12.2 Rectilinear Kinematics: Erratic Motion

From: Engineering Mechanics, Dynamics, 6th edition
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Page 17, example 12-6: A car moves along a straight line path such that its position is described by the graph shown in fig. 12-9a. Construct the v-t and a-t graphs for the time period 0<t<30s.

$0 \leq t \leq 10$:

$\boxed{v = \frac{ds}{dt}}$ $\quad v = \frac{d(t^2)}{dt}$

$v = 2t$

$\boxed{a = \frac{dv}{dt}}$ $\quad a = \frac{d(2t)}{t}$

$a = 2$

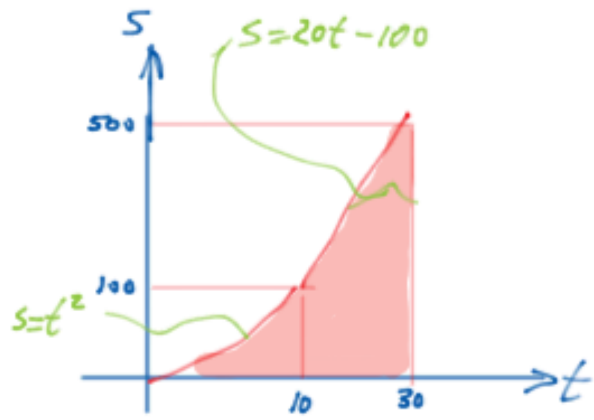


fig. 12-9a

$10 \leq t < 30$:

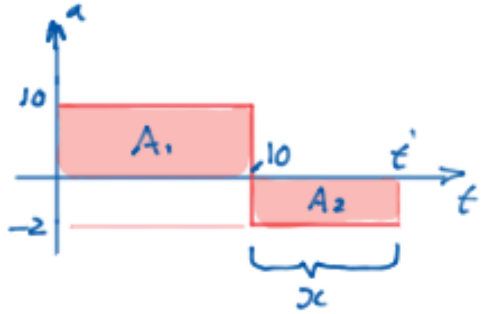
$\boxed{v = \frac{ds}{dt}}$ $\quad v = \frac{d(20t-100)}{dt}$

$v = 20$

$\boxed{a = \frac{dv}{dt}}$ $\quad a = \frac{d(20)}{dt}$

$a = 0$

Page 19, example 12-7: A rocket sled starts from rest and travels along a straight track such that it accelerates at a constant rate for 10s and then decelerates at a constant rate. Draw the v-t and s-t graphs and determine the time t' needed to stop the sled. How far has the sled traveled?



$0 < t < 10$:

$\boxed{a = \frac{dv}{dt}}$ $\quad 10 = \frac{dv}{dt}$

$dv = 10\,dt$

$v = 10t + C \Rightarrow @t=0,\ v=0 \Rightarrow C=0$

$\underbrace{10t}$ → this equals AREA A_1 →

$V_{(10)} = 10 \cdot 10 = 100\ m/s = A_1$

to stop again $A_1 = A_2 = 100$

$A_2 = -2 \cdot x$

$100 = -2 \cdot x \Rightarrow x = 50$

$t' = 50 + 10 = 60\,s$

$\boxed{v = \frac{ds}{dt}}$ $\quad 10t = \frac{ds}{dt}$

$ds = 10\,dt$

$s = 5t^2 + C \Rightarrow @t=0,\ s=0 \Rightarrow C=0$

$10 < t < t'$:

$\boxed{a = \frac{dv}{dt}}$ $\quad -2 = \frac{dv}{dt}$

$dv = -2\,dt$

$v = -2t + C \Rightarrow @t=10,\ v = 10 \cdot 10 = 100 \Rightarrow 100 = -2 \cdot 10 + C$

$100 = -20 + C$

$C = 120$

$\boxed{v = \frac{ds}{dt}}$ $\quad -2t + 120 = \frac{ds}{dt}$

$ds = (-2t + 120)\,dt$

$s = -t^2 + 120t + C \Rightarrow @t=10,\ s = 5 \cdot 10^2 = 500 \Rightarrow 500 = -(10)^2 + 120 \cdot 10 + C$

$500 = -100 + 1200 + C$

$\Leftarrow C = -600$

$S(60) = -(60)^2 + 120 \cdot 60 - 600$

$-3600 + 7200 - 600 = 3000\ m$

Page 21, problem 12-8: The v-s graph describing the motion of a motorcycle is shown in fig. 12-15a. Construct the a-s graph of the motion and determine the time needed for the motorcycle to reach the position s=400ft.

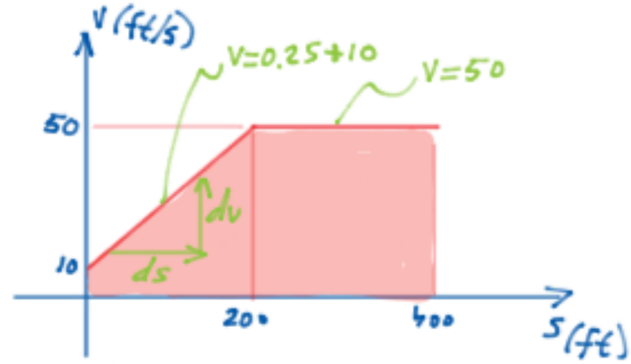


fig. 12-15a

$0 \leq S < 200$:

ds and dv are given as can be seen in the graph the relationship between ds and dv is : ⇒

