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Cardiac Cycle & Basic Cardiac Physiology

Study Guide — Cardiac Physiology

High-school/pre-med-level questions on the cardiac cycle, heart sounds, valve events, ECG relationships, and stroke volume.

32 items — Study Guide with Answers

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1 The cardiac cycle is best defined as:

- A** The time from one P wave to the next P wave on the ECG
- B** The sequence of mechanical and electrical events in one heartbeat, from one ventricular systole to the next ✓
- C** Only the period of ventricular contraction
- D** Only the period of ventricular relaxation
- E** The time for one complete circulation of blood through the body

► **Explanation:** The cardiac cycle includes all electrical and mechanical events that occur during a single heartbeat, typically described from one ventricular systole to the next.



2 In a normal cardiac cycle, systole refers primarily to:

- A** Relaxation of the ventricles and filling with blood
- B** Contraction of the ventricles and ejection of blood ✓
- C** Contraction of the atria only
- D** Relaxation of all chambers
- E** The time between two T waves

► **Explanation:** Systole is the period when the ventricles contract and eject blood into the arteries; diastole is ventricular relaxation and filling.



3 Which of the following lists the major mechanical phases of the ventricular cardiac cycle in the correct order, starting just AFTER atrial systole?

- A** Ventricular ejection → isovolumetric contraction → isovolumetric relaxation → rapid filling





B Isovolumetric contraction → ejection → isovolumetric relaxation → ventricular filling ✓

C Isovolumetric relaxation → ejection → isovolumetric contraction → ventricular filling

D Ejection → ventricular filling → isovolumetric contraction → isovolumetric relaxation

E Isovolumetric contraction → isovolumetric relaxation → ejection → ventricular filling

► **Explanation:** After atrial systole tops up the ventricles, the ventricles begin isovolumetric contraction (all valves closed). Once pressure exceeds arterial pressure, ejection occurs. Then isovolumetric relaxation is followed by ventricular filling.

4 During isovolumetric ventricular contraction:



A All four heart valves are open and blood flows freely

B AV valves are open, semilunar valves are closed, and ventricular volume falls rapidly

C AV valves are closed, semilunar valves are closed, and ventricular pressure rises at constant volume ✓

D AV valves are open, semilunar valves are open, and ventricular pressure is constant

E Semilunar valves are open, AV valves are closed, and blood is ejected

► **Explanation:** Isovolumetric contraction: the ventricles contract with both sets of valves closed; pressure rises but volume does not change.

5 Which event immediately causes closure of the atrioventricular (AV) valves (mitral and tricuspid)?



A Atrial pressure falling below ventricular pressure

B Ventricular pressure rising above atrial pressure at the start of systole ✓

C Ventricular pressure falling below atrial pressure at the start of diastole

D Aortic pressure exceeding ventricular pressure





- E** Atrial depolarisation (P wave)

► **Explanation:** AV valves close when ventricular pressure just exceeds atrial pressure at the onset of ventricular systole, producing the first heart sound.

6 The first heart sound (S1, the 'lub') is primarily caused by:



- A** Opening of the semilunar valves
- B** Closure of the AV valves at the start of ventricular systole ✓
- C** Closure of the semilunar valves at the end of ventricular systole
- D** Opening of the AV valves at the start of diastole
- E** Blood flowing from atria to ventricles

► **Explanation:** S1 occurs when the AV valves close as the ventricles begin to contract (start of systole).

7 The second heart sound (S2, the 'dub') corresponds most closely to:



- A** Opening of the AV valves at the beginning of ventricular diastole
- B** Closure of the semilunar valves (aortic and pulmonary) at the end of ventricular systole ✓
- C** Closure of the AV valves at the end of ventricular systole
- D** Atrial contraction
- E** Maximum ventricular filling

► **Explanation:** S2 occurs when the aortic and pulmonary semilunar valves close as the ventricles begin isovolumetric relaxation.



**8 During most of ventricular ejection:**

- A AV valves and semilunar valves are both closed
- B AV valves are open and semilunar valves are closed
- C AV valves are closed and semilunar valves are open ✓**
- D AV valves are open and semilunar valves are open
- E All valves are open and blood flows equally in all directions

► **Explanation:** During ejection, blood flows from ventricles into arteries, so AV valves are closed and semilunar valves are open.

9 Most of the ventricular filling in a normal resting heart occurs:

- A During atrial systole only
- B Passively during early diastole before atrial systole ✓**
- C Only when the semilunar valves are open
- D During isovolumetric contraction
- E Only when heart rate exceeds 120 beats/min

► **Explanation:** Roughly 70–80% of ventricular filling occurs passively as the ventricles relax and AV valves open; atrial systole provides an additional 'atrial kick'.

