REVIEW OF ECG BASICS

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DISCLOSURES

I have no relevant relationships with ineligible companies to disclose within the past 24 months. (Note: Ineligible companies are defined as those whose primary business is producing, marketing, selling, re-selling, or distributing healthcare products used by or on patients.)

OBJECTIVES

- Correlate electrical impulse propagation in the heart to wave formation seen on the ECG.
- Know wave formations present on ECGs and their physiologic significance (P/Q/R/S/T/U).
- Summarize the conduction system of the heart and normal sequence of impulse activation.
- Using an ECG, determine heart rate.
- Using an ECG, determine amplitude, shape, and duration of waves, intervals, and segments.
- Using an ECG, determine the anatomic origin of a heart rhythm (SA node, AV junction, atrial, ventricular).
- Not going to look at 12-lead ECGs, just rhythm strips.

ECG PAPER

1 rhythm strip

- Standard 10 second time period

Moving horizontally

- Large box is 0.20 seconds
- Small box is 0.04 seconds

Moving vertically

- Large box is 5 mm
- Small box is 1 mm (0.1 mV)

Isoelectric line

- Baseline to where all waves return
- Deflection from the baseline is called a wave - can be upward (positive) or downward (negative) or biphasic (positive and negative)

ECG is a real-time graphic representation of the heartbeat

Case #358

ECG Wave-Maven
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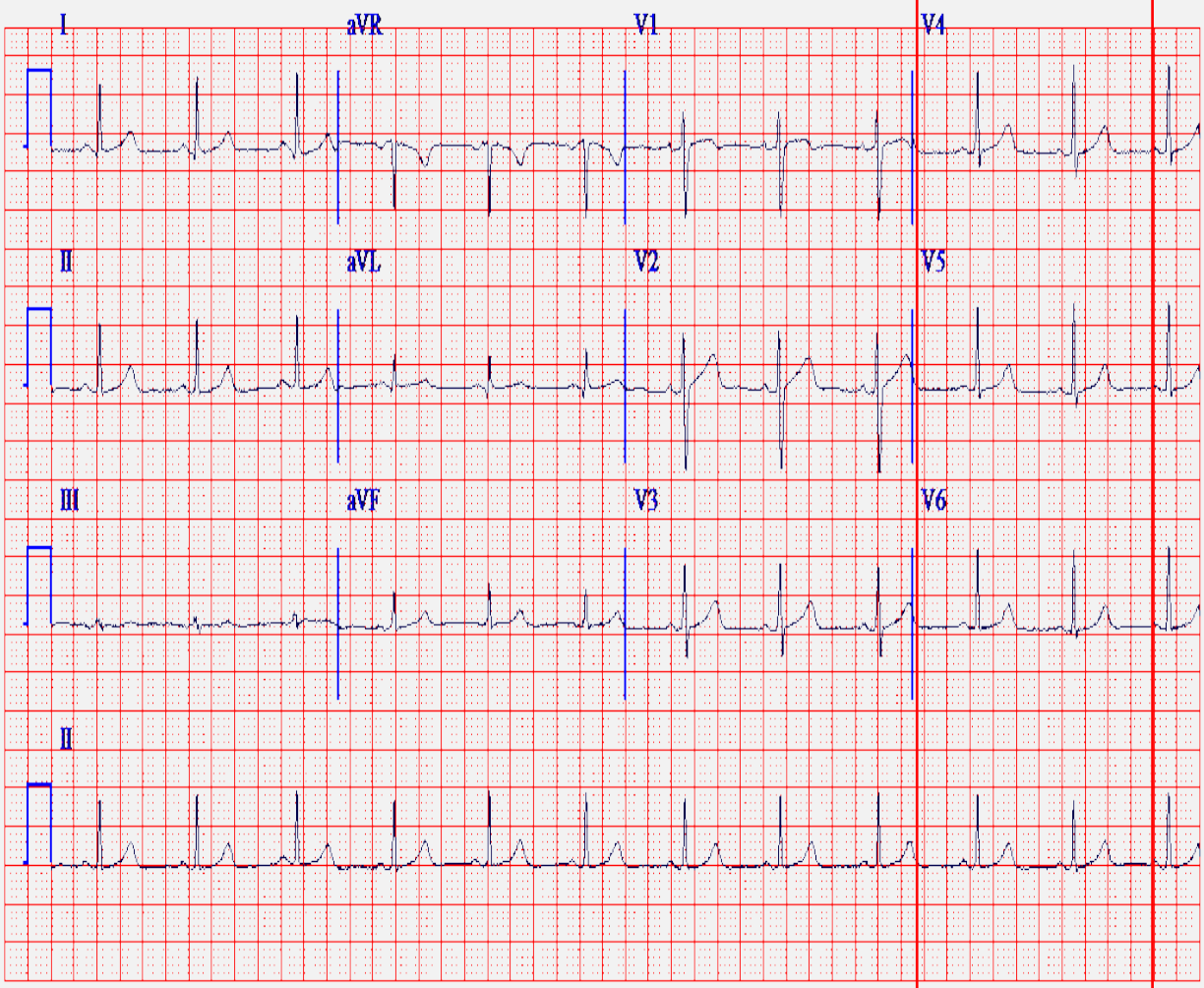
http://ecg.bidmc.harvard.edu



