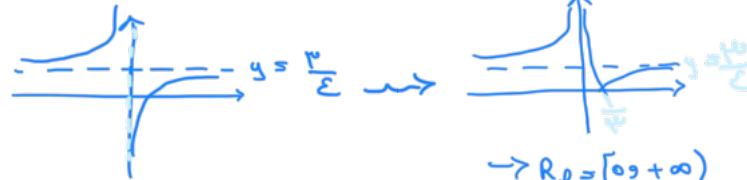
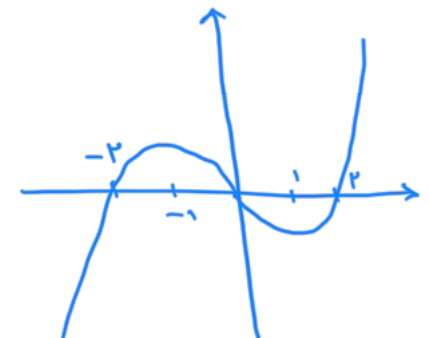
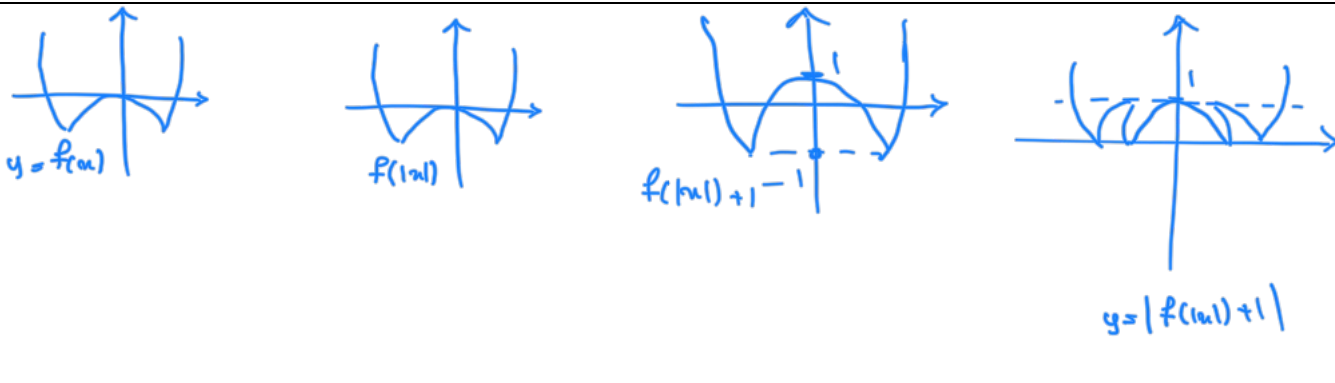


نصف کنیم x $\begin{cases} f(-x) - xf(x) = 2 x + 1 \\ (f(x) - (-x)f(-x) = 2(1-x) + 1) \times x \end{cases}$ $(x^2 + 1)f(-x) = 2x^2 + 3x + 1 \rightarrow f(-x) = \frac{2x^2 + 3x + 1}{x^2 + 1}$ $\rightarrow f(x) = \frac{2x^2 - 3x + 1}{x^2 + 1}$	۱
$f(x) + f(0) = x^2 - 3x + 4 \xrightarrow{x=0} 2f(0) = 4 \rightarrow f(0) = 2$ $f(x) + 2 = x^2 - 3x + 4 \rightarrow f(x) = x^2 - 3x + 2$ $\rightarrow f(x^2) = \underline{x^4 - 3x^2 + 2}$	۲
$y = \frac{x^2 + x + 2}{x - 1} \rightarrow y(x - 1) = x^2 + x + 2 \rightarrow x^2 - yx + x + y + 2 = 0 \rightarrow x^2 + (1 - y)x + y + 2 = 0$ $\rightarrow x = \frac{y + 1 \pm \sqrt{\Delta}}{2}$ $\rightarrow (-y + 1)^2 - 4(y + 2) \geq 0 \rightarrow (y - 7)(y + 1) \geq 0$ $\begin{array}{c c c c c} & -1 & & 7 & \\ \hline + & & - & & + \end{array}$ $\rightarrow R_f = (-\infty, -1] \cup [7, +\infty)$	۳
الف) $y = 2x^2 - 5x + 1 \rightarrow \min \left x = \frac{5}{4} \right$ $y = 2 \times \frac{25}{16} - 5 \times \frac{5}{4} + 1 = -\frac{19}{4} \rightarrow R_f = [-\frac{19}{4}, +\infty)$ ب) $y = \sqrt{-x^2 + 4x - 5} \rightarrow \max \left \begin{matrix} x \\ y \end{matrix} \right \rightarrow \sqrt{(-\infty, 5]} \rightarrow R_f = [0, 2]$ ج) $\sqrt{(-\infty, +\infty)} \rightarrow R_f = [0, +\infty)$ د) $\log(-\infty, +\infty) \rightarrow \log(0, +\infty) \rightarrow R_f = (-\infty, +\infty)$ 	۴
الف) $R_f = \mathbb{R} - \{\frac{1}{2}\}$ ب) $\sqrt{\mathbb{R} - \{1\}} \rightarrow R_f = [0, +\infty) - \{1\}$ ج) $\frac{x^2 + 3 + 1}{\sqrt{x^2 + 3}} = \sqrt{x^2 + 3} + \frac{1}{\sqrt{x^2 + 3}}$ $\downarrow$ $\min = \sqrt{3}$ $\rightarrow R_f = [\sqrt{3} + \frac{1}{\sqrt{3}}, +\infty) \cup [\frac{1}{\sqrt{3}}, +\infty)$ د) $\frac{x^2 + 1}{x^2 + 4} + \frac{1}{x} - \frac{1}{x}$ $\downarrow$ $\min = \frac{1}{4} \rightarrow \frac{1}{4} + \frac{1}{4} = \frac{1}{2}$ $\rightarrow R_f = [\frac{1}{2}, +\infty)$	۵

