$$\lim_{t \to 4} t^2 + 5t + 1$$

$$\lim_{t \to 2} \frac{t^2 - 2}{t^2 + t - 6}$$

$$\lim_{x \to 5} \frac{x^2 - x}{x^2 + 2x - 3}$$

$$\lim_{h \to 0} \frac{(1+h)^2 - 1}{h}$$

$$\lim_{t \to 0} \frac{(t+4)^2 - 16}{t}$$

$$\lim_{x \to 0} \frac{\sqrt{x+2} - \sqrt{2}}{x}$$

$$\lim_{x \to 1} \frac{x - 1}{\sqrt{x^2 + 3} - 2}$$

$$\lim_{x \to -1} \frac{x}{(x+1)^2}$$

$$\lim_{x \to -\infty} \frac{x^3 - 2x^2 + 1}{x^4 - 2}$$

$$\lim_{x \to -\infty} \frac{-x^5 - x^3 + x - 3}{2x^3 + 3x - 2}$$

$$\lim_{x \to \infty} \frac{x^4 - 5x^2 + x - 1}{3x^4 + x - 1}$$

$$\lim_{x \to -\infty} \frac{x^3 + \sqrt{4x^6 + 4}}{5x^3 + 2x}$$

For the function $f(x) = \begin{cases} x^3 - 2, & \text{if } x \geq 2 \\ 1 + x^2, & \text{if } x < 2 \end{cases}$ find the $\lim_{x \to 1} f(x)$

Q1.

$$\lim_{t\to 4} t^2+5t+1$$
$$= (4)^2+5(4)+1$$
$$= 16+20+1$$
$$\lim_{t\to 4} t^2+5t+1 = 37$$

Q2.

$$\lim_{t\to 2} \frac{t^2-2}{t^2+t-6}$$
$$= \frac{t^2-2}{(t-2)(t+3)}$$
$$\therefore \lim_{t\to 2} \frac{t^2-2}{t^2+t-6} = \text{Does not exist}$$

Q3.

$$\lim_{x\to 5} \frac{x^2-x}{x^2+2x-3}$$
$$= \frac{5^2-5}{5^2+2(5)-3}$$
$$= \frac{25-5}{25+10-3}$$
$$= \frac{20}{32}$$
$$\lim_{x\to 5} \frac{x^2-x}{x^2+2x-3} = \frac{5}{8}$$

Q4.

$$\lim_{h\to 0} \frac{(1+h)^2-1}{h}$$
$$= \frac{h^2+2h}{h}$$
$$= h+2$$
$$\lim_{h\to 0} \frac{(1+h)^2-1}{h} = 2$$

Q5.

$$
\begin{aligned}
&\lim_{t\to 0}\frac{(t+4)^2-16}{t} \\
&\qquad = \lim_{t\to 0}\frac{t^2+8t}{t} \\
&\qquad = \lim_{t\to 0}(t+8) \\
&\qquad = (0+8) \\
&\lim_{t\to 0}\frac{(t+4)^2-16}{t} = 8
\end{aligned}
$$

Q6.

$$
\begin{aligned}
&\lim_{x\to 0}\frac{\sqrt{x+2}-\sqrt{2}}{x} \\
&\qquad = \frac{\sqrt{x+2}-\sqrt{2}}{x} \times \frac{\sqrt{x+2}+\sqrt{2}}{\sqrt{x+2}+\sqrt{2}} \\
&\qquad = \frac{(\sqrt{x+2}-\sqrt{2})(\sqrt{x+2}+\sqrt{2})}{x(\sqrt{x+2}+\sqrt{2})} \\
&\qquad = \frac{x+2-2}{x(\sqrt{x+2}+\sqrt{2})} \\
&\qquad = \frac{1}{\sqrt{x+2}+\sqrt{2}} \\
&\qquad = \frac{1}{\sqrt{0+2}+\sqrt{2}} \\
&\lim_{x\to 0}\frac{\sqrt{x+2}-\sqrt{2}}{x} = \frac{\sqrt{2}}{4}
\end{aligned}
$$

Q7.

