8. Find and SIMPLIFY the derivative of the following functions
   (a) \( f(x) = 10x^4 - 32x + e^2 \)
   \[ f'(x) = 40x^3 - 32 \]

3.3.52 (b) \( h(x) = \frac{(x+1)}{x^2e^x} \) Use product rule or quotient rule. With
   product rule, \( h(x) = (x^{-1} + x^{-2}) \) \( e^{-x} \), hence
   \[ h'(x) = (x^{-1} + x^{-2})'(e^{-x}) + (x^{-1} + x^{-2})(e^{-x})' \]
   \[ = (-x^{-2} - 2x^{-3}) \ e^{-x} + (x^{-1} + x^{-2})(-e^{-x}) \]
   \[ = e^{-x}(-x^{-1} - 2x^{-2} - 2x^{-3}) = \frac{-(x^2 + 2x + 2)}{x^2e^x} \]

3.4.59 9. [5] Show that \( y = A \sin t + B \cos t \) satisfies the differential equation \( y''(t) + y(t) = 0 \) for any constants \( A \) and \( B \).
   \[ y' = A \cos t - B \sin t \]
   \[ y'' = -A \sin t - B \cos t \]
   \[ y'' + y = -A \sin t - B \cos t + A \sin t + B \cos t = 0 \]

3.2.41a 10. [7] Find all the points on the graph of \( f(x) = 2x^3 - 3x^2 - 12x + 4 \) at which the tangent line is horizontal.
   \[ f'(x) = 6x^2 - 6x - 12 = 6(x^2 - x - 2) = 6(x+1)(x-2) \]
   vanishes at \( x = -1 \) and \( x = 2 \). Compute
   \[ f(-1) = -2 - 3 + 12 + 4 = 11 \] and \( f(2) = 16 - 12 - 24 + 4 = -16 \).
   \[ \boxed{(-1, 11) \text{ and } (2, -16)} \]

3.5.51b 11. A thin rod 4 m in length is heated at its midpoint and the ends are held at a constant temperature of 0°. When the temperature reaches equilibrium, the temperature is given by \( T(x) = 40x(4 - x) \), where \( 0 \leq x \leq 4 \) is the position along the rod. The heat flux at a point on the rod equals \(-kT'(x)\) where \( k \) is a positive constant. Find the values of \( x \) that have positive heat flux and the values of \( x \) that have negative heat flux.
   \[ T(x) = 160x - 40x^2, \quad T'(x) = 160 - 80x, \]
   heat flux = \(-kT'(x)\) = 80 \( k(x-2) \)
   positive heat flux \( \boxed{2 \leq x \leq 4} \)
   negative heat flux \( \boxed{0 \leq x \leq 2} \)