1. A rocket is launching, and its height h in meters is a function of t in seconds (so we are considering the function $h(t)$). Explain what $h'(10) = 1035$ means in language your parents could understand. You answer must include units.

The rocket is rising at a rate of 1035 $\underbrace{m/s}$.

velocity: r.o.c. of position

Compute derivatives of the following functions using derivative rules.

2. $f(t) = e^t \cos(t)$

$$f'(t) = \left(\frac{d}{dt} e^t\right) \cdot \cos(t) + e^t \frac{d}{dt} \cos(t)$$

$$= e^t \cdot \cos(t) + e^t(-\sin(t))$$

$$\boxed{= e^t [\cos(t) - \sin(t)]}$$

3. $f(x) = \dfrac{x}{1+e^x}$

$$\frac{d}{dx} \frac{x}{1+e^x} = \frac{\left(\frac{d}{dx} x\right) \cdot (1+e^x) - x \frac{d}{dx}(1+e^x)}{(1+e^x)^2}$$

$$= \frac{1 \cdot (1+e^x) - xe^x}{(1+e^x)^2} = \boxed{\frac{1+e^x - xe^x}{(1+e^x)^2}}$$

4. $f(t) = e^{-t}$

$$\frac{d}{dt} e^{-t} = \frac{d}{dt} \frac{1}{e^t} = -\frac{\frac{d}{dt}(e^t)}{(e^t)^2} = -\frac{e^t}{(e^t)^2}$$

$$= -\frac{1}{e^t}$$

$$= \boxed{-e^{-t}}$$

5. $e^{-t}\cos(t)$

$$\frac{d}{dt}\left(e^{-t}\cos(t)\right) = \frac{d}{dt} e^{-t} \cdot \cos(t) + e^{-t} \cdot \frac{d}{dt}(\cos(t))$$

$$= \left(-e^{-t}\right) \cdot \cos(t) + e^{-t}\left(-\sin(t)\right)$$

$$= \boxed{-e^{-t}\left[\cos(t) + \sin(t)\right]}$$

6. $f(x) = \dfrac{1}{1+x^2}$

$$\frac{df}{dx} = \frac{d}{dx}\left(\frac{1}{1+x^2}\right) = \frac{-\frac{d}{dx}(1+x^2)}{(1+x^2)^2}$$

$$= \boxed{\frac{-2x}{(1+x^2)^2}}$$

7. $f(x) = (1+x^2)e^x\sin(x)$

$$\frac{d}{dx}\underbrace{(1+x^2)e^x\sin(x)} = \frac{d}{dx}\left[(1+x^2)e^x\right]\cdot\sin(x) + (1+x^2)e^x\cdot\frac{d}{dx}\sin(x)$$

$$= \left[\left(\frac{d}{dx}(1+x^2)\right)e^x + (1+x^2)\frac{d}{dx}e^x\right]\cdot\sin(x)$$

$$+ (1+x^2)e^x\cos(x)$$

$$= \boxed{\left[2xe^x + (1+x^2)e^x\right]\cdot\sin(x) + (1+x^2)e^x\cos(x)}$$

8. $f(v) = \underbrace{\left(1+\frac{1}{v}\right)\left(2-\frac{1}{v}\right)}$

$$(1+v^{-1})(2-v^{-1}) = 2+v^{-1}-v^{-2}$$

$$\frac{d}{dv} f(v) = \frac{d}{dv}\left[2+v^{-1}-v^{-2}\right] = 0+(-1)v^{-2}-(-2)v^{-3}$$

$$= \boxed{-v^{-2}+2v^{-3}}$$

9. $f(\theta) = \dfrac{\sin(\theta)}{\cos(\theta)}$

$$\frac{d}{d\theta}\frac{\sin\theta}{\cos\theta} = \frac{\left(\frac{d}{d\theta}\sin\theta\right)\cdot\cos\theta - \sin\theta\frac{d}{d\theta}(\cos\theta)}{\cos^2\theta}$$

$$= \frac{\cos^2\theta - \sin\theta\cdot(-\sin\theta)}{\cos^2\theta}$$

$$= \frac{\cos^2\theta + \sin^2\theta}{\cos^2\theta} = \boxed{\frac{1}{\cos^2\theta}}$$

$$\boxed{\frac{d}{d\theta}\tan\theta = \sec^2\theta}$$ $\longleftarrow$ Just showed this!