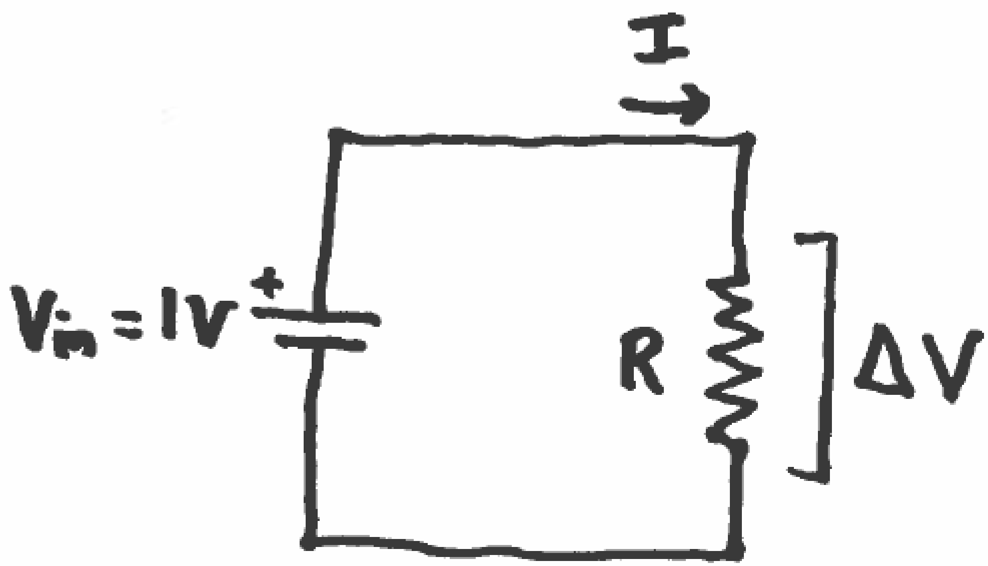
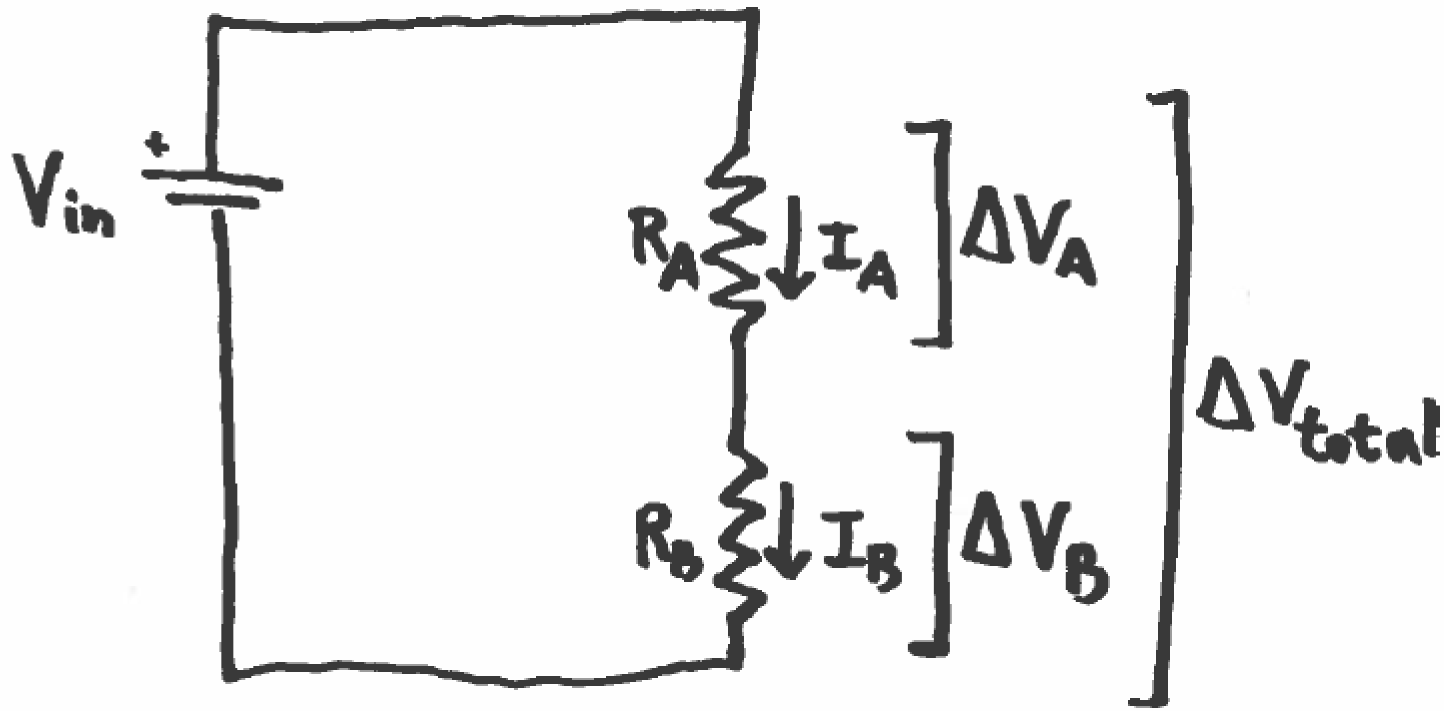
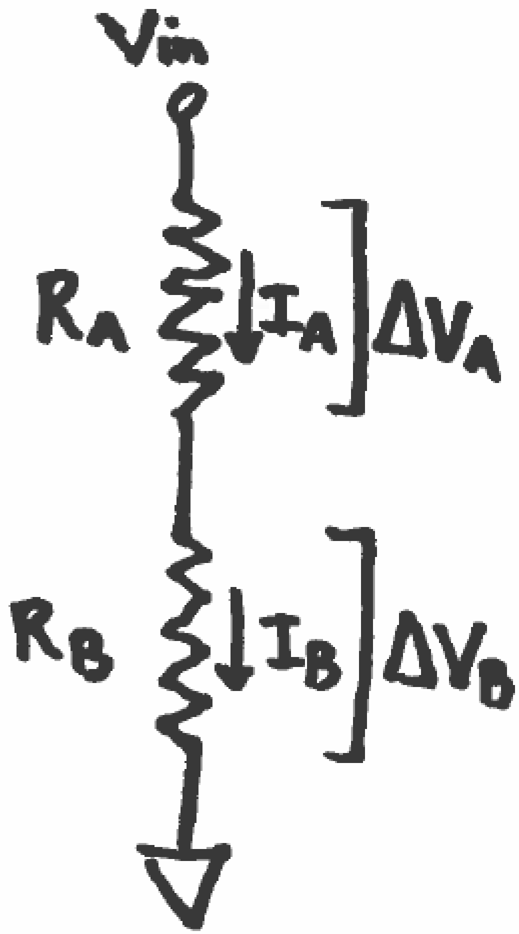

