

Electrocardiography – Normal 6

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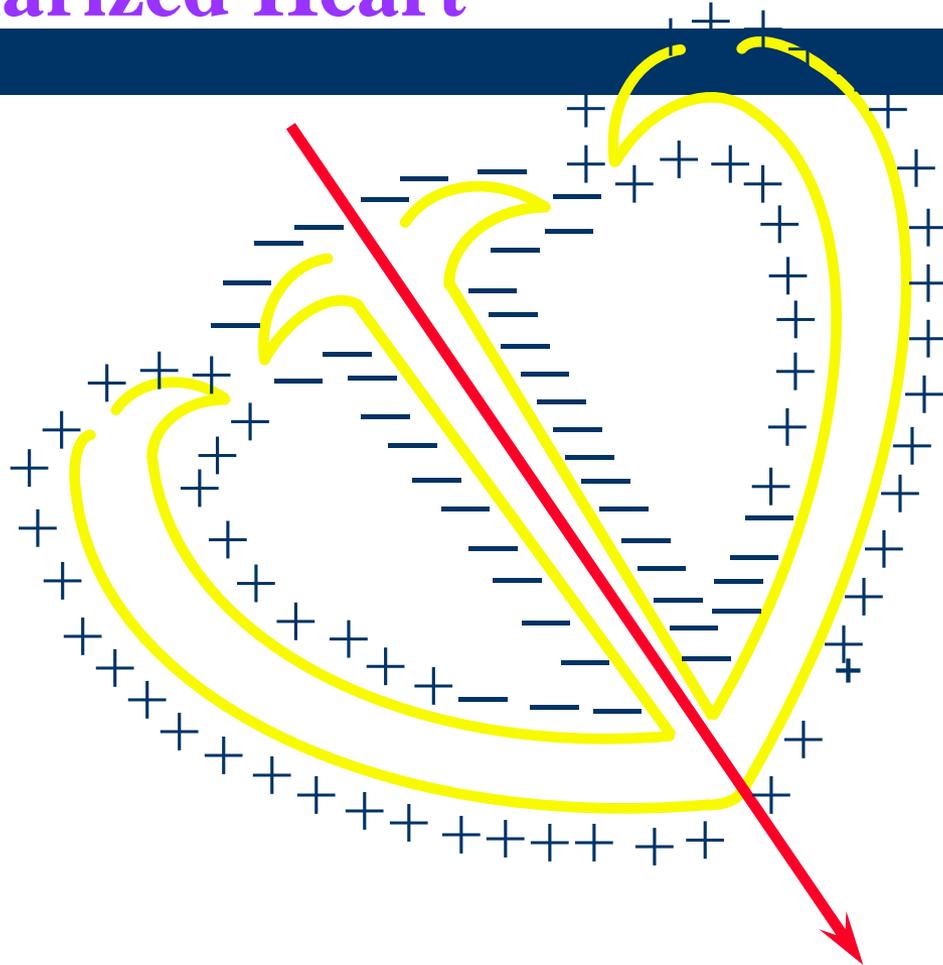
Objectives

- Recognize the normal ECG tracing
- Calculate the heart rate
- Determine the rhythm
- Calculate the length of intervals and determine the segments deflections
- Draw the Hexagonal axis of the ECG
- Find the mean electrical axis of QRS (Ventricular depolarization)

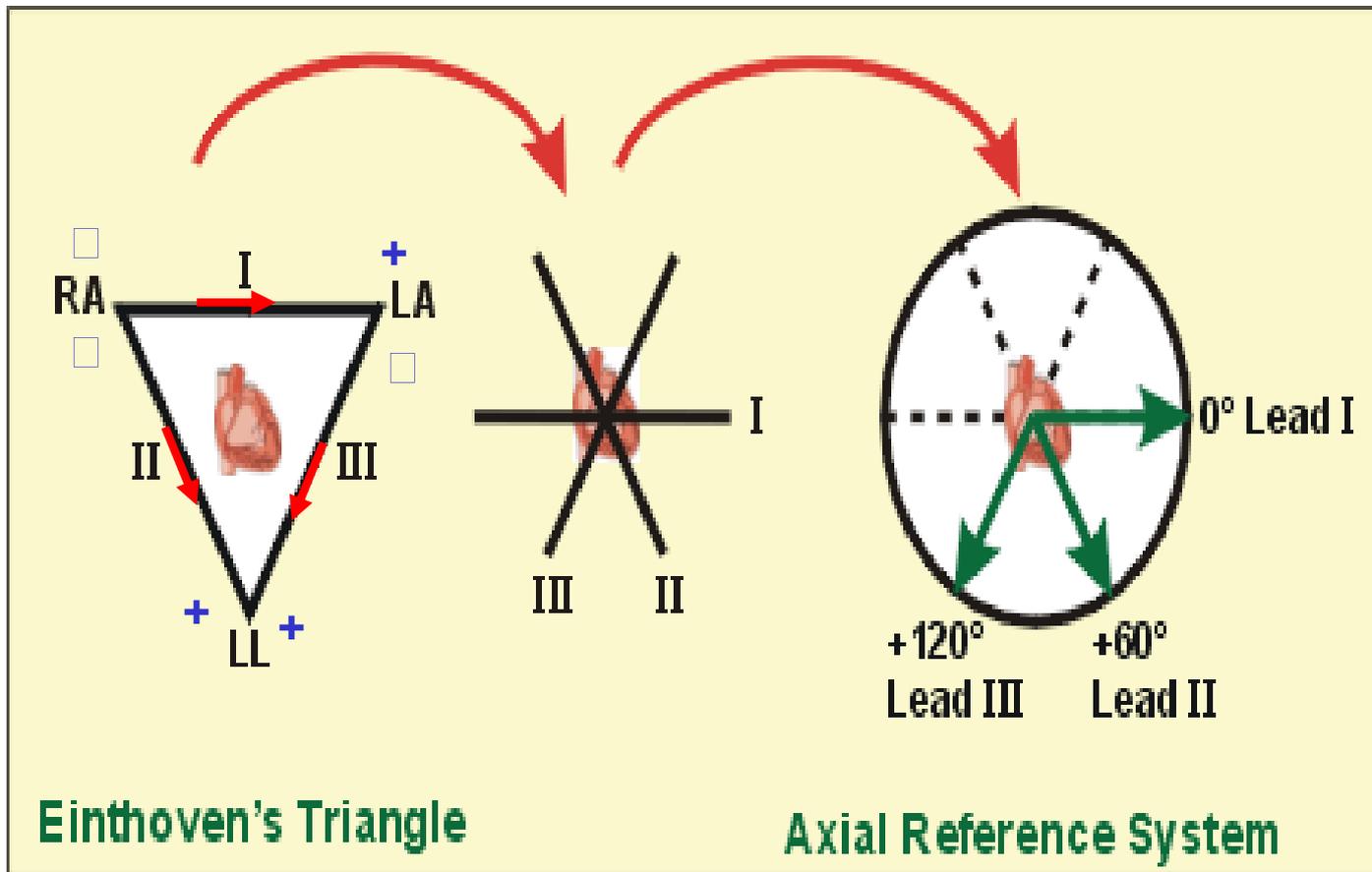
Principles of Vectorial Analysis of EKG's

