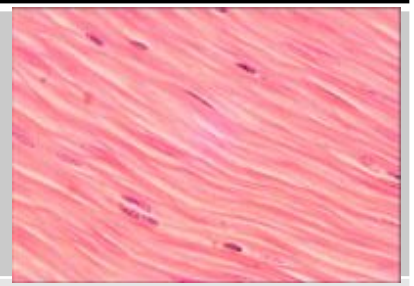
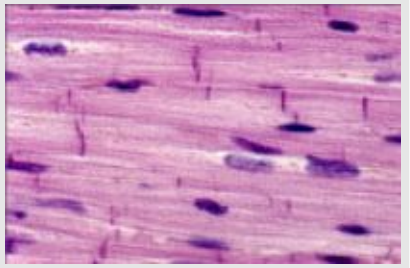
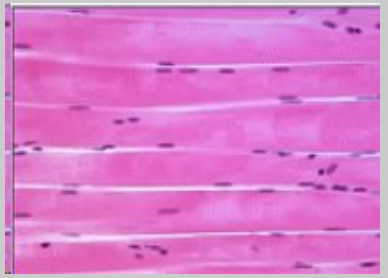

CARDIO
BIOCHEMISTRY

TABLE TO REMEMBER

Types	Branched/Unbranched	Mono/multi nucleated	Smooth or striated	Voluntary or not	
Smooth	Unbranched	Mononucleated	Smooth	Unvoluntary	
Cardiac	Branched with intercalated dics	Mononucleated	Striated	Unvoluntary	
Skeletal	Unbranched	Multinucleated	Striated	Voluntary	

