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Vascular System: Arteries, Veins, Capillaries & Regulation

Study Guide — Vascular System

Pre-med/IB-level practice on vessel anatomy (tunics, valves, compliance), artery vs vein function, capillary types and exchange, portal systems (hepatic and pituitary), and regulation of vascular tone (autonomic, endothelial and hormonal control).

60 items — Study Guide with Answers

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1 Which structural feature most directly allows arteries to withstand and maintain higher pressures than veins?

- A A larger lumen diameter that reduces pressure
- B **A thicker tunica media with more smooth muscle and elastic tissue ✓**
- C A one-cell-thick wall optimized for diffusion
- D Numerous one-way valves along their length
- E Fenestrations that allow proteins to pass through the wall

► **Explanation:** Arteries have a thick tunica media rich in smooth muscle and elastic fibers, letting them resist and buffer high pressures. Valves are typical of veins, and one-cell-thick/fenestrated walls describe capillaries specialized for exchange.



2 Valves that prevent backflow of blood are most characteristic of:

- A Elastic arteries (e.g., aorta)
- B Arterioles
- C Capillaries
- D **Medium and large veins, especially in the limbs ✓**
- E Pulmonary arteries only

► **Explanation:** Veins—particularly in the limbs where blood must travel against gravity—often contain valves that prevent backflow and support venous return. Arteries and capillaries do not typically have valves along their length.



3 Which vessels contribute the most to total peripheral resistance (TPR) in the systemic circulation?





- A Aorta
- B Large veins
- C Arterioles ✓**
- D Capillaries
- E Venules

► **Explanation:** Arterioles have small radii and lots of smooth muscle, so they provide most resistance and are the main site of TPR regulation. The aorta has low resistance, and capillaries collectively have large cross-sectional area despite tiny individual radii.

4 At rest, the greatest fraction of blood volume is found in the:



- A Aorta and elastic arteries
- B Systemic veins and venules ✓**
- C Arterioles
- D Capillaries
- E Pulmonary arteries

► **Explanation:** Systemic veins/venules are highly compliant 'capacitance' vessels and store much of the body's blood volume at rest. Arteries hold less volume because their walls are less compliant and pressures are higher.

5 Which statement about oxygen content and vessel type is correct in an adult?



- A All arteries carry oxygenated blood and all veins carry deoxygenated blood
- B Pulmonary arteries carry oxygenated blood from the lungs to the heart
- C Pulmonary veins carry deoxygenated blood from the heart to the lungs





D Systemic veins always have higher oxygen content than systemic arteries

E **Pulmonary veins generally carry oxygenated blood to the left atrium** ✓

► **Explanation:** Pulmonary veins return oxygenated blood from the lungs to the left atrium. Arteries/veins are defined by direction of flow relative to the heart, not oxygen content—pulmonary arteries are a key exception because they carry deoxygenated blood to the lungs.

6 A vessel that carries blood away from the heart is classified as an artery even if the blood is deoxygenated. Which example best illustrates this rule?



A **Pulmonary artery leaving the right ventricle** ✓

B Pulmonary vein entering the left atrium

C Superior vena cava entering the right atrium

D Hepatic vein leaving the liver

E Coronary vein leaving the myocardium

► **Explanation:** Arteries carry blood away from the heart. The pulmonary artery leaves the right ventricle and carries deoxygenated blood to the lungs, illustrating that vessel names depend on flow direction, not oxygen level.

7 The main functional advantage of elastic arteries (e.g., the aorta) is that they:



A Contain valves that prevent backflow during diastole

B Are the main site of nutrient and gas exchange

C **Stretch during systole and recoil during diastole to smooth blood flow and maintain diastolic pressure** ✓

D Generate action potentials to coordinate heartbeat

E Have the highest resistance to slow blood flow





► **Explanation:** Elastic arteries act as a 'pressure reservoir': they stretch when the heart ejects blood and recoil between beats, smoothing pulsatile flow (Windkessel effect). Exchange occurs in capillaries, and arterioles create most resistance.

