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

HUMAN PHYSIOLOGY

SECOND EXAMINATION

MONDAY, MARCH 13, 1995

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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 **7-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.**

1. Select the **FALSE** statement regarding an animal breathing a gas mixture containing 10% O_2.

   A. Left atrial pressure would increase to the same level as the pulmonary artery pressure.
   B. Right ventricular systolic pressure would increase.
   C. Blood flow to the various regions of the lung would become more uniform.
   D. Right ventricular stroke work would be augmented.
   E. Pulmonary vascular resistance would increase.

2. The total resistance to blood flow through a vascular bed with three parallel circuits is 1.5 mmHg/ml/min. If the resistances in two of the circuits are 3.0 mm Hg/ml/min and 4.0 mmHg/ml/min, what is the resistance in the third circuit?

   A. 2.0 mmHg/ml/min
   B. 5.0 mmHg/ml/min
   C. 8.0 mmHg/ml/min
   D. 12.0 mmHg/ml/min
   E. 16.0 mmHg/ml/min

3. The resistance to blood flow through a vascular bed is 50 mmHg/L/min. If the arteriovenous pressure gradient is 75 mmHg, the blood flow through this vascular bed is

   A. 0.50 L/min
   B. 0.75 L/min
   C. 1.20 L/min
   D. 1.35 L/min
   E. 1.50 L/min

4. An aneurysm (dilation) is present in the distal portion of the abdominal aorta of a 68 year old male. The cross-sectional area of the aneurysm is estimated to be 6.0 cm^2 and the blood flow is determined to be 2.4 L/min. The velocity of blood flow through the aneurysm is

   A. 50 cm/min
   B. 4.0 cm/sec
   C. 6.0 cm/min
   D. 10 cm/sec
   E. 100 cm/sec

5. Select the **FALSE** statement.

A. Blood flows through the pulmonary and systemic circuits are approximately equal.
B. The pulmonary circulation receives 100% of the cardiac output.
C. Blood volumes in the systemic and pulmonary circulations are approximately equal.
D. Pulmonary vascular resistance is considerably less than systemic vascular resistance.
E. Pulmonary artery pulse pressure is less than aortic pulse pressure.

6. If three vessels are connected in parallel, their total resistance to blood flow is

A. more than if they are connected in series.
B. less than the resistance of any vessel alone.
C. the same as the resistance of the smaller of the three vessels.
D. the average of their individual resistances.
E. the sum of their individual resistances.

7. At which of the following sites in the fetal circulation would the O_2 saturation of the blood be greatest?

A. superior vena cava
B. ductus venosus
C. pulmonary vein
D. ductus arteriosus
E. umbilical artery

8. Select the **FALSE** statement concerning the circulatory changes at birth.

A. Pulmonary vascular resistance decreases.
B. Left atrial pressure rises above right atrial pressure.
C. The foramen ovale functionally closes.
D. Left ventricular systolic pressure rises above right ventricular systolic pressure.
E. Systemic vascular resistance decreases due to the removal of the placental circulation.

9. In the fetal circulation

A. the ductus arteriosus serves as a left-to-right shunt between the aorta and pulmonary artery.
B. the umbilical arteries receive 100% of the left ventricular output.
C. pulmonary artery blood pressure is slightly greater than aortic blood pressure.
D. pulmonary venous blood O_2 content is greater than abdominal aortic blood O_2 content.
E. the pulmonary and systemic vascular circuits function in series.

For questions 10 and 11 use the data below that was obtained during a cardiac catherization.

mean right atrial pressure	=	20 mmHg
mean pulmonary artery pressure	=	25 mmHg
pulmonary capillary wedge pressure	=	10 mmHg
aortic pressure	=	100/90 mmHg
cardiac output	=	3.0 L/min
pulmonary artery O_2 content	=	12 ml/dl
femoral artery O_2 content	=	19 ml/dl

