→ Function:-

The term function was recognized by the german mathematitician "leibniz (1646-1716) to describe dependence of one quantity to another quantity. It is defined as a function is a rule or correspondence in such a way that each element in the 1st set correspond to one and only one element in the 2nd set.

→ Domain:-

set of values that can be assumed by the independent variable of the function is called the domain of function. **e.g,**

For a function $f: X \rightarrow Y$, the set X is called domain of function.

→ Range:-

Set of values that can be assumed by the dependent variable of the function is called range of the function. **e.g,**

For a function, $f: X \rightarrow Y$, the set Y is called Range of function.

Domain $\longrightarrow$ $\left[\begin{array}{l} f(x) \neq \text{undefined} \\ f(x) \neq \text{Imaginary} \end{array}\right]$

e.g, $f(x) = 1 + x^2$

Domain $= R = (-\infty, +\infty)$

Now for range,

$$y = 1 + x^2$$

$$x \geq 0$$

$$\sqrt{y-1} = \sqrt{x^2}$$

$$\pm\sqrt{y-1} = x$$

if $y - 1 \geq 0$

$$y \geq 1$$

Possible value

Range $= [1, \infty)$

→ Even and odd function:-

If the function f satisfies $f(-x) = f(x)$ for every number x in its domain then f is called even function, **e.g,** $f(x) = x^2$

$$f(-x) = (-x)^2$$

$$= x^2$$

$$= f(x)$$

If a function f satisfies $f(-x) = -f(x)$ for every number x in its domain then f is called odd function. **e.g,**

$f(x) = x^3$

$f(-x) = (-x)^3$

$f(-x) = -x^3$

$f(-x) = -f(x)$

Q ⇒ $f(x) = x^{-5}$

Sol. $f(x) = x^{-5}$

$= \frac{1}{x^5}$

$f(-x) = \frac{1}{(-x)^5}$

$= \frac{1}{-x^5}$

$= -\frac{1}{x^5}$

$f(-x) = -fx$ ⇒ odd.

① $f(x) = x^2 + 1$

$f(x) = x^2 + 1$

$f(-x) = (-x)^2 + 1$

$f(-x) = x^2 + 1$ ⇒ even

② $f(x) = |x^3|$

$f(x) = |x^3|$

$f(-x) = |(-x)^3|$

$f(-x) = |-x^3|$ ∵ absolute so, $-x^3 = x^3$.

$f(-x) = |x^3|$ ⇒ even.

③ $f(x) = x^2 + x$

$f(x) = x^2 + x$

$f(-x) = (-x)^2 + (-x)$

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$f(-x) = x^2 - x$

Since both conditions unsatisfied So, Not even nor odd.

(4)

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

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

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

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

$f(-x) = -f(x) \Rightarrow$ ~~ev~~ odd.

→ Composition of function:-

If we have two functions f and g then composition function $f(g) = fog$ is defined as "f of g of x" also written as $f(g(x))$.

Domain of fog = Domain of $f(x) \cap$ Domain of $g(x)$

Range of fog = Range of $f(x) \cap$ Rage of $g(x)$

(1) Find fogoh if

$f(x) = x+1$ $\quad h(x) = 4-x$

$g(x) = 3x$

$fogoh = f(g(h(x)))$

$= f(g(4-x))$

$= f(3(4-x))$ $\quad \because g(x) = 3x$ also $x = 4-x$.

$= f(12-3x)$

$= (12-3x+1)$

$= 13-3x$ ✓

② $fogoh = ?$

$f(x) = 3x+4, \; g(x) = 2x-1, \; h(x) = x^2$

$fogoh = f(g(h(x)))$

$= f(g(x^2))$

$= f(2x^2-1)$

$= 3(2x^2-1)+4$

$= 6x^2-3+4$

$= 6x^2+1$ ✓

③ $fogoh = ?$

$f(x) = \sqrt{x+1}, \quad h(x) = \frac{1}{x}$

$g(x) = \frac{1}{x+4}$

$fogoh = f(g(h(x)))$

$= f(g(\frac{1}{x}))$

$= f\left(\frac{1}{\frac{1}{x}+4}\right)$

$= f\left(\frac{1}{\frac{1+4x}{x}}\right)$

$= f\left(\frac{x}{1+4x}\right)$

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$$= \sqrt{\frac{x}{1+4x} + 1}$$

$$= \sqrt{\frac{x+1+4x}{1+4x}}$$

$$= \sqrt{\frac{5x+1}{1+4x}}$$

④ Fohog

$$Fohog = f(h(g(x)))$$

$$= f\left(h\left(\frac{1}{x+4}\right)\right)$$

$$= f\left(\frac{1}{\frac{1}{x+4}}\right)$$

$$= f(x+4)$$

$$fogoh = \sqrt{(x+4+1)}$$

$$= \sqrt{x+5}$$

Gofog=?