$y = \frac{\mu x^2 + \varepsilon}{x^2 + 1} \rightarrow \mu x^2 = \frac{-y - \varepsilon}{y - \mu} = \frac{y + \varepsilon}{y - \mu} \rightarrow x = \pm \sqrt{\frac{y + \varepsilon}{y - \mu}} \geq 0 \rightarrow \frac{-\varepsilon - \mu}{\mu - \varepsilon} \leftarrow \text{بالافتتاح}$ $IR_f = (-\infty, -\varepsilon] \cup (\mu, +\infty)$ $y = \frac{\mu x^2 + \varepsilon}{x^2 - 1} \xrightarrow{x^2=0} y = \frac{\varepsilon}{-1} = -\varepsilon$ $\xrightarrow{x^2 \rightarrow +\infty} y = \frac{\mu(+\infty)}{(+\infty)} = \mu$ $\left. \begin{array}{l} \text{بالافتتاح} \\ \text{بالغلق} \end{array} \right\} IR_f = (-\infty, -\varepsilon] \cup (\mu, +\infty)$	٦
$y = \frac{\mu \sin x + \varepsilon}{\sin x - \mu} \xrightarrow{\sin x = -1} \frac{-\mu + \varepsilon}{-1 - \mu} = \frac{-1}{\mu}$ $\xrightarrow{\sin x = 1} \frac{\mu + \varepsilon}{1 - \mu} = -\mu$ $\left. \begin{array}{l} \text{بالافتتاح} \\ \text{بالغلق} \end{array} \right\} R_f = [-\mu, -\frac{1}{\mu}]$	٧
الف) $y = \left \frac{\mu x - 1}{\varepsilon} \right$  $\rightarrow R_f = [0, +\infty)$ ب) $y = \sqrt{\frac{\mu x - 1}{\varepsilon x - 1}}$ $\xrightarrow{x=0} \frac{-1}{-1} = 1$ $\xrightarrow{x \rightarrow 1} \frac{0}{0} \rightarrow x \neq 1$ $\rightarrow y = \frac{\mu}{\varepsilon} \rightarrow R_f = \left\{ \frac{\mu}{\varepsilon} \right\}$	٨
$y = x x - \mu x \xrightarrow{x > 0} y = x^2 - \mu x$ $\xrightarrow{x < 0} y = -x^2 - \mu x$  $R_f = \mathbb{R} \leftarrow$	٩
 $y = f(x)$ $y = f(x)$ $y = f(x) + 1$	١٠