



(c) (i) Determine  $f''(x)$ , given that the derivative of  $f(x) = x^x$  for  $x > 0$  is  $f'(x) = x^x(\ln x + 1)$ .

(2 marks)

(ii) Hence, show that the graph of  $y = f(x)$  for  $x > 0$  is always convex (i.e. concave up).

(2 marks)

(iii) Hence, when using rectangles of equal width to approximate the area bounded by the graph of  $y = f(x)$  and the  $x$ -axis for  $1 \leq x \leq 3$ , is it more accurate to use an underestimate or overestimate? Justify your answer.

(2 marks)