

**Exam Electronics & Signal processing**  
**PHYSICS – Students**  
**April, 2013**  
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*Georg Simon Ohm*



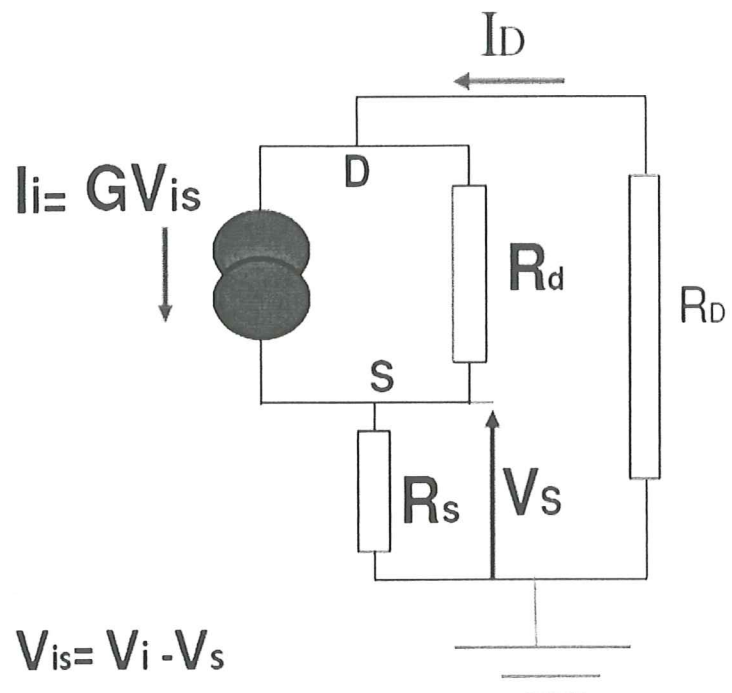
## Opgave 1 (1.5 punten)

Beschouw een externe spanning  $V_i$  die een stroom bron  $I_i = G V_{is} = G(V_i - V_s)$  genereert. De stroom bron is parallel met een weerstand  $R_d$

$G$ : is constant

$V_D$ : spanning in punt D

$V_s$ : spanning in punt S

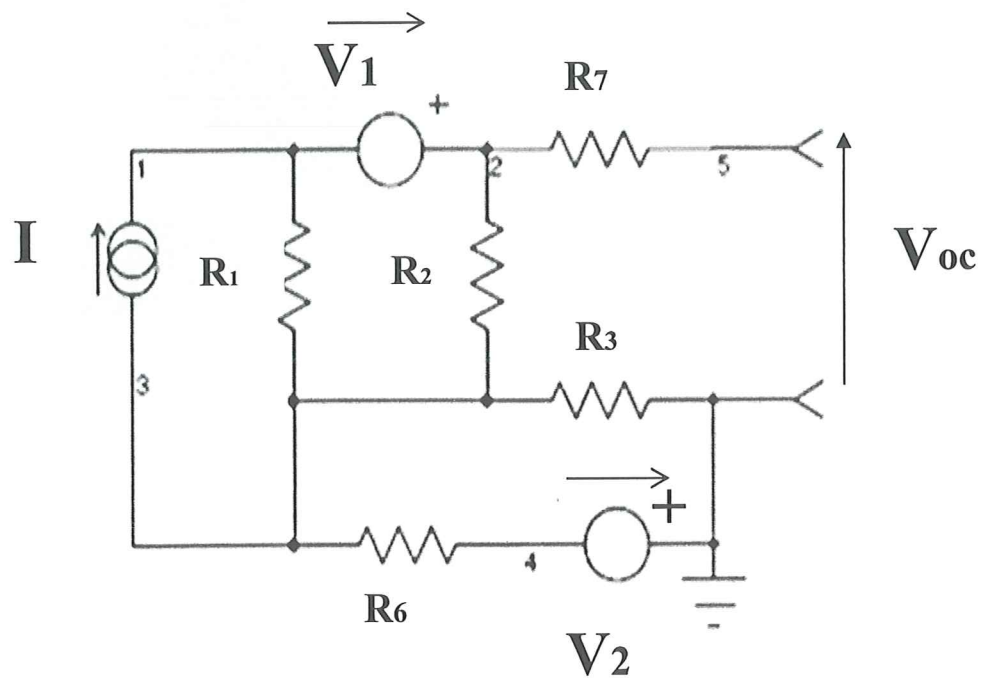


Toon aan dat :