$$\underbrace{\boxed{v = \frac{ds}{dt}} \quad \boxed{a = \frac{dv}{dt}}}$$

$$dt = \frac{ds}{v} \quad \& \quad dt = \frac{dv}{a}$$

$$\frac{ds}{v} = \frac{dv}{a}$$

$$a \cdot \frac{ds}{v} = dv$$

$$a\,ds = v \cdot dv \Rightarrow V = 0.2S + 10$$

$$a \cdot ds = (0.2S + 10)\, d(0.2S + 10)$$

$$a = \frac{(0.2S + 10)\, d(0.2S + 10)}{ds}$$

$$a = (0.2S + 10) \cdot 0.2$$

$$a = 0.04S + 2$$

$200 < S < 400$:

$$V = 50$$

$$a \cdot ds = 50 \cdot d(50)$$

$$a = \frac{50 \cdot d(50)}{ds}$$

$$a = 50 \cdot 0 = 0$$

$0 \leq S < 200$:

$$\boxed{V = \frac{ds}{dt}}$$

$$V = 0.2S + 10$$

$$0.2S + 10 = \frac{ds}{dt}$$

$$ds = (0.2S + 10)\, dt$$

$$dt = \frac{ds}{0.2S + 10}$$

Page 556: integrals

$$\int \frac{dx}{a + bx} = \frac{1}{b} \ln(a + bx) + C$$

$$t = \frac{1}{0.2} \ln(10 + 0.2S) + C$$

@ $t = 0, S = 0$

$$0 = 5 \ln(10 + 0.2 \cdot 0) + C$$

$$0 = 5 \ln(10) + C$$

$$0 = 11.51 + C$$

$$C = -11.51$$

$$t_{(200)} = 5 \ln(10 + 0.2 \cdot 200) - 11.51$$

$$t_{(200)} = 5 \ln(50) - 11.51$$

$$t_{(200)} = 8.05 \text{ sec}$$

$\underline{200 \leq s < 400:}$

$$\boxed{v = \frac{ds}{dt}} \quad v = 50 \quad \Bigg\} \quad 50 = \frac{ds}{dt}$$

$$ds = 50\, dt$$

$$s = 50t + c$$

$$t = \frac{s}{50} + c \quad \Rightarrow \quad @\, t = 8.05,\; s = 200$$

$$8.05 = \frac{200}{50} + c$$

$$t_{(s)} = \frac{s}{50} + 4.05 \quad \Leftarrow \quad c = 4.05$$

$$t_{(400)} = \frac{400}{50} + 4.05$$

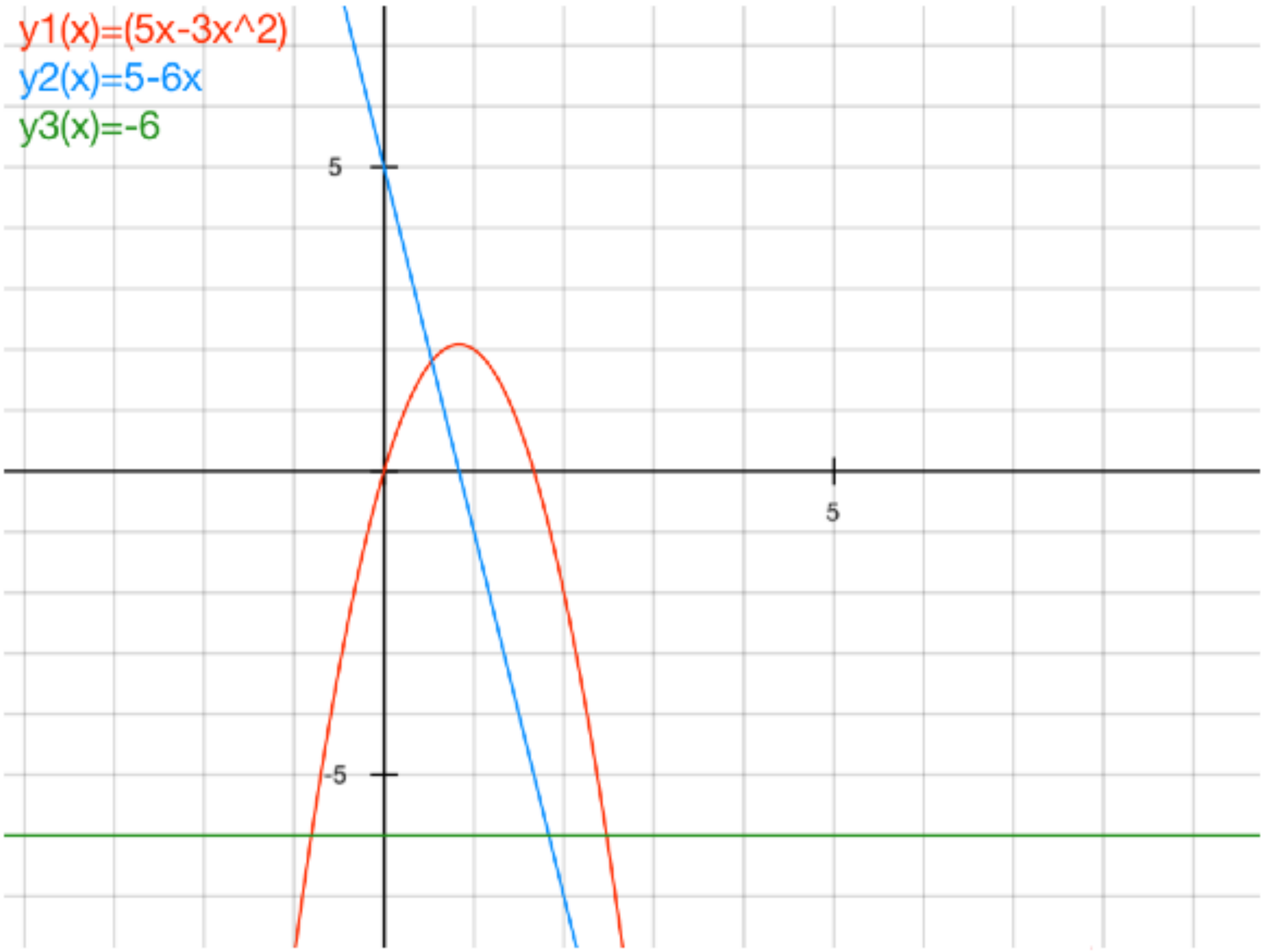
$$= 8 + 4.05 = 12.05 \text{ sec}$$

Page 22, problem 12-31: If the position of a particle is defined as s=(5t-3t^2) ft, where t is in seconds, construct the s-t, v-t and a-t graph for 0 < t < 10 s.

