P. 161 #56.

#56

a) $\frac{d}{dx} 2f(x) = (2) f'(x)$ at $x = 2$

$2f'(2) = 2 \cdot \frac{1}{3} = \boxed{\frac{2}{3}}$

b) $\frac{d}{dx}[f(x) + g(x)] = f'(x) + g'(x)$ at $x = 3$

$f'(3) + g'(3) = \boxed{2\pi + 5}$

c) $\frac{d}{dx}[f(x) \cdot g(x)] = f(x)g'(x) + f'(x)g(x)$ at $x = 3$

$f(3)g'(3) + f'(3)g(3) = 3(5) + 2\pi(-4) =$

$\boxed{15 - 8\pi}$

d) $\frac{d}{dx} \frac{f(x)}{g(x)} = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$ at $x = 2$

$\frac{g(2)f'(2) - f(2)g'(2)}{[g(2)]^2} = \frac{2 \cdot \frac{1}{3} - 8(-3)}{(2)^2}$

$= \boxed{\frac{\frac{2}{3} + 24}{4}}$

e) $\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$ at $x = 2$

$f'(g(2)) \cdot g'(2) = f'(2)(-3) = \frac{1}{3}(-3) = \boxed{-1}$

f) $\frac{d}{dx}\sqrt{f(x)} = \frac{1}{2}[f(x)]^{-1/2} f'(x)$ at $x = 2$

$\frac{1}{2}[f(2)]^{-1/2} \cdot f'(2) = \frac{1}{2}(8)^{-1/2} \cdot (\frac{1}{3}) = \frac{1}{2\sqrt{8} \cdot 3} = \frac{1}{6\sqrt{8}} = \boxed{\frac{1}{12\sqrt{2}}}$

g) $\frac{d}{dx}\frac{1}{g^2(x)} = \frac{d}{dx} g^{-2}(x) = -2g^{-3}(x) \cdot g'(x)$ at $x = 3$

$= -2g^{-3}(3) \cdot g'(3) = -2[-4]^{-3}[5] = \frac{-10}{-64} = \frac{10}{64} = \boxed{\frac{5}{32}}$

h) $\frac{d}{dx}\sqrt{f^2(x) + g^2(x)} = \frac{1}{2}[f^2(x) + g^2(x)]^{-1/2} \cdot [2f(x) \cdot f'(x) + 2g(x)g'(x)]$ at $x = 2$

$= \frac{1}{2}[f^2(2) + g^2(2)]^{-1/2} \cdot [2f(2) \cdot f'(2) + 2g(2)g'(2)]$

$= \frac{1}{2}[8^2 + 2^2]^{-1/2} \cdot [2 \cdot 8 \cdot \frac{1}{3} + 2 \cdot 2 \cdot (-3)] = \frac{1}{2}[68]^{-1/2} \cdot [\frac{16}{3} - 12]$

$= \boxed{\frac{1}{2\sqrt{68}}[\frac{16}{3} - 12]}$