Main Idea: The function of the circulatory system is to maintain adequate blood flow to all tissues.

Clinical Application Questions
1. A patient was found to have a blood pressure recording of 125/77:
   a. What is the systolic pressure?
   
   b. What is the diastolic pressure?
   
   c. What is the pulse pressure?
   
   d. What is the mean arterial pressure?
   
   e. Would any sound be heard when the pressure in an external cuff around the arm was 130 mm Hg? (Yes or No)
   
   f. Would any sound be heard when cuff pressure was 118 mm Hg? (Yes or No)
   
   g. Would any sound be heard when cuff pressure was 75 mm Hg? (Yes or No)

2. A classmate who has been standing still for several hours working on a laboratory experiment suddenly faints. What is the probable explanation? What would you do if the person next to him tried to get him up?

3. In a person that has a sudden decrease in blood pressure, describe the short-term mechanisms that will be activated in response to a sudden decrease in blood pressure.
4. Ima Fan loves to go to movies. After sitting in a movie for several hours she often develops edema in her legs and feet. Explain how this occurs (Hint: recall from your study of osmosis that a column of liquid has weight).

5. After a long leisurely lunch at a restaurant, sometimes elderly people faint when they stand up to leave the restaurant. Explain how this happens (Hint: assume that a homeostatic mechanism is not working as well as when they we younger).

6. Buster Hart has a myocardial infarct (heart attack) and his blood pressure drops. Explain why his blood pressure drops and describe the neural mechanisms that would attempt to compensate for the decreased blood pressure. In Buster’s case, his blood pressure was abnormally low following the myocardial infarct. Gradually (within a few days), however, it returned to normal. Explain how the long term mechanisms would compensate for this. Hint – think about hormonal effects.
7. Explain the effect of **respiratory activity** on venous return to the heart.

8. Explain the effect of the **cardiac vacuum** ("suction") on venous return to the heart.

9. Explain the effect of **skeletal muscle activity** on venous return to the heart.

10. Explain how each of the following antihypertensive drugs would lower arterial blood pressure: Note, for this section you are not expected to remember the drug names in parenthesis, but instead, you are expected to know how the antihypertensive drugs work given the following descriptions.

    a. Drugs that block α1-adrenergic receptors (for example, phentolamine).
b. Drugs that block β1-adrenergic receptors (for example, metoprolol).

c. Drugs that directly relax arteriolar smooth muscle (for example, hydralazine).

d. Diuretic drugs that increase urinary output (for example, furosemide).

e. Drugs that block release of norepinephrine from sympathetic endings (for example, guanethidine).

f. Drugs that act on the brain to reduce sympathetic output (for example, clonidine).

g. Drugs that block calcium channels of smooth muscle cells in blood vessels (for example, verapamil).

h. Drugs that interfere with the production of angiotensin II (for example, captopril, an ACE inhibitor).

