7. Using (1) with $f(x) = \dfrac{x-1}{x-2}$ and $P(3,2)$,

$$m = \lim_{x\to a} \frac{f(x)-f(a)}{x-a} = \lim_{x\to 3} \frac{\frac{x-1}{x-2} - 2}{x-3} = \lim_{x\to 3} \frac{\frac{x-1-2(x-2)}{x-2}}{x-3} = \lim_{x\to 3} \frac{3-x}{(x-2)(x-3)}$$

$$= \lim_{x\to 3} \frac{-1}{x-2} = \frac{-1}{1} = -1.$$

Tangent line: $y-2=-1(x-3) \;\Leftrightarrow\; y-2=-x+3 \;\Leftrightarrow\; y=-x+5$

8. Using (1),

$$m = \lim_{x\to -1} \frac{(2x^3-5x)-3}{x-(-1)} = \lim_{x\to -1} \frac{2x^3-5x-3}{x+1} = \lim_{x\to -1} \frac{(2x^2-2x-3)(x+1)}{x+1}$$

$$= \lim_{x\to -1} (2x^2-2x-3) = 1.$$

Tangent line: $y-3 = 1\,[x-(-1)] \;\Leftrightarrow\; y = x+4$

9. Using (1), $m = \displaystyle\lim_{x\to 1} \frac{\sqrt{x}-\sqrt{1}}{x-1} = \lim_{x\to 1} \frac{(\sqrt{x}-1)(\sqrt{x}+1)}{(x-1)(\sqrt{x}+1)} = \lim_{x\to 1} \frac{x-1}{(x-1)(\sqrt{x}+1)} = \lim_{x\to 1} \frac{1}{\sqrt{x}+1} = \frac{1}{2}.$

Tangent line: $y-1=\frac{1}{2}(x-1) \;\Leftrightarrow\; y=\frac{1}{2}x+\frac{1}{2}.$

10. Using (1), $m = \displaystyle\lim_{x\to 0} \frac{\frac{2x}{(x+1)^2}-0}{x-0} = \lim_{x\to 0} \frac{2x}{x(x+1)^2} = \lim_{x\to 0} \frac{2}{(x+1)^2} = \frac{2}{1^2} = 2.$

Tangent line: $y-0=2(x-0) \;\Leftrightarrow\; y=2x$

11. (a) Using (1),

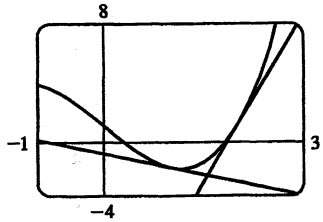
$$m = \lim_{x\to a} \frac{(x^3-4x+1)-(a^3-4a+1)}{x-a} = \lim_{x\to a} \frac{(x^3-a^3)-4(x-a)}{x-a}$$

$$= \lim_{x\to a} \frac{(x-a)(x^2+ax+a^2)-4(x-a)}{x-a} = \lim_{x\to a} (x^2+ax+a^2-4) = 3a^2-4$$

(b) At $(1,-2)$: $m=3(1)^2-4=-1$, so an equation of the tangent line is $y-(-2)=-1(x-1) \;\Leftrightarrow\; y=-x-1.$

At $(2,1)$: $m=3(2)^2-4=8$, so an equation of the tangent line is $y-1=8(x-2) \;\Leftrightarrow\; y=8x-15.$

(c)



12. (a) Using (1),

$$m = \lim_{x\to a} \frac{\frac{1}{\sqrt{x}}-\frac{1}{\sqrt{a}}}{x-a} = \lim_{x\to a} \frac{\frac{\sqrt{a}-\sqrt{x}}{\sqrt{ax}}}{x-a} = \lim_{x\to a} \frac{(\sqrt{a}-\sqrt{x})(\sqrt{a}+\sqrt{x})}{\sqrt{ax}\,(x-a)\,(\sqrt{a}+\sqrt{x})}$$

$$= \lim_{x\to a} \frac{a-x}{\sqrt{ax}\,(x-a)\,(\sqrt{a}+\sqrt{x})} = \lim_{x\to a} \frac{-1}{\sqrt{ax}\,(\sqrt{a}+\sqrt{x})} = \frac{-1}{\sqrt{a^2}\,(2\sqrt{a})} = -\frac{1}{2a^{3/2}} \text{ or } -\tfrac{1}{2}a^{-3/2}$$

(b) At $(1,1)$: $m=-\frac{1}{2}$, so an equation of the tangent line is $y-1=-\frac{1}{2}(x-1) \;\Leftrightarrow\; y=-\frac{1}{2}x+\frac{3}{2}.$

At $(4,\frac{1}{2})$: $m=-\frac{1}{16}$, so an equation of the tangent line is $y-\frac{1}{2}=-\frac{1}{16}(x-4) \;\Leftrightarrow\; y=-\frac{1}{16}x+\frac{3}{4}.$

(c)