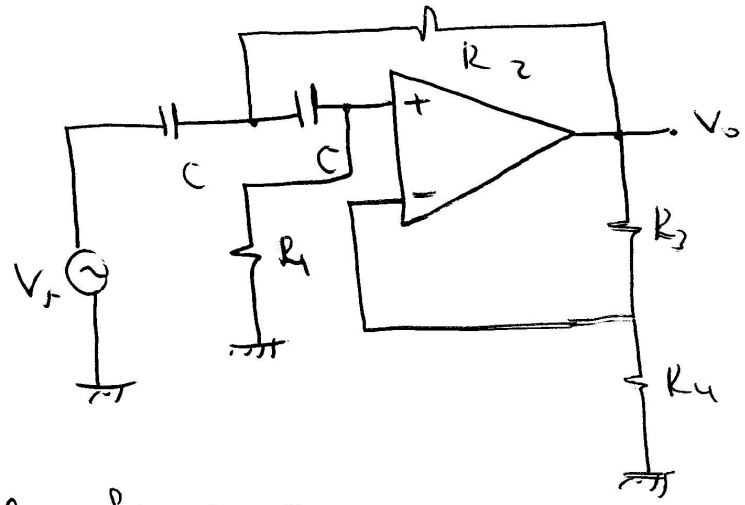
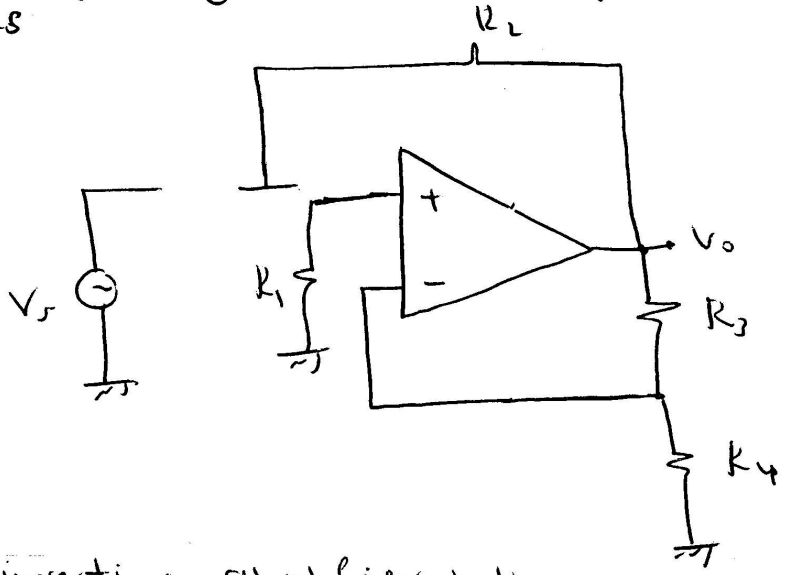
# Quiz 1 Answers (1)




at low frequencies

$\frac{1}{Cs} \to \infty$ & circuit becomes

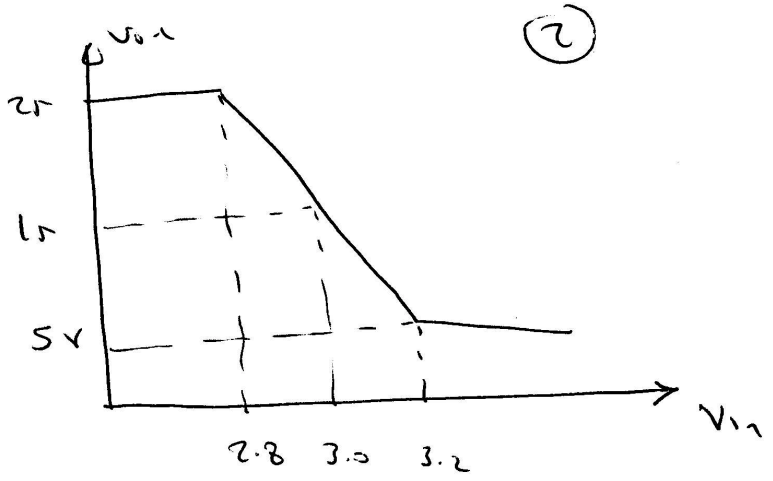



Noninverting amplifier with

Zero input $\Longrightarrow$ $V_o = 0$ regardless of $V_s$

gain = 0

(2)




(2)