i. Drugs that block angiotensin II receptors (for example, losartan).
Part I

Fun Review Study Guide

A. Completion

1. Cardiac rate is _________ (increased/decreased) by sympathoadrenal stimulation and _________ (increased/decreased) by parasympathetic stimulation of the SA node (pacemaker) region of the heart. The end-diastolic volume is also known as the __________ load (pre(after), while the __________ load (pre(after)) refers to the total peripheral resistance to blood flow in the arterioles. An increased venous return __________ (increases/decreases) preload, and will ultimately __________ (increase/decrease) the contractility of the ventricles that will eject more blood from the heart. 2. The organ most responsible for regulating the total blood volume is the __________. Tissue fluid (ECF) is formed from __________ and roughly 85% will return to the __________. The pressure that forces fluid out of the arteriolar end of capillaries is called __________ pressure, while the __________ pressure of the plasma encourages the return of fluid to the venular end of capillaries. 3. Any extra tissue fluid (the remaining 15%) becomes __________ fluid and is returned to the blood via __________ vessels or remains in the tissues, causing swelling or __________. 4. Reabsorption of water from the kidney filtrate is regulated by __________ hormone made by the hypothalamus, while the hormone __________ is secreted by the adrenal __________ (cortex/medulla) to promote the __________ (loss/retention) of salt (and water). 5. The law relating the vascular and the resistance to the flow of blood in blood vessels is __________. Vasoconstriction of arterioles usually occurs due to stimulation by the __________ branch of the autonomic nervous system, whereas the local myogenic response to __________ (high/low) blood pressure would also cause vasoconstriction. 6. The heart normally respires __________ because its capillary supply, myoglobin, and enzyme content are all __________ (high/low); consequently, during exercise the coronary arteries dilate due to __________ (intrinsic/extrinsic) or accumulated metabolic factors. 7. The heart rate increases due to the __________ (increased/decreased) activity of the vagus nerve and the __________ (increased/decreased) activity of the sympathetic nerves to the SA node. Cardiac rate multiplied by __________ volume equals cardiac __________. 8. High blood pressure to the brain causes cerebral vessels to __________ (constrict/dilate), while accumulation of metabolites causes local __________ (constriction/dilation). As body temperature falls, __________ nerve fibers cause cutaneous arterioles and shunts called arteriovenous __________ to __________ (constrict/dilate). 9. Baroreceptors located in the __________ and __________ __________ send sensory action potentials to the cardiac control centers in the __________, which regulates both cardiac __________ and peripheral __________ through efferent nerves of the __________ nervous system. 10. Normal blood flow is smooth or __________, yet compression by a sphygmomanometer cuff causes __________ flow, which is heard as the sounds of __________. 11. If systolic pressure is 122 and diastolic pressure is 74 mmHg, then pulse pressure = __________ mmHg and mean arterial pressure = __________ mmHg. Essential hypertension or __________ hypertension may be the result of many factors, whereas __________ hypertension is the direct result of known, specific, diseases. 12. Circulatory shock occurs when there is inadequate delivery of __________ to the organs of the body. This is also seen in congestive heart failure, where "congestion" refers to the accumulation of __________ (arterial/venous) blood surrounding the heart that has failed.

13. A person whose blood pressure is 135/85 mmHg has a pulse pressure of ___ mmHg.
   a. 35  
   b. 50  
   c. 60  
   d. 85  
   e. 135

14. The mean arterial pressure (MAP) in a person whose blood pressure reads 135/85 mmHg is approximately ___ mmHg?
   a. 98  
   b. 100  
   c. 102  
   d. 110  
   e. 120
True or False/Edit

15. The **greatest** resistance to blood flow in the arterial system is found in the capillaries.
16. Vasodilation of arterioles downstream (away from the heart) decreases the peripheral resistance and results in a lower arterial blood pressure upstream (closer to the heart).
17. Baroreceptors are stretch receptors located in the aortic arch and carotid sinuses regions, monitoring the degree of stretch in the walls of these arteries as pressure changes.
18. The vagus and glossopharyngeal nerves carry sensory action potentials from baroreceptors to the vasomotor control center in the pons region of the brainstem.
19. Manual massage of the carotid sinus regions can mimic high blood pressure and thereby, through the baroreceptor reflex, can slow any existing tachycardia and lower blood pressure.
20. Antiuretic hormone (ADH) and aldosterone increase blood pressure by increasing blood volume, while angiotensin II increases blood pressure by stimulating vasoconstriction.
21. Nothing is heard through a stethoscope when listening to normal blood flow through an artery because normal flow is smooth or laminar (in layers).
22. The **first** sound of Korotkoff is heard when pressure in the cuff equals the pressure in the artery during the diastole phase of the heart.
23. The **mean arterial pressure** is simply the average pressure, calculated as halfway between the systolic and diastolic pressures.

Multiple Choice

24. The blood vessel with the greatest total cross-sectional area is the
   a. artery
   b. arteriole
   c. capillary
   d. venule
   e. vein
25. Which of the following is **not** one of the three most important variables affecting blood pressure?
   a. cardiac rate
   b. stroke volume (blood volume)
   c. total peripheral resistance
   d. coronary artery vasodilation