$$Gofog = G(f(g(x)))$$

$$= G\left(f\left(\frac{1}{x+4}\right)\right)$$

$$= G\left(\sqrt{\frac{1}{x+4} + 1}\right)$$

$$= G\left(\sqrt{\frac{1+x+4}{x+4}}\right)$$

$$= G\left(\sqrt{\frac{x+5}{x+4}}\right)$$

$$Gofog = \frac{1}{\sqrt{\frac{x+5}{x+4}} + 4}$$

⇒ LIMIT of a function:-

Suppose $f(x)$ is defined when x is near the number A (this means then f is defined on some open interval that contains A except possible at A itself) then we can write $\lim_{x \to a} f(x) = L$ and we say "the limit of $f(x)$, as x approaches to a is equal to L".

If we make the values of $f(x)$ arbitrarly close to L by restricting x to be sufficiently closed to 'a' but not equal to 'a'.

Types of Limits:-

① → Left hand-side limit:-

$$\lim_{x \to a^-} f(x) = L$$

② → Right hand-side limit:-

$$\lim_{x \to a^+} f(x) = L$$

$$\lim_{x \to a^-} f(x) = \lim_{x \to a^+} f(x) = L$$

Limit exists when both sides are equal.

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Methods of solving Limits:-

1. Factorization
2. Rationalization
3. Substitution

⇒ LIMITS LAWS:-

(i) $\lim_{x\to a}[f(x)+g(x)] = \lim_{x\to a} f(x) + \lim_{x\to a} g(x)$

(ii) $\lim_{x\to a}[f(x)-g(x)] = \lim_{x\to a} f(x) - \lim_{x\to a} g(x)$

(iii) $\lim_{x\to a}[cf(x)] = c\lim_{x\to a} f(x)$

(iv) $\lim_{x\to a}[f(x)\,g(x)] = \lim_{x\to a} f(x) \cdot \lim_{x\to a} g(x)$

(v) $\lim_{x\to a} \frac{f(x)}{g(x)} = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}$

$\lim_{x\to a} g(x) \neq 0$

Q.1 $\lim_{x\to -7} (2x+5)$

$= \lim_{x\to -7} 2x + \lim_{x\to -7} 5$

$= 2(-7)+5$

$= -14+5$

$= -9$ ✓

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Q.2 $\lim_{x \to 12} (10-3x)$

$= \lim_{x \to 12} 10 - \lim_{x \to 12} 3x$

$= 10 - 3(12)$

$= 10 - 36 = -26$ ✓

Q.3 $\lim_{x \to 2} (-x^2+5x-2)$

$= \lim_{x \to 2} (-x^2) + \lim_{x \to 2} 5x - \lim_{x \to 2} 2$

$= -(2)^2 + 5(2) - 2$

$= -4 + 10 - 2 = -6 + 10 = 4$ ✓

Q.4 $\lim_{x \to -2} (x^3 - 2x^2 + 4x + 8)$

$= \lim_{x \to -2} x^3 - \lim_{x \to -2} 2x^2 + \lim_{x \to -2} 4x + \lim_{x \to -2} 8$

