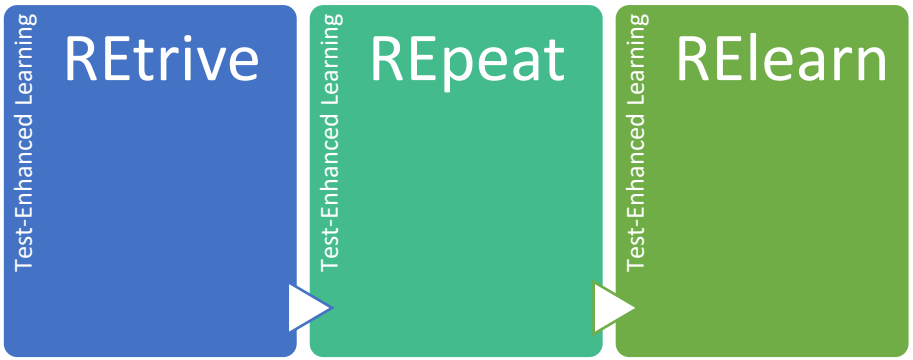
Test-Enhanced Learning based

ECG practice E-book



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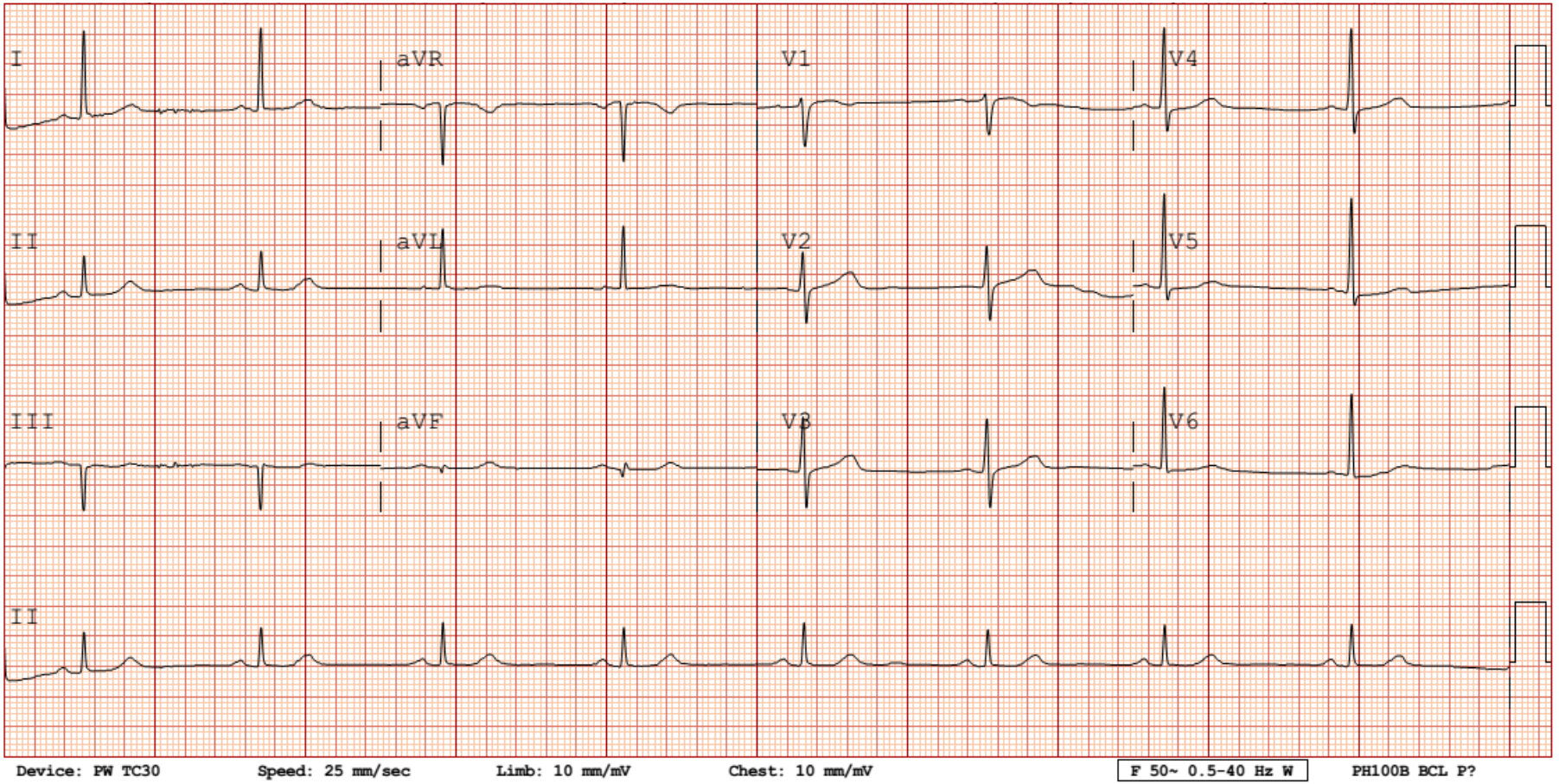
GENERAL INTRUCTION

1. Describe the electrocardiogram (For the first time user, it is better if you go in order)
2. Pick all findings
3. Commit to the answer before reading the answer
4. Repeat

Abbreviation

AF	Atrial fibrillation
ECG	Electrocardiogram (EKG)
HR	Heart rate
ICD	Implantable Cardioverter Defibrillator
LA	Left atrium
LAE	Left atrial enlargement
LAFB	Left anterior fascicular block
LBBB	Left bundle branch block
LPFB	Left posterior fascicular block
LV	Left ventricle
LVH	Left ventricular hypertrophy
MR	Mitral valve regurgitation
MS	Mitral stenosis
msec	Millisecond(s)
NSTEMI-ACS	Non ST Segment Elevation Myocardial Infarction – Acute Coronary Syndrome
PAC	Premature atrial contraction
PSVT	Paroxysmal supraventricular tachycardia
PVC	Premature ventricular contraction
QTc	Corrected QT
RA	Right atrium
RAE	Right atrial enlargement
RBBB	Right bundle branch block
RV	Right ventricle
RVH	Right ventricular hypertrophy
STEMI-ACS	ST Segment Elevation Myocardial Infarction – Acute Coronary Syndrome
SVT	Supraventricular tachycardia
U/D	underlying disease
VT	Ventricular tachycardia
VF	Ventricular fibrillation
WPW	Wolff-Parkinson-White syndrome

ECG # 1: A 56-year-old man with dizziness



ECG # 1: A 56-year-old man with dizziness

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

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Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

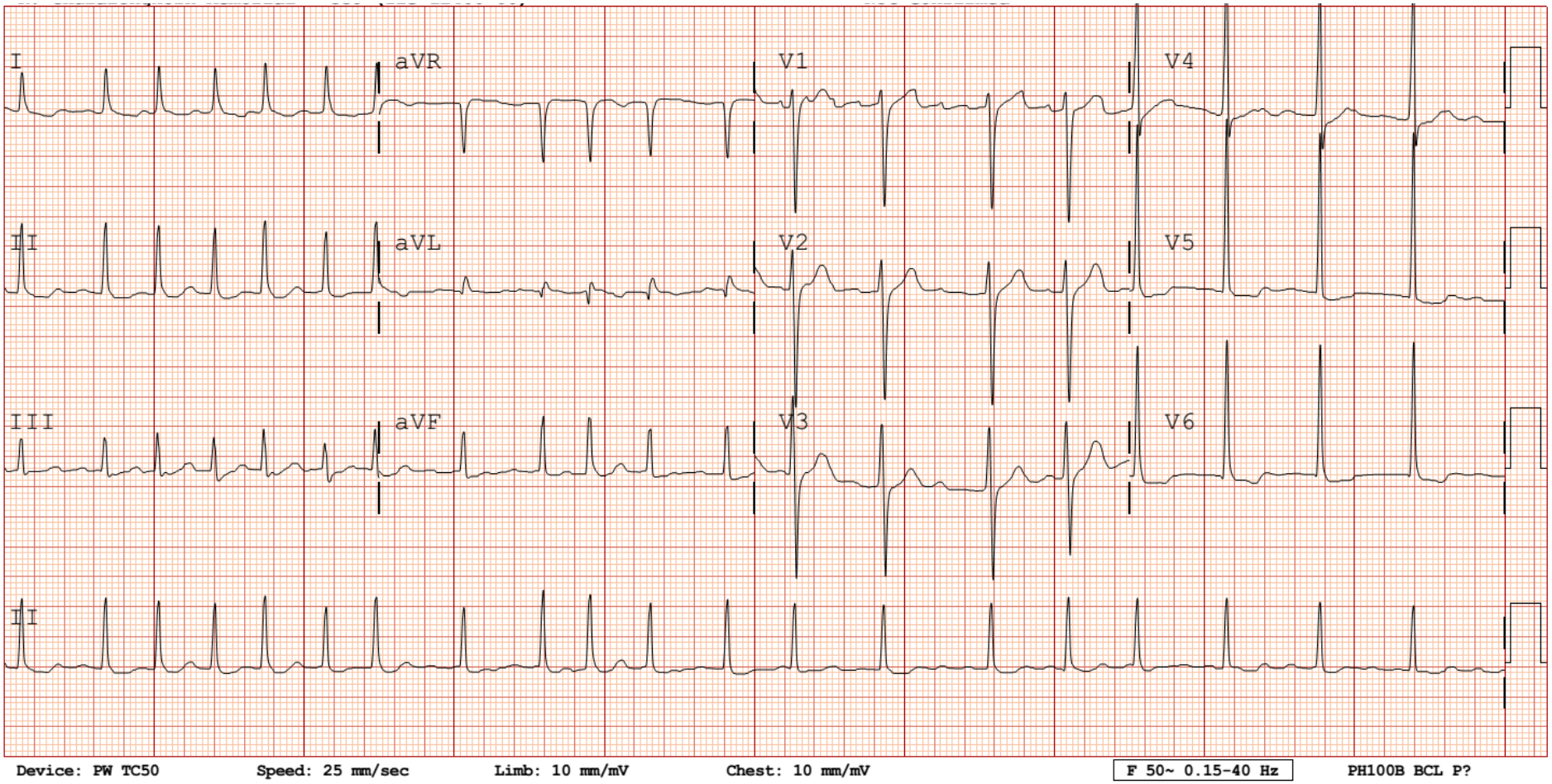
ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 1: A 56-year-old man with dizziness

Selected Findings	Description
Bradycardia	When we talk about "the rate" what do we really mean is the ventricular rate. On this ECG, the QRS complex which represents the ventricular depolarization happens every 6 big boxes. Most people would call this RR interval. Since this ECG is running (printing) at a normal speed or calibration (25mm/second), one can calculate the heart rate by Heart Rate = $\frac{300}{\text{big box}} = \frac{300}{6}$ = 50 bpm This can be calculated using RR interval in msec as well. To change from big box to millisecond (msec), you can do it easily by thinking – This ECG is running at 25 mm/second and 25 mm is 5 big box so 1 big box is =____ second (Ans: 0.2 second) which is 200 msec. Since the heart rate is how often the heart beat in 1 minute (1 minute = 60 seconds → 6,000 msec), The heart rate can be calculated by Heart Rate = $\frac{6000}{\text{msec}} = \frac{6000}{120}$ = 50 bpm
Regular Sinus rhythm	This is the sinus rhythm because the P wave are regular and has the same "normal looking" P wave (positive in I and II). Because the rate was < 60. This ECG rhythm is sinus bradycardia
Normal axis	The axis is normal because the QRSs in limb leads are positive in I and II. This ECG shows axis of 0°. How do we know this? If you inspect closely in lead aVF, the QRS complex was bi-phasic. It means the axis of the heart is 90 degree to aVF vector – either 0° or 180°. Because we see the positive QRS in I, II, aVL, the axis of this ECG has to be 0° not 180°.