True or False/Edit

26. The blood pressure that is exerted against the inner wall of the capillary, causing the filtration of plasma and the formation of tissue fluid is called hydrostatic pressure.
27. Hydrostatic pressure can also be the pressure measured in the tissues outside the capillary which opposes the filtration pressure of the blood.
28. The protein concentration of tissue fluid (ECF) is greater than the protein concentration of blood plasma.
29. About 15% of fluid filtered from the arteriolar end of the capillary (amounting to at least 2 L per day) is returned to the blood as lymph rather than being absorbed into the venular end of the capillary.
30. Capillaries of the kidney that filter plasma and begin the formation of urine, are called glomeruli.
31. After drinking several large glasses of water, your plasma osmolality would decrease, stimulating osmoreceptors, that, in turn, stimulate the release of ADH from the posterior pituitary.
32. Water is a diuretic substance because water intake inhibits the secretion of antidiuretic hormone (ADH) and causes a larger volume of urine to be excreted.
33. Very high blood volume stimulates specialized stretch receptors located in the left atrium of the heart, that, in turn, send signals to inhibit ADH secretion, ultimately reducing the blood volume.
34. A drug inhibiting angiotensin-converting enzyme (ACE) would be expected to cause an increase in both the total peripheral resistance and blood pressure.
35. Which statement about colloid osmotic pressure of the plasma is false?
   a. It is the osmotic pressure exerted by the presence of plasma proteins.
   b. It is normally a very high pressure if measured in the tissue fluid.
   c. It is essentially equal to the oncotic pressure of the plasma.
   d. It has been estimated to be 25 mm Hg.
   e. It usually favors the movement of water by osmosis into capillaries.

36. Starling forces refer to the
   a. ejection pressures exerted by the heart during contraction
   b. pressures exerted by the peripheral resistance blood vessels that dilate and constrict, affecting the cardiac output
   c. opposing hydrostatic and colloid osmotic pressures that determine the distribution of fluid across the capillary wall
   d. pressures that influence the return of venous blood to the heart

37. Which of the following is not a cause of edema?
   a. high blood pressure in the arteries
   b. blood congestion or obstruction in the veins
   c. an increase in capillary permeability causing plasma proteins to leak into tissue fluid
   d. liver disease or kidney disease which results in a drop in the levels of plasma proteins
   e. All of these are causes of edema.

38. Both the blood volume and the urine volume are regulated ultimately by the amount of glomerular filtrate reabsorbed in the kidney, which, in turn, is normally adjusted by the
   a. amount of fluid consumed during the day
   b. action of specific hormones on the kidneys
   c. neuron control of bladder function
   d. frequency of micturition (urination)

39. Which statement about antidiuretic hormone (ADH) is false?
   a. ADH is a hormone also known as vasopressin.
   b. ADH is synthesized by neurons located in the hypothalamus.
   c. Receptors (osmoreceptors) release ADH when the plasma osmolality rises.
   d. ADH decreases water reabsorption from the glomerular filtrate and increases water loss in the form of urine.
   e. All of these statements regarding ADH are true.

40. Which of the following statements about aldosterone is false?
   a. It is a steroid hormone.
   b. It is secreted by the cortex region of the adrenal gland.
   c. It promotes the excretion of both salt and water in proportionate amounts from the kidneys.
   d. Its secretion is stimulated during salt deprivation, when the blood volume and pressure are reduced.
   e. Unlike ADH, aldosterone does not act to dilute the blood.

41. The juxtaglomerular apparatus (JGA) of the kidney
   a. is stimulated by increased blood flow and blood pressure in the renal arterioles
   b. secretes the enzyme called renin into the blood
   c. secretes the angiotensin converting enzyme (ACE)
   d. filters blood and reabsorbs water

42. Which of the following actions is not used by angiotensin II to produce a rise in blood pressure?
   a. vasoconstriction of smooth muscle in the walls of small arteries
   b. stimulation of thirst centers located in the hypothalamus to drink more water
   c. stimulation of the heart, causing an increase in myocardial contractility
   d. stimulation of the adrenal cortex to secrete aldosterone, which then acts to reabsorb salt from the kidney

43. Which mode of treatment would not be used to treat hypertension?
   a. angiotensin II to help constrict peripheral arterioles
   b. various diuretics to decrease blood volume and increase urine volume
   c. beta-adrenergic blocking drugs to decrease cardiac rate
   d. ACE inhibitors, calcium antagonists, and various vasodilators to decrease peripheral resistance
   e. lifestyle changes: stop smoking, limit alcohol intake, weight reduction, reduce salt ingestion, and regular physical exercise
Part II

1. Type O is known as the universal (donor? recipient?) with regard to the ABO group because type O blood lacks __________ of the ABO group. Type _______ is known as the universal recipient. Explain why.

2. Complete this exercise about the Rh system.

3. The Rh (+? −?) group is more common. Rh (+? −?) blood has Rh antigens on the surfaces of RBCs.


5. Rh (+? −?) people can develop these antibodies when they are exposed to Rh (+? −?) blood.

6. The most common example of this occurs in fetal–maternal incompatibility when a mother who is Rh (+? −?) has a baby who is Rh (+? −?) and some of the baby’s blood enters the mother’s bloodstream. The mother develops anti-Rh antibodies, which may cross the placenta in future pregnancies and hemolyze the RBCs of Rh (+? −?) babies. Such a condition is known as ____________________________.

