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11-13-17
MW 5-6

EE 16A Homework HW 10

1

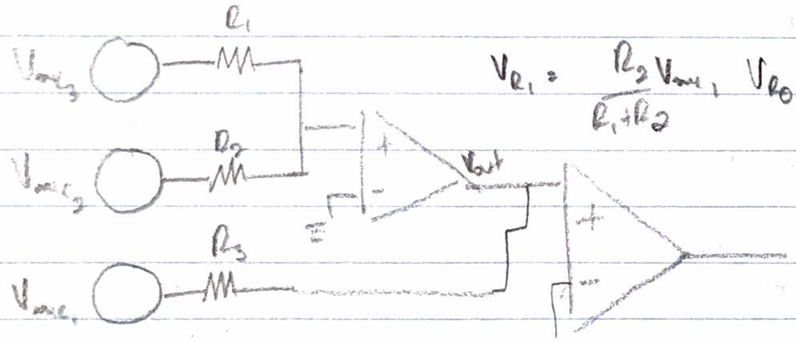
A $\vec{S}_{mic} = A \vec{S}_{mic}$

$(2\times3)\,2\times1$

$A = 2\times3$ matrix $\quad \boxed{A = \begin{bmatrix} a_1\,left & a_2\,left & a_3\,left \\ a_1\,right & a_2\,right & a_3\,right \end{bmatrix}}$

B $S_{ear} = S_{noise} = \begin{bmatrix} a_1\,left & a_2\,left & a_3\,left \\ a_1\,right & a_2\,right & a_3\,right \end{bmatrix} \begin{bmatrix} a_1 \\ a_2 \\ a_3 \end{bmatrix} = \begin{bmatrix} V_{mic1} \\ V_{mic2} \\ V_{mic3} \end{bmatrix}$

D



$V_{R_1} = \frac{R_2 V_{mic1}}{R_1+R_2}, \quad V_{R_2} = \frac{R_1}{R_1R_2} V_{mic2}$

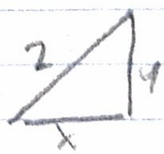
$V_{R_3} = \frac{V_{out} - V_{mic}}{I_R}$

C $\vec{S}_{noise} = \begin{bmatrix} s_{left} \\ s_{right} \end{bmatrix}$

$S_{cancel} \cdot S_{noise} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad \boxed{S_{cancel} = \begin{bmatrix} 1 & 0 \end{bmatrix}}$

2 $|\langle \vec{x}, \vec{y} \rangle| = |\vec{x}^T \vec{y}| \leq \|\vec{x}\| \cdot \|\vec{y}\|$

$\|\vec{x} + \vec{y}\| \leq \|\vec{x}\| + \|\vec{y}\|$



$\|x+y\|^2$.

Details of triangle = $x + y > z$

$\langle (\vec{x}+\vec{y}), (\vec{x}+\vec{y}) \rangle = \vec{x}(\vec{x}+\vec{y}) + \vec{y}(\vec{x}+\vec{y})$

$= \|\vec{x}\|^2 + 2\vec{x}\vec{y} + \|\vec{y}\|^2$

3

A $x_1 = [1\ 1\ 1 \dots 1]^T$ $x_2 = [1\ -1\ 1 \dots -1]^T$

$(x_1)(x_2) = \boxed{\frac{N}{2}}$

B $\vec{X} = [-1\ 1\ 1\ -1\ 1\ 1\ -1\ 1]$

$\vec{X} = [x_1\ x_2\ x_3\ x_4\ x_5\ x_6\ x_7\ x_8]$

$\vec{y} = [1\ 1\ -1]^T$ $y = [1\ 1\ 1]^T$

$[x_i\ x_{i+1}\ x_{i+2}]^T$ Best I = 2, 5

We can use a correlation matrix.

C $\vec{y} = [1\ 2\ 3]^t$ $\vec{X} = [1\ 2\ 3\ 4\ 5\ 6\ 7\ 8]$

$$\vec{X} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 3 & 4 & 5 \\ 4 & 5 & 6 \\ 5 & 6 & 7 \\ 6 & 7 & 8 \\ 7 & 8 & 1 \\ 8 & 1 & 2 \end{bmatrix}$$

$x \cdot y^T =$ see if any equal $\vec{y} \cdot \vec{y}$

← use this correlation matrix

D ipython

E ipython

4

A Yes this is valid as generally the ground placement doesn't make a significant difference. It is merely a reference point

B Yes, v_4 and v_2 are identical, as they are connected by an ideal wire, so they have the same current, voltage, etc.

C No, v_4 is labeled incorrectly. Voltage drop from + to +, when not passive sign convention

5

A $V_1 = \frac{V_1}{V_1 + V_2} = \frac{4}{4+4} = \frac{1}{2} \cdot 12V = 6V$

B $R_{Th} = \frac{4}{4+4} = \frac{1}{2}$

$V_{Th} = 12V$

C $R_{No} = \frac{2V}{\frac{1}{\frac{1}{4}+\frac{1}{4}} + 2} = \frac{2}{8+2} = \boxed{\frac{1}{5}}$

