

MULTIPLE CHOICE

VT HEMODYNAMICS AND PHYSICS - PRACTICE SET

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. $(\text{Peak systolic velocity} - \text{end diastolic velocity}) / \text{peak systolic velocity}$
- B. $\text{Peak systolic velocity} / \text{end diastolic velocity}$
- C. $\text{Mean velocity} / \text{peak systolic velocity}$
- D. $(\text{Peak systolic velocity} - \text{end diastolic velocity}) / \text{mean velocity}$

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