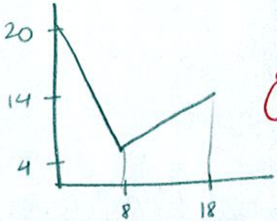
A person's velocity (in meters per minute) at time t (in minutes) is given by $v(t) = \begin{cases} 20-2t, & 0 \le t \le 8 \\ t-4, & 8 \le t \le 18 \end{cases}$. **SCORE: _____ / 5 PTS**

[a] Find the exact distance the person travelled from time $t = 0$ seconds to $t = 18$ seconds.
NOTE: You must show the arithmetic expression that you used to get your answer.



$\frac{1}{2}(20+4)(8-0) + \frac{1}{2}(4+14)(18-8)$

1 $= \frac{1}{2}(20+4)(8) + \frac{1}{2}(4+14)(10)$ 1

$= 96 + 90$

$= 186$ m $\frac{1}{2}$

[b] Estimate the distance the person travelled from time $t = 0$ seconds to $t = 18$ seconds using three subintervals and left endpoints.
NOTE: You must show the arithmetic expression that you used to get your answer.

$\Delta t = \frac{18-0}{3} = 6$

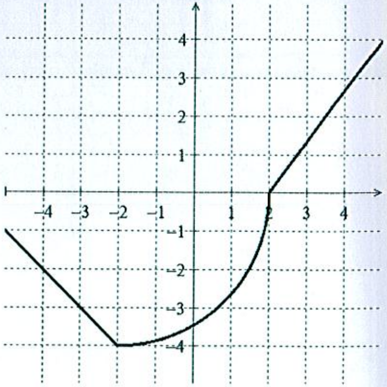
$v(0)\Delta t + v(6)\Delta t + v(12)\Delta t$

$= (20 + 8 + 8)(6)$ 2

$= 216$ m $\frac{1}{2}$

The graph of function f is shown on the right. **SCORE: _____ / 4 PTS**

The graph consists of a diagonal line, an arc of a circle, then another diagonal line.



[a] Evaluate $\int_{-5}^{5} f(x)\,dx$.

NOTE: You must show the arithmetic expression that you used to get your answer.

① $\underbrace{-\frac{1}{2}(1+4)(3)}\ \underbrace{-\frac{1}{4}\pi(4)^2}_{①} + \underbrace{\frac{1}{2}(3)(4)}_{\frac{1}{2}}$

$= \underbrace{-\frac{3}{2} - 4\pi}$ $\frac{1}{2}$

[b] Evaluate $\int_{5}^{-2} f(x)\,dx$.

$= -\int_{-2}^{5} f(x)\,dx = -\left[-\frac{1}{4}\pi(4)^2 + \frac{1}{2}(3)(4)\right] = \underline{4\pi - 6}$ ①

NO POINTS FOR $6-4\pi$

Using the limit definition of the definite integral, and right endpoints, find $\int_{-3}^{-1}(3x^2+15x+18)\,dx$. **SCORE: _____ / 10 PTS**

NOTE: Solutions using any other method will earn 0 points.

$$\Delta x = \frac{-1--3}{n} = \frac{2}{n}$$

$$① \underbrace{\lim_{n\to\infty}\sum_{i=1}^{n}}\, f\left(-3+\frac{2i}{n}\right)\frac{2}{n}$$

$$= \lim_{n\to\infty}\underbrace{\boxed{\frac{2}{n}}}_{①}\sum_{i=1}^{n}\underbrace{\left[3\left(-3+\frac{2i}{n}\right)^2+15\left(-3+\frac{2i}{n}\right)+18\right]}\ ②$$

$$= \lim_{n\to\infty}\frac{2}{n}\sum_{i=1}^{n}\left(-\frac{36i}{n}+\frac{12i^2}{n^2}+\frac{30i}{n}\right)$$

$$= \lim_{n\to\infty}\frac{2}{n}\sum_{i=1}^{n}\underbrace{\left(-\frac{6i}{n}+\frac{12i^2}{n^2}\right)}\ ②$$

$$= \lim_{n\to\infty}\frac{2}{n}\left(-\frac{6}{n}\sum_{i=1}^{n} i+\frac{12}{n^2}\sum_{i=1}^{n} i^2\right)$$

$$= \lim_{n\to\infty}\frac{2}{\cancel{n}}\left(-\frac{\overset{3}{\cancel{6}}}{n}\underbrace{\frac{\cancel{n}(n+1)}{\cancel{2}}}_{①}+\frac{\overset{2}{\cancel{12}}}{n^2}\underbrace{\frac{n(n+1)(2n+1)}{\cancel{6}}}_{①}\right)$$

$$= 2(-3+4)$$

$$= \underbrace{2}_{①}$$

① FOR HAVING $\lim\limits_{n\to\infty}$ ON EACH LINE THAT STILL INVOLVES "n"

Evaluate $\int_{-4}^{4} (|x-1| - 5\sqrt{16-x^2})\,dx$ using the properties of definite integrals and interpreting in terms of area. **SCORE: _____ / 5 PTS**

NOTE: You must show the proper use of the properties of the definite integral, NOT just the arithmetic.

$$= \underbrace{\int_{-4}^{4} |x-1|\,dx - 5\int_{-4}^{4} \sqrt{16-x^2}\,dx}_{2} = \underbrace{\tfrac{1}{2}(5)(5) + \tfrac{1}{2}(3)(3)}_{1} \underbrace{- 5\left(\tfrac{1}{2}\pi(4)^2\right)}_{1}$$

$$= \underbrace{17 - 40\pi}_{1}$$