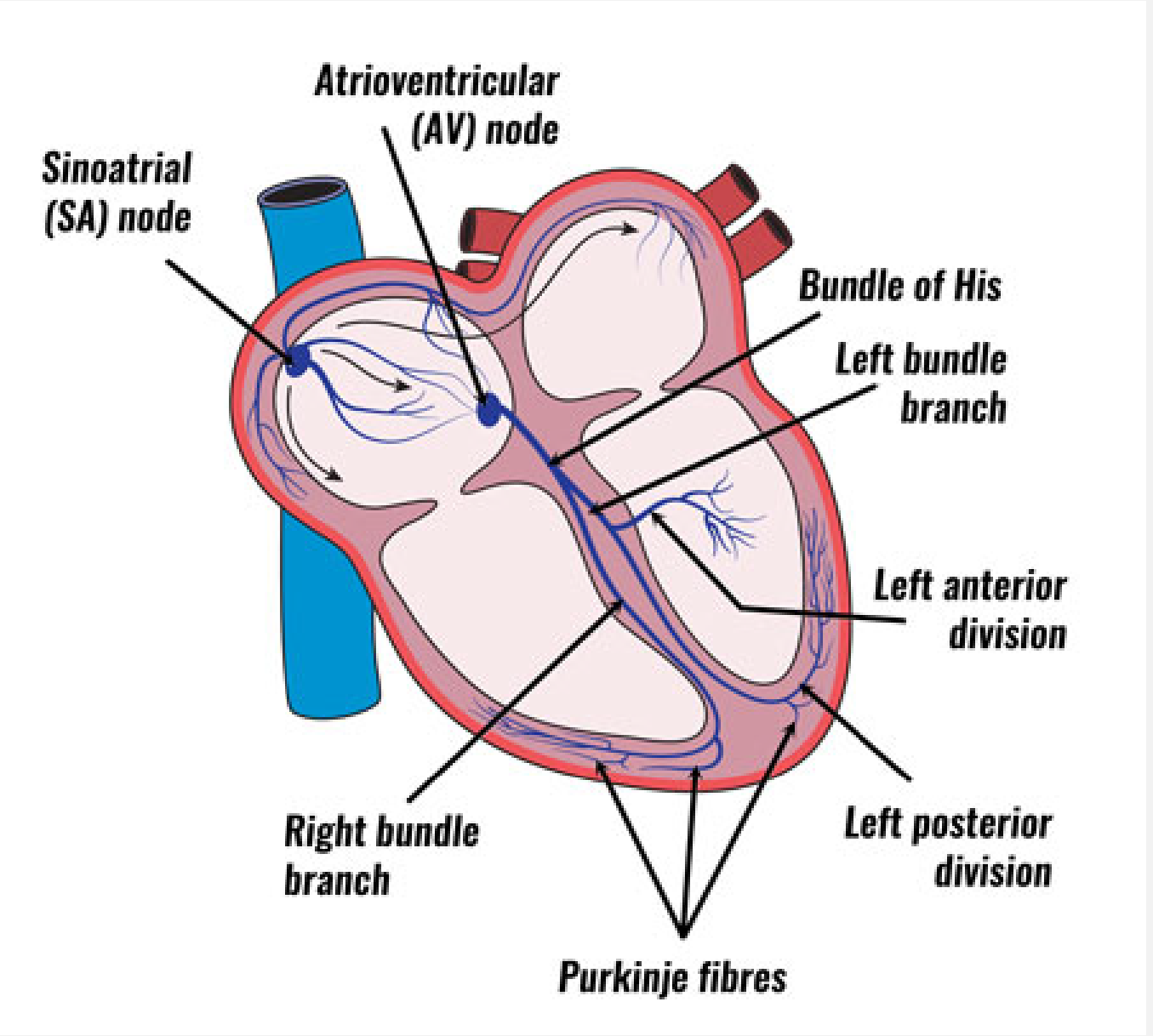
CARDIAC ELECTRICAL IMPULSE PROPAGATION, PHASES OF CONTRACTION

- Sinoatrial (SA) node – right atria and left atria contract
- Atrioventricular (AV) node, bundle of His (Atrioventricular Junction)
- Left and right bundle branches
- Left and right Purkinje fibers – right ventricle and left ventricle contract

***SA node is the normal pacemaker of the heart**

CARDIAC CONDUCTION SYSTEM

- SA Node
- AV Node
- Bundle of His
- Bundle Branches
- Purkinje Fibers



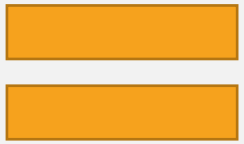
CARDIAC CONDUCTION SYSTEM

- Resting cardiac cell is polarized (charge gradient)
- Sinoatrial (SA) – depolarizes atria (outside becomes negative, inside positive)
- Atrioventricular (AV) node, bundle of His (Atrioventricular Junction)
- Left and right bundle branches
- Left and right Purkinje fibers – depolarizes ventricles (outside becomes negative, inside positive)
- Repolarization (outside positive, inside negative) to return to resting membrane potential

***SA node is the normal pacemaker of the heart**

5 BASIC ECG WAVEFORMS

- P wave – represents atrial depolarization (deflection preceding QRS complex)
- QRS complex (contains Q wave, R wave, and S wave) – represents ventricular depolarization
- ST segment
- T wave
- U wave



ventricular repolarization

*where is atrial repolarization?

