

$$1) \lim_{h \rightarrow 0} \frac{2(-3+h)^2 - 18}{h}$$

$$\lim_{h \rightarrow 0} \frac{2(h^2 + 9 - 6h) - 18}{h}$$

$$\lim_{h \rightarrow 0} \frac{2h^2 + 18 - 12h - 18}{h}$$

$$\lim_{h \rightarrow 0} \frac{h(2h - 12)}{h} = -12$$

$$2) f(x) = \begin{cases} 2x & x < 6 \\ x-1 & x \geq 6 \end{cases}$$

$$(a) x=4 \quad \lim_{x \rightarrow 4^+} 2x = 2 \times 4 = 8$$

$$\text{Continuous at } x=4 \quad \lim_{x \rightarrow 4^-} 2x = 2 \times 4 = 8 \quad \lim_{x \rightarrow 4} 2x = 2 \times 4 = 8$$

$$b) x=6 \quad \lim_{x \rightarrow 6^-} 2x = 2 \times 6 = 12$$

$$\text{Discontinuity at } x=6 \quad \lim_{x \rightarrow 6} x-1 = 6-1 = 5$$

$$\lim_{x \rightarrow 6^+} x-1 = 6-1 = 5$$

$$3) \lim_{x \rightarrow 9} \frac{x-9}{3-\sqrt{x}} = \lim_{x \rightarrow 9} \frac{x-9}{3-\sqrt{x}} \cdot \frac{(3+\sqrt{x})}{(3+\sqrt{x})}$$

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

$$\lim_{x \rightarrow 9} = -1(3+\sqrt{9}) = -6$$

4) i) at $n=1$

$$f(n) = \frac{4n+5}{9-3n} = \frac{-4+5}{9+3} = 1/12 \text{ Continuous}$$

b) $n=0$ $\frac{4n+5}{9-3n} = \frac{5}{9} = \text{Continuous}$

c) $n=3$ $\frac{4n+5}{9-3n} = \frac{4 \times 3+5}{9-9} = \text{Discontinuous}$

5) $\lim_{n \rightarrow \infty} \frac{6e^{4n} - e^{-2n}}{8e^{4n} - e^{2n} + 3e^{-n}}$ Let $2n = y$

$$\lim_{n \rightarrow \infty} \frac{6^{2y} - e^{-y}}{8e^{2y} - e^y + 3e^{-y/2}}$$

$$\Rightarrow \frac{6}{8} = \frac{3}{4} \text{ Ans}$$

6) $g(y) = \begin{cases} y^2+5 & y < -2 \\ 1-3y & y \geq -2 \end{cases}$

(a) $\lim_{y \rightarrow 6} g(y) = y^2+5 = (6)^2+5 = 41$

(b) $\lim_{y \rightarrow -2} g(y) = 1-3y = 1-3(-2) = 7$

7) $f(t) = (4t^2-t)(t^3-8t^2+12)$
 $= (8t-1)(t^3-8t^2+12) + (4t^2-t)(3t^2-16t)$

$$8) R(w) = \frac{3w + w^4}{2w^2 + 1}$$

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

$$9) y(n) = 2e^n - 8^n$$

$$= 2e^n - 8^n \log 8$$

$$10) y = z^5 - e^z \ln(z)$$

$$= 5z^4 - \frac{1}{z} e^z + e^z \ln(z)$$

$$11) a) y(n) = (6n^2 + 7n)^4$$

$$= 4(6n^2 + 7n)^3 (12n + 7)$$

$$b) y(t) = 5e^{4t+t^7} + e^{4t+t^7}$$

$$= e^{4t+t^7} (4 + 7t^6)$$

$$12) a) z = \log(7 - n^3)$$

$$z' = \frac{1}{(7 - n^3)} (-3n^2)$$

$$z'' = \frac{(7 - n^3)(-6n) - (-3n^2)(-3n^2)}{(7 - n^3)^2}$$

$$12) b) Q(v) = \frac{2}{(6+2v-v^2)^4}$$

$$= 2(6+2v-v^2)^{-4}$$

$$= -8(6+2v-v^2)^{-5}(2-2v)$$

$$Q''(v) = 40(6+2v-v^2)^{-6}(2-2v)(2-2v) +$$

$$= -8(6+2v-v^2)^{-5}(-2)$$

$$Q''(v) = 40(6+2v-v^2)^{-6}(2-2v) + 16(6+2v-v^2)^{-5}(2-2v)$$

$$c) y(t) = \ln(1+t^2)$$

$$y'(t) = \frac{1}{(1+t^2)} \times 2t$$

$$y''(t) = \frac{(1+t^2) \times 2 - 2t \times 2t}{(1+t^2)^2} = \frac{2(1+t^2)-4t^2}{(1+t^2)^2}$$