LIGHTNING
ROUND


I
Vin = 1V
+
R
ΔV

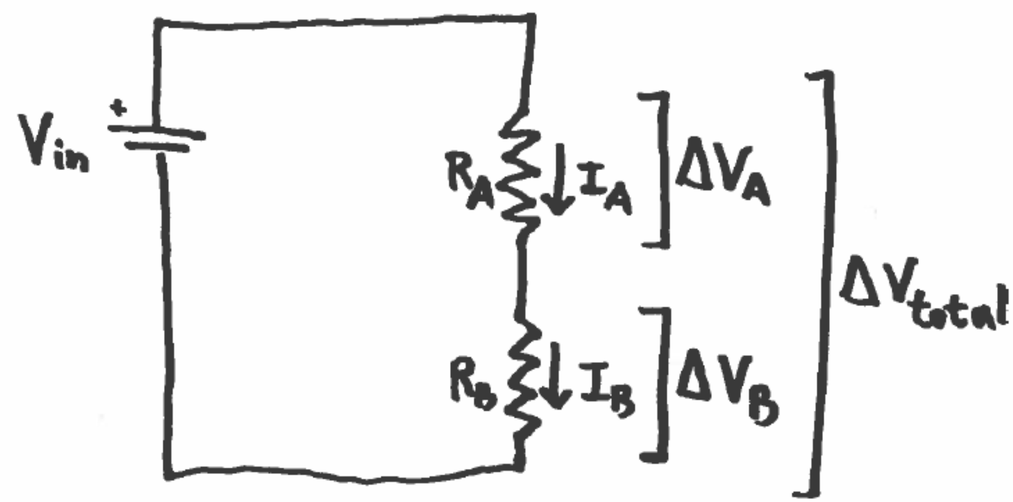
USB



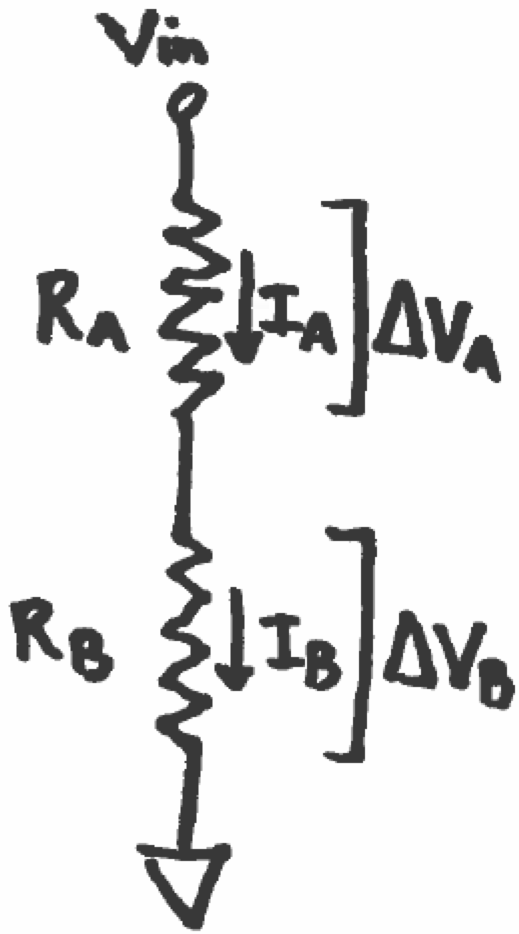
V in
+
R A
I A
ΔV A
R B
I B
ΔV B
ΔV total