Note: The patient may have light headedness from bradycardia. More detailed history taking is very important.

ECG # 2: A 72-year-old woman with hypertension



ECG # 2: A 72-year-old woman with hypertension

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 2: A 72-year-old woman with hypertension

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☒ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☒ Totally irregular ☐ Junctional rhythm ☒ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☒ Other **No P wave**
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☒ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in **V4-V6**	☐	☐	☒	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

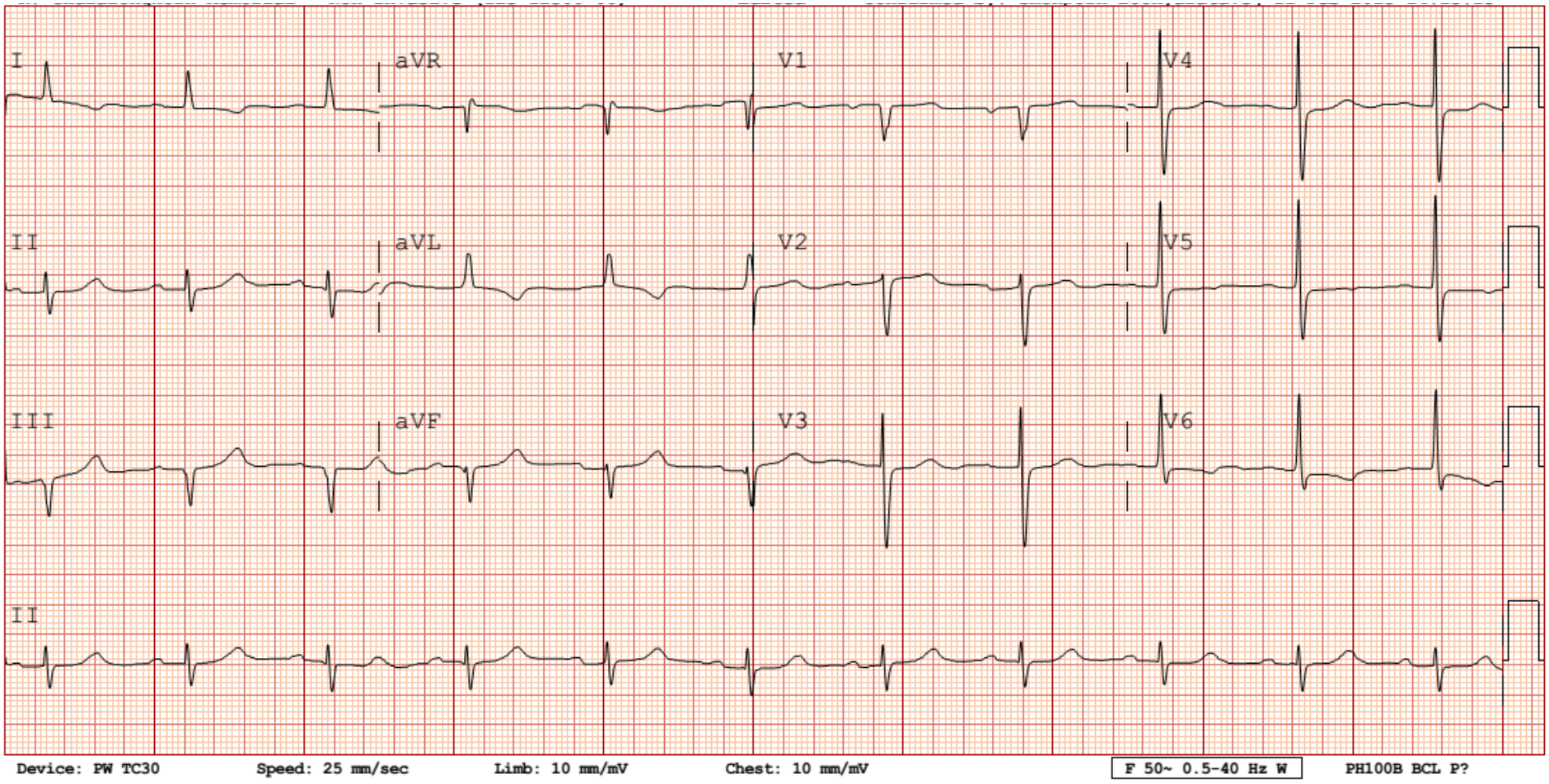
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☒ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 2: A 72-year-old woman with hypertension

Selected Findings	Description
Tachycardia	When the rhythm is not regular or the RR interval is not constant, we can calculate the HR by understanding that 1 page of ECG is _____ seconds. GO AHEAD AND COUNT!!! 5 big boxes are 1 second. How many seconds are there on 1 single ECG? Ans: 10 seconds. So if you multiply the number of QRS complex on 1 page of ECG with 6, you will get the HR. On this ECG, there are 20 QRS complexes **Heart Rate = QRS complex x 6 = 20 x 6 = 120 bpm** The HR was 120 bpm.
Totally irregular Atrial Fibrillation	This ECG consistent with atrial fibrillation because there is no identifiable P wave and the rhythm is irregular. In atrial fibrillation, there is no organized atrial contraction so there is no P wave. Some of those signals pass thru AV node and conduct the QRS. This is the reason for irregularity.
Normal axis	The axis is normal because the QRS is positive in I and II.
LVH	The QRS complex meet one of the criteria for left ventricular hypertrophy **Sokolow+ Lyon criteria for LVH = S in V1 + R V5 or V6 > 35 mm** The ventricle is thicker or bigger, the mass increases. This show up on ECG as and increasing in amplitude of the ECG on that vector. For LVH the bigger the LV is, the higher the R wave in lead V6 (the LV is pointing toward V6) and deeper S in lead V1 (V1 is pointing away from LV).
ST depression in V4-V6 ST changes due to hyperthropy	When there is a LVH or RVH, the ST segment usually shows "strain" pattern (ST depression, sometime with inverted T wave) which is showed nicely in lead V4-V6 on this ECG. This is sometimes difficult to differentiate from myocardial ischemia by ECG only. The clinical correlation (history and physical exam) is needed.

Note: The ventricular rate of atrial fibrillation can be fast or slow. Since the rate of this ECG is 120 bpm, we may call this atrial fibrillation with rapid ventricular response.

ECG # 3: A 71-year-old asymptomatic woman



ECG # 3: A 71-year-old asymptomatic woman

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

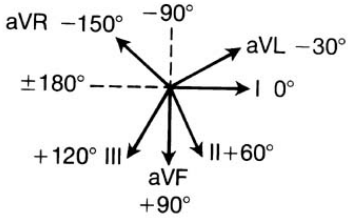
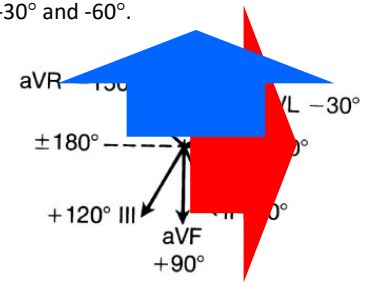
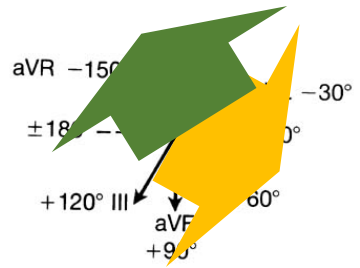
ECG # 3: A 71-year-old asymptomatic woman

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☒ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☒ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in III	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

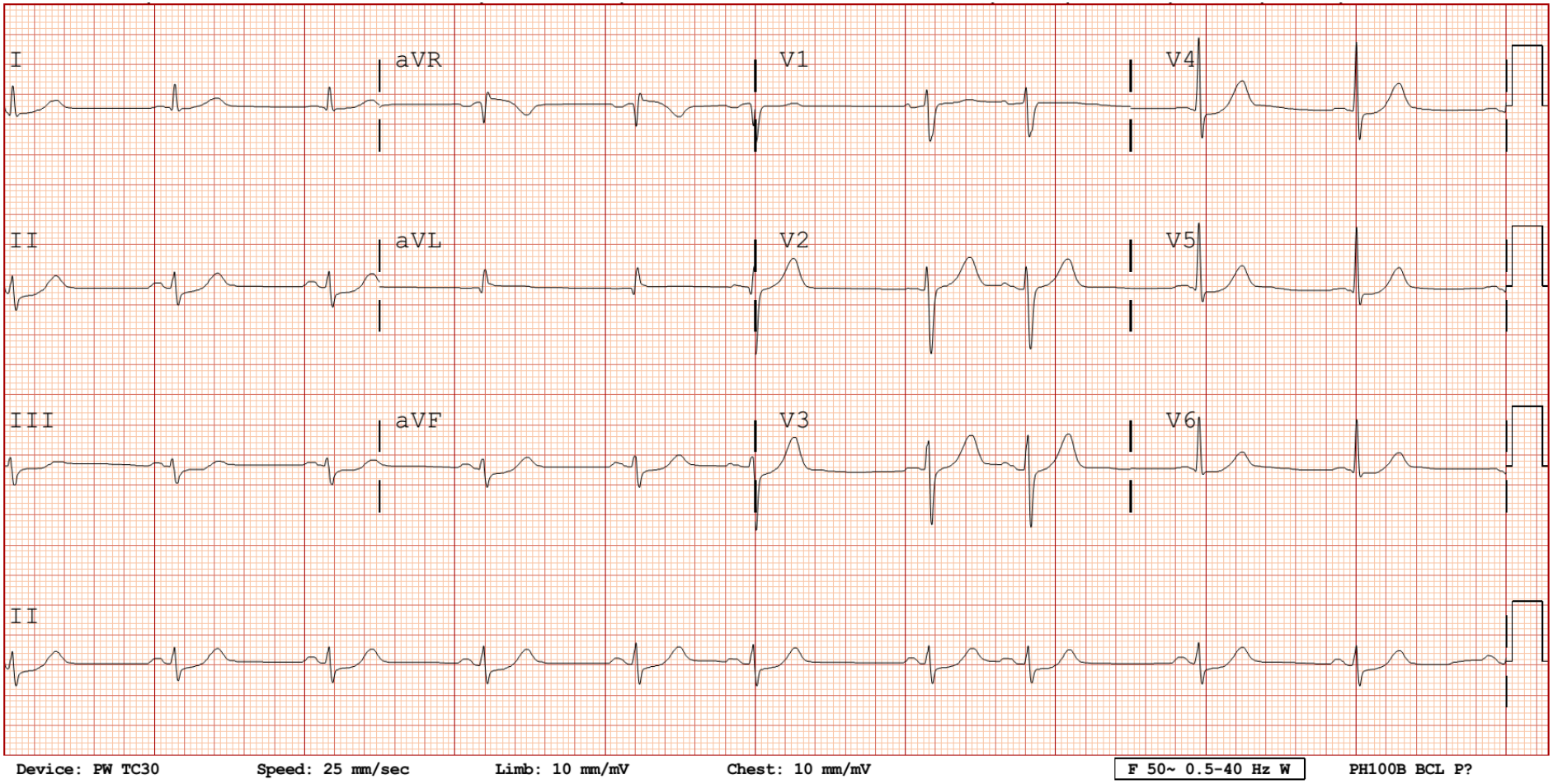
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☒ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☒ Inverted T aVL, V6	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 3: A 71-year-old asymptomatic woman

