

MULTIPLE CHOICE

VT HEMODYNAMICS AND PHYSICS - PRACTICE SET - ANSWER KEY

PROPOSED FOR REVIEW - questions are the author's verbatim Q&A; distractors are auto-selected from other answers in the same bank and must be checked by a subject-matter reviewer (a distractor could coincidentally be correct). Not authoritative assessment content.

1. Which fluid property primarily determines viscous resistance to blood flow?

- A. Density
- B. Compressibility
- C. Viscosity**
- D. Temperature

2. The 'no-slip' boundary condition in blood flow implies that velocity at the vessel wall is:

- A. Higher than at the center
- B. Negative across the cardiac cycle
- C. Equal to the centerline velocity
- D. Approximately zero**

3. Spectral broadening on Doppler waveforms is best defined as:

- A. Increased peak systolic velocity above 125 cm/s
- B. A wider range of velocities present within the sample volume during a cardiac cycle**
- C. Loss of the spectral window only in early diastole
- D. Wider color flow bandwidth on a duplex image

4. To reduce aliasing while maintaining sensitivity to high velocities, the operator should first:

- A. Decrease the transmit frequency only
- B. Increase the pulse repetition frequency or velocity scale**
- C. Increase the Doppler angle toward 90 degrees
- D. Decrease the gain

5. Poiseuille's law predicts that, for steady laminar flow in a rigid tube, flow is proportional to:

- A. The fourth power of the radius**
- B. The radius itself
- C. The cube of the radius
- D. The square of the radius

6. For a fixed Doppler angle and constant blood velocity, increasing the transmit frequency will:

- A. Leave the Doppler shift unchanged
- B. Increase the Doppler shift frequency**
- C. Eliminate aliasing automatically
- D. Decrease the Doppler shift frequency

7. In the carotid duplex, an internal carotid artery PSV that is greatly elevated above the common carotid PSV most likely reflects:

- A. A focal hemodynamically significant ICA stenosis**
- B. Increased downstream cerebral resistance
- C. Tortuosity of the common carotid only
- D. A common carotid origin stenosis

8. A peripheral arterial waveform that is monophasic with continuous forward flow most likely indicates:

- A. Acute deep vein thrombosis
- B. Increased peripheral resistance
- C. Normal flow in a young patient
- D. Flow distal to a hemodynamically significant proximal stenosis or occlusion**

9. Which statement BEST describes the relationship between volume flow, pressure gradient, and resistance in a vascular bed?

A. Flow equals pressure gradient divided by resistance

B. Flow equals pressure gradient plus resistance

C. Flow equals resistance divided by pressure gradient

D. Flow equals pressure gradient times resistance

10. Compared to a normal peripheral artery at rest, exercise hyperemia produces a waveform that is:

A. Monophasic with absent systolic component

B. Higher resistance with deeper diastolic reversal

C. Unchanged from the resting waveform

D. Lower resistance with increased diastolic forward flow

11. A tardus parvus waveform distal to a stenosis is characterized by:

A. Sharp systolic upstroke and increased amplitude

B. Slow systolic upstroke and decreased peak amplitude

C. Reversed diastolic flow only

D. Absent systolic component with preserved diastolic flow

12. For the most accurate calculation of true blood velocity from a Doppler shift, the operator must:

A. Align the angle correction cursor parallel to the long axis of flow at an insonation angle of 60 degrees or less

B. Disable angle correction for color Doppler imaging only

C. Set the angle correction cursor perpendicular to the vessel wall

D. Maintain an insonation angle of 90 degrees

13. A normal peripheral arterial spectral Doppler waveform in a resting lower extremity is best described as:

A. Monophasic with continuous forward flow

B. Triphasic

C. Biphasic with absent diastolic flow

D. Continuous high-diastolic flow

14. Across a hemodynamically significant stenosis, the relationship between kinetic energy and pressure is best described by which principle?

A. Newton's first law: an object in motion stays in motion

B. Boyle's law: pressure and volume are inversely related at constant temperature

C. Bernoulli's principle: as velocity rises, lateral pressure falls

D. Pascal's principle: pressure applied is transmitted equally

15. A renal artery tardus parvus waveform distal to its origin is most suggestive of:

A. Intrarenal small vessel disease only

B. A proximal renal artery stenosis

C. Renal vein thrombosis

D. Increased downstream renal resistance

16. A vascular sonographer observes a sharp color shift (mosaic) at a focal segment of an artery on color Doppler. The most likely underlying phenomenon is:

A. Turbulence with aliasing at a stenosis

B. Mirror image artifact

C. Range ambiguity from a deep vessel

D. Increased Doppler gain only

17. End diastolic velocity becomes elevated in the internal carotid artery primarily when:

A. The Doppler angle is set at 45 degrees

B. The CCA waveform is biphasic

C. The patient is bradycardic

D. A high-grade stenosis is present in the ICA

18. Which option BEST distinguishes continuous wave from pulsed wave Doppler?

A. CW measures any velocity along the beam but lacks depth selectivity

B. CW cannot detect high velocities encountered in tight stenoses

C. CW provides better range resolution than PW

D. CW has a Nyquist limit similar to PW

19. What is the maximum Doppler angle that should be used when measuring peripheral arterial velocities to keep velocity error within acceptable limits?

- A. 45 degrees or less only
- B. 60 degrees**
- C. 90 degrees
- D. 75 degrees

20. A peripheral arterial waveform that has lost the early diastolic reversal but retains a sharp systolic upstroke is best classified as:

- A. Monophasic
- B. Triphasic
- C. Biphasic**
- D. Tardus parvus

21. In the modified Bernoulli equation used clinically, a pressure gradient across a stenosis is estimated as:

- A. Two times the peak velocity
- B. Four times the peak velocity squared**
- C. Peak velocity squared divided by two
- D. Eight times the peak velocity

22. Which statement best describes the relationship between Doppler angle and calculated velocity error?

- A. Velocity error is independent of the cosine of the angle
- B. As the angle approaches 90 degrees, small angle errors produce large velocity errors**
- C. Velocity error is largest at angles below 30 degrees
- D. Velocity error is constant at all angles below 90 degrees

23. The pulsatility index (PI) is calculated as:

- A. (Peak systolic velocity - end diastolic velocity) / peak systolic velocity
- B. Peak systolic velocity / end diastolic velocity
- C. Mean velocity / peak systolic velocity
- D. (Peak systolic velocity - end diastolic velocity) / mean velocity**

24. Which vascular bed normally exhibits low-resistance flow with continuous forward diastolic flow?

- A. Internal carotid artery**
- B. External carotid artery
- C. Resting brachial artery
- D. Resting common femoral artery

25. What flow pattern is characterized by orderly, parallel streamlines with the highest velocity in the center of the vessel?

- A. Laminar flow**
- B. Disturbed flow
- C. Turbulent flow
- D. Plug flow