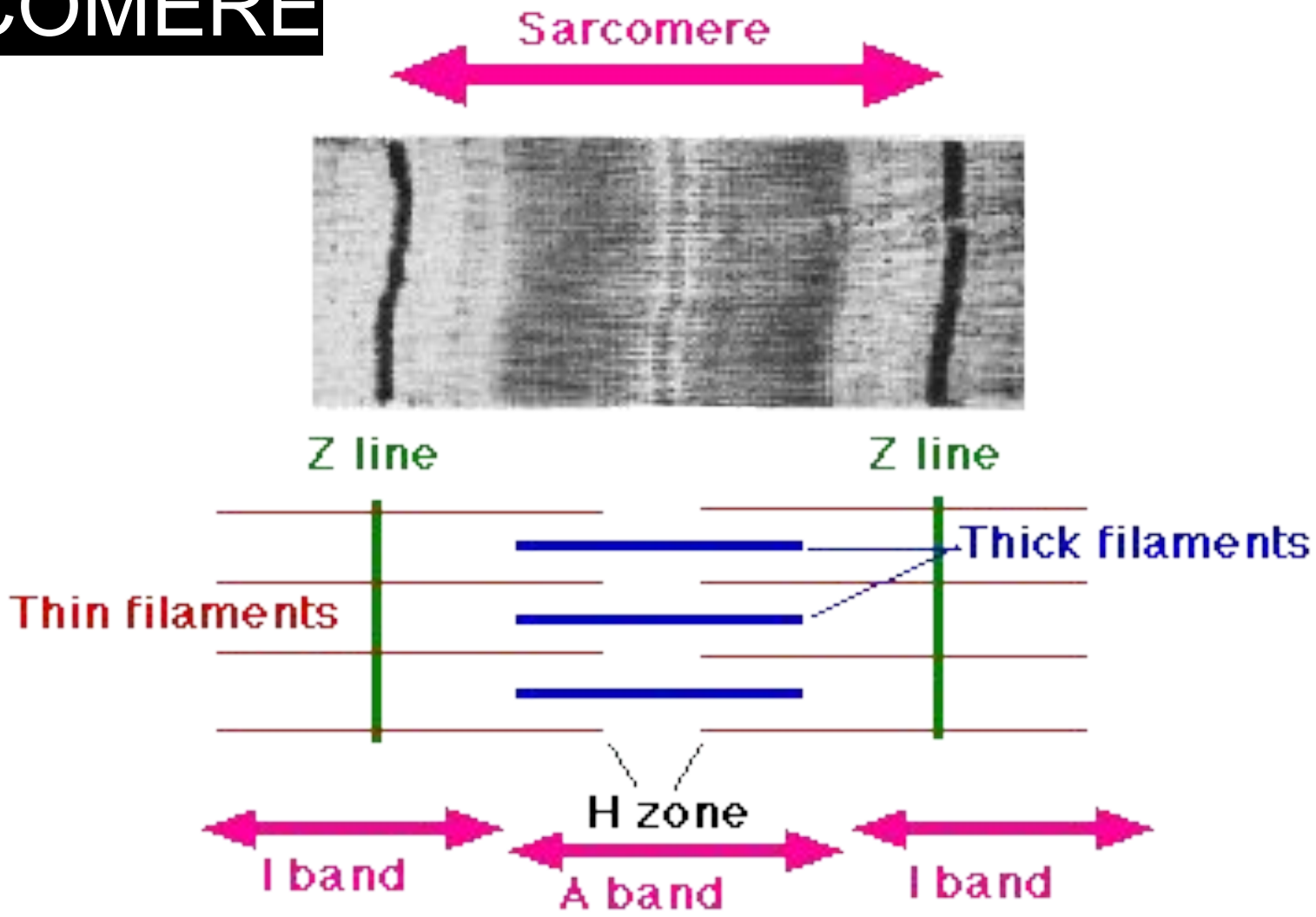
CREDS - THARUN RAJASEKAR Y4

- Sarcomere- contractile unit in muscle
- Z line = neighbouring parallel lines that make up the sarcomere
- M line – line at the centre of the sarcomere where the myosin myofilaments bind
-

  A-band: The length of a myosin myofilament within a sarcomere. There are both thin and thick filaments.
- H-band: The area adjacent to the M-line, where there are thick filaments only
- I-band: The area adjacent to the Z-line, where there are thin filaments only. *This shortens during contraction.*

- Thin filaments are light – **I FOR I band**
- **A band is** d**A**rk **–**

SARCOMERE


Sarcomere
Z line
Z line
Thick filaments
Thin filaments
H zone
I band
A band
I band

