Lecture 6 : ECG (Part 2)

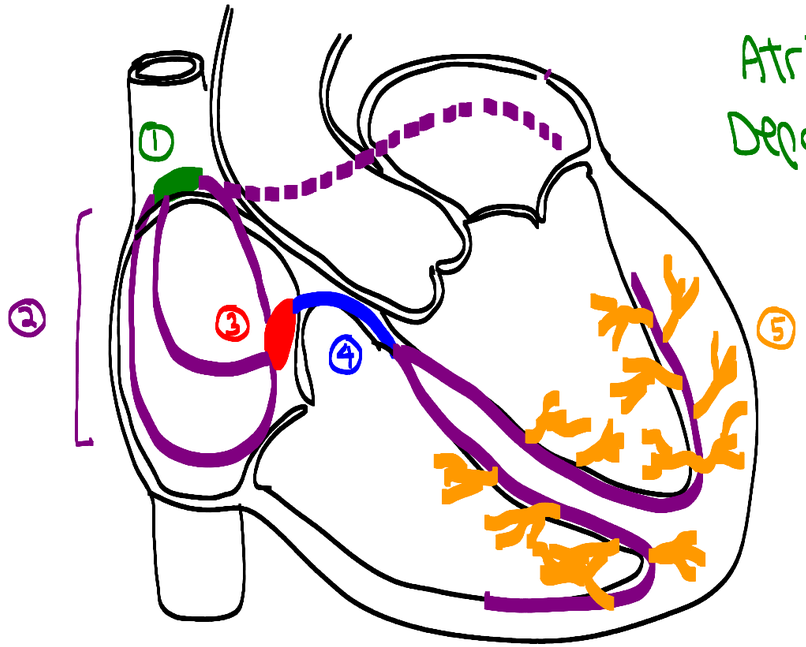
0. Review
1. 12-Lead ECG
2. ECG System
3. Mini Lab

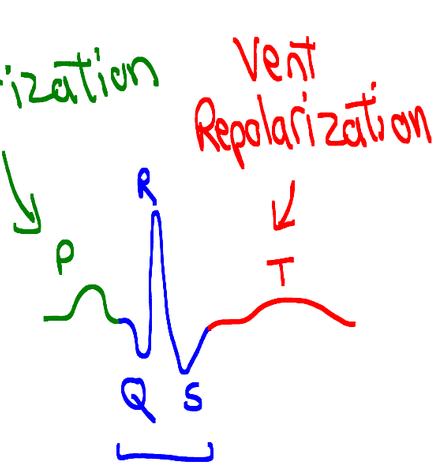
- Today : HW2 due
- Fri (Jan 24) : Lab 1 report due
- Next week : Quiz (Jan 28) ← HW2 material
  PreLab 3 (due at lab session)
  HW 3 (due Jan 30)
  Lab2 report (due Jan 31)
  ↑ see course website for template
- Exam #1 (Feb 6) !
  → Course website will have sample exam + solutions

0. Review

A. Electrical network of the heart

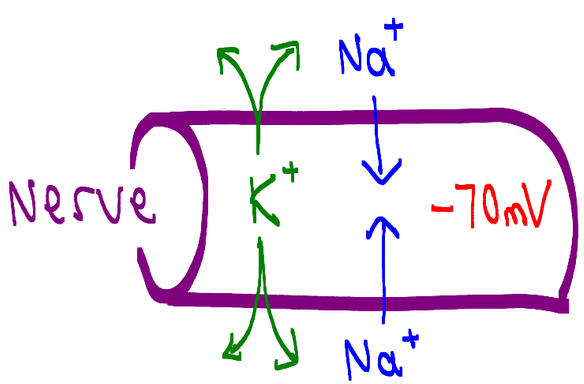
① SA node
② Internodal Tracts
+ Bachmann's Bundle
③ AV node
④ His, left + right bundles
⑤ Purkinje fibers

