Applications:

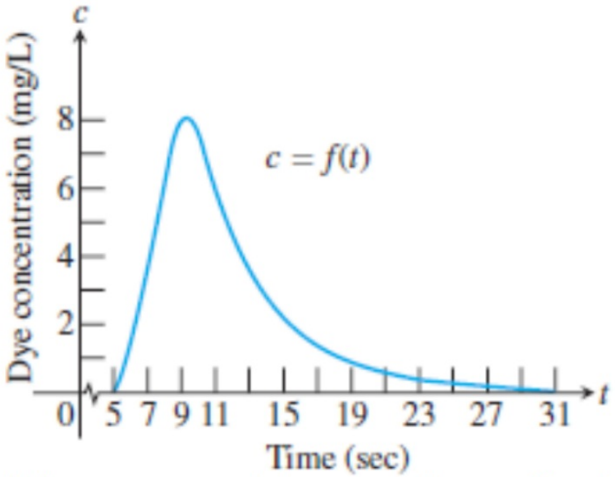
The number of liters of blood your heart pumps in a fixed time interval is called your cardiac output. For a person at rest, the rate may be 5 or 6 liters/min. During strenuous exercise, it could be as high as 30 liters/min.

To measure the cardiac output without interrupting the blood flow, a dye is injected into a main vein near the heart. The dye is drawn through the right side of the heart , pumped through the lungs and out the left side of the heart into the aorta. There, it's concentration can be measured every few seconds as the blood flows past.

The data below show the response of a healthy, resting patient to an injection of 5.6 mg of dye.

Table 5.2 Dye Concentration Data

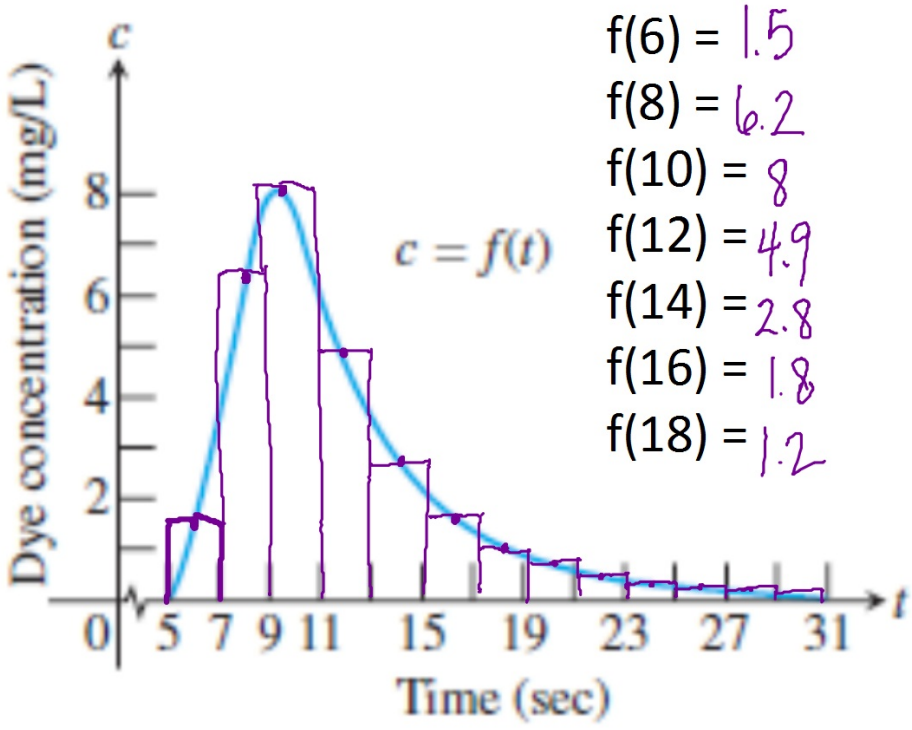
Seconds after Injection t	Dye Concentration (adjusted for recirculation) c
5	0
7	3.8
9	8.0
11	6.1
13	3.6
15	2.3
17	1.45
19	0.91
21	0.57
23	0.36
25	0.23
27	0.14
29	0.09
31	0



Could we use this graph to find the cardiac output? YES!

Divide the number of mg of dye injected by the area under the dye concentration curve.

Example: Estimate the cardiac output of the patient whose data appears in the graph. Give the estimate in liters/min.



f(6) = 1.5
f(8) = 6.2
f(10) = 8
f(12) = 4.9
f(14) = 2.8
f(16) = 1.8
f(18) = 1.2

f(20) = 1
f(22) = .8
f(24) = .5
f(26) = .3
f(28) = .2
f(30) = .1

Total Area Under Curve = $2(1.5+6.2+8+4.9+2.8+1.8+1.2+1+.8+.5+.3+.2+.1)$

$= 58.6 \text{ sec} \cdot \text{mg/L}$

Cardiac Output = $\frac{\text{amt injected}}{\text{area under curve}} = \frac{5.6 \text{ mg}}{58.6 \text{ sec} \cdot \text{mg/L}}$

$= .096 \frac{\text{L}}{\text{sec}} \cdot \frac{60 \text{ sec}}{1 \text{ min}}$

$= 5.734 \text{ L/min}$

$\frac{\text{mg}}{\text{sec} \cdot \frac{\text{mg}}{\text{L}}}$

$\frac{\text{mg}}{\text{sec}} \cdot \frac{\text{L}}{\text{mg}}$

p. 270
#9-12, 15-19