A clinical challenge. Discuss precautions taken with Rh+ mothers during pregnancy or soon after delivery, miscarriage, or abortion of an Rh+ baby to prevent future problems with Rh incompatibility.

(Hint: see text page 360.)

Answer these questions about oxygen transport. Refer to Figure 18.11 (page 460 in your text).

6. About 98.5 percent of oxygen is carried in blood as ______________. Only a small amount

7. Oxygen is attached to the ______________ atoms in hemoglobin. The chemical formula for oxy- hemoglobin is __________. When hemoglobin carries all of the oxygen it can hold, it is said to be fully ______________.

8. In people with type 1 diabetes mellitus,
   a. large amounts of free fatty acids are released from adipose cells (lipolysis).
   b. the liver raises the blood levels of ketone bodies (ketosis).
   c. the pH of the blood may go down (become more acidic) as more acids are made.
   d. osmotic diuresis may cause dehydration and thirst as water follows the excess solute into the urine.

9. All of these occur in people with type 1 diabetes mellitus. Reactive hypoglycemia is a condition characterized by
   a. inadequate insulin secretion from the beta cells.
   b. being genetically predisposed to type 1 diabetes (IDDM).
   c. an exaggerated response of beta cells to a rise in blood glucose levels.
   d. diagnosis when the oral glucose tolerance test results in blood glucose levels that rise sharply and stay elevated for 5 hours.
   e. treatment consisting of two or three large, high-carbohydrate meals a day.

True or False/Edit

10. Type 1 diabetes is insulin-dependent diabetes mellitus (IDDM), formerly called juvenile-onset diabetes, occurring in about 10% of the patients with diabetes in this country.

11. Type II diabetes mellitus, also known as non-insulin-dependent diabetes mellitus (NIDDM) usually occurs in adults over thirty years of age (maturity-onset diabetes) and is commonly associated with obesity.

12. Type I diabetics (IDDM) may actually secrete normal or slightly elevated amounts of the hormone insulin from the beta cells of the islets of Langerhans.

13. Obesity seems to increase the sensitivity of target cells to insulin, increasing the efficiency of glucose uptake by tissue cells.

14. People with NIDDM have an abnormally high tissue sensitivity to insulin, or a lowered insulin resistance.

15. People with NIDDM do not usually develop ketoacidosis; but are at risk of blindness, kidney failure, and amputation of the lower extremities due to prolonged exposure to high blood glucose levels.

16. Hypoglycemia, and possibly a coma, can result in patients with type 1 diabetes (IDDM) who inject themselves with an overdose of insulin to prevent hyperglycemia and ketoacidosis.
is a diagram of a capillary bed. Arrows indicate the direction of blood flow. Select five different colors and color the coding circles and their structures on the figure. Then answer the questions that follow by referring to Figure 3. Notice that questions 1–9 concern fluid flows at capillary beds and the forces (hydrostatic and osmotic pressures) that promote such fluid shifts.

- Arteriole
- Thoroughfare channel
- Postcapillary venule
- Precapillary sphincters
- True capillaries
- Metarteriole

17. If the precapillary sphincters are contracted, by which route will the blood flow?

18. Under normal conditions, in which area does hydrostatic pressure predominate: A, B, or C?

19. Which area has the highest osmotic pressure?

20. Which pressure is in excess and causes fluids to move from A to C? (Be specific as to whether the force exists in the capillary or the interstitial space.)

21. Which pressure causes fluid to move from A to B?

22. Which pressure causes fluid to move from C to B?

23. Which blood protein is most responsible for osmotic pressure?
Part III
Using the answer code, indicate whether the following factors increase or decrease venous return:

A. increases venous return  B. decreases venous return  C. has no effect on venous return

1. ______ sympathetically induced venous vasoconstriction
2. ______ skeletal muscle activity
3. ______ gravitational effect on the venous system
4. ______ respiratory activity
5. ______ increased atrial pressure associated with a leaky AV valve
6. ______ ventricular pressure change associated with diastolic recoil

Fill in the blanks with the answers provided:

<table>
<thead>
<tr>
<th>Baroreceptors</th>
<th>Hypovolemic</th>
<th>Vasogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiogenic</td>
<td>Neurogenic</td>
<td>Varicose veins</td>
</tr>
<tr>
<td>Hypertension</td>
<td>Orthostatic hypotension</td>
<td></td>
</tr>
</tbody>
</table>

7. __________ is when the blood pressure is above 140/90 mm Hg
8. __________ is a transient hypotensive condition resulting from insufficient compensatory responses to the gravitational shifts in blood that occur when a person moves from a horizontal to a vertical position
9. __________ shock is due to a weakened heart’s failure to pump blood adequately
10. __________ shock is induced by a fall in blood volume, through hemorrhage or low of fluids like diarrhea and sweating.
11. __________ occur when the venous valves become incompetent and can no longer support the column of blood above them.
12. Mean arterial pressure is constantly monitored by __________ within the circulatory system.
Part IV
Using the answer code, indicate what kind of compensatory changes occur in the factors in question to resort blood pressure to normal in response to hypovolemic hypotension resulting from severe hemorrhage:

A. Increased  B. Decreased  C. No effect

1. ______ rate of afferent firing generated by the carotid sinus and aortic arch baroreceptors
2. ______ sympathetic output by the cardiovascular center
3. ______ parasympathetic output by the cardiovascular center
4. ______ heart rate
5. ______ stroke volume
6. ______ cardiac output
7. ______ arteriolar radius
8. ______ total peripheral resistance
9. ______ venous radius
10. ______ venous return
11. ______ urinary output
12. ______ fluid retention within the body
13. ______ fluid movement from interstitial fluid into plasma across the capillaries

14. Whereas ______ mechanisms are most important for regulating mean arterial pressure on a short-term basis; ______ mechanisms are most important for regulating mean arterial pressure on a long-term basis.

A. Baroreceptor, chemoreceptor  D. baroreceptor, baroreceptor
B. Chmoreceptor, baroreceptor  E. baroreceptor, hormonal
C. Hormonal, hormonal

Part V
A. Match these terms with the correct statement or definition:

Auscultatory  Blood pressure  Diastolic pressure  Korotkoff sounds  Systolic pressure

1. ___________________________ A measure of the force blood exerts against the blood vessel walls; responsible for the movement of blood through blood vessels.
2. ___________________________ Maximum blood pressure; caused by ventricular systole.
3. ___________________________ Minimum blood pressure; caused by ventricular diastole.
4. ___________________________ The most common clinical method of determining blood pressure; uses a stethoscope and a sphygmomanometer.
5. ___________________________ Result from vibrations caused by turbulent blood flow through a constricted artery.
6. ___________________________ The pressure when the first Korotkoff sound is heard.
7. ___________________________ The 80 in a blood pressure measurement of 120/80.
B. Using the terms provided, complete these statements:

<table>
<thead>
<tr>
<th>Decrease(s)</th>
<th>Increase(s)</th>
<th>Pulse</th>
<th>Pulse pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The difference between the systolic and diastolic pressure is called (1)________________. During exercise, stroke volume (2)_____________ , causing pulse pressure to (3)_____________. In arteriosclerosis, the pulse pressure (4)_____________ because arteries are less elastic than normal. The (5)_________________ is a pressure wave produced by ejection of blood from the left ventricle. If stroke volume (6)_______________ , or constriction of the muscular arteries (7)_______________, a weak pulse results.

C. Match these terms with the correct statement or definition:

<table>
<thead>
<tr>
<th>Blood pressure</th>
<th>Lymphatic capillaries</th>
<th>Diffusion</th>
<th>Osmosis</th>
<th>Edema</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ______________</td>
<td>Means by which nutrients and waste products move across the capillary walls into interstitial spaces.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ______________</td>
<td>Force that moves fluid out of blood into tissues.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ______________</td>
<td>Force that moves fluid out of tissues into blood.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ______________</td>
<td>At the arterial end of capillaries this force is the greatest.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. ______________</td>
<td>At the venous end of capillaries this force is the greatest.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. ______________</td>
<td>Removes excess fluid from tissues and returns the fluid to the blood.</td>
<td></td>
<td></td>
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<tr>
<td>7. ______________</td>
<td>Swelling caused by excess fluid accumulation.</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Local and nervous control of blood vessels. Match these terms with the correct statement or definition:

<table>
<thead>
<tr>
<th>Contraction</th>
<th>Relaxation</th>
<th>Local control</th>
<th>Vasomotor center</th>
<th>Nervous control</th>
<th>Vasomotor tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ______________</td>
<td>Achieved by contraction and relaxation of the arterioles and precapillary sphincters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. ______________</td>
<td>Effect of decreased oxygen or increased carbon dioxide on the arterioles and precapillary sphincters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ______________</td>
<td>Regulates most blood vessels except for capillaries and precapillary sphincters.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. ______________</td>
<td>Part of the sympathetic nervous system; continually stimulates most blood vessels.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. ______________</td>
<td>Condition of partial constriction of blood vessels caused by sympathetic stimulation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. ______________</td>
<td>Control system that routes blood from the skin and viscera to exercising muscles.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. ______________</td>
<td>Control system that allows more blood to flow through exercising muscle tissue.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The more metabolically active a tissue, the more capillaries it has, allowing greater delivery of blood to the tissue.
The baroreceptor reflexes are important in regulating blood pressure on a moment-to-moment basis.

E. Baroreceptor Reflexes. Using the terms provided, complete these statements:

<table>
<thead>
<tr>
<th>Baroreceptors</th>
<th>Vasoconstrict</th>
<th>Vasodilate</th>
<th>Decrease(s)</th>
<th>Increase(s)</th>
</tr>
</thead>
</table>
| Pressure receptors that respond to stretch produced by blood pressure are called (1) _____________. They are located in the walls of the aortic arch and the carotid sinuses (dilations of the carotid arteries in the neck). Action potentials from the baroreceptors pass to the medulla oblongata, which produces responses in blood vessels and in the heart. A decrease in blood pressure is detected by these receptors and activates baroreceptor reflexes. As a result, blood vessels (2) _____________ , and vasomotor tone (3) _____________. The change in blood vessel diameter causes peripheral resistance to (4) _____________ , and this in turn causes blood pressure to (5) _______________. At the same time, baroreceptor reflexes cause heart rate and stroke volume to (6) _______________. These changes cause blood pressure to (7) _______________.

The chemoreceptor reflexes function under emergency conditions and usually do not play an important role in the regulation of the cardiovascular system.

F. Chemoreceptor Reflexes. Using the terms provided, complete these statements:

<table>
<thead>
<tr>
<th>Chemoreceptors</th>
<th>Vasoconstrict</th>
<th>Vasodilate</th>
<th>Decrease(s)</th>
<th>Increase(s)</th>
</tr>
</thead>
</table>
| Receptors that respond to oxygen, carbon dioxide, and pH are called (1) _____________. They are located in the carotid bodies, aortic bodies, and medulla oblongata. A decrease in blood oxygen, an increase in blood carbon dioxide, or a decrease in blood pH activate chemoreceptor reflexes. As a result, blood vessels (2) _______________ , and vasomotor tone (1) _______________. The change in blood vessel diameter causes peripheral resistance to (4) _______________ , and this in turn causes blood pressure to (5) _______________. The change in blood pressure (6) _______________ causes blood flow to the lungs, which helps to increase blood oxygen levels and decrease blood carbon dioxide levels.

The renin-angiotensin-aldosterone system and atrial natriuretic hormone are important in the long-term regulation of blood pressure.

G. Hormonal Mechanisms. Match these terms with the correct statement or definition:

<table>
<thead>
<tr>
<th>Antidiuretic hormone</th>
<th>Aldosterone</th>
<th>Angiotensin II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial natriuretic hormone</td>
<td>Epinephrine</td>
<td>Renin</td>
</tr>
</tbody>
</table>

1. _______________ Released by the adrenal medulla; increases blood pressure by increasing heart rate, stroke volume, and vasoconstriction.
2. _______________ Released by the kidneys in response to a decrease in blood pressure; converts angiotensinogen into angiotensin I.
3. _______________ Produced from angiotensin I by angiotensin-converting enzyme; increases blood pressure by causing vasoconstriction.
4. _______________ Acts on the adrenal cortex to cause increased aldosterone secretion.
5. _______________ Increases sodium and water uptake in the kidneys; maintains or increases blood pressure by maintaining or increasing blood volume.
6. _______________ Secreted by the hypothalamus this hormone prevents water loss from the kidneys; maintains blood pressure by maintaining blood volume; also causes vasoconstriction.
7. _______________ Released from the right atrium this hormone stimulates increased urine production; decreases blood pressure by decreasing blood volume.