10 End-diastolic volume (EDV) in the ventricle is the volume of blood:

- A Remaining after ventricular contraction (end of systole)
- B Just after atrial systole, at the end of ventricular filling ✓**





- C In the atrium before atrial contraction
- D Ejected in one beat
- E In the ventricle during isovolumetric relaxation

► **Explanation:** EDV is the volume in the ventricle at the end of diastole, just before ventricular contraction and ejection.

11 End-systolic volume (ESV) is:



- A The total volume of blood in the ventricle after filling
- B The volume of blood ejected during one beat
- C **The volume of blood remaining in the ventricle after ventricular systole ✓**
- D The volume of blood in the atrium after atrial contraction
- E The volume of blood in the aorta at end-systole

► **Explanation:** ESV is the blood volume left in the ventricle after contraction and ejection have finished.

12 Stroke volume (SV) is calculated as:



- A $SV = EDV + ESV$
- B **$SV = EDV - ESV$ ✓**
- C $SV = ESV - EDV$
- D $SV = HR \times EDV$
- E $SV = CO \times HR$

► **Explanation:** Stroke volume is the amount of blood ejected from a ventricle in one beat: $SV = EDV - ESV$.





13 A left ventricle has an EDV of 140 mL and an ESV of 70 mL. What is the stroke volume?



- A 70 mL ✓
- B 140 mL
- C 210 mL
- D 110 mL
- E 35 mL

► **Explanation:** $SV = EDV - ESV = 140 - 70 = 70 \text{ mL}$.

14 Using the previous data (EDV = 140 mL, ESV = 70 mL), what is the ejection fraction (EF) of this ventricle?



- A 25%
- B 35%
- C 50% ✓
- D 70%
- E 100%

► **Explanation:** Ejection fraction $EF = SV/EDV = (140 - 70)/140 = 70/140 = 0.5 = 50\%$.

15 Cardiac output (CO) is defined as:



- A Heart rate divided by stroke volume





- B Stroke volume minus heart rate
- C Stroke volume multiplied by heart rate ✓
- D End-diastolic volume multiplied by heart rate
- E End-systolic volume divided by heart rate

► **Explanation:** Cardiac output is the volume of blood pumped by a ventricle per minute: $CO = SV \times HR$.

16 If a person has a heart rate of 75 beats/min and a stroke volume of 80 mL/beat, what is their approximate cardiac output?



- A 6 L/min ✓
- B 4 L/min
- C 8 L/min
- D 2 L/min
- E 10 L/min

► **Explanation:** $CO = HR \times SV = 75 \text{ beats/min} \times 80 \text{ mL/beat} = 6000 \text{ mL/min} = 6 \text{ L/min}$.

17 On a normal ECG, which wave corresponds to ventricular depolarisation?



- A P wave
- B QRS complex ✓
- C T wave
- D U wave
- E PR segment





► **Explanation:** The QRS complex represents ventricular depolarisation; the P wave is atrial depolarisation; the T wave is ventricular repolarisation.

18 Mechanical ventricular contraction begins:



- A Exactly at the start of the P wave
- B Slightly AFTER the QRS complex begins ✓**
- C Exactly at the start of the T wave
- D During the TP segment only
- E Only after the T wave ends

► **Explanation:** Electrical events precede mechanical events; ventricular contraction follows ventricular depolarisation (QRS), with a slight delay.

19 Atrial systole (atrial contraction) occurs most closely after which ECG feature?



- A Onset of the P wave ✓**
- B Onset of the QRS complex
- C Peak of the T wave
- D End of the TP segment
- E No relationship to the ECG

► **Explanation:** Atrial contraction follows atrial depolarisation, which is represented by the P wave on the ECG.





20 Which BEST explains why very fast heart rates (e.g. 180 beats/min) can reduce cardiac output, even though heart rate is higher?

- A Systole becomes much shorter, and the ventricles cannot contract
- B Diastole is greatly shortened, so the ventricles do not have enough time to fill ✓**
- C The lungs cannot oxygenate blood at high heart rates
- D Stroke volume always falls to zero at high heart rates
- E The AV valves remain open throughout systole

► **Explanation:** At very high heart rates, diastole shortens more than systole, so filling time is reduced and stroke volume may decrease, lowering cardiac output.



21 During isovolumetric RELAXATION of the ventricles:

- A All valves are open; ventricular volume is falling rapidly
- B AV valves are open and semilunar valves are closed; rapid filling occurs
- C AV valves and semilunar valves are both closed; ventricular pressure falls at constant volume ✓**
- D Semilunar valves are open and AV valves are closed; blood is ejected
- E AV valves are open and semilunar valves are open; blood flows in both directions

► **Explanation:** Isovolumetric relaxation follows closure of the semilunar valves (S2); both valve sets are closed while ventricular pressure falls.