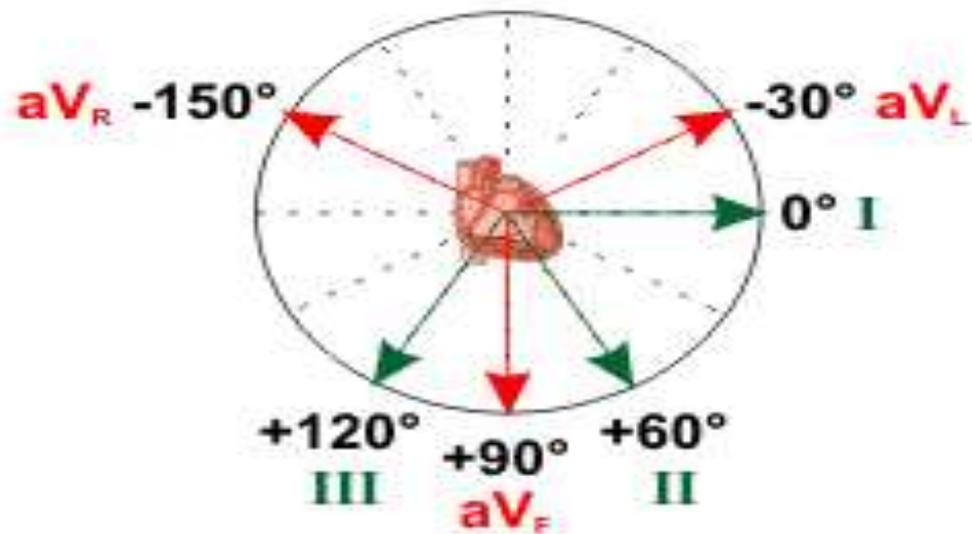
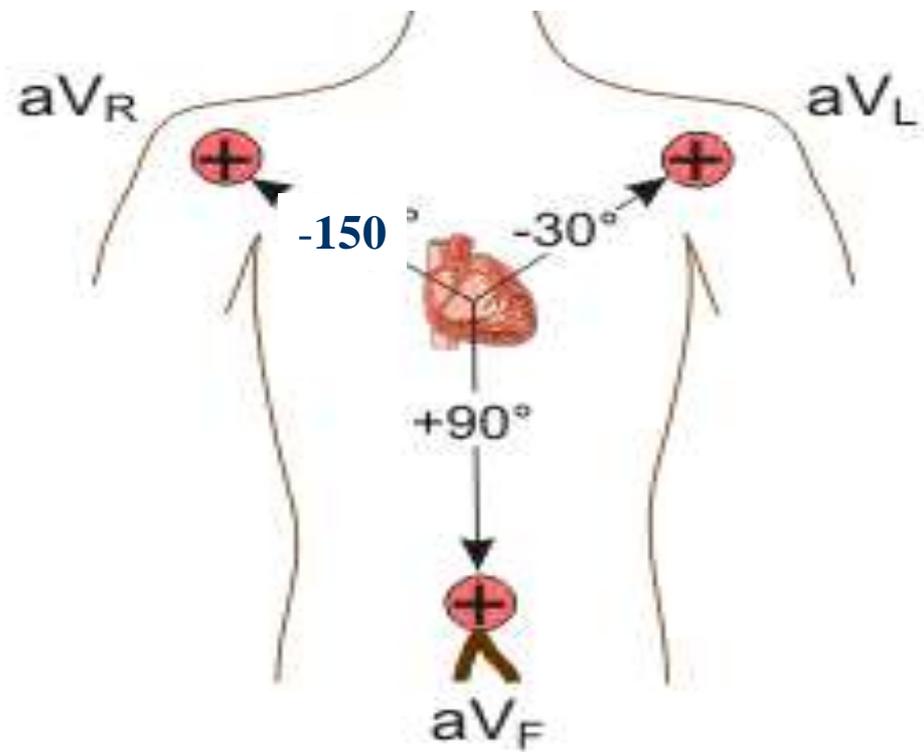
- The current in the heart flows from the area of depolarization to the polarized areas, and the electrical potential generated can be represented by a vector, with the *arrowhead pointing in the positive direction*.
- The length of the vector is *proportional to the voltage of the potential*.
- The generated potential at any instance can be represented by an *instantaneous mean vector*.
- The normal mean QRS vector is 60° (-30° - 110°)

