

Exercise walk-through

5.3

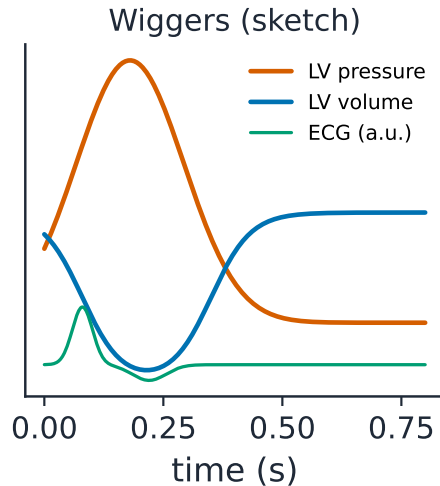
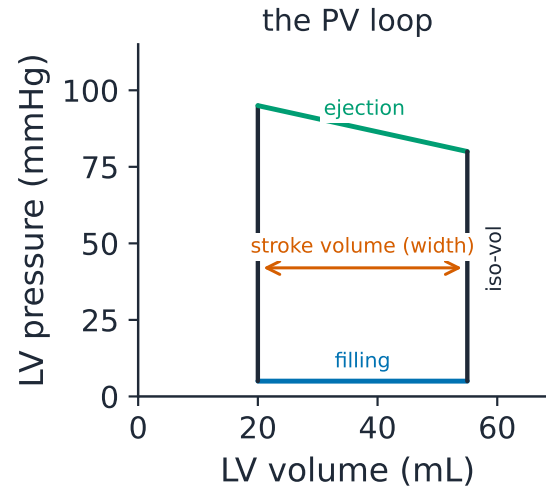
Cardiovascular physiology

University Medicine

Cardiovascular: the three equations

- 1 **Output** $CO = HR \times SV: 70 \times 70 = 4.9 \text{ L/min}$; $MAP = CO \times SVR$; $MAP \approx DBP + (SBP - DBP)/3 \approx 93 \text{ mmHg}$.
- 2 **Loop** PV loop: width = **stroke volume**, area = work; preload widens (Starling), contractility tilts, afterload narrows.
- 3 **Shock** Haemorrhage: $CO \rightarrow 3$ with $SVR \times 2$ holds pressure at $\sim 120\%$ of baseline while organ flow has fallen 40% - trust perfusion, not the cuff.

Cardiovascular physiology - the PV loop



Wiggers sketch beside the **pressure-volume loop** (width = SV).

Exercises 2.1-2.3

2.1 Compute MAP for 120/80.

[3]

2.2 HR rises to 100 with SV 50 mL – what happens to CO?

[3]

2.3 Name the loop's three levers and their geometric effect.

[3]

Exercises 2.1-2.3

2.1 Compute MAP for 120/80. [3]

2.1

- $80 + 40/3 \approx 93$ mmHg ✓.

2.2 HR rises to 100 with SV 50 mL – what happens to CO? [3]

2.2

- $100 \times 50 = 5$ L/min – unchanged if SV falls proportionally ✓.

2.3 Name the loop's three levers and their geometric effect. [3]

2.3

- Preload widens, contractility tilts up, afterload narrows.

Exercises 3.1-3.2

3.1 Haemorrhage (fictional): 1 L lost.

Predict CO and the reflex SVR change. Compute the new relative MAP (3×2 vs 5×1).

Explain why organ perfusion falls more than pressure suggests. [8]

3.2 A new systolic murmur after myocardial infarction (fictional).

Explain how regurgitation splits the loop's width. Predict the reflex heart-rate change and its purpose. State what the loop's width now OVERestimates. [7]

Exercises 3.1-3.2

3.1 Haemorrhage (fictional): 1 L lost.

Predict CO and the reflex SVR change. Compute the new relative MAP (3×2 vs 5×1).
Explain why organ perfusion falls more than pressure suggests. [8]

3.1

- Filling falls $\rightarrow$ CO $\approx$ 3 L/min; baroreflex roughly doubles SVR.
- $MAP \propto 3 \times 2 = 6$ vs baseline $5 \times 1 = 5$: $\sim 120\%$ – pressure near-normal.
- Perfusion = flow per organ: CO is down 40% while pressure looks defended – flow, not pressure, feeds kidneys.

3.2 A new systolic murmur after myocardial infarction (fictional).

Explain how regurgitation splits the loop's width. Predict the reflex heart-rate change and its purpose. State what the loop's width now OVERestimates. [7]

3.2

- Regurgitant ejection returns part of the width to the atrium: forward + backward = total width.
- Reflex tachycardia: hold forward CO by rate when SV leaks.
- Width overestimates FORWARD stroke: part is regurgitant.