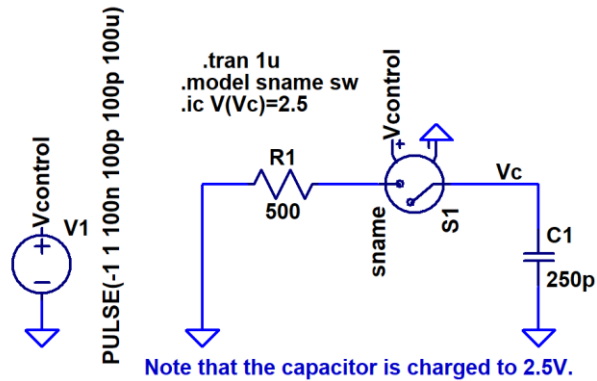


Closed book and notes.

**Show your work for credit and place a box around each of your answers. Note the information on the back of the quiz!**

- At 100 ns the switch seen below closes. Using the Laplace transform determine, and sketch, the voltage across the capacitor from 0 to 1 us. (5 points)



### 12-2.1 Definition of the Laplace Transform

The symbol  $\mathcal{L}[f(t)]$  is a short-hand notation for “the Laplace transform of function  $f(t)$ .” Usually denoted  $F(s)$ , the Laplace transform is defined by

$$F(s) = \mathcal{L}[f(t)] = \int_{0^-}^{\infty} f(t) e^{-st} dt, \quad (12.10)$$

**Table 12-2:** Examples of Laplace transform pairs for  $T \geq 0$ . Note that multiplication by  $u(t)$  guarantees that  $f(t) = 0$  for  $t < 0^-$ .

<b>Laplace Transform Pairs</b>	
$f(t)$	$F(s) = \mathcal{L}[f(t)]$
1	$\delta(t) \leftrightarrow 1$
1a	$\delta(t - T) \leftrightarrow e^{-Ts}$
2	1 or $u(t) \leftrightarrow \frac{1}{s}$
2a	$u(t - T) \leftrightarrow \frac{e^{-Ts}}{s}$
3	$e^{-at} u(t) \leftrightarrow \frac{1}{s + a}$
3a	$e^{-a(t-T)} u(t - T) \leftrightarrow \frac{e^{-Ts}}{s + a}$
4	$t u(t) \leftrightarrow \frac{1}{s^2}$
4a	$(t - T) u(t - T) \leftrightarrow \frac{e^{-Ts}}{s^2}$
5	$t^2 u(t) \leftrightarrow \frac{2}{s^3}$
6	$t e^{-at} u(t) \leftrightarrow \frac{1}{(s + a)^2}$
7	$t^2 e^{-at} u(t) \leftrightarrow \frac{2}{(s + a)^3}$
8	$t^{n-1} e^{-at} u(t) \leftrightarrow \frac{(n-1)!}{(s + a)^n}$
9	$\sin \omega t u(t) \leftrightarrow \frac{\omega}{s^2 + \omega^2}$
10	$\sin(\omega t + \theta) u(t) \leftrightarrow \frac{s \sin \theta + \omega \cos \theta}{s^2 + \omega^2}$
11	$\cos \omega t u(t) \leftrightarrow \frac{s}{s^2 + \omega^2}$
12	$\cos(\omega t + \theta) u(t) \leftrightarrow \frac{s \cos \theta - \omega \sin \theta}{s^2 + \omega^2}$
13	$e^{-at} \sin \omega t u(t) \leftrightarrow \frac{\omega}{(s + a)^2 + \omega^2}$
14	$e^{-at} \cos \omega t u(t) \leftrightarrow \frac{s + a}{(s + a)^2 + \omega^2}$
15	$2e^{-at} \cos(bt - \theta) u(t) \leftrightarrow \frac{e^{j\theta}}{s + a + jb} + \frac{e^{-j\theta}}{s + a - jb}$
16	$\frac{2t^{n-1}}{(n-1)!} e^{-at} \cos(bt - \theta) u(t) \leftrightarrow \frac{e^{j\theta}}{(s + a + jb)^n} + \frac{e^{-j\theta}}{(s + a - jb)^n}$

Note:  $(n-1)! = (n-1)(n-2) \dots 1$ .