Mean Vector Through the Partially Depolarized Heart



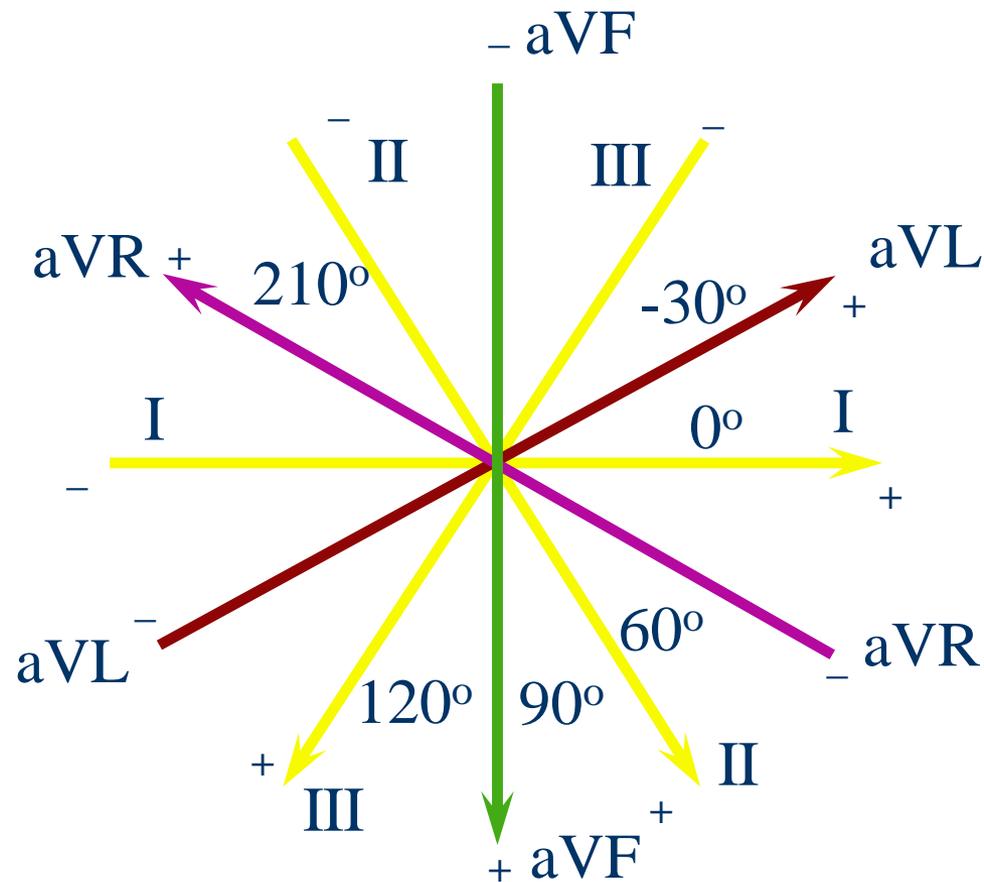
Einthoven's triangle and law



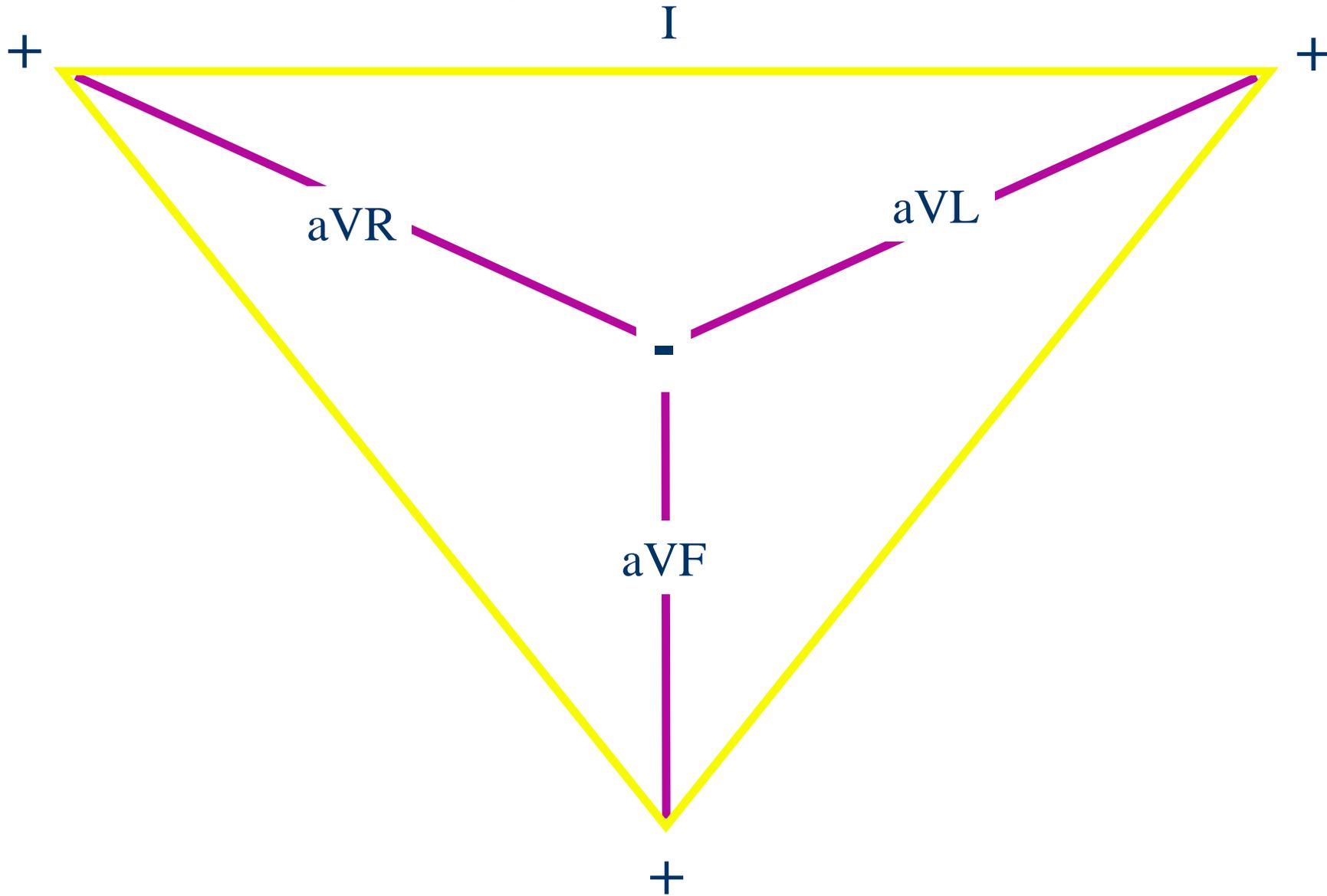


Principles of Vectorial Analysis of EKG's (cont'd)

