

**8.** (18 points) (For full credit, show all your work on each part of this question.) Mushroom growth  $G = f(x)$  in a controlled environment is a function of light intensity  $x$ . Specifically,

$$G = f(x) = (x^2 + 2x + 2 - Q) * e^{-x},$$

where  $Q$  is a constant depending on the species of mushroom. We did some differentiation for you:

$$f'(x) = (-x^2 + Q) * e^{-x}$$

$$f''(x) = (x^2 - 2x - Q) * e^{-x}$$

$$f'''(x) = (-x^2 + 4x - 2 + Q) * e^{-x}$$

**a)** (5 pts) Taking  $Q$  to be an unknown constant, find the values of all critical points of this function, assuming its domain is  $(-\infty, \infty)$ .

**b)** (2 pts) The Greater Mycoparadeigma mushroom has  $Q = .81$ . What are the critical points of its growth function? Again assume its domain is  $(-\infty, \infty)$ .

**c)** (6 pts) Is each critical point found above a local minimum, a local maximum, or neither? (Use any method, but indicate how you know.)

**d)** (5 pts) Your variable-intensity bulb can be set at  $x=0$ ,  $x=4$ , or anywhere in between. What is the optimal lighting intensity for the Greater Mycoparadeigma? Show your work so we know you have been thorough!