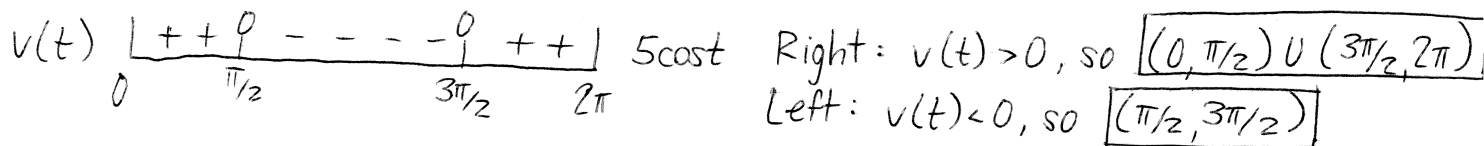


Section 8.1: 1-27 odd

1.  $v(t) = 5 \cos t$ ,  $0 \leq t \leq 2\pi$

a)  $v(t) = 0 \rightarrow 5 \cos t = 0 \rightarrow \cos t = 0$  at  $t = \pi/2, 3\pi/2$  (stopped)



b)  $\int_0^{2\pi} 5 \cos t \, dt = 5 \sin t \Big|_0^{2\pi} = 5 \sin 2\pi - 5 \sin 0 = 5(0) - 5(0) = 0 - 0 = 0$

$3 + 0 = 3$

c)  $\int_0^{\pi/2} 5 \cos t \, dt = 5 \sin t \Big|_0^{\pi/2} = 5 \sin \frac{\pi}{2} - 5 \sin 0 = 5(1) - 5(0) = 5 - 0 = 5$

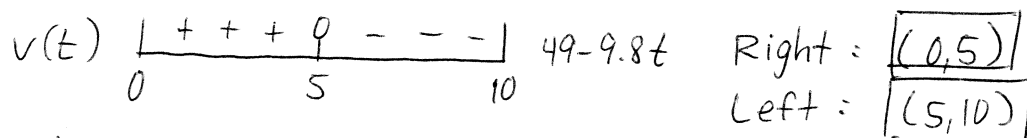
$\int_{\pi/2}^{3\pi/2} 5 \cos t \, dt = 5 \sin t \Big|_{\pi/2}^{3\pi/2} = 5 \sin \frac{3\pi}{2} - 5 \sin \frac{\pi}{2} = 5(-1) - 5(1) = -5 - 5 = -10$

$\int_{3\pi/2}^{2\pi} 5 \cos t \, dt = 5 \sin t \Big|_{3\pi/2}^{2\pi} = 5 \sin 2\pi - 5 \sin \frac{3\pi}{2} = 5(0) - 5(-1) = 0 + 5 = 5$

Total distance traveled =  $5 + |-10| + 5 = 5 + 10 + 5 = 20$

3.  $v(t) = 49 - 9.8t$ ,  $0 \leq t \leq 10$

a)  $v(t) = 0 \rightarrow 49 - 9.8t = 0 \rightarrow 9.8t = 49 \rightarrow t = 5$  (stopped)



b)  $\int_0^{10} (49 - 9.8t) \, dt = 49t - 4.9t^2 \Big|_0^{10} = 49(10) - 4.9(10)^2 = 490 - 490 = 0$

$3 + 0 = 3$

c)  $\int_0^5 (49 - 9.8t) \, dt = 49t - 4.9t^2 \Big|_0^5 = 49(5) - 4.9(5)^2 = 122.5$

$$3. c) \int_5^{10} (49 - 9.8t) dt = 49t - 4.9t^2 \Big|_5^{10} = (49 \cdot 10 - 4.9 \cdot 10^2) - (49 \cdot 5 - 4.9 \cdot 5^2) = -122.5$$

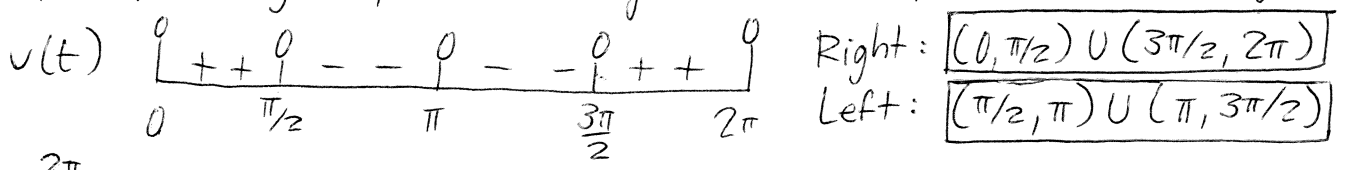
$$\text{Total distance traveled} = 122.5 + |-122.5| = \boxed{245}$$

$$5. v(t) = 5 \sin^2 t \cos t, \quad 0 \leq t \leq 2\pi$$

$$a) v(t) = 0 \rightarrow 5 \sin^2 t \cos t = 0 \text{ when } \sin t = 0 \text{ or } \cos t = 0$$

$$\text{Stopped when } \boxed{t = 0, \pi/2, \pi, 3\pi/2, 2\pi}$$

$\sin^2 t$  is always +, so the sign of  $v(t)$  depends on the sign of  $\cos t$ .



