DEPARTMENT OF PHYSIOLOGY AND BIOPHYSICS
SCHOOL OF MEDICINE AND THE GRADUATE SCHOOL

HUMAN PHYSIOLOGY

SECOND EXAMINATION

MONDAY, MARCH 11, 1996

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Instructions for Use of Optical Scan Answer Sheet

1. **DO NOT** bend fold or tear answer sheet in any way.

2. Use **ONLY** a **#2 pencil**. **DO NOT** use a pen.

3. **DO NOT** make any marks along the edge with the black lines. The computer will not be able to grade your sheet if you do so.

4. Print your name (**last name first**) in the boxes provided on the sheet.

5. **Darken** the blanks which correspond to each letter in your name and initial.

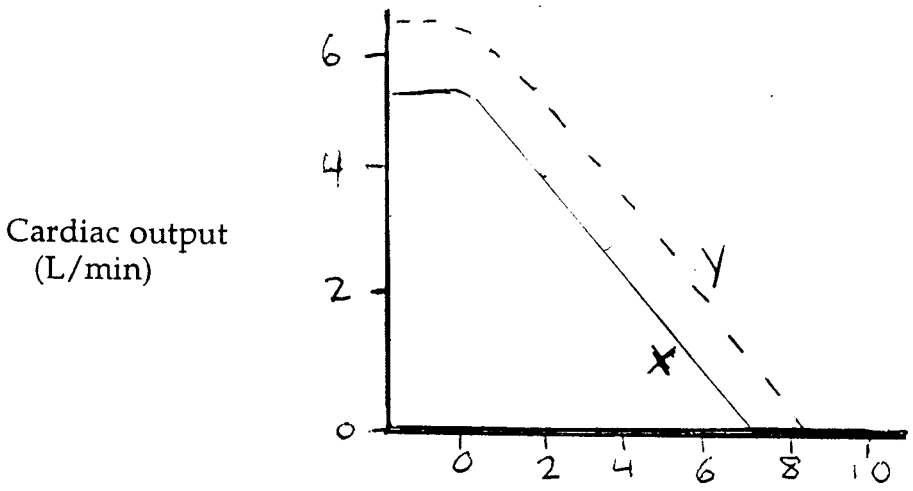
6. In the box marked "Student I.D. Number" write your **5-digit identifying number. DO NOT WRITE IN YOUR SOCIAL SECURITY NUMBER! Darken** the corresponding number box.

7. For each question, **darken** the letter blank which corresponds to the correct answer. **DO NOT** write in more than one answer -- **the computer will reject your answer sheet and it will be marked wrong (i.e. no credit). Erase** thoroughly any mismarked blanks.

8. **NO EXTRA TIME WILL BE ALLOWED TO TRANSCRIBE ANSWERS ONTO THE ANSWER SHEET.**

9. **IF YOU DO NOT FOLLOW THE ABOVE INSTRUCTIONS, IT WILL NOT BE POSSIBLE TO GRADE YOUR EXAM.**

3/11/96



1. Use the graph above. An experiment is performed on an anesthetized dog. The vascular function curve labelled X results. After administration of an unknown drug, the vascular function curve labelled Y is obtained. Based on these data, the drug is probably a

   A. positive inotropic agent.
   B. negative inotropic agent.
   C. venodilator.
   D. venoconstrictor.
   E. diuretic.

2. The following data are obtained during cardiac catheterization of a patient with a continuous thoracic murmur:

arterial oxygen content	19 ml/dl blood
inferior vena caval oxygen content	15 ml/dl blood
right atrial oxygen content	15 ml/dl blood
right ventricular oxygen content	14 ml/dl blood
pulmonary arterial oxygen content	16 ml/dl blood

   These data are most consistent with a(n)

   A. atrial septal defect.
   B. ventricular septal defect.
   C. patent ductus arteriosus.
   D. abdominal aortic aneurysm.
   E. mitral stenosis.

3. Select the **FALSE** statement. A large left ventricular stroke volume would occurs as a result of

A. administration of a positive chronotropic drug.
B. an incompetent mitral valve.
C. an incompetent aortic valve.
D. increased left ventricular end-diastolic pressure.
E. an aorto-caval fistula.

4. Maximum generation of force occurs when cardiac muscle contraction is stimulated under conditions of

A. zero afterload.
B. isometric contraction.
C. zero preload.
D. low extracellular calcium ion concentration.
E. low frequency of contraction.

5. During the normal cardiac cycle, all four of the heart valves are open

A. during isovolumic contraction.
B. during the ejection phase.
C. during isovolumic relaxation.
D. during diastole.
E. at no point.

6. Arterial blood pressure of 175/130 mmHg is most consistent with

A. essential hypertension.
B. patent ductus arteriosus.
C. aortic insufficiency.
D. arteriosclerosis.
E. hemorrhagic shock.