Axes of the Three Bipolar and Augmented Leads



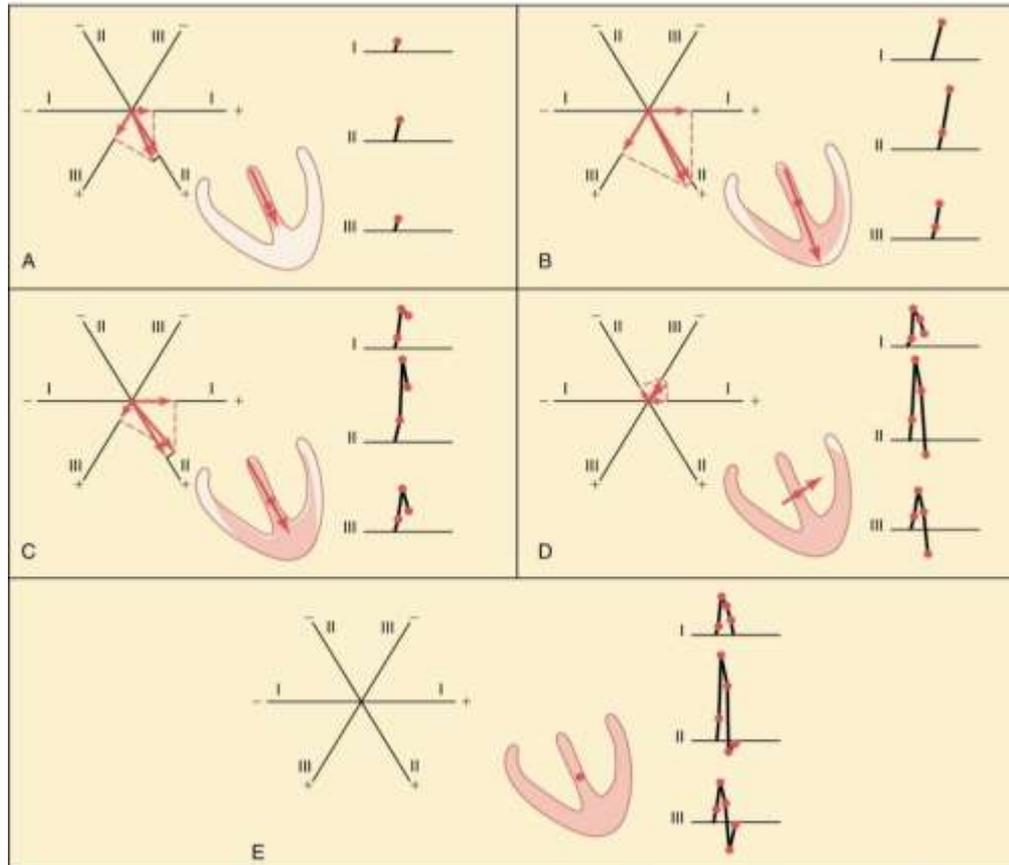
Axes of the Unipolar Limb Leads



Principles of Vectorial Analysis of EKG's (cont'd)

- *The axis of lead I is zero degrees* because the electrodes lie in the horizontal direction on each of the arms.
- *The axis of lead II is +60 degrees* because the right arm connects to the torso in the top right corner, and left leg connects to the torso in the bottom left corner.
- *The axis of lead III is 120 degrees.*

Principles of Vectorial Analysis of EKG's (cont'd)

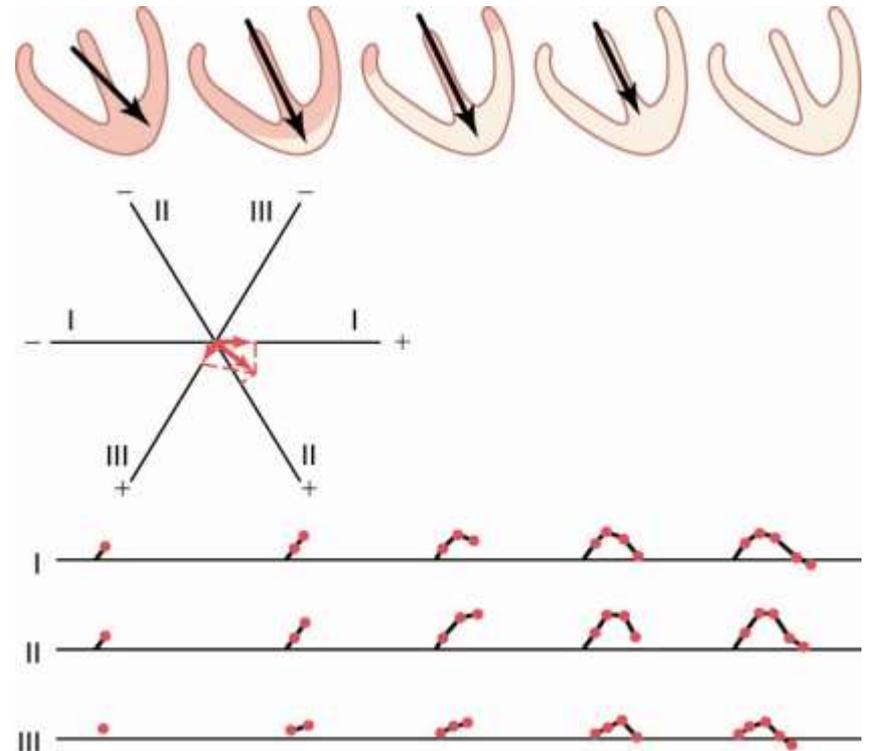


Principles of Vectorial Analysis of EKG's (cont'd)

- In figure B, the depolarization vector is large because half of the ventricle is depolarized.
- Lead II should be largest voltage when compared to I and III when the mean vector is 60° .
- In figure C, left side is slower to depolarize.
- In figure D, the last part to depolarize is near the left base of the heart which gives a negative vector (S wave).
- Q wave is present if the left side of the septum depolarizes first.

The T Wave (Ventricular Repolarization)

- First area to repolarize is near the apex of the heart.
- Last areas, in general, to depolarize are the first to repolarize.
- Repolarized areas will have a + charge first; therefore, a + net vector occurs and a positive T wave

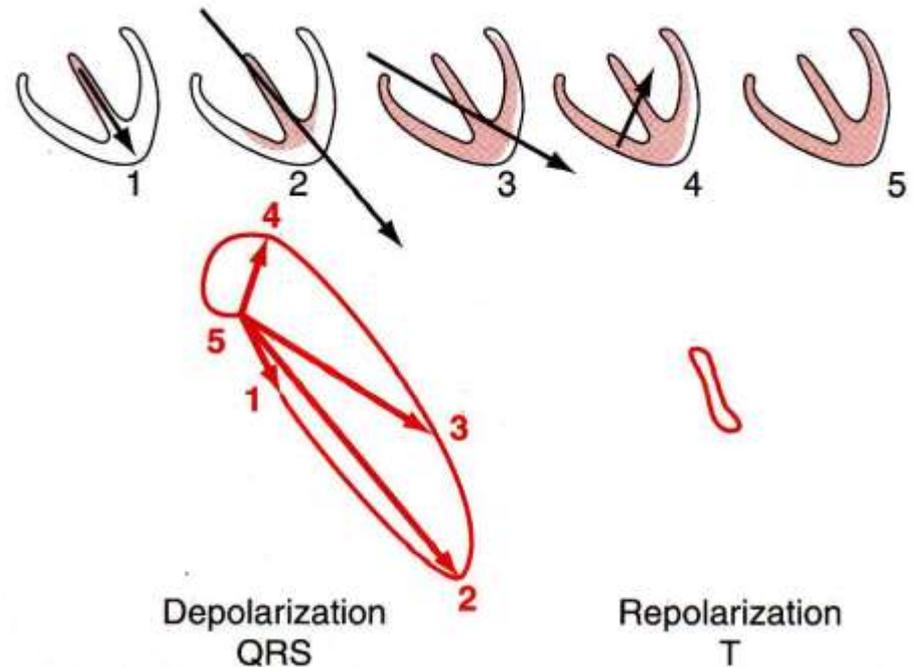


Atrial Depolarization (P-Wave) and Atrial Repolarization (Atrial T Wave)

