Section 3.1

1. $h'(x) = \left[\frac{x^3 - 6x^2 + 8x}{x^2 - 2x}\right]' = \left[\frac{x(x-2)(x-4)}{x(x-2)}\right]' = [(x-4)]' = \boxed{1}$

2.

a. $f'(t) = 3t^2 - 27$

$0 = 3t^2 - 27$

$= t^2 - 9$

$= (t+3)(t-3)$

$\Rightarrow t = \boxed{\pm 3}$

b. $f'(t) = 3t^2 - 27$

$21 = 3t^2 - 27$

$0 = 3t^2 - 48$

$= t^2 - 16$

$= (t+4)(t-4)$

$\Rightarrow t = \boxed{\pm 4}$

3.

a. $g'(x) = 2x + f'(x)$

$m = g'(3) = 2(3) + f'(3)$

$= 6 + 4$

$= 10$

$y - g(3) = 10(x-3)$

$\Rightarrow \boxed{y = 10x - 20}$

b. $h'(x) = 3f'(x)$

$m = h'(3) = 3f'(3)$

$= 3(4)$

$= 12$

$y - h(3) = 12(x-3)$

$\boxed{y = 12x - 33}$

4.

a. For $x = 1$, $F(x) = (-3x + 10) + (x + 1)$

$= -2x + 11$

$F'(x) = -2$

$F'(1) = \boxed{-2}$

b. For $x = 5$, $G(x) = 3(x-2) - (-x + \ )$

$= 4x - 13$

$G'(x) = 4$

$G'(5) = \boxed{4}$

Section 3.3

1. $f'(x) = (1-2x)'e^{-x} + (1-2x)\left[e^{-x}\right]'$

$= -2e^{-x} - (1-2x)e^{-x}$

$= -3^{-x} + 2xe^{-x}$

$= \boxed{(2x-3)e^{-x}}$

3. $h'(x) = \dfrac{(x+1)'x^2e^x - \left[x^2e^x\right]'(x+1)}{(x^2e^x)^2}$

$= \dfrac{x^2e^x - \left[2xe^x + x^2e^x\right](x+1)}{x^4e^{2x}}$

$= \boxed{-\dfrac{x^2+2x+2}{x^3e^x}}$

4.

a. $g(x) = x^2 \cdot f(x)$

$g'(x) = 2x\,f(x) + x^2 f'(x)$

$g'(2) = 2(2)(2) + 4(3) = \boxed{20}$

b. $h(x) = \dfrac{f(x)}{x-3}$

$h'(x) = \dfrac{f'(x)(x-3) - f(x)}{(x-3)^2}$

$h'(2) = \dfrac{f'(2)(2-3) - f(2)}{(2-3)^2}$

$= 3(-1) - 2$

$= \boxed{-5}$

5. $\left.\frac{d}{dx}[f(x)g(x)]\right|_{x=1} = \left.f'(x)g(x) + f(x)g'(x)\right|_{x=1}$

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

$= 3(4) + 5(2)$

$= 12 + 10$

$= \boxed{22}$