7. The c wave of the atrial pressure curve is temporally most closely associated with

A. diastasis.
B. protodiastole.
C. isovolumic contraction.
D. isovolumic relaxation.
E. rapid active ventricular filling.

8. During cardiac catheterization of a patient who is generally asymptomatic, a pressure of 28/12 mmHg is recorded. The catheter tip is most likely located in the

A. aorta.
B. left ventricle.
C. right atrium.
D. right ventricle.
E. pulmonary artery.

9. During the irreversible stage of hemorrhagic shock

A. pulse pressure is increased.
B. respiratory rate is usually reduced.
C. myocardial contractility is usually reduced.
D. diastolic blood pressure is increased.
E. heart rate is usually reduced.

10. In a normally functioning heart, the greatest stroke volume is expected at a left ventricular end-diastolic pressure (mmHg) of

A. 3
B. 6
C. 12
D. 24
E. 36

11. Which of the following would **NOT** occur as a result of a large, acute hemorrhage?

A. high systemic total peripheral resistance
B. decreased afferent impulses from the aortic baroreceptors
C. high stroke work
D. low left ventricular systolic pressure
E. low capillary hydrostatic pressure

12. In going from the recumbent to the standing position, which of the following would **NOT** be expected?

A. an acute reduction in venous return to the right atrium
B. an acute reduction in pulmonary blood volume
C. an increase in blood volume in the legs
D. a collapse of superficial veins in the neck and head regions
E. a collapse of superficial veins in the legs

13. Twenty (20) mg of dye is injected into a femoral artery of an experimental animal, and the following data are recorded. The first circulation concentration curve for the dye in the femoral vein is 2 minutes in duration, with an average dye concentration of 0.2 mg/ml during that first circulation. The blood flow (ml/min) is

A. 10
B. 20
C. 50
D. 100
E. 200

14. A large drop in cerebral blood flow would be expected when

A. systemic arterial pressure rises from 110/70 to 170/110 mmHg.
B. cerebral venous PCO_2 rises from 40 to 50 mmHg.
C. arterial PCO_2 falls from 40 to 20 mmHg.
D. arterial PO_2 falls from 80 to 40 mmHg.
E. systemic arterial pressure falls from 110/70 to 70/40 mmHg.

15. Left coronary artery blood flow

A. reaches a greater peak in systole compared to diastole.
B. rises during isovolumic contraction of the heart.
C. is greater during diastole than right coronary artery blood flow.
D. supplies a greater portion of the total myocardium than right coronary artery blood flow in most people.
E. falls rapidly during early diastole.

16. The oxygen supply/demand ratio would be most directly enhanced by

A. increased left ventricular systolic pressure.
B. increased left ventricular end diastolic pressure.
C. increased systemic arterial systolic pressure.
D. increased systemic arterial diastolic pressure.
E. increased heart rate.

17. The primary response to the Bainbridge reflex is

A. increased central venous pressure.
B. increased heart rate.
C. reduced myocardial contractility.
D. decreased afferent impulses from the carotid sinus baroreceptors.
E. reduced venous return to the heart.

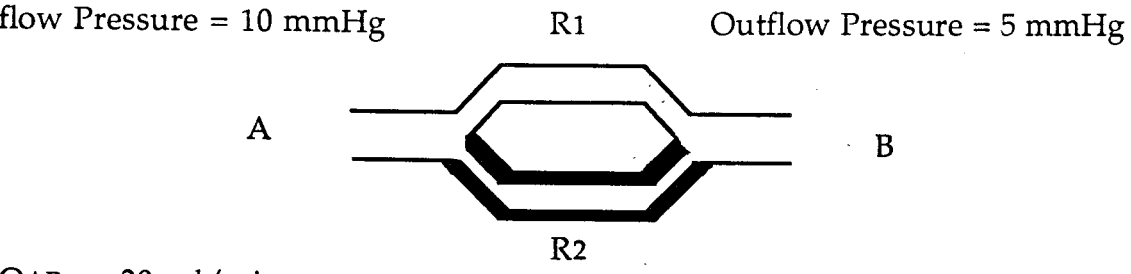
23. Refer to the vessel above and note that the radii of segments A and C are identical. If blood flow through segments A, B, and C remains constant, then the

A. lateral pressure is greatest in segment B.
B. velocity of blood flow through segment B will be directly related to the decrease in cross-sectional area of that segment.
C. kinetic energy will be less in segment B than segments A and C.
D. end pressures in segments A and B will be the same.
E. lateral pressure will be less in segment C than segment B.

24. If the same conditions exist in the vessel shown above, then

A. mean blood flow velocity will be lower in segment B than in segment A.
B. velocity of blood flow in segment A is greatest immediately adjacent to the vessel wall.
C. an audible murmur over segment B indicates the presence of laminar blood flow.
D. the calculated Reynold's number in segment C is directly related to the diameter of the vessel in that segment.
E. the lateral pressure will be greater in segment C than segment A.