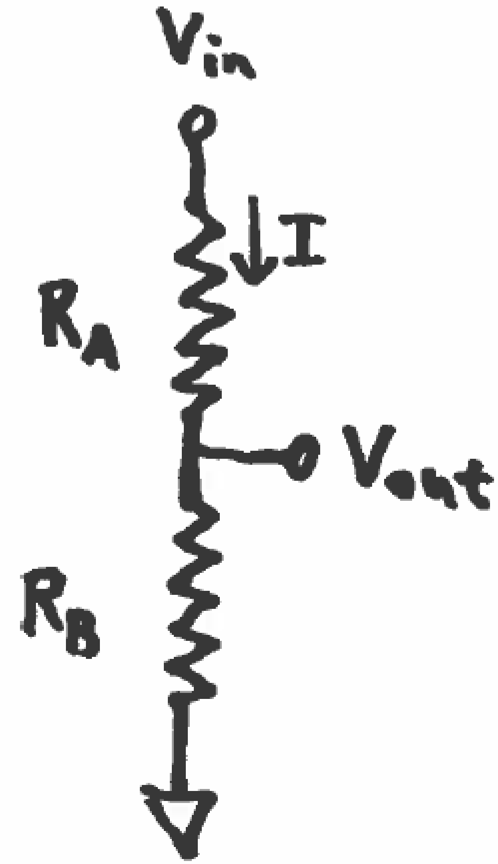
Vin
RA
IA
ΔVA
RB
IB
ΔVB



Vin
+
RA
IA
ΔVA
RB
IB
ΔVB
ΔVtotal

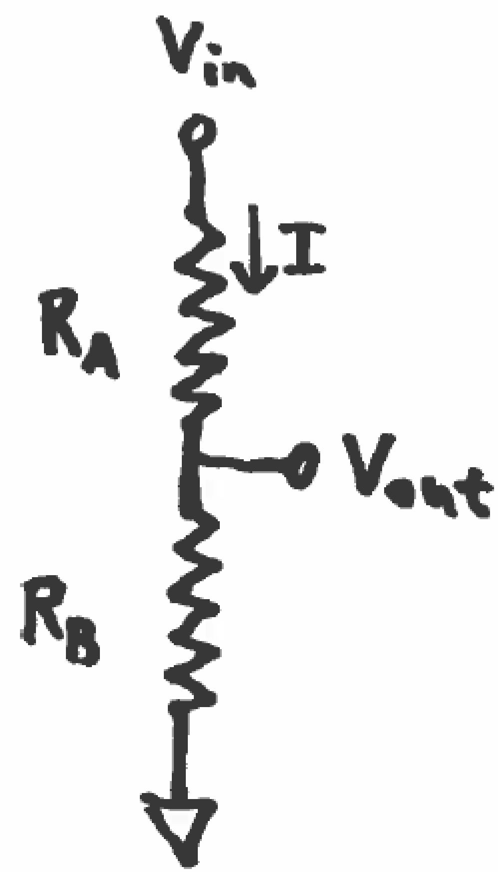


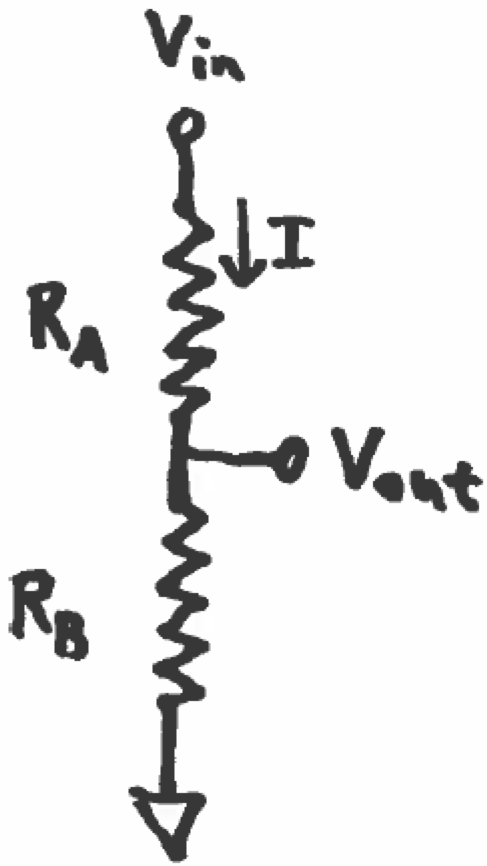
Vin
RA
IA
ΔVA
RB
IB
ΔVB



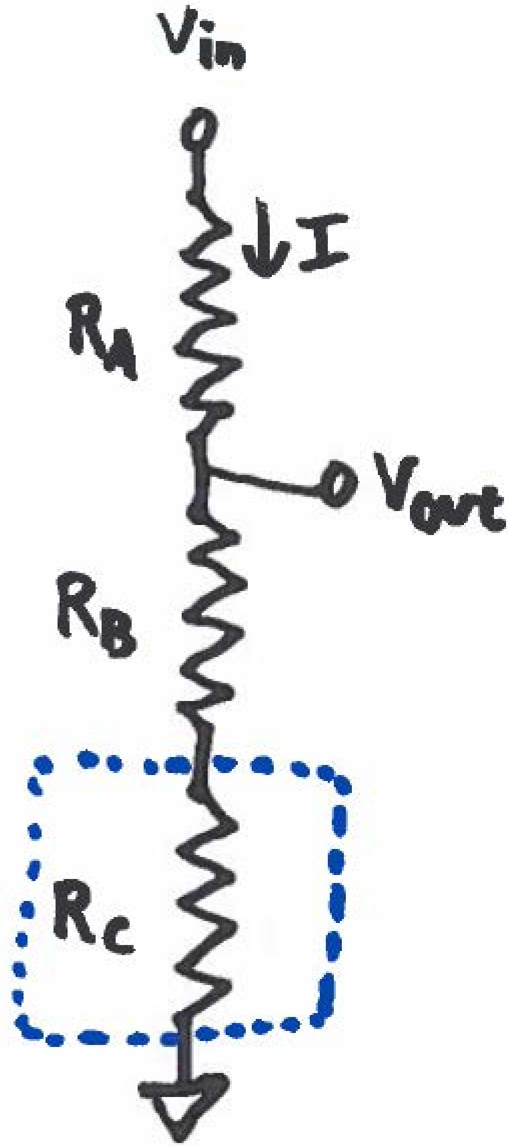
Vin
I
RA
Vout
RB