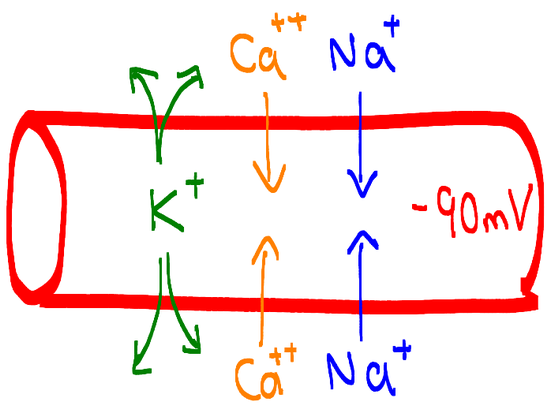




B. Action Potentials

Rest potential
Depolarization
Repolarization



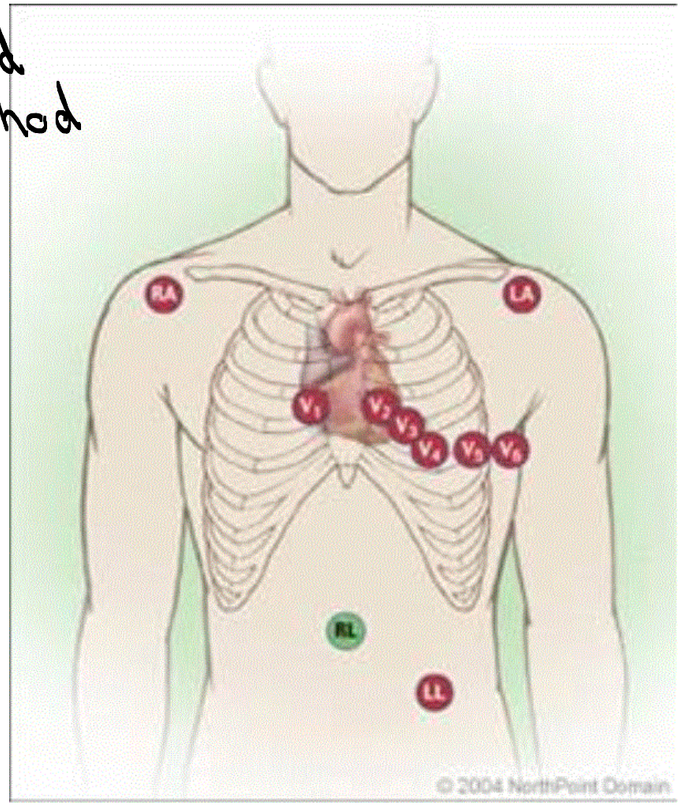


Cardiac Muscle

(6.1)

1. 12-Lead ECG ← standard method

3 Einthaven's Triangle



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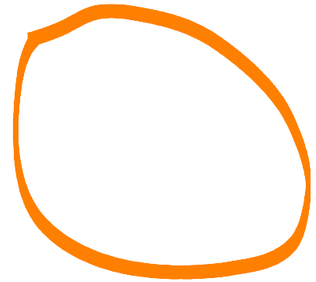
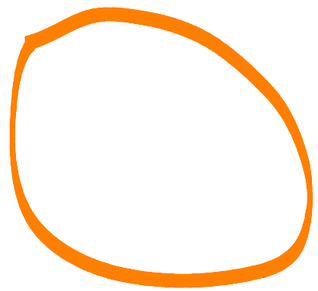


