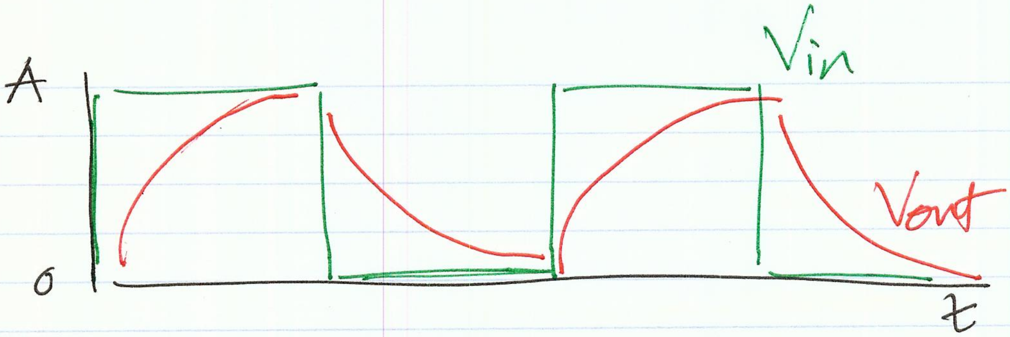

Rising

$$V_{out} = A\left(1-e^{-t/T}\right)$$

To find the 10%, 50% and 90% points, set V_{out} = desired fraction of A and solve for t.

For example, to find the 10% point,

$$V_{out} = 0.1A = A\left(1-e^{-t/T}\right)$$

$$0.1 = 1-e^{t/T}$$

$$e^{-t/T} = 0.9$$

$$\log\left(e^{-t/T}\right) = \log(0.9)$$

$$-\frac{t}{T} = \log(0.9)$$

$$t = -T\log(0.9)$$

The rise time, t_{Rise}, is the difference between when $V_{out} = 0.1A$ and when $V_{out} = 0.9A$ in seconds.

Falling

$$V_{out} = A e^{-t/\tau}$$

To find when it falls through the 90% point:

$$V_{out} = 0.9A = Ae^{-t/\tau}$$

$$0.9 = e^{-t/\tau}$$

$$\log(0.9) = \log(e^{-t/\tau})$$

$$= -t/\tau$$

$$t = -\tau \log(0.9)$$

Note that rising 10% or falling 10% takes the same time. It's symmetric.

Propagation times are measured between the 50% point on the input and the 50% point on the output.

The input is a square wave that passes thru 50% instantly (as far as we're concerned).

So t_{PLH} (propagation low-to-high) =

time when $V_{out} = 0.5A$ rising

t_{PHL} (prop. high-to-low) = time when $V_{out} = 0.5A$ falling

Again, it's symmetric $t_{PLH} = t_{PHL}$.

Extracting the slope (6.2)

Falling

$$V_{out} = Ae^{-t/T}$$

$$\log(V_{out}) = \log(A) + \log(e^{-t/T})$$

$$= \log(A) - \frac{t}{T}$$

Think of this as a function, f(t) and take the derivative of both sides

$$\frac{df}{dt} = \frac{d(\log(V_{out}))}{dt} = \frac{d}{dt}\left(\log(A) - \frac{t}{T}\right)$$

$$= 0 - \frac{1}{T} = -\frac{1}{T}$$

There's the slope.

Rising

$$V_{out} = A\left(1 - e^{-t/\tau}\right)$$

$$\frac{V_{out}}{A} = 1 - e^{-t/\tau}$$

$$1 - \frac{V_{out}}{A} = e^{-t/\tau}$$

$$\log\left(1 - \frac{V_{out}}{A}\right) = \log\left(e^{-t/\tau}\right)$$

$$= -t/\tau$$

Again, think of this as a function f(t) and take the derivative of both sides

$$\frac{df}{dt} = \frac{d}{dt}\left(\log\left(1 - \frac{V_{out}}{A}\right)\right) = \frac{d}{dt}\left(-\frac{t}{\tau}\right)$$

$$= -\frac{1}{\tau}$$

Again, there's the slope