2.3

2) $g(t) = t^2 + 4t$, $t = 1$ using definition 2/5

$g(t+h) = (t+h)^2 + 4(t+h) = (t^2 + 2th + h^2) + 4t + 4h$

$= (t^2 + 2th + h^2 + 4t + 4h)$

$g'(t) = \lim_{h\to 0} \frac{g(t+h) - g(t)}{\boxed{h}} = \lim_{h\to 0} \frac{(t^2+2th+h^2+4t+4h) - (t^2+4t)}{\boxed{h}}$

$= \lim_{h\to 0} \frac{2th + h^2 + 4h}{\boxed{h}} = \lim_{h\to 0} \frac{h(2t+h+4)}{\boxed{h}} = \lim_{h\to 0} (2t+h+4) = 2t + (0) + 4 = 2t+4$

$g'(1) = 2(1) + 4 = \underline{\underline{6}}$

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4) $p(r) = 2r^3$, $r = 1$ using definition 2/5

$p(r+h) = 2(r+h)^3 = 2(r+h)(r^2 + 2rh + h^2) = 2\{r^3 + 2r^2h + rh^2 + r^2h + 2rh^2 + h^3\}$

$= 2\{r^3 + 3r^2h + 3rh^2 + h^3\} = (2r^3 + 6r^2h + 6rh^2 + 2h^3)$

$p'(r) = \lim_{h\to 0} \frac{p(r+h) - p(r)}{\boxed{h}} = \lim_{h\to 0} \frac{(2r^3 + 6r^2h + 6rh^2 + 2h^3) - (2r^3)}{\boxed{h}}$

$= \lim_{h\to 0} \frac{6r^2h + 6rh^2 + 2h^3}{\boxed{h}} = \lim_{h\to 0} \frac{h(6r^2 + 6rh + 2h^2)}{\boxed{h}}$

$= \lim_{h\to 0} (6r^2 + 6rh + 2h^2) = 6r^2 + 6r(0) + 2(0)^2 = 6r^2$

$p'(1) = 6(1)^2 = \underline{\underline{6}}$

---

6) $s(t) = 48 - 4.9t^2$ $\quad s(t+h) = 48 - 4.9(t+h)^2 = 48 - 4.9(t^2 + 2th + h^2)$

$= 48 - 4.9t^2 - 9.8th - 4.9h^2$

$s'(t) = \lim_{h\to 0} \frac{s(t+h) - s(t)}{\boxed{h}} = \lim_{h\to 0} \frac{(48 - 4.9t^2 - 9.8th - 4.9h^2) - (48 - 4.9t^2)}{\boxed{h}}$

$= \lim_{h\to 0} \frac{-9.8th - 4.9h^2}{\boxed{h}} = \lim_{h\to 0} \frac{h(-9.8t - 4.9h)}{\boxed{h}} = \lim_{h\to 0} (-9.8t - 4.9h) = -9.8t - 4.9(0) = -9.8t$

$s'(2) = -9.8(2) = \underline{\underline{-19.6 \text{ m/sec}}}$

10) $f(x) = 3x - x^2 \quad , \quad x = 1$

$$f(x+h) = 3(x+h) - (x+h)^2 = 3x + 3h - (x^2 + 2xh + h^2)$$
$$= (3x + 3h - x^2 - 2xh - h^2)$$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{\boxed{h}} = \lim_{h \to 0} \frac{(3x + 3h - x^2 - 2xh - h^2) - (3x - x^2)}{\boxed{h}}$$
$$= \lim_{h \to 0} \frac{3h - 2xh - h^2}{\boxed{h}} = \lim_{h \to 0} \frac{h(3 - 2x - h)}{\boxed{h}} = \lim_{h \to 0} (3 - 2x - h)$$
$$= 3 - 2x - (0) = 3 - 2x$$

$$f'(1) = 3 - 2(1) = \underline{\underline{1}}$$

---

12) $P(t) = t^2 - 4 \quad , \quad t = -2$

$$P(t+h) = (t+h)^2 - 4 = (t^2 + 2th + h^2) - 4 = (t^2 + 2th + h^2 - 4)$$

$$P'(t) = \lim_{h \to 0} \frac{P(t+h) - P(t)}{\boxed{h}} = \lim_{h \to 0} \frac{(t^2 + 2th + h^2 - 4) - (t^2 - 4)}{\boxed{h}}$$
$$= \lim_{h \to 0} \frac{2th + h^2}{\boxed{h}} = \lim_{h \to 0} \frac{h(2t + h)}{\boxed{h}} = \lim_{h \to 0} (2t + h) = 2t(0) = 2t$$