$$V_{out} = V_{in} \cdot \frac{R_B}{R_A + R_B}$$

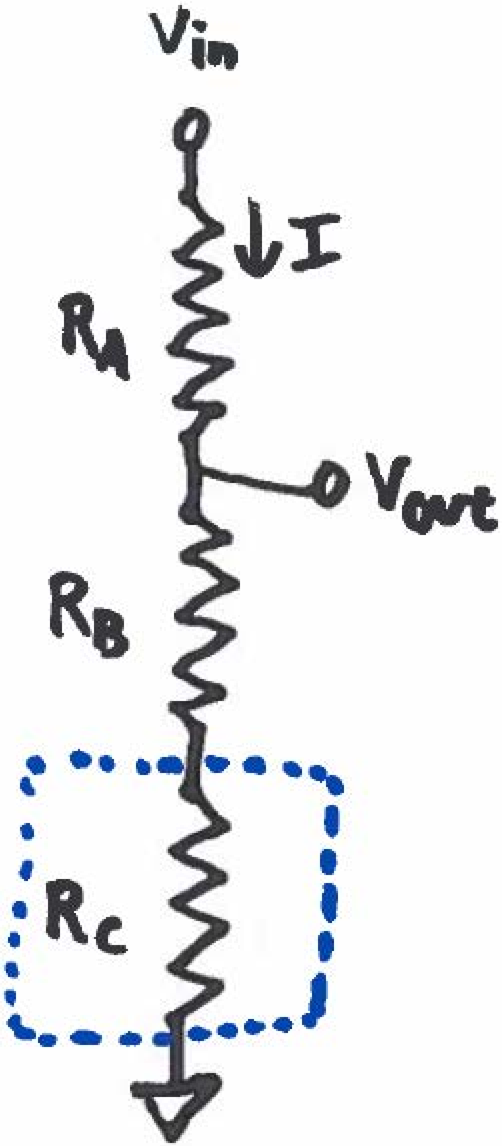


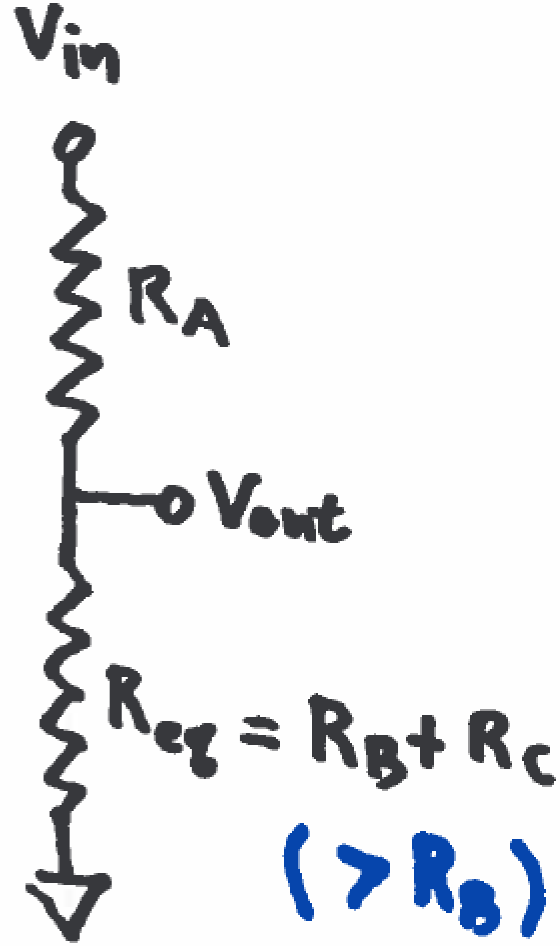


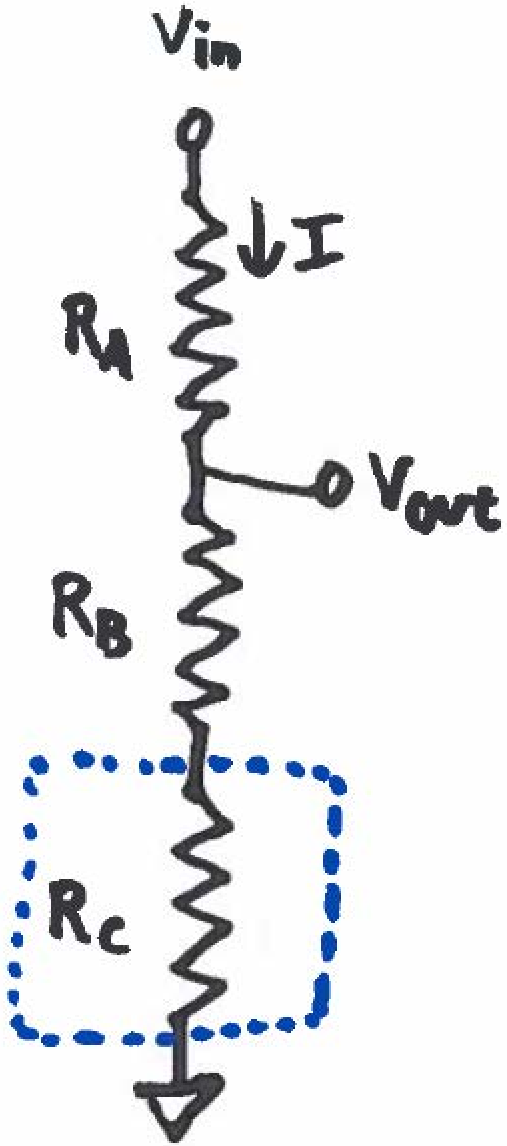
V_{in}
I
R_A
V_{out}
R_B

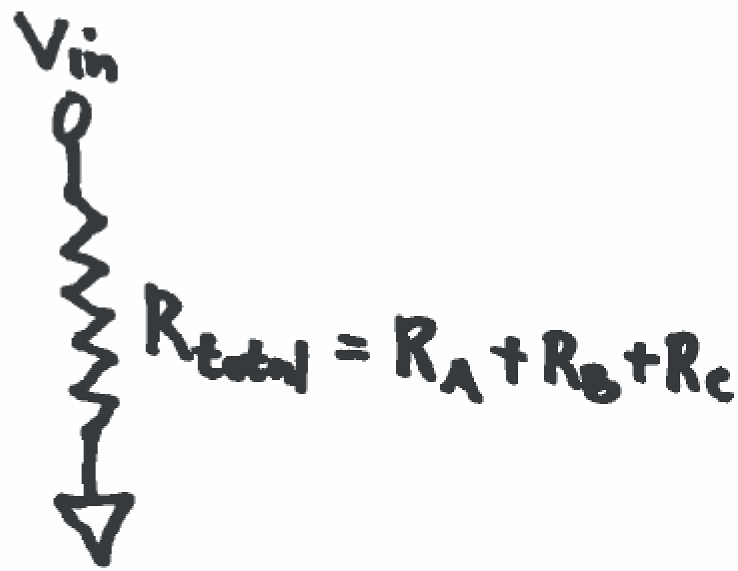


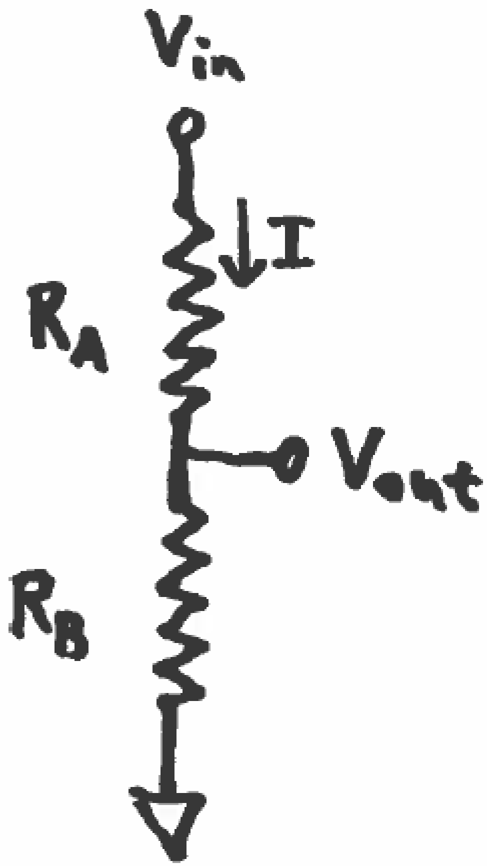
V_{in}
I
R_A
V_{out}