$$V_s / V_i = GR_s / [ 1 + GR_s + [(R_s + R_D) / R_d] ]$$

## Opgave 2 (1.5 punten)

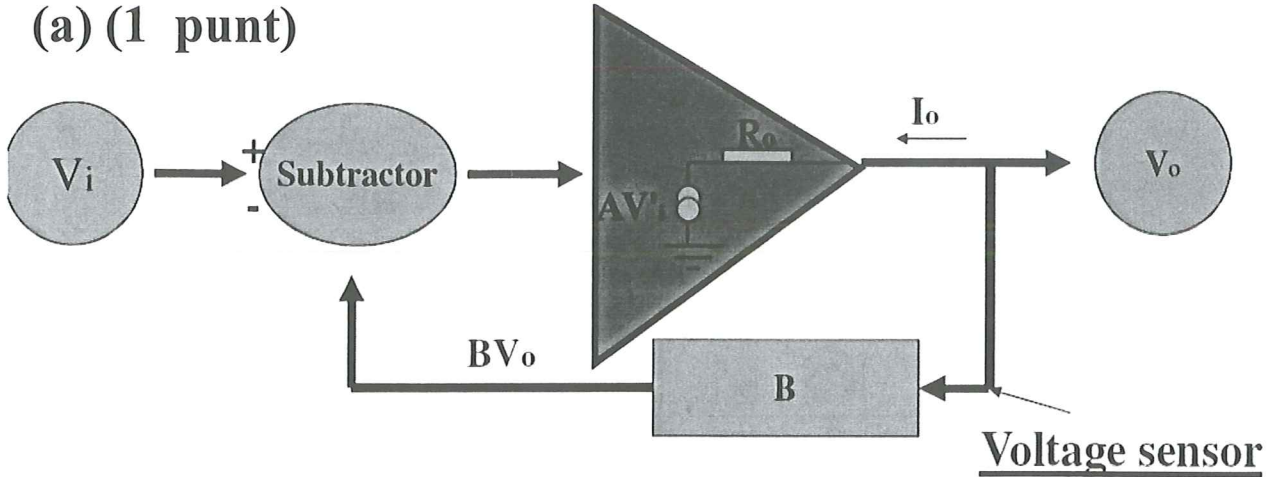
Beschouw de kring  $\rightarrow$



Geef het vervangingsschema van Thévenin en bereken:  
 $V_{oc}$  en  $R_{oc}$ .

## Opgave 3 (2 punten)

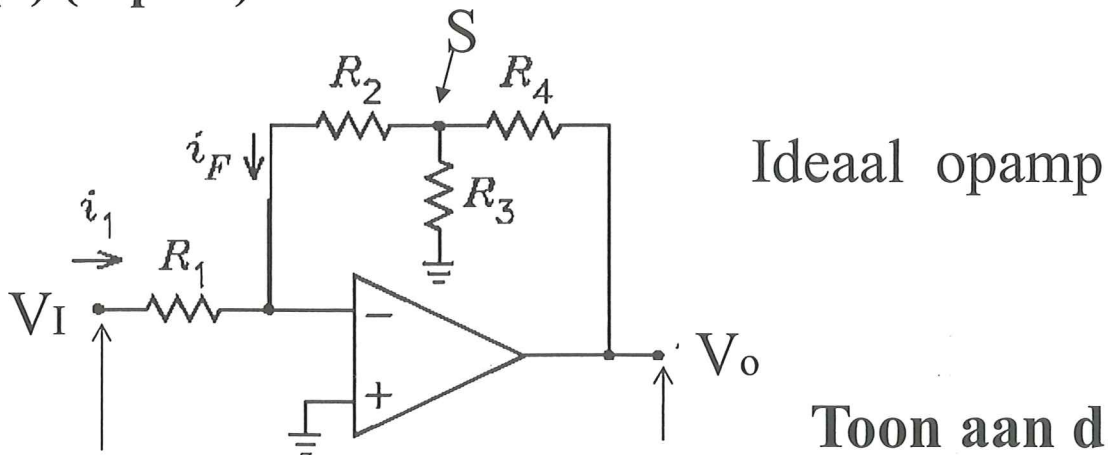
(a) (1 punt)