$$s = 5t - 3t^2$$

$$v = \frac{ds}{dt} = \frac{d(5t-3t^2)}{dt} = 5 - 6t$$

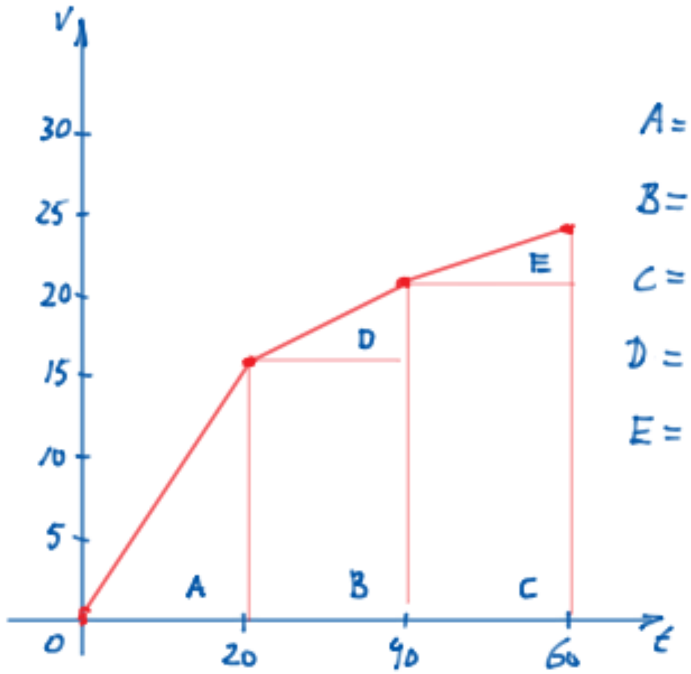
$$a = \frac{dv}{dt} = \frac{d(5-6t)}{dt} = -6$$



Page 22, problem 12-33: The speed of a train during the first minute of its motion has been recorded as follows:

t (s)	0	20	40	60
v (m/s)	0	16	21	24

Plot the v-t graph, approximating the curve as straight line segments between the given points. Determine the total distance traveled.



$$A = \frac{20 \times 16}{2} = 160$$

$$B = 20 \times 16 = 320$$

$$C = 20 \times 21 = 420$$

$$D = \frac{20 \times 5}{2} = 50$$

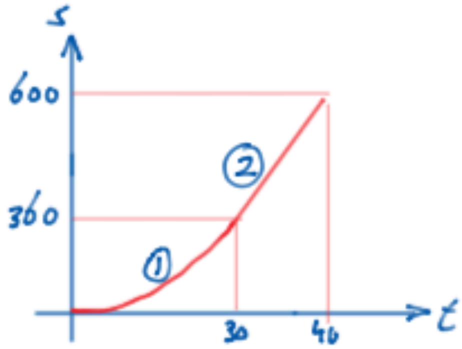
$$E = \frac{3 \times 20}{2} = 30 \; +$$

$$\boxed{980 \text{ m}} = \text{distance traveled}$$

Page 22, problem 12-34: The s-t graph for a train has been determined experimentally. From the data, construct the v-t and a-t graphs for the motion.

① $s = 0.4t^2$ $\quad 0 \leq t < 30$

② $s = 24t - 360$ $\quad 30 < t < 40$



$$v = \frac{ds}{dt} = \frac{d(0.4t^2)}{dt} \overset{*}{=} 0.8\,t \qquad 0 \leq t < 30$$

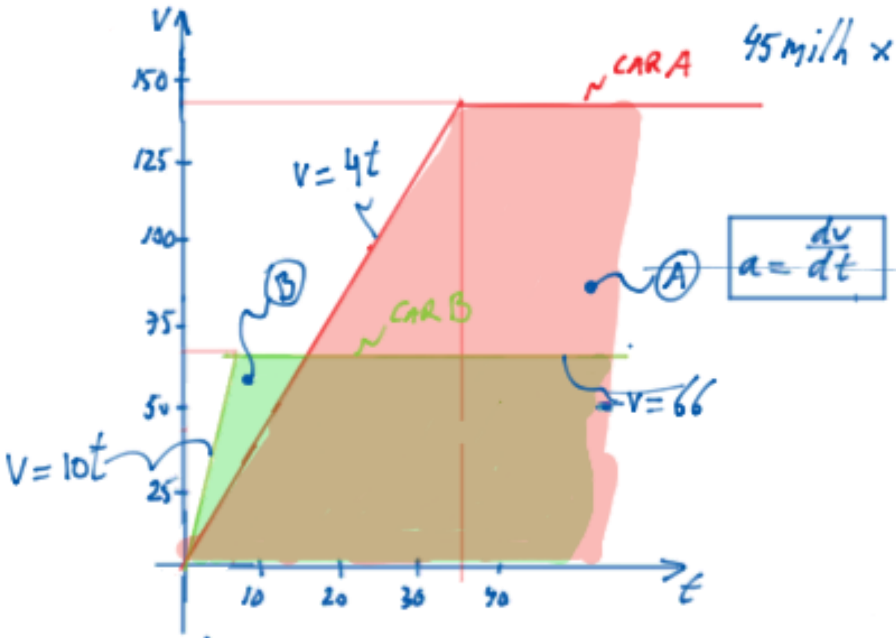
$$v = \frac{ds}{dt} = \frac{d(24t - 360)}{dt} = 24 \qquad 30 < t < 40$$

