10.49

RC time constant τ is based on $C = 0.500e{-}6\,F$ & some R value.

Need a time constant from $t = 2.00s$ to $15.00s$

For $t = 2.00s = \tau = RC$

$2.00s = R(0.5e{-}6)$

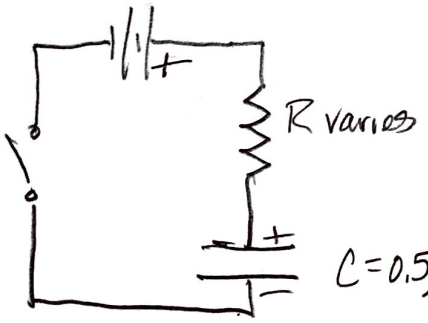
$R = \frac{2.00s}{0.5e{-}6} = \boxed{4.0e6\,\Omega} = 4.0M\Omega$

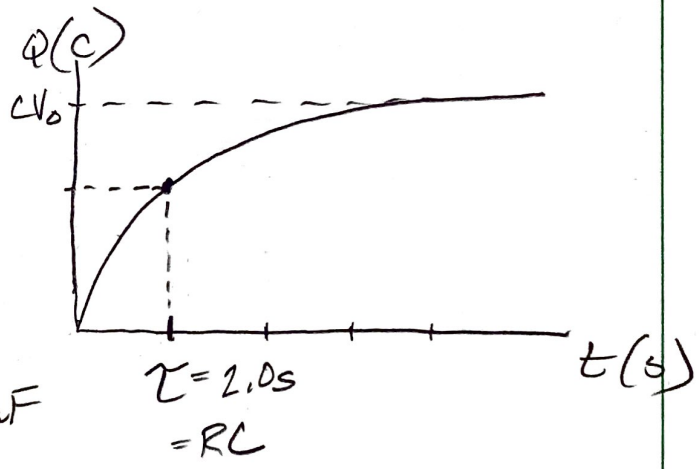
For $t = 15.00s$

$15.0s = R(0.5e{-}6)$

$R = \frac{15}{0.5e{-}6} = \boxed{3.0e7\,\Omega} = 30.M\Omega$

RC Circuit





One time constant $\tau = RC$ is the amount of time it takes for $Q = 0.632\,Q_{max}$.

$= 63.2\%$ of full charge

10.50 Pacemaker fires 72x/minute * $\frac{1\,min}{60s}$ = 1.2 times/sec

→ 0.833 sec/firing.

Each time it fires a 25.0e-9 F capacitor is charged to 0.632 of its Voltage (= 1 τ)

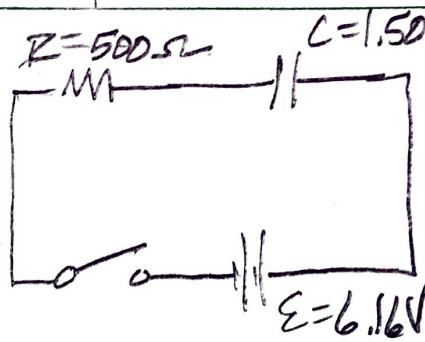
Find R.

So $\tau = 0.833s = RC$

$0.833s = (R)(2.5e-9\,F)$

$R = \frac{0.833s}{2.5e-9} = \boxed{3.33e8\,\Omega}$

10.53



a) Initial current happens when there is no ΔV across the plates of the capacitor yet.

$$I_0 = \frac{\mathcal{E}}{R} = \frac{6.16\,V}{500\,\Omega} = \boxed{0.123\,A}$$

b) The time constant $\tau = RC$

$$= (500\,\Omega)(1.5e{-}6\,F)$$

$$= \boxed{7.5e{-}4\,s}$$

c) Current after one time constant (when $\tau = RC$)

$$I = \frac{V_0}{R}(e^{-t/RC})$$

$$= \frac{6.16}{500}(e^{-1}) = \boxed{4.53e{-}3\,A}$$

d) Voltage on capacitor after one τ?

$V = \frac{Q}{C}$, so $V = \frac{\mathcal{E}V_0(1-e^{-1})}{\mathcal{E}}$

$$= 6.16\left(1 - \frac{1}{e}\right)$$

$$= \boxed{3.89\,V}$$