1. Let \( f(x) = x^{\frac{2}{3}}(3 - x)^{\frac{1}{3}} \).
   
   (a) i. Find \( f'(x) \) for \( x \neq 0, 3 \).
   
   ii. Show that \( f''(x) = \frac{-2}{x^{\frac{4}{3}}(3 - x)^{\frac{2}{3}}} \). [2]

   (b) Determine with reasons whether \( f'(0) \) and \( f'(3) \) exist or not. [2]

   (c) Determine the values of \( x \) for each of the following cases:
   
   i. \( f'(x) > 0 \).
   
   ii. \( f'(x) < 0 \).
   
   iii. \( f''(x) > 0 \).
   
   iv. \( f''(x) < 0 \). [3]

   (d) Find all relative extrema and points of inflexion of \( f(x) \). [3]

   (e) Find all asymptotes to the graph of \( f(x) \). [2]

   (f) Sketch the graph of \( f(x) \). [3]

2. Let \( f(x) = \frac{|x|(x + 1)}{x + 2} \) for \( x \neq -2 \).

   (a) i. Find \( f'(x) \) and \( f''(x) \) for \( x \neq 0, -2 \).
   
   ii. Is \( f \) differentiable at \( x = 0 \)? Explain your answer. [4]

   (b) Determine the values of \( x \) for each of the following cases:
   
   i. \( f'(x) > 0 \).
   
   ii. \( f'(x) < 0 \).
   
   iii. \( f''(x) > 0 \).
   
   iv. \( f''(x) < 0 \). [3]

   (c) Find all relative extrema and points of inflexion of \( f(x) \). [2]

   (d) Find all asymptotes to the graph of \( f(x) \). [3]

   (e) Sketch the graph of \( f(x) \). [3]