$= (-2)^3 - 2(-2)^2 + 4(-2) + 8$

$= -8 - 2(4) - 8 + 8$

$= -8 - 8 - 8 + 8$

$= -16$ ✓

Q.5 $\lim_{t \to 6} 8(t-5)(t-7)$

$= 8 \lim_{t \to 6} (t-5) \cdot \lim_{t \to 6} (t-7)$

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$= 8(6-5)\cdot(6-7)$

$= 8(1)\cdot(-1)$

$= 8(-1) = -8$ ✓

Q.6 $\lim_{s \to 2/3} 3s(2s-1)$

$= \lim_{s \to 2/3} 3s \cdot \lim_{s \to 2/3} (2s-1)$

$= 3\left(\frac{2}{3}\right) \cdot 2\left(\frac{2}{3}\right) - 1$

$= 2\left(\frac{4}{3} - 1\right) = 2\left(\frac{4-3}{3}\right)$

$= 2\left(\frac{1}{3}\right)$

$= \frac{2}{3}$ ✓

Q.7 $\lim_{x \to 2} \frac{x+3}{x+6}$

$= \frac{\lim_{x \to 2} x+3}{\lim_{x \to 2} x+6}$

$= \frac{2+3}{2+6} = \frac{5}{8}$ ✓

Q.8 $\lim_{x \to 5} \frac{4}{x-7}$

$= \frac{\lim_{x \to 5} 4}{\lim_{x \to 5} x-7}$

$$= \frac{4}{5-7} = -\frac{4}{2} = -2$$

Q.9 $\lim_{y \to -5} \frac{y^2}{5-y}$

$$= \frac{\lim_{y \to -5} y^2}{\lim_{y \to -5} 5-y}$$

$$= \frac{(-5)^2}{5-(-5)} = \frac{25}{5+5} = \frac{25}{10} = \frac{5}{2}$$

Q.10 $\lim_{y \to 2} \frac{y+2}{y^2+5y+6}$

$$= \lim_{y \to 2} \frac{y+2}{y^2+5y+6}$$

$$= \frac{2+2}{(2)^2+5(2)+6} = \frac{4}{4+10+6} = \frac{4}{20} = \frac{1}{5}$$

Q.11 $\lim_{x \to -6} 3(2x-1)^2$

$$= \lim_{x \to -6} 3(2x-1)^2$$

$$= 3(2(-6)-1)^2$$

$$= 3(-12-1)^2 = 3(+169) = 507$$

Q.12 $\lim_{x \to -4} (x+3)^{1984}$

$$= (-4+3)^{1984}$$

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$= (-1)^{1984} = 1$ ✓

Q.13 $\lim_{x \to -3} (5-x)^{4/3}$

$= (5-(-3))^{4/3}$

$= (5+3)^{4/3}$

$= (8)^{4/3} = (2.2.2)^{4/3} = 2^{3 \times \frac{4}{3}}$

$= 16$ ✓

Q.14 $\lim_{z \to 0} (2z-8)^{1/3}$

$= (2(0)-8)^{1/3}$

$= (-8)^{1/3} = -2^{3 \times \frac{1}{3}} = -2$ ✓

→ By Rationalization:-

① $\lim_{h \to 0} \frac{3}{\sqrt{3h+1}+1}$

$= \frac{3}{\sqrt{3(0)+1}+1} = \frac{3}{\sqrt{0+1}+1} = \frac{3}{\sqrt{1}+1}$

$= \frac{3}{1+1} = \frac{3}{2}$ ✓

② $\lim_{h \to 0} \frac{5}{\sqrt{5h+4}+2}$

$= \frac{5}{\sqrt{5(0)+4}+2}$

$= \frac{5}{\sqrt{0+4}+2} = \frac{5}{\sqrt{4}+2} = \frac{5}{2+2} = \frac{5}{4}$ ✓

③ $\lim_{t \to -1} \dfrac{t^2+3t+2}{t^2-t-2}$

$= \dfrac{t^2+t+2t+2}{t^2+t-2t-2}$

$= \dfrac{t(t+1)2(t+1)}{t(t+1)-2(t+1)}$

$= \dfrac{(t+2)\cancel{(t+1)}}{(t-2)\cancel{(t+1)}}$

$= \dfrac{(-1+2)}{(-1-2)} = \dfrac{1}{-3}$ ✓

④ $\lim_{u \to 1} \dfrac{u^4-1}{u^3-1}$

$= \lim_{u \to 1} \dfrac{(u^2)^2-(1)^2}{(u)^3-(1)^3}$

$= \lim_{u \to 1} \dfrac{(u^2+1)(u^2-1)}{(u^1-1)[(u^1)^2+u^1+1)}$

$= \lim_{u \to 1} \dfrac{(u^2+1)(u)^2-(1)^2}{(u^1-1)(u^2+u+1)}$

$= \lim_{u \to 1} \dfrac{(u^2+1)(u+1)\cancel{(u-1)}}{\cancel{(u-1)}(u^2+u+1)}$

$= \dfrac{((1)^2+1)(1+1)}{((1)^2+1+1)} = \dfrac{(1+1)(2)}{(1+1+1)}$

$= \dfrac{(2)(2)}{3} = \dfrac{4}{3}$ ✓

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⑤ $\lim_{u \to 2} \frac{u^3-8}{u^4-16}$