- Atrial depolarization begins at sinus node and spreads toward A-V node.
- This should give a + vector in leads I, II, and III.
- Atrial repolarization can't be seen because it is masked by QRS complex.
- Atrial depolarization is slower than in ventricles, so first area to depolarize is also the first to repolarize. This gives a negative atrial repolarization wave in leads I, II, and III

Vectorcardiogram

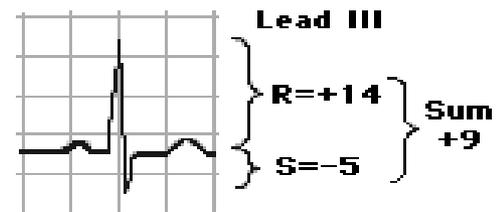
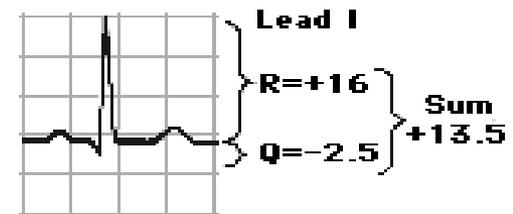
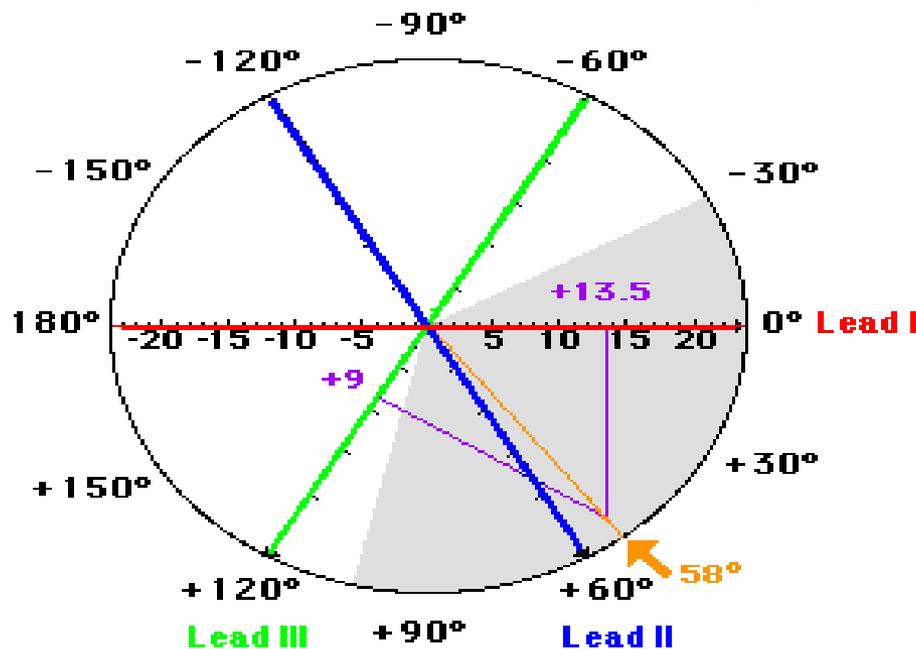
- This traces vectors throughout cardiac cycle.
- When half of the ventricle is depolarized, vector is largest.



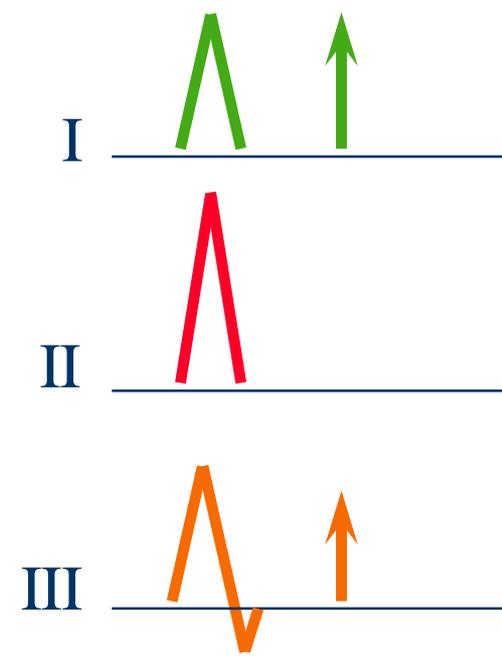
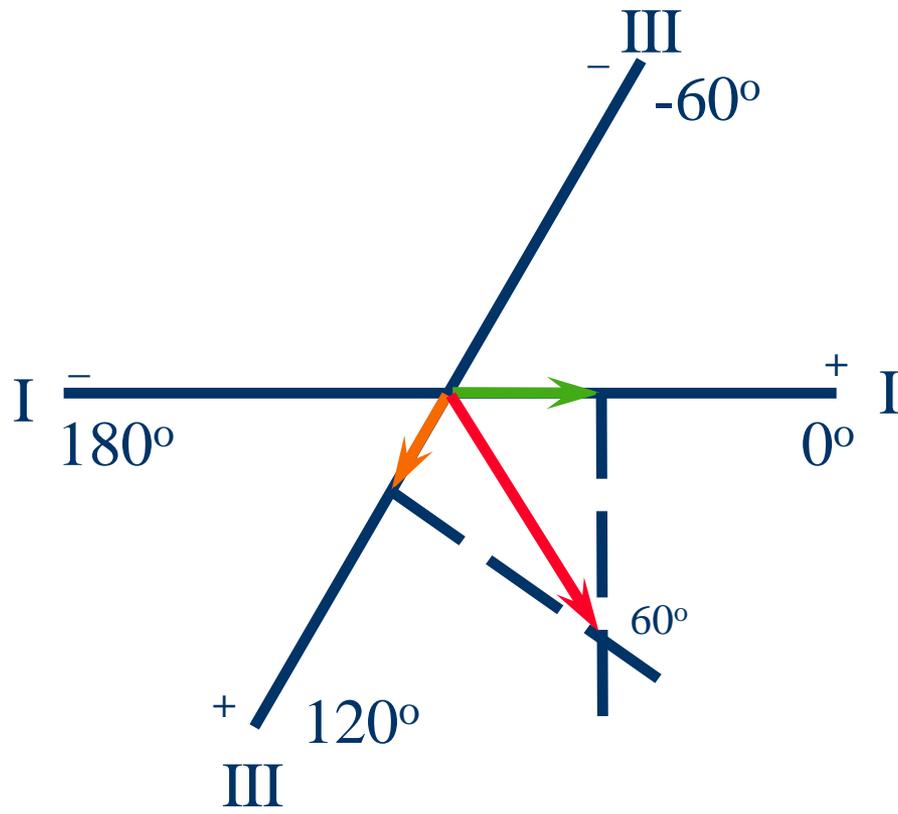
- Note zero reference point, number 5, is point of full depolarization

Determining Mean Electrical Axis

- Use 2 different leads
- Measure the sum of the height and the negative depth of the QRS complex
- Measure that value in mm onto the axis of the lead and draw perpendicular lines
- The intersection is at the angle of the mean axis.