$$b) \int_0^{2\pi} 5 \sin^2 t \cos t dt = \frac{5}{3} (\sin t)^3 \Big|_0^{2\pi} = \frac{5}{3} (\sin 2\pi)^3 - \frac{5}{3} (\sin 0)^3 = \frac{5}{3} (0) - \frac{5}{3} (0) = \boxed{0}$$

$$3 + 0 = \boxed{3}$$

$$c) \int_0^{\pi/2} 5 \sin^2 t \cos t dt = \frac{5}{3} (\sin t)^3 \Big|_0^{\pi/2} = \frac{5}{3} (1^3 - 0^3) = \frac{5}{3} \cdot 1 = \frac{5}{3}$$

$$\int_{\pi/2}^{\pi} 5 \sin^2 t \cos t dt = \frac{5}{3} (\sin t)^3 \Big|_{\pi/2}^{\pi} = \frac{5}{3} (0^3 - 1^3) = \frac{5}{3} \cdot (-1) = -\frac{5}{3}$$

$$\int_{\pi}^{3\pi/2} 5 \sin^2 t \cos t dt = \frac{5}{3} (\sin t)^3 \Big|_{\pi}^{3\pi/2} = \frac{5}{3} ((-1)^3 - 0^3) = \frac{5}{3} (-1) = -\frac{5}{3}$$

$$\int_{3\pi/2}^{2\pi} 5 \sin^2 t \cos t dt = \frac{5}{3} (\sin t)^3 \Big|_{3\pi/2}^{2\pi} = \frac{5}{3} (0^3 - (-1)^3) = \frac{5}{3} \cdot 1 = \frac{5}{3}$$

$$\text{Total distance traveled} = \frac{5}{3} + \left| -\frac{5}{3} \right| + \left| -\frac{5}{3} \right| + \frac{5}{3} = \boxed{\frac{20}{3}}$$

$$7. v(t) = e^{\sin t} \cos t, \quad 0 \leq t \leq 2\pi$$

$$a) e^{\sin t} \cdot \cos t = 0 \text{ when } \cos t = 0 \rightarrow \boxed{t = \pi/2, 3\pi/2} \text{ (stopped)}$$

$$v(t) \quad | \quad + \quad + \quad | \quad - \quad - \quad | \quad + \quad + \quad | \quad e^{\sin t} \cdot \cos t \quad \text{Right: } \boxed{(0, \pi/2) \cup (3\pi/2, 2\pi)}$$

$0 \quad \pi/2 \quad 3\pi/2 \quad 2\pi$

$$\text{Left: } \boxed{(\pi/2, 3\pi/2)}$$

$$b) \int_0^{2\pi} e^{\sin t} \cdot \cos t \, dt = e^{\sin t} \Big|_0^{2\pi} = e^{\sin 2\pi} - e^{\sin 0} = e^0 - e^0 = 1 - 1 = \boxed{0}$$

$$3 + 0 = \boxed{3}$$

$$c) \int_0^{\pi/2} e^{\sin t} \cos t \, dt = e^{\sin t} \Big|_0^{\pi/2} = e^1 - e^0 = e - 1$$

$$\int_{\pi/2}^{3\pi/2} e^{\sin t} \cos t \, dt = e^{\sin t} \Big|_{\pi/2}^{3\pi/2} = e^{-1} - e^1 = \frac{1}{e} - e$$

$$\int_{3\pi/2}^{2\pi} e^{\sin t} \cos t \, dt = e^{\sin t} \Big|_{3\pi/2}^{2\pi} = e^0 - e^{-1} = 1 - \frac{1}{e}$$

$$\text{Total distance} = e - 1 + \left| \frac{1}{e} - e \right| + 1 - \frac{1}{e} = e - 1 + e - \frac{1}{e} + 1 - \frac{1}{e} = \boxed{2e - \frac{2}{e}}$$

$$a(t) = 1 + 3\sqrt{t}$$

$$9. \int_0^9 (1 + 3\sqrt{t}) \, dt = \int_0^9 (1 + 3t^{1/2}) \, dt = t + 2t^{3/2} \Big|_0^9 = 9 + 2 \cdot 9^{3/2} = 9 + 2 \cdot 27 = \boxed{63 \text{ mph}}$$

$$v(t) = t + 2t^{3/2}$$

$$\int_0^9 (t + 2t^{3/2}) \, dt = \frac{1}{2}t^2 + \frac{4}{5}t^{5/2} \Big|_0^9 = \frac{1}{2} \cdot 9^2 + \frac{4}{5} \cdot 9^{5/2} = \frac{234.9 \text{ mi} \cdot \text{s}}{\text{hr}}$$

$$\frac{234 \text{ mi}}{\text{hr}} \cdot \frac{\cancel{\text{s}}}{\cancel{60 \text{ min}}} \cdot \frac{1 \text{ hr}}{\cancel{60 \text{ s}}} \cdot \frac{5,280 \text{ ft}}{1 \text{ mi}} = \boxed{344.52 \text{ ft}}$$