$= \lim_{u \to 2} \frac{(u)^3-(2)^3}{(u^2)^2-(4)^2}$

$= \lim_{u \to 2} \frac{(u-2)(u^2+2u+2)}{(u^2+4)(u^2-4)}$

$= \lim_{u \to 2} \frac{\cancel{(u-2)}(u^2+2u+4)}{(u^2+4)(u+2)\cancel{(u-2)}}$

$= \frac{((2)^2+2(2)+4)}{((2)^2+4)(2+2)} = \frac{(4+4+4)}{(4+4)(4)}$

$= \frac{12}{8(4)} = \frac{12}{32} = \frac{\cancel{8}\ 4}{\cancel{16}\ 4} = \frac{3}{8}$ ✓

⑥ $\lim_{x \to 2} \frac{x^2-7x+10}{x-2}$

$= \lim_{x \to 2} \frac{x^2-2x-5x+10}{x-2}$

$= \lim_{x \to 2} \frac{x(x-2)-5(x-2)}{x-2}$

$= \lim_{x \to 2} \frac{(x-5)\cancel{(x-2)}}{\cancel{(x-2)}}$

$= (2-5) = -3$ ✓

⑦ $\lim_{x \to 4} \frac{4x-x^2}{2-\sqrt{x}}$

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

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

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

$$= \lim_{x \to 4} \frac{x\cancel{(4-x)}(2 + \sqrt{x})}{\cancel{(4-x)}}$$

$$= 4(2 + \sqrt{4}) = 4(2+2) = 4(4) = 16$$

(8) $$\lim_{x \to -1} \frac{\sqrt{x^2+8} - 3}{x+1}$$

$$= \lim_{x \to -1} \frac{\sqrt{x^2+8} - 3}{x+1} \times \frac{\sqrt{x^2+8} + 3}{\sqrt{x^2+8} + 3}$$

$$= \lim_{x \to -1} \frac{(\sqrt{x^2+8})^2 - (3)^2}{(x+1)(\sqrt{x^2+8} + 3)}$$

$$= \lim_{x \to -1} \frac{(x^2+8) - 9}{(x+1)(\sqrt{x^2+8} + 3)}$$

$$= \lim_{x \to -1} \frac{x^2 + 8 - 9}{(x+1)(\sqrt{x^2+8} + 3)}$$

$$= \lim_{x \to -1} \frac{x^2 - 1}{(x+1)(\sqrt{x^2+8} + 3)}$$

$$= \lim_{x \to -1} \frac{\cancel{(x+1)}(x-1)}{\cancel{(x+1)}(\sqrt{x^2+8} + 3)}$$

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$$= \frac{(-1-1)}{\sqrt{(-1)^2+8}+3}$$

