11 cont.)

$$v(t) = \frac{t^2}{2} - 2t = 0$$

$$t\left(\tfrac{1}{2}t - 2\right) = 0$$

$$t = 0 \mid t = 4$$

$- - - \quad + + +$

$0 \qquad 4$

Disp: $\displaystyle\int_1^5 \frac{t^2}{2} - 2t\,dt = -10/3$ ✓

T.A: $\displaystyle -\int_1^4 \frac{t^2}{2} - 2t\,dt + \int_4^5 \frac{t^2}{2} - 2t\,dt = -\left(\frac{-9}{2}\right) + \frac{7}{6} = \frac{17}{3}$ ✓

Ditto #2 - Rectilinear Motion - ALL

1. $a(t) = 6t + 6 \qquad v(0) = -9 \qquad s(0) = -27$

a.) $v(t) = \int 6t + 6\,dt = 3t^2 + 6t + c$

$v(0) \Rightarrow 0 + 0 + c = -9$
$c = -9$

$\therefore\ v(t) = 3t^2 + 6t - 9$

b.) $v(t) = 3t^2 + 6t - 9 = 0$
$3(t^2 + 2t - 3) = 0$
$(t+3)(t-1) = 0$
$t = -3 \mid t = 1$

$- - - - \quad + + +$ ✓

1

$\therefore$ Right $t > 1$

c.) $x(t) = \int 3t^2 + 6t - 9\,dt$
$= t^3 + 3t^2 - 9t + c$

$s(0) \Rightarrow 0 + 0 - 0 + c = -27$
$c = -27$

$\therefore\ s(t) = t^3 + 3t^2 - 9t - 27$

d.) $V_{AVE} = \dfrac{1}{2-0}\displaystyle\int_0^2 3t^2 + 6t - 9\,dt = \frac{1}{2}\left(t^3 + 3t^2 - 9t\right)\Big]_0^2$

$= \frac{1}{2}\left[(8 + 12 - 18) - (0)\right] = \frac{2}{2} = 1$ ✓

$$T.D = -\int_0^1 V(t)dt + \int_1^2 V(t)dt = 5 + 7 = 12 \checkmark$$

$$Disp = \int_0^2 V(t)dt = 2 \checkmark$$

1e, f)

t	$t^3+3t^2-9t-27$	$s(t)$	
0		-27	> 5
1		-32	
2		-25	> 7

Disp: 2 ✓

T.D: 12 ✓

$$V(t) = \int \cos t \, dt = \sin t + c$$

$$V(0) \Rightarrow \sin 0 + c = 2$$
$$c = 2$$

$$\therefore V(t) = \sin t + 2 \checkmark$$

) $x(t) = \int V(t)dt = \int \sin t + 2 \, dt = -\cos t + 2t + c$

$$x(0) \Rightarrow -\cos 0 + 2(0) + c = 5$$
$$-1 + c = 5$$
$$c = 6$$

$$\therefore x(t) = -\cos t + 2t + 6 \checkmark$$

$$V(t) = \sin t + 2 = 0$$
$$\sin t = -2$$
$$\emptyset$$

$\underline{+ + + + +}$ $V(t)$

$\therefore$ ALWAYS moving Right ✓

$$Disp \int_0^{\pi/2} \sin t + 2 \, dt = -\cos t + 2t \Big]_0^{\pi/2} = (-0 + \pi) - (-1 + 0) = \pi + 1 \checkmark$$

$$T.D = \int_0^{\pi/2} \sin t + 2 \, dt = \pi + 1 \checkmark$$

$$V_{AVE} = \frac{1}{\frac{\pi}{2} - 0} \int_0^{\pi/2} (\sin t + 2)dt = \frac{2}{\pi}(1 + \pi) = \frac{2}{\pi} + 2$$

2 g.) $A_{AVE} = \dfrac{1}{\frac{\pi}{2} - 0} \displaystyle\int_0^{\pi/2} \cos t \, dt = \dfrac{2}{\pi} \cdot \sin t \Big]_0^{\pi/2} = \dfrac{2}{\pi}\left[(1) - (0)\right]$

