1. Let f be a function such that $f(-1) = 1$. At each point (x, y) on the graph of f, the slope is given by $\frac{dy}{dx} = -x^2 - xy + y^2 - 1$. Which of the following statements is true?

$(-1, 1)$

$$\left.\frac{dy}{dx}\right|_{-1,1} = -(-1^2) - (-1)(1) + y^2 - 1$$
$$= -1 + 1 + 1 - 1 = 0$$

Passed 1st der. test

(A) f has a relative minimum at $x = -1$.

(B) f has a relative maximum at $x = -1$.

(C) f has neither a relative minimum nor a relative maximum at $x = -1$.

(D) There is insufficient information to determine whether f has a relative minimum, a relative maximum, or neither at $x = -1$.

2nd $f''(x) = -2x - x\cdot 1 + y\cdot 1 + 2y$
$= -2x - x + y + 2y$
$f''(-1) = -2(-1) - (-1) + 1 + 2(1)$
$2 + 1 + 1 + 2$
$f''(-1) = 6$ positive, so concave up

2.

x	0	1	2	3	4	5
$f'(x)$	−3	0	−1	5	0	−3
$f''(x)$	5.3	−2.0	1.7	−0.5	1.2	−5.1

positive - up
min

neg down
max

Let f be a twice-differentiable function. Selected values of f' and f'' are shown in the table above. Which of the following statements are true?

1. f has neither a relative minimum nor a relative maximum at $x = 1$. ✗
2. f has a relative maximum at $x = 1$. ✓
3. f has a relative maximum at $x = 4$. ✗

(A) I only

(B) II only

(C) III only

(D) I and III only

3. Let f be a twice-differentiable function. Which of the following statements are individually sufficient to conclude that $x = 2$ is the location of the absolute maximum of f on the interval $[-5, 5]$?

1. $f'(2) = 0$ ~~not~~ needs more support

✓ 2. $x = 2$ is the only critical point of f on the interval $[-5, 5]$, and $f''(2) < 0$.

✓ 3. $x = 2$ is the only critical point of f on the interval $[-5, 5]$, and $f(-5) < f(5) < f(2)$.

(A) II only

(B) III only

(C) I and II only

(D) II and III only