1. The count in a bacteria culture was 400 after 2 hours and 25,600 after 6 hours.

   (a) What was the initial population of the culture?
   (b) Find an expression for the population after \( t \) hours.
   (c) In what period of time does the population double?
   (d) When will the population reach 100,000?
2. Polonium-210 has a half-life of 140 days.
   
   (a) If a sample has a mass of 200 mg, find a formula for the mass that remains after $t$ days.
   (b) Find the mass after 100 days.
   (c) When will the mass be reduced to 10 mg?
3. A curve passes through the point $(0, 5)$ and has the property that the slope of the curve at every point $P$ is twice the $y$-coordinate of $P$. What is the equation of the curve?
4. A roast turkey is taken from an oven when its temperature has reached 185°F and is placed on a table in a room where the temperature is 75°F.

(a) If the temperature of the turkey is 150°F after half an hour, what is the temperature after 45 min?

(b) When will the turkey have cooled to 100°F?
5. If $500 is borrowed at 14% interest, find the amounts due at the end of 2 years if the interest is compounded (a) annually, (b) quarterly, (c) monthly, (d) daily, (e) hourly, and (f) continuously.
6. How long will it take an investment to double in value if the interest rate is 6% compounded continuously?
7. Find the exact value of the expression.

(a) \( \sin^{-1}\left(\frac{1}{2}\right) \)

(b) \( \arcsin(-1) \)

(c) \( \csc^{-1}\sqrt{2} \)

(d) \( \sin(\sin^{-1}0.7) \)
(e) $\sin^{-1}(\sin 1)$

(f) $\tan^{-1} \left( \tan \frac{4\pi}{3} \right)$

(g) $\sin \left( \cos^{-1} \frac{4}{5} \right)$

(h) $\sin \left( 2\sin^{-1} \frac{3}{5} \right)$

(i) $\cos \left( 2\sin^{-1} \frac{5}{13} \right)$
8. Simplify each expression.

(a) $\tan(\sin^{-1} x)$

(b) $\sin(\tan^{-1} x)$
9. Find the derivative of the function.

(a) \( y = (\sin^{-1} x)^2 \)

(b) \( y = \sin^{-1}(x^2) \)

(c) \( y = \tan^{-1}(x^3) \)

(d) \( f(x) = (\arcsin x) \ln x \)

(e) \( g(t) = \sin^{-1} \left( \frac{4}{t} \right) \)

(f) \( y = \tan^{-1} \left( \frac{x}{a} \right) + \ln \sqrt{\frac{x - a}{x + a}} \)
(g) \( y = \tan^{-1}(\sin x) \)

(h) \( y = \sin^{-1}\left(\frac{\cos x}{1 + \sin x}\right) \).

(i) \( g(x) = \sin^{-1}(\tan^{-1} x) \)

(j) \( u(t) = 2\arctan t \)

(k) \( R(t) = \arcsin(2^t) \)
10. Find each limit.

(a) \( \lim_{x \to \infty} \sin^{-1} \left( \frac{x + 1}{2x + 1} \right) \)

(b) \( \lim_{x \to \infty} \tan^{-1}(x - x^2) \)
11. Find the limit.

(a) \[ \lim_{x \to -1} \frac{x^6 - 1}{x^4 - 1} \]

(b) \[ \lim_{x \to 1} \frac{\ln x}{x - 1} \]

(c) \[ \lim_{x \to \pi} \frac{\tan x}{x} \]

(d) \[ \lim_{x \to \infty} \frac{(\ln x)^3}{x^2} \]

(e) \[ \lim_{x \to 0} \frac{6^x - 2^x}{x} \]

(f) \[ \lim_{x \to 0} \frac{\sin x}{e^x} \]

(g) \[ \lim_{x \to 0} \frac{\sin x - x}{x^3} \]
(h) \( \lim_{x \to 2^-} \frac{\ln x}{\sqrt{2 - x}} \)

(i) \( \lim_{x \to \infty} \frac{\ln \ln x}{\sqrt{x}} \)

(j) \( \lim_{x \to 0^+} \frac{x + \sin 3x}{x - \sin 3x} \)

(k) \( \lim_{x \to 0^+} \sqrt{x} \ln x \)

(l) \( \lim_{x \to \infty} e^{-x} \ln x \)

(m) \( \lim_{x \to 1} \left( \frac{1}{\ln x} - \frac{1}{x - 1} \right) \)
(n) \( \lim_{x \to \infty} \left( \frac{x^3}{x^2 - 1} - \frac{x^3}{x^2 + 1} \right) \)

(o) \( \lim_{x \to 0^+} x^{\sin x} \)

(p) \( \lim_{x \to 0} (1 - 2x)^{\frac{1}{x}} \)

(q) \( \lim_{x \to \infty} \left( \frac{2x - 3}{2x + 5} \right)^{2x+1} \)

(r) \( \lim_{x \to 0^+} (-\ln x)^x \)