Hemodynamics: Physical Principles

Chapter 1 Pre-Lecture Worksheet | Student Resource

Review of Sonographic Vocabulary Terms

Match each term with the appropriate definition.

Key Terms	Definitions
☐ 1. Hemodynamics	A. The internal friction of a fluid that resists motion between adjacent layers.
☐ 2. Kinetic energy	B. An estimate of downstream vascular resistance calculated from systolic and diastolic velocities.
☐ 3. Potential energy	C. Energy possessed by blood as a result of its motion.
☐ 4. Hydrostatic pressure	D. The difference in pressure between two locations within a fluid.
☐ 5. Pressure gradient	E. The tendency of matter to resist changes in its state of motion.
☐ 6. Viscosity	F. Pressure generated by the weight of a fluid at rest.
☐ 7. Inertia	G. The application of fluid physics to the movement of blood through vessels.
☐ 8. Hagen-Poiseuille principle	H. Opposition to blood flow as it perfuses an organ or tissue bed.
☐ 9. Peripheral vascular resistance	I. Stored energy, including gravitational and elastic forms.
☐ 10. Resistivity index (RI)	J. A fluid-flow relationship in which volume flow varies with the fourth power of vessel radius.

Hemodynamics: Physical Principles

Chapter 1 Pre-Lecture Worksheet | Student Resource

Fill in the Blanks

Name: _____ Date: _____

1. Hemodynamics is the clinical application of _____ to the movement of blood.
2. The primary function of the human circulatory system is _____.
3. The three governing categories are hemodynamic forces, properties of blood, and properties of _____.
4. The three fundamental Doppler flow characteristics are presence, direction, and flow _____.
5. Physiologically, blood flows from regions of _____ pressure toward regions of _____ pressure.
6. Clinical Doppler systems display blood flow direction relative to the _____.
7. Kinetic energy is the energy of _____.
8. When blood velocity doubles, its kinetic energy increases by a factor of _____.
9. Elastic potential energy stored in the arterial wall during systole is released during _____.
10. Gravitational potential energy depends on mass and vertical _____.
11. Total fluid energy includes gravitational potential energy, kinetic energy, and _____ energy.
12. For most clinical hemodynamic applications, blood is considered effectively _____.

Hemodynamics: Physical Principles

Chapter 1 Pre-Lecture Worksheet | Student Resource

Fill in the Blanks continued

13. Friction is a resistive force that tends to oppose _____.
14. Pressure is defined as force per unit _____.
15. Hydrostatic pressure is generated by the weight of fluid at _____.
16. Hydrostatic pressure varies with the height and _____ of the fluid column.
17. Fluid at rest transmits pressure equally in all directions, a property called _____.
18. Pascal's principle concerns pressure changes transmitted through an enclosed _____.
19. Transmural pressure equals pressure inside a vessel minus pressure _____ the vessel.
20. Under the Law of Laplace, wall tension increases as vessel _____ increases.
21. Hydrodynamic pressure is associated with fluid in _____.
22. A pressure gradient is the pressure _____ between two points.
23. Doppler ultrasound measures blood _____ rather than pressure directly.
24. The Bernoulli Principle is based on conservation of _____.
25. In an arterial stenosis, increasing blood velocity is associated with _____ pressure.
26. At the narrowest portion of a stenosis, blood velocity is typically at its _____.

Hemodynamics: Physical Principles

Chapter 1 Pre-Lecture Worksheet | Student Resource

Fill in the Blanks continued

27. Incomplete pressure recovery distal to a stenosis results from irreversible _____ losses.
28. The three primary physical properties of blood are density, inertial mass, and _____.
29. Density is defined as mass per unit _____.
30. Blood consists of approximately 55% plasma and 45% formed _____.
31. Inertial mass is a measure of resistance to _____.
32. Viscosity is the internal _____ of a fluid.
33. Increasing blood viscosity generally _____ vascular resistance.
34. According to Hagen-Poiseuille, flow volume is proportional to vessel radius raised to the _____ power.
35. Vasodilation increases vessel diameter and generally _____ vascular resistance.
36. Vascular elasticity allows a vessel to _____ to its original shape after deformation.
37. A smooth endothelial lining promotes _____ blood flow.
38. Low-resistance arterial flow has persistent forward flow during _____.
39. Peripheral vascular resistance is the pressure gradient divided by flow _____.
40. Resistivity index (RI) is calculated from peak systolic and _____ velocities.