VS



RA LA RA LA

VS

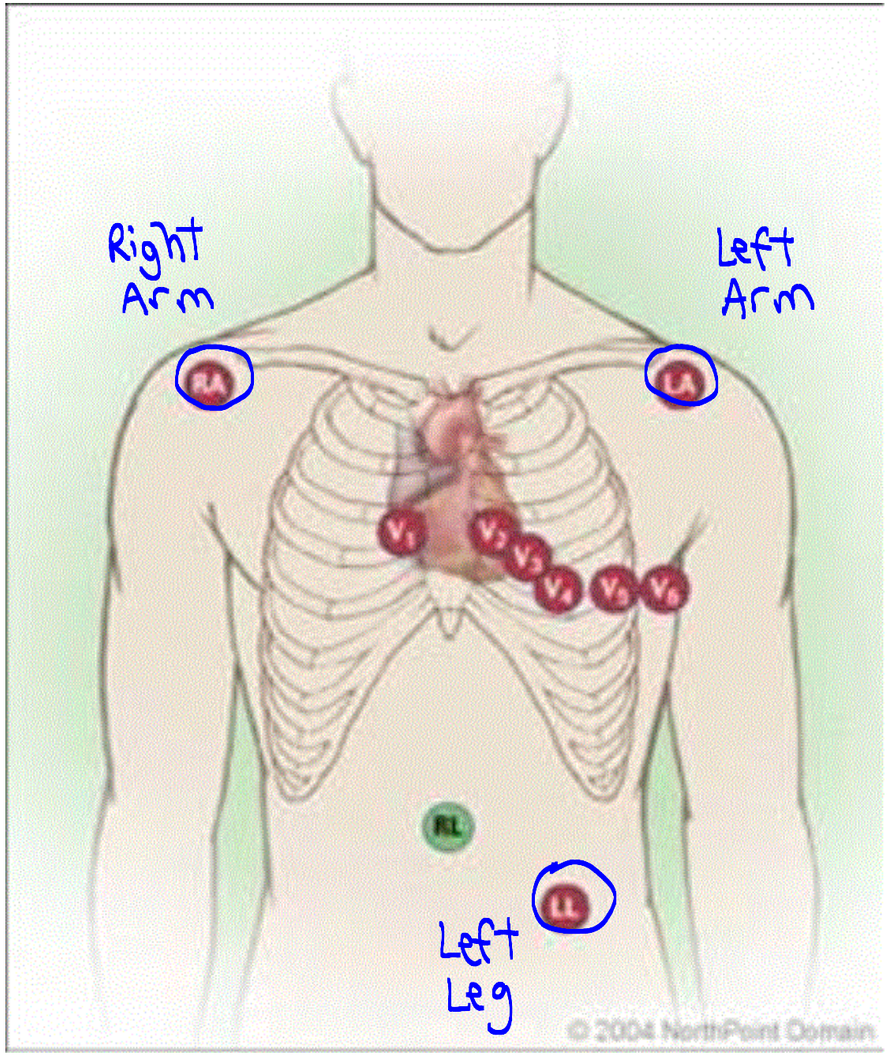
LL LL

Q: Why so many leads?

(6.2)

- Augmented Leads

The RA, LA, and LL electrodes also define



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RA LA LL

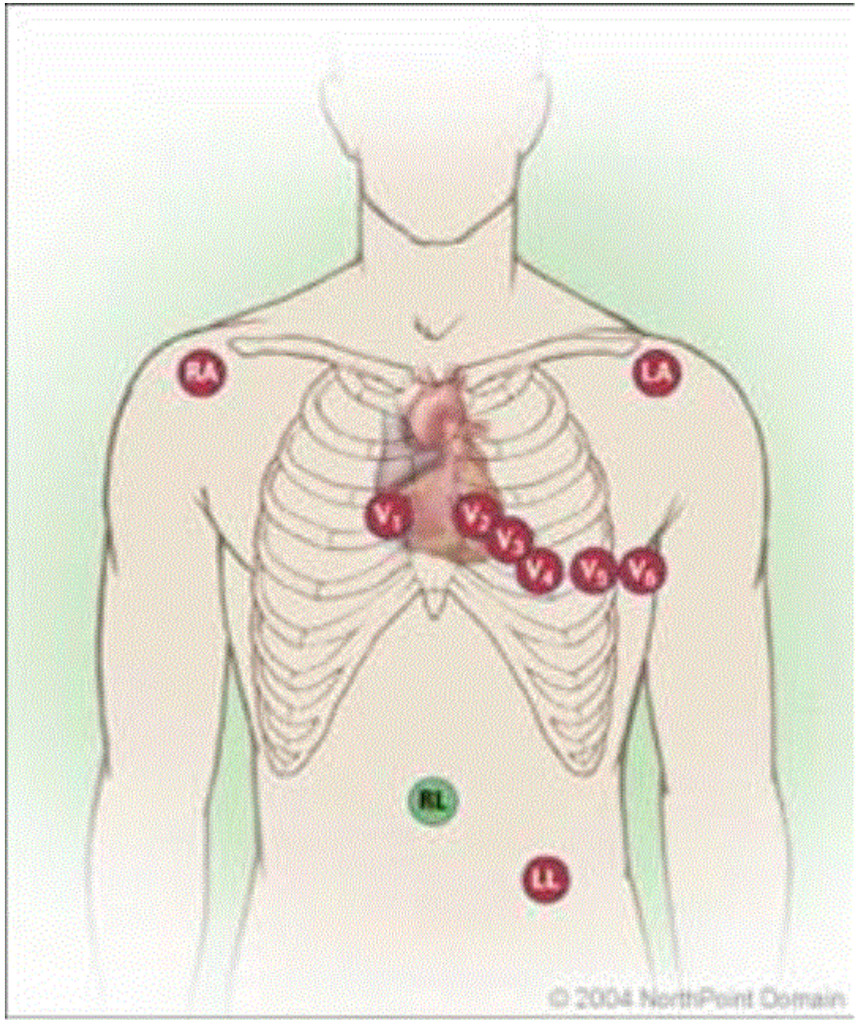
- Precordial Leads

⇒ __ more electrodes placed on _____.