25. Refer to the diagram above.



If Q_{AB} = 20 ml/min
Q_{R1} = 15 ml/min
Q_{R2} = 5 ml/min

Calculate the resistance to blood flow in R1.

A. 3.2 mmHg/ml/min
B. 2.4 mmHg/ml/min
C. 1.0 mmHg/ml/min
D. 0.75 mmHg/ml/min
E. 0.33 mmHg/ml/min

26. Select the **FALSE** statement concerning the pulmonary circulation.

A. Pulmonary blood flow always exceeds renal blood flow.
B. The pulmonary circulation serves as a reservoir of blood for the left ventricle.
C. The pulmonary circulation plays a role in the degradation and activation of specific vasoactive substances.
D. Approximately 30% of the total circulating blood volume is located in the pulmonary circulation in the resting state.
E. During left ventricular failure pulmonary blood volume increases.

27. Select the **FALSE** statement. Generalized alveolar hypoxia

A. increases pulmonary vascular resistance.
B. increases right ventricular work.
C. may cause right ventricular failure when exposure to hypoxia occurs over a long period of time.
D. results in a reduction of blood flow to the superior or apical regions of the lung.
E. reduces alveolar dead space.

28. Select the **FALSE** statement concerning Zone II pulmonary blood flow.

A. Alveolar pressure is intermediate between pulmonary arterial and venous pressures.
B. Pulmonary venous pressure has no influence on the magnitude of blood flow in this region.
C. Pulmonary arterial pressure increases from the top to the bottom of Zone II.
D. Alveolar pressure increases significantly from the top to the bottom of Zone II.
E. Blood flow throughout this zone is determined by pulmonary arterial pressure minus alveolar pressure.

29. The second heart sound

A. is due to rapid active filling of the ventricles in diastole.
B. occurs during the period of diastasis.
C. is related to closure of the aortic and pulmonic valves.
D. results from opening of the mitral and tricuspid valves.
E. occurs in early ventricular systole.

30. The fourth heart sound

A. is a common finding in children.
B. occurs during active rapid filling of the ventricles.
C. is coincident with ventricular depolarization.
D. occurs during isometric relaxation of the ventricles.
E. is coincident with the T-wave of the ECG.

31. The first heart sound

A. is coincident with the P-wave of the ECG.
B. occurs during diastasis.
C. occurs during peak ventricular ejection.
D. may be split with mitral valve closure preceding tricuspid valve closure.
E. immediately precedes the onset of the QRS complex of the ECG.

32. In the fetal circulation

A. the majority of right ventricular output is shunted through the ductus arteriosus into the aorta.
B. the descending thoracic aorta contains blood with a lower O_2 content than the pulmonary veins.
C. the ductus venosus is a shunt between the inferior vena cava and the left atrium.
D. aortic pressure is greater than pulmonary arterial pressure.
E. the blood O_2 content is greater in the pulmonary veins than the umbilical vein.

33. Select the **FALSE** statement concerning the fetal circulation.

A. The right and left ventricles function in parallel rather than in series.
B. Blood is returned to the placenta by the two umbilical arteries.
C. Left atrial pressure is greater than right atrial pressure.
D. The ductus arteriosus is a right-to-left shunt.
E. The ductus venosus empties directly into the inferior vena cava.

34. Select the **FALSE** statement concerning the circulatory changes that occur at birth.

A. The foramen ovale functionally closes.
B. Systemic vascular resistance increases due to the removal of the placental circulation.
C. Exposure of the ductus arteriosus to well oxygenated blood initiates constriction of ductal smooth muscle.
D. Pulmonary blood flow increases.
E. Pulmonary vascular resistance increases.

35. Select the **FALSE** statement concerning the coronary circulation.

A. Blood flow in the right coronary artery is maximum in systole.
B. Blood flow is maximum in the left coronary artery in late diastole.
C. Systolic intramyocardial tissue pressure is maximum in the subendocardial region of the left ventricle.
D. Atherosclerosis of the coronary arteries primarily involves the extramural (epicardial) vessels.
E. Most myocardial infarcts result from sudden occlusion of a coronary artery with a thrombus.

36. Select the **FALSE** statement concerning coronary heart disease.

A. Coronary artery disease is due to atherosclerosis in the vast majority of cases.
B. Angina pectoris frequently indicates significant involvement of the coronary arteries with atherosclerosis.
C. Significant involvement of the coronary arteries with atherosclerosis may occur without producing anginal symptoms.
D. Angina pectoris occurs when O_2 demand of the myocardium exceeds the ability of the coronary circulation to increase blood flow sufficiently to meet the demand.
E. Each attack of angina pectoris is associated with release of specific enzymes from myocardial cells.