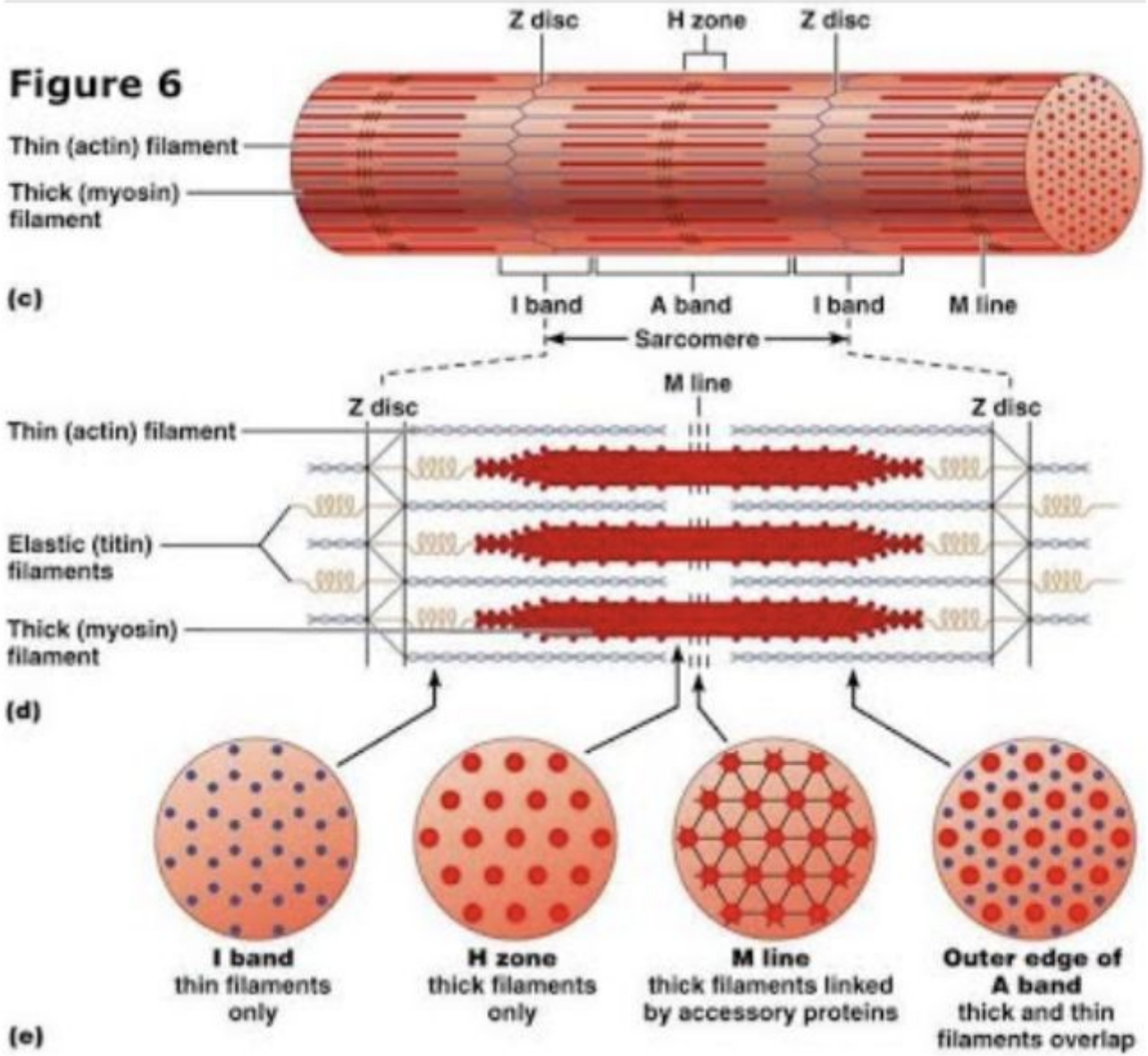


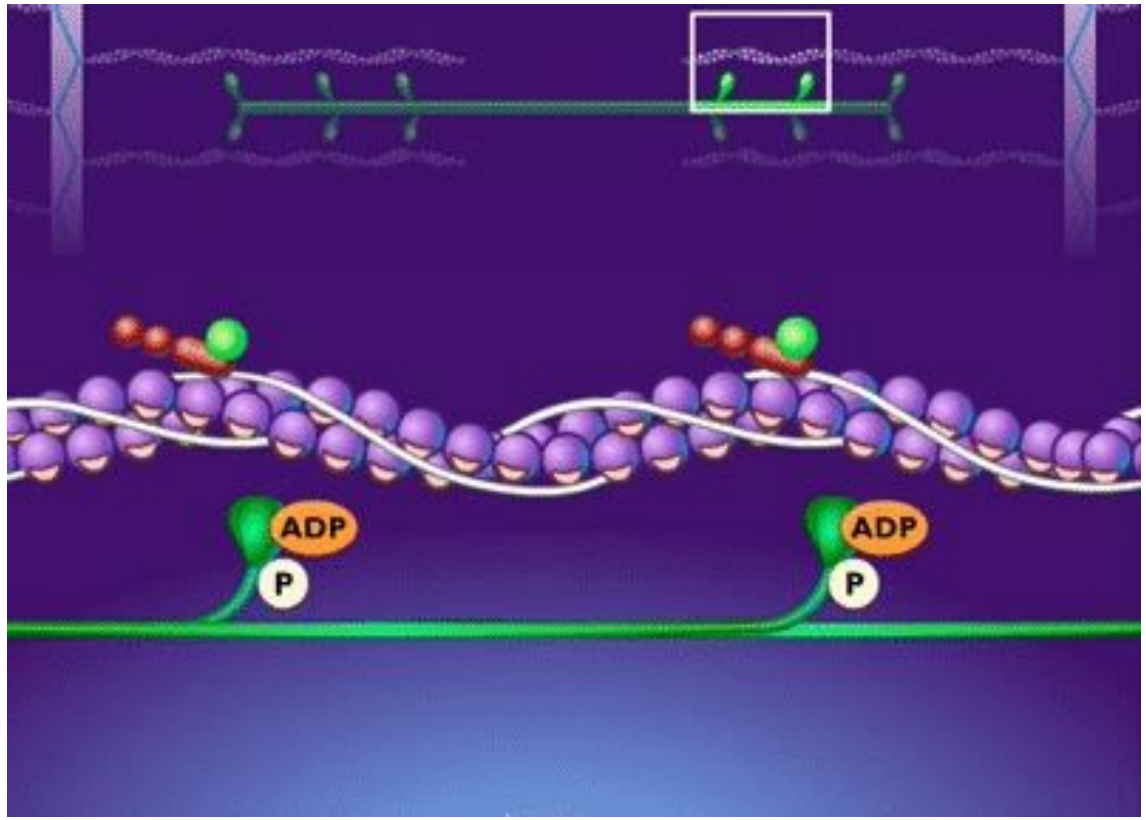
Figure 6
Z disc
H zone
Z disc
Thin (actin) filament
Thick (myosin) filament
(c)
I band
A band
I band
M line
Sarcomere
M line
Z disc
Z disc
Thin (actin) filament
Elastic (titin) filaments
Thick (myosin) filament
(d)
I band
thin filaments only
H zone
thick filaments only
M line
thick filaments linked by accessory proteins
Outer edge of A band
thick and thin filaments overlap
(e)