Toon aan dat de feedback de uitgangsweerstand  $R_{out}$  van een spanningversterker vermindert ( $R_{out} = V_o / I_o < R_o$ ):

$$R_{out} = R_o / (1 + AB) < R_o$$

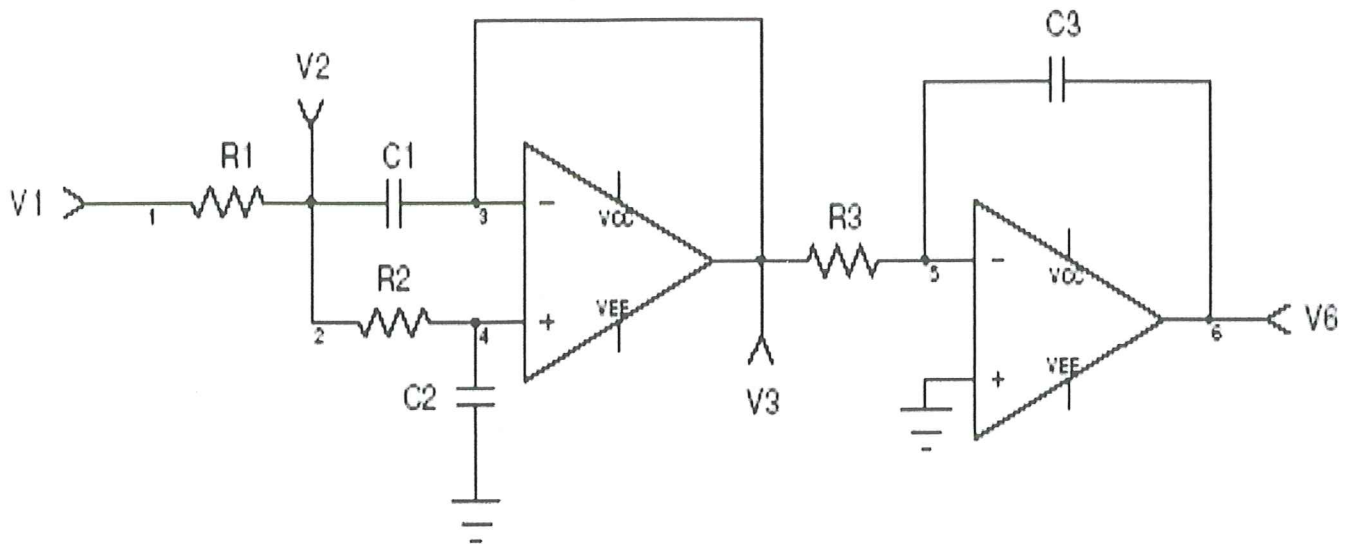
(b) (1 punt)



Toon aan dat:

$$\frac{V_o}{V_I} = - \left[ \frac{R_2}{R_1} + \frac{R_4}{R_1} \left( 1 + \frac{R_2}{R_3} \right) \right]$$

## Opgave 4 (2 punten)



(a: 0.5 punt) Toon aan dat:  $\frac{V(6)}{V(3)} = - \frac{1}{j\omega\tau_3}$   
 $\tau_3 = R_3C_3$

(b: 1 punt) Toon aan dat:  $V(2) = \frac{(\frac{R_1}{R_2} + j\omega\tau_1) V(3) + V(1)}{1 + \frac{R_1}{R_2} + j\omega\tau_1}$   
 $\tau_1 = R_1C_1$

(c: 0.5 punt) Toon aan dat:  $V(3) = V(4) = \frac{V(2)}{1 + j\omega\tau_2}$   
 $\tau_2 = R_2C_2$

Hint: *Ideaal opamps ( $V^+ = V^-$ ).*

Schrijf  $V(2)$  als superpositie van  $V(1)$  en  $V(3) = V(4)$ .

