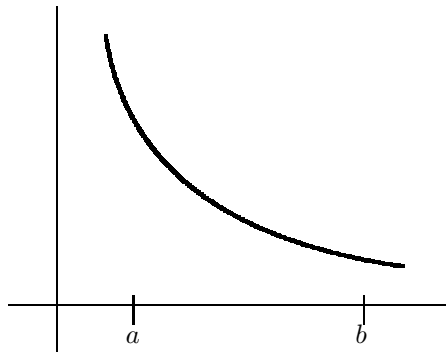


- d) What is the maximum number of hours of sunlight?
- e) What is the period? (Think about it; then verify it.)

6.(15) Mark or draw the following quantities on the graph of  $f$ . Be sure to label your marks on the graph so that I know what your answer is to (a), (b), etc.



- a) A length representing  $|f(b) - f(a)|$
- b) A slope representing  $\frac{f(b) - f(a)}{b - a}$
- c) An area representing  $F(b) - F(a)$  where  $F' = f$ .
- d) A length roughly approximating  $\frac{F(b) - F(a)}{b - a}$  where  $F' = f$ .
- e) On which part(s) of this exercise did you use the Fundamental Theorem of Calculus? Explain how it is used.

1.(30 points) Compute derivatives of the following functions.

a)  $f(x) = 4x^3 - 5x^2 + 3^3$   
 $f'(x) =$

b)  $y = \frac{4}{x} - \frac{x}{4} + 4^x - x^4$   
 $dy/dx =$

c)  $g(t) = \sqrt{t} + \frac{7}{\sqrt{t}}$   
 $g'(t) =$

d)  $h(z) = z^{10} + e^z + \ln 4$   
(11<sup>th</sup> derivative of  $h$ )  $h^{(11)}(z) =$

e)  $y = \ln(5x^6)$   
 $dy/dx =$

2.(10) Find an equation for the line tangent to the graph of  $f(x) = 2x^3 + 8x$  at the point  $x = 1$ .

3.(15) My bottle of aspirin says that the minimum effective concentration of the brand is 10 ng/ml. It conveniently provides me with the surge function giving me the concentration as a function of time:  $C = 5t e^{-0.05t}$ . (Assume  $t$  is measured in minutes.)

- a) Approximately how long after I take the aspirin do I have to wait to have some relief from my splitting headache? How did you arrive at your answer?
- b) When will I be getting the most pain relief?
- c) Use the graph or the function itself to estimate how long will I be pain free?

4.(15) The population of a small country was 3.5 million in 1980 and in 1990 it was 4 million. Assume that exponential growth will continue for quite a few years.

- a) What population would you predict for  $t$  years from 1980?
- b) What population would you predict for 2010?
- c) How fast is the population growing in 2010? What are the units on your answer?
- d) What is the doubling time for this population?

5.(15) The number of hours,  $H$ , of daylight in Madrid as a function of the date is given by the formula  $H = 12 + 2.4 \sin(0.0172(t - 80))$  where  $t$  is the number of days since the beginning of the year.

- a) What are the units of  $dH/dt$ ?
- b) Explain the meaning of  $\left. \frac{dH}{dt} \right|_{t=100}$
- c) What is the amplitude of the function?