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الف) $f(u) = \sqrt{\frac{u-1}{u}} - \frac{u}{u-1} \geq 0 \Rightarrow \frac{(u-1)^2 - u^2}{u(u-1)} \geq 0 \Rightarrow \frac{u^2 - 2u + 1 - u^2}{u(u-1)} \geq 0 \Rightarrow \frac{-2u+1}{u(u-1)} \geq 0$

$\Rightarrow \frac{0}{+} \frac{1}{-} \frac{1}{+} \Rightarrow D_f = (-\infty, 0) \cup [\frac{1}{2}, 1) \Rightarrow$ جواب

ب) $f(u) = \frac{1}{u+1} - \frac{2}{u} \geq 0 \Rightarrow \frac{1}{u+1} \geq \frac{2}{u} \Rightarrow u \neq -1, \frac{2}{u} \rightarrow u \neq 0 \rightarrow \mathbb{R} - \{0, -1\} \text{ I}$

$\star \rightarrow \frac{3(u+2)+1(u-1)}{(u-1)(u+2)} \geq 0 \Rightarrow \frac{3u+6+u-1}{(u-1)(u+2)} \geq 0 \Rightarrow \frac{4u+5}{(u-1)(u+2)} \geq 0 \Rightarrow \mathbb{R} - \{-\frac{5}{4}, -2\} \text{ II}$

الف) $f(u) = \sqrt{(\frac{1}{u})^4 - 9} [32 - \varepsilon^u] \geq 0 \Rightarrow (\frac{1}{u})^4 - 9 \leq 0 \Rightarrow (\frac{1}{u})^4 = 9 \Rightarrow u = -\frac{2}{3}$

$\Rightarrow \frac{-2}{+} \frac{9}{-} \frac{+}{+} \rightarrow D_f = (-\infty, -\frac{2}{3}] \cup [\frac{2}{3}, +\infty) \rightarrow$ جواب

ب) $\sqrt{u-1} + \sqrt{u+1} = 3 \Rightarrow \sqrt{u+1} = 3 - \sqrt{u-1} \Rightarrow$ عبارت (جواب) جلوی ر. د. میکل هورن بزرگتر یا مساوی منفی

$\star \rightarrow \sqrt{u-1} \rightarrow u-1 \geq 0 \rightarrow u \geq 1 \text{ I}$

$3 - \sqrt{u-1} \geq 0 \rightarrow \sqrt{u-1} \leq 3 \Rightarrow u-1 \leq 9 \Rightarrow u \leq 10 \text{ II} \Rightarrow \text{I} \cap \text{II} \rightarrow D_f = [1, 10] \rightarrow$ جواب

$f(u) = \frac{\log_e(u^2 - u - 2)}{\sqrt{u^2 - 1} + 1} \rightarrow \star \rightarrow \sqrt{u^2 - 1} + 1 \neq 0 \rightarrow \sqrt{u^2 - 1} \neq -1 \checkmark \rightarrow$ هورن بزرگتر

$\star \rightarrow \sqrt{u^2 - 1} \rightarrow u^2 - 1 \geq 0 \rightarrow u^2 \geq 1 \rightarrow u \geq 1 \rightarrow D_f = (-\infty, -1] \cup [1, +\infty) \text{ I}$

$\star \rightarrow \log_e(u^2 - u - 2) \rightarrow \begin{cases} u^2 - u - 2 \geq 0 \rightarrow (u-2)(u+1) \geq 0 \rightarrow \frac{-1}{+} \frac{2}{-} \rightarrow D_f = (-\infty, -1) \cup (2, +\infty) \text{ II} \\ \varepsilon \geq 0 \checkmark \\ \varepsilon \neq 1 \checkmark \end{cases}$

$\text{I} \cap \text{II} \rightarrow D_f = (-\infty, -1) \cup (2, +\infty) \rightarrow$ جواب

$\sqrt{3+au-u^2} \rightarrow D_f = [-2, b] \rightarrow \star u = -2 \rightarrow 3 - 2a - (-2)^2 = 0 \rightarrow 3 - 2a - 4 = 0 \rightarrow -2a - 1 = 0 \rightarrow a = -\frac{1}{2}$

$\star u = b \rightarrow 3 + bx - \frac{1}{x} - b^2 = 0 \rightarrow -b^2 - \frac{1}{x}b + 3 = 0 \rightarrow u = \frac{-b \pm \sqrt{\Delta}}{2a} \Rightarrow \frac{1}{x} \pm \frac{\sqrt{\frac{\varepsilon^2}{x}}}{-2} \rightarrow \frac{1}{x} \pm \frac{u}{x} \rightarrow u = -2 \text{ ق ق ق}$

