

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) $a(t)\big|_{t=2} = \frac{dv}{dt}\bigg|_{t=2} = -9$ (m/s²)
 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/s²) (constant)
 c) $\dot{y}\big|_{t=4} \approx -13.2$ (m/s)
 d) at $t = 4$ (sec), $\underline{V} \approx 15 \underline{i} - 13.2 \underline{j}$ (m/s) or $|\underline{V}| \approx 20$ (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/s²)
 c) $a\big|_{t=0} = -50$ (ft/s²)
 d) $a(t) \approx 158.1 \sin(10t - 2.82)$
 $v(t)$ is maximum or minimum when $t \approx 0.282, 0.596, 0.910, \dots$ (sec)
 The times start at $t = 0.282 + (n T / 2)$ (sec) for $(n = 1, 2, 3, \dots)$

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/s²)
 c) $a\big|_{t=0} \approx -470$ (ft/s²)
 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)