22 When do the AV valves OPEN during the cardiac cycle?

- A When ventricular pressure exceeds aortic and pulmonary artery pressure





B When ventricular pressure falls below atrial pressure at the start of ventricular diastole ✓

- C** Immediately after the QRS complex begins
- D** During isovolumetric contraction
- E** During ventricular ejection

► **Explanation:** At the start of ventricular diastole, ventricular pressure drops below atrial pressure, causing AV valves to open and ventricles to fill.

23 Which of the following is TRUE about atrial contraction (atrial systole) in a healthy resting adult?



- A** It contributes almost all of the ventricular filling volume
- B** It contributes only a small fraction (about 10–20%) of ventricular filling, the rest is passive ✓
- C** It occurs before ventricular filling begins
- D** It is essential for survival at rest; without it, the heart cannot pump any blood
- E** It occurs at the same time as ventricular ejection

► **Explanation:** Most ventricular filling is passive; atrial systole adds an 'atrial kick' (about 10–20%) to EDV in normal conditions.

24 In atrial fibrillation, the atria do not contract effectively. Which effect on the cardiac cycle is MOST likely at rest in an otherwise healthy person?



- A** Stroke volume becomes zero because ventricles cannot fill at all
- B** Ventricular filling is slightly reduced because the atrial 'kick' is lost ✓
- C** Ventricular filling becomes much greater than normal
- D** Heart sounds disappear completely





- E Semilunar valves do not open

► **Explanation:** Without coordinated atrial contraction, passive filling still occurs but the atrial contribution to EDV is lost, slightly reducing stroke volume.

25 Preload is most closely related to which quantity in the cardiac cycle?



- A End-systolic volume (ESV)
- B End-diastolic volume (EDV) or ventricular stretch just before contraction ✓**
- C Systolic blood pressure in the aorta
- D Heart rate
- E Stroke volume

► **Explanation:** Preload reflects the degree of stretch of ventricular muscle at the end of diastole, often approximated by EDV or venous return.

26 Afterload for the left ventricle is most closely approximated by:



- A Venous pressure in the vena cava
- B End-diastolic volume
- C Aortic pressure during systole ✓**
- D Heart rate
- E End-systolic volume

► **Explanation:** Afterload is the load the ventricle must work against to eject blood; for the left ventricle this is largely the aortic (systemic arterial) pressure.





27 Which change would most directly **INCREASE** stroke volume according to the Frank–Starling mechanism?



- A Decreased venous return and EDV
- B Increased venous return leading to greater EDV ✓**
- C Decreased EDV and increased afterload
- D No change in EDV but decreased contractility
- E Increased heart rate with no change in filling

► **Explanation:** The Frank–Starling law states that within limits, increased EDV (greater stretch) leads to a stronger contraction and larger stroke volume.

28 Which phase of the cardiac cycle corresponds to the **RAPID RISE** in left ventricular pressure without any change in volume?



- A Atrial systole
- B Isovolumetric contraction ✓**
- C Rapid ejection
- D Isovolumetric relaxation
- E Ventricular filling

► **Explanation:** During isovolumetric contraction, AV valves have just closed, semilunar valves are still closed, and pressure rises sharply at constant volume.

29 Which event marks the **BEGINNING** of ventricular systole in the left heart?



- A Opening of the mitral valve
- B Closure of the aortic valve





- C Closure of the mitral valve (S1) ✓
- D Opening of the aortic valve
- E Peak of the T wave

► **Explanation:** Ventricular systole starts with isovolumetric contraction and closure of the AV valves (mitral and tricuspid), producing S1.

30 Which statement about the timing of the cardiac cycle is TRUE?



- A At resting heart rate, systole and diastole are equal in duration
- B At resting heart rate, diastole is longer than systole ✓
- C At resting heart rate, diastole is shorter than systole
- D Increasing heart rate lengthens diastole more than systole
- E Systole disappears at very low heart rates

► **Explanation:** At rest, diastole lasts longer than systole, allowing ample filling time; as heart rate increases, diastole shortens proportionally more.

31 During which part of the cardiac cycle is coronary blood flow to the LEFT ventricle greatest?



- A During ventricular systole, when the myocardium is contracting strongly
- B During ventricular diastole, when the myocardium is relaxed ✓
- C Only during isovolumetric contraction
- D Only during atrial systole
- E Coronary flow is constant throughout the cycle





► **Explanation:** Contraction compresses coronary vessels in the left ventricle, reducing flow in systole; most left coronary perfusion occurs during diastole.

32 A murmur heard between S1 and S2 (during ventricular systole) is BEST described as:



- A A diastolic murmur
- B A systolic murmur ✓
- C An atrial murmur
- D An innocent venous hum unrelated to the heart
- E A pericardial friction rub

► **Explanation:** S1 marks the start of systole and S2 marks its end; a murmur between them is by definition a systolic murmur.