8 In the systemic circulation, blood pressure is highest in the:



- A Aorta ✓
- B Large veins
- C Capillaries
- D Venules
- E Vena cava

► **Explanation:** Pressure is highest closest to the pumping heart—largest in the aorta—and progressively falls across the circulation, reaching the lowest values in large veins near the right atrium.

9 The greatest drop in blood pressure in the systemic circulation occurs across the:



- A Aorta
- B Large arteries
- C Capillaries
- D Arterioles ✓
- E Large veins

► **Explanation:** Arterioles are the primary resistance vessels, so they cause the largest pressure drop. Capillaries have low pressure that supports exchange, but most of the pressure fall has already happened upstream.





10 Blood flow velocity is lowest in the:

- A Aorta
- B Arterioles
- C Capillaries ✓
- D Large veins
- E Pulmonary artery



► **Explanation:** Velocity is lowest in capillaries because the total cross-sectional area of all capillaries combined is greatest, allowing slow flow for efficient exchange.

11 Blood velocity decreases dramatically from arteries to capillaries mainly because:

- A Capillaries have the highest pressure
- B The total cross-sectional area of capillaries is very large ✓
- C Capillaries have valves that slow flow
- D Blood becomes more viscous in capillaries
- E Capillaries actively pump blood forward



► **Explanation:** For a given flow rate (Q), velocity $v = Q/A$. Total cross-sectional area (A) is maximal in capillary beds, so velocity is minimal there. Capillaries do not have valves or pumps.

12 Compared with arteries, veins generally have a thinner tunica media. In many veins, the most prominent layer is the:

- A Tunica intima only
- B Endothelium + basement membrane only





- C Tunica media only
- D Elastic lamina only
- E **Tunica externa (adventitia) ✓**

► **Explanation:** Veins typically have a relatively thicker tunica externa (adventitia) compared with their tunica media. Arteries usually have a thicker tunica media to handle higher pressures.

13 Veins are often called 'capacitance' vessels primarily because they:



- A Have the highest resistance in the circulation
- B Always carry oxygenated blood
- C Act as the main exchange surface for gases
- D **Can store large volumes of blood with relatively small changes in pressure ✓**
- E Contain pacemaker cells that control heart rate

► **Explanation:** High compliance allows veins to hold (store) a lot of blood with little increase in pressure, making them important reservoirs. Arterioles create most resistance, and capillaries are the exchange surface.

14 Large arteries (e.g., aorta) contain vasa vasorum mainly because:



- A They need valves to prevent backflow
- B **Diffusion of oxygen/nutrients from the lumen is insufficient to supply the outer wall layers ✓**
- C They must exchange glucose directly with tissues like capillaries
- D They have no endothelium so must be supplied externally
- E They are always surrounded by skeletal muscle that consumes oxygen





► **Explanation:** The walls of large vessels are too thick for diffusion from the lumen to nourish outer layers, so small vessels (vasa vasorum) supply them. Valves are typical of veins, and arteries do have endothelium.

15 Which capillary type has large gaps that can allow proteins (and sometimes cells) to pass and is common in liver and bone marrow?



- A Sinusoidal (discontinuous) capillaries** ✓
- B Continuous capillaries
- C Fenestrated capillaries
- D Arterioles
- E Lymphatic capillaries only

► **Explanation:** Sinusoidal capillaries have discontinuous endothelium/basement membrane, enabling passage of larger molecules and even cells (e.g., in liver, spleen, bone marrow). Continuous and fenestrated capillaries are less permeable.

16 Fenestrated capillaries are especially common where rapid filtration/absorption occurs, such as in the:



- A Skeletal muscle
- B Brain (blood–brain barrier)
- C Kidney glomeruli** ✓
- D Aorta
- E Large veins of the leg

► **Explanation:** Fenestrated capillaries have pores that enhance exchange and are common in kidneys (filtration) and some endocrine/intestinal tissues. Brain capillaries are typically continuous with tight junctions.





