

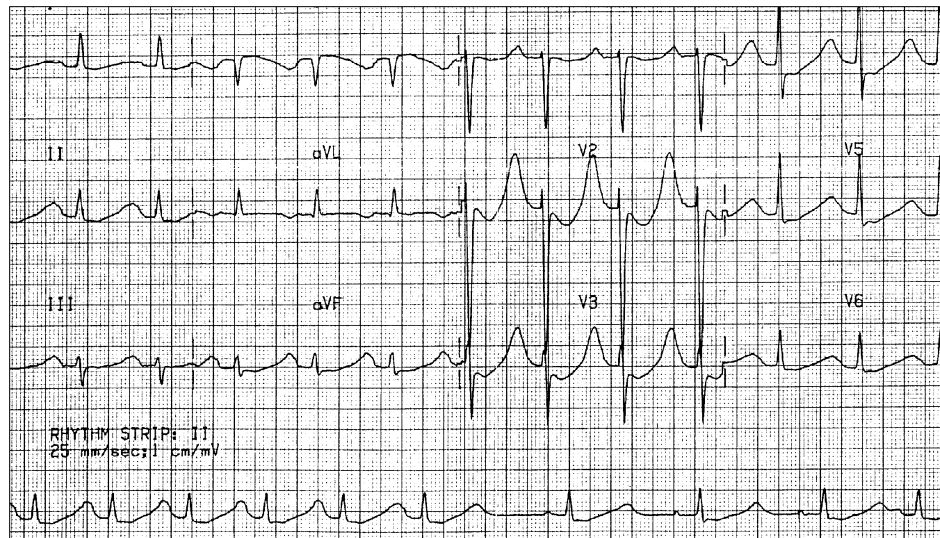
## Electrocardiography Case Studies: Review Questions

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### QUESTIONS

Determine the rate, rhythm, axis, PR interval, QRS duration, QT duration, ST-/T-wave changes and diagnosis for each electrocardiogram (ECG) from the following four patients.

1. This ECG is from a 59-year-old man who has had chest pain and weakness for the previous 3 hours.



Rate:  
PR interval:  
ST-/T-wave changes:  
Diagnosis:

Rhythm:  
QRS duration:

Axis:  
QT duration:

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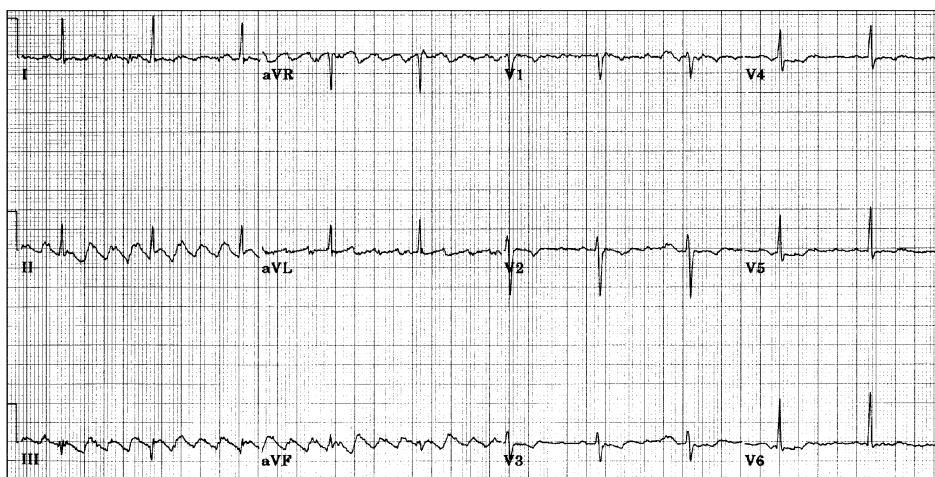
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2. This ECG is from a 63-year-old woman who has a long-term history of pulmonary hypertension secondary to sarcoidosis.



