

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