EXCITATION-CONTRACTION COUPLING

- Relaxed muscle – the tropomyosin binds to the actin, which block the attachment sites for myosin crossbridge, so the myosin can't bind to actin
- During platue phase – tropomyosin binds to actin, L-type Ca^{2+} Channels causes influx of Ca^{2+}
- Ca^{2+} binds to the ryanodine receptor on the sarcoplasm reticulum and this causes Ca^{2+} induced Ca^{2+} realease
- The Ca^{2+} released binds to troponin -> causing a conformational change so now tropomyosin moves away from actin -> so the myosin can bind

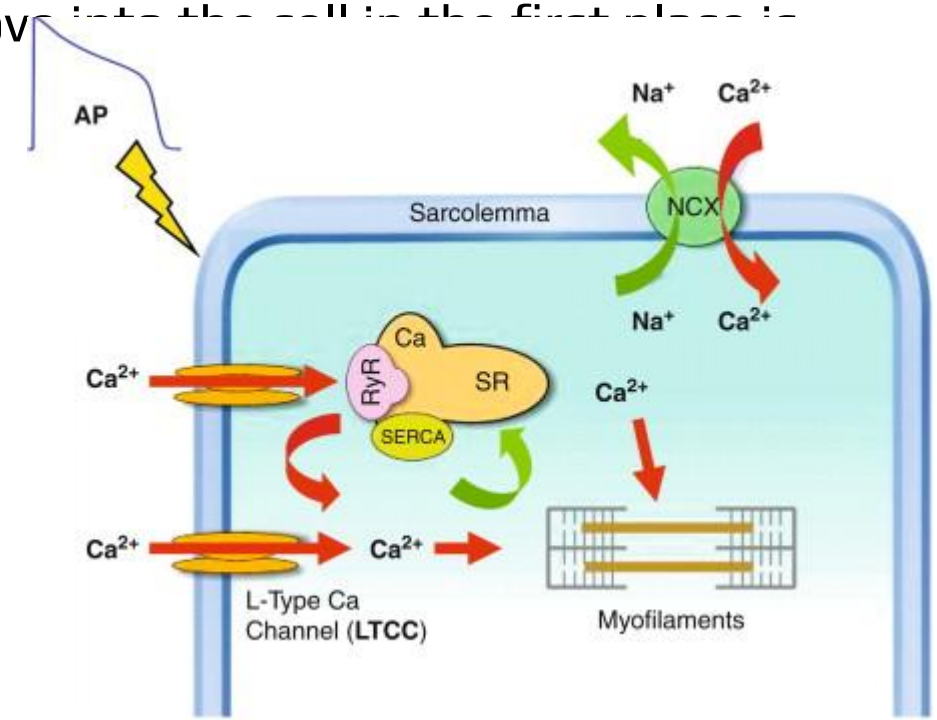
EXCITATION-CONTRACTION COUPLING

- Myosin and actin bind via ATP hydrolysis forming a cross bridge
- Power stroke occurs, making actin slide over myosin -> muscle contracts
- Myosin and actin then release each other using ATP
- Eventually Ca2 decreases and tropomyosin can go back to blocking the attachment sites on actin -> myosin can’t bind


ADP
P
ADP
P

HOW IS CA2+ REMOVED FROM CELLS

- Ca2+ pumped back into the sarcoplasmic reticulum via SERCA (H+/Ca2+ ATPase)
- Ca2+ moves out via NCX antiporter (Na+ moves into the cell whilst Ca2+ is pumped out of the cell... the concentration gradient for Na+ to even move into the cell in the first place is set up by an Na+/K+ ATPase pumping Na+ out.)



LEARN THESE EQUATION

- Cardiac output= SV x heart rate
- Stroke volume= EDV-ESV
- Ejection fraction= SV/EDV
- Blood pressure= CO x peripheral vascular resistance
- Mean arterial pressure= diastolic BP + (1/3 x pulse pressure)

FACTORS AFFECTING STROKE VOLUME

- Preload – the amount of blood in the ventricle that is available for pumping
- Afterload – the arterial pressure against which the ventricle had to contract
- Contractility – force that the heart muscle can contract with

KEY TERMS

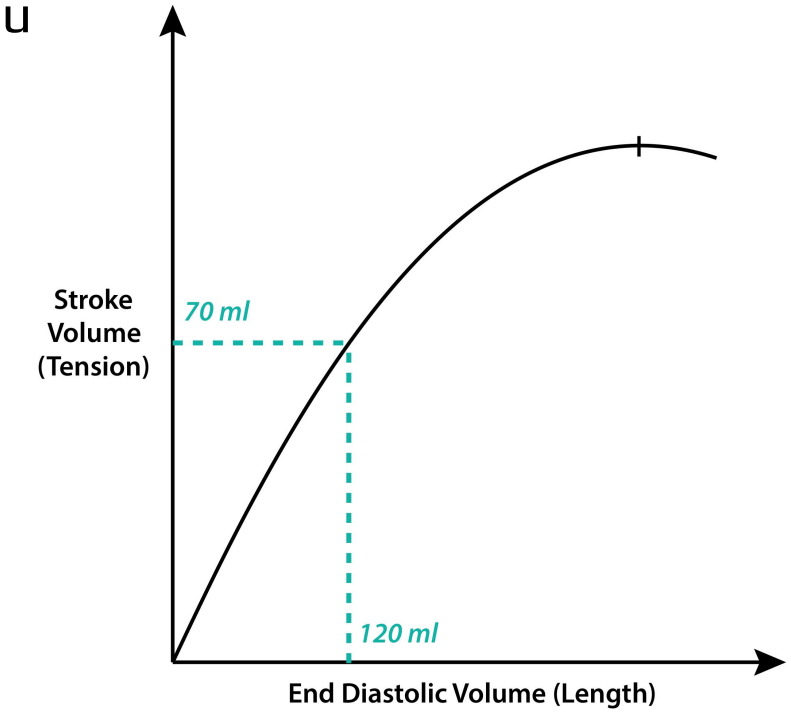
- Chronotropy- affecting the heart rate
- Dronotropy- affecting the speed of conduction
- Inotropy- affecting the force of contraction

CONTRACTILITY IS AFFECTED BY:

Increased contractility	Decreased contractility
Increased contractility: SNS – noradrenaline , adrenaline Ca2+ Increased body temperature Increased T3 and T4 – thyroid hormones	PNS – Ach Low calcium levels Hyperkalaemia - high K+