Selected Findings	Description
Normal rate	The heart rate is around 60-75 bpm because the RR interval is between 4 and 5 big boxes. If you would like to know exactly, look closely. The RR interval is 4 big boxes and 3 small boxes. You can calucate by calculate the heart rate by Heart Rate = $\frac{300}{\text{big box}} = \frac{300}{4.6}$ = 65 bpm But it is not necessary. Clinically, it is not that different between 60, 65, or 70 bpm.
Left axis deviation	To determine axis, we look at limb leads. Normal axis is between ____ to ____ degree (Ans: 90° to -30°) and shows on ECG as a positive QRS in I and II. On this ECG, the QRS in lead II is slightly negative to bi-phasic. You need 2 things to determine the axis of the EXG 1. Know that the vector toward that lead will be positive. 2. You have to be able to draw a circle and all the limb leads. Looking at the lead one by one to determine the axis. You can start with any limb leads but for now, let's try lead I first. **QRS is positive in I so the axis must point toward lead I (red in figure).** Thinking as if you are eating a pizza. Then let's use lead aVF**. QRS is negative in aVF so the axis must point away from aVF (blue)**. Now we know the axis has to be between 0° and -90° or Left upper quadrant. Adding more of the same by using other leads such as **negative in aVR (yellow**). Now we know the axis is between 0 to -60°). Then adding **negative in II (green)**. Finally, we come to the conclusion that the axis is between -30° and -60°.   
First degree AV block	The PR duration is longer than 1 big boxes (200 msec), this is the criteria for 1st degree AV block. You can see clearly in lead II. The PR segment is a time from P wave (atrial depolarization) to the beginning of QRS complex (ventricular depolarization) which tell us how fast or slow the AV node is working. Normally PR duration is 3-5 small boxes. When PR is prolong but all the P wave still conduct (follow by) a QRS, this is called first degree AV block.
Q in III Non-specific ST changes Inverted T wave in aVL, V6	These slightly changes are not recognized as any ischemic changes or other significant diseases. These "pattern" are not typical or not showing up on many leads in the same wall.

Note: 1st degree AV block is common in elderly and does not need any specific treatment unless there is symptom.

ECG # 4: A 74-year-old woman with the feeling of extra heart beats



ECG # 4: A 74-year-old woman with the feeling of extra heart beats

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

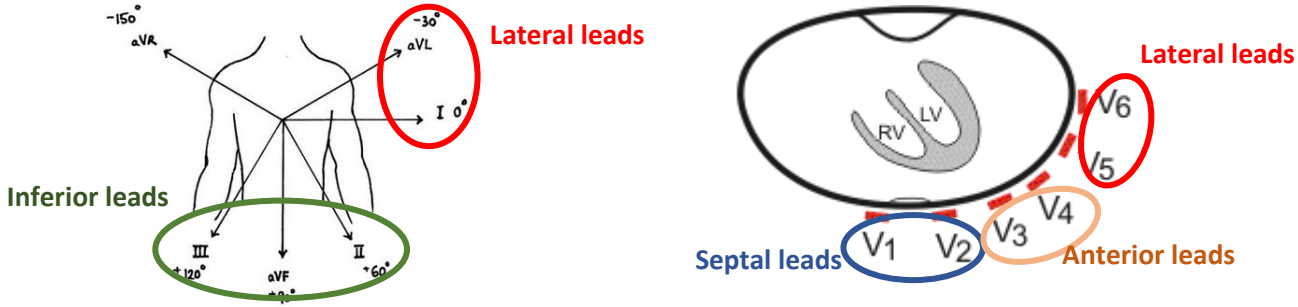
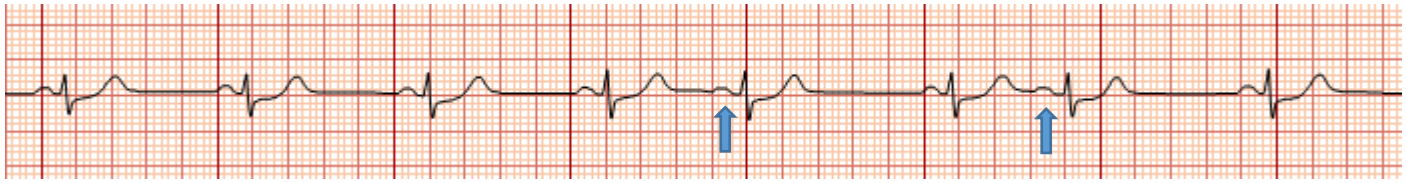
ECG # 4: A 74-year-old woman with the feeling of extra heart beats

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ● Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☒ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in II, III, aVF, V4-V6	☐	☐	☒	☒	☐
ST elevation in _____	☐	☐	☐	☐	☐

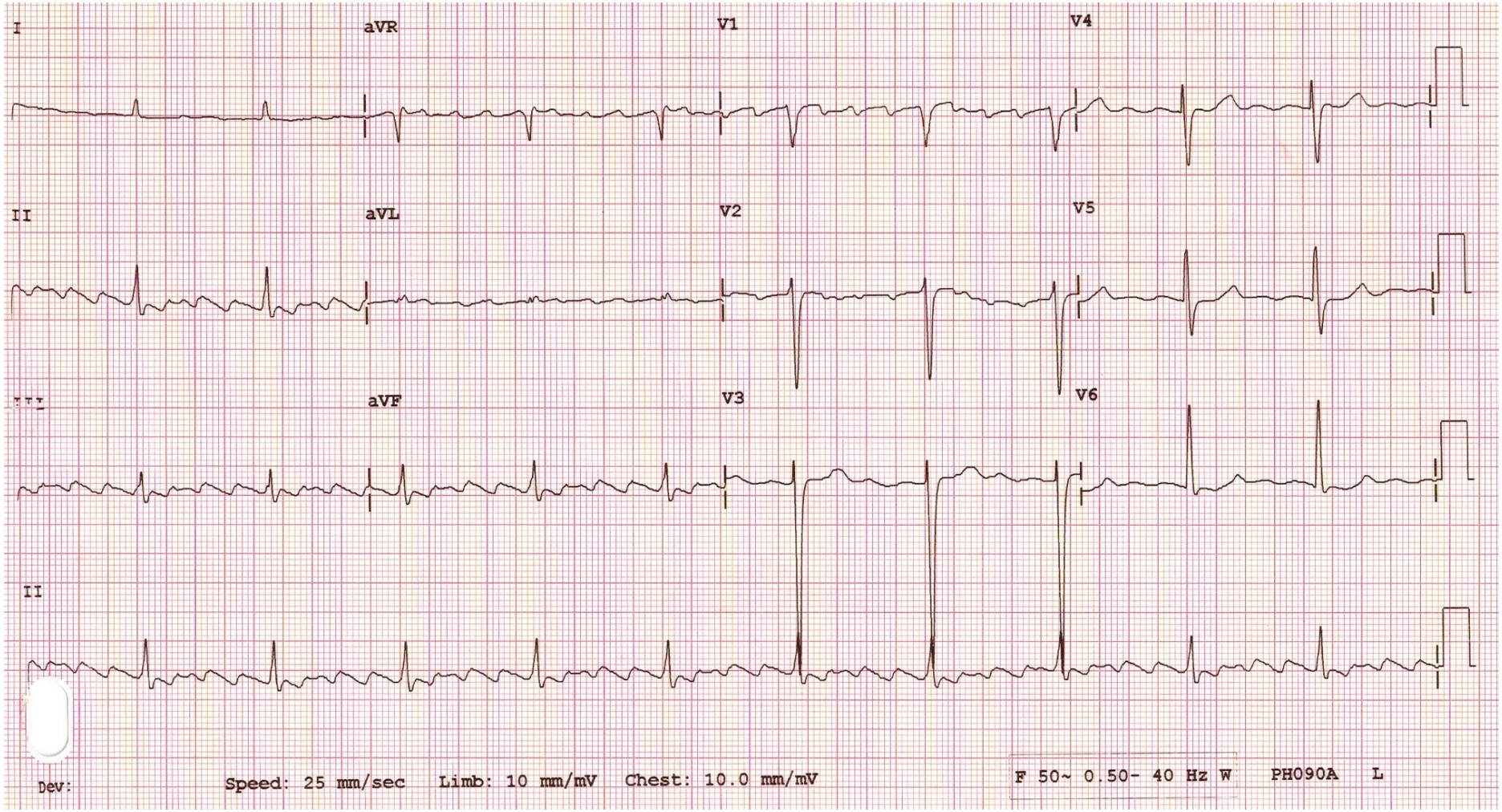
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ● Other Possible MI	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☒ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 4: A 74-year-old woman with the feeling of extra heart beats

Selected Findings	Description
Rate: Normal Bradycardia is also acceptable	The ventricular rate is around 60 bpm. Even though there are extra beats in the middle of the ECG, overall the RR interval is roughly about 5 big boxes. So the HR is = 300 / big box = 300 / 5 = 60 bpm Or multiply the number of QRS complex on 1 page of ECG with HR = QRS complex x 6 = 10 x 6 = 60 bpm. The same !
Regular Sinus rhythm	This is the sinus rhythm because (most of the) P waves are regular and has the same "normal looking" P wave (positive in I and II). Do not worry about the extra P wave for now (see below).
Left axis	The axis is normal when QRSs in lead I and II are positive. On this ECG, the QRS in lead II is not positive. It is slightly negative to bi-phasic. You can do the same exercise by looking at each limb leads and cutting "half of the pizza". To know the axis**, if there is a limb lead that has biphasic QRS, the axis is 90° to that lead.** On this ECG, QRS in lead II is the most biphasic, so the axis is either – 30° or 150°. It is -30° because of supporting evidence of positive QRS in I, aVL.
ST depression in lateral and inferior wall Possible MI	Let's review which leads define which cardiac wall. Think of this as we think about how 12-lead ECG aligns. 
PAC	PAC – Premature atrial complex is an extra beat from foci in atrium which fires a signal "too early", hence the work premature. On ECG, there are **slightly different looking P waves that come prematurely** (sometime this too early P wave is very small and not seen). Then the signals conduct via the same path thru AV node to the ventricle s**o they generate the QRS complexs which look like other beats.** 

Note: ST depression which is horizontal and shows up in the same wall is concerning for possible ischemic process.

