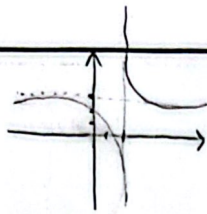
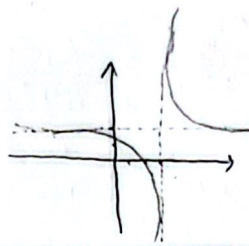


$f(x) = \begin{cases} x^3 - 4 & ; x > a \\ 12x - 20 & ; x \leq a \end{cases}$ $\rightarrow 12a - 20 \leq a^3 - 4 \rightarrow a^3 \geq 12a - 16$ $a=0 \rightarrow 0 \geq -16, a=1 \rightarrow 1 \geq -8, a=2 \rightarrow 8 \geq 8 \checkmark$ $a=-1 \rightarrow -1 \geq -12, a=-2 \rightarrow -8 \geq -24, a=-3 \rightarrow -27 \geq -36, a=-4 \rightarrow -64 \geq -44 \checkmark$ $a=-4, a=2 \Rightarrow a \geq -4$	۱
$f^{-1}(2) \leq 4 \rightarrow f(4) = 2 \rightarrow 3(4) + K = 2, K = -10$ $f(v) \leq 3(v) - 10 \leq 11$ ب) $f(f(x)) \leq 3(3x - 1) - 10 \leq 9x - 4 - 10 = 9x - 14$	۲
$y = \frac{ax}{x-1} \rightarrow yx - y \leq ax \rightarrow x(y-a) \leq y, x \leq \frac{y}{y-a}, f(x) = \frac{a}{x-a}$ $A(2a, a) \rightarrow \frac{2a}{2a-a} \leq a \Rightarrow a \leq 2$	۳
$f^{-1} = \{(\omega, 3), (v, 4), (2, 7), (4, 9)\} \quad g^{-1} = \{(2, 3), (4, 1), (\omega, 9)\}$ الف) $f \circ f^{-1} = \{(\omega, \omega), (v, v), (2, 2), (4, 4)\}$ ب) $f \circ g^{-1} = \{(3, 3), (4, 4), (v, v), (9, 9)\}$ ج) $f \circ g^{-1} = \{(2, \omega), (\omega, 4)\}$ د) $g^{-1} \circ f = \{(3, 9), (v, 3), (9, 1)\}$	۴
$g^{-1} = \{(1, 2), (3, 4), (\omega, 4)\} \quad f \circ g^{-1} = \{(1, 4), (3, 8), (\omega, 8)\}$ $\frac{h}{f \circ g^{-1}} = \{(1, \frac{4}{8}), (3, \frac{8}{8}), (\omega, \frac{8}{8})\} = \frac{h}{f \circ g^{-1}} = \{(1, \frac{1}{2}), (3, \frac{1}{1}), (\omega, \frac{1}{1})\}$	۵

تابع معكبر اوليك و معلوس بنظر اوليك
 $x = 2$ و معانب قائم
 $x = \frac{a}{3}$ و معانب افقي



$y = x - 2y \leq 3x + 1 \rightarrow x(y-3) \leq 1+2y \rightarrow x \leq \frac{1+2y}{y-3}$, $f^{-1}(x) \leq \frac{2x+1}{x-3}$
 معانب قائم $x = 3$ و معانب افقي $y = 2$



6

$f(x) = |x-1| - |x-3|$
 $\frac{1}{-2} \leq \frac{x}{2x-2} \leq \frac{3}{2} \Rightarrow [a, b] \leq [-2, 2]$

$f(x) = 2x - 4 \rightarrow 2x \leq y + 4, x \leq \frac{y+4}{2}$, $f^{-1}(x) \leq \frac{x+4}{2}$
 دایره $[-2, 2]$

7

$f(x) = \begin{cases} x^3 + 4 & ; x \geq 1 \\ 4x - 1 & ; x \leq 0 \end{cases}$
 $R \in [\infty, +\infty)$ و $R \in (-\infty, -1]$ $\rightarrow$ یک به یک و دایره وار

$y = x^3 + 4, x^3 \leq y - 4, x \leq \sqrt[3]{y-4}$ / $y = 4x - 1, 4x \leq y + 1, x \leq \frac{y+1}{4}$
 $f^{-1}(x) = \begin{cases} \sqrt[3]{x-4} & ; x \geq 1 \\ \frac{x+1}{4} & ; x \leq 0 \end{cases}$

8

$f(x) \leq \frac{x^2(x+3)}{x+3} - \frac{(x+1)^3}{x+3} \rightarrow \frac{x^3 + 3x^2 - x^3 - 3x^2 - 3x - 1}{x+3} \leq \frac{-3x-1}{x+3}$

$y \leq \frac{-3x-1}{x+3} \rightarrow yx + 3y \leq -3x - 1 \rightarrow x(y+3) \leq -1-3y \rightarrow x \leq \frac{-1-3y}{y+3} \Rightarrow f^{-1}(x) = \frac{-3x-1}{x+3} \xrightarrow{x^2}$

9

$f^{-1}(x) \leq \frac{-4x-2}{2x+4} \rightarrow a = -4, b = -2, d = 4 \rightarrow f(-2) \leq \frac{1+2}{-2+4} \leq \infty$

$y = \frac{x}{x^2+1} \rightarrow yx^2 + y = x \rightarrow yx^2 - x + y = 0 \Delta = 1 - 4y^2 \rightarrow x = \frac{1 \pm \sqrt{1-4y^2}}{2y}$

$f^{-1}(x) \leq \begin{cases} \frac{1 - \sqrt{1-4x^2}}{2x} & ; x > 0 \\ \frac{1 + \sqrt{1-4x^2}}{2x} & ; x < 0 \end{cases}$

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