1. Compute the derivative of each function.

a) $f(x) = 3x - 7$ $\quad$ **3**

b) $y = 2x^5 - 4x^3 + 5x + 10$ $\quad$ **$10x^4 - 12x^2 + 5$**

c) $g(x) = 5e^x$ $\quad$ **$5e^x$**

d) $h(x) = \dfrac{x}{1+e^x}$ $\quad$ **$[(1+e^x) - xe^x]/(1+e^x)^2$**

e) $y = e^x(1 + \tan x)$ $\quad$ **$e^x \sec^2 x + e^x(1 + \tan x)$**

f) $f(x) = \sqrt{1 + \sin x}$ $\quad$ **$-\cos x/(2\sqrt{1+\sin x})$**

g) $P(x) = (e^x + x^2)^{100}$ $\quad$ **$100(e^x + 2x)^{99}(e^x + 2)$**

h) $g(x) = e^{-x^2/2}$ $\quad$ **$(-x)e^{-x^2/2}$**

i) $y = \sqrt[3]{1 - 2x^5}$ $\quad$ **$-10x^4/(3\sqrt[3]{(1-2x^5)^2})$**

2. Let $f(x) = x^2 + 3$.

a) Graph $f(x)$

f(x)
$y = 0$
$y = -4x + 1$ **$y = 2x + 2$**
$y = -2x + 2$
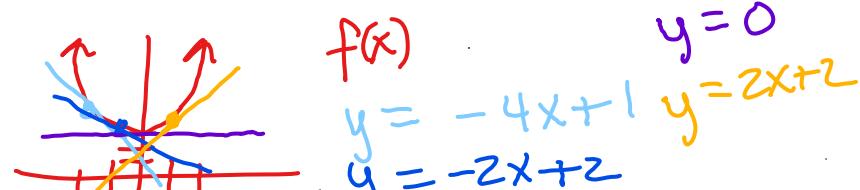
b) Find the equations of the lines tangent to $f(x)$ at $x = -2$, $x = -1$, $x = 0$ and $x = 1$. **lines**

c) Add the graphs of your tangent **lines** in b) to the graph from a)

3. Is there a function $f(x)$ so that $f(x) = 2f'(x)$? If so, give a function and prove it satisfies the equation. **yes: $f(x) = e^{x/2}$**

4. Let $f(x) = \sin(x)$. Find all values of n so that $\dfrac{d^n}{dx^n}[\sin(x)] = \sin(x)$, that is, $f^{(n)}(x) = f(x)$.

$n = 4, 8, 12, 16, \ldots$

5. Prove each of the following statements using only the facts that $\frac{d}{dx}[\sin x] = \cos x$ and $\frac{d}{dx}[\cos x] = -\sin x$ with rules for combining derivatives.

 a) $\frac{d}{dx}[\tan x] = \sec^2 x$

 b) $\frac{d}{dx}[\sec x] = \sec x \tan x$

 c) $\frac{d}{dx}[\csc x] = -\csc x \cot x$

 d) $\frac{d}{dx}[\cot x] = -\csc^2 x$

Use

$\tan x = \dfrac{\sin x}{\cos x}$

$\sec x = \dfrac{1}{\cos x}$

$\csc x = \dfrac{1}{\sin x}$

$\cot x = \dfrac{\cos x}{\sin x}$

6. Take the derivative of both sides of the identity
$$\cos(2\theta) = \cos^2(\theta) - \sin^2(\theta)$$ **Use chain rule**
to prove that the following identity is true:
$$\sin(2\theta) = 2\sin(\theta)\cos(\theta)$$

7. The height of a model rocket with an initial launch velocity of 120 ft/sec is given by $S(t) = -16t^2 + 120t + 0.5$ t seconds after launch.

 a) What are the units of $S(0)$? $S'(0)$? $S''(0)$? $S^{(3)}(0)$?
   ft   ft/s   ft/s²   ft/s³

 b) What is the instantaneous velocity 2 seconds after launch? **56 ft/s** instantaneous acceleration? **-32 ft/s²**

 c) When is the rocket speeding up? slowing down? **always**

8. Bill is on a trip. His distance from home as a function of time is below. Sketch graphs of his instantaneous velocity and acceleration.

— velocity
— acceleration