ECG WAVES

P wave – deflection preceding QRS complex

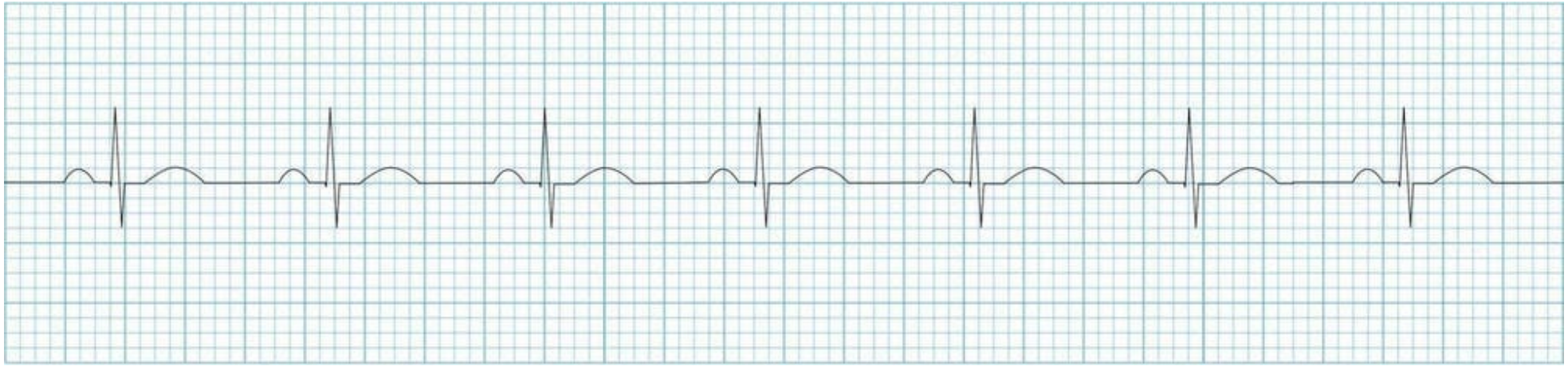
Q wave – first negative deflection after p wave

R wave – first positive deflection after p wave

S wave – first negative deflection after r wave

T wave – first deflection after QRS complex

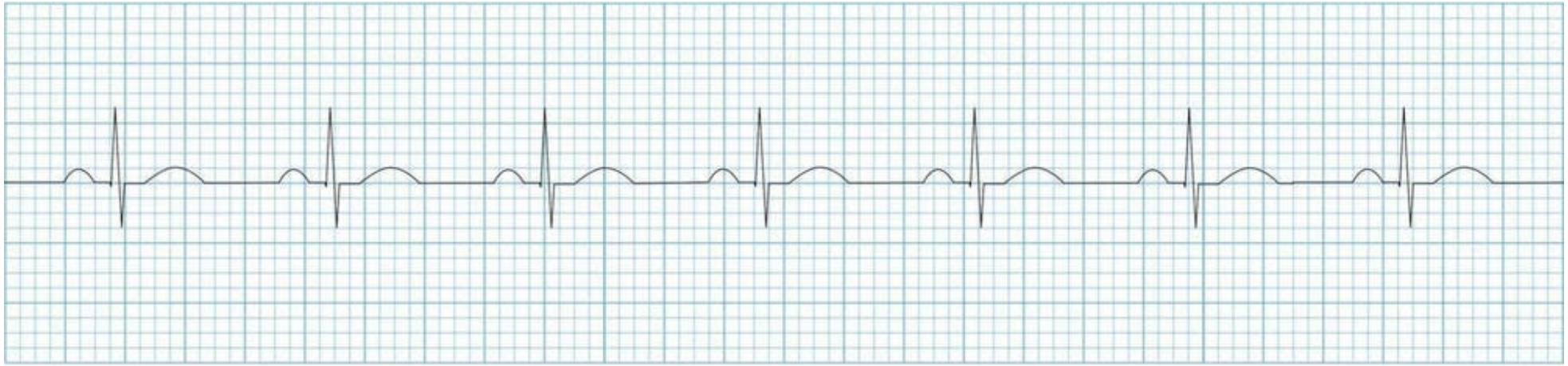
U wave – deflection immediately following t wave (variable)



INTERVALS/SEGMENTS

- Intervals – include the waveform
  - PR interval – beginning of p wave to the beginning of QRS complex
  - QRS interval – beginning to end of QRS
  - QT interval – beginning of QRS to end of the t wave
  - RR interval – r wave to next r wave (typically same as p-p interval)
- Segments – do not include the waveform
  - PR segment – end of p wave to beginning of QRS complex
  - ST segment – end of QRS complex to beginning of the t wave
  - TP segment – end of the t wave to beginning of the p wave