$$P(-2) = 2(-2) = \underline{\underline{-4}}$$

---

18) $h(x) = 3x^2 - 4x$

$$h(x+k) = 3(x+k)^2 - 4(x+k) = 3(x^2 + 2xk + k^2) - 4x - 4k$$
$$= (3x^2 + 6xk + 3k^2 - 4x - 4k)$$

$$h'(x) = \lim_{k \to 0} \frac{h(x+k) - h(x)}{\boxed{k}} = \lim_{k \to 0} \frac{(3x^2 + 6xk + 3k^2 - 4x - 4k) - (3x^2 - 4x)}{\boxed{k}}$$
$$= \lim_{k \to 0} \frac{6xk + 3k^2 - 4k}{\boxed{k}} = \lim_{k \to 0} \frac{k(6x + 3k - 4)}{\boxed{k}} = \lim_{k \to 0} (6x + 3k - 4) = 6x + 3(0) - 4 = 6x - 4$$

a) $h'(1) = 6(1) - 4 = \underline{\underline{2}}$

b) $h'(a) = 6(a) - 4 = \underline{\underline{6a - 4}}$

20) $W(t)=t^2+5t-2$

$$W(t+h)=(t+h)^2+5(t+h)-2=(t^2+2th+h^2)+5t+5h-2$$
$$=(t^2+2th+h^2+5t+5h-2)$$

$$W'(t)=\lim_{h\to 0}\frac{W(t+h)-W(t)}{\boxed{h}}=\lim_{h\to 0}\frac{(t^2+2th+h^2+5t+5h-2)-(t^2+5t-2)}{\boxed{h}}$$

$$=\lim_{h\to 0}\frac{2th+h^2+5h}{\boxed{h}}=\lim_{h\to 0}\frac{h(2t+h+5)}{\boxed{h}}=\lim_{h\to 0}(2t+h+5)=2t+(0)+5=2t+5$$

a) $W'(a)=2(a)+5=2a+5$

b) $m=W'(2)=2(2)+5=4+5=9$

c) $W'(3)=2(3)+5=6+5=11$

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24) steepest positive E ; D , zero slope C , B , steepest negative A

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30) $G(x)=x^2-3x+3$

$$G(x+h)=(x+h)^2-3(x+h)+3=(x^2+2xh+h^2)-3x-3h+3$$
$$=(x^2+2xh+h^2-3x-3h+3)$$

$$G'(x)=\lim_{h\to 0}\frac{G(x+h)-G(x)}{\boxed{h}}=\lim_{h\to 0}\frac{(x^2+2xh+h^2-3x-3h+3)-(x^2-3x+3)}{\boxed{h}}$$

$$=\lim_{h\to 0}\frac{2xh+h^2-3h}{\boxed{h}}=\lim_{h\to 0}\frac{h(2x+h-3)}{\boxed{h}}=\lim_{h\to 0}(2x+h-3)=2x+(0)-3=2x-3$$

$(0,3)$ $m=G'(0)=2(0)-3=-3$

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

$y-3=-3x$

$\underline{y=-3x+3}$

$(2,1)$ $m=G'(2)=2(2)-3=4-3=1$

$y-(1)=1(x-(2))$

$y-1=x-2$

$\underline{y=x-1}$

34) $y = f(x) = \dfrac{2x}{(x+1)^2}$ $(0,0)$

$$f(0) = \frac{2(0)}{((0)+1)^2} = \frac{0}{(1)^2} = 0$$

$$f(0+h) = f(h) = \frac{2(h)}{((h)+1)^2} = \frac{2h}{(h+1)^2}$$

$$m = \lim_{h\to 0} \frac{f(0+h) - f(0)}{\boxed{h}} = \lim_{h\to 0} \frac{\left(\frac{2h}{(h+1)^2}\right) - (0)}{\boxed{h}}$$

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

$$= \frac{2}{((0)+1)^2} = \frac{2}{(1)^2} = 2$$

$$y - (0) = 2(x - (0))$$

$$\underline{\underline{y = 2x}}$$