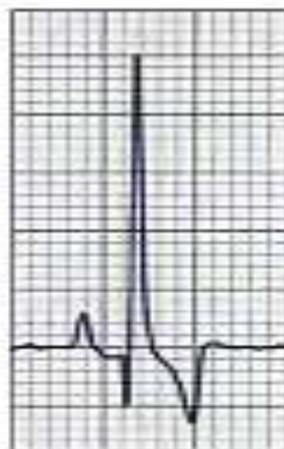
Plot of the Mean Electrical Axis of the Heart from Two Electrocardiographic Leads





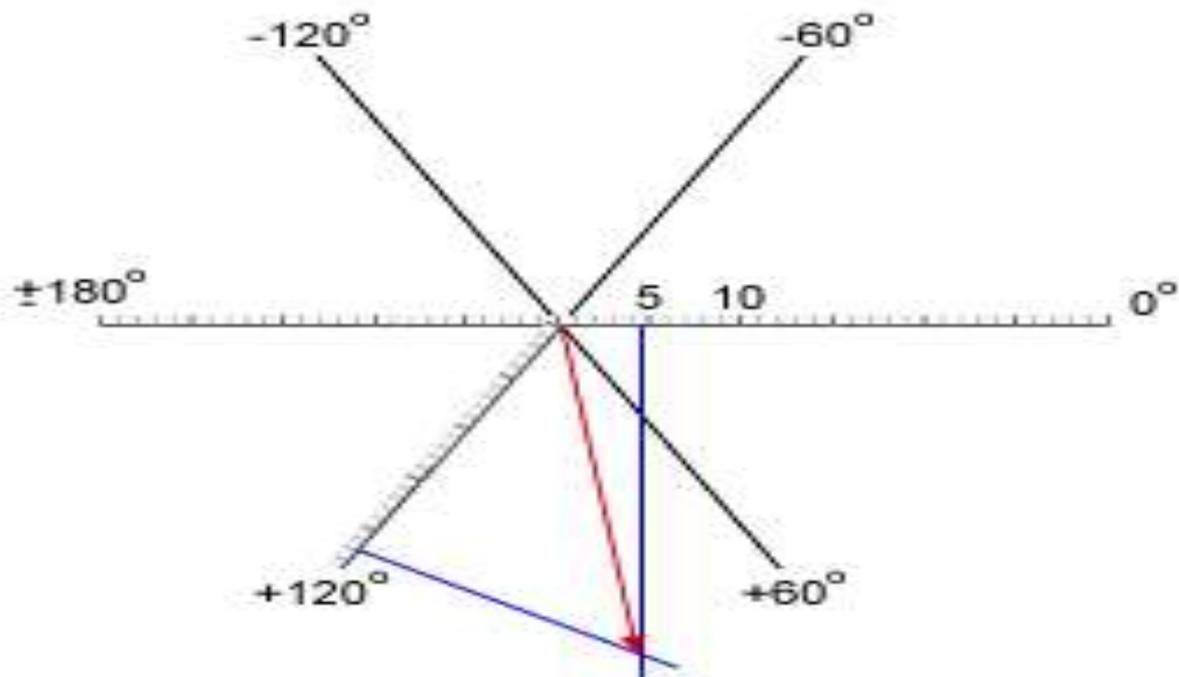
Lead I

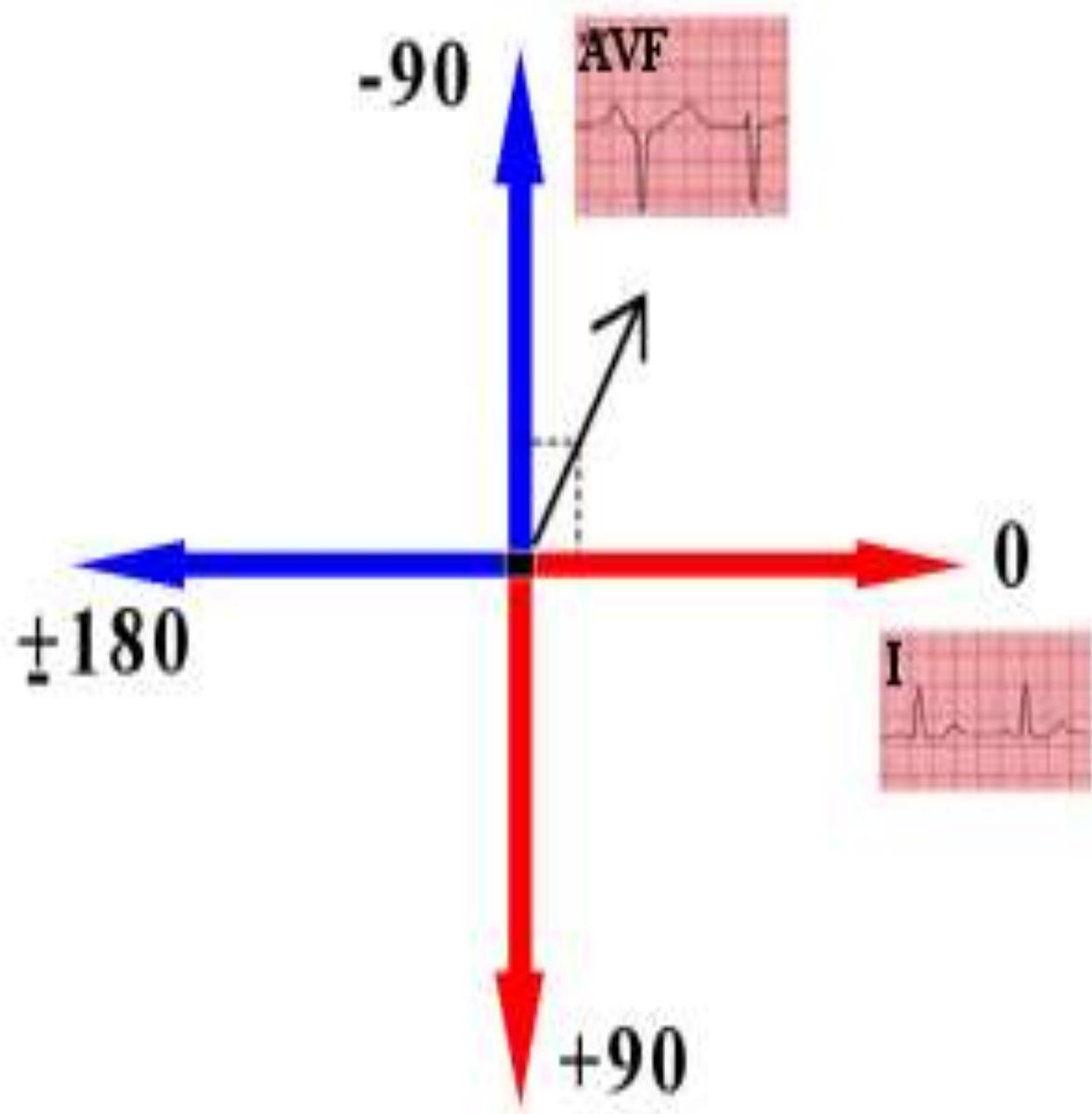
$$\begin{array}{r}
 Q = -0.5 \\
 R = +5 \\
 \hline
 +4.5
 \end{array}$$



