HW #19 Solutions (cont'd)

6.3 12) $s(t) = t^4 - 4t + 12$

(a) $s'(t) = v(t) = 4t^3 - 4$ $\quad s''(t) = a(t) = 12t^2$

(b) $s(1) = 1 - 4 + 12 = 9$ $\quad v(1) = 4 - 4 = 0$ $\quad a(1) = 12$

(c) $4t^3 - 4 = 0$ $\quad 4t^3 = 4$ $\quad \boxed{t = 1}$

(d) $12t^2 = 0 \rightarrow t = 0$ $\quad a(1) = 12$, so the particle is speeding up when $t > 0$ and slowing down when $t < 0$

(e) From $t = 0$ to $t = 1$: $s(0) = 12$ $\quad s(1) = 9$ $\quad d = 12 - 9 = 3$

From $t = 1$ to $t = 5$: $|s(5) - s(1)| = |625 - 20 + 12 - 9| = 608$

Total = $\boxed{611}$

14) $s(t) = \frac{1}{t^2+4}$

(a) $v(t) = \frac{-1}{(t^2+4)^2}(2t) = \frac{-2t}{(t^2+4)^2} = -2t(t^2+4)^{-2}$

$a(t) = -2\left(t(-2(t^2+4)^{-3}(2t)) + (t^2+4)^{-2}\right) = 2\left(\frac{4t^2}{(t^2+4)^3} + \frac{-1}{(t^2+4)^2}\right) = \frac{2(3t^2-4)}{(t^2+4)^3}$

(b) $v(1) = \frac{-2}{(1+4)^2} = -\frac{2}{25}$ $\quad s(1) = \frac{1}{5}$ $\quad a(1) = \frac{2(3-4)}{(1+4)^3} = \frac{-2}{125}$

(c) $\frac{-2t}{(t^2+4)^2} = 0 \rightarrow t = 0$

(d) $a(t) = 0 \rightarrow 3t^2 - 4 = 0 \rightarrow t = \sqrt{4/3}$ $\quad a(1) = \frac{-2}{125} < 0$ $\quad a(2) > 0$

Particle slows down until $t = \sqrt{4/3}$, then speeds up

(e) $s(0) = \frac{1}{4}$ $\quad s(5) = \frac{1}{29}$ $\quad |s(5) - s(0)| = \boxed{\frac{25}{116}}$

25) $s(t) = -\frac{1}{2}gt^2 = -4.9t^2$ $\quad v(t) = -9.8t$

(a) $s(1.5) = -4.9(1.5)^2 = -11.025$ m

(b) $v(1.5) = -9.8(1.5) = 14.7$ m/s

(c) $v(t) = -9.8t = -12$ $\quad t = \frac{12}{9.8} = 1.22$ s

(d) $s(t) = -4.9t^2 = -100$ $\quad t = \sqrt{\frac{100}{4.9}} = 4.52$ s

HW # 19 (continued)

6.3 27) $h(t) = 60t - 4.9t^2$ $\quad v(t) = 60 - 9.8t$ $\quad a = -9.8$

(a) $v(t) = 0 \longrightarrow t = \frac{60}{9.8} = 6.1$ s

(b) $h(6.1) = 183.7$ m

(c) $h(t) = 0 \longrightarrow t(60 - 4.9t) = 0 \longrightarrow t = 0, \frac{60}{4.9} = 0, 12.2$

6.1 more seconds

(d) $v(12.2) = -60$ m/s

32) $s = s_0 + vt + \frac{1}{2}gt^2$ $\quad s_0 = 1000$ ft $\quad \frac{1}{2}g = -16$ ft/s^2

At $t = 5$

$0 = 1000 + 5v - 16(25) \longrightarrow v = \frac{-1000 + 400}{5} = -120$ ft/s