$$\lim_{x \to 1} \frac{x-1}{\sqrt{x^2+3}-2}$$

$$= \frac{x-1}{\sqrt{x^2+3}-3} \times \frac{\sqrt{x^2+3}+2}{\sqrt{x^2+3}+2}$$
$$= \frac{(x-1)(\sqrt{x^2+3}+2)}{(\sqrt{x^2+3}-2)(\sqrt{x^2+3}+2)}$$
$$= \frac{(x-1)(\sqrt{x^2+3}+2)}{x^2+3-4}$$
$$= \frac{(x-1)(\sqrt{x^2+3}+2)}{x^2-1}$$
$$= \frac{(x-1)(\sqrt{x^2+3}+2)}{(x-1)(x+1)}$$
$$= \frac{\sqrt{x^2+3}+2}{x+1}$$
$$= \frac{\sqrt{1^2+3}+2}{1+1}$$
$$= \frac{4}{2}$$
$$\lim_{x \to 1} \frac{x-1}{\sqrt{x^2+3}-2} = 2$$

Q8.

$$\lim_{x \to -1} \frac{x}{(x+1)^2}$$

$$= \frac{x}{x^2+2x+1}$$
$$= \frac{x}{x(x+2+\frac{1}{x})}$$
$$= \frac{-1}{-1(-1+2-1)}$$
$$= \frac{-1}{0}$$
$$\lim_{x \to -1} \frac{x}{(x+1)^2} = -\infty$$

Q9.

$$\lim_{x\to-\infty} \frac{x^3-2x^2+1}{x^4-2}$$

$$= \frac{\frac{1}{x}-\frac{2}{x^2}+\frac{1}{x^4}}{1-\frac{2}{x^4}}$$

$$= \frac{-\frac{1}{\infty}-\frac{2}{\infty}+\frac{1}{\infty}}{1-\frac{2}{\infty}}$$

$$= \frac{0-0+0}{1-0}$$

$$\lim_{x\to-\infty} \frac{x^3-2x^2+1}{x^4-2} = 0$$

Q10.

$$\lim_{x\to-\infty} \frac{-x^5-x^3+x-3}{2x^3+3x-2}$$

$$= \frac{x^3(-x^2-1+\frac{x}{x^3}-\frac{3}{x^3})}{x^3(2+\frac{3x}{x^3}-\frac{2}{x^3})}$$

$$= \frac{x^2-1+\frac{1}{x^2}-\frac{3}{x^3}}{2+\frac{3}{x^2}-\frac{2}{x^2}}$$

$$= \frac{-\infty-1+0+0}{2+0+0}$$

$$= \frac{-\infty-1}{2}$$

$$\lim_{x\to-\infty} \frac{-x^5-x^3+x-3}{2x^3+3x-2} = -\infty$$

Q11.

$$\lim_{x\to\infty} \frac{x^4-5x^2+x-1}{3x^4+x-1}$$

$$= \frac{x^4(1-\frac{5x^2}{x^4}+\frac{x}{x^4}-\frac{1}{x^4})}{x^4(3+\frac{x}{x^2}-\frac{1}{x^4})}$$

$$= \frac{1-\frac{5}{x^2}+\frac{1}{x^3}-\frac{1}{x^4}}{3+\frac{1}{x^2}-\frac{1}{x^4}}$$

$$= \frac{1-\frac{5}{\infty}+\frac{1}{\infty}-\frac{1}{\infty}}{3+\frac{1}{\infty}-\frac{1}{\infty}}$$

$$= \frac{1-0+0-0}{3+0-0}$$

$$\lim_{x\to\infty} \frac{x^4-5x^2+x-1}{3x^4+x-1} = \frac{1}{3}$$

Q12.

$$\lim_{x\to-\infty} \frac{x^3+\sqrt{4x^6+4}}{5x^3+2x}$$

$$=$$

$$= \frac{x^3+2\sqrt{x^6+1}}{5x^3+2x}$$

$$= \frac{x^3(1-2\sqrt{1+\frac{1}{x^6}})}{x^3(5+\frac{2}{x^2})}$$

$$= \frac{1-2\sqrt{1+\frac{1}{x^6}}}{5+\frac{2}{x^2}}$$

$$= \frac{1-2\sqrt{1+0}}{5+0}$$

$$\lim_{x\to-\infty} \frac{x^3+\sqrt{4x^6+4}}{5x^3+2x} = -\frac{1}{5}$$

Q13.

$$\lim_{x\to1} f(x)$$

$$=$$