10. The pulmonary vascular resistance in this patient is

A. 0.3 mmHg/ml/sec.
B. 3.0 mmHg/ml/min.
C. 4.5 mmHg/ml/min.
D. 30 mmHg/ml/sec.
E. 50 mmHg/L/min.

11. The O_2 consumption in this patient is

A. 500 ml/min.
B. 75 ml/min.
C. 150 ml/min.
D. 210 ml/min.
E. 350 ml/min.

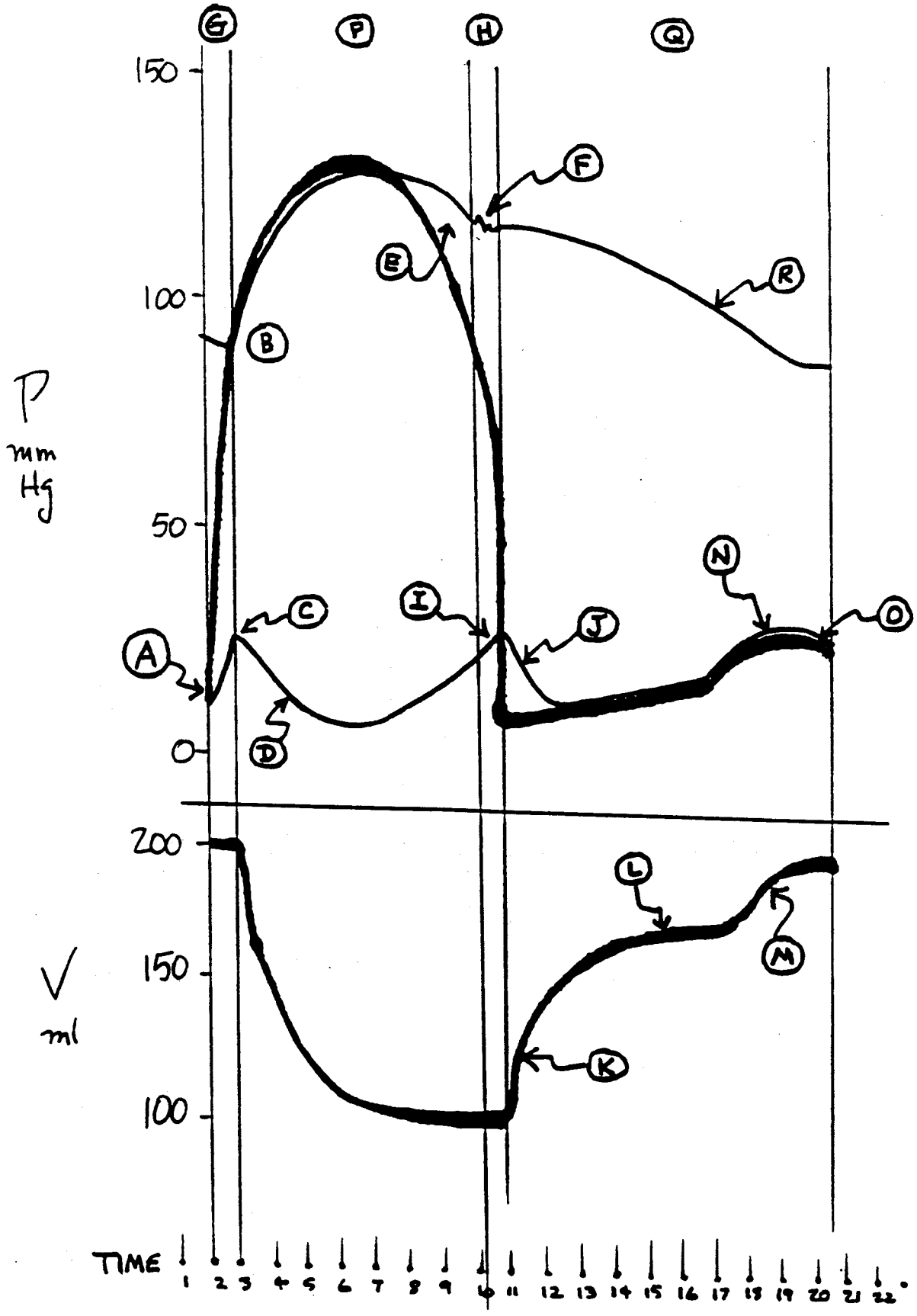
12. Select the **FALSE** statement.

A. The third and fourth heart sounds are ventricular filling sounds.
B. The pulmonary artery dicrotic notch is synchronous with pulmonic valve opening.
C. The first heart sound is associated with closure of the mitral and tricuspid valves.
D. The fourth heart sound is associated with active rapid filling of the ventricles.
E. Aortic valve closure normally precedes pulmonic valve closure.

13. Select the **FALSE** statement.

A. According to the Law of Laplace, T=P x r in a thin-walled vessel.
B. Volume flow per unit of time is proportional to the pressure gradient and inversely proportional to the resistance.
C. Resistance varies inversely with blood viscosity.
D. In laminar flow, velocity is greatest at the center of the stream.
E. The velocity of blood flow through a vessel is inversely related to the cross-sectional area.