*see figure 2.3 on page 8 of your textbook



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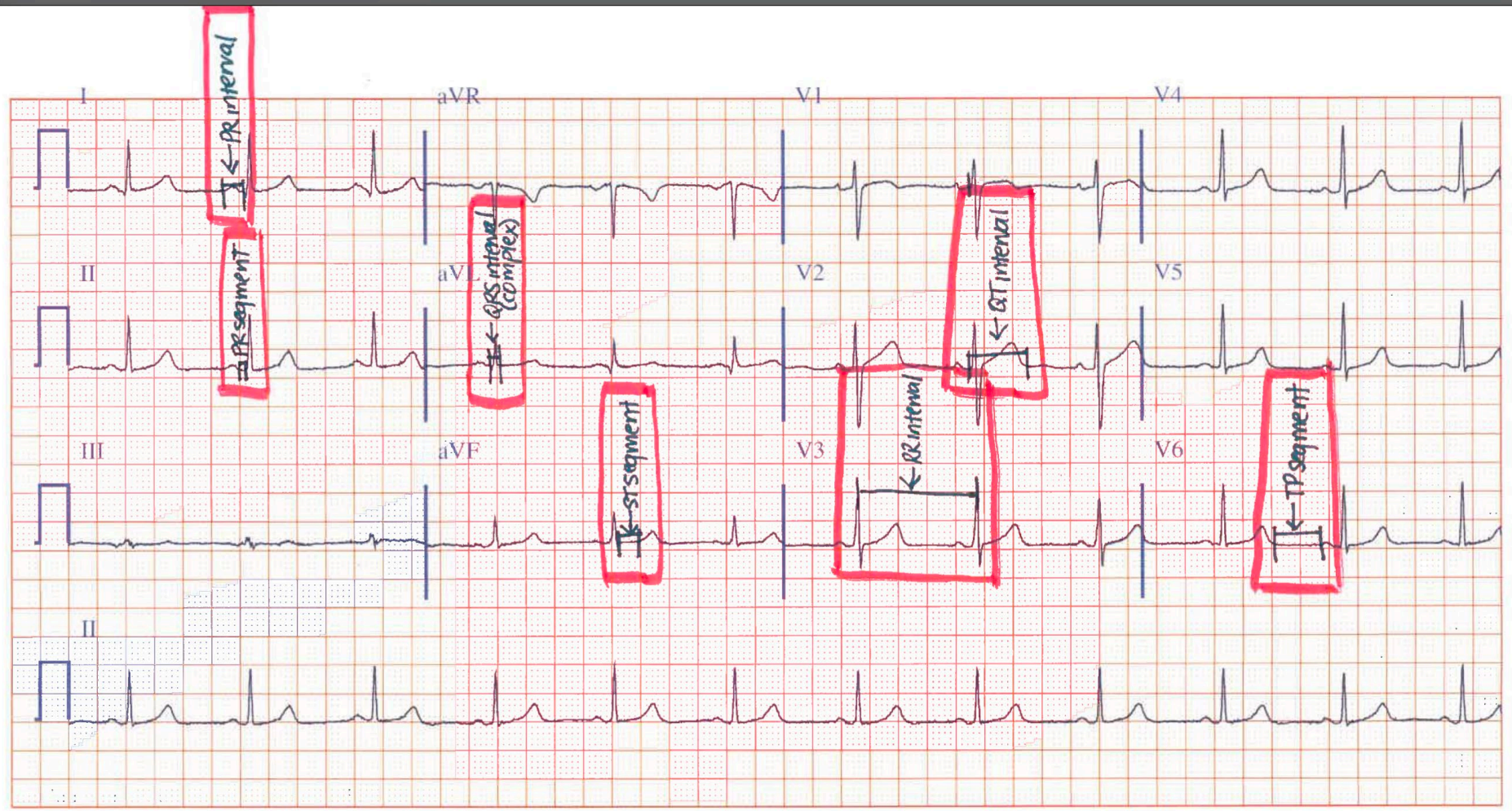
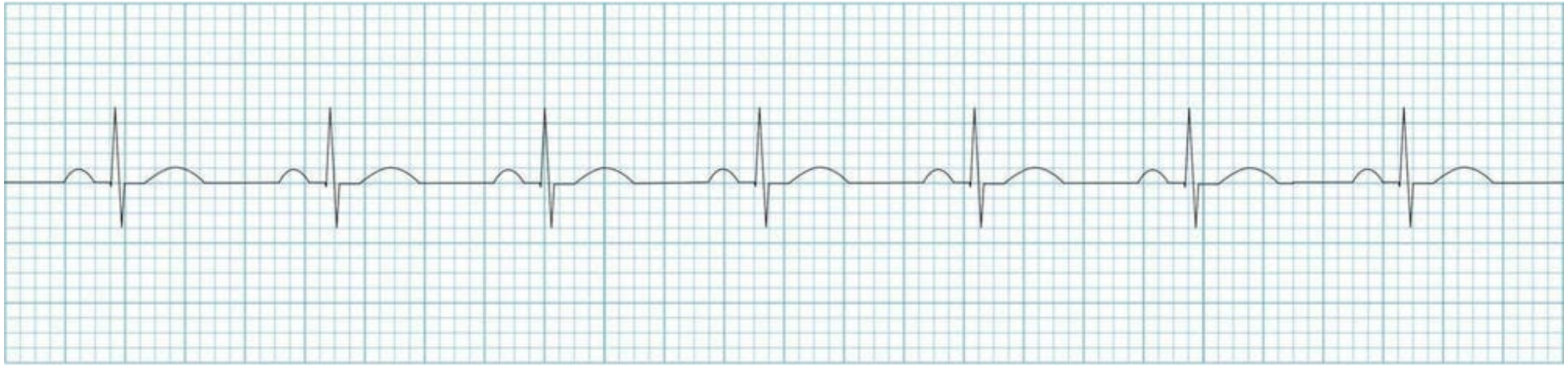