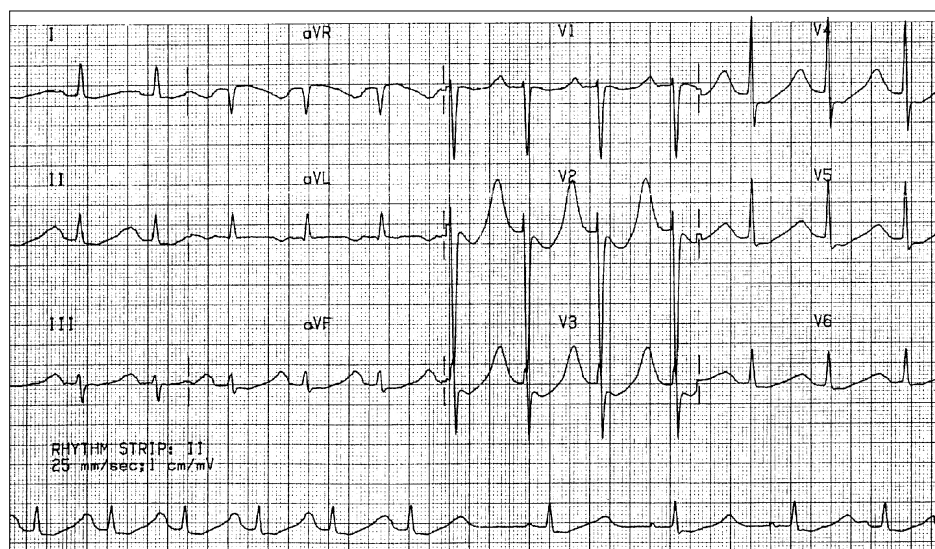
Rate: \_\_\_\_\_ Rhythm: \_\_\_\_\_ Axis: \_\_\_\_\_  
PR interval: \_\_\_\_\_ QRS duration: \_\_\_\_\_ QT duration: \_\_\_\_\_  
ST-/T-wave changes: \_\_\_\_\_  
Diagnosis: \_\_\_\_\_

3. This ECG is from a 71-year-old woman with known mitral valve prolapse and mitral regurgitation who presents with increasing dyspnea and fatigue on exertion.



Rate: \_\_\_\_\_ Rhythm: \_\_\_\_\_ Axis: \_\_\_\_\_  
PR interval: \_\_\_\_\_ QRS duration: \_\_\_\_\_ QT duration: \_\_\_\_\_  
ST-/T-wave changes: \_\_\_\_\_  
Diagnosis: \_\_\_\_\_

4. This ECG is from an 80-year-old man with a history of ischemic heart disease and recurrent syncopal episodes. His current medications include a tricyclic antidepressant and amiodarone.



**Rate:**  
**PR interval:**  
**ST-/T-wave changes:**  
**Diagnosis:**

**Rhythm:**  
**QRS duration:**

**Axis:**  
**QT duration:**

#### ANSWERS AND DISCUSSION

1. A 59-year-old man with chest pain and weakness.  
**Rate:** 41 bpm  
**Rhythm:** normal sinus rhythm  
**Axis:** 40 degrees  
**PR interval:** variable  
**QRS duration:** 86 ms  
**QT duration:** 460 ms  
**ST-/T-wave changes:** ST elevation in leads II, III, and aV<sub>F</sub> with reciprocal ST depression in aV<sub>L</sub>  
**Diagnosis:** normal sinus rhythm with second-degree atrioventricular (AV) block (Mobitz type I or Wenckebach) and with an acute, inferior-wall injury  
**Discussion:** This ECG initially suggests a Mobitz type II, second-degree AV block; however, when an isolated 2:1 block is observed, one should not assume that the block is Mobitz type II. It is necessary to look at a long rhythm strip—especially the part before the block—to find the complexes where the typical PR prolongation is followed by a dropped QRS complex. The fourth QRS complex in the rhythm strip at the bottom shows the PR interval is 280 ms, the next complex is 360 ms, and the sixth complex is 240 ms.

This variable PR interval is characteristic of the phenomenon described by Wenckebach, in which the AV conduction gradually prolongs until the atrial impulse is eventually blocked in the AV node. Before the invention of electrocardiography, Wenckebach described this phenomenon by timing the venous pulsations in the jugular vein compared with the carotid impulse and heart tones. By definition, the PR interval before the dropped QRS is the longest; the interval immediately after the dropped beat is the shortest. Transient AV blocks are common in patients with an inferior myocardial infarction.

