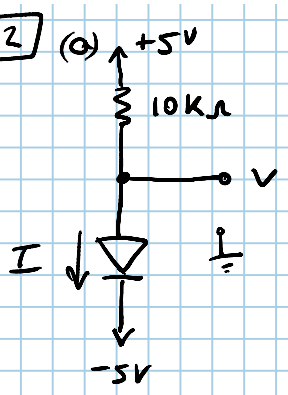
4.2

(a)



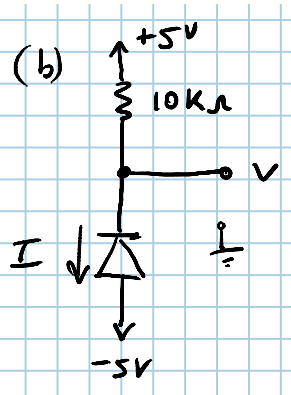
ASSUMING FWD. BIAS,

$V = -5V$

$I = \frac{5-(-5)}{10}\left(\frac{V}{k\Omega}\right)$

$I = 1mA$

(b)



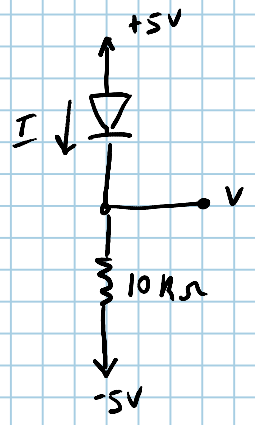
MORE NEG POTENTIAL @ ANODE ⇒ REV. BIASED

$\therefore I = 0A$

NO IR DROP ACROSS RESISTOR

$\therefore V = +5V$

(c)

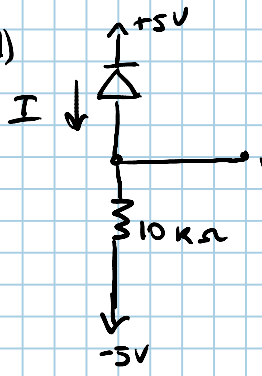


FWD. BIASED

$\therefore V = +5V$

$I = \frac{5-(-5)}{10k\Omega} = 1mA$

(d)

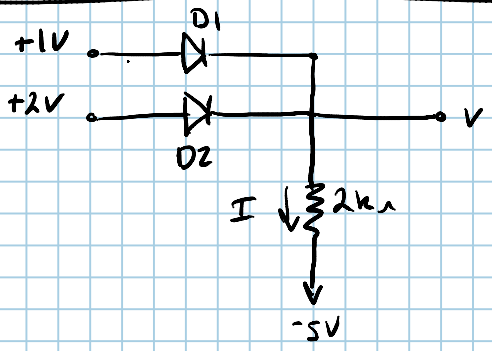


MORE POS. POTENTIAL @ CATHODE ⇒ REV. BIASED

$\therefore I = 0A$

ALSO, $V = -5V$

4.3 (a)



- IF D1 & D2 ARE FWD BIASED, $V = 1V$ AND $2V$: CAN'T BE!!

- IF D1 IS FWD BIASED, D2 IS REV. BIASED

  $V = 1V$, AND 1V IS ON CATHODE OF D2 WHICH FWD BIASED D2.

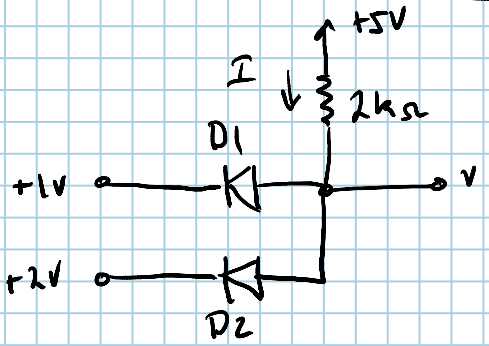
  • BOTH CAN'T BE FWD BIASED.

- IF D2 IS FWD BIASED, $V = 2V$, AND 2V IS ON CATHODE OF D1. THIS REV. BIASES D1.