37. If pulmonary vascular resistance is 4.0 mmHg/L/min and the cardiac output is 6.0 L/min, what is the driving pressure of the pulmonary circulation?

A. 10 mmHg
B. 18 mmHg
C. 24 mmHg
D. 28 mmHg
E. 30 mmHg

38. How much O_2 is transferred from blood to a tissue if the arterial blood O_2 content is 20 ml/100 ml of blood, the venous blood O_2 content is 14 ml/100 ml and blood flow is 300 ml/min?

A. 4 ml of O_2/min
B. 8 ml of O_2/min
C. 13 ml of O_2/min
D. 18 ml of O_2/min
E. 24 ml of O_2/min

39. Select the **FALSE** statement concerning coronary heart disease.

A. Coronary artery atherosclerosis is a disease of multifactorial origin.
B. The initial stages of coronary atherosclerosis often occur in young men in their 20's.
C. Myocardial ischemia associated with coronary heart disease is most likely to occur in the subendocardial region of the left ventricle.
D. When coronary heart disease becomes symptomatic, the disease is usually extensive and severe.
E. Coronary artery restenosis rarely occurs following angioplasty.

40. Microcirculation is

A. the part of the circulation which begins with small arteries of 600 μm in diameter.
B. the site where blood flow velocity is the greatest.
C. the largest reservoir of blood in the body.
D. the part of the circulation which is not innervated by sympathetic nerves.
E. the site of exchange of nutrients and waste products.

41. Filtration in a capillary bed is favored by

A. increased arteriolar pressure.
B. decreased venular pressure.
C. decreased interstitial oncotic pressure.
D. constriction of the precapillary sphincters.
E. reduction in blood volume.

42. Comparing vascular smooth muscle and skeletal muscle, which of the following is **NOT** unique to vascular smooth muscle.

A. the ability to maintain longer lasting contraction
B. the ability to form non-cycling actin-myosin cross-bridges
C. the ability to relax in response to prostacyclin
D. the ability to respond to increased workload with muscle hypertrophy
E. the ability to form a syncytium

43. Select the **FALSE** statement. Electrical stimulation of the vagus nerve

A. decreases total peripheral resistance.
B. stops paroxysmal atrial tachycardia
C. activates the chemoreceptor reflex.
D. lowers blood pressure
E. elicits severe bradycardia.

44. Select the **FALSE** statement. Active vasodilation by arterioles can be elicited in response to

A. epinephrine.
B. elevation of intracellular cyclic GMP.
C. increased perfusion pressure.
D. acetylcholine.
E. shear stress.

45. Select the **FALSE** statement. Reactive hyperemia

A. results from accumulation of vasoactive metabolites.
B. continues until the oxygen debt is paid back.
C. is preceded by a period of occlusion of an artery.
D. is a reflex elicited by activation of pain receptors.
E. can occur in the absence of sympathetic innervation.

46. Select the **FALSE** statement. Removal of endothelium in the artery

A. eliminates the myogenic reflex.
B. changes the vasodilator effects of bradykinin and acetylcholine into vasoconstrictor effects.
C. enhances platelet adhesion.
D. augments norepinephrine-induced vasoconstriction.
E. augments smooth muscle cell proliferation.

47. Select the **FALSE** statement. Orthostatic hypotension

A. can occur following a period of extremely elevated plasma catecholamine levels.
B. may result from decreased sensitivity of baroreceptors.
C. can occur in patients treated with drugs blocking sympathetic ganglionic transmission.
D. may result from pooling of blood in peripheral veins.
E. may result from destruction of the nucleus of the solitary tract.

48. Select the **FALSE** statement. Increased carbon dioxide tension in systemic arterial blood

A. activates aortic and carotid chemoreceptors.
B. can cause reflex systemic vasoconstriction.
C. decreases afferent vagal activity.
D. increases activity of the sympathetic postganglionic nerves.
E. acts locally as a vasodilator (in the systemic circulation).

49. Select the **FALSE** statement. A characteristic of the sympathetic nervous system is that it

A. provides innervation for all arteries and veins.
B. releases norepinephrine which activates alpha-adrenergic receptors.
C. is activated during fight-and-flight response.
D. is inactivated during Valsalva maneuver.
E. releases acetylcholine in the ganglia.