ECG # 5: A 42-year-old man with sudden onset palpitation



ECG # 5: A 42-year-old man with sudden onset palpitation

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

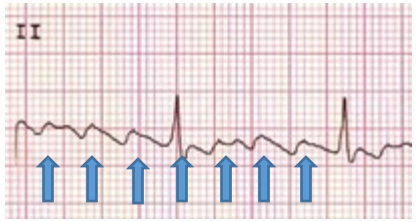
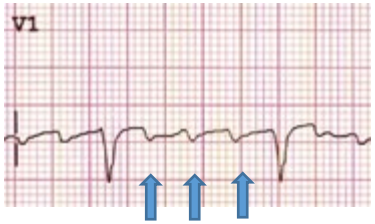
ECG # 5: A 42-year-old man with sudden onset palpitation

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☒ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☒ Other **Saw-tooth wave, P wave = 300 bpm**
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

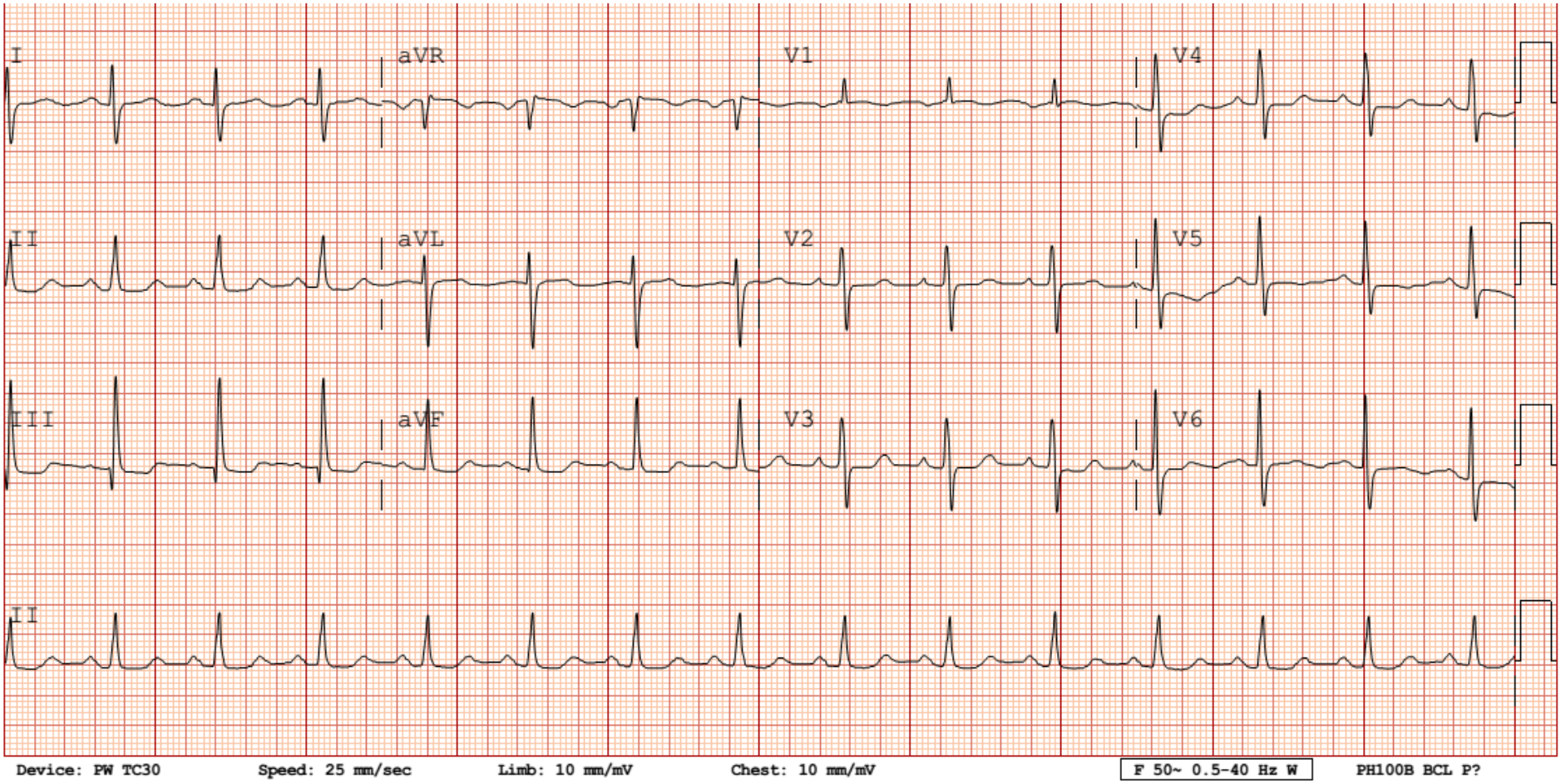
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☒ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 5: A 42-year-old man with sudden onset palpitation

Selected Findings	Description
Normal rate	The ventricular rate is 60-75 bpm, about 70 bpm.
Regular Atrial Flutter	There is no "regular and normal looking P wave" on This ECG so this is not a sinus rhythm. Instead, there are a very fast P wave (easily seen in lead II and V1. It happens every 1 big box so the atrial rate is 300 bpm). This make the **baseline of the ECG look like a saw-tooth.** These are characteristics of atrial flutter. The QRS is usually regular in atrial flutter but not always.  
Non specific ST changes.	The ST segments are flat and there are no T wave in all limb leads (diffuse flattening of T waves). There is no clinical significant of this finding. It is not specific to any diseases so we describe it as non-specific ST changes.

Note: In atrial fibrillation, the QRS complex is totally irregular and there is no identifiable P wave. In atrial flutter, The QRS is usually regular (not always) and there is a saw-tooth baseline.

ECG # 6: A 54-year-old woman with dyspnea



ECG # 6: A 54-year-old woman with dyspnea

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 6: A 54-year-old woman with dyspnea

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☒ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☒ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in III	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

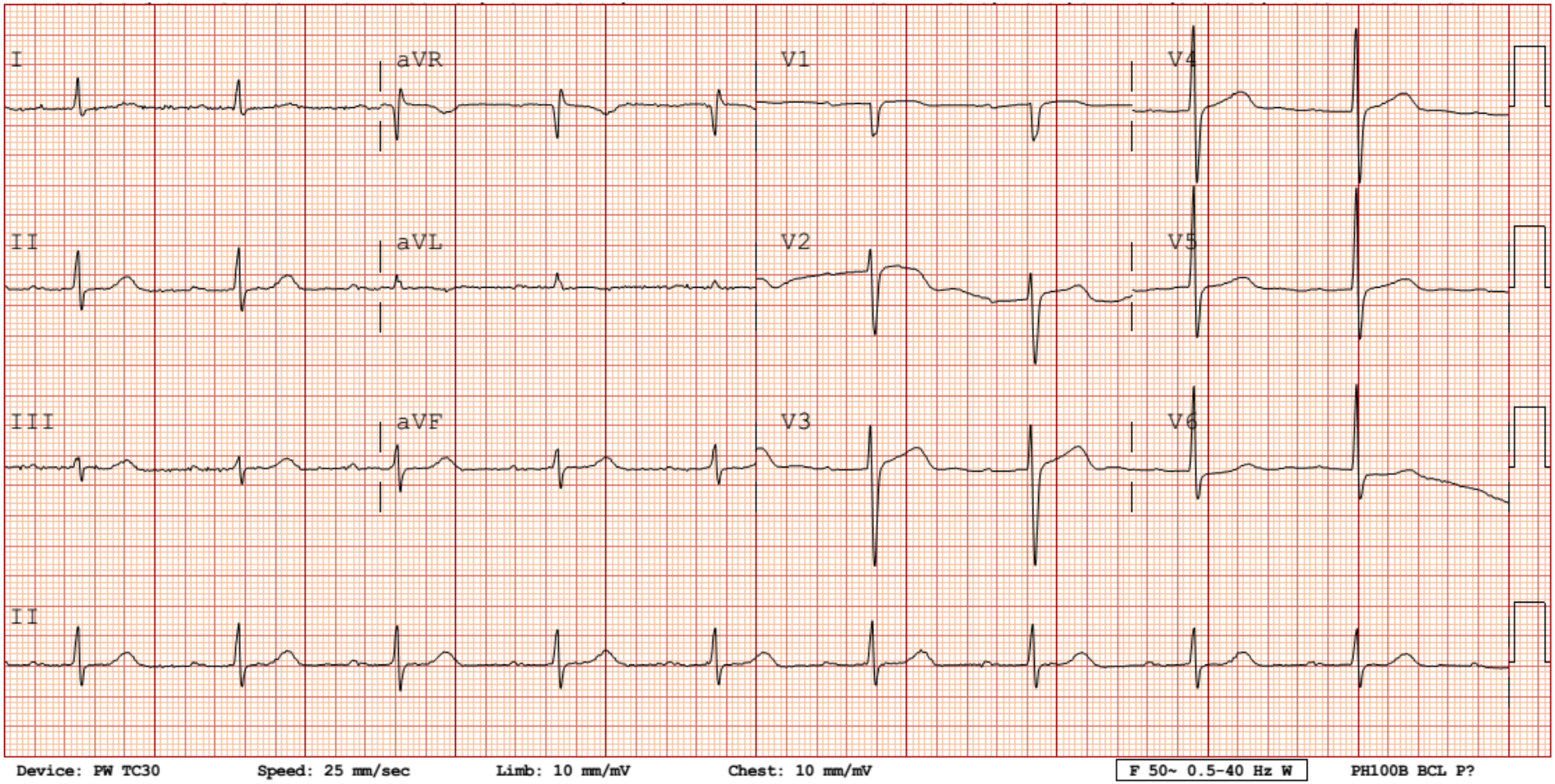
ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 6: A 54-year-old woman with dyspnea

Selected Findings	Description
Right Axis deviation	Seeing negative QRS in lead I and positive QRS in aVF means that the axis is in left lower quadrant (-90° to -180°)
RVH	The R in V1 is prominent which is not a typical pattern of WRS in lead V1. Normally, In lead V1, we usually see a small R follow by deep S wave. As one can imagine, As right ventricle become hypertrophy and has more mass, the axis of the heart would point to V1 since the right ventricle is position to the front side of the chest wall where lead V1 is).
Normal P wave	P wave on this ECG is slightly pointed but do not meet the criteria for RAE.
Q in III	A narrow Q in lead III does not have any clinical significant and do not mean ischemia. This finding is common in patient with RV abnormalities.

Note: RVH in this patient may be secondary from pulmonary hypertension of chronic lungs disease.