$$13) x^3 - 3x^2 - 9x + 12$$

$$f'(x) = 3x^2 - 6x - 9$$

$$3x^2 - 9x + 3x - 9 = 0$$

$$3x(x-3) + 3(x-3) = 0$$

$$x = 3, -1$$

$$\Rightarrow f''(x) = 6x - 6$$

$$f''(3) = 12 \text{ +ve (min value at } x=3)$$

$$f''(-1) = -12 \text{ (-ve) (max value at } x=-1)$$

$$f(3) = 27 - 27 - 27 + 12 = -15 \text{ (min value)}$$

$$f(-1) = -1 - 3 + 9 + 12 = 17 \text{ (max value)}$$

$$14) f(x) = 4x^3 - 18x^2 + 24x - 7$$

$$f'(x) = 12x^2 - 36x + 24$$

$$\Rightarrow 12x^2 - 24x - 12x + 24$$

$$12x(x-2) - 12(x-2)$$

$$\Rightarrow (12x - 12)(x-2)$$

$$x = 1, +2$$

$$f''(x) = 24x - 36 \quad f''(2) = 12 \text{ (min)}$$

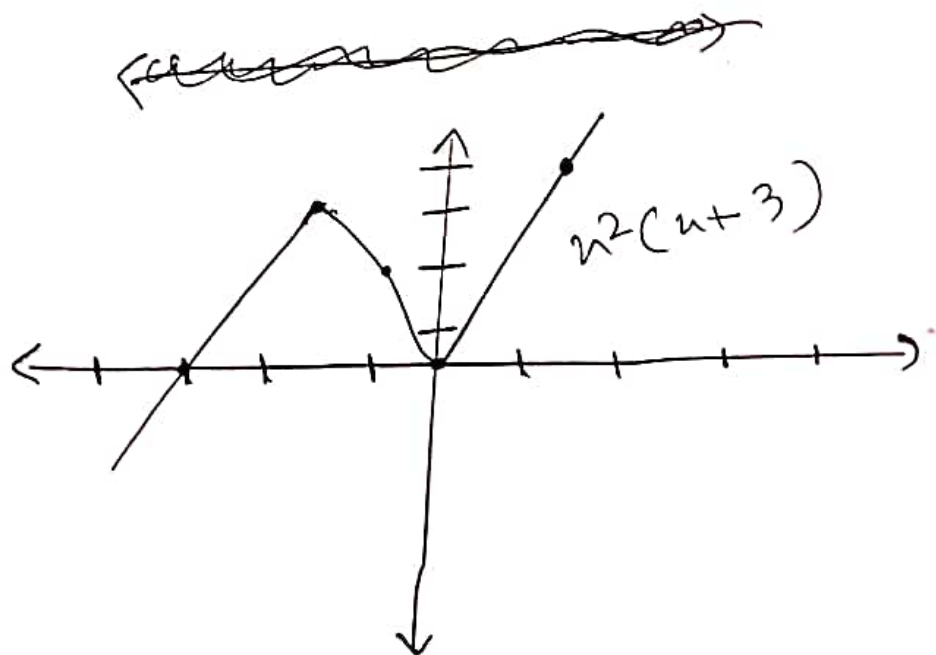
$$f''(1) = -12 \text{ (max)}$$

$$f(2) = 32 - 72 + 48 - 7 = 1 \text{ (min value)}$$

$$f(1) = 4 - 18 + 24 - 7 = 3 \text{ (max value)}$$

$$15) f(x) = x^2(x+3) = x^3 + 3x^2$$

x	0	1	-1	-2	3
f(x)	0	4	2	4	54



(6) $y(n) = 3n^2 - 6n$

n	0	1	2	-1	-2	3	-3
$y(n)$	0	-3	0	9	24	9	45