For questions 14 through 17, refer to this figure.



14. Select the **FALSE** statement.

A. The aortic valve opens at **B**.
B. The mitral valve opens at **I**.
C. The second heart sound occurs at **F**.
D. A physiologic third heart sound would be audible at **K**.
E. A fourth heart sound would be audible at **L**.

15. The murmur of aortic valvular stenosis would be audible

A. during the period from **A to I**.
B. during **K, L and M**.
C. during **P**.
D. during the period from **K to L**.
E. during the period from **F to R**.

16. The "v" wave of the atrial pressure curve is labelled

A. C
B. I
C. K
D. M
E. N

17. Diastasis is labelled

A. E
B. F
C. K
D. L
E. N

18. Assume streamline blood flow of 64 ml/min in a segment of an artery. If the diameter is decreased by one-half without a change in pressure gradient, the flow becomes

A. 32 ml/min.
B. 4 ml/min.
C. 128 ml/min.
D. 16 ml/min.
E. 256 ml/min.

19. Select the **FALSE** statement. Angina pectoris

A. may be precipitated by physical activity.
B. indicates significant obstruction of one or more coronary arteries.
C. indicates inadequate O_2 supply to heart muscle.
D. is usually relieved with sublingual nitroglycerin.
E. implies necrosis of myocardial tissue.

20. While managing a patient who has recently suffered a myocardial infarction in the left ventricle, you are concerned about the oxygen supply-demand balance. Which of the following would adversely affect this balance?

A. a reduction in heart rate
B. reduced myocardial contractility
C. coronary vasodilation
D. increased blood volume
E. collateral blood flow in the heart

21. Which of the following would have the greatest effect on total cerebral blood flow in a normal individual?

A. a fall in arterial PO_2, from 95 mmHg to 65 mmHg
B. a rise in arterial PCO_2, from 40 mmHg to 50 mmHg
C. a fall in arterial blood pressure, from 120/80 mmHg to 90/50 mmHg
D. increased neuronal metabolism during a problem-solving exercise
E. elicitation of myogenic reflexes

22. The sharpest rise in left coronary artery blood flow occurs during

A. the peak ventricular pressure.
B. isovolumetric contraction.
C. isovolumetric relaxation.
D. early ejection.
E. atrial contraction.

23. Blood pressure and flow are measured in a third generation systemic artery of an individual with aortic blood pressure of 120/80 mmHg. Select the **FALSE** statement concerning the smaller artery.

A. Mean arterial pressure is less than 93 mmHg.
B. Blood flow is greatest during systole.
C. The dicrotic notch is prominent and sharply defined.
D. Pulse pressure is greater than 40 mmHg.
E. The rise in systolic pressure occurs later than in the aorta.

24. Calculate the pulmonary arterial oxygen content given the following measurements made in a child:

right atrial oxygen content	=	13 vol %
femoral artery oxygen content	=	20 vol %
oxygen consumption	=	120 ml/min
hematocrit	=	42%
aortic blood flow	=	3 L/min

A. 10 vol %
B. 12 vol %
C. 14 vol %
D 16 vol %
E. 18 vol %

25. In the patient above, a continuous murmur is heard. Based on the measurements above and the murmur, you suspect

A. mitral valve incompetence.
B. an atrial septal defect.
C. aortic valve incompetence.
D. patent ductus arteriosus.
E. aortic valve stenosis.

26. In an anesthetized patient with an electrically-paced heart, heart rate is increased from 90 to 160 BPM. Select the **FALSE** statement.

A. Stroke volume falls.
B. The oxygen supply:demand ratio in the left ventricle will be reduced.
C. Atrial contraction will account for a greater proportion of ventricular filling than at the lower heart rate.
D. Residual volume in the left ventricle will fall.
E. Central venous pressure will fall.

27. An increase in preload on an isolated segment of papillary muscle will produce

a. greater velocity of contraction at 0 afterload.
B. reduced maximal force of contraction.
C. greater velocity of shortening at a specific, submaximal afterload.
D. increased inotropic status.
E. decreased inotropic status.