ECG # 7: A 72-year-old asymptomatic man



ECG # 7: A 72-year-old asymptomatic man

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

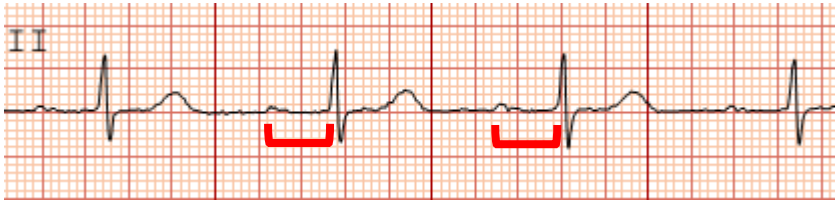
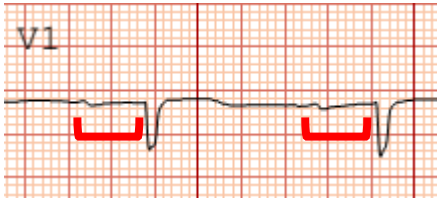
ECG # 7: A 72-year-old asymptomatic man

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☒ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☒ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

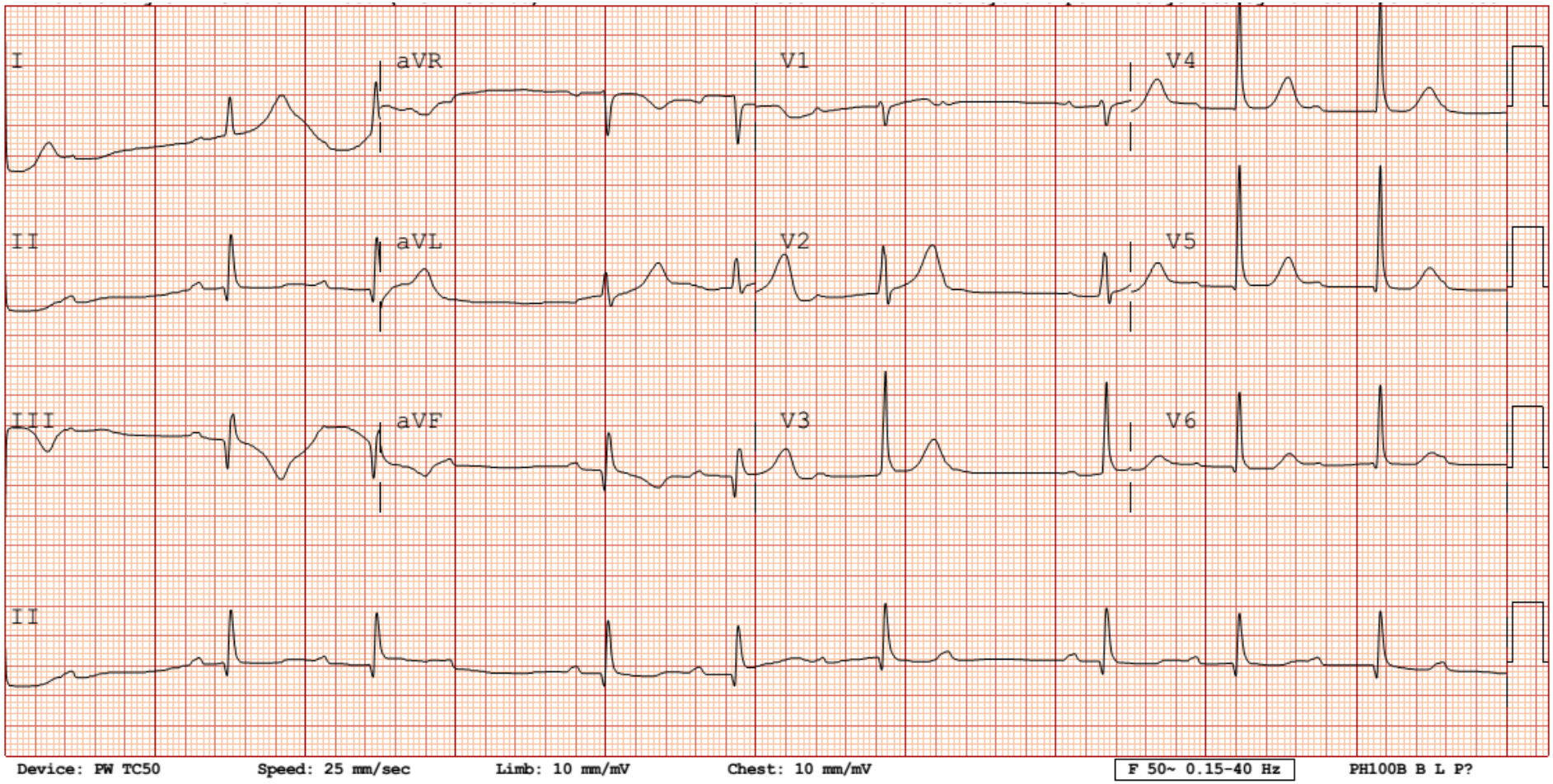
ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 7: A 72-year-old asymptomatic man

Selected Findings	Description
Bradycardia	The HR is 54 bpm.
Regular Sinus rhythm	This is the sinus rhythm because the P wave are regular and has the same "normal looking" P wave (positive in I and II). Because the rate was < 60. This ECG rhythm is sinus bradycardia
Normal axis	The axis is normal because the QRSs in limb leads are positive in I and II.
1st degree AV block	The PR duration is 1 big box and 3 small boxes (320 msec). This is 1st degree AV block since **the PR is prolong (more than 1 big box) and every P wave still follow by QRS.**  

Note: When look for P wave look in lead II and V1. So these 2 leads are good for measuring PR interval

ECG # 8: A 66-year-old man with 7-dayhistory of chest pain



ECG # 8: A 66-year-old man with 7-dayhistory of chest pain

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

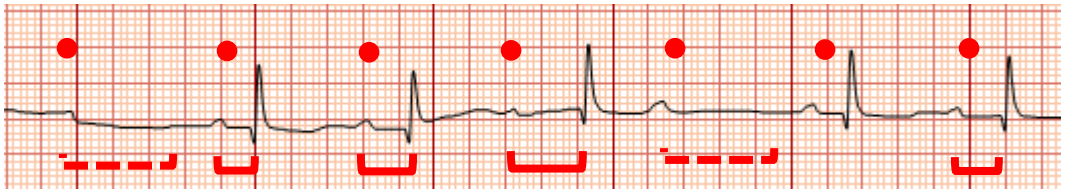
ECG # 8: A 66-year-old man with 7-dayhistory of chest pain

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☒ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ● Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☒ Other __Group beating__	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☒ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in **II III aVF**	☐	☐	☐	☒	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

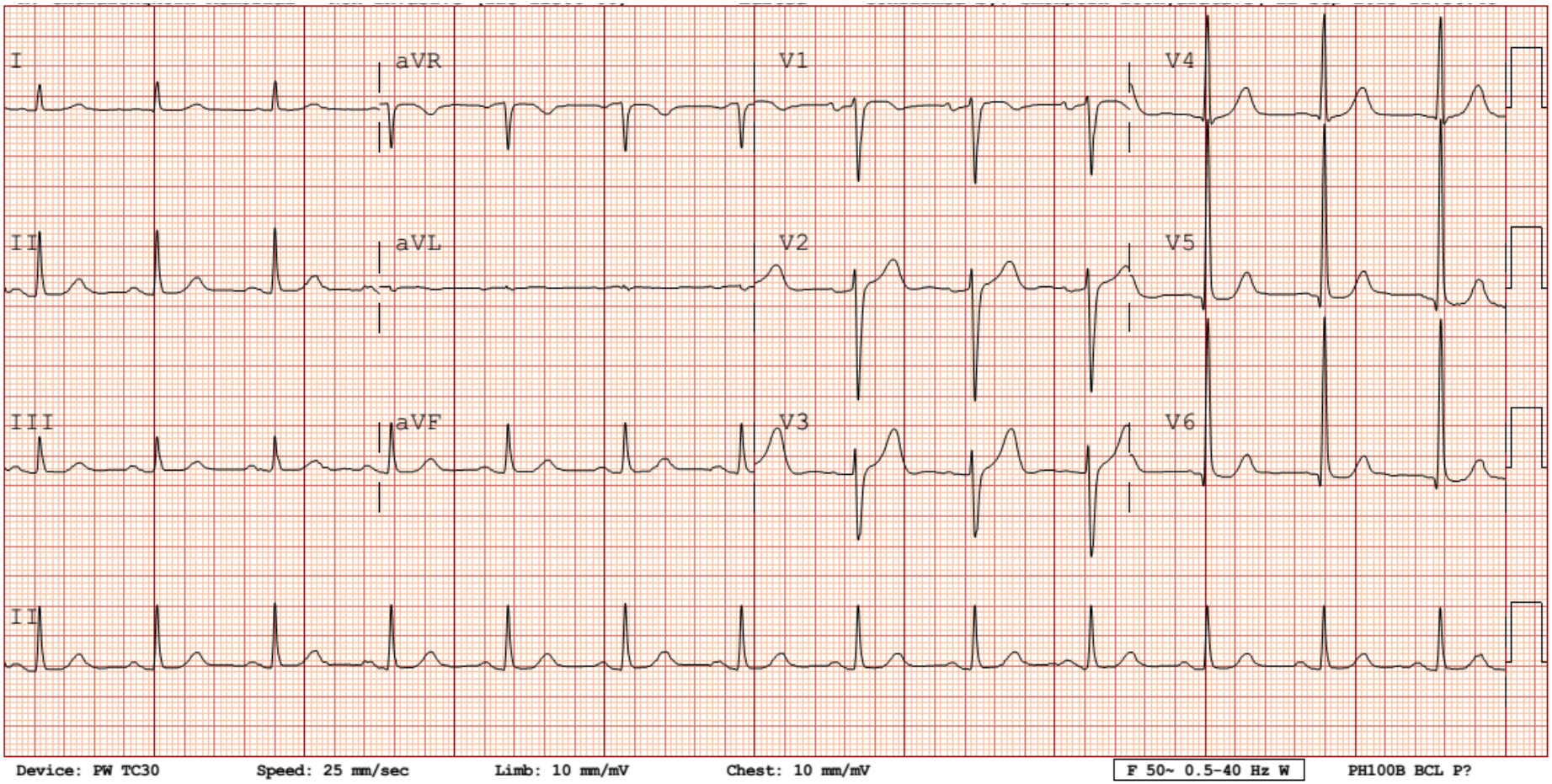
ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☒ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☒ Remote MI (Old MI)	☐ Pericarditis

ECG # 8: A 66-year-old man with 7-dayhistory of chest pain

Selected Findings	Description
Bradycardia Regular Group beating Sinus rhythm	Since the RR interval is not regular. The ventricular rate can be calculated by **the number of QRS complex multiply by 6**. The HR is about 48 bpm. Even though the complex is not regular. The P wave (an atrial rate is regular) at about 70-75 bpm. So even though these "regular and normal looking P waves" are not all follow by QRS complex (because of AV block – see below) . This is sinus rhythm.
2nd degree AV block type I	The ECG shows **PR interval that is getting longer and longer before "a drop beat"** (a P wave which is not follow by QRS complex) them the PR become shorter compare to previous beat. The characteristic of 2nd degree AV block is a non conducting P wave. There are 2 type of 2nd degree AV block Mobiz type 1 and mobiz type II. In mobiz type 1, the PR interval is longer and longer before drop beat. Please note P wave 
Q wave in II, III, aVF Remote MI T wave inversion	The Q wave, inverted T wave in inferior leads all represent a pathologic process of ischemic heart disease. Q wave means old MI

Note: The patient is likely suffer from acute MI a week ago.