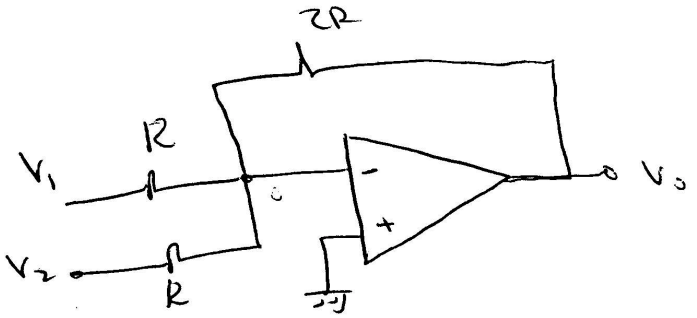
$$\text{gain} = \frac{\Delta y}{\Delta x} = \frac{5-15}{3.2-3.0} = \frac{-10}{0.2} = -50$$

$$V_{out} = 15 + \text{gain} * V_{at}$$

$$= 15 - 50 * 0.1 \sin \omega t$$

$$V_{out} = 15 - 5 \sin \omega t$$

(3)




$$V_o = -2(V_1 + V_2)$$

$$V_o = A_{CM}\left(\frac{V_1 + V_2}{2}\right) + A_d (V_1 - V_2)$$

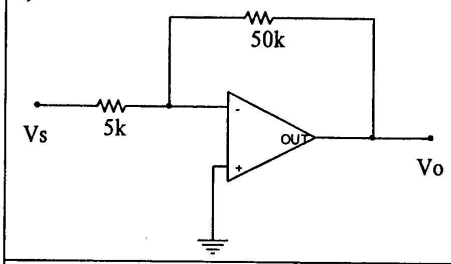
$\therefore A_d = 0$

$\therefore A_{CM} = -4$

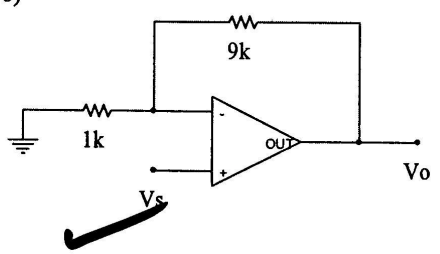
Student Name: ID:

4) Which one of the shown circuits gives a gain $V_o/Vs$ of 10 with an input resistance ≥ 10K?

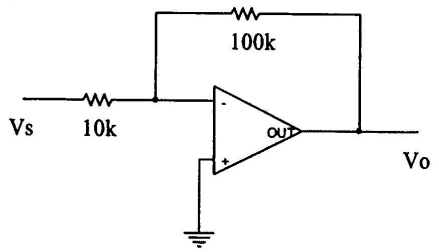
a)



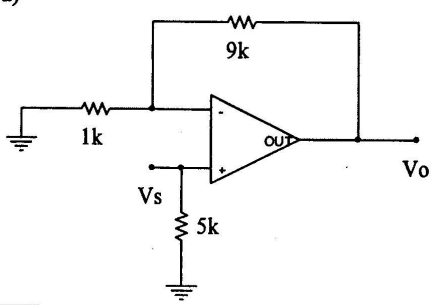

b)



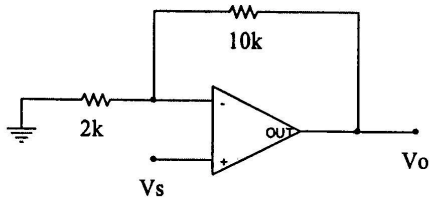

c)




d)




e)




5) A 5-bit A/D converter has $V_{Ref}$=10V. The digital output word and the quantization error corresponding to an input $V_{in}$=4.375V are

a) 01110, 0
b) 01101, -ve
c) 01111, +ve
d) 10000, +ve
e) 01011, -ve

(5)

$$4.375 = (z^{-1}b_1 + z^{-2}b_2 + z^{-3}b_3 + \dots)\,16$$

$$0.4375 = b_1 z^{-1} + b_2 z^{-2} + b_3 z^{-3} + b_4 z^{-4} + b_5 z^{-5}$$

or

$$14 = 16b_1 + 8b_2 + 4b_3 + 2b_4 + b_5$$

$$\therefore \quad b_1 = 0 \quad b_2 = 1, \quad b_3 = 1, \quad b_4 = 1, \quad b_5 = 0$$

