**Homework 12**

**P11.1.2** The switch in Figure P11.1.2 is moved to position ‘b’ at *t* = 0 after being in position ‘a’ for a long time. Determine, for *t* ≥ 0: (a) *vc*; (b) *ic*, from initial and final values as well as from the *v*-*i* relation for the capacitor.



**Solution:** (a) *VC*0 = -40×60/80 = -30 V; *VCS* = 90 V. Time constant = 400×103×0.5×10-6 = 0.2 s. It follows that *vC* = 90 + (-30 – 90) =  V.

(b) Just before the switch is moved, *iC* = 0 and *vC* = -30 V. Just after the switch is moved is moved, *vC* = -30 V and *iC* = (90 – (-30)) /400 = 120/400 = 0.3 mA. The final value of *iC* is zero. Hence,  mA.

Alternatively, *iC* = *CdvC*/*dt* = *C*(-120)(-5)= (0.5×10-6)(600)*=*  mA.



**P11.1.6** The switch

in Figure P11.1.6

is opened

at *t* = 0 after

being closed for a long time. Determine *vO* for *t* ≥ 0.

**Solution:** *IL*0 is the same just after closing the switch as just before closing it. *IL*0 is the steady-state current given by:  A. From current division, the initial value of *vO* is:  V. The resistance seen by the



inductor is 3 + 2 + (60||20) = 5 +  = 20 Ω. The time constant is *L*/*R* = 0.2/20 = 0.01 s. It follows that  V.



**P11.1.7** (a) The switch in Figure P11.1.6 is closed at *t* = 0 after being opened for a long time. Determine *vO* for *t* ≥ 0. (b) The switch opens again at *t* = 10 s. Determine *vO* for *t* ≥ 10 s.

**Solution:** (a) *VC*0 = 9×10/30 = 3 V. With the switch closed, *VCS* = 9×10/(20 + 10||20) = 9×10/(20 + 20/3) = 2.25 V, and the time constant is 3(20||20||10) = 15 s. It follows that *vO* = 2.25 + (3 – 2.25)*=* 2.25 + 0.75V, 0 ≤ *t* ≤ 10 s.

(b) At *t* = 10 s, *vO* = 2.25 + 0.75 = 2.635 V. VCS = 3 V and the time constant is 3(20||10) = 20 s. It foll0ws that *vO* = 3 + (2.635 – 3) = 3 – 0.365 V, *t* ≥ 10 s.

**P11.1.9** The capacitor is initially uncharged In Figure P11.1.9 and the switch is closed at  Determine for *t* ≥ 0: (a) *vC*; (b) *ix* .



**Solution:** (a) *VC*0 = 0. *VCS* = 45×10/15 = 30 V. The time constant after the switch is closed and with the source set to zero, is: 10-6(5||10)×10-3 = 10/3 ms. It follows that *vC* = 30V, where *t* is in ms.

(b) Just after the switch is closed, *VC0* = 0 and *Ix*0 = 45/5 = 9 mA. *ICS* = 45/15 = 3 mA. It follows that *ix* = 3 + ( 9 – 3) = 3 + mA.