$$a = \frac{dv}{dt} = \frac{d(0.8t)}{dt} = 0.8 \qquad 0 \leq t < 30$$

$$a = \frac{dv}{dt} = \frac{d(24)}{dt} = 0 \qquad 30 < t < 40$$

* ANSWER page 571, $v = 8t$, is WRONG

Page 22, problem 12-35: Two cars start from rest side by side at the same time and position and race along a straight track. Car A accelerates at 4 ft/s^2 for 35 s and then maintains a constant speed. Car B accelerates at 10 ft/s^2 until reaching a speed of 45mi/h and then maintains a constant speed. Determine the time at which the cars will again be side by side. How far has each car traveled? Construct the v-t graphs for each car.



$$45\,mi/h \times 5280 = \frac{237600\,ft/h}{3600\,sec} = 66\,ft/s$$

CAR A: $4 = \frac{dv}{35} \Rightarrow dv = 140\,ft/s$

CAR B: $10 = \frac{66}{dt} \Rightarrow dt = 6.6\,sec$

the cars pass each other when AREA Ⓐ equals AREA Ⓑ meaning both cars traveled an equal distance:

$4t = \frac{ds}{dt}$

$ds = 4t \cdot dt \quad S=0 @ t=0 \Rightarrow C=0$

$S_A = 2t^2 + c$

$10t = \frac{ds}{dt}$

$ds = 10t \cdot dt \quad S=0 @ t=0 \Rightarrow C=0$

$S_B = 5t^2 + c$

$140 = \frac{ds}{dt}$

$ds = 140\,dt$

$S_A = 140t + c$

$@t=35,\ S_A = 2 \cdot 35^2 = 2450$

$2450 = 140 \cdot 35 + C \Rightarrow C = -2450$

$S_A = 140t - 2450$

$66 = \frac{ds}{dt}$

$ds = 66\,dt$

$S_B = 66t + C$

$@t=6.6,\ S_B = 5 \cdot 6.6^2 = 217.8$

$217.8 = 66 \cdot 6.6 + C \Rightarrow C = -217.8$

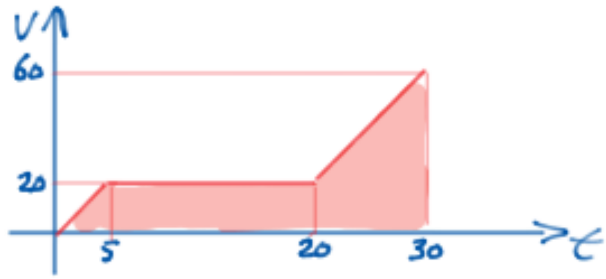
$S_B = 66t - 217.8$

$\Longleftrightarrow$

$140t - 66t = -217.8 + 2450$

$74t = 2232.2 \Rightarrow \boxed{t = 30.16}$

Page 22, problem 12-37: From experimental data, the motion of a jet plane while traveling along a runway is defined by the v-t graph. Construct the s-t and a-t graphs for the motion.



$0 \leq t < 5$: $v(t) = 4t$

$\boxed{a = \frac{dv}{dt}}$ $a = \frac{d(4t)}{dt} = 4$

$\boxed{v = \frac{ds}{dt}}$ $\Rightarrow 4t = \frac{ds}{dt}$

$ds = 4t \cdot dt$

$s = 2t^2 + C$ [@ $t=0, s=0 \Rightarrow C=0$]

$5 \leq t < 20$: $v(t) = 20$

$a = 0$

$s = 20t + C$ @ $t=5$, $s = \frac{5 \times 20}{2} = 50$ $\Rightarrow$ $50 = 20 \cdot 5 + C$

$C = -50$

$s = 20t - 50$

$20 \leq t$ 30:

$\boxed{a = \frac{dv}{dt}}$ $a = \frac{60-20}{30-20} = \frac{40}{10} = 4$

$dv = a \cdot dt = 4 \cdot dt$

$v = 4t + C$ @ $t = 20$, $V = 20$ $\Rightarrow$ $20 = 4 \cdot 20 + C$

$C = -60$

$v = 4t - 60$

$\boxed{v = \frac{ds}{dt}}$ $4t - 60 = \frac{ds}{dt}$

$ds = (4t - 60)\,dt$

$s = 2t^2 - 60t + C$ @ $t = 20$, $s = (20 \cdot 20) - 50 = 350$

$350 = (2 \cdot 20^2) - (60 \cdot 20) + C$

$350 = 800 - 1200 + C$

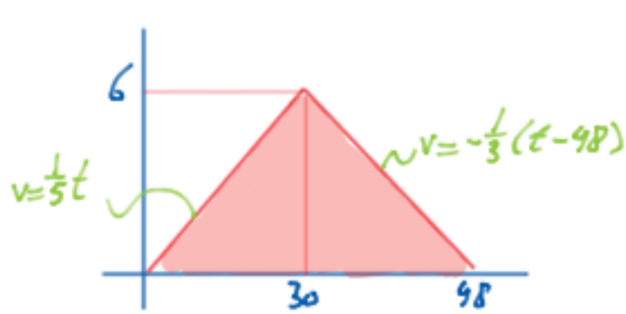
$350 = -400 + C$

$s = 2t^2 - 60t + 750$ $C = 750$

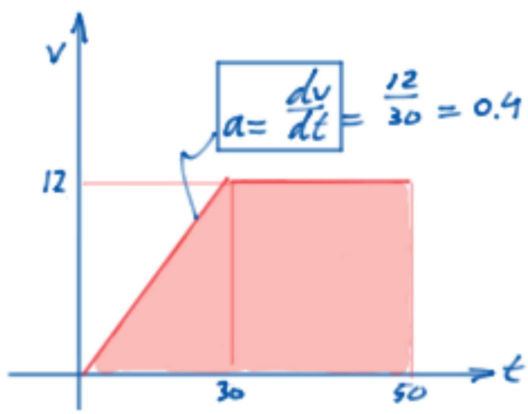
Page 23, problem12-38: The car travels along a straight road according to the v-t graph. Determine the total distance the car travels until it stops when t=48sec. Also plot the s-t and a-t graphs.

distance traveled is area under graph:

$$s = \left(\frac{30\cdot 6}{2}\right) + \left(\frac{(48-30)\cdot 6}{2}\right)$$
$$= 90 + 54$$
$$= 144$$



Page 23, problem 12-39: The snowmobile moves along a straight course according to the v-t graph. Construct the s-t and a-t graphs for the same 50 s time interval. When t=0, s=0.



$0 \leq t < 30$:

$v(t) = 0.4t$

$a(t) = 0.4$

$\boxed{v = \frac{ds}{dt}} \quad 0.4t = \frac{ds}{dt}$

$ds = 0.4t \cdot dt$

$s = 0.2t^2 + c \quad [@t=0, s=0 \Rightarrow c=0]$

$30 \leq t < 50$:

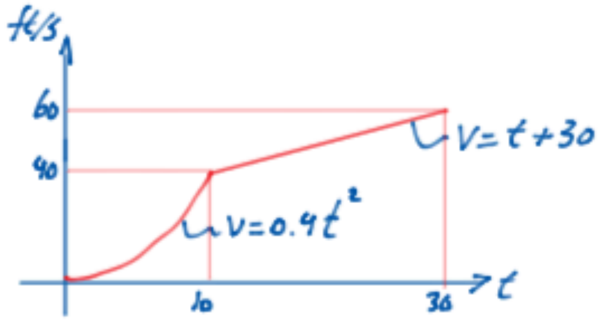
$v(t) = 12$

$a(t) = 0$

$s(t) = 12t + c \quad \left[@t=30, s = 0.2\cdot 30^2 = 180 \Rightarrow \begin{array}{l} 180 = 12\cdot 30 + c \\ 180 = 360 + c \\ c = -180 \end{array}\right]$

$s(t) = 12t - 180$

Page 23, problem 12-41: The v-t graph for the motion of a car as it moves along a straight road is shown. Construct the s-t graph and determine the average speed and the distance traveled for the 30 s time interval. The car starts from rest at s=0.



$0 \leq t < 10$:

$V_{(t)} = 0.4t^2$

$\boxed{V = \frac{ds}{dt}}$ $\quad 0.4t^2 = \frac{ds}{dt}$

$ds = 0.4t^2 \cdot dt$

$s = 0.13t^3 + C \Rightarrow @t=0, s=0 \Rightarrow C = 0$

$S_{(10)} = 0.13(10^3) = 133.3 \text{ ft}$

$10 \leq t < 30$:

$V_{(t)} = t + 30$

$\boxed{V = \frac{ds}{dt}}$ $\quad t + 30 = \frac{ds}{dt}$

$ds = (t+30)\,dt$

$ds = t \cdot dt + 30\,dt$

$s = \frac{1}{2}t^2 + 30t + c \Rightarrow @t=10, s=133 \Rightarrow 133 = \frac{1}{2}\cdot 10^2 + 30\cdot 10 + C$

$133 = 50 + 300 + C$

$s = \frac{1}{2}t^2 + 30t - 217 \Leftarrow C = -217$

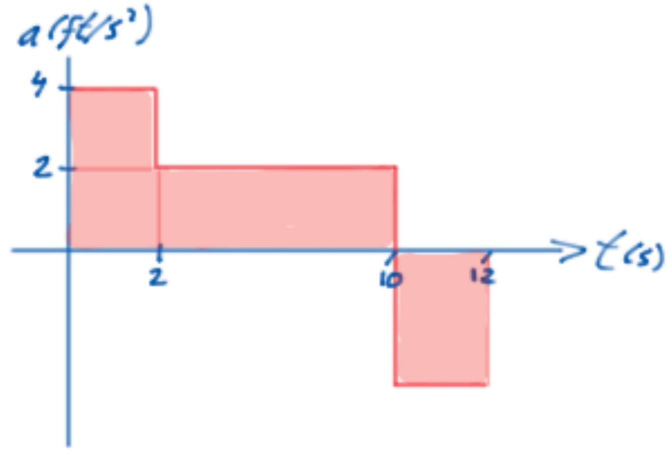
$S_{(30)} = \left(\frac{1}{2}\cdot 30^2\right) + (30\cdot 30) - 217$

$= 450 + 900 - 217$

$= 1133 \text{ ft}$

$V_{AVG} = \frac{S_{total}}{t_{total}} = \frac{1133}{30} = 37.8 \text{ m/s}$

Page 23, problem 12-42: A particle starts from rest and is subjected to the acceleration shown. Construct the v-t graph for the motion, and determine the distance traveled during the time interval 2s < t < 6s.