ECG Wave-Maven / Beth Israel Deaconess Medical Center

25 mm/sec, 10 mm/mV

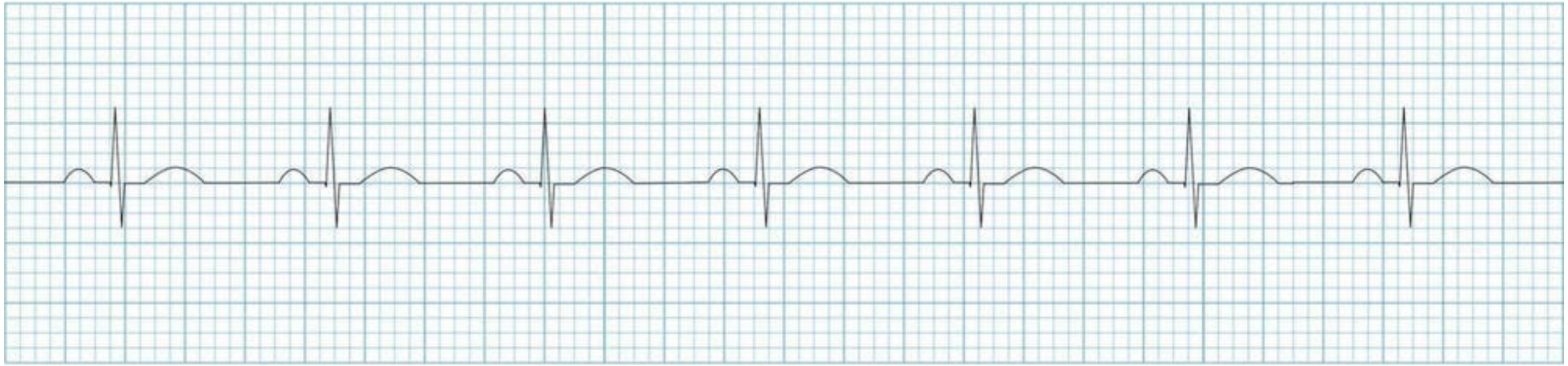
ECG WAVEFORM MEASUREMENTS

- P wave – <2.5 mm, <0.12 sec
- PR interval - 0.12 - 0.2 seconds
- QRS complex - <0.10 sec
- ST segment – normally isoelectric (J point)
- T wave – normally asymmetrical
- QT interval (corrected QTc) – normal depends on heart rate, calculate corrected, normal is <0.44 seconds
- U wave – presence is variable