17 Continuous capillaries with tight junctions are most associated with tissues requiring controlled exchange, such as the:



- A Liver
- B Brain (blood–brain barrier) ✓
- C Bone marrow
- D Kidney glomerulus
- E Splenic red pulp

► **Explanation:** The blood–brain barrier relies on continuous capillaries with tight junctions to tightly regulate movement of substances. Liver and marrow often use more permeable sinusoidal capillaries; kidney glomeruli are fenestrated.

18 A portal system is best defined as:



- A A single artery that branches into many capillaries and then returns directly to the heart
- B A direct artery-to-vein connection that bypasses capillaries
- C Any vein that carries blood back to the heart
- D Blood flowing from one capillary bed to a second capillary bed before returning to the heart ✓
- E Any circulation that includes both arteries and veins

► **Explanation:** A portal system connects two capillary beds in series via a portal vein (or vessels), allowing substances absorbed or released in one region to be delivered directly to another before systemic dilution.





19 The hepatic portal system is important because it:

- A** Delivers nutrient-rich blood from the gastrointestinal tract to the liver for processing before it enters systemic circulation ✓
- B** Carries oxygenated blood from the liver to the intestines
- C** Bypasses the liver so nutrients reach the heart faster
- D** Is the only route for blood to reach the kidneys
- E** Carries lymph directly into the portal vein

► **Explanation:** The hepatic portal vein carries absorbed nutrients (and some toxins/drugs) from the gut to the liver first, enabling metabolism, storage, and detoxification ('first-pass' processing). It does not bypass the liver.



20 The hypothalamic–hypophyseal (pituitary) portal system is especially useful because it:

- A** Carries oxygenated blood to the brain
- B** Allows the posterior pituitary to release insulin directly into the liver
- C** Delivers hypothalamic releasing hormones to the anterior pituitary at high concentration without systemic dilution ✓
- D** Prevents any hormones from reaching the pituitary
- E** Connects the pituitary directly to the right ventricle

► **Explanation:** Hypothalamic hormones regulate the anterior pituitary. A portal system sends these signals directly from hypothalamic capillaries to pituitary capillaries, keeping concentrations high and responses fast.



21 Medium-sized muscular arteries are sometimes called 'distributing arteries' because they primarily:





- A Perform gas exchange with tissues
- B Deliver blood to specific organs and can adjust regional flow by changing diameter**
- C Store the largest fraction of blood volume
- D Generate the greatest pressure drop in the circulation
- E Contain valves to prevent backflow during standing

► **Explanation:** Muscular arteries distribute blood to organs and have substantial smooth muscle to regulate regional blood flow. Arterioles create the greatest resistance/pressure drop; veins are the major reservoirs and have valves.

22 Which statement correctly compares elastic arteries and muscular arteries?



- A Elastic arteries have more smooth muscle than muscular arteries
- B Muscular arteries are closest to the heart and mainly buffer pulse pressure
- C Elastic arteries are the main site of nutrient exchange
- D Elastic arteries have more elastin and help smooth pulsatile flow; muscular arteries have more smooth muscle and regulate distribution to organs** ✓
- E Both types are identical; the names only reflect location

► **Explanation:** Elastic arteries (aorta) have abundant elastin to stretch/recoil and smooth pulsatile output. Muscular arteries have more smooth muscle relative to elastin and actively regulate organ blood distribution.

23 Nitric oxide (NO) released by endothelial cells causes vasodilation mainly by:



- A Directly opening voltage-gated Na^+ channels in smooth muscle
- B Increasing intracellular Ca^{2+} in smooth muscle
- C Activating actin–myosin cross-bridges in smooth muscle





- D Blocking oxygen delivery to tissues
- E Diffusing into smooth muscle and increasing cGMP, which promotes relaxation ✓**

► **Explanation:** Endothelial NO diffuses into vascular smooth muscle and activates guanylate cyclase, increasing cGMP and causing relaxation (vasodilation). Increased Ca^{2+} would promote contraction, not dilation.

24 Endothelin is best described as a molecule that:



- A Is released by red blood cells to increase oxygen delivery by vasodilation
- B Is produced by endothelium and is a potent vasoconstrictor ✓**
- C Is a valve-like structure inside veins
- D Always causes vasodilation in all tissues
- E Only exists in capillaries and never affects arterioles

► **Explanation:** Endothelin is an endothelium-derived peptide that strongly constricts blood vessels. It contrasts with NO, which tends to dilate vessels.