BACK

TOP VIEW

CHEST



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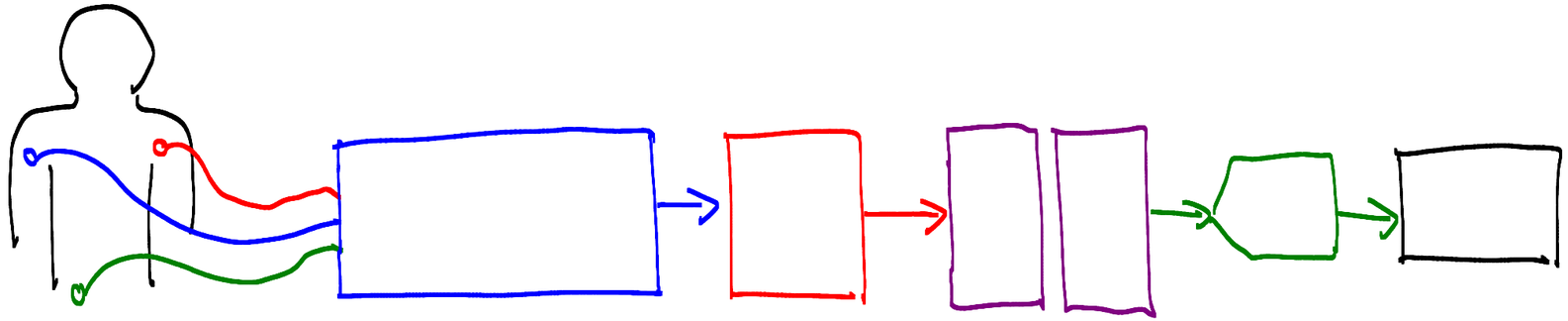
2. ECG System

Lab3 is the simplest ECG case:

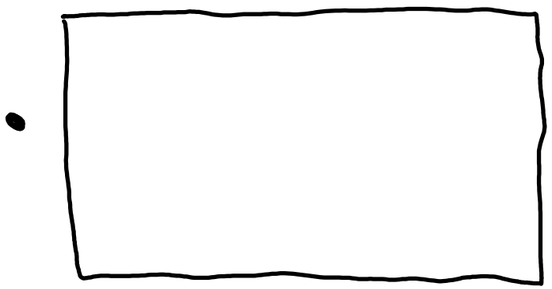


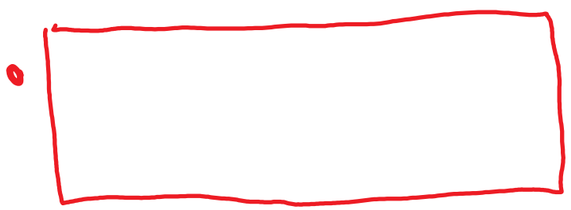
A. Preamplifier

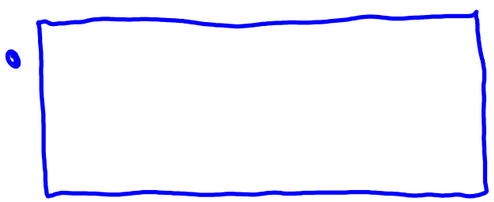
- Instrumentation amplifier amplifies ΔV =