50. Which will **NOT** occur in a healthy person during isotonic exercise?

A. activation of sympathetic cholinergic nerve fibers at the onset of exercise.
B. reduction in splanchnic blood flow
C. activation of beta-1 adrenergic receptors
D. decreased total peripheral resistance
E. baroreceptor-mediated resetting of blood pressure to a lower level

51. Which would **NOT** occur following larger than needed blood volume replacement in a patient with bleeding ulcer?

A. activation of atrial mechanoreceptors
B. stimulation of vasopressin secretion
C. stimulation of atrial natriuretic factor release
D. inhibition of renal sympathetic nerve activity
E. activation of vagal afferent fibers

52. Select the **FALSE** statement. During prolonged exercise

A. adrenomedullary secretion of epinephrine increases.
B. aortic pulse pressure increases.
C. fatigue occurs as intramuscular ADP/ATP ratio increases.
D. myocardial oxygen demand increases.
E. ventilation to perfusion ratio decreases.

53. Select the **FALSE** statement. Immersion of a person's hand into a bucket of ice-cold water which lowers the temperature of this hand below 15°C

A. constricts arteriovenous anastamoses in the immersed hand.
B. causes cutaneous vasodilation of the immersed hand.
C. directly enhances norepinephrine release in the cutaneous circulation of the immersed hand.
D. initially increases and then decreases the body's metabolic rate.
E. lowers core body temperature.

54. Select the **FALSE** statement. Prolonged exposure to heat

A. increases cardiac output.
B. causes neurogenic vasodilation in the skin.
C. activates sympathetic cholinergic fibers innervating sweat glands.
D. causes heat loss primarily through breathing and insensible perspiration.
E. may lead to heat stroke if rectal temperature rises above 41.3°C (106°F).

55. Select the **FALSE** statement:

A. The combined diameter of the small airways is greater than the tracheal diameter.
B. Approximately 10% of the alveolar cells are type II cells.
C. The respiratory bronchioles have both conductive and gas exchange function.
D. The small airways (less than 2 mm in diameter) contribute the most to airway resistance.
E The internal surface area of the lung is between 50-100 square meters.

56. Select the **FALSE** statement:

A. The radial traction around the bronchioli contributes greatly to airway patency.
B. The major pathology in emphysema is the distention of alveoli and disruption of alveolar septae.
C. The surfactant layer the alveoli is very thick and provides a significant barrier to diffusion.
D. The interstitial space in the alveolar septae contains the collagen fibers.
E. Henry's law states the relationship between dissolved gases, solubility and partial pressure.

57. Select the **FALSE** statement:

A. When the lung is completely degassed, it looks like the liver.
B. The muco-cilliary layer moves toward the alveoli.
C. The lamellar bodies are in the type II cells and probably contain surfactant.
D. The terminal bronchioli do not have a ciliated epithelium.
E. Macrophages are mostly responsible for the removal of particles from the alveoli.

58. Select the **FALSE** statement:

A. Pulmonary capillary oxygen tension is always lower than arterial oxygen tension.
B. Diffusion across the alveolar-capillary membrane is enhanced if the membrane is thin.
C. Diffusing capacity is expressed in mL/min/mmHg.
D. Nitrous oxide is used to determine pulmonary blood flow.
E. The crossing of carbon monoxide over the alveolar-capillary membrane is diffusion limited.

59. Select the **FALSE** statement:

A. The transit time in the capillary is more than sufficient for complete PO_2 equilibration between alveolus and capillary.
B. The reason for a decrease in PO_2 between the lung capillaries and systemic arteries is venous admixture.
C. The initial PO_2 gradient between alveoli and venous capillaries is about 60 mmHg, but the average gradient is less.
D. The alveolar-arterial (A-a) PO_2 gradient is increased by the presence of a shunt.
E. The combination of hemoglobin (Hb) and oxygen has no effect on diffusion.

60. Select the **FALSE** statement:

A. Mixed venous blood is sampled by catheter from the pulmonary artery.
B. Pulmonary capillary blood gases cannot be sampled, because they are inaccessible.
C. The measurement of an organ's O_2 consumption will require sampling of arterial blood and blood from the vein draining the organ.
D. Increased mixed venous PO_2 is a sign of increased oxygen consumption.
E. CO_2 production depends on the level of activity of a subject.

61. Select the **FALSE** statement:

A. The O_2-Hb dissociation curve is shifted to the left by decreased hydrogen ion concentration.
B. It takes less of a PO_2 gradient to unload 5 mL/dL O_2 from hemoglobin on the steep slope of the dissociation curve than on the flat part.
C. The affinity of Hb for carbon monoxide is less than the affinity for oxygen.
D. 2,3 diphosphoglycerate is increased in the red blood cells during hypoxemia.
E. A sustained decrease of PaO_2 under 60 mmHg will result in polycythemia.

62. Select the **FALSE** statement:

A. The volume of O_2 in arterial blood depends on PaO_2, dissolved O_2, and the quantity of Hb.
B. At high altitude, polycythemia will enhance the quantity of transported O_2, but will have no effect on the tissue pressure of O_2.
C. The amount of O_2 carried by the mixed venous blood depends on O_2 consumption.
D. The O_2 content of blood is the amount of Hb/dL in grams multiplied by 1.34 times the Hb saturation (expressed as a fraction).
E. The Haldane effect is a mechanism responsible for decrease in CO_2 transport.