$= \dfrac{2}{\pi}$

3. a.) $v(t) = \displaystyle\int 6t - 18 \, dt = 3t^2 - 18t + c$

$v(0) \Rightarrow 0 - 0 + c = 24$

$c = 24$

$\therefore v(t) = 3t^2 - 18t + 24$ ✓

b.) $v(t) = 3t^2 - 18t + 24 = 0$

$3(t^2 - 6t + 8) = 0$

$3(t - 2)(t - 4) = 0$

$t = 2 \quad | \quad t = 4$

$\therefore$ Rest @ $t = 2, 4$ ✓

c.) $x(t) = \displaystyle\int 3t^2 - 18t + 24 \, dt = t^3 - 9t^2 + 24t + c$

$x(1) \Rightarrow 1 - 9 + 24 + c = 20$

$16 + c = 20$

$c = 4$

$\therefore x(t) = t^3 - 9t^2 + 24t + 4$ ✓

d.) $\underset{1 \qquad 2 \qquad 3}{+\,+\,+ \quad -\,-\,-} \; v$

$T.\Delta = \displaystyle\int_1^2 v(t)\,dt + -\int_2^3 v(t)\,dt = 6$ ✓

OR

t	$t^3 - 9t^2 + 24t + 4$	$x(t)$
1		20
2		24
3		22

> 4

> 2

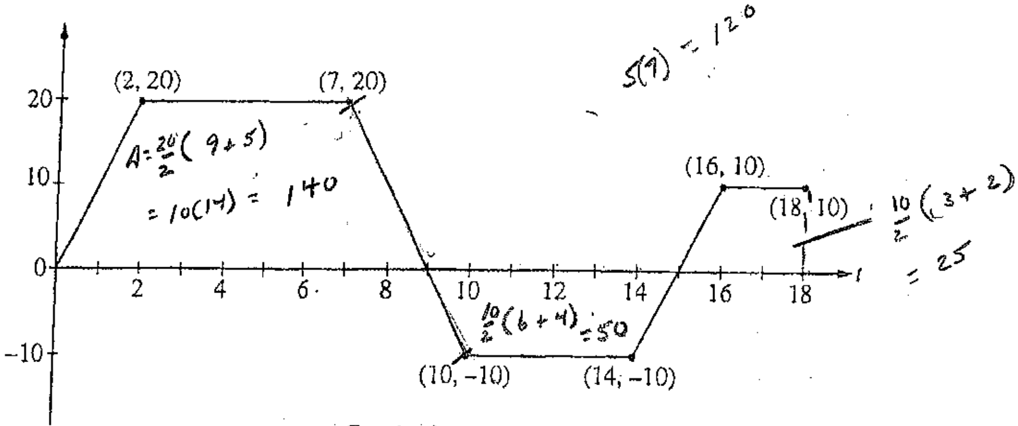
$T.\Delta = 6$ ✓

e.) $V_{AVE} = \dfrac{1}{3-1}\displaystyle\int_1^3 v(t)\,dt = \dfrac{1}{2}\left[t^3 - 9t^2 + 24t\right]_1^3 = 1$ ✓

F.) $A_{AVE} = \dfrac{1}{3-1}\displaystyle\int_1^3 a(t)\,dt = \dfrac{1}{2}\left[3t^2 - 18t\right]_1^3 = -6$ ✓

MOTION
AP – HW 2010

No calculator is allowed for these problems.



Graph of v

4. A squirrel starts at building A at time $t = 0$ and travels along a straight, horizontal wire connected to building B. For $0 \le t \le 18$, the squirrel's velocity is modeled by the piecewise-linear function defined by the graph above.

 (a) At what times in the interval $0 < t < 18$, if any, does the squirrel change direction? Give a reason for your answer.

 (b) At what time in the interval $0 \le t \le 18$ is the squirrel farthest from building A? How far from building A is the squirrel at that time?

 (c) Find the total distance the squirrel travels during the time interval $0 \le t \le 18$.

 (d) Write expressions for the squirrel's acceleration $a(t)$, velocity $v(t)$, and distance $x(t)$ from building A that are valid for the time interval $7 < t < 10$.

---

a.) Changes direction at $t = 9$ and $t = 15$. $v(t)$ changes sign

b.) $t = 9$, 140 units Away

* (d)

c.) $T.D. = 140 + 50 + 25 = 215$ units

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d.) $a(t) = $ slope

$\text{Slope} = \frac{-10-20}{10-7} = \frac{-30}{3} = -10$

$\therefore\ a(t) = -10$

$v(t) = $ equation of line

$y - 20 = -10(x - 7)$

$y - 20 = -10x + 70$

$y = -10x + 90$

$\therefore\ v(t) = -10t + 90$

$s(t) = \int -10t + 90 \, dt$

$s(t) = -5t^2 + 90t + c$

$s(9) = -5(9^2) + 90(9) + c = 140$

$= -405 + 810 + c = 140$

$c = -265$

$\therefore\ s(t) = -5t^2 + 90t - 265$