  $\therefore$ D1: REV. BIASED
  D2: FWD. BIASED ⇒ $V = 2V$

$I = \frac{2-(-5)}{2k\Omega} = 3.5mA$

(b)



- BOTH DIODE CAN'T BE FWD BIASED @ SAME TIME.

- IF D1 FWD BIASED, $V = 1V$ AND D2 IS REV. BIASED. THIS COULD WORK.

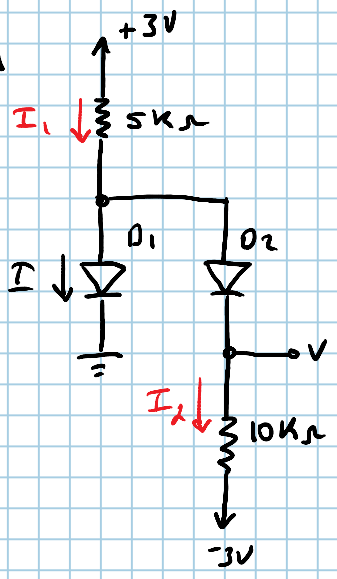
- IF D2 IS FWD. BIASED $V = 2V$, AND D1 IS ALSO FWD. BIASED. CAN'T WORK.

$\therefore$ D1 IS FWD BIASED, D2 IS REV. BIASED.

$V = +1V$, $I = \frac{5-1}{2k\Omega} = 1mA$

4.9

(a)



- IF BOTH D1 & D2 ARE FWD BIASED:

$\boxed{V = 0}$

$I_1 = \frac{3-0}{5} = \frac{3}{5}\,mA = 0.6\,mA$

$I_2 = \frac{0-(-3)}{10} = 0.3\,mA$

$I = I_1 - I_2 = 0.6 - 0.3 = \boxed{0.3\,mA}$

- IF D1 ≡ R.B. & D2 ≡ F.B., THEN:

$I = \emptyset\,mA$, $I_1 = I_2 = \frac{3-(-3)}{15k\Omega} = \frac{2}{5}\,mA = 0.4\,mA = \frac{V-(-3)}{10k\Omega}$

$\therefore V = +1V$

THEN 1V IS ON ANODE OF D1, THEN D1 IS F.B.

- IF D1 ≡ F.B. & D2 ≡ R.B., THEN:

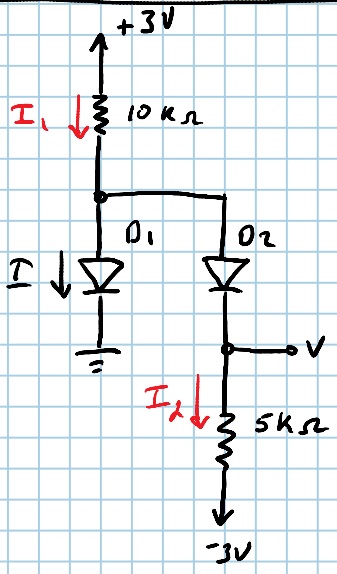
$V = -3V$, $I = I_1 = \frac{3-0}{5k\Omega} = 0.6\,mA$

$(I_2 = \emptyset)$

AND, ANODE OF D2 IS @ $\emptyset V$ THRU F.B. D1.

THIS MAKES D2 ≡ FWD. BIASED.

(b)



- IF D1 & D2 ARE BOTH F.B.:

$I_1 = \frac{3V}{10k\Omega} = 0.3\,mA$, $I_2 = \frac{0-(-3)V}{5k\Omega} = 0.6\,mA$

$I = I_1 - I_2 = 0.3\,mA - 0.6\,mA = -0.3\,mA \Rightarrow D1 \equiv R.B.$

$\therefore$ D1 & D2 AREN'T BOTH F.B.

- IF D1 ≡ R.B. & D2 ≡ F.B.:

$I = 0$, $I_1 = I_2 = \frac{3-(-3)}{15k\Omega} = 0.4\,mA = \frac{V-(-3)}{5k\Omega}$

$V = -1V$ (CHECKS WORKS)

- IF D1 ≡ F.B., D2 ≡ R.B.: $I_2 = 0$, $V = -3V$

$I = I_1 = \frac{3-0}{10k\Omega} = 0.3\,mA$, BUT $\emptyset V$ @ ANODE D1 (& D2) AND $V = -3V$ @ CATHODE OF D2 MAKES D2 F.B.