Lead III

$$\begin{array}{r}
 Q = -4 \\
 R = +26 \\
 \hline
 +22
 \end{array}$$





**SEVERE RIGHT
OR
LEFT
AXIS DEVIATION
OF QRS**
From 180 to 360 (-90)

**LEFT AXIS
DEVIATION OF
QRS**

Lead I

□ 180°

Lead I

0° +

**RIGHT AXIS
DEVIATION OF
QRS**
From +90 to +180

**NORMAL MEAN
ELECTRICAL
AXIS OF QRS**
From 0 to +90

aVF



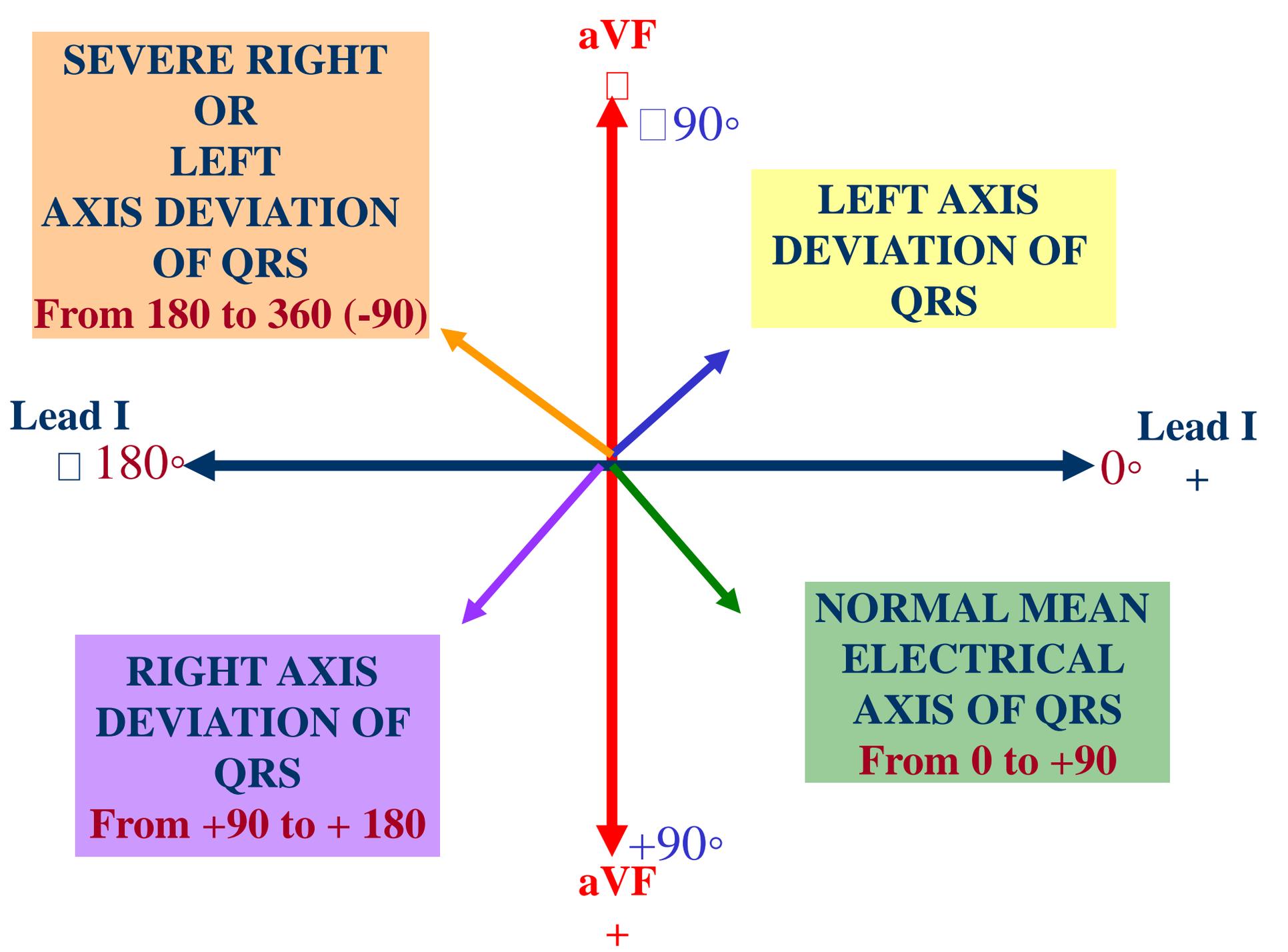
□ 90°

aVF



+90°

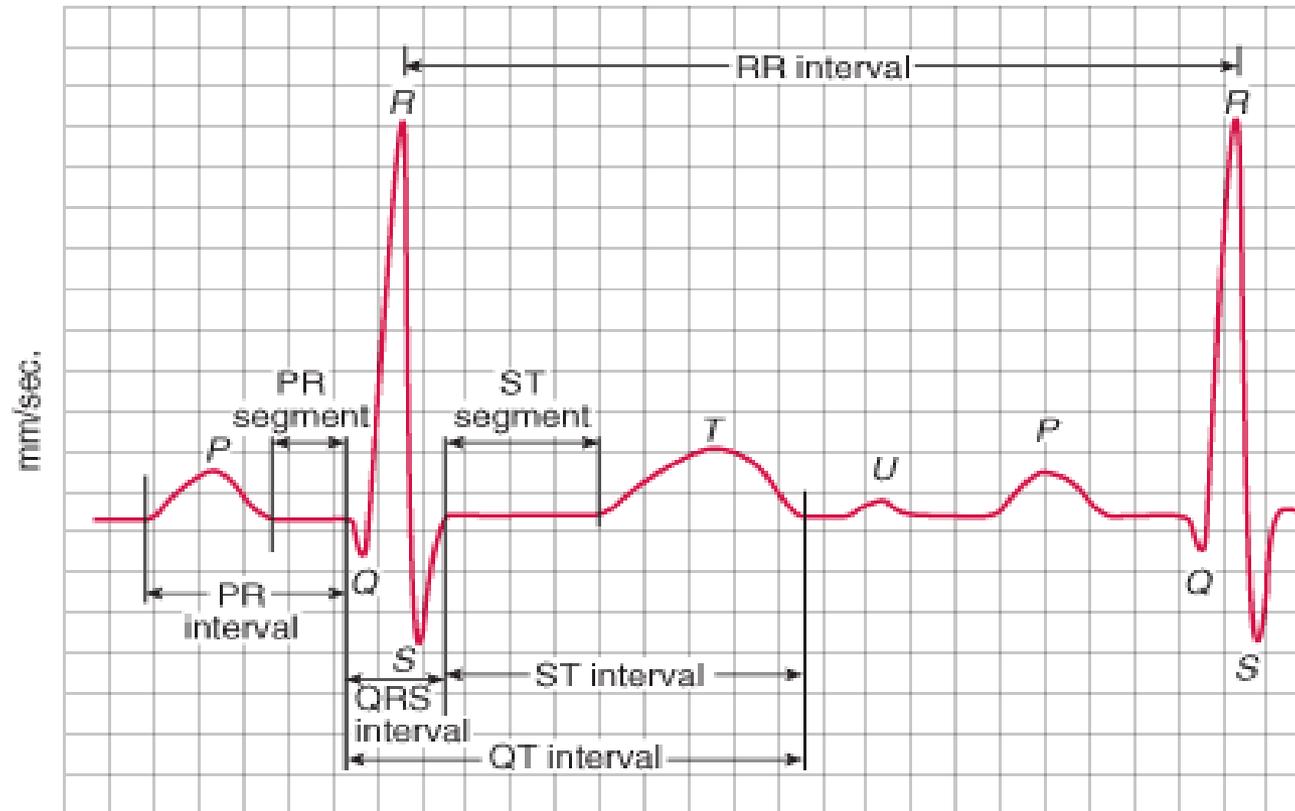
+



Heart Rate Calculation

