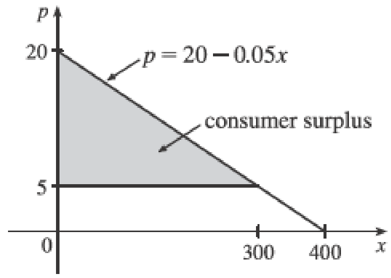
4. Consumer surplus $= \int_0^{300} [p(x) - p(300)]\, dx$

$$= \int_0^{300} [20 - 0.05x - (5)]\, dx$$

$$= \int_0^{300} (15 - 0.05x)\, dx = \left[15x - 0.025x^2\right]_0^{300}$$

$$= 4500 - 2250 = \$2250$$



7. $P = p_S(x) \quad \Rightarrow \quad 400 = 200 + 0.2x^{3/2} \quad \Rightarrow \quad 200 = 0.2x^{3/2} \quad \Rightarrow \quad 1000 = x^{3/2} \quad \Rightarrow \quad x = 1000^{2/3} = 100.$

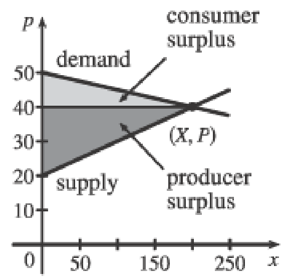
Producer surplus $= \int_0^{100} [P - p_S(x)]\, dx = \int_0^{100} [400 - (200 + 0.2x^{3/2})]\, dx = \int_0^{100} \left(200 - \frac{1}{5}x^{3/2}\right) dx$

$$= \left[200x - \tfrac{2}{25}x^{5/2}\right]_0^{100} = 20{,}000 - 8{,}000 = \$12{,}000$$

8. $p = 50 - \frac{1}{20}x$ and $p = 20 + \frac{1}{10}x$ intersect at $p = 40$ and $x = 200$.

Consumer surplus $= \int_0^{200} \left(50 - \frac{1}{20}x - 40\right) dx = \left[10x - \frac{1}{40}x^2\right]_0^{200} = \$1000$

Producer surplus $= \int_0^{200} \left(40 - 20 - \frac{1}{10}x\right) dx = \left[20x - \frac{1}{20}x^2\right]_0^{200} = \$2000$



13. $N = \displaystyle\int_a^b Ax^{-k}\, dx = A\left[\frac{x^{-k+1}}{-k+1}\right]_a^b = \frac{A}{1-k}\left(b^{1-k} - a^{1-k}\right).$

Similarly, $\displaystyle\int_a^b Ax^{1-k}\, dx = A\left[\frac{x^{2-k}}{2-k}\right]_a^b = \frac{A}{2-k}\left(b^{2-k} - a^{2-k}\right).$

Thus, $\displaystyle\bar{x} = \frac{1}{N}\int_a^b Ax^{1-k}\, dx = \frac{[A/(2-k)](b^{2-k} - a^{2-k})}{[A/(1-k)](b^{1-k} - a^{1-k})} = \frac{(1-k)(b^{2-k} - a^{2-k})}{(2-k)(b^{1-k} - a^{1-k})}.$

15. $F = \dfrac{\pi P R^4}{8\eta l} = \dfrac{\pi(4000)(0.008)^4}{8(0.027)(2)} \approx 1.19 \times 10^{-4}\ \text{cm}^3/\text{s}$

18. As in Example 2, we will estimate the cardiac output using Simpson's Rule with $\Delta t = (20 - 0)/10 = 2$.

$$\int_0^{20} c(t)\, dt \approx \tfrac{2}{3}[c(0) + 4c(2) + 2c(4) + 4c(6) + 2c(8) + 4c(10) + 2c(12) + 4c(14) + 2c(16) + 4c(18) + c(20)]$$

$$= \tfrac{2}{3}[0 + 4(2.4) + 2(5.1) + 4(7.8) + 2(7.6) + 4(5.4) + 2(3.9) + 4(2.3) + 2(1.6) + 4(0.7) + 0]$$

$$= \tfrac{2}{3}(110.8) \approx 73.87\ \text{mg}\cdot\text{s/L}$$

Therefore, $F \approx \dfrac{A}{73.87} = \dfrac{8}{73.87} \approx 0.1083\ \text{L/s}$ or $6.498\ \text{L/min}$.