7-11

(a) 

$q = CV$

$= (20\mu F)\ 100\,V = 2.0\ mC$

(b) $V = \frac{q}{C} = \frac{2.0\ mC}{5\mu F} = 0.4\ kV = 400\,V$

(c) $V = \frac{q}{C} = \frac{50\mu C}{2\mu F} = 25\,V$

(d) $W_C = \frac{1}{2}CV^2 = \frac{1}{2}(20\mu F)(100\,V)^2$

$= 0.1\ J$

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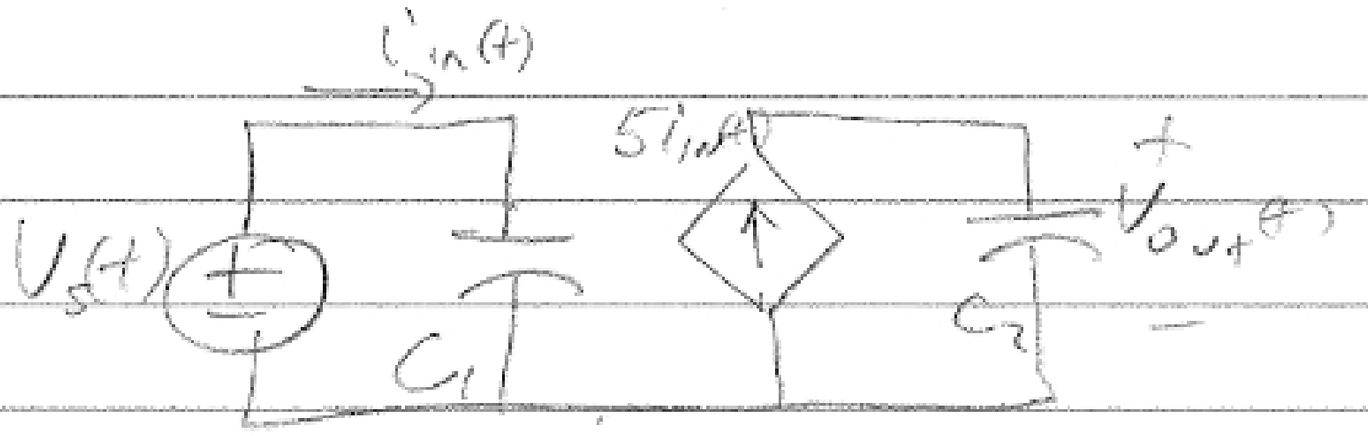

$C_1 = 20\,\mu F$

$C_2 = 0.1\,mF$

$v_s(t) = 5\sin(2000t)\,V$

$v_{out}(0) = 10\,V$

(a) $i_{in}(t) = C_1 \frac{dv_s(t)}{dt} = 20\mu F \cdot 5\,(2000/s)\cos 2000t\,V$

$= 0.2\cos 2000t\ A$

$5\,i_{in}(t) = 1.0\cos 2000t\ A$

$v_{out} = \frac{1}{C_2}\int_0^t 5\,i_{in}(t')\,dt' + v_{out}(0)$

$= \frac{1}{0.1mF}\,\frac{1.0}{2000/s}\sin 2000t\Big|_0^t + 10V$

$$\boxed{v_{out} = (5\sin 2000t + 10)\,V}$$

Since $i_{in}(t)$ depends on $\frac{dv_s}{dt}$, any initial voltage on C_1 does not affect $i_{in}(t)$ or v_{out}

(b) $p_{DS} = 5\,i_{in}(t)\,v_{out}(t)$

$= (1.0\cos 2000t\ A)(5\sin 2000t + 10)\,V$

$= (2.5\sin 4000t + 10\cos 2000t)\,W$

(c) $W_C(t) = \frac{1}{2} C_2 V_{out}^2(t)$

$= \frac{1}{2} (0.1\,mF)(5 \sin 2000t + 1)^2 V^2$

$W_C(mJ) = 5 (0.5 \sin 2000t + 1)^2 \; mJ$