25 In most systemic arterioles, sympathetic release of norepinephrine (NE) primarily causes:



- A Vasoconstriction via 1 receptors, increasing resistance ✓**
- B Vasodilation via 2 receptors, decreasing resistance
- C No change because arterioles lack receptors
- D Opening of venous valves
- E Direct increase in blood viscosity





► **Explanation:** NE commonly activates α_1 receptors on arteriolar smooth muscle, causing vasoconstriction and raising total peripheral resistance. α_2 -mediated dilation is more associated with epinephrine in certain tissues.

26 During a stress response, epinephrine can increase blood flow to skeletal muscle despite overall sympathetic activation. The best explanation is:



- A** Epinephrine only binds receptors in veins, not arteries
- B** Skeletal muscle arterioles have no smooth muscle so they cannot constrict
- C** β_2 receptors in skeletal muscle arterioles can mediate vasodilation (especially at lower epinephrine levels) ✓
- D** α_1 receptors in skeletal muscle arterioles always cause vasoconstriction
- E** Epinephrine decreases cardiac output, lowering resistance everywhere

► **Explanation:** Skeletal muscle has significant β_2 receptors; epinephrine can promote vasodilation there (notably at lower concentrations), supporting 'fight-or-flight' muscle perfusion. α_1 effects can dominate elsewhere or at higher doses.

27 During intense exercise, why is blood flow to active skeletal muscle able to rise even though sympathetic tone is increased?



- A** Sympathetic nerves stop firing during exercise
- B** Arterioles in active muscle have valves that open wider
- C** Oxygenated blood becomes less viscous, reducing resistance everywhere
- D** Local metabolic factors (e.g., CO_2 , H^+ , adenosine, K^+) cause strong vasodilation that can override sympathetic vasoconstriction in active regions ✓
- E** Active muscle switches from arteries to veins for oxygen delivery





► **Explanation:** Active tissues release metabolites that dilate local arterioles ('active hyperemia'), increasing regional flow even if sympathetic tone is elevated overall. This local control is crucial for matching supply to demand.

28 The myogenic response of arterioles refers to the tendency of vascular smooth muscle to:



- A Dilate whenever oxygen levels fall, regardless of pressure
- B **Constrict in response to increased stretch (pressure), helping stabilize blood flow**
- C Stop contracting when sympathetic nerves fire
- D Only respond to hormones, not physical forces
- E Contract only in veins, not arteries

✓
► **Explanation:** When pressure rises, arteriolar walls stretch; smooth muscle responds by constricting, which helps maintain relatively constant flow (autoregulation). It's a pressure/stretch-based response, not purely hormonal.

29 Flow-mediated dilation (FMD) is most directly triggered by:



- A **Increased shear stress on endothelial cells leading to NO release** ✓
- B Decreased blood viscosity causing smooth muscle to contract
- C Valve closure in veins
- D A sudden fall in hematocrit
- E Increased oxygen binding to hemoglobin

► **Explanation:** When flow increases, shear stress rises and endothelial cells release NO, which relaxes smooth muscle and dilates the vessel. This is a key endothelium-dependent mechanism.





30 According to Poiseuille's relationship (all else equal), if an arteriole's radius is reduced to half its original value, its resistance will:



- A Decrease by a factor of 2
- B Decrease by a factor of 4
- C Increase by a factor of 4
- D Increase by a factor of 8
- E Increase by a factor of 16 ✓**

► **Explanation:** Resistance is inversely proportional to r^4 . Halving radius ($r \rightarrow r/2$) makes resistance increase by $1/(1/2)^4 = 16$. This is why small arteriolar diameter changes have big effects on blood pressure and flow.