R_B
R_C


V_{in}
I
R_A
V_{out}
R_B
R_C

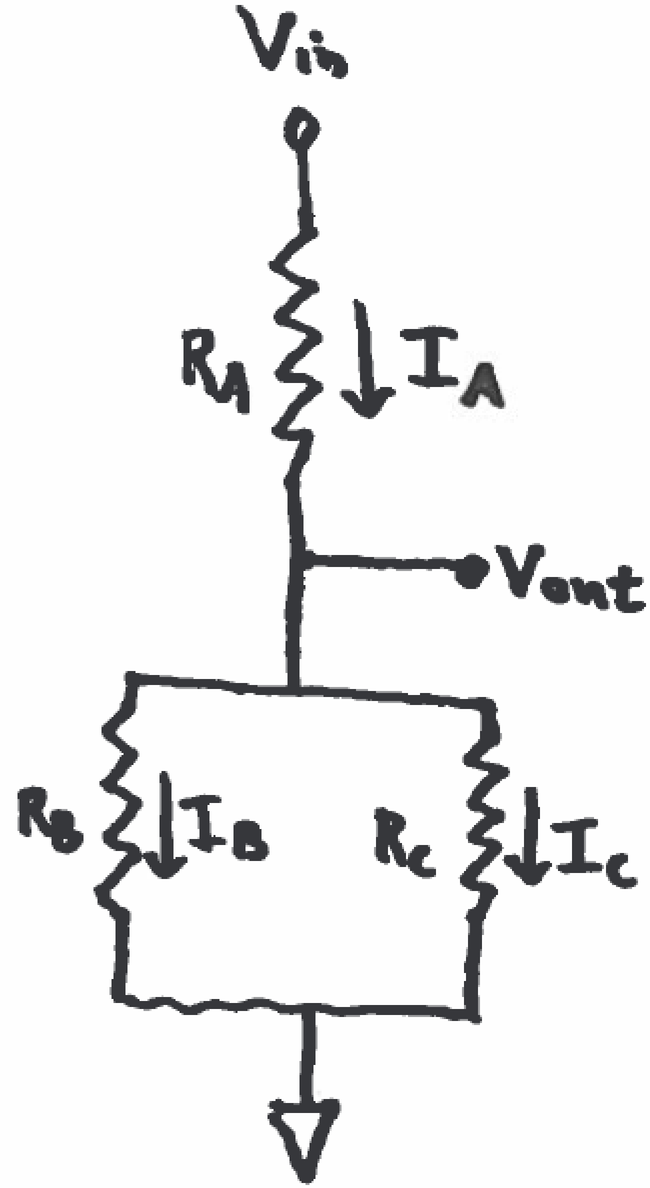

V_{in}
R_A
V_{out}
$R_{eq} = R_B + R_C$
$(> R_B)$


Vin
I
RA
Vout
RB
Rc

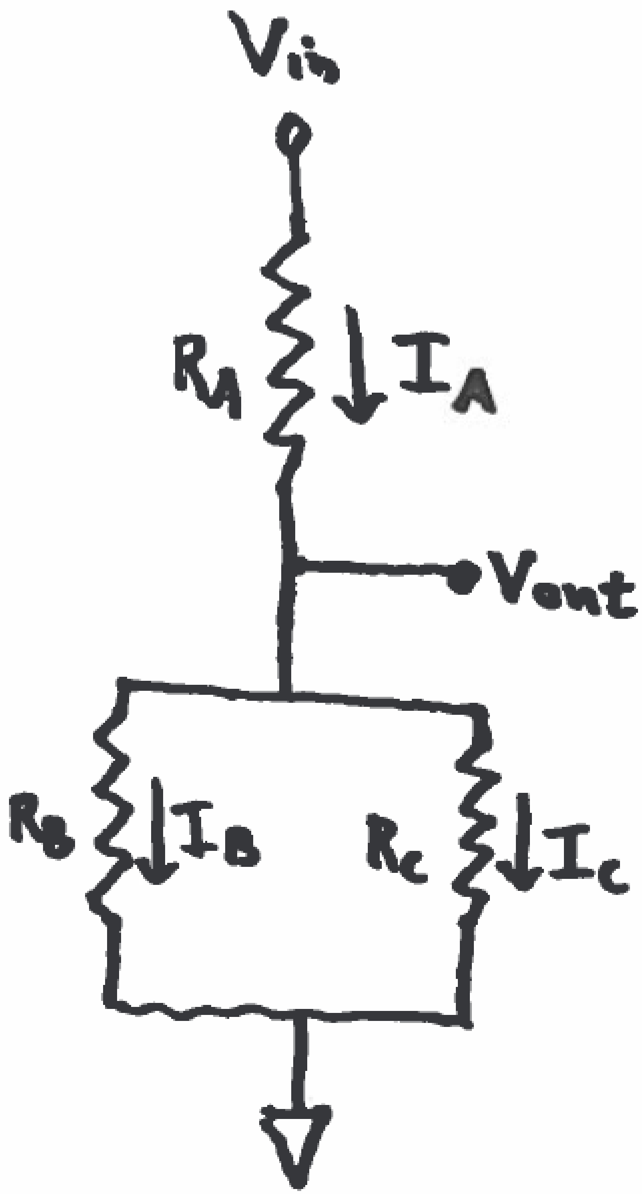

Vin
Rtotal = RA + RB + Rc

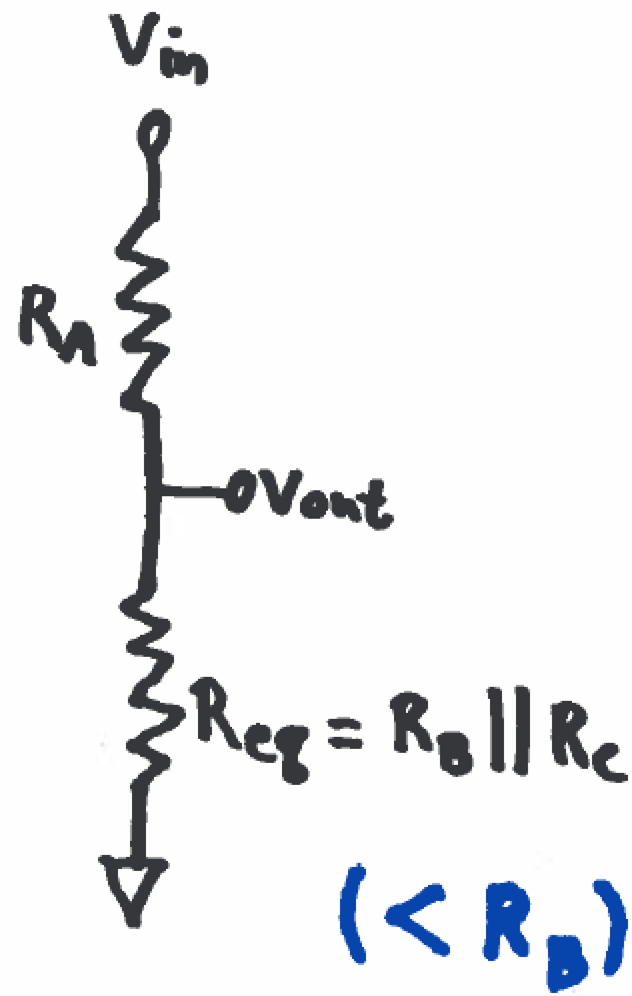