$0 \leq t < 2$:

$a = 4$

$\boxed{a = \frac{dv}{dt}}$ $\quad 4 = \frac{dv}{dt}$

$dv = 4 \cdot dt$

$v = 4t + C \Rightarrow @\, t = 0, v = 0 \Rightarrow C = 0$

$\boxed{v = \frac{ds}{dt}}$ $\quad 4t = \frac{ds}{dt}$

$ds = 4t \cdot dt$

$s = 2t^2 + C \Rightarrow @\, t = 0, s = 0 \Rightarrow C = 0$

$2 \leq t < 6$:

$a = 2$

$\boxed{a = \frac{dv}{dt}}$ $\quad 2 = \frac{dv}{dt}$

$dv = 2 \cdot dt$

$v = 2t + C \Rightarrow @\, t = 2, v = 4 \cdot 2 = 8 \Rightarrow 8 = 2 \cdot 2 + C$

$C = 4$

$v = 2t + 4$

$\boxed{v = \frac{ds}{dt}}$ $\quad 2t + 4 = \frac{ds}{dt}$

$ds = (2t + 4)\, dt$

$ds = 2t \cdot dt + 4\, dt$

$s = t^2 + 4t + C \Rightarrow @\, t = 2, s = 2 \cdot 2^2 = 8 \Rightarrow 8 = 2^2 + 4 \cdot 2 + C$

$8 = 4 + 8 + C$

$C = -4$

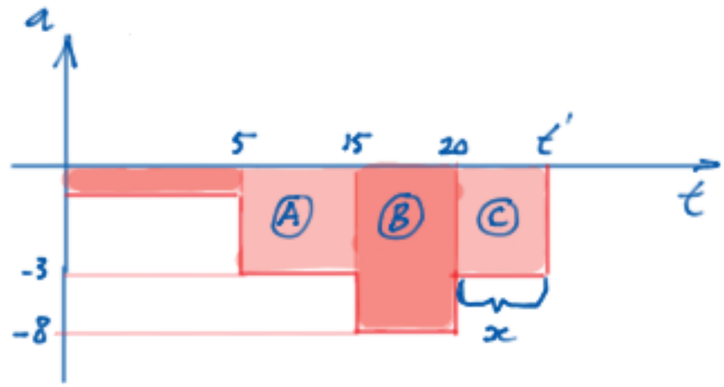
$s = t^2 + 4t - 4$

$S(2) = 2^2 + 4 \cdot 2 - 4 = 4 + 8 - 4 = 8\ ft$

$S(6) = 6^2 + 4 \cdot 6 - 4 = 36 + 24 - 4 = 56\ ft$

$S_{(2-6)} = 56 - 8 = 48\ ft$

Page 24, problem 12-43: An airplane lands on the straight runway, originally traveling at 110ft/s when s=0. If it is subjected to the decalerations shown, determine the time t' needed to stop the plane and construct the s-t graph for the motion:



$0 \le t < 5$: No decaleration

$V_{(5)} = 110$ ft/s

$5 \le t < 15$: decaleration is area A

$A = (15-5) \cdot -3 = -30$

$V_{(15)} = 110 - 30 = 80$

$15 \le t < 20$: deceleration is area B

$B = (20-15) \cdot -8 = -40$

$V_{(20)} = 80 - 40 = 40$

$20 \le t < t'$: decaleration C $= -40$ (to get to 0)

$-40 = x \cdot -3$

$x = 13.33$ total time $= 20 + 13.33 =$ 33.33 sec

Page 24, problem 12-45: The a-t graph for a car is shown. Construct the v-t graph if the car starts from rest at t=0. At what time t' does the car stop?

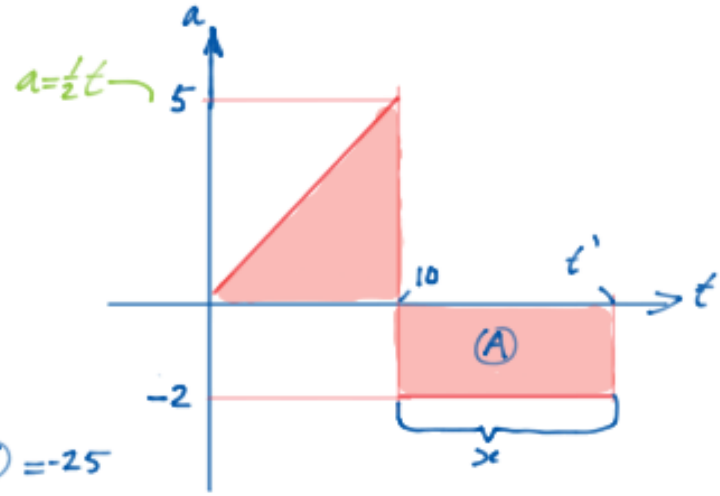
$\boxed{a = \frac{dv}{dt}}$ $\Rightarrow a = \frac{1}{2}t = \frac{dv}{dt}$

$dv = \frac{1}{2}t\, dt$

$v = \frac{1}{4}t^2 + C$

$@t=0,\ v=0 \Rightarrow C=0$

$@t=10,\ v = \frac{1}{4}10^2 = 25$

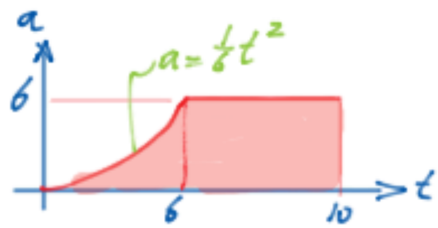


deceleration to stop = AREA Ⓐ $= -25$

$x \cdot -2 = -25 \Rightarrow x = 12.5$

total time $t' = 12.5 + 10 =$ **22.5 sec**

Page 24, problem 12-46: A race car starting from rest travels along a straight road and for 10s has the acceleration shown. Construct the v-t graph that describes the motion and find the distance traveled in 10s.