63. Select the **FALSE** statement:

A. The combination of H_2O and CO_2 is catalyzed by carbonic anhydrase in the plasma.
B. The chloride shift in the peripheral blood is from the plasma into the RBC.
C. Diffusion in the tissues is between the capillaries and interstitial fluid.
D. A PO_2 of 1 mmHg on the mitochondria is sufficient to sustain aerobic metabolism.
E. Basal metabolic rate (BMR) and resting O_2 consumption are synonymous.

64. In a 70 Kg man, arterial O_2 tension will be highest under which of the following conditions?

	Alveolar Ventilation (L/min)	Hemoglobin Content (g/dL)	P_AO_2 (mm Hg)	Saturation (%)
A.	6	15	150	100
B.	6	20	80	85
C.	6	10	400	100
D.	3	15	150	75
E.	3	21	300	100

65. Select the **FALSE** statement.

A. Under normal resting conditions the pressure gradient for O_2 between alveolar air and capillary blood after 0.5 second of contact is zero.
B. The mean gradient for O_2 diffusion in the normal lung is less than the arterial-venous gradient for O_2.
C. O_2 reserves in the body are substantially higher than CO_2 reserves.
D. The diffusion of nitrous oxide (N_2O) across the alveolar-capillary membrane is perfusion limited.
E. A decrease in cardiac output might increase contact time between alveolar gas and capillary blood.

For questions 66-69. Match each set of conditions (66-69) with the correct acid-base disturbance (A-E).

A. Chronic compensated respiratory acidosis
B. Acute metabolic acidosis.
C. Acute respiratory alkalosis
D. Acute respiratory acidosis
E. Respiratory alkalosis of chronic hyperventilation

	PaO_2	$PaCO_2$	pH	HCO_3^-
66.	increased	decreased	near normal	decreased
67.	decreased	increased	near normal	increased
68.	decreased	increased	decreased	near normal
69.	increased	decreased	decreased	decreased

70. Select the **FALSE** statement:

A. Arterial pH is the best indicator whether a blood test is from an acutely ill or a chronically ill patient.
B Metabolic compensation for respiratory acidosis takes between 24-48 hours.
C. The normal ratio between bicarbonate and dissolved CO_2 is 20.
D. During metabolic acidosis respiration will be slow.
E. During hypoventilation, the PCO_2 will be elevated.

71. Select the **FALSE** statement:

A. The ventilation/perfusion ratio (V_A/Q) is highest at the top of the lung.
B. Hypoxia due to V_A/Q imbalance can be corrected by the administration of 100% O_2.
C. The composition of alveolar air in an area of shunt is the same as inspired air.
D. The pleural pressure is more negative during inspiration at the top than at the bottom of the lung.
E. The alveoli are fully distended in every lung area only at total lung capacity.

72. Select the **FALSE** statement:

A. Ventilation is decreased at the top of the lung due to greater distention of alveoli.
B. The lung is less compliant at high lung volumes.
C. Some shunt commonly occurs at the bottom of the lung.
D. The V_A/Q in a shunt is zero.
E. The top to bottom gradient in the lung is steeper for ventilation than perfusion.

73. Select the **FALSE** statement:

A. Lung compliance is influenced by tissue elasticity and surface tension.
B. Compliance is greater at low lung volumes.
C. Lung elastic recoil pressure is greater at high lung volumes.
D. The chest wall is less compliant than the lung at high lung volumes.
E. At total lung capacity (TLC) the recoil pressure of the lung is about 30 cmH_2O.

74. Select the **FALSE** statement:

A. Airway resistance during quiet breathing is greater than during forced expiration.
B. Maximal expiratory flow (Vmax) is a function of elastic recoil pressure.
C. The intrathoracic pressure is negative during inspiration.
D. Muscular forces are the most important factor in inspiratory flow.
E. In the Waterfall phenomenon, resistance downstream beyond the choke point does not affect air flow.

75. Select the **FALSE** statement:

A. In the supine position, the lung volumes are smaller than in the erect position.
B. In the supine position, PaO_2 might be lower than in the erect position.
C. When immersed in water, the V_A/Q is the same throughout the whole lung.
D. Presence of an obstruction in the airways will decrease Vmax.
E. Inspiratory flow is effort independent.

For questions 76-79. Match the definitions (76-79) with the correct choice (A-E).