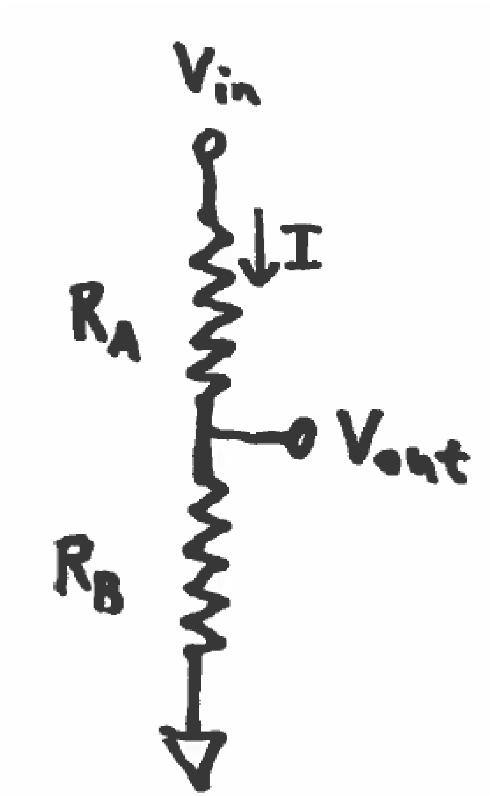
V_{in}
I
R_A
V_{out}
R_B



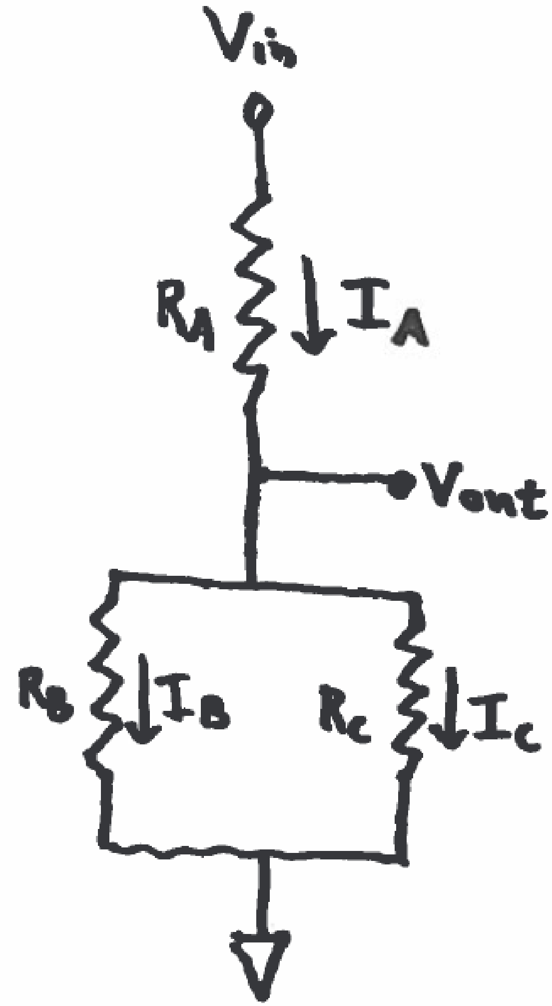
V_{in}
R_A
I_A
V_{out}
R_B
I_B
R_C
I_C


Vin
RA
IA
Vout
RB
IB
RC
IC


Vin
RA
Vout
Req = RB || RC
(< RB)



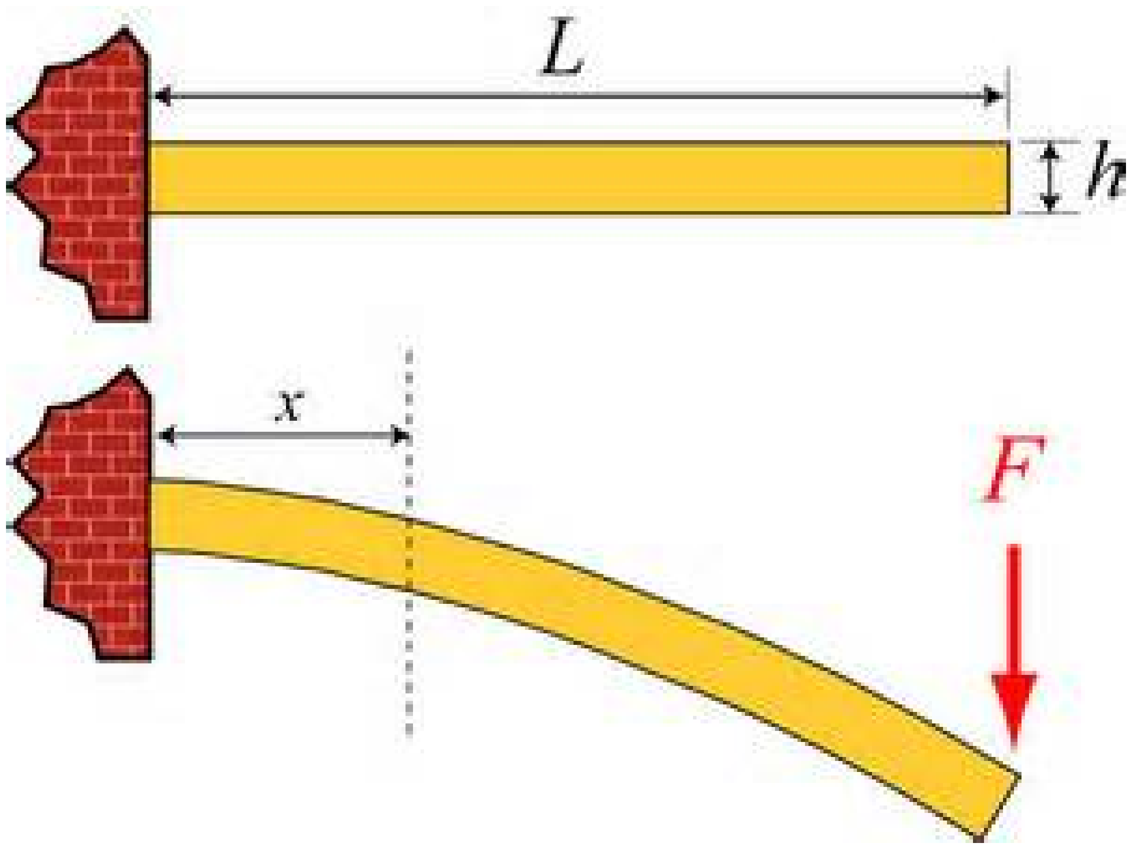
Known Vin and Ra:
find Rb as a function of Vout



