ENGR 1990 Engineering Mathematics
Homework #8 Answers

1. a) \( f'(3) = 16 \text{ (lb/in)} \)
   b) \( f(x) \approx 91 + 16x \) for \( x \) close to 3
   c) approximation errors range from zero to \(-3.6\%\)

2. a) \( a(2) = \frac{dv}{dt}(2) = -9 \text{ (m/s}^2\text{)} \)
   b) \( v(t) \approx 36 - 9t \text{ (m/s)} \)
   c) approximation errors range from zero to \(-6.25\%\)

3. a) \( \dot{x}(t) = 15 \text{ (m/s) (constant), and } \ddot{x}(t) = 0 \)
   b) \( \ddot{y}(t) = 26 - 9.81t \text{ (m/s)} \) and \( \dot{y}(t) = -9.81 \text{ (m/s}^2\text{)} \) (constant)
   c) \( \ddot{y}(t) = 4 = -13.2 \text{ (m/s)} \)
   d) at \( t = 4 \text{ (sec)} \), \( V = 15i - 13.2j \text{ (m/s)} \) or \( |V| = 20 \text{ (m/s)} \) at an angle of \( \theta = -41.4 \text{ (deg)} \)
   e) Maximum vertical position occurs at \( t^* = 2.65 \text{ (sec)} \). Position is \( (39.8, 39.5) \text{ (m)} \)

4. a) \( v(t) = \dot{x}(t) = 15 \cos(10t) - 5 \sin(10t) \text{ (ft/s)} \)
   b) \( a(t) = \dot{v}(t) = -150 \sin(10t) - 50 \cos(10t) \text{ (ft/s}^2\text{)} \)
   c) \( a(t = 0) = -50 \text{ (ft/s}^2\text{)} \)
   d) \( a(t) = 158.1 \sin(10t + 3.46) \)

\( v(t) \) is maximum or minimum when \( t = 0.282, 0.596, 0.910, \cdots \text{ (sec)} \)

The times start at \( t = 0.282 + (n T / 2) \text{ (sec)} \) for \( n = 1, 2, 3, \cdots \)

5. a) \( x(t) = 1.3727 e^{-4.202t} - 0.8727 e^{-23.8t} \text{ (ft)} \) and \( v(t) = \dot{x}(t) = -5.77 e^{-4.20t} + 20.8 e^{-23.8t} \text{ (ft/s)} \)
   b) \( a(t) = \ddot{v}(t) = 24.2 e^{-4.20t} - 494 e^{-23.8t} \text{ (ft/s}^2\text{)} \)
   c) \( a(0) = -470 \text{ (ft/s}^2\text{)} \)
   d) \( t = 0.0654 \text{ (sec)} \)

6. a) \( i(t) = -37.7 \sin(240 \pi t) \text{ (amps)} \)
   b) \( p(t) = -1885 \sin(480 \pi t) \text{ (watts)} \), \( p_{\text{max}} = 1885 \text{ (watts)} \)