11.  $a = -32 \text{ ft/s}^2$

a)  $\int_0^3 -32 dt = -32t \Big|_0^3 = -32(3) + 32(0) = -96 \text{ ft/s}$

$90 \text{ ft/s} - 96 \text{ ft/s} = \boxed{-6 \text{ ft/s}}$

b)  $v(t) = -32t + 90$

$s(t) = -16t^2 + 90t + C \rightarrow 0 = 0 + 0 + C \rightarrow C = 0$

$-16t^2 + 90t = 0 \rightarrow 2t(-8t + 45) = 0 \rightarrow t = 0 \text{ or } 45 = 8t \rightarrow \boxed{t = 5.625 \text{ s}}$

c)  $\boxed{0}$  (no net change from initial position)

d)  $v(t) = 0 \rightarrow -32t + 90 = 0 \rightarrow t = 2.8125$

$v(t) \begin{array}{|c|c|c|c|} \hline + & + & 0 & - \\ \hline \end{array}$   
 $\begin{array}{c} 0 \qquad 2.8125 \qquad 5.625 \end{array}$

$\int_0^{2.8125} (-32t + 90) dt = -16t^2 + 90t \Big|_0^{2.8125} = 126.5625$

$\int_{2.8125}^{5.625} (-32t + 90) dt = -16t^2 + 90t \Big|_{2.8125}^{5.625} = -126.5625$

Total distance traveled =  $126.5625 + |-126.5625| = \boxed{253.125 \text{ ft}}$

13.  $4 + 5 + |-24| = 4 + 5 + 24 = \boxed{33 \text{ cm}}$

15. Greatest acceleration = greatest slope of velocity graph:  $\boxed{t = a}$

17. 4  $\Delta$ 's

$4 \cdot \frac{1}{2} \cdot 1 \cdot 2 = 4$  units right

a)  $2 + 4 = \boxed{6}$

b)  $\boxed{4}$

19.  $-\frac{1}{2}(1)(2) = -1$  (left)

$\frac{1}{2} \cdot 2(1+4) = 1.5 = 5$  (right)

$-\frac{1}{2} \cdot 2 \cdot 1 = -1$  (left)

a)  $2 - 1 + 5 - 1 = \boxed{5}$

b)  $1 + 5 + 1 = \boxed{7}$

$$21. \int_0^{10} 27.08 e^{\frac{1}{25}t} dt = 25 \cdot 27.08 e^{\frac{1}{25}t} \Big|_0^{10} = 25 \cdot 27.08 (e^{10/25} - e^0) = \boxed{332.965 \text{ billion barrels}}$$

$$23. \text{Density} = 10,000(2-r)$$

a)  $10,000(2-r)$  approaches 0 as  $r$  approaches 2, so  $\boxed{r = 2 \text{ mi}}$

$$b) A = lw = Cw = \boxed{2\pi r \Delta r}$$

c) Population size = Population Density  $\times$  Area

$$= 10,000(2-r) \cdot 2\pi r \Delta r = 20,000\pi r(2-r) \Delta r$$

$$d) \int_0^2 20,000\pi(2r-r^2) dr = 20,000\pi \left( r^2 - \frac{1}{3}r^3 \right) \Big|_0^2 = 83,775.804 \rightarrow \boxed{83,776 \text{ people}}$$

$$25. a) 5 + 8.9 + 16 + \dots + 155.3 + 188 = \boxed{797.5 \text{ thousand bagels}}$$

$$b) \boxed{B(x) = 1.6x^2 + 2.3x + 5}$$

$$c) \int_0^{11} (1.6x^2 + 2.3x + 5) dx = \left. \frac{1.6}{3}x^3 + \frac{2.3}{2}x^2 + 5x \right|_0^{11} = \boxed{904.017 \text{ thousand bagels}}$$

d) The answer to part a represents left hand rectangles. The answer to part c represents the exact area under the curve, which is greater than LRAM since the curve is increasing on  $[0, 11]$ .

$$27. T = \frac{1}{2} \cdot 1 (120 + 2(110) + 2(115) + 2(115) + \dots + 2(110) + 121) = \boxed{1,156.5 \text{ cases of milk}}$$