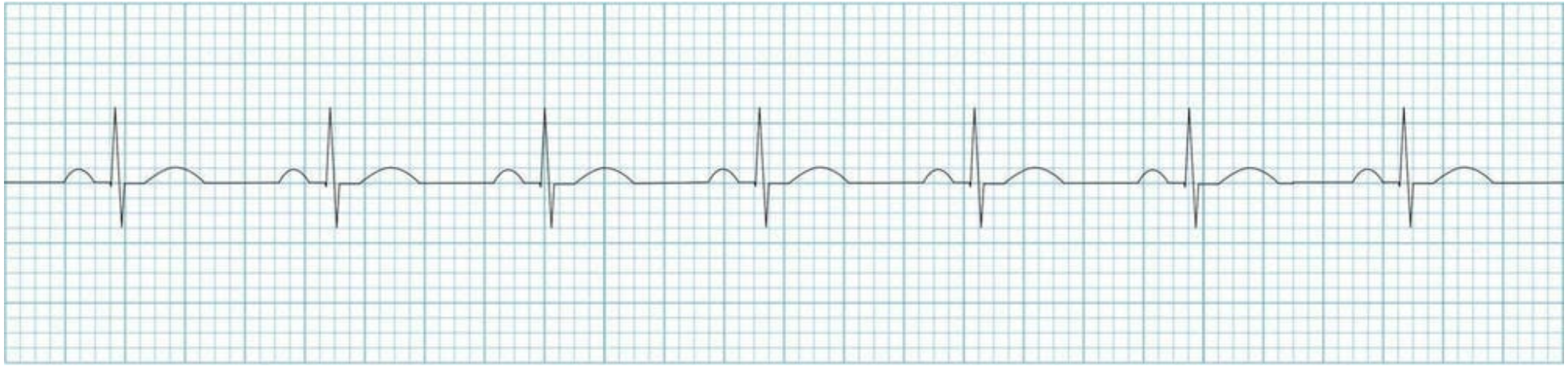
RATE

- Inherent pacemakers
  - SA Node – 60-100 bpm
  - AV junction – 40-60 bpm
  - Bundle of His or Purkinje Fibers – 20-40 bpm
- Calculating heart rate
  - Box method (regular) – count large boxes in between QRS complexes, then divide into 300
  - QRS counting (irregular) – count QRS complexes in 10 second strip and multiply by 6
- Terms
  - Tachycardia – over 100 bpm
  - Bradycardia – less than 60 bpm