2. A 63-year-old woman with history of pulmonary hypertension secondary to sarcoidosis.  
**Rate:** 109 bpm  
**Rhythm:** atrial flutter with 2:1 conduction  
**Axis:** 110 degrees  
**PR interval:** indeterminate  
**QRS duration:** 84 ms  
**QT duration:** 360 ms  
**ST-/T-wave changes:** ST-segment depression and T-wave inversion in V<sub>1</sub> to V<sub>3</sub>

**Diagnosis:** atrial flutter with 2:1 conduction or right ventricular hypertrophy (RVH)

**Discussion:** The findings of a tall R wave in lead V<sub>1</sub> with an R to S ratio of 1 or more, suggest the presence of RVH. There is counterclockwise rotation of the precordial leads (ie, early R-wave progression). Changes in the right-sided precordial leads suggest diastolic overload of the right ventricle with ST-segment depression and T-wave inversion, termed *RVH with strain* pattern. With RVH, the most common QRS axis is normal, but right axis deviation can occur.

3. A 71-year-old woman with mitral valve prolapse and mitral regurgitation.

**Rate:** 64 bpm

**Rhythm:** atrial flutter

**Axis:** 20 degrees

**PR interval:** indeterminate

**QRS duration:** 84 ms

**QT duration:** 380 ms

**ST-/T-wave changes:** nonspecific

**Diagnosis:** atrial flutter with 4:1 conduction; nonspecific ST- and T-wave abnormalities

**Discussion:** This 71-year-old woman presents with increasing dyspnea on exertion and is diagnosed with congestive heart failure, which is commonly associated with many supraventricular and ventricular arrhythmias. The saw-tooth configuration of the P waves—typically seen in the inferior limb leads of II, III, and aV<sub>F</sub>—indicates atrial flutter. The typical rate of atrial flutter waves is 250 to 350/min and averages 300/min. The conduction abnormality (a ratio of four atrial f waves to one ventricular R wave) suggests AV nodal or infranodal conduction disease. Any medication that blocks the AV node should be used cautiously in the treatment of this patient.

4. An 80-year-old man with history of ischemic heart

disease whose current medications include tricyclic antidepressants and amiodarone.

**Rate:** 80 bpm

**Rhythm:** normal sinus rhythm with accelerated junctional

**Axis:** 20 degrees

**PR interval:** 238 ms

**QRS duration:** 95 ms

**QT duration:** 700 ms

**ST-/T-wave changes:** nonspecific ST abnormalities

**Diagnosis:** normal sinus rhythm with paroxysmal accelerated junctional tachycardia, first-degree AV block, prolonged QT duration, and nonspecific ST-segment abnormalities

**Discussion:** Patients who present with QT-duration prolongation are classified as: 1) primary or idiopathic, or 2) secondary or acquired. The idiopathic long QT syndromes are further divided into: 1) Jervell and Lange-Nielsen syndrome (prolonged QT duration, congenital deafness, and syncopal episodes that are associated with sudden death and inherited as an autosomal recessive trait); 2) Romano-Ward syndrome (autosomal dominant inheritance and no associated deafness); or 3) sporadic, long QT syndrome.

The secondary causes of a prolonged QT duration include coronary artery disease, mitral valve prolapse, cardiomyopathies, intracranial hemorrhage, autonomic nervous system dysfunctions, hypocalcemia, liquid protein diet, drugs (quinidine, procainamide, flecainide, amiodarone, phenothiazines, and tricyclic antidepressants), hypothyroidism, hypothermia, pheochromocytoma, and organophosphorus poisoning. Patients with these conditions are predisposed to arrhythmic death from a polymorphic ventricular tachycardia typically known as *torsades de pointes*.

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*Adapted from Zaks JM, Moran MD, Saba SE, et al: Electrocardiography case studies: a self-assessment test. Hospital Physician Cardiology Board Review Manual 1995:2(2).*

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## CARDIOLOGY

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