$\therefore$ D1 ≡ R.B., D2 ≡ F.B.

$\boxed{I = \emptyset\,mA,\ V = -1V}$

4.57

EQN 4.20: $V_z = V_{z0} + r_z I_{zT}$

a) $V_z = 10\,V$, $V_{zk} = 9.6\,V$, $I_{zT} = 50\,mA$, $(V_{z0} \approx V_{zk} = 9.6\,V)$

$r_z = \frac{V_z - V_{z0}}{I_{zT}} = \frac{10 - 9.6}{50\,mA}$, $r_z = 8\,\Omega$

$2I_{zT} = 100\,mA$

$V_z = V_{z0} + r_z(2I_{zT}) = 10.4\,V$

$P = (10.4\,V)(100\,mA) = 1.04\,W$

b) $I_{zT} = 10\,mA$, $V_z = 9.1\,V$, $r_z = 30\,\Omega$

$V_{z0} = V_z - r_z I_{zT} = 9.1 - (0.03\,k\Omega)(10\,mA)$

$V_{z0} = 8.8\,V$

$2I_{zT} = 20\,mA$, $V_z = V_{z0} + r_z(2I_{zT}) = 8.8 + (0.03\,k\Omega)(20\,mA) = 9.4\,V$

$P = (9.4\,V)(20\,mA) = 0.188\,W$

c) $r_z = 2\,\Omega$, $V_z = 6.8\,V$, $V_{zk} = 6.6\,V$

$I_{zT} = \frac{V_z - V_{z0}}{r_z} = \frac{6.8 - 6.6}{0.002\,k\Omega} = 100\,mA$, $2I_{zT} = 200\,mA$

$V_z = V_{z0} + r_z(2I_{zT}) = 6.6\,V + (0.002\,k\Omega)(200\,mA) = 7\,V$

$P = (7\,V)(200\,mA) = 1.4\,W$

d) $V_z = 18\,V$, $I_{zT} = 5\,mA$, $V_{zk} = 17.6\,V$ $(= V_{z0})$

$V_z = V_{z0} + r_z I_{zT} \Rightarrow r_z = \frac{V_z - V_{z0}}{I_{zT}} = \frac{18 - 17.6}{5\,mA} = 0.08\,k\Omega = 80\,\Omega$

$2I_{zT} = 10\,mA$, $V_z = V_{z0} + r_z(2I_{zT}) = 17.6\,V + (0.08\,k\Omega)(10\,mA)$

$V_z = 18.4\,V$

$P = (18.4\,V)(10\,mA) = 184\,mW$

e) $I_{zT} = 200\,mA$, $V_z = 7.5\,V$, $r_z = 1.5\,\Omega$

$V_z = V_{z0} + r_z I_{zT} \Rightarrow V_{z0} = V_z - r_z I_{zT} = 7.5\,V - (0.0015\,k\Omega)(200\,mA)$

$V_{z0} = 7.2\,V$

$2I_{zT} = 400\,mA$

$V_z = 7.2\,V + (0.0015\,k\Omega)(400\,mA) = 7.8\,V$

$P = V_z(2I_{zT}) = 3.12\,W$

4.60

$V_z = 9.1\,V$ @ $I_{zT} = 28\,mA$

$r_z = 5\,\Omega = 0.005\,k\Omega$

$V_z = V_{z0} + r_z I_{zT} \Rightarrow V_{z0} = V_z - r_z I_{zT} = 9.1\,V - (0.005\,k\Omega)(28\,mA) = 8.96\,V$

@ $I_{zT} = 10\,mA$, $V_z = V_{z0} + r_z I_{zT} = 8.96\,V + (0.005\,k\Omega)(10\,mA)$

$\boxed{V_z = 9.01\,V}$

@ $I_{zT} = 100\,mA$, $V_z = V_{z0} + r_z I_{zT} = 8.96\,V + (0.005\,k\Omega)(100\,mA)$

$\boxed{V_z = 9.46\,V}$