$$= \frac{-2}{\sqrt{1+8}+3} = \frac{-2}{\sqrt{9}+3}$$

$$= \frac{-2}{3+3} = \frac{-2}{6} = -\frac{1}{3}$$

(9) $\lim_{x\to 1} \frac{x-1}{\sqrt{x+3}-2}$

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

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

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

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

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

$$= \sqrt{1+3}+2 = \sqrt{4}+2 = 2+2 = 4$$

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

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

$$= \lim_{t \to 1} \frac{t(t-1)\,2(t-1)}{(t+1)(t-1)}$$

$$= \lim_{t \to 1} \frac{(t+2)\cancel{(t-1)}}{(t+1)\cancel{(t-1)}}$$

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

(11) $$\lim_{x \to 9} \frac{\sqrt{x}-3}{x-9} = \left(\frac{1}{6}\right)$$

$$= \lim_{x \to 9} \frac{\sqrt{x}-3}{x-9} \times \frac{\sqrt{x}+3}{\sqrt{x}+3}$$

$$= \lim_{x \to 9} \frac{(\sqrt{x})^2-(3)^2}{(x-9)(\sqrt{x}+3)}$$

$$= \lim_{x \to 9} \frac{\cancel{(x-9)}}{\cancel{(x-9)}(\sqrt{x}+3)}$$

$$= \frac{1}{(\sqrt{9}+3)} = \frac{1}{3+3} = \frac{1}{6}$$

(12) $$\lim_{y \to 0} \frac{5y^3+8y^2}{3y^4-16y^2}$$

$$= \lim_{y \to 0} \frac{\cancel{y^2}(5y+8)}{\cancel{y^2}(3y^2-16)} = \frac{(5(0)+8)}{(3(0)^2-16)}$$

$$= \frac{8}{-16} = -\frac{1}{2}$$

Exercise 2

① ~~f(x)=5~~ if $\lim_{x \to c} f(x) = 5$ and

$\text{Limit}_{x \to c} g(x) = -2$

then

i) $\lim_{x \to c} f(x)\, g(x)$

$= \lim_{x} (5)(-2) = -10$ ✓

(ii) $\lim_{x \to c} 2(f(x)\, g(x))$

$= 2(5)(-2) = -20$ ✓

(iii) $\lim_{x \to c} f(x) + 3g(x)$

$= (5) + 3(-2) = 5 - 6 = -1$ ✓

(iv) $\lim_{x \to c} \dfrac{f(x)}{f(x) - g(x)}$

$= \dfrac{5}{5-(-2)} = \dfrac{5}{5+2} = \dfrac{5}{7}$ ✓

② If $\lim_{x \to 4} f(x) = 0$, $\lim_{x \to 4} g(x) = -3$,

(i) $\lim_{x \to 4} (g(x) + 3)$

$= (-3+3)$

0

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(ii) $\lim_{x \to 4} x f(x)$

$= 4(0) = 0$ ✓

(iii) $\lim_{x \to 4} (g(x))^2$

$= (-3)^2 = 9$ ✓

(iv) $\lim_{x \to 4} \frac{g(x)}{f(x)-1}$

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

Q. (i) $\lim_{x \to -0.5} \frac{\sqrt{x+2}}{\sqrt{x+1}}$

$= \lim_{x \to -0.5} \frac{\sqrt{x+2}}{\sqrt{x+1}}$ $\because x = -0.5$

$= \sqrt{\frac{-0.5+2}{-0.5+1}} = \sqrt{\frac{1.5}{0.5}} = \sqrt{3}$ ✓

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

$= \sqrt{\frac{1-1}{1+2}} = \sqrt{\frac{0}{3}} = 0$ ✓

(iii) $\lim_{x \to -2} \left(\frac{x}{x+1}\right)\left(\frac{2x+5}{x^2+x}\right)$

$= \lim_{x \to -2} \left(\frac{x}{x+1}\right) \cdot \lim_{x \to -2} \left(\frac{2x+5}{x^2+x}\right)$

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$$= \left(\frac{-2}{-2+1}\right) \cdot \left(\frac{2(-2)+5}{(-2)^2+(-2)}\right)$$

$$= \left(\frac{-2}{-1}\right) \cdot \left(\frac{-4+5}{4-2}\right) = \cancel{2} \cdot \frac{1}{\cancel{2}} = 1 \checkmark$$

iv) $\lim_{x \to 1} \left(\frac{1}{x+1}\right)\left(\frac{x+6}{x}\right)\left(\frac{3-x}{7}\right)$

$$= \lim_{x \to 1} \left(\frac{1}{x+1}\right) \cdot \lim_{x \to 1} \left(\frac{x+6}{x}\right) \cdot \lim_{x \to 1} \left(\frac{3-x}{7}\right)$$

$$= \left(\frac{1}{1+1}\right) \cdot \left(\frac{1+6}{1}\right) \cdot \left(\frac{3-1}{7}\right)$$

$$= \left(\frac{1}{\cancel{2}}\right) \cdot \left(\frac{\cancel{7}}{1}\right) \cdot \left(\frac{\cancel{2}}{\cancel{7}}\right) = 1 \checkmark$$