Known Vin, Ra, Rb:
find Rc as a function of Vout

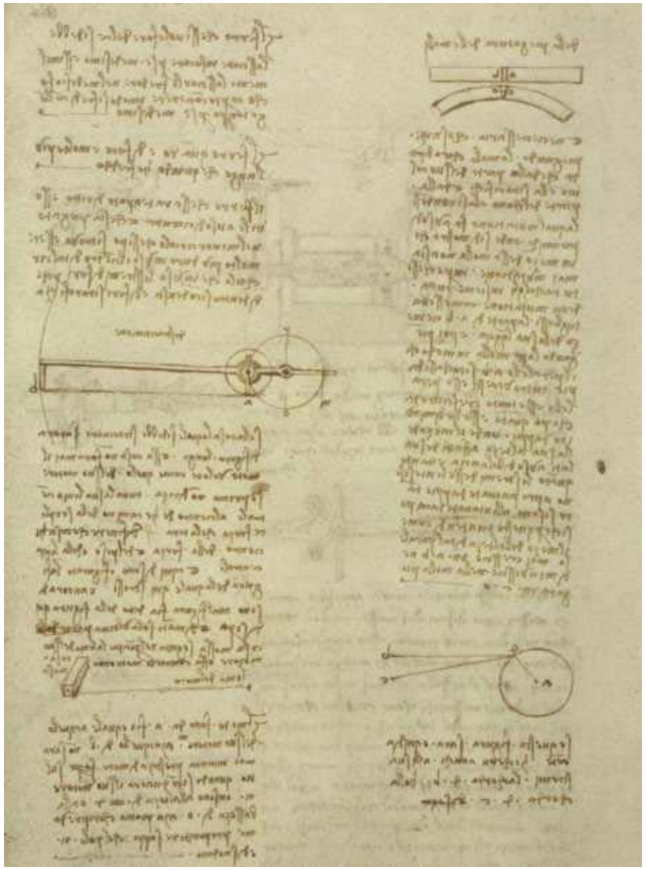
Strain gauges and resistors

Beams bend when loaded



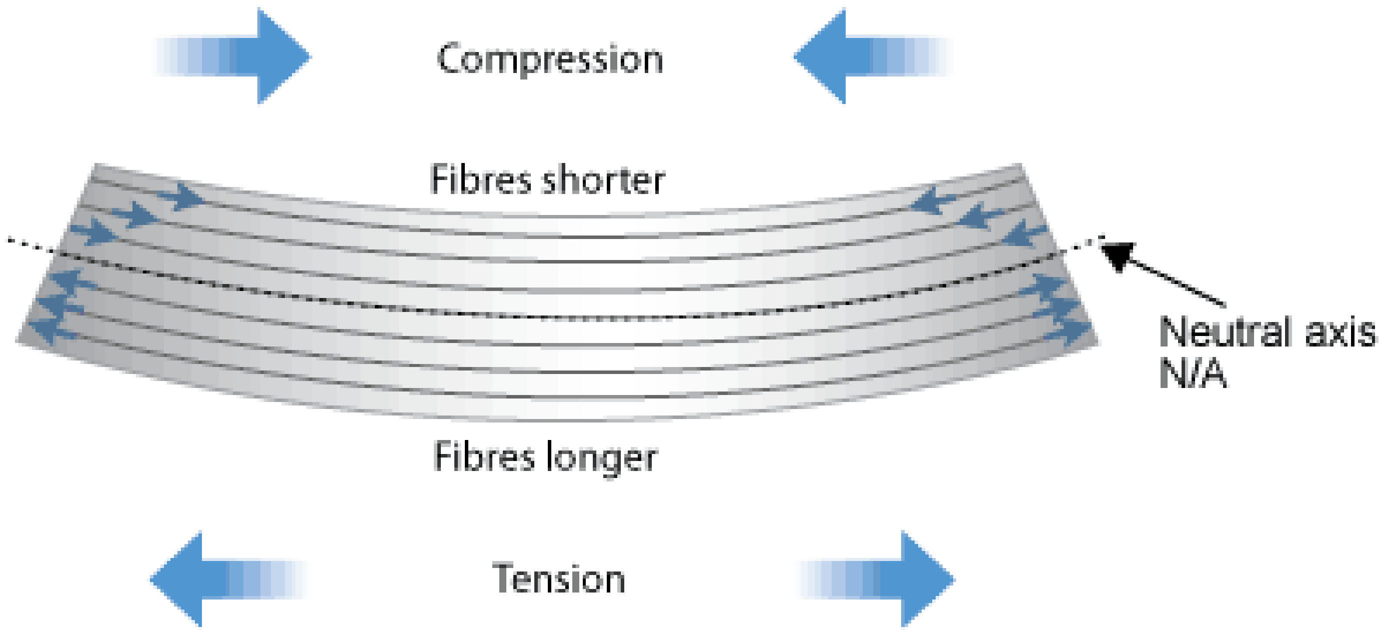
How does the loading deform the beam?

DaVinci-1493

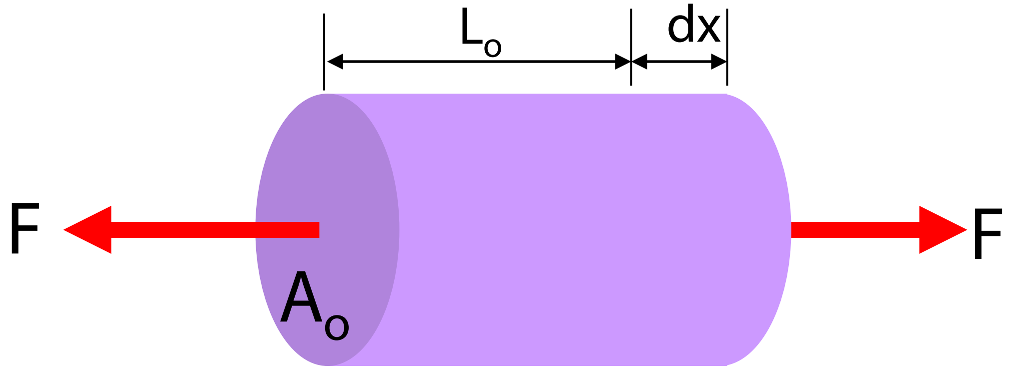


"Of bending of the springs: If a straight spring is bent, it is necessary that its convex part become thinner and its concave part, thicker. This modification is pyramidal, and consequently, there will never be a change in the middle of the spring. You shall discover, if you consider all of the aforementioned modifications, that by taking part 'ab' in the middle of its length and then bending the spring in a way that the two parallel lines, 'a' and 'b' touch a the bottom, the distance between the parallel lines has grown as much at the top as it has diminished at the bottom. Therefore, the center of its height has become much like a balance for the sides. And the ends of those lines draw as close at the bottom as much as they draw away at the top. From this you will understand why the center of the height of the parallels never increases in 'ab' nor diminishes in the bent spring at 'co.'

What was Da Vinci saying?

