7. Rules for Differentiation
#1-17

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1. $f'(2) = 2^3 = 8 \leftarrow m \qquad (2, f(2))$

$$\boxed{y = 8(x-2) + f(2)}$$

2. $(f-g)'(x) = f'(x) - g'(x)$

$(f-g)'(1) = f'(1) - g'(1)$

$= 3 - 5 = \boxed{-2}$

3. $f(x) = 4x^2 - x + 3$

$f(2) = 4(2)^2 - (2) + 3 = 17$

$$f'(2) = \lim_{x \to 2} \frac{4x^2 - x + 3 - 17}{x - 2}$$

$$= \lim_{x \to 2} \frac{4x^2 - x - 14}{x - 2}$$

$$= \lim_{x \to 2} \frac{(x-2)(4x+7)}{(x-2)}$$

$$= \lim_{x \to 2} 4x + 7 = \boxed{15}$$

4. $f(x) = 3x^2 - 1$

$f(-2) = 3(-2)^2 - 1 = 11$

$$f'(-2) = \lim_{x \to -2} \frac{3x^2 - 1 - 11}{x + 2}$$

$$= \lim_{x \to -2} \frac{3x^2 - 12}{x + 2}$$

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

$$= \lim_{x \to 2} 3(x-2) = \boxed{-12}$$

5. $f(x) = 2x^3 - 3x^2 + 5$

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

6. $g(x) = 4x^{5/3} - 3x^{-2} - 10g_3 x$

$g'(x) = \frac{20}{3} x^{2/3} + 6x^{-3} - \frac{1}{x \ln 3}$

7. $P(s) = (4s-3)^2$

$P'(s) = (4)(4s-3) + (4)(4s-3)$

$\frac{4s-3}{4} \times \frac{4s-3}{4}$

8. $q(r) = (1-2r)(3r+5)$

$q'(r) = (-2)(3r+5) + (3)(1-2r)$

$1-2r \quad -2$ ∞ $3r+5 \quad 3$

9. $S(t) = \frac{1-2t}{\sqrt{t}}$

$1-2t \quad -2$ ∞ $\sqrt{t} \quad \frac{1}{2\sqrt{t}}$ $\qquad t^{1/2}$

$S'(t) = \frac{(-2)(\sqrt{t}) - (\frac{1}{2\sqrt{t}})(1-2t)}{(\sqrt{t})^2}$

10. $g(x) = \frac{x^2+4\sqrt{x}}{(3x+1)(2x-7)}$

$x^2+4\sqrt{x} \quad 2x+\frac{2}{\sqrt{x}}$ ∞ $(3x+1)(2x-7) \quad (3)(2x-7)+(2)(3x+1)$

$g'(x) = \frac{(2x+\frac{2}{\sqrt{x}})(3x+1)(2x-7) - (3(2x-7)+2(3x+1))(x^2+4\sqrt{x})}{[(3x+1)(2x-7)]^2}$ $\qquad 3x+1 \quad 3$ ∞ $2x-7 \quad 2$

OR $g(x) = \frac{x^2+4\sqrt{x}}{6x^2-19x-7}$

$x^2+4\sqrt{x} \quad 2x+\frac{2}{\sqrt{x}}$ ∞ $6x^2-19x-7 \quad 12x-19$

$g'(x) = \frac{(2x+\frac{2}{\sqrt{x}})(6x^2-19x-7) - (12x-19)(x^2+4\sqrt{x})}{(6x^2-19x-7)^2}$

11. $f(x) = 9 - 12x^{1/3} + 8e^x$

$f'(x) = -4x^{-2/3} + 8e^x$

$= -\frac{4}{x^{2/3}} + 8e^x$

12. A, D → III , B → I , C → II

13. $f(x) = 12x - x^3$

$f'(x) = 12 - 3x^2$

$0 = 12 - 3x^2$

$x = \pm 2$

f' is horizontal ⇒ $f'(x) = 0$

14. $f(x) = x^2 + 3x - 7$ $\qquad f'(x) = 4$

$f'(x) = 2x + 3$

$4 = 2x + 3$

$x = 1/2$

15. $p(x) = x^2 + ax + b$

$p'(x) = 2x + a$

$\boxed{a = 2,\ b = -3}$

$p(1) = 0 \qquad 0 = 1^2 + a(1) + b$

$\boxed{a + b = -1}$

$p'(1) = 4 \qquad 4 = 2(1) + a$

$a = 2$

$b = -3$

16. $y = \dfrac{2x^2 - 7}{-x^3 + 2x}$ $\qquad x = 1$ $\qquad (1, -5)$

$y(1) = \dfrac{2(1)^2 - 7}{-(1)^3 + 2(1)} = \dfrac{-5}{1}$

$y' = \dfrac{(4x)(-x^3 + 2x) - (-3x^2 + 2)(2x^2 - 7)}{(-x^3 + 2x)^2}$

$2x^2 - 7 \qquad -x^3 + 2x$

$4x \qquad -3x^2 + 2$

$y'(1) = \dfrac{(4)(1) - (-1)(-5)}{(1)^2}$

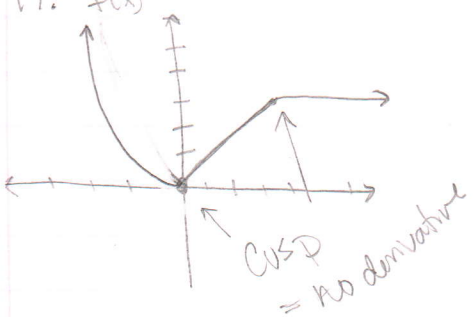
$y'(1) = \dfrac{4 - 5}{1^2} = -1 \longrightarrow m = -1$

$f'(a)(x - a) + f(a)$

$y = -1(x - 1) - 5$

$\boxed{y = -x - 4}$

17. $f(x)$



$$f'(x) = \begin{cases} 2x & x < 0 \\ 1 & 0 < x < 3 \\ 0 & x > 3 \end{cases}$$

all open circles b/c f does not have a derivative at a cusp

$f'(x)$