$\Delta = b^2 - 4ac \rightarrow \Delta = \frac{1}{x} - (\frac{\varepsilon x - 1 \times 3}{-1x}) \rightarrow \Delta = \frac{\varepsilon^2}{x}$

$a+b \rightarrow \frac{3}{x} - \frac{1}{x} = \frac{2}{x} = 1 \rightarrow$ جواب

$g(u) = \sqrt{f(u)} - u \rightarrow f(u) - u \geq 0 \rightarrow f(u) \geq u$

$f(u) = \begin{cases} 2u-2; u \geq 1 \rightarrow 2u-2 \geq u \rightarrow 2u \geq 2 \rightarrow u \geq 1 \checkmark \rightarrow \text{هورن بزرگتر} \text{ I} \\ 2u+3; u < 1 \rightarrow 2u+3 \geq u \rightarrow u \geq -3 \text{ II} \end{cases}$

$\text{I} \cap \text{II} \rightarrow D_f = [-3, +\infty) \rightarrow$ جواب

$f(u) = \begin{cases} (a+1)(u+r) & ; u \geq 1 \\ ra+ru & ; u \leq 1 \end{cases}$ $rf(a) = f(-r) + a \xrightarrow{+9} 12a+12 = 3a-2+a \rightarrow 12a+12 = 2a-2 \rightarrow 10a = -14$ $f(a) \rightarrow (a+1)(\frac{a+r}{r}) \rightarrow va+v \rightarrow rf(a) = 12a+12 \quad \text{جواب}$ $f(-r) \rightarrow ra+rx-r \rightarrow 3a-2 \quad \text{جواب}$	6
$rf(u) - rf(-u) = \varepsilon u^2 - u$ $\times \begin{cases} rf(u) - rf(-u) = \varepsilon u^2 - u \\ rf(-u) - rf(u) = \varepsilon u^2 + u \end{cases}$ $\frac{\varepsilon f(u) - 9f(u) = 14u^2 - ru + 12u^2 + ru}{-8f(u) = 20u^2 + u}$ $f(u) = -\frac{20u^2 + u}{8} \xrightarrow{\text{مشتق}} f'(u) = -\varepsilon u^2 \rightarrow \text{جواب}$	7
$f(r+\sqrt{r}) \xrightarrow{\text{مشتق}} \frac{1}{r+\sqrt{r}} \xrightarrow{\text{بسط}} \frac{1}{r+\sqrt{r}} \times \frac{r-\sqrt{r}}{r-\sqrt{r}} = r-\sqrt{r} \rightarrow f(r+\sqrt{r}) = f(r-\sqrt{r})$ $f(r+\sqrt{r}) + f(r-\sqrt{r}) \rightarrow f(r+\sqrt{r}) + f(\frac{1}{r+\sqrt{r}}) \rightarrow f(t) + f(\frac{1}{t}) \rightarrow$ $r(\sqrt{t} + \frac{1}{\sqrt{t}}) + 2 \rightarrow r(\sqrt{r+\sqrt{r}} + \frac{1}{\sqrt{r+\sqrt{r}}}) \rightarrow r(\sqrt{r+\sqrt{r}} + \sqrt{r-\sqrt{r}}) + 2$ $s^2 = (r-\sqrt{r})(r+\sqrt{r}) + r\sqrt{(r-\sqrt{r})(r+\sqrt{r})} \rightarrow s^2 = r \rightarrow s = \sqrt{r}$ $f(r+\sqrt{r}) + f(r-\sqrt{r}) = rs + 2 \rightarrow f(r+\sqrt{r}) + f(r-\sqrt{r}) = r \times \sqrt{r} + 2$ $= r\sqrt{r} + 2 \rightarrow \text{جواب}$	8
$(u+r)f(u) - ru f(u+r) = \varepsilon u^2 - mu + rm - 1$ $\begin{cases} u=0 \rightarrow rf(0) = rm - 1 \\ u=-r \rightarrow -rf(0) = 14 + \frac{rm+rm-1}{rm} \end{cases}$ $\rightarrow rf(0) = rm - 1 \xrightarrow{+9} rf(0) = 3 \times \frac{9}{r} - 1 \rightarrow rf(0) = \frac{27}{r} - 1 \rightarrow rf(0) = \frac{2a}{r}$ $\rightarrow f(0) = \frac{2a}{\varepsilon} \rightarrow \text{جواب}$	9
$f(u) + f(\frac{1}{u}) = \frac{ru^2 - 12u + r}{u} \xrightarrow{u=-1} f(-1) + f(-1) = \frac{r \times (-1)^2 - 12 \times -1 + r}{-1}$ $\rightarrow rf(-1) = \frac{r+12+r}{-1} \rightarrow rf(-1) = -18 \rightarrow f(-1) = -9$	10