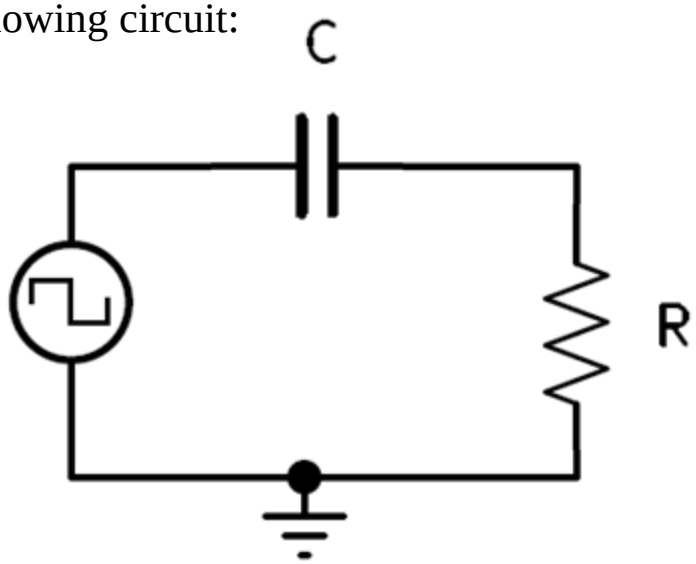
Consider the following circuit:



Differentiation

- "Differentiation is a measure of rate of change." (Bell p.56)
- There is more than enough time for the capacitor to fully charge and discharge.
    1. PW or PS is greater than 5τ.
    2. "When RC is less than one-tenth of the pulse width, the capacitor is charged very rapidly. Only a brief pulse of current is necessary to charge and discharge the capacitor at the beginning and end of the pulse. The resultant waveform of the resistor voltage is a series of positive and negative spikes at the pulse leading and lagging edges, respectively." (Bell p.56)
    3. The standard formulas for designing an Integrating RC circuit is:
        - $\boldsymbol{RC = \tau}$
        - $50\%\ DC,\ PW = PS$
        - $PW = Time\ to\ charge, PS = Time\ to\ discharge$
        - $\boldsymbol{RC}$=$(\frac{\mathbf{1}}{\mathbf{10}}\boldsymbol{PW})$ (Differentiation in terms of τ)
        - $\boldsymbol{Time\ = 10 \times \tau}$ (Differentiation formula in terms of Time, lots of Time to charge or discharge)

See Image:

a) Is **not** a Differentiator, the capacitor is not fully charging or discharging.
b) Is **not** an Differentiator, $\tau =$ PW. 63% charge and discharge
c) Is a **Differentiator,** the capacitor is fully charging and discharging within a relatively fast amount of time when comparted to the PW and PS and the resulting resistor voltage appears as positive and negative going spikes.