ECG # 9: A 73-year-old man with systolic ejection murmurs



ECG # 9: A 73-year-old man with systolic ejection murmurs

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

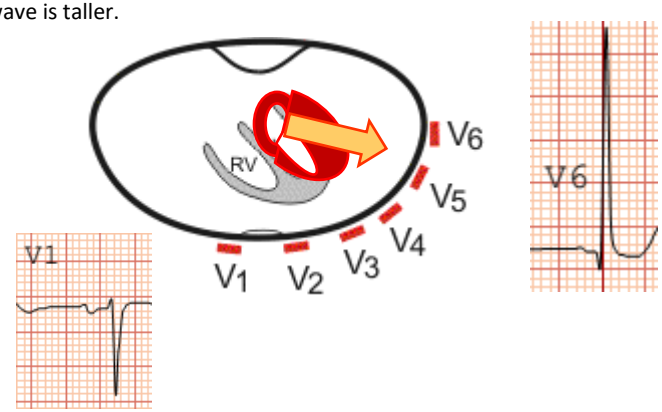
ECG # 9: A 73-year-old man with systolic ejection murmurs

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☒ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

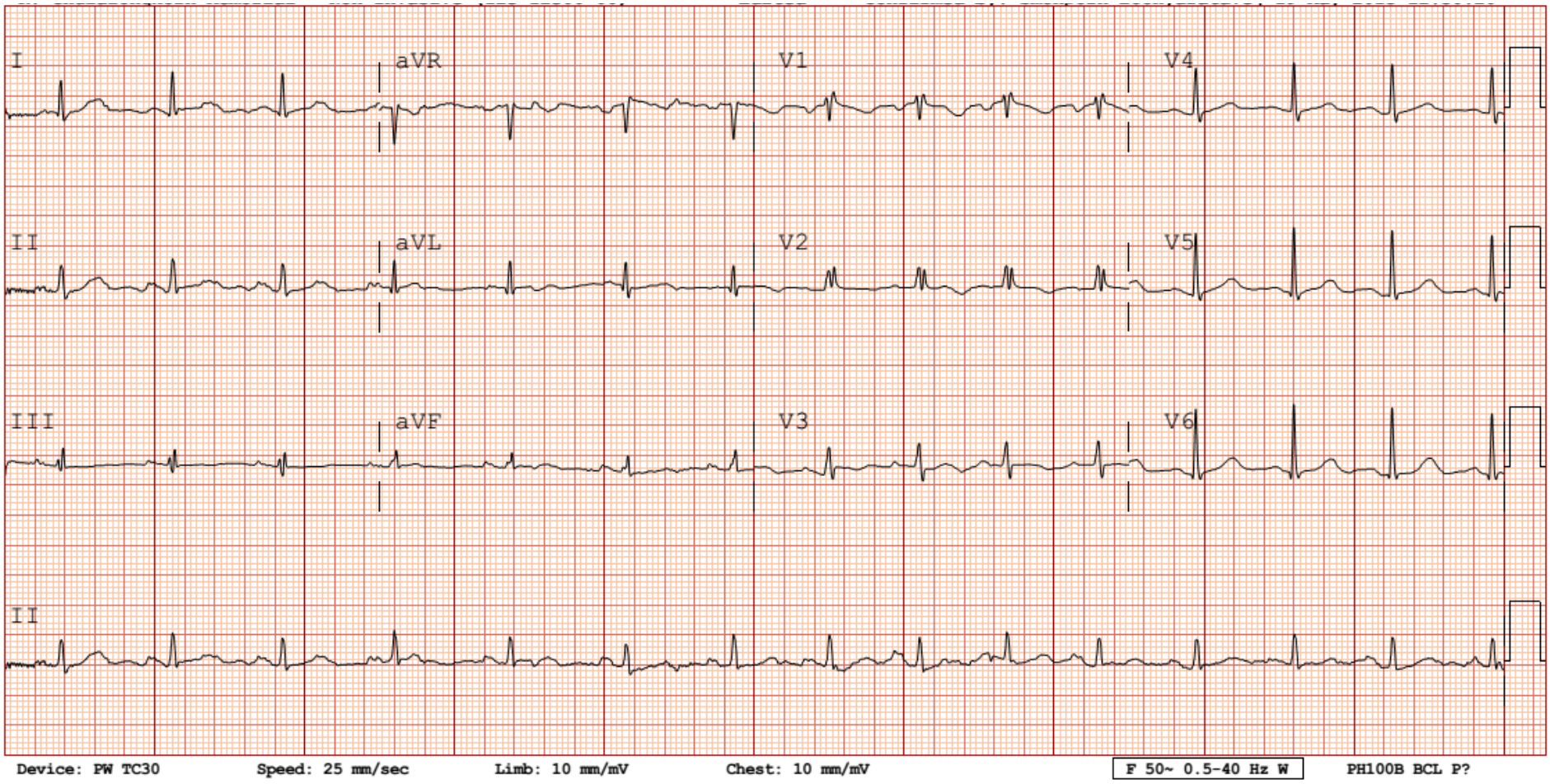
ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☒ Other **Possible aortic stenosis**	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 9: A 73-year-old man with systolic ejection murmurs

Selected Findings	Description
Normal rate	The HR is 75 bpm
Normal Axis	The axis is normal because the QRSs in limb leads are positive in I and II. This ECG axis is about 60 degree
LVH	S in lead V1 + R in V5 or V6 > 35 mm or 7 big boxes Remember when the heart become hypertrophy, the mass increase and show up as a higher amplitude on ECG. In lead V1, the higher LV mass would point away from lead V1 so the S is deeper and deeper. In Lead V6, the higher LV mass would point the same wasy as lead V6 so the R wave is taller. 

Note: LVH is commonly cause by hypertension but any pressure load to the LV can cause LVH as well such as aortic stenosis (systolic ejection murmurs)

ECG # 10: A 44-year-old asymptomatic woman



ECG # 10: A 44-year-old asymptomatic woman

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

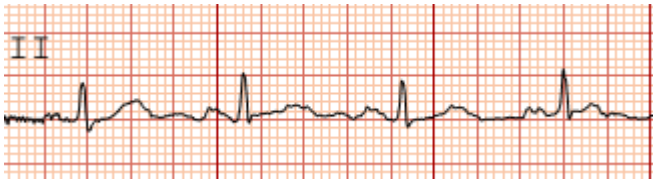
ECG # 10: A 44-year-old asymptomatic woman

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☒ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☒ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

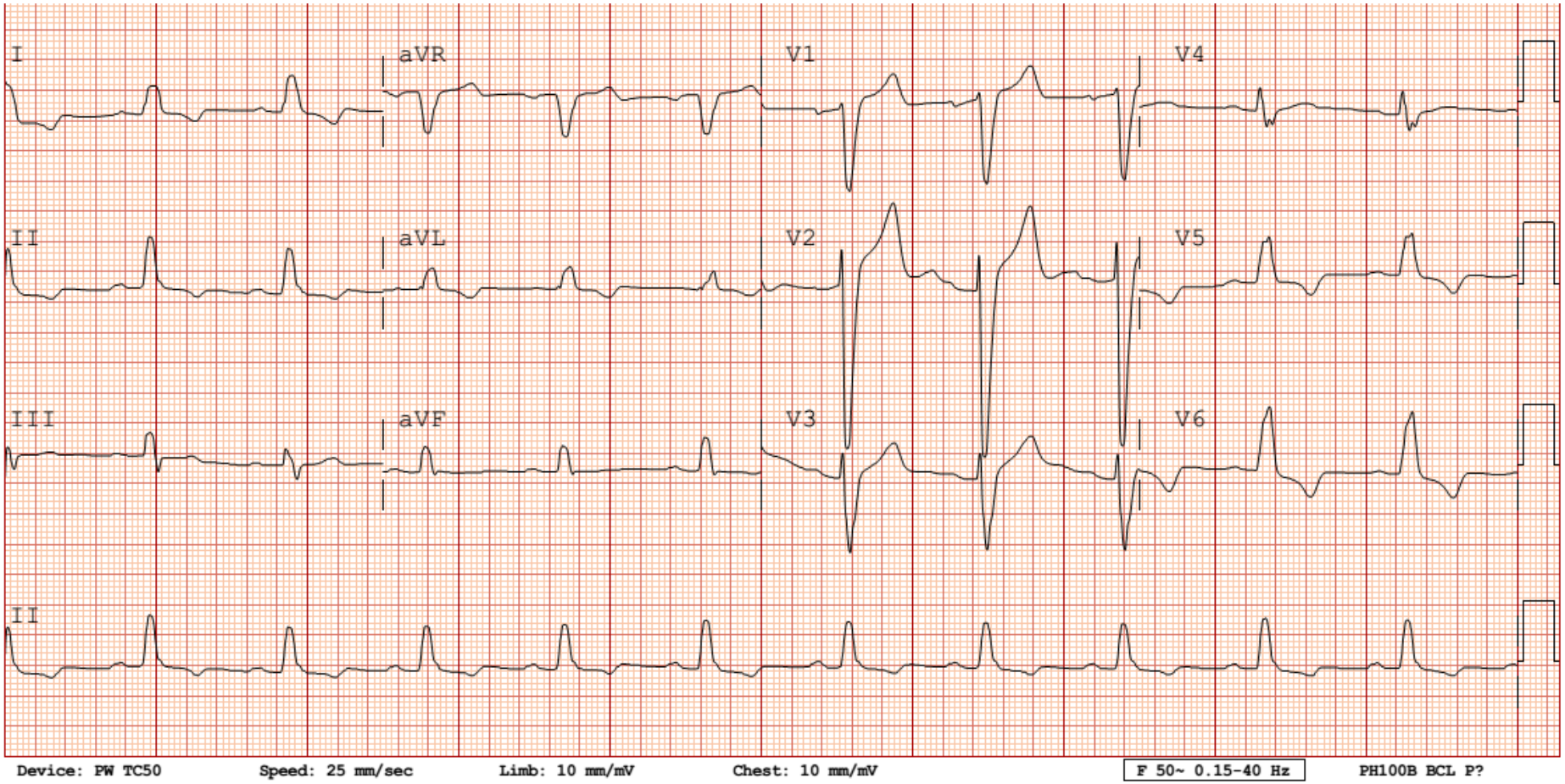
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☒ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 10: A 56-year-old man with dizziness

Selected Findings	Description
LAE	Left atrial enlargement is characterize by a broad p wave with bifid (notch at the top of P wave) or negative terminal in V1 (the second part of P wave in V1 is negative).  
RBBB (incomplete)	RsR' in V1 or V2 is a characteristic sign of right bundle branch block (RBBB). RBBB has overall positive QRS in V1 When the bundle branch cannot function normally we called it bundle branch block. Since the ventricle cannot depolarize in the same pattern, the QRS pattern becomes abnormal**. If BBB is severe enough, the duration of ventricular conduction is longer. When QRS is > 120 msec (3 small boxes), we diagnose complete BBB.** **Understand that,** **1.** If the ventricle is bigger (hypertrophy) → QRS is taller **2.** If the ventricle cannot conduct via conduction pathway (bundle branch block) → QRS wider

Note: RsR' in V1 = look like Rabbit ears = RBBB

ECG # 11: A 79-year-old woman with history of progressive dyspnea



ECG # 11: A 79-year-old woman with history of progressive dyspnea

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 11: A 79-year-old woman with history of progressive dyspnea

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☒ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☒ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