$\underline{0 \le t < 6:}$

$\frac{1}{6}t^2 = \frac{dv}{dt} \Rightarrow dv = \frac{1}{6}t^2 \cdot dt$

$v = \frac{1}{18}t^3 + C$

$@t=0,\ v=0 \Rightarrow C=0$

$\boxed{a = \frac{dv}{dt}}$

$\frac{1}{18}t^3 = \frac{ds}{dt} \Rightarrow ds = \frac{1}{18}t^3 \cdot dt$

$s = \frac{1}{72}t^4 + C$

$\boxed{v = \frac{ds}{dt}}$

$@t=0, s=0 \Rightarrow C=0$

$\underline{6 \le t < 10:}$

$6 = \frac{dv}{dt}$

$dv = 6 \cdot dt$

$v = 6t + C$

$@t=6,\ v = \frac{1}{18}6^3 = 12 \Rightarrow 12 = 6t + C$

$12 = 6 \cdot 6 + C$

$12 = 36 + C$

$v = 6t - 24 \Leftarrow C = -24$

$6t - 24 = \frac{ds}{dt}$

$ds = (6t - 24)\, dt$

$s = 3t^2 - 24t + C$

$@t=6,\ s = \frac{1}{72} \cdot 6^4 = 18$

$18 = 3 \cdot 6^2 - 24 \cdot 6 + C$

$18 = 108 - 144 + C$

$C = 54$

$S_{(10)} = 3t^2 - 24t + 54$

$= 3 \cdot 10^2 - 24 \cdot 10 + 54$

$= 300 - 240 + 54$

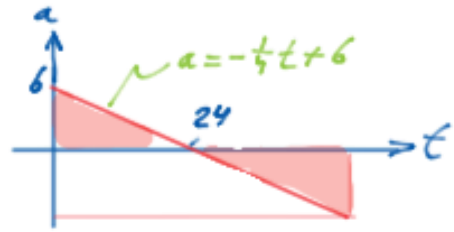
$=$ **114 m**

Page 25, problem 12-47: The boat is originally traveling at a speed of 8 m/s when it is subjected to the acceleration shown in the graph. Determine the boat's maximum speed and the time t when it stops.

$$\boxed{a = \frac{dv}{dt}} \qquad -\frac{1}{4}t + 6 = \frac{dv}{dt}$$

$$dv = \left(-\frac{1}{4}t + 6\right)dt$$

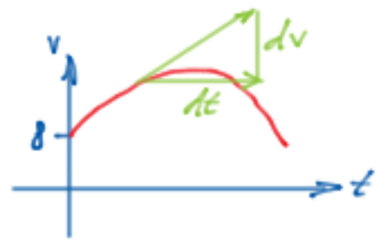
$$v = -\frac{1}{8}t^2 + 6t + c$$



$$@t=0,\ v=8 \Rightarrow 8 = -\frac{1}{8}\cdot 0^2 + 6\cdot 0 + c$$

$$c = 8$$

$$v = -\frac{1}{8}t^2 + 6t + 8$$



$$V_{(24)} = -\frac{1}{8}\cdot 24^2 + 6\cdot 24 + 8 \quad \Leftarrow \begin{cases} V = \text{max when } \frac{dv}{dt} = 0 \\ \text{this is when } a = 0 \ @\ t = 24 \end{cases}$$

$$= -72 + 144 + 8$$

$$= 80 \text{ m/s}$$

$$0 = -\frac{1}{8}t^2 + 6t + 8 \quad \Leftarrow \begin{cases} \text{when the boat stops} \\ V = 0 \end{cases}$$

$$(\times -8) \Rightarrow t^2 - 48t - 64 = 0$$

$$t = \frac{48 \pm \sqrt{(-48)^2 - (4\cdot 1\cdot -64)}}{2} \quad \Leftarrow \boxed{\text{Page 555: } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}}$$

$$t = \frac{48 \pm \sqrt{2304 - (-256)}}{2}$$

$$t = \frac{48 \pm 50.59}{2}$$

$$t = 49.29 \text{ sec}$$

$$t = -1.29 \text{ sec}$$

Page 25, problem 12-49: The a-s graph for a race car moving along a straight track has been experimentally determined. If the car starts from rest, determine its speed when s=50 ft, 150ft and 200ft, respectively.

$0 \le s < 50$:

$$\boxed{a=\frac{dv}{dt}} \qquad 5=\frac{dv}{dt}$$

$$dv = 5\,dt$$

$$v = 5\cdot t + c$$

$$@t=0,\ v=0 \Rightarrow c=0$$

$$\boxed{v=\frac{ds}{dt}} \qquad 5t=\frac{ds}{dt}$$

$$ds = 5t\cdot dt$$

$$s = 2.5t^2 + c$$

$$@t=0,\ s=0 \Rightarrow c=0$$

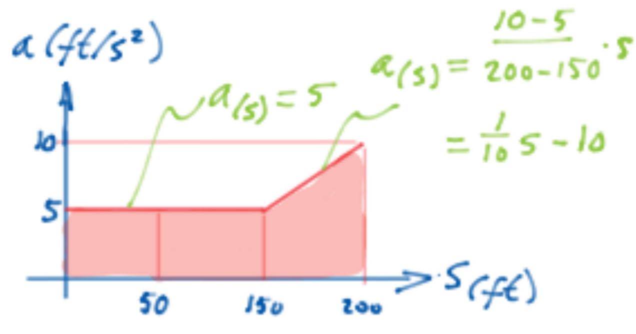
$$\Downarrow$$

$$50 = 2.5t^2 \Rightarrow t = 4.47$$

$$v(4.47) = 5\cdot 4.47 = 22.36\ ft/s$$

$$150 = 2.5t^2 \Rightarrow t = 7.75$$

$$v(7.75) = 5\cdot 7.75 = 38.73\ ft/s$$



$150 \le s < 200$:

$$\boxed{a=\frac{dv}{dt}} \qquad \frac{1}{10}s-10=\frac{dv}{dt}$$

$$dt = \frac{dv}{\frac{1}{10}s-10}$$

$$\boxed{v=\frac{ds}{dt}} \qquad dt = \frac{ds}{v}$$

$$\frac{dv}{\frac{1}{10}s-10} = \frac{ds}{v}$$

$$v\cdot\frac{dv}{\frac{1}{10}s-10} = ds$$

$$v\cdot dv = \left(\frac{1}{10}s-10\right) ds$$

$$\frac{1}{2}v^2 = \frac{1}{20}s^2 - 10s + c$$

$$@s=150,\ v=38.73$$

$$\frac{1}{2}\cdot 38.37^2 = \frac{1}{20}\cdot 150^2 - 10\cdot 150 + c$$

$$736.12 = 1125 - 1500 + c$$

$$c = 1111.12$$

$$@s=200,\ v=?$$

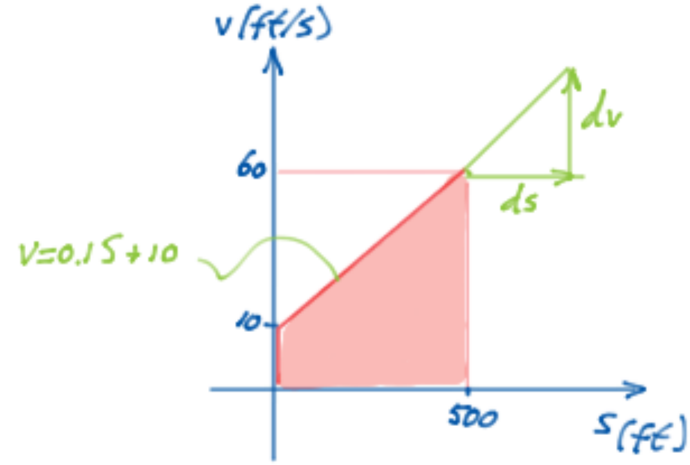
$$\frac{1}{2}v^2 = \frac{1}{20}\cdot 200^2 - 10\cdot 200 + 1111.12$$

$$\frac{1}{2}v^2 = 2000 - 2000 + 1111.12$$

$$v^2 = 2222.24$$

$$v = 47.14\ ft/s$$

Page 26, problem 12-53: The v-s graph for the car is given for the first 500ft of its motion. Construct the a-s graph for 0<s<500ft. How long does it take to travel the 500ft distance? The car starts at s=0 when t=0.



$\boxed{v = \frac{ds}{dt}}$

$v = 0.1s + 10$

$0.1s + 10 = \frac{ds}{dt}$

$ds = (0.1s + 10) \cdot dt$

$dt = \frac{ds}{0.1s + 10}$

$t = \frac{1}{0.1} \ln(10 + 0.1s) + C$

$\boxed{\begin{matrix} a = 10 \\ b = 0.1 \end{matrix}}$

page 556, differentials:

$$\int \frac{dx}{a+bx} = \frac{1}{b} \ln(a+bx) + C$$

@ $t=0$, $s=0$

$0 = 10 \ln(10) + C$

$0 = 23.026 + C$

$C = -23.026$

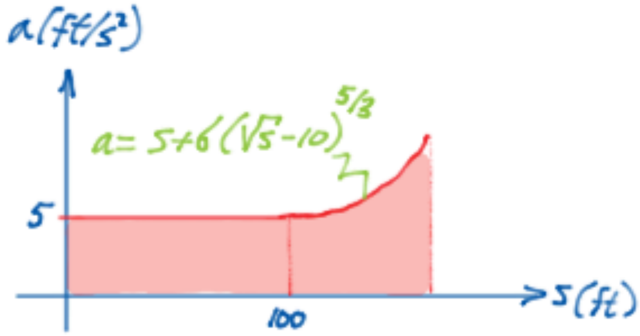
$\Downarrow$

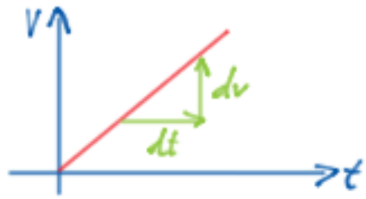
@ $s=500$: $t = 10 \ln(10 + 0.1 \cdot 500) - 23.026$

$t = 40.943 - 23.026$

$t = 17.92\ s$

Page 26, problem 12-54: The a-s graph for a boat moving along a straight path is given. If the boat starts at s=0 when v=0, determine its speed when it is at s=75ft and 125ft respectively. Use Simpson's rule with n=100 to evaluate v at s=125ft.





$\underline{0 \leq s < 100:}$

$$\left.\begin{array}{l} \boxed{a = \frac{dv}{dt}} \\ a = 5 \end{array}\right\} \quad 5 = \frac{dv}{dt}$$

$$dv = 5\,dt$$

$$v = 5 \cdot t + c \quad \left\{\begin{array}{l} @t=0, v=0 \\ C=0 \end{array}\right.$$

$$\left.\begin{array}{l} \boxed{v = \frac{ds}{dt}} \\ v = 5t \end{array}\right\} \quad 5t = \frac{ds}{dt}$$

$$ds = 5t \cdot dt$$

$$s = 2.5t^2 + c \quad \left\{\begin{array}{l} @t=0, s=0 \\ C=0 \end{array}\right.$$

$$75_{(t)} = 2.5t^2$$

$$t^2 =$$

$$t = 5.48 \Rightarrow V(5.48) = 5 \cdot 5.48 = 27.39$$