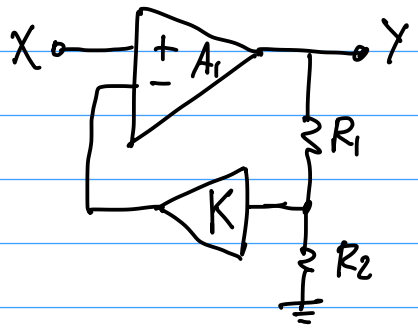
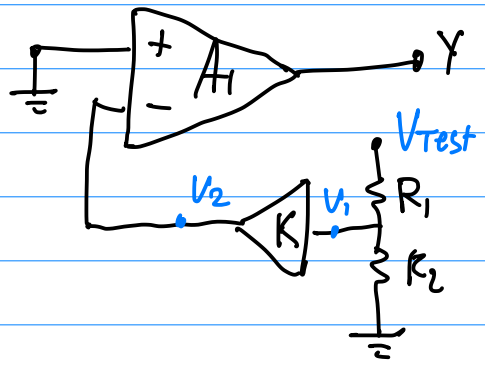
(a)



Open loop gain $= A_1$

For loop gain, set $X = 0$ and break the loop.



$$V_1 = \frac{R_2}{R_1+R_2} V_{Test}$$

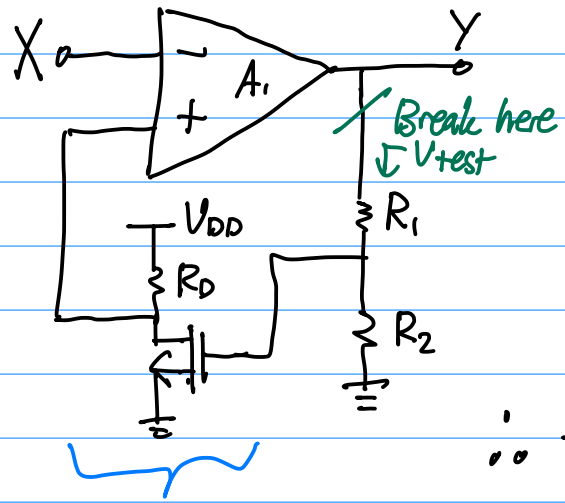
$$V_2 = K V_1 = K \frac{R_2}{R_1+R_2} V_{test}$$

$$Y = -A_1 V_2 = -\frac{A_1 K R_2 V_{test}}{R_1+R_2}$$

$$\text{Loop gain} = -\frac{Y}{V_{test}} = \frac{A_1 K R_2}{R_1+R_2}$$

$$\therefore \frac{Y}{X} = \frac{A_1}{1+\left(\frac{A_1 K R_1}{R_1+R_2}\right)}$$

(b)



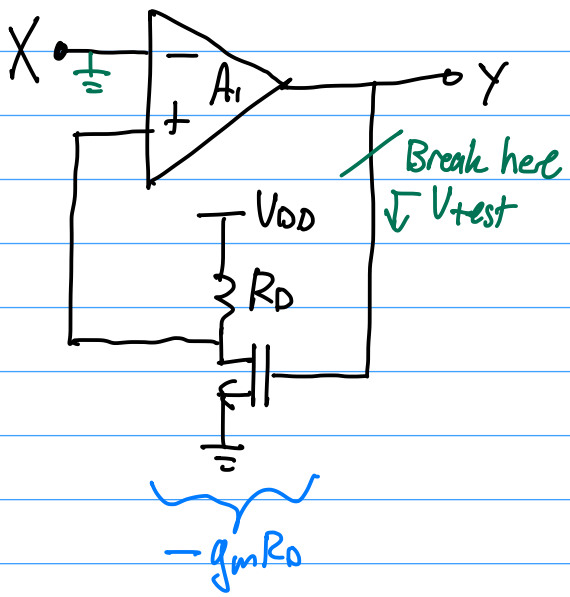
CS gain $= -g_m R_D$

Open loop gain $= -A_1$

$$\text{Loop gain} = \frac{-Y}{V_{test}} = \frac{+R_2}{R_1+R_2} g_m R_D A_1$$

$$\therefore \frac{Y}{X} = \frac{-A_1}{1+\left(\frac{A_1 g_m R_D R_2}{R_1+R_2}\right)}$$

(c)



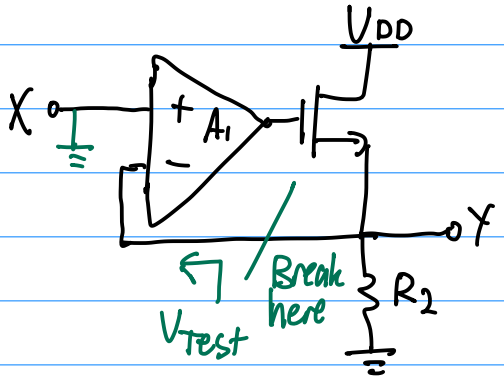
Open loop gain $= -A_1$

$\frac{Y}{V_{test}} = -g_m R_D A_1$

Loop gain $= +g_m R_D A_1$

$\therefore \frac{Y}{X} = \frac{-A_1}{1+g_m R_D A_1}$.

(d)



Output is a source follower with gain of $\frac{R_2}{\frac{1}{g_m} + R_2}$

$\therefore$ Open loop gain $= \frac{A_1 R_2}{\frac{1}{g_m} + R_2}$

$\frac{Y}{V_{Test}} = \frac{-A_1 R_2}{\frac{1}{g_m} + R_2}$ $\therefore$ Loop gain $= \frac{+A_1 R_2}{\frac{1}{g_m} + R_2}$.

$\therefore \frac{Y}{X} = \frac{\left(\frac{A_1 R_2}{\frac{1}{g_m} + R_2}\right)}{1 + \left(\frac{A_1 R_2}{\frac{1}{g_m} + R_2}\right)} \approx 1.$