A. Shunt or venous admixture
B. Alveolar-capillary block
C. Equal pressure point.
D. Pulmonary blood volume
E. Pulmonary capillary blood volume

76. The location along the airways where the intrabronchial and the pleural pressure are the same.

77. The situation where the gas exchange area is compromised by increased alveolar wall thickness.

78. The condition in which the pulmonary capillary $P\overset{c}{O}_2$ is normal, but the arterial PO_2 is reduced.

79. The volume of blood in the lung actively participating in gas exchange.

80. Select the **FALSE** statement. A normal individual (Hb=15g/dL) breathing a mixture of 40% O_2 and 60% N_2 at an altitude where atmospheric pressure is 547 mmHg. This person has an

A. arterial PO_2 of about 140mmHg
B. alveolar PO_2 of about 150 mmHg
C. alveolar PCO_2 of 50 mmHg.
D. arterial O_2 content of about 20.5 ml/dL
E. arterial O_2 saturation of 100%.

Use the following information for questions 81-83.

A two year old child is brought into the emergency room with shortness of breath that developed suddenly while playing with marbles. On physical examination there is absence of breath sounds on the left side of the chest. The diagnosis is made that the child aspirated a marble which lodged in the left main bronchus. PaO_2 is somewhat reduced.

81. Select the **FALSE** statement:

A. Shunting is increased on the left.
B. Alveolar ventilation is increased on the right.
C. Most of the cardiac output is now routed through the right lung.
D. Dead space ventilation will increase.
E. The alveoli of the left lung will have the gas composition of venous blood.

82. Which of the following procedures will be best suited to deal with this situation:

A. Administer oxygen.
B. Intubate the child and ventilate her with a respirator.
C. Perform a bronchoscopy (insert a tube and look into the airways) to remove the marble.
D. Give sedatives to allay her anxiety.
E. Prepare for emergency surgery.

83. Which of the following will **NOT** occur.

A. The left diaphragm will move less than the right.
B. Chest wall movement will be reduced on the left.
C. PaO_2 is reduced. Giving 100% O_2 would not raise it above 550 mmHg.
D. The pressure change to move a normal tidal volume by the right lung will have to increase, i.e. more energy will be spent on breathing.
E. The alveolar-arterial (A-a) gradient will be decreased.

Use the following information for questions 84-87.

A 37 year old miner from West Virginia is complaining of increasing shortness of breath over the last three years and reduced ability to work an eight hour shift. He is referred to the hospital, where the diagnosis of diffuse interstitial disease is made.

84. Which of the following changes would **NOT** be present in this patient?

A. decreased vital capacity (VC)
B. decreased residual volume (RV)
C. normal or increased FEV_1/FVC ratio
D. normal total lung capacity (TLC)
E. increased respiratory rate

85. Which of the following would **NOT** be present in this patient?

A. increased $PaCO_2$
B. decreased PaO_2
C. increased arterial blood pH
D. decreased plasma HCO_3^- concentration
E. decreased arterial O_2 content

86. Which of the following would **NOT** be revealed with additional studies?

A. decreased lung compliance
B increased recoil pressure
C. increased dead space ventilation
D. decreased tidal volume
E. decreased work of breathing

87. Which of the following pathophysiologic changes is **NOT** present in the patient?

A. There is an alveolar-capillary block.
B. V_A/Q imbalance is exaggerated.
C. The alveolar-arterial O_2 gradient $(A\text{-}a)O_2$ is greater than normal.
D. The diffusing capacity (DLCO) is decreased.
E. Airway resistance is increased.

Use the following information for questions 88-90.

A 58 year old woman is hospitalized for severe shortness of breath. From her history you learn that she is a smoker, has had a chronic cough and many previous hospitalizations for respiratory infections. She is from another town, so there is no immediate access to her medical records. On admission you see an obese woman, cyanotic, dyspneic and lethargic. She has a fever and feebly coughs up green purulent (pus) sputum. The chest X-ray shows patchy densities in the lung consistent with bronchopneumonia. The arterial blood gases on admission are:

PaO_2 = 58 mmHg
$PaCO_2$ = 65 mmHg
pH = 7.23
HCO_3^- = 38 mEq/L

88. The blood gases most likely reflect

A. chronic respiratory acidosis only.
B. acute respiratory acidosis only.
C. acute respiratory acidosis superimposed on chronic respiratory acidosis.
D. combined metabolic and respiratory acidosis.
E. metabolic acidosis only.

The patient is getting worse and is ventilated with a respirator and 40% O_2. After 36 hours, the arterial blood gases are:

PaO_2 = 120 mmHg
$PaCO_2$ = 38 mmHg
pH = 7.44
HCO_3^- = 26 mEq/L

89. Select the **TRUE** statement.

A. These values are just right in this case.
B. The patient should be provided even more O_2 to improve her condition.
C. This patient was hyperventilated, but it will be easy for her to sustain these values after weaning from the respirator.
D Considering her chronic condition the patient was hypoventilated.
E. Her records should be obtained, and her ventilation adjusted to match her usual blood gases.

