From where	A. Atrial systole	B. Ventricular systole			C. Ventricular Diastole			
	1. Atrial contraction phase (late diastole)	2. Isometric (iso-volumetric) contraction phase	3. Rapid (maximum) ejection phase	4. Reduced (minimum) ejection phase	5. Protodiastolic phase	6. Isometric relaxation phase	7. Maximal (rapid) filling phase	8-.Reduced filling phase
Duration	0.1 Sec.	0.05 sec	0.15 sec	0.1 sec.	0.04 sec	0.06 sec	0.1 sec.	0.2 sec.
Events	the atria contract and pump 30% of the ventricular filling (to the ventricles) مهم	It begins by closure of A.V. valve and the ventricles begin to contract isometrically (without change in muscle fiber length) - Thus, the ventricles are closed chambers filled with blood.	it begins by opening of the aortic valve and rushing of blood into the aorta where 70% of stroke volume ejected in this phase.	the remaining 30% of stroke volume is ejected to the aorta.	the period between the end of ventricular systole and the closure of the aortic valve.	it begins by closure of the aortic valve and the ventricles relax isometrically without change in the ventricular volume.	It begins by opening of A.V. valve due to the increased atrial pressure above the ventricular pressure (60% of SV is rushed to the ventricle).	10% of the stroke volume flow slowly to the ventricle.
The atrial pressure	rise from 4 mmHg to 8 mmHg and return to 4 mmHg at the end of this phase due to the atria evacuation.	rise due to bulging of the A.V. valves into the atria and also due to regurgitation of some blood into the atria before closure of the A.V. valves.	decreases due to down displacement of the A.V. valve during shortening of ventricular muscles.	increased due to venous return.	--------	increased above the ventricular pressure due to accumulation of venous return, this pressure can open the A.V. valve at the end of this phase.	- Atrial and ventricular pressure: around zero. - Aortic pressure: decreases due to escape of blood to peripheral vessels.	
Ventricular pressure	rise from 4 mmHg to 8 mmHg and return to 4 mmHg at the end of this phase as the ventricles dilate to accommodate the blood passing to it.	rise from 4 mmHg to 80 mmHg in the left ventricle.	- The ventricular and aortic pressures : rise from 80 to 120 mmHg. Because the amount of blood ejected through the aortic valve exceeds that which leaves the aorta.	- The ventricular and aortic pressures : reach their maximum and begin to decrease (due to escape of blood to peripheral circulation is more than the amount of blood ejected from the ventricle.	- The ventricular and aortic pressures: The ventricle begins to relax but still contracted and its pressure decreases about 20 mmHg and the aortic pressure decreases also (due to escape of blood to peripheral circulation). But still above the ventricular pressure. This causes the blood in the aorta to regurgitate to the ventricles leading to	falls rapidly from 90 to 0 mmHg. - Aortic pressure: due to elastic recoil of the aorta its pressure increased leading to upward (dicrotic) wave.		rises to 4 mmHg.

					closure of the aortic valve at the end of this phase. - The closure of semilunar valves occurs as a result of fall of ventricular pressure below that of aortic and pulmonary arteries. - The closure of the aortic valve and the change of potential energy to kinetic energy leads to sharp momentary fall in the aortic pressure called the dicrotic (incisura) notch.			
Ventricular volume	Increased by (20 ml) to reach the end diastolic volume (E.D.V. = 140 ml) ~~مم~~	is constant (isometric) this is because the blood is not compressible.	decreases greatly due to change of the isometric contraction to isotonic contraction and ejection of the blood.	decreases to reach the end systolic volume (ESV = 70ml). So, Stroke volume is 140 – 40 = 70 (50% of EDV)	is constant		increased	increase gradually
Heart sounds	The 4 th heart sound which is weak and inaudible due to vibration of atrial muscle during the contraction and rushing of blood into the ventricles.	the first components of the 1 st heart sound due to closure of the A.V. valves	the second component of the 1 st heart sound due to rushing of blood into the aorta and vibration of the aortic wall.	------	-------	the 2nd heart sound due to closure of the aortic valve and pulmonary valve (semilunar valves). -The semilunar valves (aortic, pulmonary) close at the beginning of this phase	the 3 rd heart sound due to rushing of blood into the ventricles and vibration of the ventricular wall	
Valves	- The Semilunar valves are closed. - The A.V. valves are opened .	are closed (A-V and semilunar valve) .	- The semilunar valves are opened. - The A.V. valve is closed .	------	-------	- The A.V. valves open at the end of this phase. -So, during this phase the 4 valves are closed		

- **All valves are closed during :** isometric contraction + isometric relaxation
- **First heart sound :** first component → isometric contraction → AV closure
  Second component → rapid (maximum) ejection → rushing of blood
- **Second heart sound :** isometric relaxation → semilunar closure
- **Third heart sound :** rapid filling → rushing of blood
- **Fourth heart sound :** atrial systole → inaudible (NEVER)
- **P wave :** atrial systole
- **QRS wave :** isometric contraction
- **Beginning of T wave :** maximum ejection
- **Down slope of T wave :** protodiastolic phase
- **End of T wave :** isometric relaxation
- **Down slope of dicrotic (incisura) notch** → protodiastolic phase
- **Up slope of dicrotic (incisura) notch** → isometric relaxation
- **EDV** is reaches in atrial contraction
- **ESV** is reached in minimum ejection