



Maxima and Minima 18.3 Q1(i)

$$f(x) = x^4 - 62x^2 + 120x + 9$$

$$\therefore f'(x) = 4x^3 - 124x + 120 = 4(x^3 - 31x + 30)$$

$$f''(x) = 12x^2 - 124 = 4(3x^2 - 31)$$

For maxima and minima,

$$f'(x) = 0$$

$$\Rightarrow 4(x^3 - 31x + 30) = 0$$

$$\Rightarrow 4(x^3 - 31x + 30) = 0$$

$$\Rightarrow x = 5, 1, -6$$

Now,

$$f''(5) = 176 > 0$$

$$\Rightarrow x = 5 \text{ is point of local minima}$$

$$f''(1) = -112 < 0$$

$$\Rightarrow x = 1 \text{ is point of local maxima}$$

$$f''(-6) = 308 > 0$$

$$\Rightarrow x = -6 \text{ is point of local minima}$$

$$\therefore \text{local max value} = f(1) = 68$$

$$\text{local min value} = f(5) = -316$$

$$\text{and } = f(-6) = -1647.$$

Maxima and Minima 18.3 Q1(ii)

We have,

$$f(x) = x^3 - 6x^2 + 9x + 15$$

$$\begin{aligned}\therefore f'(x) &= 3x^2 - 12x + 9 \\ &= 3(x^2 - 4x + 3)\end{aligned}$$

$$\begin{aligned}f''(x) &= 6x - 12 \\ &= 6(x - 2)\end{aligned}$$

For maxima and minima,

$$f'(x) = 0$$

$$\Rightarrow 3(x^2 - 4x + 3) = 0$$

$$\Rightarrow 3(x - 3)(x - 1) = 0$$

$$\Rightarrow x = 3, 1$$

Now,

$$f''(3) = 6 > 0$$

$\therefore x = 3$  is point of local minima

$$f''(1) = -6 < 0$$

$\therefore x = 1$  is point of local maxima

$$\therefore \text{local max value} = f(1) = 19$$

$$\text{local min value} = f(3) = 15.$$

Maxima and Minima 18.3 Q1(iii)

We have,

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

$$\begin{aligned}\therefore f'(x) &= (x + 2)^2 + 2(x - 1)(x + 2) \\ &= (x + 2)(x + 2 + 2x - 2) \\ &= (x + 2)(3x)\end{aligned}$$

$$\begin{aligned}\text{and, } f''(x) &= 3(x + 2) + 3x \\ &= 6x + 6\end{aligned}$$

For maxima and minima,

$$f'(x) = 0$$

$$\Rightarrow 3x(x + 2) = 0$$

$$\Rightarrow x = 0, -2$$

Now,

$$f''(0) = 6 > 0$$

$$\therefore x = 0 \text{ is point of local minima}$$

$$f''(-2) = -6 < 0$$

$$\therefore x = -2 \text{ is point of local maxima}$$

$$\therefore \text{local max value} = f(-2) = 0$$

$$\text{local min value} = f(0) = -4.$$

We have,

$$f(x) = \frac{2}{x} - \frac{2}{x^2}, \quad x > 0$$

$$\therefore f'(x) = \frac{-2}{x^2} + \frac{4}{x^3}$$

$$\text{and, } f''(x) = \frac{+4}{x^3} - \frac{12}{x^4}$$

For maxima and minima,

$$f'(x) = 0$$

$$\Rightarrow \frac{-2}{x^2} + \frac{4}{x^3} = 0$$

$$\Rightarrow \frac{-2(x-2)}{x^3} = 0$$

$$\Rightarrow x = 2$$

Now,

$$f''(2) = \frac{4}{8} - \frac{12}{6} = \frac{1}{2} - \frac{3}{4} = \frac{-1}{4} < 0$$

$\therefore x = 2$  is point of local maxima

$$\text{local max value} = f(2) = \frac{1}{2}.$$

\*\*\*\*\*END\*\*\*\*\*