Solutions: CH: 2 — Fall Semester 2001 (011)

7: $x(t) = 9.75 + 1.50t^3$

a) $\bar{v}_{2s \to 3s} = \dfrac{x(3) - x(2)}{3-2} = \dfrac{[\cancel{9.75} + 1.50(3)^3] - [\cancel{9.75} + 1.50(2)^3]}{3-2}$

$= \underline{28.5 \text{ cm/s}}$

$v_{inst}(t) = (1.50) * 3 * t^2$ $\qquad v_{inst} = \dfrac{dx}{dt}$

$v_{inst}(2.00s) = 1.50 * 3 * (2.00)^2 = \underline{18.0 \text{ cm/s}}$

c) $v_{inst}(3.00s) = 1.50 * 3 * (3.00)^2 = \underline{40.5 \text{ cm/s}}$

$v_{inst}(2.50s) = 1.50 * 3 * (2.50)^2 = \underline{28.1 \text{ cm/s}}$

Midway between its position at $t = 2.00s$ and $t = 3.00s$ means that $t = 2.596s$?**

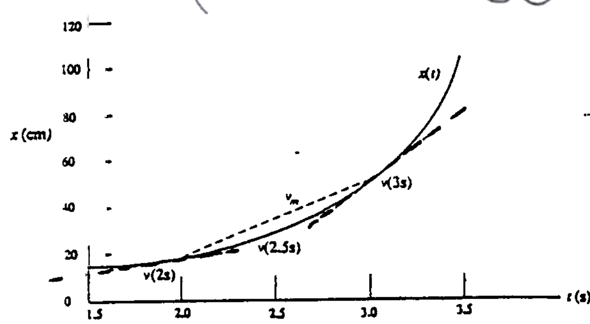
$v_{inst}(2.596s) = 1.50 * 3 * (2.596)^2 = \underline{30.3 \text{ cm/s}}$

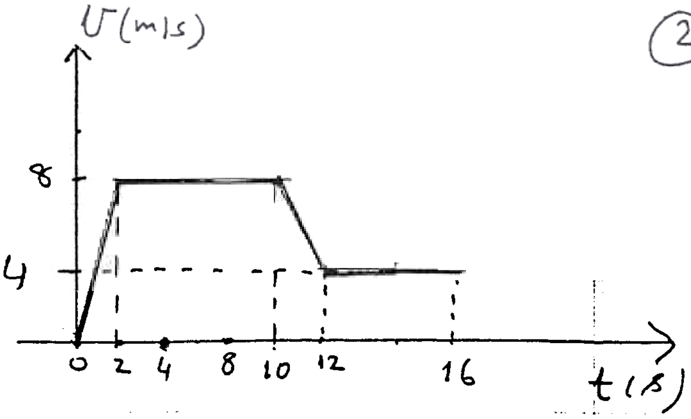
** $x(t_m) = 9.75 + 1.5t_m^3 = \dfrac{x(t=3s) + x(t=2s)}{2}$

$= \dfrac{9.75 + 1.5*3^3 + 1.5*2^3 + 9.75}{2} = 36.0$

$t_m^3 = 17.5 \implies t = (17.5)^{1/3} = 2.596s$

f) Find the slopes and the answers are given by the slopes:





13: Distance = Area under the curve

$$\therefore\ S = \tfrac{1}{\cancel{2}}(8)(\cancel{2}) + 8*8 + \tfrac{1}{\cancel{2}}(\cancel{2})4 + 2*4 + 4*4$$

$$= 8+64+4+8+16 = 100\ m$$

20: $x(t) = 16t\,e^{-t}$ m

When the electron momentarily stops its velocity at that moment is equal to zero. So

$$v(t) = \frac{dx}{dt} = 16e^{-t} + 16t\,e^{-t} * -1 = 0$$

or $16e^{-t} - 16t\,e^{-t} = 0 \Rightarrow 1 - t = 0 \Rightarrow t = 1s$

$$x(1s) = 16*1*e^{-1}\ m = 5.89\ m$$

28: Let the least constant acceleration is a, then

$\Delta x = v_0 t + \frac{1}{2}at^2$ (you can not use this)

so $v^2 - \cancel{v_0^2} \stackrel{0}{=} 2a\Delta X \Longrightarrow a = \dfrac{v^2}{2\Delta X}$

$$a = \frac{(360\ km/hr)^2}{2\,(1.80\ km)} = 36000\ km/hr^2$$

or $36000\ km/hr^2 = \left(\dfrac{36000\ km}{hr^2}\right)\left(\dfrac{10^3\ m}{1\ km}\right)\left(\dfrac{1\ hr}{3600\ s}\right)^2 = 2.8\ m/s^2$

33: Given: $v_0 = 56.0 \frac{km}{hr} = \left(56 \frac{km}{hr}\right)\left(\frac{10^3 m}{1 km}\right)\left(\frac{1 hr}{3600 s}\right) = 15.55 \, m/s$

$x = 24.0 \, m$

a) $t = 2.00 \, s$

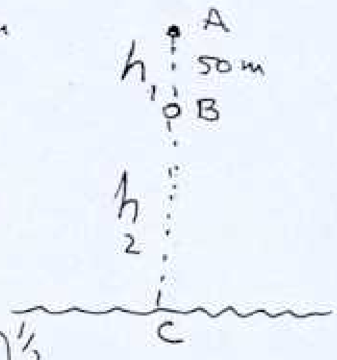
$$\Delta x = v_0 t + \frac{1}{2} a t^2 \Rightarrow a = \frac{2\Delta x - 2 v_0 t}{t^2}$$

$$\therefore \; a = \frac{2 * 24.0 - 2 * 15.55 * 2}{4} = -3.56 \, m/s^2$$

b)

$$v = v_0 + at = 15.55 - (3.56) * 2 = 8.43 \, m/s$$

64: The parachutist is in free fall from A → B and the velocity at A = 0



a) $t = t_{A \to B} + t_{B \to C} = 17 \, s$

$t_{A \to B}$: $h_1 = \frac{1}{2} g t_{A \to B}^2 \Rightarrow t_{A \to B} = \left(\frac{2 h_1}{g}\right)^{1/2}$

$$\therefore \; t_{A \to B} = 3.2 \, s$$

from B → C: $v_B = ?$ $v_C = 3.0 \, m/s$, $a = -2.0 \, \frac{m}{s^2}$

$$v_B = v_A + gt = 0 + 9.8 * 3.2 = 31 \, \frac{m}{s} \text{ downward}$$

$$\therefore \; v_C = v_B + a t_{B \to C} \Rightarrow t_{B \to C} = \frac{v_C - v_B}{a} = \frac{3.0 - 31}{-2.0}$$

$$\therefore \; t_{B \to C} = 14 \, s$$

b) $h = h_1 + h_2 = 50 + h_2 = 50 + 240 = 290 \, m$

$$2 a h_2 = v_C^2 - v_B^2 \Rightarrow h_2 = 240 \, m$$

$$h = 290 \, m$$