
Advanced Sinusoidal Modeling

1) Skyscrapers sway in high-wind conditions. In one case, at $t = 2$ sec, the top floor of a building swayed 30 cm to the left (30 cm), and at $t = 12$ sec, the top floor swayed 30 cm to the right (–30 cm) of its starting position.

    a) What is the equation of a sinusoidal function that describes the motion of the building in terms of time?

    b) Dampers, in the forms of large tanks of water, are often added to the top floors of skyscrapers to reduce the severity of the sways. If a damper is added to this building, it will reduce the sway (not the period) by 70%. What is the equation of the new function that describes the motion of the building in terms of time?

2) An oscilloscope hooked up to an alternating current (AC) circuit shows a sine curve. The device records the current in amperes (A) on the vertical axis and the time in seconds on the horizontal axis (See graph below). At $t = 0.002$ s, the current reads its first maximum value of 3 A. At $t = 0.01$ s, the current reads its first minimum value of –3 A. Determine the equation of the function that expresses the current in terms of time and graph the function on the axes below.



3) Eddie is swinging back and forth on a trapeze. His distance from a vertical support beam in terms of time can be modeled by a sinusoidal function. At 1 s, he is the maximum distance from the beam, 12 m. At 3 s, he is the minimum distance from the beam, 4 m. Determine an equation of a sinusoidal function that describes Eddie's distance from the vertical beam in relation to time.

4) Rocky, having checked out completely from swimming, is floating in an inner tube in a wave pool. She is 1.5 m from the bottom of the pool when he is at the trough of a wave. A stopwatch starts timing at this point. In 1.25 s, she is on the crest of the wave, 2.1 m from the bottom of the pool.
   a) Determine the equation of the function that expresses Rocky's distance from the bottom of the pool in terms of time.

   b) What is the amplitude of the function, and what does it represent in this situation?

   c) How far above the bottom of the pool is Rocky at $t = 4$ s?

   d) If data are collected for only 40 s, how many complete cycles of the sinusoidal function will there be?

   e) If the period of the function changes to 3 s, what is the equation of this new function?