5. a. $x \in [0, 4) \cup (6, 8)$

f only increases when $f' > 0$

b. $x = 4, 6, 8$

Local min & max occurs when $f' = 0$
and sign change

c. Concave up: $(0, 1) \cup (2, 3) \cup (5, 7)$
Concave down: $(1, 2) \cup (3, 5) \cup (7, \infty)$

When $f'' > 0$, f is concave up, when $f'' < 0$
it's concave down.

d. $x = 1, 2, 3, 5, 7$

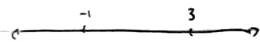**9. a.** $f'(x) = 3x^2 - 6x - 9$

$= 3(x^2 - 2x - 3)$

$= 3(x - 3)(x + 1)$

Increase: $(-\infty, -1) \cup (3, \infty)$
Decrease: $(-1, 3)$

b. $f'(x) = 3(x - 3)(x + 1)$

$0 = 3(x - 3)(x + 1)$

$x = -1, 3$

$f' \quad + \quad - \quad +$

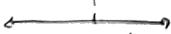Local Max   Local Min

$f(-1) = 9 \qquad f(3) = -27$

Local Max: $(-1, 9)$ Local Min: $(3, -27)$

c. $f''(x) = 6x - 6$

$0 = 6x - 6$

$x = 1$

$- \quad +$

Inflection pt.

$f(1) = -7$

Inflection point: $(1, -7)$

Concave up: $(1, \infty)$
Concave down: $(-\infty, 1)$

10. a. $f'(x) = 6x^2 - 18x + 12$

$= 6(x^2 - 3x + 2)$

$= 6(x - 2)(x - 1)$

f increases: $(-\infty, 1) \cup (2, \infty)$

f decreases: $(1, 2)$

b. $f'(x) = 6(x - 2)(x - 1)$

$0 = 6(x - 2)(x - 1)$

$x = 1, 2$

$f' \quad + \quad - \quad +$

Local Max   Local min

$f(1) = 2 \qquad f(2) = 1$

Local Max: $(1, 2)$ Local Min $(2, 1)$

c. $f''(x) = 12x - 18$

$0 = 12x - 18$

$x = \dfrac{3}{2}$

$- \quad +$
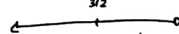
Inflection pt

$f\left(\dfrac{3}{2}\right) = \dfrac{3}{2}$

Inflection point: $\left(\dfrac{3}{2}, \dfrac{3}{2}\right)$

Concave up: $\left(\dfrac{3}{2}, \infty\right)$
Concave down: $\left(-\infty, \dfrac{3}{2}\right)$

15. First Derivative Test:

$f(x) = -2x^3 + 3x^2 + 1$

$f'(x) = -6x^2 + 6x$

$= -6x(x - 1)$

$0 = -6x(x - 1)$

$x = 0, 1$

$f' \quad - \quad + \quad -$
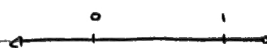
Local min   Local Max

$f(0) = 1 \qquad f(1) = 2$

Local Min: $(0, 1)$ Local Max: $(1, 2)$
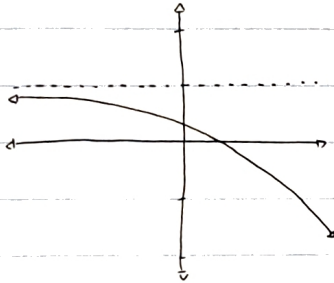
15. Second Derivative Test:

$f''(x) = -12x + 6$

$f''(0) > 0$

$f''(1) < 0$

Local Min: $(0, 1)$ Local Max: $(1, 2)$

1st derivativ test is better as it doesn't
require getting 2nd derivative

20. a.

22.