Two hours after removal from the respirator, she develops respiratory distress and her blood gases show:

PaO_2 = 50 mmHg
$PaCO_2$ = 70 mmHg
pH = 7.22
HCO_3^- = 28 mEq/L

90. Which of the following does **NOT** apply to this situation?

A. The patient is hypoventilating.
B. The patient is in acute respiratory acidosis.
C. The patient is in need of immediate treatment.
D. The patient, if left alone, might compensate for this situation in a day or two.
E. The patient needs only O_2 administered through a nasal tube.

91. Which of the following subjects will have the highest arterial O_2 content?

	Alveolar Ventilation (L/min)	Hemoglobin Content (g/dL)	PAO_2 (mm Hg)	Saturation (%)
A.	6	15	100	100
B.	6	15	500	100
C.	6	18	300	100
D.	3	20	50	80
E.	3	22	40	75

92. Which of the following measurements would **NOT** assist in the diagnosis of restrictive lung disease?

A. airway resistance
B. lung compliance
C. diffusing capacity
D. spirometry
E. arterial blood gases

93. Which of the following does **NOT** affect airway resistance?

A. cross sectional area of the airways
B. length of the airways
C. lung volume at which it is measured
D. oxygen consumption
E. the muscular tonus of the wall of the airways

94. Maximal expiratory flow (MEF) is **NOT** dependent on which of the following?

A. the equal pressure point
B. airway resistance in the small airways
C. elastic recoil pressure of the lung
D. the force of the muscles of respiration.
E. lung volume

95. Select the **FALSE** statement regarding surfactant.

A. It acts at low lung volumes by reducing surface tension.
B. It does not affect surface tension at high lung volumes.
C. It is a phospholipid, rich in disaturated lecithin.
D. It's deficiency is the most common cause of respiratory distress of the newborn.
E. It is secreted from the 10th week of gestation in the human.

96. Select the **FALSE** statement. The CO_2 response is

A. a measure of respiratory drive.
B. potentiated in the presence of hypoxia.
C. the relationship between CO_2 content and PCO_2.
D. mostly evaluated by a rebreathing method.
E. blunted in the presence of chronic obstructive lung disease.

97. Select the **FALSE** statement.

A. Exercise will immediatelly result in increased ventilation due to afferent impulses from proprioceptors in the joints.
B. Hypoxic response is mediated from the carotid chemoreceptors via the glossopharyngeal nerves to the respiratory center.
C. In central apnea, nasal CPAP (continuous positive airway pressure) can be an effective treatment.
D. In central apnea, diaphragmatic activity is present during the apneic period.
E. The central response to hypoxemia (excluding the carotid bodies) is respiratory depression.

98. The most important measurement to distinguish between central and obstructive apnea is

A. expiratory flow.
B. oxymetry (measurement of O_2 saturation).
C. motion of the diaphragm.
D. EEG (electroencephialogram).
E. FEV_1/FVC ratio.

99. Which is **NOT** a lipid or associated with lipids?

A. steroid absorption through the stratum corneum
B. the keratins
C. sebum
D. pre-vitamin D_3
E. holocrine glands

100. Which does **NOT** favor skin pigmentation or increase melanin?

A. androgens
B. type B ultraviolet light
C. melatonin
D. dopaquinone
E. transfer of melanosomes between basal cells

101. Water loss or dehydration causes or accompanies

A. Langer's lines.
B. immunotolerance.
C. decreased resiliency of the skin.
D. the division of basal cells.
E. the graying of hair.

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PLACE YOUR ANSWER SHEET AND EVALUATIONS IN THE APPROPRIATELY LABELLED BOXES, THEN PICK-UP YOUR NEXT SET OF HANDOUTS.

REVISED

HUMAN PHYSIOLOGY
EXAM #2 ANSWERS

March 11, 1996

1. D
2. C
3. A
4. B
5. E
6. A
7. C
8. E
9. C
10. C
11. C
12. E
13. C
14. C
15. C
16. D
17. B
18. C
19. A
20. B
21. D
22. D
23. D
24. D
25. E
26. D
27. D
28. D
29. C
30. B
31. D
32. A
33. C
34. E
35. B
36. E
37. C
38. D
39. E
40. E
41. A
42. D
43. A or C
44. C
45. D
46. A
47. E
48. C
49. D
50. E
51. B
52. E
53. OMITTED
54. D
55. D
56. C
57. B
58. A
59. E
60. D
61. C
62. E
63. A
64. C
65. C
66. E
67. A
68. D
69. B
70. D
71. C
72. E
73. D
74. A
75. E
76. C
77. B
78. A
79. E
80. C
81. D
82. C
83. E
84. D
85. A
86. E
87. E
88. C
89. E
90. E
91. C
92. A
93. D
94. D
95. E
96. C
97. C or D
98. C
99. B
100. C
101. C