Hemodynamics: Physical Principles

Chapter 1 Worksheet Answer Key | Educator Resource

Review of Sonographic Vocabulary Terms

Match each term with the appropriate definition.

	Key Terms	Definitions
G	1. Hemodynamics	A. The internal friction of a fluid that resists motion between adjacent layers.
C	2. Kinetic energy	B. An estimate of downstream vascular resistance calculated from systolic and diastolic velocities.
I	3. Potential energy	C. Energy possessed by blood as a result of its motion.
F	4. Hydrostatic pressure	D. The difference in pressure between two locations within a fluid.
D	5. Pressure gradient	E. The tendency of matter to resist changes in its state of motion.
A	6. Viscosity	F. Pressure generated by the weight of a fluid at rest.
E	7. Inertia	G. The application of fluid physics to the movement of blood through vessels.
J	8. Hagen-Poiseuille principle	H. Opposition to blood flow as it perfuses an organ or tissue bed.
H	9. Peripheral vascular resistance	I. Stored energy, including gravitational and elastic forms.
B	10. Resistivity index (RI)	J. A fluid-flow relationship in which volume flow varies with the fourth power of vessel radius.

Hemodynamics: Physical Principles

Chapter 1 Worksheet Answer Key | Educator Resource

Fill in the Blanks

Name: _____ Date: _____

1. Hemodynamics is the clinical application of **fluid physics** to the movement of blood.
2. The primary function of the human circulatory system is **transport**.
3. The three governing categories are hemodynamic forces, properties of blood, and properties of **blood vessels**.
4. The three fundamental Doppler flow characteristics are presence, direction, and flow **profile**.
5. Physiologically, blood flows from regions of **higher** pressure toward regions of **lower** pressure.
6. Clinical Doppler systems display blood flow direction relative to the **transducer**.
7. Kinetic energy is the energy of **motion**.
8. When blood velocity doubles, its kinetic energy increases by a factor of **four**.
9. Elastic potential energy stored in the arterial wall during systole is released during **diastole**.
10. Gravitational potential energy depends on mass and vertical **height**.
11. Total fluid energy includes gravitational potential energy, kinetic energy, and **pressure** energy.
12. For most clinical hemodynamic applications, blood is considered effectively **incompressible**.

Hemodynamics: Physical Principles

Chapter 1 Worksheet Answer Key | Educator Resource

Fill in the Blanks continued

13. Friction is a resistive force that tends to oppose **motion**.
14. Pressure is defined as force per unit **area**.
15. Hydrostatic pressure is generated by the weight of fluid at **rest**.
16. Hydrostatic pressure varies with the height and **density** of the fluid column.
17. Fluid at rest transmits pressure equally in all directions, a property called **isotropy**.
18. Pascal's principle concerns pressure changes transmitted through an enclosed **fluid**.
19. Transmural pressure equals pressure inside a vessel minus pressure **outside** the vessel.
20. Under the Law of Laplace, wall tension increases as vessel **radius** increases.
21. Hydrodynamic pressure is associated with fluid in **motion**.
22. A pressure gradient is the pressure **difference** between two points.
23. Doppler ultrasound measures blood **velocity** rather than pressure directly.
24. The Bernoulli Principle is based on conservation of **energy**.
25. In an arterial stenosis, increasing blood velocity is associated with **decreasing** pressure.
26. At the narrowest portion of a stenosis, blood velocity is typically at its **maximum**.

Hemodynamics: Physical Principles

Chapter 1 Worksheet Answer Key | Educator Resource

Fill in the Blanks continued

27. Incomplete pressure recovery distal to a stenosis results from irreversible **energy** losses.
28. The three primary physical properties of blood are density, inertial mass, and **viscosity**.
29. Density is defined as mass per unit **volume**.
30. Blood consists of approximately 55% plasma and 45% formed **elements**.
31. Inertial mass is a measure of resistance to **acceleration**.
32. Viscosity is the internal **friction** of a fluid.
33. Increasing blood viscosity generally **increases** vascular resistance.
34. According to Hagen-Poiseuille, flow volume is proportional to vessel radius raised to the **fourth** power.
35. Vasodilation increases vessel diameter and generally **decreases** vascular resistance.
36. Vascular elasticity allows a vessel to **return** to its original shape after deformation.
37. A smooth endothelial lining promotes **laminar** blood flow.
38. Low-resistance arterial flow has persistent forward flow during **diastole**.
39. Peripheral vascular resistance is the pressure gradient divided by flow **volume**.
40. Resistivity index (RI) is calculated from peak systolic and **end-diastolic** velocities.