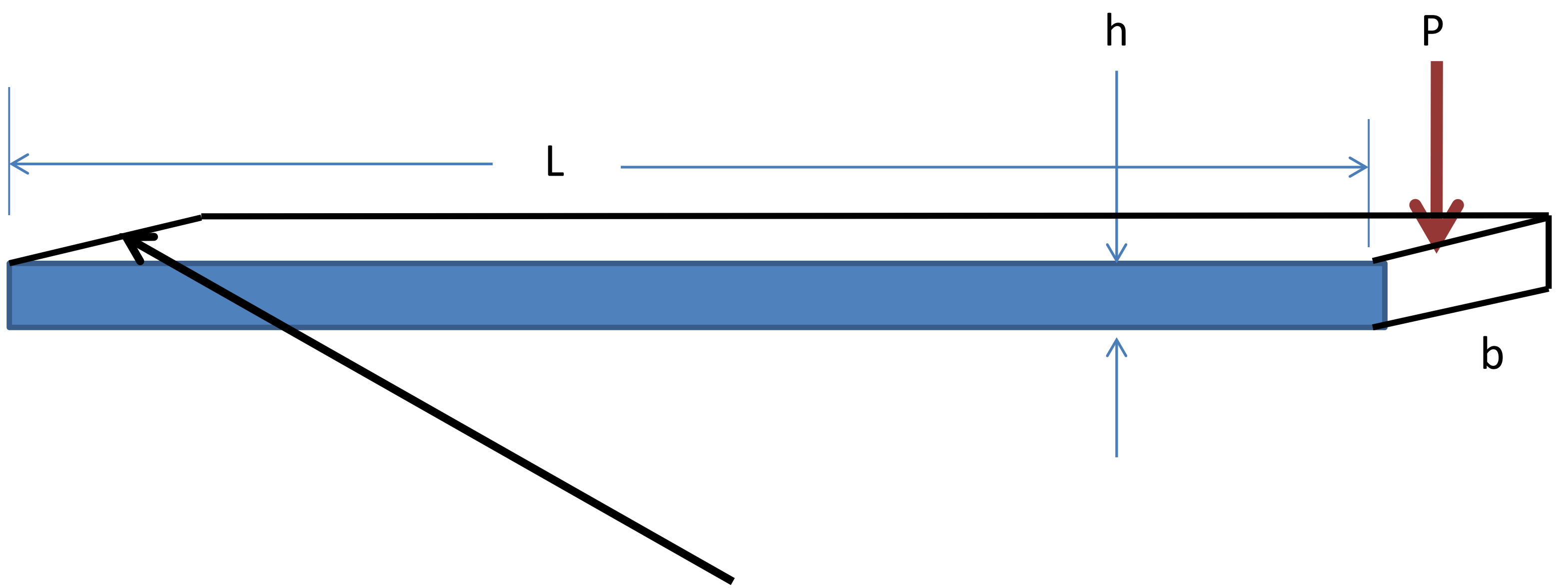


Strain = normalized deformation



$$\varepsilon = \frac{dx}{L_o}$$

Strain in cantilever beam (will use this formula next week)

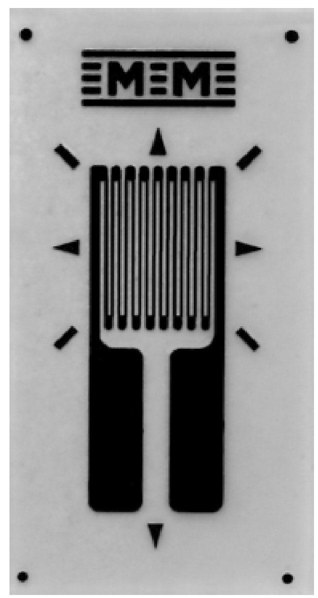


$$\varepsilon = \frac{6(PL)}{Ebh^2}$$

Young's modulus (material prop.)

Strain gauges measure axial strain

The resistance of gage changes as it stretches or compresses.



6.4 x 4.3 mm

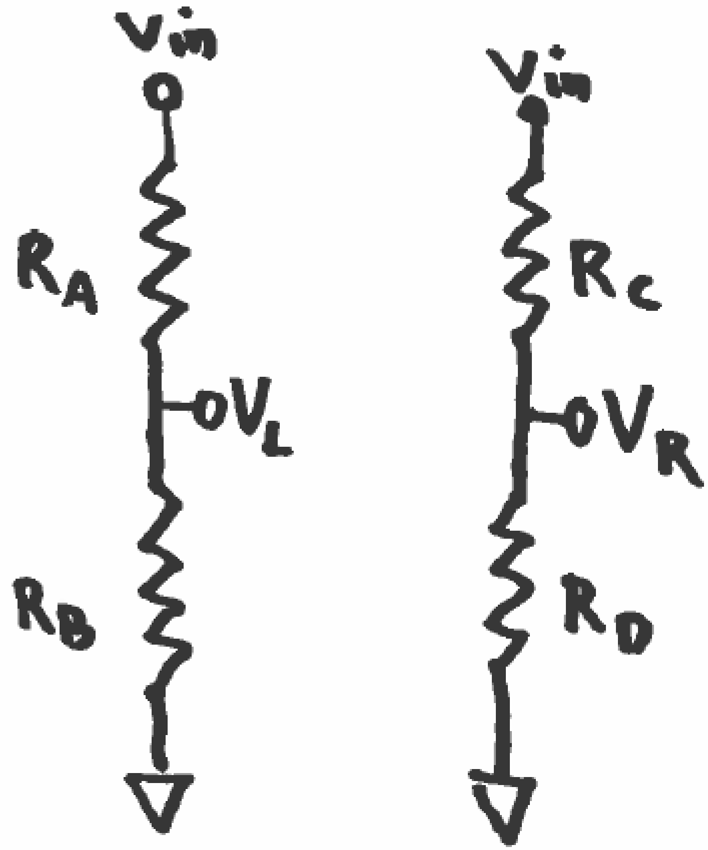
Strain gauges must be well attached to the surface of a material so that it deforms as the material deforms.

Strain is proportional to the change of resistance

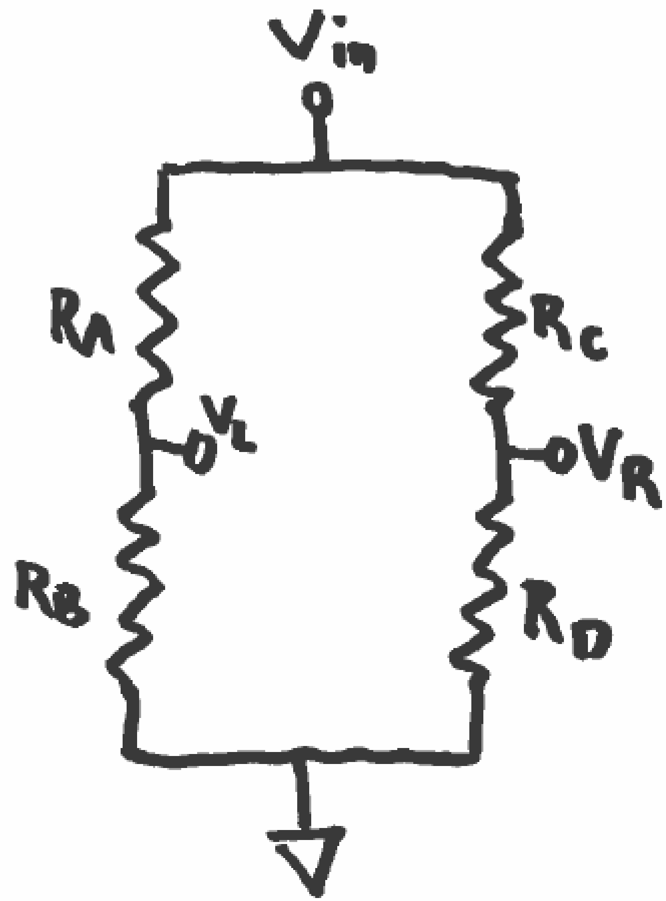
$$\frac{\Delta R}{R} = \epsilon \, G_F$$

R is nominal resistance
GF is gage factor-a calibration constant. Ours have GF = 2.1

Change in resistance is very small-need a circuit to measure.



Vin
RA
VL
RB
Vin
RC
VR
RD



Vin
RA
VL
RB
RC
VR
RD

Bridge circuit