v) $\lim_{x \to 0} \frac{\sqrt{x^2+4x+5} - \sqrt{5}}{x}$

$$= \lim_{x \to 0} \frac{\sqrt{x^2+4x+5} - 5}{x} \times \frac{\sqrt{x^2+4x+5}+\sqrt{5}}{\sqrt{x^2+4x+5}+\sqrt{5}}$$

$$= \lim_{x \to 0} \frac{\left(\sqrt{x^2+4x+5}\right)^2 - (5)^2 \times \frac{1}{2}}{(x)\left(\sqrt{x^2+4x+5}+\sqrt{5}\right)}$$

$$= \lim_{x \to 0} \frac{x^2+4x+\cancel{5}-\cancel{5}}{(x)\left(\sqrt{x^2+4x+5}+\sqrt{5}\right)}$$

$$= \lim_{x \to 0} \frac{(\cancel{x})(x+4)}{(\cancel{x})\left(\sqrt{x^2+4x+5}+\sqrt{5}\right)}$$

$$= \frac{0+4}{\sqrt{0^2+4(0)+5}+\sqrt{5}} = \frac{4}{\sqrt{5}+\sqrt{5}}$$

$$= \frac{\cancel{4}^{2}}{\cancel{2}\sqrt{5}} = \frac{2}{\sqrt{5}} \checkmark$$

vi) $\lim_{h\to 0} \dfrac{\sqrt{6}-\sqrt{5h^2+11h+6}}{h}$

$= \lim_{h\to 0} \dfrac{\sqrt{6}-\sqrt{5h^2+11h+6}}{h} \times \dfrac{\sqrt{6}+\sqrt{5h^2+11h+6}}{\sqrt{6}+\sqrt{5h^2+11h+6}}$

$= \lim_{h\to 0} \dfrac{(\sqrt{6})^2-(\sqrt{5h^2+11h+6})^2}{(h)(\sqrt{6}+\sqrt{5h^2+11h+6})}$

$= \lim_{h\to 0} \dfrac{6-(5h^2+11h+6)}{(h)(\sqrt{6}+\sqrt{5h^2+11h+6})}$

$= \lim_{h\to 0} \dfrac{\cancel{6}-5h^2-11h-\cancel{6}}{(h)(\sqrt{6}+\sqrt{5h^2+11h+6}}$

$= \lim_{h\to 0} \dfrac{(\cancel{h})(-5h-11)}{(\cancel{h})(\sqrt{6}+\sqrt{5h^2+11h+6})}$

$= \dfrac{-5(0)-11}{\sqrt{6}+\sqrt{5(0)^2+11(0)+6}} = \dfrac{-11}{\sqrt{6}+\sqrt{6}} = \dfrac{-11}{2\sqrt{6}}$ ✓

Q. (i) $\lim_{\theta\to 0} \dfrac{\sin\sqrt{2\theta}}{\sqrt{2\theta}}$

let, $x=\sqrt{2\theta}$

$= \lim_{\theta\to 0} \dfrac{\sin\sqrt{2\theta}}{\sqrt{2\theta}} = \lim_{\theta\to 0} \dfrac{\sin x}{x} = 1$ ✓

(ii) $\lim_{t\to 0} \dfrac{\sin t}{t} \dfrac{\sin kt}{t}$

$= \lim_{t\to 0} \dfrac{\sin t}{t}(k)$

$= 1 \cdot k = k$ ✓

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(iii) $\lim_{y \to 0} \frac{\sin 3y}{4y}$

$= \lim_{y \to 0} \frac{\sin 3y}{4y} \times \frac{3}{3} = \lim_{y \to 0} \frac{\sin 3y}{3y} \times \frac{3}{4}$

$= 1 \times \frac{3}{4} = \frac{3}{4}$ ✓

iv) $\lim_{h \to 0} \frac{h}{\sin 3h}$

$= \lim_{h \to 0} \frac{h}{3h \sin 3h} \times \frac{3}{3}$

$= \lim_{h \to 0} \frac{3h}{3 \sin 3h} = \lim_{h \to 0} \frac{\frac{3h}{1}}{\frac{3 \sin 3h}{1}}$

$= \lim_{h \to 0} \frac{1}{\frac{3 \sin 3h}{3h}} = \frac{1}{3} \cdot \lim_{h \to 0} \frac{\sin 3h}{3h}$

$= \frac{1}{3} \cdot 1 = \frac{1}{3}$ ✓