

(۱) الف) $y = f\left(\frac{x}{p} - \left[\frac{x}{p}\right]\right) \quad 0 \leq \frac{x}{p} - \left[\frac{x}{p}\right] < 1 \rightarrow R_f = [0, 1]$ ✓

ب) $-\sin u + \log y - f = 0 \quad \log y = \sin u + f \quad -1 \leq \sin u \leq 1 \rightarrow f \leq \sin u \leq 1$
 $f \leq \log y \leq 1 \rightarrow 10^f \leq y \leq 10^1 \quad R_f = [10^f, 10^1] \quad \checkmark$

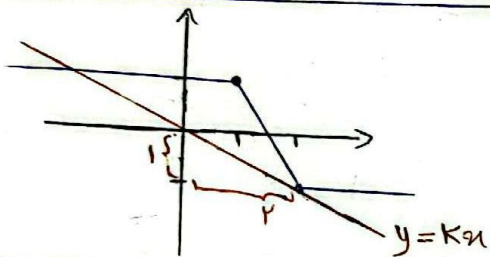
(۲) $f(x) = \sqrt{\frac{x^2-4}{x^2-9}} \quad x^2=0 \rightarrow f(x) = \frac{2}{3} \quad x^2=+\infty \rightarrow f(x)=1 \quad f(x) \geq 0 \rightarrow R_f = \left[0, \frac{2}{3}\right] \cup (1, +\infty)$ ✓

(۳) الف) $f(x) = x + \frac{1}{x} + 2\sqrt{x + \frac{1}{x}} \quad x + \frac{1}{x} = t \quad x > 0 \rightarrow t \geq 2$
 $R_f = [t + 2\sqrt{t} + \infty) \xrightarrow{t=2} R_f = [2 + 2\sqrt{2} + \infty)$ ✓
 $x < 0 \rightarrow t \leq -2$ غ غ غ

ب) $y = (3 - \sin u)(1 + \sin u) \quad y = -\sin^2 u + 3\sin u + 3$
 $R_f = [0, 4] \quad \checkmark$
 $\begin{cases} \sin u = -1 \rightarrow y = 0 \\ \sin u = 1 \rightarrow y = 4 \\ \sin u = \frac{b}{ka} = 1 \rightarrow y = 4 \end{cases}$

$n=9 \quad S_n = \frac{n}{p}(a_1 + a_n) \quad S_9 = \frac{9}{p}\left(-\frac{1}{p} + 10 - \frac{9}{p} + 10\right) = \frac{9}{p} \times \frac{20}{p} = 180 \quad \checkmark$ (۴)

$a=0$ است و $a_n^2 + b_n + c$ یک ریشه دارد پس خط است و $f(2)=0 \rightarrow \sqrt{2b+c}=0 \quad c=-2b$ (۵)
 $f(3)=1 \rightarrow \sqrt{3b+c}=1 \quad c=-2b \rightarrow b=1, c=-2 \quad g(x) = \sqrt{x^2+4} \quad R_g = [2, +\infty)$ ✓



شکل $\rightarrow y = Kx = -\frac{1}{p}x$
 $K = -\frac{1}{p} \quad \checkmark$ (۶)

الف) $y = x[x]$
 $\begin{cases} -2x & -2 \leq x < -1 \\ -x & -1 \leq x < 0 \\ 0 & 0 \leq x < 1 \\ x & 1 \leq x < 2 \\ 4 & x = 2 \end{cases}$

 $R_f = [-4, 4] \quad \checkmark$

ب) $y = x|x| - x$
 $\begin{cases} -x^2 + x & x \leq 0 \\ x^2 - x & x \geq 0 \end{cases}$

 $R_f = [-2, 2] \quad \checkmark$ (۷)

$y = \frac{1}{x} + \frac{1}{x+1} + \frac{1}{x^2+x} \quad y = \frac{2x+2}{x^2+x} = \frac{2(x+1)}{x(x+1)} = \frac{2}{x}$
 $x \neq -1, 0 \quad x = -1 \rightarrow \frac{2}{x} = -2 \quad R_f = \mathbb{R} - \{0, -2\} \quad \checkmark$ (۸)

$f(x) = \frac{(\sqrt{x}-1)(\sqrt{x}-3)}{(\sqrt{x}-1)(\sqrt{x}-1)} = \frac{\sqrt{x}-3}{\sqrt{x}-1}$
 $\sqrt{x}=0 \rightarrow f(x)=3 \quad \sqrt{x}=+\infty \rightarrow f(x)=1$
 $R_f = (-\infty, 1) \cup [3, +\infty) \quad \checkmark$ (۹)

$f(x) = \frac{x^2(x+2) - (x+2)}{x^2-1} = \frac{(x+2)(x^2-1)}{x^2-1} = x+2$
 $R_f = \mathbb{R} - \{1, 3\} \quad 1+3=4 \quad x \neq \{-1, 1\} \quad y \neq \{1, 3\} \quad \checkmark$ (۱۰)