31 Constriction of arterioles feeding a capillary bed would most directly tend to:



- A Increase capillary hydrostatic pressure and increase filtration
- B Decrease capillary hydrostatic pressure and reduce filtration ✓**
- C Increase venous oxygen content immediately
- D Increase the number of venous valves
- E Convert continuous capillaries into fenestrated capillaries

► **Explanation:** Arteriolar constriction reduces pressure downstream in the capillaries, lowering capillary hydrostatic pressure and decreasing net filtration. This can reduce fluid loss into tissues.

32 Sympathetic venoconstriction (constriction of veins) would most directly:





- A Decrease venous return by trapping blood in capillaries
- B Decrease cardiac preload by increasing venous compliance
- C Increase venous return by reducing venous capacitance (compliance) and pushing blood toward the heart ✓**
- D Lower total peripheral resistance dramatically
- E Stop blood flow in arteries

► **Explanation:** Constriction of veins reduces their capacity to hold blood, shifting blood toward the heart and increasing venous return (and preload). It affects volume distribution more than arteriolar resistance.

33 How do venous valves and skeletal muscle contractions work together to improve venous return from the legs?



- A Valves open only during expiration to pull blood upward
- B Muscles squeeze arteries only; veins are unaffected
- C Valves force blood to move away from the heart
- D Muscle contraction compresses veins; valves prevent backflow so blood is pushed toward the heart ✓**
- E Valves increase capillary exchange by creating turbulence

► **Explanation:** When leg muscles contract, they compress veins and push blood. One-way valves stop backflow, so the net movement is toward the heart. This 'muscle pump' is key against gravity.

34 The respiratory pump increases venous return during inspiration mainly because:



- A Thoracic pressure falls while abdominal pressure rises, promoting flow of venous blood toward the thorax ✓**
- B Thoracic pressure rises and pushes blood back into the abdomen





- C Veins actively contract in response to lung expansion
- D Arteries collapse during inspiration, forcing blood into veins
- E Capillaries double in number during inspiration

► **Explanation:** Inspiration decreases intrathoracic pressure (helping draw blood into the chest) and can increase abdominal pressure, together promoting venous return to the heart.

35 Varicose veins in the legs are most directly related to:



- A Excessive thickness of the tunica media in veins
- B An abnormally high pressure in the aorta only
- C Overproduction of red blood cells
- D Complete closure of venous valves preventing any flow
- E Failure of venous valves leading to pooling and vein dilation ✓

► **Explanation:** If venous valves fail, gravity promotes backflow and pooling, increasing venous pressure and dilating superficial veins (varicosities). Arteries are not the primary site of this problem.

36 Compared with the systemic circulation, the pulmonary circulation normally has:



- A Higher arterial pressure and higher resistance
- B Lower arterial pressure and lower resistance ✓
- C Higher arterial pressure but lower resistance
- D Lower arterial pressure but higher resistance
- E The same pressure and resistance





► **Explanation:** Pulmonary circulation is a low-pressure, low-resistance system so the right ventricle can pump blood through the lungs without causing edema under normal conditions. Systemic circulation is higher pressure.

37 Which statement correctly compares the effect of hypoxia on systemic versus pulmonary arterioles?



- A Hypoxia causes vasoconstriction in both systemic and pulmonary arterioles
- B Hypoxia causes vasodilation in both systemic and pulmonary arterioles
- C Hypoxia generally causes systemic vasodilation but pulmonary vasoconstriction ✓**
- D Hypoxia has no effect on vascular tone
- E Hypoxia causes systemic vasoconstriction but pulmonary vasodilation

► **Explanation:** In most systemic tissues, low O₂ promotes vasodilation to increase delivery. In the lungs, low alveolar O₂ triggers pulmonary vasoconstriction to divert blood toward better-ventilated alveoli—an important 'opposite rule' trap.

38 Angiotensin II tends to increase arterial blood pressure primarily by:



- A Causing vasodilation and decreasing blood volume
- B Blocking sympathetic activity at the heart
- C Directly increasing red blood cell production within minutes
- D Causing vasoconstriction and stimulating aldosterone release (which increases Na⁺ and water retention) ✓**
- E Opening venous valves to prevent pooling

► **Explanation:** Angiotensin II is a potent vasoconstrictor and promotes aldosterone secretion, raising blood volume and pressure. It does not cause vasodilation or rapidly increase RBC count.





