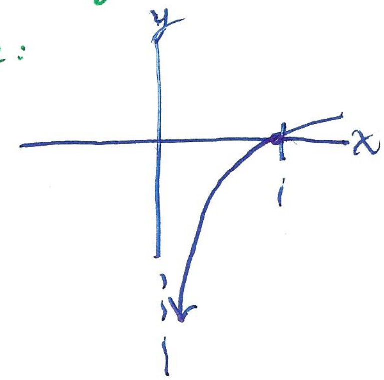
17. $\displaystyle\int_0^1 \frac{x-1}{\sqrt{x}}\,dx$

For this function, the value in question is $x=0$. The graph looks something like:



$$= \int_0^1 \left(\frac{x}{\sqrt{x}} - \frac{1}{\sqrt{x}}\right) dx$$

$$= \int_0^1 \left(\sqrt{x} - x^{-1/2}\right) dx$$

$$= \lim_{t \to 0} \int_t^1 \left(x^{1/2} - x^{-1/2}\right) dx$$

$$= \lim_{t \to 0} \left(\frac{2}{3}x^{3/2} - \frac{2}{1}x^{1/2}\right)\Bigg|_t^1$$

$$= \lim_{t \to 0} \left[\left(\frac{2}{3}\cdot 1^{3/2} - 2\cdot 1^{1/2}\right) - \left(\frac{2}{3}t^{3/2} - 2t^{1/2}\right)\right]$$

$$= \frac{2}{3}\cdot -2\cdot 1 - \frac{2}{3}\cdot 0 + 2\cdot 0$$

$$= \frac{2}{3} - 2$$

$$= \boxed{\frac{-4}{3} \quad \text{Converges}}$$

Note: Because the answer is negative, it must have been that the integral was not intended to be an area. In other words, we solved the integral that we were given, it is negative, and we leave it that way.

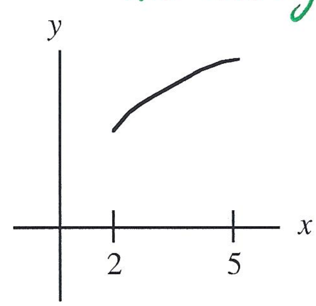
Chapter 8

* At times, how far to simplify is unclear. If you are uncertain how far to simplify an integrand, just ask.

Set up the integral and simplify the integrand—but do not solve—for the requested value.

18. The arc length of the function on the given interval.

$y = x^{3/2}$, for $2 \le x \le 5$



$y = x^{3/2}$

$y' = \frac{3}{2} x^{1/2}$

$$L = \int_a^b \sqrt{1 + (y')^2}\, dx$$

$$L = \int_2^5 \sqrt{1 + \left(\tfrac{3}{2} x^{1/2}\right)^2}\, dx$$

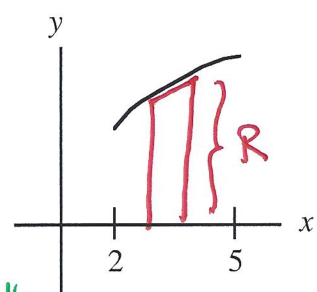
$$= \boxed{\int_2^5 \sqrt{1 + \tfrac{9}{4} x}\, dx}$$

* This is probably simplified far enough.

$$= \int_2^5 \sqrt{\frac{4 + 9x}{4}}\, dx = \int_2^5 \frac{\sqrt{4+9x}}{\sqrt{4}}\, dx = \boxed{\frac{1}{2} \int_2^5 \sqrt{4 + 9x}\, dx}$$

19. The area of the surface of revolution.

$y = x^{3/2}$, for $2 \le x \le 5$ rotated about the y-axis.



$R = y$

This has a vertical radius so $R = y$.

$$SA = 2\pi \int_a^b R \cdot \sqrt{1 + (y')^2}\, dx$$

the value of R is typically either x (if rotated about the y-axis) or y (if rotated about the x-axis).

$$SA = 2\pi \int_2^5 y \cdot \sqrt{1 + \left(\tfrac{3}{2} x^{1/2}\right)^2}\, dx$$

$$= \boxed{2\pi \int_2^5 x^{3/2} \sqrt{1 + \tfrac{9}{4} x}\, dx}$$

there's not much we can do to simplify this integrand.