The regular solutions provide relatively complete solutions except for Problem 9.

9. The definition of the derivative is given by

$$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}.$$

a. For $f(x)=x^3$, we have

$$\begin{aligned}\lim_{h\to 0}\frac{(x+h)^3-x^3}{h} &= \lim_{h\to 0}\frac{(x^3+3x^2h+3xh^2+h^3)-x^3}{h}\\ &= \lim_{h\to 0}\frac{3x^2h+3xh^2+h^3}{h}\\ &= \lim_{h\to 0}(3x^2+3xh+h^2)=3x^2.\end{aligned}$$

c. For $f(x)=\sqrt{4-x}$, we have

$$\begin{aligned}\lim_{h\to 0}\frac{\sqrt{4-(x+h)}-\sqrt{4-x}}{h} &= \lim_{h\to 0}\frac{\left(\sqrt{4-(x+h)}-\sqrt{4-x}\right)}{h}\frac{\left(\sqrt{4-(x+h)}+\sqrt{4-x}\right)}{\left(\sqrt{4-(x+h)}+\sqrt{4-x}\right)}\\ &= \lim_{h\to 0}\frac{(4-(x+h))-(4-x)}{h\left(\sqrt{4-(x+h)}+\sqrt{4-x}\right)}\\ &= \lim_{h\to 0}\frac{-h}{h\left(\sqrt{4-(x+h)}+\sqrt{4-x}\right)}\\ &= \lim_{h\to 0}\frac{-1}{\sqrt{4-(x+h)}+\sqrt{4-x}}=-\frac{1}{2\sqrt{4-x}}\end{aligned}$$