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 m/s at time $t = 10$ seconds.

Compute derivatives of the following functions using derivative rules.

2. $f(t) = \sqrt{t}e^t$

$$f'(t) = \frac{1}{2}t^{-1/2}e^t + \sqrt{t}e^t$$

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

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

4. $f(t) = e^{2t}$

$$\frac{d}{dt} e^{2t} = \frac{d}{dt}\left(e^{t} e^{t}\right) = \left(\frac{d}{dt} e^{t}\right) e^{t} + e^{t} \frac{d}{dt} e^{t}$$

$$= e^{t} e^{t} + e^{t} e^{t}$$

$$= 2e^{2t}$$

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

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

$$f'(v) = -\frac{1}{v^2} + \frac{2}{v^3}$$

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

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

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

$$= \frac{2e^{2x} - 3e^{3x}}{\left(1 - e^{x}\right)^2}$$

7. $f(x) = \dfrac{\sin(x)}{\cos(x)}$

$$f'(x) = \frac{d}{dx}\frac{\sin(x)}{\cos(x)} = \frac{\left(\frac{d}{dx}\sin(x)\right)\cos(x) - \sin(x)\frac{d}{dx}\cos x}{\cos^2(x)}$$

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

$$= \frac{1}{\cos^2(x)} = \sec^2(x)$$

8. $f(x) = e^{2x}\sin(x)$

$$f'(x) = 2e^{2x}\sin(x) + e^{2x}\cos(x)$$

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

$$f'(x) = 2x\,e^x\sin(x) + (1+x^2)e^x\sin(x) + (1+x^2)e^x\cos(x)$$