FRANK STARLING'S LAW

- The higher the EDV – the higher the SV
- This is because the EDV -> stretching the heart muscle -> high preload -> myocardium more stretched -> sarcomere lengthens -> increased sensitivity to Ca2+ ions -> more forceful contraction (+ve inotropic) -> increased stroke volu



QUESTIONS

1

- With regard to afterload:
- A) The mean arterial pressure in the systemic vascular system
- B) The left ventricular end-diastolic pressure (LVEDP)
- C The jugular venous pressure
- D) The pressure the heart must work against to eject blood during systole.
- E) The myocardial contractility

1

- With regard to afterload:
- A) The mean arterial pressure in the systemic vascular system
- B) The left ventricular end-diastolic pressure (LVEDP)
- C The jugular venous pressure
- **D) The pressure the heart must work against to eject blood during systole.**
- E) The myocardial contractility

FACTORS AFFECTING STROKE VOLUME

- Preload – the amount of blood in the ventricle that is available for pumping
- Afterload – the arterial pressure against which the ventricle had to contract
- Contractility – force that the heart muscle can contract with

2

- The cardiovascular effect of the PNS is:
- A) Decreased heart rate
- B) Increased contractility
- C) Increased heart rate
- D) Decreased contractility
- E) Increase in Blood Pressure

2

- The cardiovascular effect of the PNS is:
- A) **Decreased heart rate**
- B) Increased contractility
- C) Increased heart rate
- D) Decreased contractility
- E) Increase in Blood Pressure

PNS has no effect on contracitlity

3

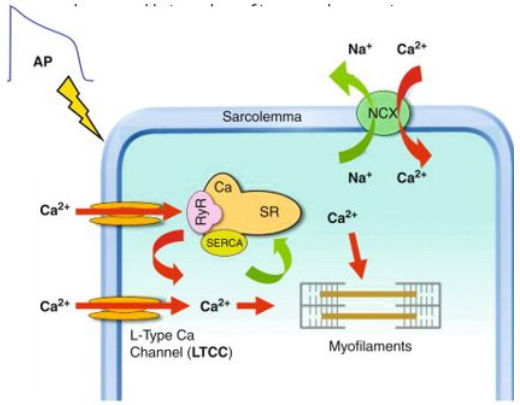
- Which one of the following removes calcium from ventricular cardiomyocytes to the extracellular space?
- A) Na+/K+ ATPase
- B) Na+/Ca2+ exchanger
- C) calcium efflux pump
- D) Ryanodine receptor
- E) SERCA

3

- Which one of the following removes calcium from ventricular cardiomyocytes to the extracellular space?
- A) Na+/K+ ATPase
- **B) Na+/Ca2+ exchanger**
- C) calcium efflux pump
- D) Ryanodine receptor
- E) SERCA

HOW IS CA2+ REMOVED FROM CELLS

- Ca2+ pumped back into the sarcoplasmic reticulum via SERCA (H+/Ca2+ ATPase)
- Ca2+ moves out via NCX antiporter (Na+ moves into the cell whilst Ca2+ is pumped out of the cell... the concentration gradient for Na+ to even move set up by an Na+/K+ ATPase pumping Na+ out.)



4

- Which one of the following will cause a decrease in left ventricular oxygen demand?
- A) increased afterload
- B) increased preload
- C) decrease in ventricular wall tension
- D) increased blood viscosity

4

- Which one of the following will cause a decrease in left ventricular oxygen demand?
- A) increased afterload
- B) increased preload
- C) **decrease in ventricular wall tension**
- D) increased blood viscosity

5

- What is the formula for Mean Arterial Pressure (MAP)?
- A) MAP = systolic blood pressure (SBP) + diastolic blood pressure (DBP)
- B) MAP = DBP + (2/3 x pulse pressure)
- C) MAP = DBP + (1/3 x pulse pressure)
- D) MAP = SBP - DBP
- E) MAP = (SBP + DBP) / 2

