

# Homework #17

## Math 211

### Problems for Section 5.4

In Problems 3–6, explain in words what the integral represents and give units.

- $\int_1^3 v(t) dt$ , where  $v(t)$  is velocity in meters/sec and  $t$  is time in seconds.
- $\int_{2000}^{2004} f(t) dt$ , where  $f(t)$  is the rate at which the world's population is growing in year  $t$ , in billion people per year.
- Oil leaks out of a tanker at a rate of  $r = f(t)$  gallons per minute, where  $t$  is in minutes. Write a definite integral expressing the total quantity of oil which leaks out of the tanker in the first hour.

Problems 16–18 concern the future of the US Social Security Trust Fund, out of which pensions are paid. Figure 5.48 shows the rates (billions of dollars per year) at which income,  $I(t)$ , from taxes and interest is projected to flow into the fund and at which expenditures,  $E(t)$ , flow out of the fund. Figure 5.49 shows the value of the fund as a function of time.<sup>8</sup>

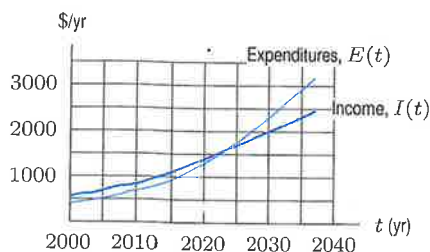


Figure 5.48

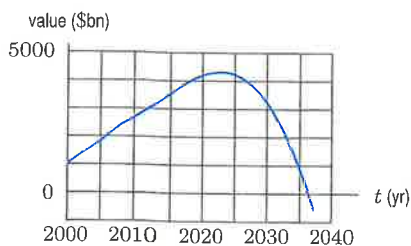


Figure 5.49

- Decide when the value of the fund is projected to be a maximum using
  - Figure 5.48
  - Figure 5.49

- Figure 5.50 shows the rate of growth of two trees. If the two trees are the same height at time  $t = 0$ , which tree is taller after 5 years? After 10 years?

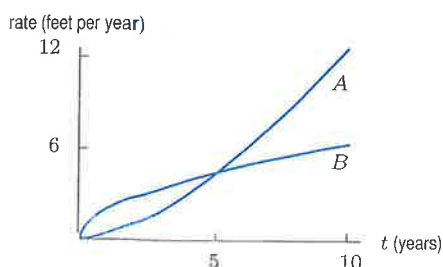


Figure 5.50

- The rates of consumption of stores of protein and fat in the human body during 8 weeks of starvation are shown in Figure 5.54. Does the body burn more fat or more protein during this period?

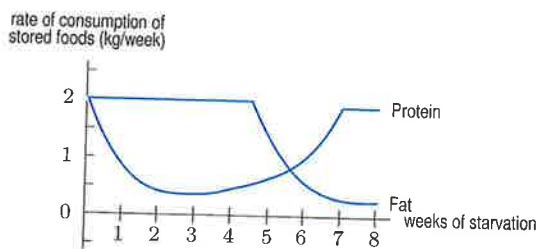
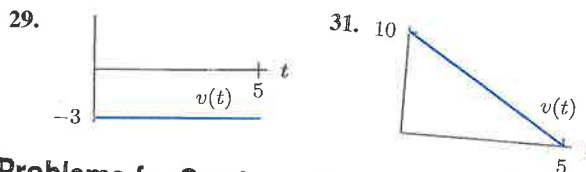


Figure 5.54

Problems 29–32 show the velocity, in cm/sec, of a particle moving along the  $x$ -axis. Compute the particle's change in position, left (negative) or right (positive), between times  $t = 0$  and  $t = 5$  seconds.



### Problems for Section 5.5

- If the marginal cost function  $C'(q)$  is measured in dollars per ton, and  $q$  gives the quantity in tons, what are the units of measurement for  $\int_{800}^{900} C'(q) dq$ ? What does this integral represent?
- The population of Tokyo grew at the rate shown in Figure 5.65. Estimate the change in population between 1970 and 1990.