- Input protection

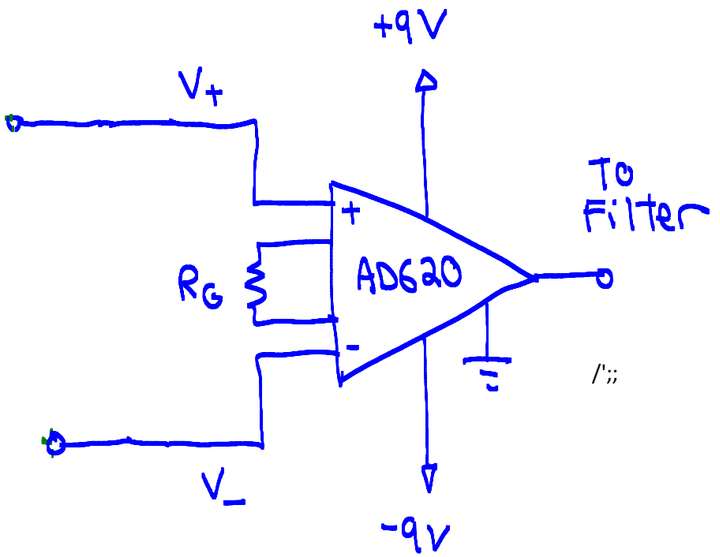
ECG amplifier inputs usually have





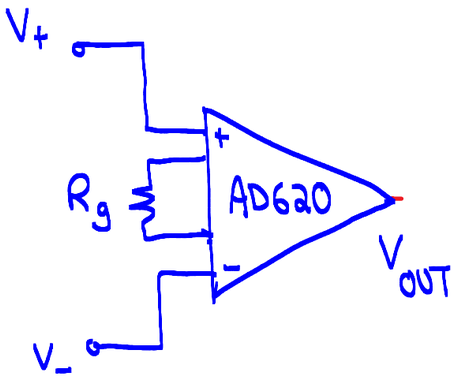


Ex:



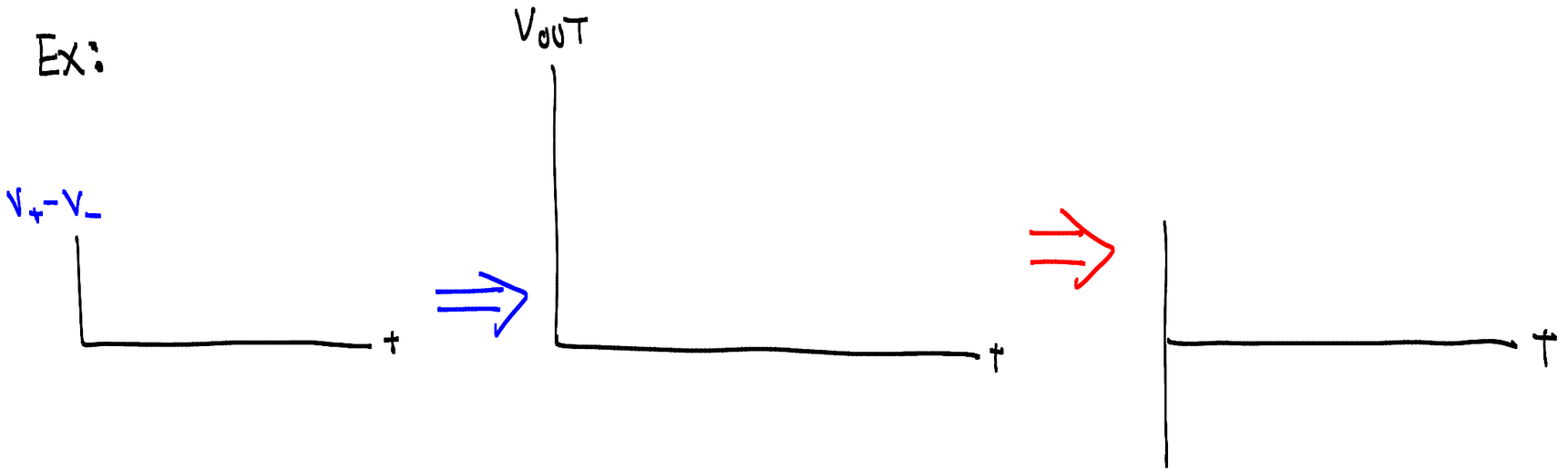
B. Filter

- Mismatch in skin-electrode contact potential creates an input DC offset voltage



- At DC

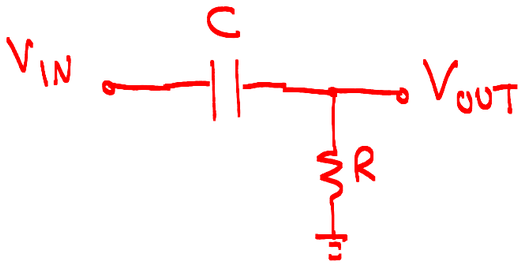
Ex:



- At high freq,

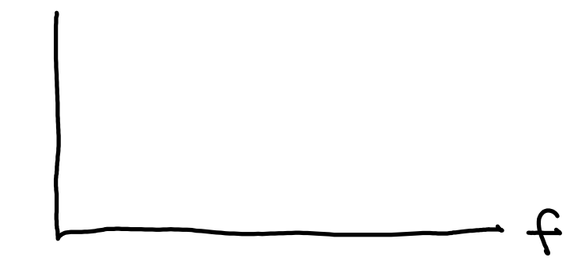
- HPF Frequency Response

Straightforward to show that:



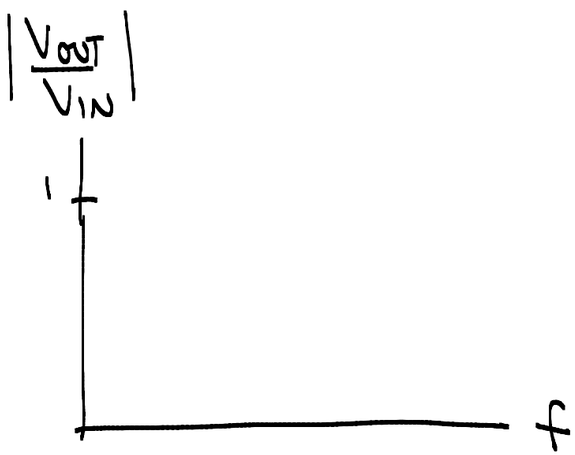
$$\frac{V_{OUT}}{V_{IN}} =$$

NOTE: $\left|\frac{V_o}{V_i}\right|$

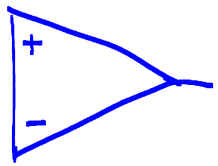


Can easily show that

$$\left|\frac{V_{OUT}}{V_{IN}}\right| =$$

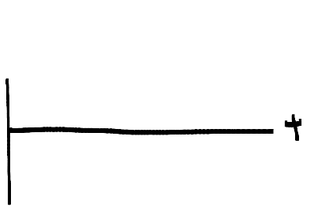


- After the HPF, the ECG signal is pretty <u>small</u>



①

②



How to derive V_{OUT}/V_{IN}?

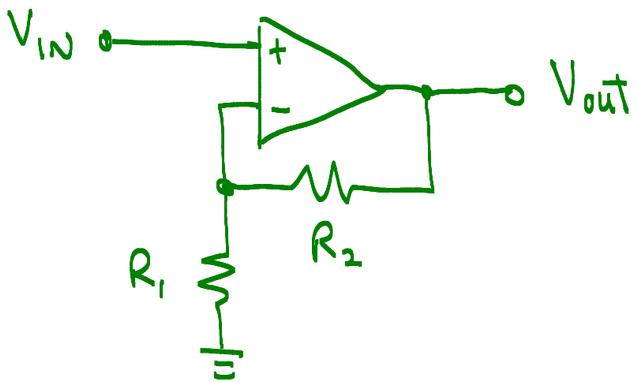
Recall the op Amp Golden Rules:

(1)

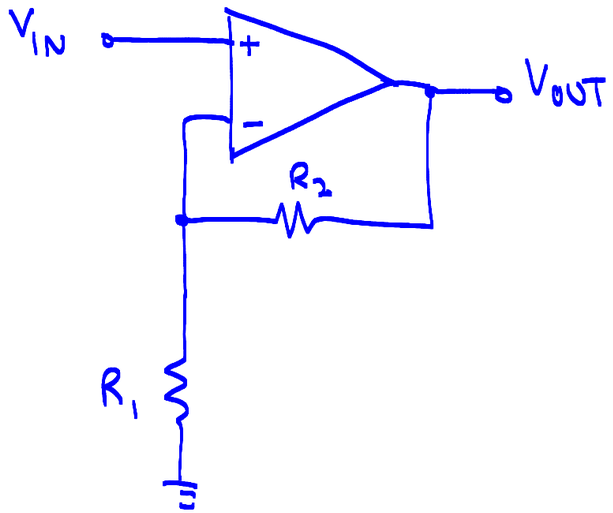
(2)