5

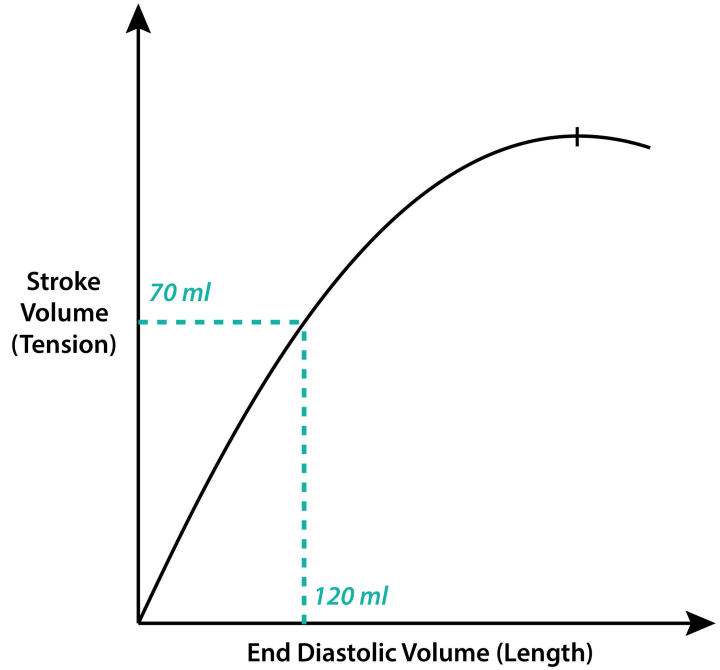
- What is the formula for Mean Arterial Pressure (MAP)?
- A) MAP = systolic blood pressure (SBP) + diastolic blood pressure (DBP)
- B) MAP = DBP + (2/3 x pulse pressure)
- **C) MAP = DBP + (1/3 x pulse pressure)**
- D) MAP = SBP - DBP
- E) MAP = (SBP + DBP) / 2

6

- According to the Frank-Starling law of the heart, what happens to stroke volume (SV) as end-diastolic volume (EDV) increases?
- A) SV remains unchanged
- B) SV decreases
- C) SV increases
- D) It depends on contractility
- E) It depends on afterload

6

- According to the Frank-Starling law of the heart, what happens to stroke volume (SV) as end-diastolic volume (EDV) increases?
- A) SV remains unchanged
- B) SV decreases
- **C) SV increases**
- D) It depends on contractility
- E) It depends on afterload



7

- What is the term for the amount of blood in the ventricle that is available for pumping?
- A) Contractility
- B) Afterload
- C) Preload
- D) Stroke volume
- E) End-diastolic volume

7

- What is the term for the amount of blood in the ventricle that is available for pumping?
- A) Contractility - force of the heart muscle contraction.
- B) Afterload - force the ventricle muscle needs to overcome to eject blood into the arteries.
- **C) Preload**
- D) Stroke volume - amount of blood ejected from the ventricle in a single heartbeat.
- E) End-diastolic volume - volume of blood i

FACTORS AFFECTING STROKE VOLUME

- Preload – the amount of blood in the ventricle that is available for pumping
- Afterload – the arterial pressure against which the ventricle had to contract
- Contractility – force that the heart muscle can contract with

8

- Which of the following can decrease contractility of the heart muscle?
- A) Increased temperature
- B) Increased levels of calcium ions (Ca^{2+})
- C) Increased stimulation by the sympathetic nervous system (SNS) - noradrenaline, adrenaline
- D) Normal levels of thyroid hormones (T3 and T4)
- E) Ach (Acetylcholine)

8

- Which of the following can decrease contractility of the heart muscle?
- A) Increased temperature
- B) Increased levels of calcium ions (Ca2+)
- C) Increased stimulation by the sympathetic nervous system (SNS) - noradrenaline, adrenaline
- D) Normal levels of thyroid hormones (T3 and T4)
- **E) Ach (Acetylcholine)**

Increased contractility	Decreased contractility
Increased contractility: SNS – noradrenaline , adrenaline Ca2+ Increased body temperature Increased T3 ad T4 – thyroid hormones	PNS – Ach Low calcium levels Hyperkalaemia - high K+