39 Aldosterone increases blood pressure mainly by:



- A Direct vasodilation of arterioles
- B Increasing Na^+ reabsorption (and therefore water retention), raising blood volume
- C Destroying red blood cells to reduce viscosity
- D Closing the hepatic portal vein
- E Inhibiting the release of ADH

► **Explanation:** Aldosterone acts on the kidney to increase sodium reabsorption; water follows, expanding blood volume and increasing blood pressure. It is not primarily a direct vasoconstrictor.

40 ADH (vasopressin) can contribute to an increase in blood pressure by:



- A Increasing glucose uptake into skeletal muscle
- B Breaking down hemoglobin in red blood cells
- C Blocking all sympathetic nerve activity
- D Causing vasodilation in all arterioles
- E Promoting water reabsorption in the kidneys and (at higher levels) vasoconstriction

► **Explanation:** ADH is best known for conserving water (increasing blood volume). At higher concentrations it can also constrict blood vessels (hence 'vasopressin'), increasing blood pressure further.

41 Atrial natriuretic peptide (ANP) tends to:





- A Lower blood pressure by promoting Na^+ excretion (natriuresis) and reducing blood volume; it also opposes the RAAS ✓**
- B Raise blood pressure by increasing angiotensin II levels
- C Cause strong vasoconstriction of arterioles
- D Increase red blood cell count to improve oxygen delivery
- E Stop filtration in capillaries

► **Explanation:** ANP is released when atria are stretched and promotes natriuresis/diuresis, lowering blood volume and pressure. It functionally counteracts RAAS-driven salt and water retention.

42 Histamine released during an allergic response most directly causes which vascular effects in the affected area?



- A Vasoconstriction and decreased capillary permeability
- B No vascular changes; only nerves are affected
- C Decreased blood flow due to arteriolar spasm and no swelling
- D Vasodilation and increased capillary permeability, contributing to redness and swelling ✓**
- E Permanent closure of venous valves

► **Explanation:** Histamine causes local vasodilation and increases capillary permeability, allowing fluid and immune components to enter tissues—leading to redness, warmth, and swelling.

43 Bradykinin is best associated with which effect in many tissues?



- A Potent vasoconstriction to increase blood pressure instantly
- B Vasodilation and increased vascular permeability during inflammation ✓**
- C Direct stimulation of oxygen binding to hemoglobin





- D Closure of arteriovenous shunts in skin to conserve heat
- E Conversion of veins into arteries by thickening the tunica media

► **Explanation:** Bradykinin is an inflammatory mediator that promotes vasodilation and increased permeability, contributing to swelling and pain. It is not primarily a vasoconstrictor.

44 A sudden drop in arterial blood pressure activates the baroreceptor reflex. Which vascular change is most expected?



- A Decreased sympathetic tone causing widespread vasodilation
- B Increased parasympathetic tone causing arteriolar dilation throughout the body
- C Increased sympathetic tone causing arteriolar vasoconstriction to raise total peripheral resistance ✓**
- D Immediate increase in capillary fenestrations to raise blood volume
- E Permanent closure of the hepatic portal system

► **Explanation:** When BP falls, baroreceptor firing decreases, leading to increased sympathetic output. This causes arteriolar vasoconstriction (raising TPR) and often venoconstriction, helping restore BP.

45 Pulse pressure is most directly determined by the combination of:



- A Stroke volume and arterial compliance ✓**
- B Blood glucose and insulin levels
- C Capillary permeability and lymph flow
- D Venous valve number and venous oxygen content
- E Hemoglobin saturation and RBC count





► **Explanation:** Pulse pressure (systolic — diastolic) increases with higher stroke volume and decreases with higher arterial compliance. Stiff arteries (low compliance) produce a larger pulse pressure for the same stroke volume.