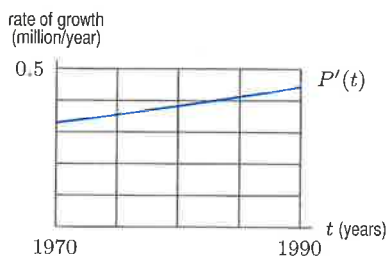


Figure 5.65

- The marginal cost  $C'(q)$  (in dollars per unit) of producing  $q$  units is given in the following table.
  - If fixed cost is \$10,000, estimate the total cost of producing 400 units.
  - How much would the total cost increase if production were increased one unit, to 401 units?

$q$	0	100	200	300	400	500	600
$C'(q)$	25	20	18	22	28	35	45

- The graph of a derivative  $f'(x)$  is shown in Figure 5.67. Fill in the table of values for  $f(x)$  given that  $f(0) = 2$ .

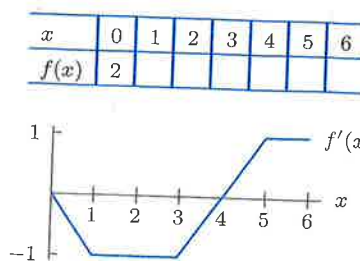
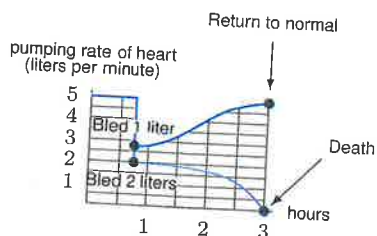


Figure 5.67: Graph of  $f'$ , not  $f$

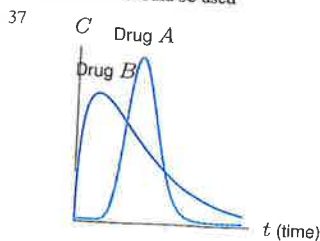
# Solutions

## Section 5.4

- 1 (a) Emissions 1970–2000, m. metric tons  
 (b) 772.8 million metric tons
- 3 Change in position; meters
- 5 Change in world pop; bn people
- 7 Total amount =  $\int_0^{60} f(t) dt$ .
- 9 1417 antibodies
- 11 29,089.813 megawatts
- 13 3.4 ft
- 15 (a) Concave up  
 (b) 3.1 kg
- 17 (a) 2023, at crossing of curves  
 (b) 2023, at highest point of curve
- 19 2627 acres
- 21 Tree B is taller after 5 years.  
 Tree A is taller after 10 years.
- 23 (a) Boys: black curve; girls: colored curve  
 (b) About 43 cm  
 (c) Boys: about 23 cm; girls: about 18 cm  
 (d) About 13 cm taller
- 25 More fat
- 27 (a) About 750 liters  
 (b)  $\int_0^3 60g(t) dt$   
 (c) About 150 liters



- 29 15 cm to the left
- 31 25 cm to the right
- 33 65 km from home  
 3 hours  
 90 km
- 35 Product B has a greater peak concentration  
 Product A peaks sooner  
 Product B has a greater overall bioavailability  
 Product A should be used

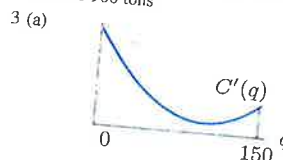


- 39 About \$13,800

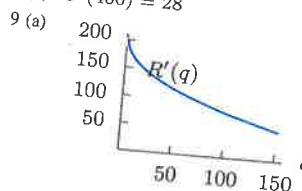
41 (a)  $\int_0^T 49(1 - (0.8187)^t) dt$   
 (meters)  
 (b)  $T \approx 107$  seconds

## Section 5.5

- 1 Dollars; cost of increasing production from 800 tons to 900 tons



- (b) \$22,775  
 (c)  $C'(150) = 18.5$   
 (d)  $C(151) \approx \$22,793.50$
- 5 7.65 million people
- 7 (a) \$18,650  
 (b)  $C'(400) = 28$



- (b) \$12,000  
 (c) Marginal revenue is \$80/unit  
 Total revenue is \$12,080
- 11 (a) 7.54 inches after 8 hours  
 (b) 1.41 inches/hour