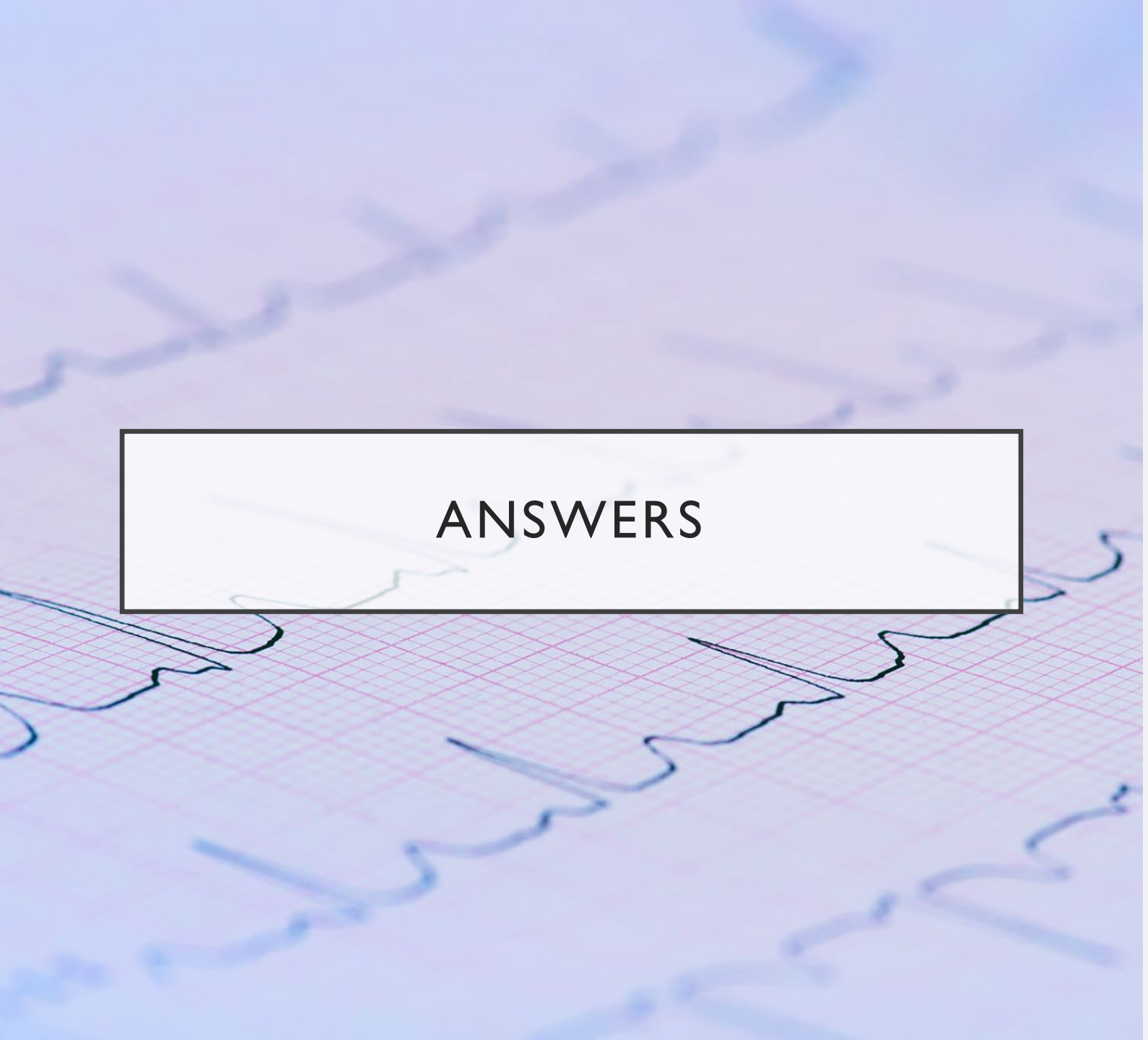
ORIGIN OF RHYTHM

LOOK FOR THE P wave!



REPORT

- Heart rate – atrial and ventricular the same?
- Heart rhythm
- Waveforms
  - P wave (width, amplitude, shape)
  - QRS complex (width)
  - T wave (shape)
  - U wave (if present)
- Intervals
  - PR interval (width)
  - QT interval (width)
  - RR interval (width)
- Segments
  - PR segment (width)
  - ST segment (isoelectric)
  - TP segment (width)



ANSWERS

- Heart rate – ~70 bpm
- Heart rhythm - sinus
- Waveforms
  - P wave (width, amplitude, shape) – 0.08 sec, 1 mm, round
  - QRS complex (width) – 006 sec
  - T wave (shape) – round
  - U wave (if present) – not present
- Intervals
  - PR interval (width) – 0.18 sec
  - QT interval (width) – 0.32 sec
  - RR interval (width) – 0.68 sec
- Segments
  - PR segment (width) – 0.04 sec
  - ST segment (isoelectric) – yes
  - TP segment (width) – 0.24 sec

QUESTIONS