

1. There are 7 girls on a bus. Each girl is carrying 7 backpacks. In each backpack, there are 7 big cats. For every big cat there are 7 little cats.

Question: How many legs are there on the bus?

2. After investing \$1000 at an annual interest rate of 7% compounded continuously for  $t$  years, your balance is \$ $B$ , where  $B = f(t)$ . What are the units of  $dB/dt$ ? What is the financial interpretation of  $dB/dt$ ?
3. If  $t$  is the number of years since 1993, the population,  $P$ , of China, in billions, can be approximated by the function

$$P = f(t) = 1.15(1.014)^t.$$

Estimate  $f(6)$  and  $f'(6)$ , giving units for each. What do these two numbers tell you about the population of China?

4. A particle moves along a line so that its position at time  $t$  is  $s(t) = 6 \sin 2t$ .
  - (a) Find the velocity at time  $t$ .
  - (b) At which values of  $t$  does the motion of the particle change direction?
  - (c) What is its maximum distance from the origin?
5. The number of gallons of water in a tank  $t$  minutes after the tank has started to drain is  $Q(t) = 20(300 - t^2)$ .
  - (a) How fast is the water running out at the end of 10 min?
  - (b) What is the average rate at which the water flows out during the first 10 min?
6. Suppose that the distance an aircraft travels along a runway before takeoff is given by  $D = (10/9)t^2$ , where  $D$  is measured in meters from the starting point and  $t$  is measured in seconds from the time the brakes are released. The aircraft will become airborne when its speed reaches 200 km/hr. How long will it take to become airborne, and what distance will it travel in that time?
7. For what value(s) of  $x$  does the graph of  $f(x) = x + 2 \sin(x)$  have a horizontal tangent?
8. Evaluate the derivative of  $y = \cos x \cdot \tan x$  in each of the following 2 ways.
  - (a) Use product rule, and then simplify algebraically.
  - (b) Simplify algebraically, and then take the derivative.

9. Find the derivative of each of the given functions.

(a)  $f(x) = 8x^3 - x^2$

(b)  $g(x) = a^5 + 3a^2x^2 + x^3$

(c)  $h(x) = \pi^2 + \pi x + \pi^3x^2$

(d)  $f(x) = \frac{x^2 + 5}{2}$

(e)  $g(x) = x^{\frac{1}{2}}(x^2 - 1)$

(f)  $h(x) = \frac{x + 2}{x - 2}$

(g)  $f(x) = \frac{(8x + 2)(x + 1)}{x - 3}$

(h)  $g(x) = \frac{(2x + 1)(3x + 2)}{(x + 1)(x - 1)}$

(i)  $h(x) = (x - 2) \left( x + \frac{1}{x} \right)$

(j)  $f(x) = (x^5 + x^{-2})(x^3 - x^{-7})$

(k)  $g(t) = \frac{t^2 + t - 4}{t^3 + 3t^2 + 3}$

(l)  $h(x) = \frac{x^{-3} - x^4}{x^4}$

(m)  $f(x) = x^2 \cdot 3^x$

10. Compute  $\frac{dy}{dx}$  for each of the following:

(a)  $y = \cos(x) + 2 \cot(x) - 3x^2$

(b)  $y = x \sin(x)$

(c)  $y = 2x(\sqrt{x} - \cot(x))$

(d)  $y = x \cos^2(x)$

(e)  $y = \frac{x + 1}{x^3(1 + \cos(x))}$