$I_{No} = \frac{12}{1/5} = \boxed{60 \text{ Amps}}$ $V = IR$ $I = \frac{V}{R}$

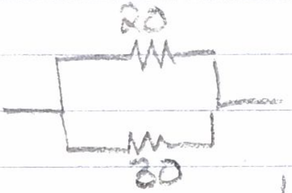
6

A $\rho = R\dfrac{A}{l}$ $\quad R = \dfrac{\rho l}{A}$

$$\frac{1\times10^{-8}\,\Omega \cdot 75\times10^{-9}}{(5\times10^{-9})^2} = \frac{75\times10^{-9}}{25\times10^{-18}} = 3\times10^{9}\times10^{-8} = \boxed{30}$$

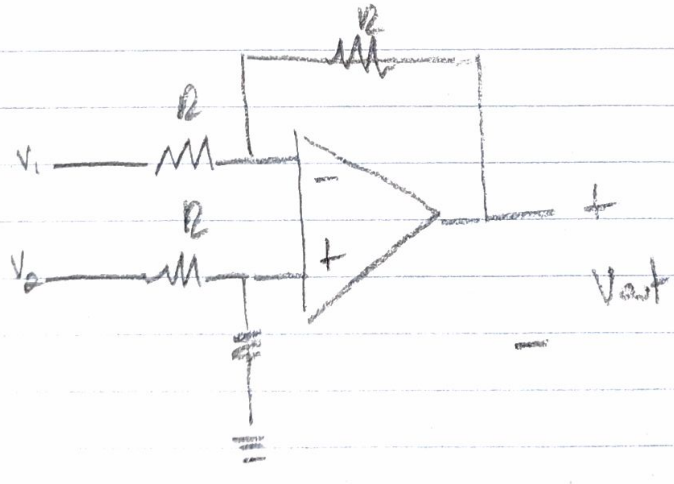
B $$\frac{2\times10^{-8}\,\Omega \cdot 75\times10^{-9}}{(10\times10^{-9})^2-(5\times10^{-9})^2} = 2\times10^{-8}\,\frac{75\times10^{-9}}{75\times10^{-18}} = \boxed{20}$$

C



D $$R_{eq} = \frac{1}{\frac{1}{20}+\frac{1}{30}} = \frac{1}{\frac{30}{600}+\frac{20}{600}} = \frac{600}{50} = \boxed{12}$$

7



$V_+ = V_-$

$V_{out} = \boxed{\frac{1}{2}V_1}$ $\quad V_2$ does not matter

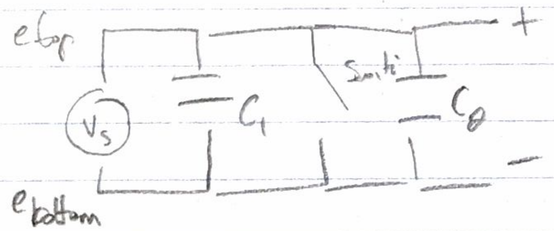
C

A $V_{press} = \frac{R_{touch}}{R_{rest} + R_{touch}} \cdot V_s$ Incorrect

B $V_{press} = \frac{R_{bottom} + R_{middle}}{R_{bot} + R_{middle} + R_{rest}} V_s$

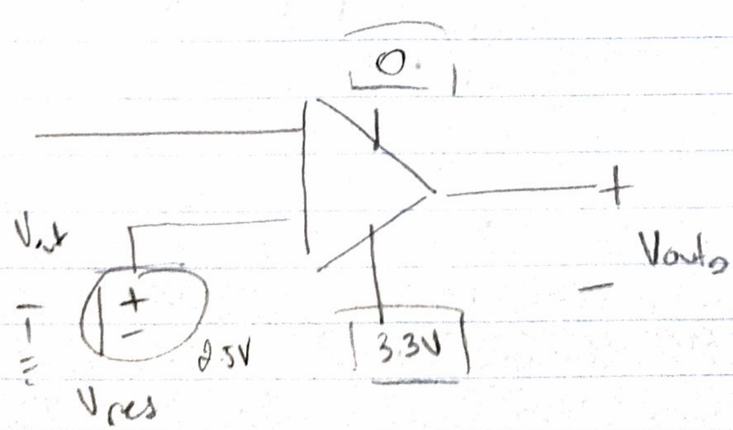
9

A $C_{notouch} = \frac{\varepsilon A}{d} = \boxed{\frac{\varepsilon_1 A}{d}}$

B 

C $C_{force} = \boxed{\frac{\varepsilon_1 A}{d'}}$

D $V_{out} = \frac{C_{screen}}{C_{screen} + C_{ref}} V_s$

E 

10

A $I_{RL} = \frac{V_s}{R_{eq}}$

$V_- = V_+$ $I^- = 0$

$R_{eq} = \frac{R_L}{R_s + R_L}$

$V_- = V_s \cdot \frac{R_L}{R_L + R_S}$

B $I_{RL} = \frac{V_s}{R_S}$

C $I_{RL} = \frac{V_s}{R_S}$

D $V_- = \frac{V_s R_L}{R_L + R_S}$

b $V_{out} = \boxed{-\frac{V_s R_L}{R_L + R_S}}$

10 A $R_{special} = -1000$

B $V_{out} = \frac{500}{500 + R_{spec}} = \frac{500}{-500} = \boxed{-V_s}$

10C , yes negative feedback

ground → +

V_{out} → V_-

$V_{out} = \frac{R_{spec}}{500 + R_{spec}} =$

10D $\frac{-R_{spec}}{500 + R_{spec}} = \frac{-1000}{-500} = 2$

Incorrect

(11) How to check if vectors are orthogonal.

$\vec{U} \cdot \vec{V} = 0$

(12) Worked alone