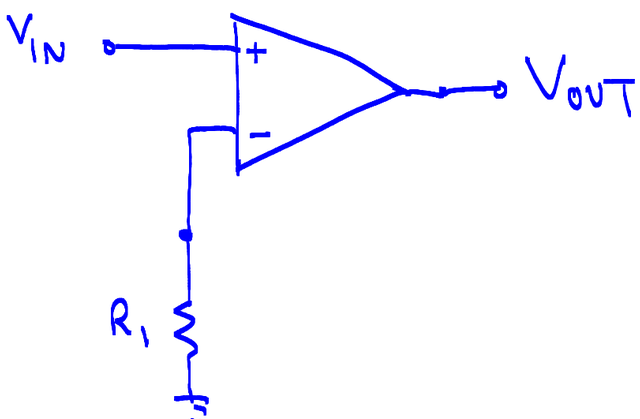
NOTE: These golden rul
an ideal op amp used
with negative feedback!

Ex:



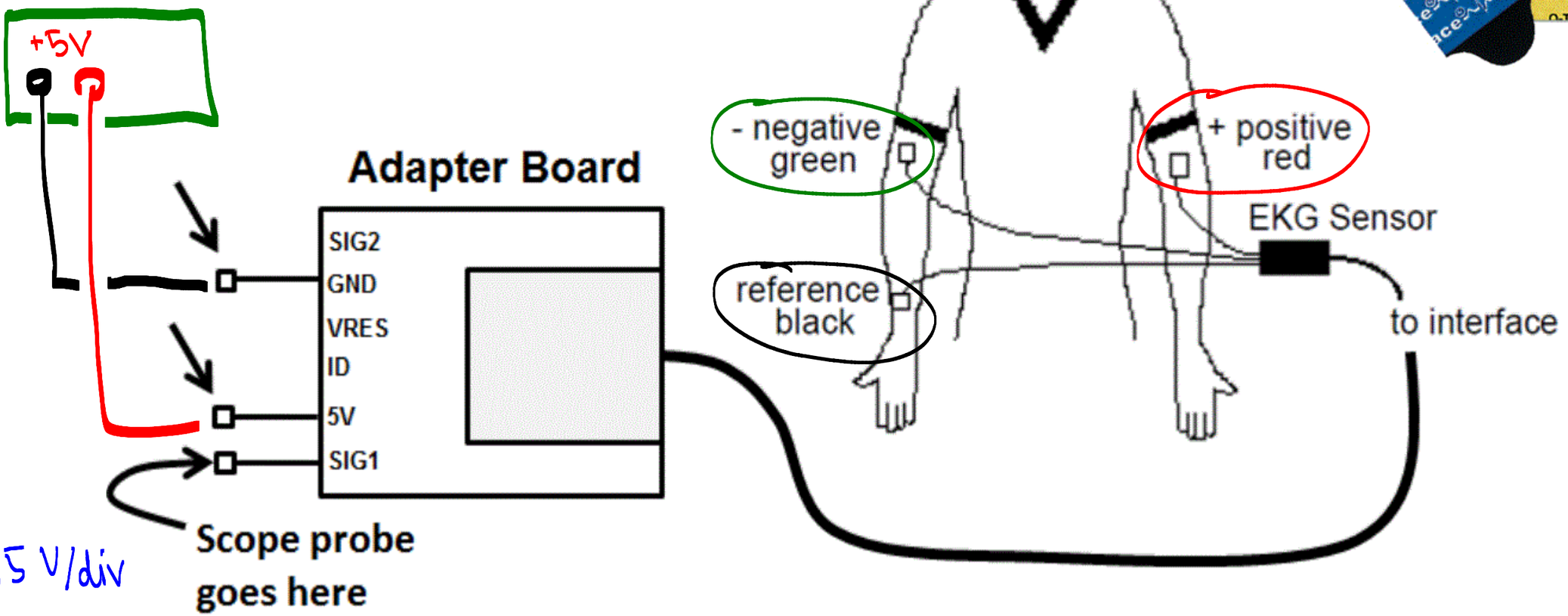
Adding a capacitor





3. MiniLab

GOAL: Use a commercial ECG sensor to detect PQRST waveform!



Scope:

Vertical = 0.5 V/div

Horizontal = 200 ms/div