46 If large arteries become less compliant (stiffer) with age, which change is most likely?



- A Lower systolic pressure and narrower pulse pressure
- B Lower diastolic pressure and narrower pulse pressure
- C Higher diastolic pressure only, with unchanged systolic pressure
- D Higher systolic pressure and wider pulse pressure ✓**
- E Complete disappearance of pulse waves in arteries

► **Explanation:** Stiffer arteries cannot expand as well during systole, so systolic pressure rises. Reduced recoil can also lower diastolic support, widening pulse pressure. Pulse waves still occur but become more pronounced.

47 Mean arterial pressure (MAP) is best approximated by which relationship?



- A $\text{MAP} = \text{Heart rate} \times \text{Blood viscosity}$
- B $\text{MAP} = \text{Cardiac output} \times \text{Total peripheral resistance} ✓$**
- C $\text{MAP} = \text{Venous return} \times \text{Capillary permeability}$
- D $\text{MAP} = \text{Stroke volume} \div \text{Arterial radius}$
- E $\text{MAP} = \text{Oxygen saturation} \times \text{Hemoglobin concentration}$

► **Explanation:** A core cardiovascular relationship is $\text{MAP} = \text{CO} \times \text{TPR}$. Changes in cardiac output or arteriolar resistance strongly influence average arterial pressure.





48 If cardiac output stays constant, which change would most directly increase mean arterial pressure (MAP)?

- A Decreased arteriolar radius (vasodilation)
- B Increased venous compliance
- C Decreased blood viscosity to zero
- D Opening more capillary beds to increase total cross-sectional area
- E Increased arteriolar vasoconstriction (higher TPR) ✓**

► **Explanation:** With CO constant, increasing TPR (often via arteriolar vasoconstriction) increases MAP. Increased venous compliance tends to reduce venous return, and vasodilation reduces TPR.



49 Capillaries are especially suited for exchange mainly because they:

- A Have thick smooth muscle layers to pump blood
- B Contain valves that slow blood for diffusion
- C Have very thin walls (a single endothelial layer) minimizing diffusion distance ✓**
- D Have the highest blood pressure to force substances across
- E Have the greatest amount of elastin to store energy

► **Explanation:** Capillary walls are one cell thick, enabling efficient diffusion of gases, nutrients, and wastes. They generally lack smooth muscle and valves; exchange depends on short diffusion distance and large surface area.



50 Most white blood cells (leukocytes) leave the bloodstream to enter tissues primarily through:

- A Elastic arteries





B Postcapillary venules ✓

C Capillaries of the aorta

D Large veins near the heart

E Arterioles only

► **Explanation:** Leukocyte rolling, adhesion, and diapedesis typically occur in postcapillary venules, where flow is slower and the vessel wall properties support immune cell exit.

51 At the arterial end of a typical systemic capillary, net fluid movement is most likely to be:



A Out of the capillary into the interstitial space (filtration) ✓

B Into the capillary from the interstitial space (reabsorption)

C Zero because no forces exist in capillaries

D From venules into arterioles directly

E From lymph into capillaries only

► **Explanation:** Capillary hydrostatic pressure tends to be higher near the arterial end, favoring filtration out of the capillary. Reabsorption is more likely near the venous end if oncotic pressure dominates.

52 The lymphatic system is essential in microcirculation mainly because it:



A Pumps blood from veins into arteries

B Directly oxygenates deoxygenated blood

C Prevents any filtration from capillaries

D Returns excess interstitial fluid and proteins to the bloodstream ✓

E Creates the pressure drop across arterioles





► **Explanation:** Not all filtered fluid is reabsorbed by capillaries. Lymphatic vessels collect excess interstitial fluid and proteins and return them to the circulation, helping prevent edema.

53 A major reason low plasma albumin can cause edema is that it:



- A Increases arterial compliance, raising systolic pressure
- B Increases blood viscosity, slowing venous return
- C Raises capillary hydrostatic pressure in arterioles
- D Directly opens fenestrations in all capillaries
- E **Decreases plasma oncotic pressure, reducing reabsorption of fluid into capillaries ✓**

► **Explanation:** Albumin contributes significantly to plasma oncotic pressure. When albumin is low, the inward 'pull' for fluid reabsorption falls, so more fluid remains in the interstitial space, producing edema.