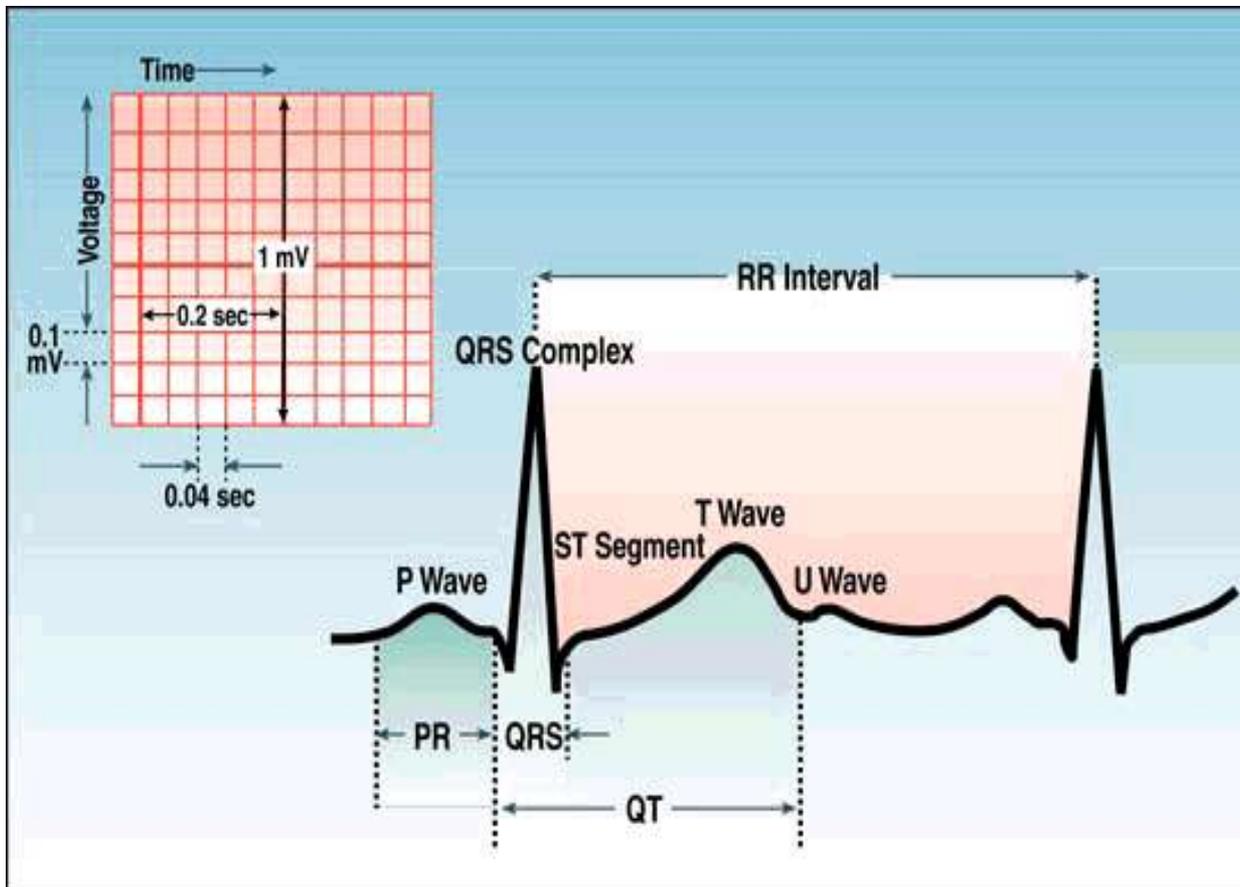
- R-R interval = 0.83 sec
- Heart rate = $\frac{(60 \text{ sec})}{(0.83 \text{ sec})} = 72$
beats/min min beat

ECG Calculations



mm/mV 1 square = 0.04 sec/0.1mV

ECG Calculations



Determine regularity



- Look at the R-R distances (using a caliper or markings on a pen or paper).
- Regular (are they equidistant apart)? Occasionally irregular? Regularly irregular? Irregularly irregular? Interpretation?

Thank You

