1. You are given the function $f(x) = x\ln x$.
   (a) State its domain, giving a brief explanation of your answer.
   (b) Does the function intercept the *x*- and *y*-axes? If so, determine where.
   (c) Determine whether the function is odd, even, or neither of these.
   (d) Explain how we can tell that this function has no horizontal asymptotes. By calculating an appropriate limit, find whether $f(x)$ has a vertical asymptote as $x \to 0$.
   (e) Determine the intervals of increase and decrease of the function.
   (f) Find any local maxima and minima of the function, and give their *x* and *y* coordinates.
   (g) Show that the function is concave up (i.e. it has $f'' > 0$) over the whole of its domain.
   (h) Use your answers to parts (a) to (g) to sketch the graph of $f(x)$.

2. For the function $g(x) = \dfrac{2(x-2)}{x^2}$, answer the following questions:
   (a) State the domain of this function, giving a brief explanation of your answer.
   (b) Does $g(x)$ intercept the *x*- and *y*-axes? If so, determine where.
   (c) Determine whether the function is odd, even, or neither of these.
   (d) Find the vertical and horizontal asymptotes of this function.
   (e) Find the intervals of increase and decrease of $g(x)$.
   (f) Find any local maxima and minima of the function, and give their *x* and *y* coordinates.
   (g) Find where, if anywhere, the function is concave up and concave down. Determine whether it has any points of inflection, and, if so, give the *x* and *y* coordinates of these.
   (h) Use your answers to parts (a) to (g) to sketch the graph of $g(x)$.

3. For $h(x) = \dfrac{x^2}{\sqrt{x+1}}$, answer the following:
   (a) State the domain of $h(x)$, giving a short explanation.
   (b) Find where $h(x)$ intercepts the *x*- and *y*-axes.
   (c) Determine whether the function is odd, even, or neither of these.
   (d) (i) Show that $h(x)$ has no horizontal asymptote.
   (ii) Locate the vertical asymptote of the function.
   (e) Determine on which intervals $h(x)$ increases and decreases.
   (f) Find the local extremum of the function, and classify it as a maximum or minimum.
   (g) Show that $h(x)$ is concave up over the whole of its domain.
   (h) Use your answers to the preceding parts of the question to sketch the graph of $h(x)$.