*Name:* *Student number:*

1. (10) Each part of the following question is worth 2 points. NO PARTIAL CREDIT will be given.

(i) $f(x) = \dfrac{x}{1 - \ln(x)}$. Find $f'(x)$.

(ii) $f(x) = x^2 \sin(\tan(x))$. Find $f'(x)$.

(iii) State L'Hospital's Rule.

(iv) Find $\lim_{x \to 1} \dfrac{1}{(1-x)^2}$.

(v) Sketch the graph of a function which satisfies $\lim_{x\to\pm\infty} f(x) = 0$, $f$ is increasing on the interval $(-\infty, 0)$, decreasing on the interval $(0, \infty)$, and concave down on the interval $(-1, 1)$.

 *continued on next page*

*Name:* *Student number:*

2. () Find all critical numbers for the function $f(x) = x^2 e^{-x^2}$. Use the first or second derivative test to classify the critical numbers as local maxima or minima.

 *continued on next page*

3. () Consider the function $f(x) = \begin{cases} x^2 \ln(|x|), & \text{if } x \neq 0; \\ 0, & \text{if } x = 0. \end{cases}$ Use the definition of the derivative to find $f'(0)$. No credit will be given for attempting to find the derivative without the definition.

4. () Derive the quotient rule for derivatives from the product rule and the chain rule.

 *continued on next page*

5. () Consider the function $f(x) = 1 + 1/x + 1/x^2$.

   (i) $f'(x) = \frac{-1}{x^2}(1+\frac{1}{2x})$. Find the intervals on which $f$ is increasing and the intervals on which $f$ is decreasing.

   (ii) $f''(x) = \frac{1}{2x^3}(1+\frac{1}{3x})$. Find the intervals on which $f$ is concave up and the intervals on which $f$ is concave down.

 *continued on next page*

(iii) Find $\lim_{x\to\infty} f(x)$ and $\lim_{x\to-\infty} f(x)$.

(iv) Sketch the graph of $y = f(x)$, incorporating all of the above information.

 *continued on next page*