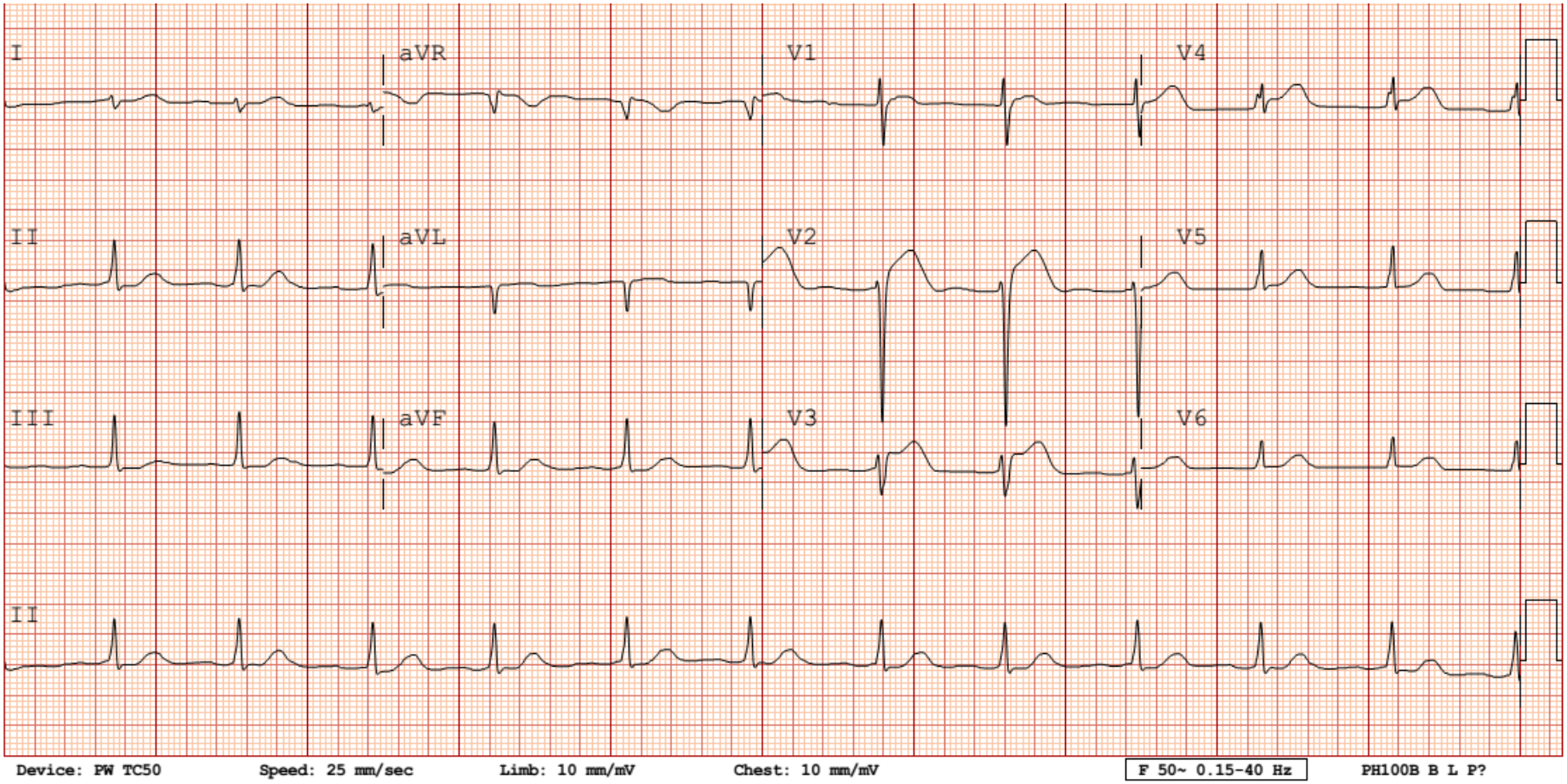
ST segment	☐ No ST-T changes ☒ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☒ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 11: A 79-year-old woman with history of progressive dyspnea

Selected Findings	Description
Normal rate	This ECG shows ventricular rate of 65-70 bpm.
Normal axis	The axis is normal because the QRSs in limb leads are positive in I and II.
LAE	The P wave is broad and bifid. This is go along with LBBB is is commonly seen inLV abnormlaitites.
LBBB complete	When the QRS is broad (wide), it means that the ventricular depolarization is not happening at the same time. This is because of bunble branch block. The pattern shown in this ECG is typical LBBB. The QRS is overall postitive in V5 and V6. The QRS is > 3 small boxes (120 msec). This is complete LBBB  
ST changes due to BBB Inverted T	When ventricle is depolarized abnormally such as hypertrophy or BBB. The ST and T waves are commonly abnormal. ST and T wave usually on the opposite site of the QRS. In LBBB, QRS is positive in V5, V6, the ST is usually depressed with invert T in V5, V6.

Note: LBBB is usually represent structural abnormalities in the heart. The patient may have cardiomyopathy, MI or other heart problem in the past.

ECG # 12: A 52-year-old man with 12 hours of chest pain



ECG # 12: A 52-year-old man with 12 hours of chest pain

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

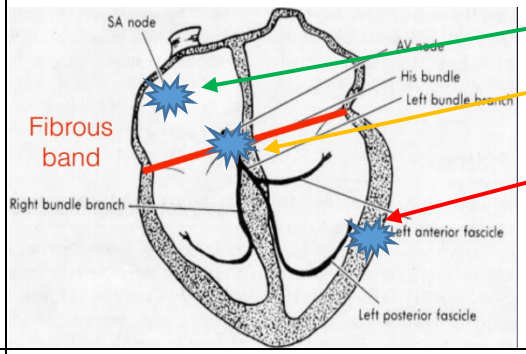
ECG # 12: A 52-year-old man with 12 hours of chest pain

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☒ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☒ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☒ Other **No P wave seen**
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☒ Other **Poor R pregression**	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in **V2 V3 V4** _____	☒	☐	☐	☐	☐

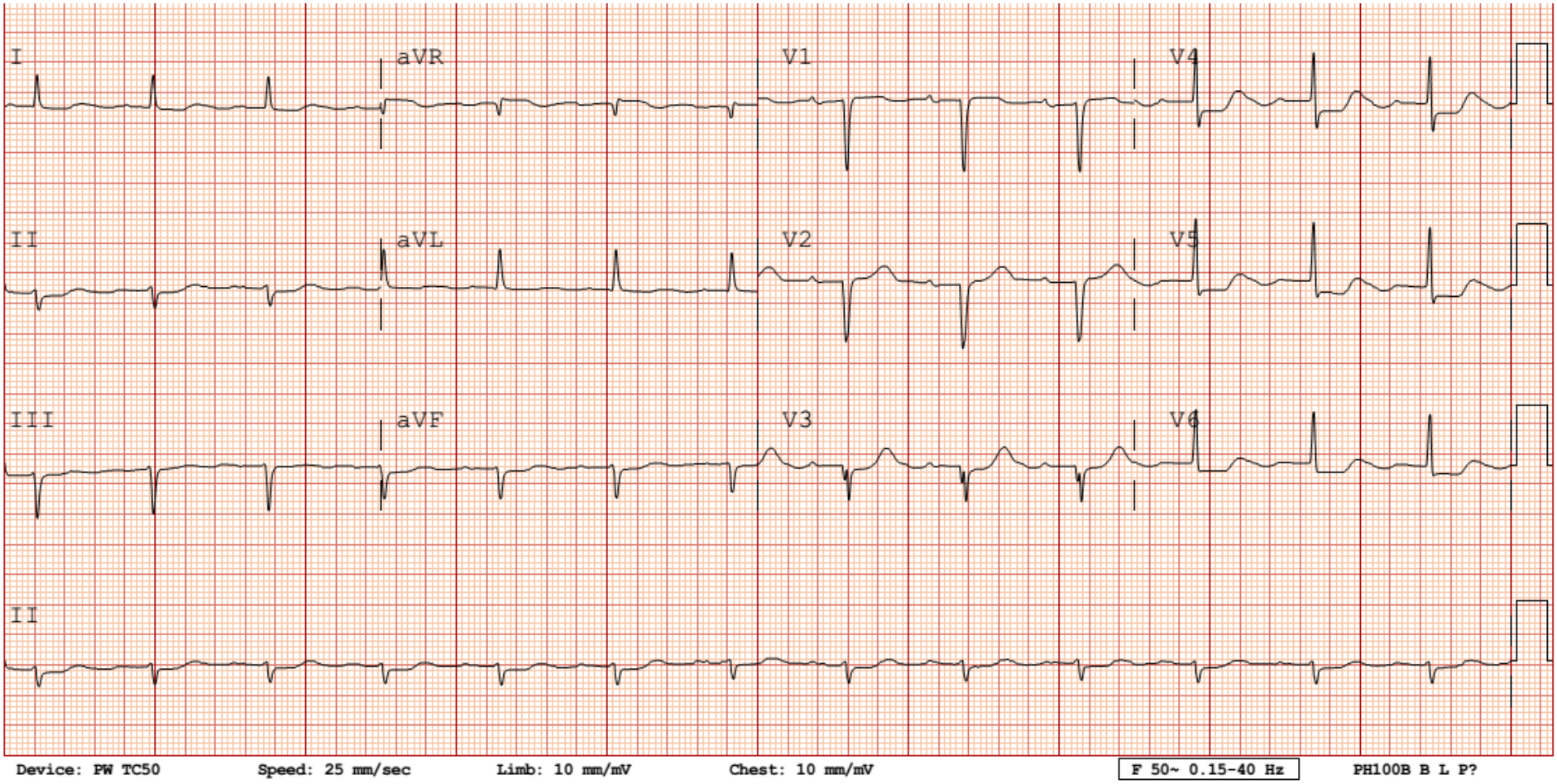
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☒ Normal	☐ Inverted T	☐ Other _____	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☒ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 12: A 52-year-old man with 12 hours of chest pain

Selected Findings	Description
Right axis deviation	Negative in I and positive in aVF.
Regular Normal rate No P wave	Since there is no P wave. This is not a sinus or atrial rhythm**. The QRS is still narrow which mean that the ventricular depolarization is coming from top (AV node, his bundle, and bundle branch)**. It is possible that the SA node become dysfunction for unknown reason and now the subsidiary pacemaker cell is working instead, which is junctional rhythm. <u>Pace maker cells</u>  SA node 80 - 100 bpm Junctional 60 – 80 bpm Ventricular 40 bpm
ST elevation in lead V2-V4 Anterior wall STEMI Poor R progression	The ST elevation on ECG in a right clinical setting could help physician diagnose acute coronary syndrome but there are other causes of ST elevation on ECG as well such as pulmonary embolism or pericarditis. This ECG shows typical pattern of ST elevation from myocardial ischemia i.e. a convex, tomb stone-like ST elevation in multiple leads on the same wall (septal- anterior wall). The R wave in V2-V4 becomes smaller because losing myocardial. **By definition If the R wave in lead V3 is < 3 mm, there is a poor R progression.** The minimal ST depression in lead II, III, aVF (inferior) are likely reciprocal changes which is secondary from the opposite site ischemia.

Note: ST elevation on ECG is not the same as STEMI.