## Opgave 5 (2 punten)

(a: 0.5 punt)

$F$

$CD \backslash AB$	00	01	11	10
00	0	1	1	1
01	1	1	1	1
11	0	1	1	0
10	0	1	1	0

Toon aan dat:

$$F = B + A\bar{C} + \bar{C}D$$

Tip: geven de juiste “groepering” en het resultaat voor elke term

**(c) (1.5 punten)**

**Bouw een synchrone teller 1→4**

	Voor			Na		
	Q3	Q2	Q1	Q3	Q2	Q1
1	0	0	1			
2	0	1	0			
3	0	1	1			
4	1	0	0			

$Q_{n-1}$	$Q_n$	J	K
0	0	0	*
0	1	1	*
1	0	*	1
1	1	*	0

**\*: don't care**

J	K	$Q_n$
0	0	$Q_{n-1}$
0	1	0
1	0	1
1	1	$\overline{Q_{n-1}}$



## Boolean laws:

$$\overline{A+B} = \overline{A} \cdot \overline{B}$$

$$\overline{A \cdot B} = \overline{A} + \overline{B}$$

$$A + AB = A$$

$$A(A+B) = A$$

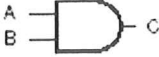






$$(AB)C = A(BC)$$

$$(A+B)+C = A+(B+C)$$

$$A(B+C) = AB+AC$$

$$(A+B)(A+C) = A+BC$$

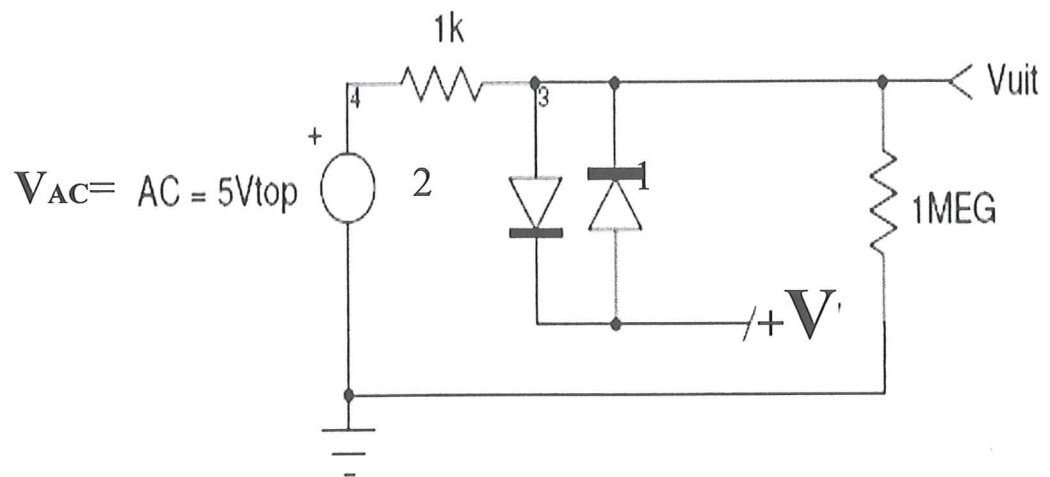
Tabel 1 Logische poorten.

Functie	Symbol	Boolean	Waarheidstabel															
AND		$C = A \cdot B$	<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td><td>1</td></tr> </table>	A	B	C	0	0	0	0	1	0	1	0	0	1	1	1
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0	0	0																
0	1	0																
1	0	0																
1	1	1																
OR		$C = A \times B$	<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td></tr> </table>	A	B	C	0	0	0	0	1	1	1	0	1	1	1	1
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0	0	0																
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1	0	1																
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NOT		$B = \overline{A}$	<table border="1"> <tr><td>A</td><td>B</td></tr> <tr><td>0</td><td>1</td></tr> <tr><td>1</td><td>0</td></tr> </table>	A	B	0	1	1	0									
A	B																	
0	1																	
1	0																	
NAND		$C = \overline{A \cdot B}$	<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>0</td><td>0</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td></tr> </table>	A	B	C	0	0	1	0	1	1	1	0	1	1	1	0
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XOR		$C = A \oplus B$	<table border="1"> <tr><td>A</td><td>B</td><td>C</td></tr> <tr><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td></tr> </table>	A	B	C	0	0	0	0	1	1	1	0	1	1	1	0
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## Opgave 6 (1 punt)

Beschouw dat  $V + V_c < V_{AC}$



$V_c = 0.5 V$  (diode forward geleiding spanning)

$V = 3.5 V$

Sketch  $V_{uit}$  (en waarom ?)