Elementary Engineering Mathematics
Exercises #8 Answers

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

2. a) $a(t)\big|_{t=2} = \left.\dfrac{dv}{dt}\right|_{t=2} = -9$ (m/s^2)
   b) $v(t) \approx 36 - 9t$ (m/s)
   c) approximation errors range from zero to -6.25%

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

4. a) $v(t) = \dot{x}(t) = 15\cos(10t) - 5\sin(10t)$ (ft/s)
   b) $a(t) = \dot{v}(t) = -150\sin(10t) - 50\cos(10t)$ (ft/s^2)
   c) $a\big|_{t=0} = -50$ (ft/s^2)
   d) $a(t) \approx 158.1\sin(10t - 2.82)$
   $v(t)$ is maximum or minimum when $t \approx 0.282,\ 0.596,\ 0.910,\ \cdots$ (sec)
   The times start at $t = 0.282 + (nT/2)$ (sec) for $(n = 1,\ 2,\ 3,\ \cdots)$

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

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