ECG # 13: A 72-year-old man with worsening angina at rest for 3 hours



ECG # 13: A 72-year-old man with worsening angina at rest for 3 hours

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 13: A 72-year-old man with worsening angina at rest for 3 hours

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☒ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in V1 V2 V3	☐	☒	☐	☐	☐
ST depression in V4 V5 V6	☐	☐	☒	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

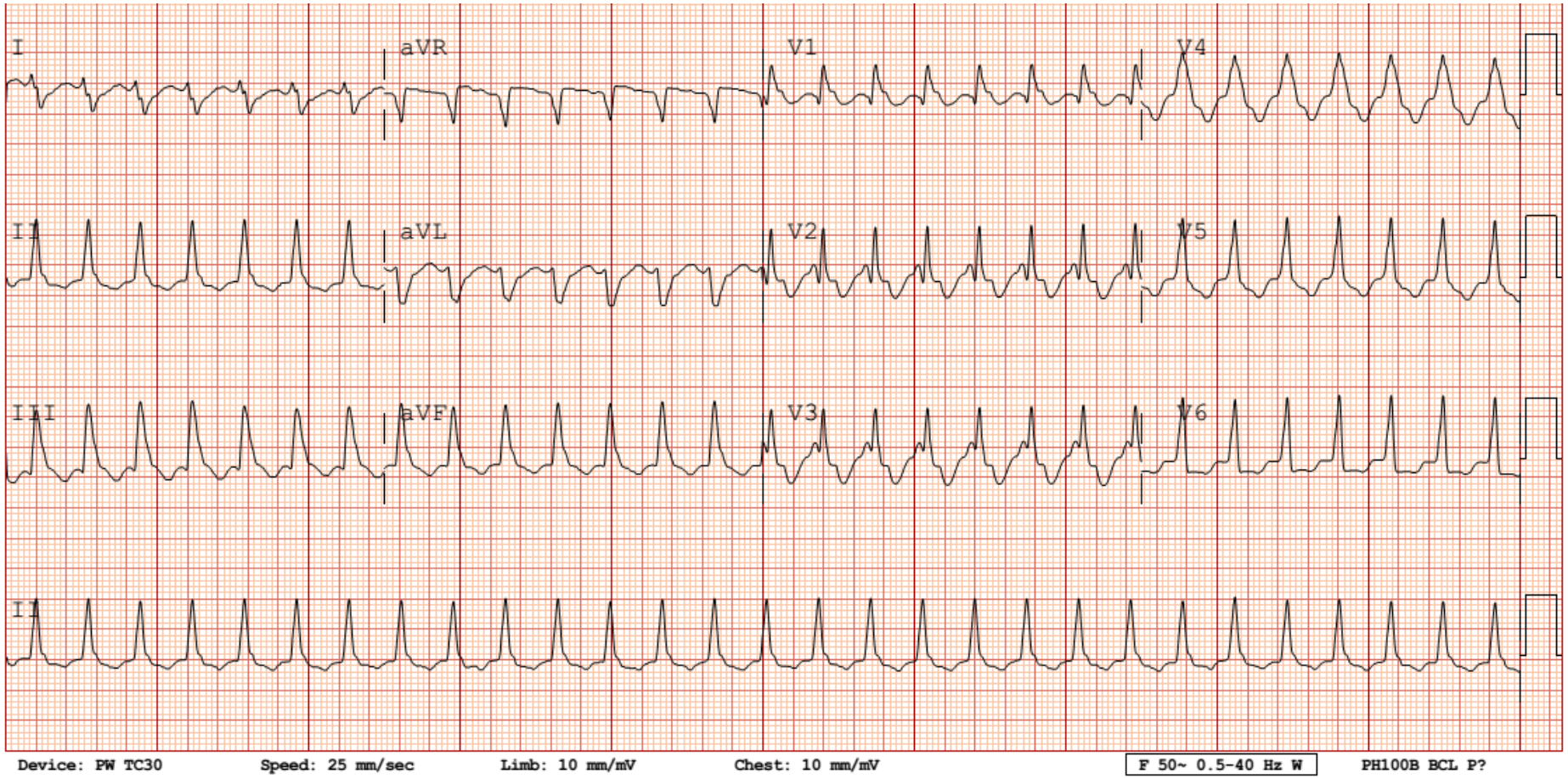
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☒ Other Diffused flattening T wave	
QT interval	☒ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☒ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☒ Remote MI (Old MI)	☐ Pericarditis

ECG # 13: A 72-year-old man with worsening angina at rest for 3 hours

Selected Findings	Description
Left axis deviation	Negative in lead II, Positive in Lead I This make the axis between -30° and -90°
Q in V1, V2, V3 Septal wall Remote MI (old MI)	Q waves which is > 1 mm wide and 1 mm tall is a significant Q wave. This make the diagnosis of Old MI in the septal wall.
ST depression in V4, V5, V6 Lateral wall NSTEMI-ACS	Interestingly, ECG shows **horizontal ST depression in V4-V6.** In a clinical setting of worsening chest pain, this could be acute coronary syndrome. Even though the NSTEMI (by definition) is diagnosed by clinical and abnormal cardiac enzyme, This ECG is very likely a NSTEMI. **ST depression is significant when it is more than or equal to 1 mm depression.**

Note:

ECG # 14: A 64-year-old man with alteration of conscious



ECG # 14: A 64-year-old man with alteration of conscious

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 14: A 64-year-old man with alteration of conscious

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☒ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☒ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☐ Sinus rhythm ☐ SVT ☒ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☒ Other **Wide QRS complex**	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

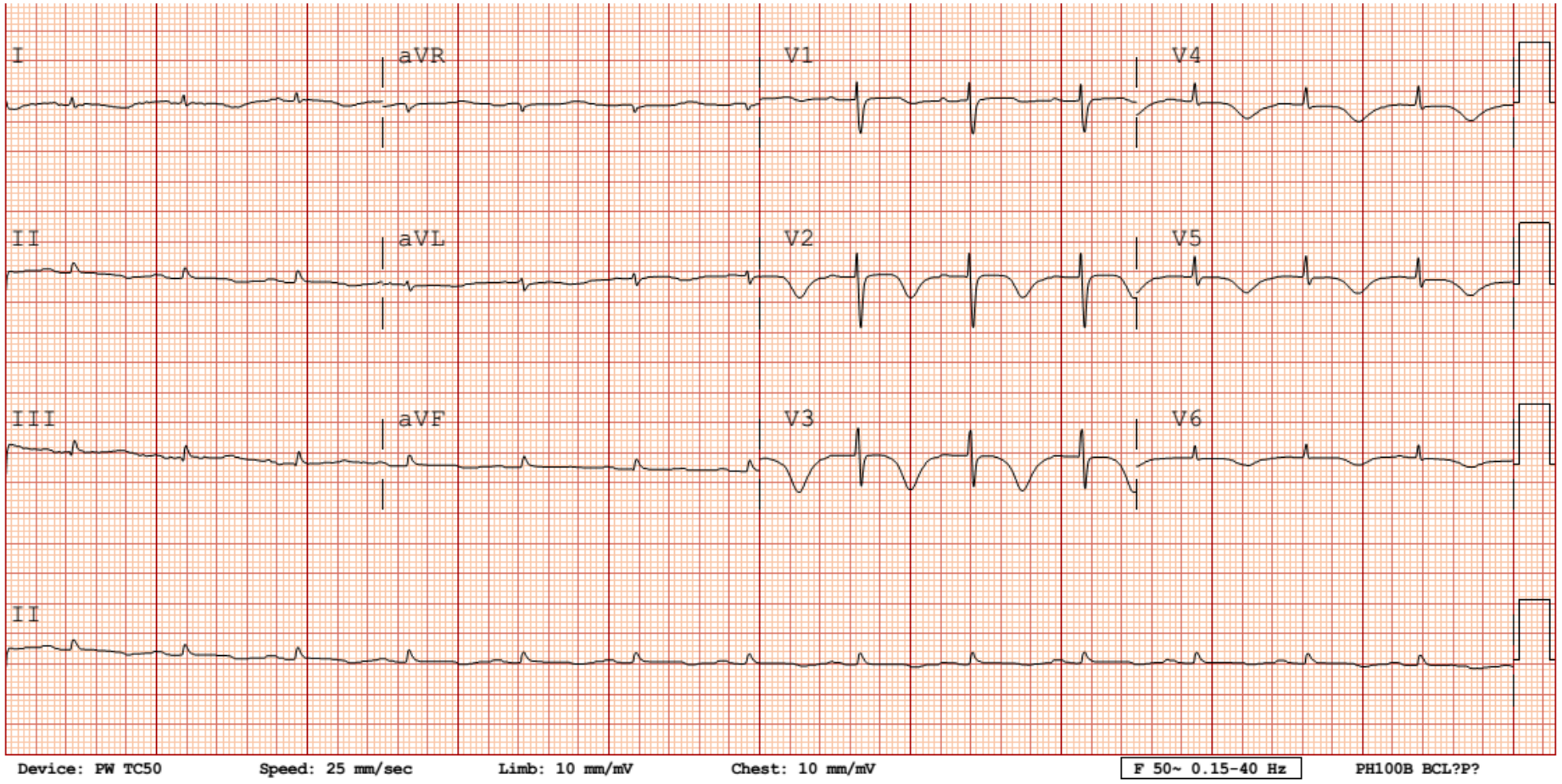
ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☒ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 14: A 64-year-old man with alteration of conscious

Selected Findings	Description
Tachycardia Regular VT	The rate is very fast. The RR interval is about 1.5 big boxes. The HR is around 200 bpm. The QRS is wide and regular. There are a few differential diagnosis for **wide complex tachycardia but the most likely diagnosis is VT.** In ventricular tachycardia The QRS is wide because of the conduction is not thru a conduction system such as his bundle and bundle branch.
Right axis deviation	In ventricular rhythm, the axis is usually abnormal. This ECG shows right axis deviation.

Note: Think ACLS when dealing with tachycardia, bradycardia or cardiac arrest.

ECG # 15: A 56-year-old man with syncope



ECG # 15: A 56-year-old man with syncope

Calibration	☐ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☐ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☐ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☐ Regular ☐ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☐ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☐ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☐ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☐ Inverted T	☐ Other _____	
QT interval	☐ Normal	☐ Prolong QT interval	☐ Other _____	
U wave	☐ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 15: A 56-year-old man with syncope

Calibration	☒ Standard (25 mm/sec, 10 mm/mV) ☐ Non-standard : _____			
Rate	☒ Normal (60-100 bpm) ☐ Bradycardia	☐ Tachycardia		
Axis	☒ Normal axis ☐ Left axis deviation	☐ Right axis deviation	☐ Extreme axis deviation	
Rhythm	☒ Regular ☒ Sinus rhythm ☐ SVT ☐ VT	☐ Totally irregular ☐ Junctional rhythm ☐ Atrial fibrillation ☐ VF	☐ Atrial flutter ☐ Other _____	
P wave	☒ Normal	☐ LAE	☐ RAE	☐ Other _____
PR interval	☒ Normal ☐ 1st degree AV block ☐ Other _____	☐ 2nd degree AV block (type I)	☐ 2nd degree AV block (type II)	☐ 3rd degree AV block
QRS	☐ LVH ☐ RVH ☐ LBBB (incomplete) ☐ Other _____	☐ LBBB (complete)	☐ RBBB (incomplete)	☐ RBBB (complete)

	Anterior	Septal	Lateral	Inferior	Posterior
Q wave in _____	☐	☐	☐	☐	☐
ST depression in _____	☐	☐	☐	☐	☐
ST elevation in _____	☐	☐	☐	☐	☐

ST segment	☒ No ST-T changes ☐ ST changes due to BBB	☐ Nonspecific ST changes ☐ Other _____	☐ ST changes due to hypertrophy	
T wave	☐ Normal	☒ Inverted T	☐ Other _____	
QT interval	☐ Normal	☒ Prolong QT interval	☐ Other _____	
U wave	☒ Absent	☐ Present		
Clinical Diagnosis	☐ PAC ☐ STEMI-ACS ☐ Pulmonary embolism ☐ WPW ☐ Other _____	☐ PVC ☐ NSTSEMI-ACS ☐ Hyperkalemia ☐ Ventricular pacing	☐ Remote MI (Old MI)	☐ Pericarditis

ECG # 15: A 56-year-old man with syncope

Selected Findings	Description
Sinus rhythm	The P wave may not be easily seen but can be seen in lead V1 so this is definitely a normal sinus rhythm.
Prolong QT	The QT is consider prolong if QTc is > 440 msec in men or > 460 msec in women. One can estimate this by if the end of T wave is beyond half of the RR interval, the QTc is likely to be prolong. The QT interval is the time from the start of the QRS to the end of the T wave. Corrected QT interval is a standardize adjustment at a different heart rate. The most common formular being used is Bazett's formula: **QTC = QT / √ RR (RR is in second)**
Inverted T wave	This ECG shows a very abnormal looking T wave.