54 Standing still for a long time can cause ankle swelling mainly because gravity increases:



- A Arterial oxygen content in the feet
- B **Venous pressure in the legs, raising capillary hydrostatic pressure and filtration ✓**
- C Plasma protein concentration in the legs, raising oncotic pressure
- D Valve number in leg veins
- E Heart rate variability

► **Explanation:** Gravity increases venous pressure in dependent limbs, which increases capillary hydrostatic pressure and promotes filtration into tissues. If lymphatic/venous return can't keep up, edema can occur.





55 Compared with arteries, veins are more likely to collapse when external pressure is applied because veins generally have:

- A** Lower internal pressure and thinner walls ✓
- B** Higher internal pressure and thicker walls
- C** More elastin and higher recoil force
- D** More smooth muscle and stronger contraction
- E** A complete absence of endothelium

► **Explanation:** Veins operate at low pressures and have thinner walls than arteries, making them more compressible and prone to collapse. Both arteries and veins have endothelium.



56 Which change would most directly increase capillary hydrostatic pressure in a tissue (promoting filtration), all else equal?

- A** Constriction of the upstream arteriole
- B** Increased plasma albumin concentration
- C** Increased lymphatic drainage
- D** Dilation of the upstream arteriole ✓
- E** Decreased venous pressure

► **Explanation:** Arteriolar dilation increases pressure and flow delivered to capillaries, raising capillary hydrostatic pressure and promoting filtration. Constriction does the opposite; more albumin increases oncotic reabsorption, not hydrostatic pressure.



57 Precapillary sphincters and local arterioles tend to dilate most directly in response to:

- A** High local oxygen and low CO₂





- B** High local blood pressure only
- C** Low local oxygen and/or high local CO_2/H^+ (metabolic demand signals) ✓
- D** Closure of venous valves
- E** High plasma albumin

► **Explanation:** Local metabolic conditions (low O_2 , high CO_2/H^+ , adenosine, etc.) signal increased demand and cause dilation, opening capillary beds to boost delivery. This local control is central to matching flow to tissue needs.

58 Arteriovenous anastomoses (AV shunts) in the skin are particularly important for:



- A** Increasing filtration in kidney glomeruli
- B** Producing red blood cells
- C** Converting venous blood into arterial blood
- D** Maintaining the hepatic portal system
- E** Thermoregulation by diverting blood away from or toward surface capillaries ✓

► **Explanation:** AV shunts can bypass capillary beds in the skin. When open, they can reduce capillary perfusion (reducing heat loss); when closed, more blood flows through surface capillaries to lose heat.

59 Blood in the hepatic portal vein is typically best described as:



- A** Oxygen-rich and nutrient-poor
- B** Nutrient-rich and relatively oxygen-poor compared with systemic arterial blood ✓
- C** Identical in composition to blood in the aorta
- D** Free of any absorbed drugs or toxins





- E** Purely lymph with no red blood cells

► **Explanation:** After passing through intestinal capillaries, portal blood is enriched in absorbed nutrients (and potentially drugs/toxins) but has already delivered some oxygen to gut tissues, so it is less oxygenated than arterial blood.

60 Which sequence correctly describes blood flow through the hepatic portal system (starting from nutrient absorption in the gut)?



- A** Gut capillaries → hepatic veins → liver sinusoids → hepatic portal vein → inferior vena cava
- B** Gut capillaries → inferior vena cava → hepatic portal vein → liver sinusoids → hepatic veins
- C** Gut capillaries → hepatic portal vein → liver sinusoids → hepatic veins → inferior vena cava ✓
- D** Gut capillaries → aorta → hepatic portal vein → liver sinusoids → pulmonary veins
- E** Gut capillaries → lymphatic vessels → hepatic portal vein → liver sinusoids → aorta

► **Explanation:** Portal blood flows from gut capillaries into the hepatic portal vein, then into liver sinusoids (a second capillary bed), then drains via hepatic veins to the inferior vena cava. The incorrect options scramble vessel order or add unrelated structures.