$$01110 \qquad \text{error} = 0$$

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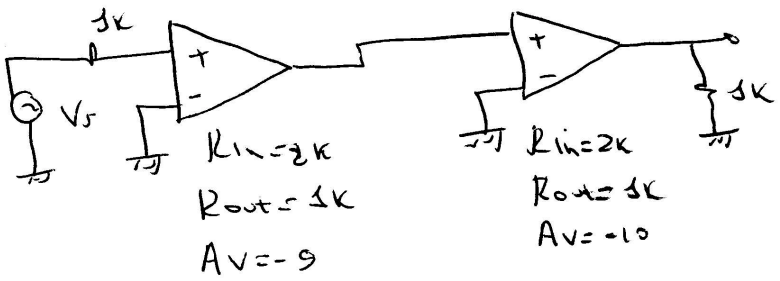
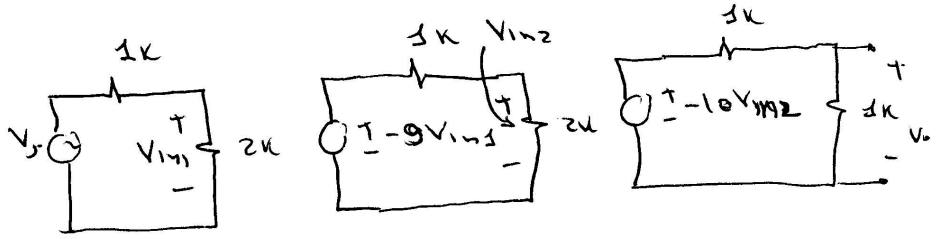
(6)




$$V_{in1} = \frac{2}{3} V_s \quad , \quad V_{in2} = -9 V_{in1} * \frac{2}{3}$$

$$V_{in2} = -9 * \frac{2}{3} V_s * \frac{2}{3} = -4 V_s$$

$$V_o = -10 V_{in2} * 0.5 = -5 V_{in2} = 20 V_s$$

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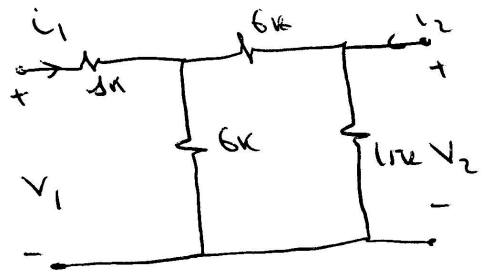
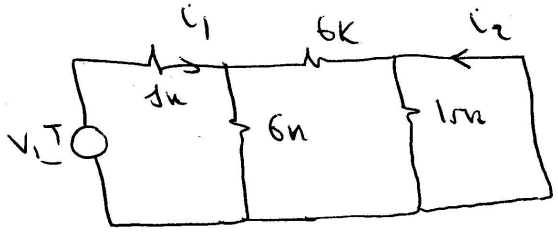
(7)

$$V_1 = h_{11} i_1 + h_{12} V_2$$
$$i_2 = h_{21} i_1 + h_{22} V_2$$




To get $h_{11}$ & $h_{21}$ we set $V_2 = 0$




$$\frac{V_1}{i_1} = h_{11} = 4K$$

$$h_{21} = \frac{i_2}{i_1} = -0.5$$

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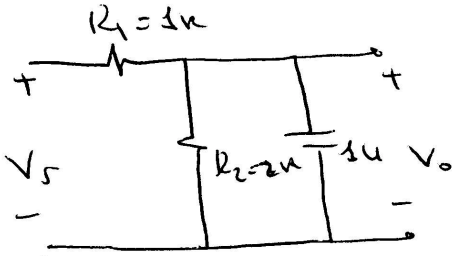
(8)




$$V_o = \frac{Z_2}{Z_2 + Z_1} V_s = \frac{R_2 \| \frac{1}{sC}}{R_2 + \frac{1}{sC}} V_s = \frac{\frac{R_2}{1+sCR_2}}{R_1 + \frac{R_2}{1+sCR_2}} V_s$$

$$\frac{V_o}{V_s} = \frac{R_2}{R_2 + R_1(1+sCR_2)} = \frac{R_2}{R_2 + R_1 + sCR_1R_2}$$

$$\therefore \quad \frac{V_o}{V_s} = \frac{R_2}{(R_1+R_2)} * \frac{1}{1 + \frac{sCR_1R_2}{(R_1+R_2)}} = \frac{A}{1+\frac{s}{\omega_H}}$$

$$\therefore \quad A = \frac{R_2}{(R_1+R_2)} = \frac{2K}{2K+3K} = 0.666$$

$$\omega_H = \frac{(R_1+R_2)}{R_1R_2C} = \frac{3K}{2*10^{6}*10^{-6}} = 1.5K \text{ rad/sec}$$