28. If cardiac output is held constant, decrease in systemic arteriolar tone will **NOT** produce

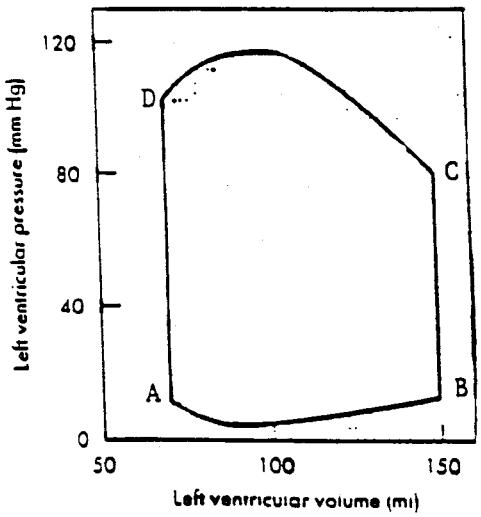
A. a fall in arterial pressure.
B. a decrease in arterial blood volume.
C. a rise in central venous pressure.
D. a rise in circulatory filling pressure.
E. a rise in right ventricular end diastolic volume.

29. A resting patient has a heart rate of 40 and arterial pressure of 150/50 mmHg. Based on these values, you predict that

A. stroke volume is higher than normal.
B. cardiac index is higher than normal.
C. end diastolic volume is reduced.
D. myocardial blood flow is diminished during diastole.
E. cerebral blood flow is elevated.

30. A rapid i.v. infusion results in a fall in heart rate in a resting individual. The most likely mechanism is

A. treppe.
B. sympathetic activation.
C. reduced myocardial contractility.
D. baroreceptor reflex.
E. Bainbridge reflex.



31. In reference to the above diagram, the ejection phase of systole is represented by segment

A. AB
B. BC
C. CD
D. DA
E. ABCD

32. Pulmonary capillary wedge pressure can be used to approximate

A. pulmonary arterial pressure.
B. systemic venous pressure.
C. right atrial pressure.
D. left atrial pressure.
E. left ventricular systolic pressure.

33. Temporally, the "a" wave of the atrial pressure curve most closely follows the

A. P wave of the ECG.
B. QRS complex of the ECG.
C. T wave of the ECG.
D. z-point of the cardiac cycle.
E. the incisura of the arterial pressure curve.

34. In a patient reclining at a 45 degree angle, you observe that the external jugular vein is distended or filled with blood up to a point several cm above the clavicle. You conclude that

A. venous return is lower than normal.
B. systemic arterial blood pressure is elevated significantly.
C. heart rate is significantly elevated.
D. blood volume is reduced.
E. central venous pressure is elevated.

35. During an accident in minor surgery, a rapid loss of 500 ml of blood occurs. Five minutes later, the greatest percent change, compared to the value before hemorrhage, is observed in

A. hematocrit.
B. systolic systemic arterial blood pressure.
C. diastolic systemic arterial blood pressure.
D. heart rate.
E. pulmonary arterial pressure.

36. Which of the following statements best describe the effects of intense stimulation of the vasomotor center

A. arteriolar constriction, increased peripheral resistance, decreased venous capacitance, increased capillary filtration, and increased heart rate and stroke volume.
B. release of norepinephrine, vasoconstriction, increased total peripheral resistance, increased cardiac output, and increased arterial pressure.
C. increased cutaneous blood flow, decreased splanchnic blood flow, decreased volume of the spleen, increased cadiac output.
D. venoconstriction, decreased venous capacitance, tachycardia, and vagal activation.
E. increased capillary pressure, increased circulating blood volume, increased stroke volume and cardiac output.

37. In a healthy individual, isometric exercise (handgrip) at 50% of maximal voluntary contraction normally elicits the following changes

A. Increase in both systolic and diastolic blood pressure, and tachycardia but without an increase in cardiac output.
B. Increase in systolic blood pressure but decrease in diastolic blood pressure, with increased heart rate and stroke volume.
C. Decreased vascular resistance in the exercising arm but increased resistance in the vessels of the rest of the body, with overall increase in total peripheral resistance.
D. Increased diastolic and mean blood pressure, increased heart rate, but no change in stroke volume.
E. Activation of the adrenal medulla to a greater extent than activation of the sympathetic nervous system.

38. Select the **FALSE** statement about the systemic microcirculation.

A. Blood flow velocity is the lowest in the capillaries.
B. Patency of the capillaries depends on the activity of the pre-capillary sphincters.
C. Capillary hydrostatic pressure is the main force favoring filtration of fluid.
D. Sympathetic nerves do not form neuro-effector junctions with the endothelial cells.
E. Capillaries do not play any role in vasomotion.

39. Complete the **FALSE** statement. Vasodilation may be induced by increased

A. sheer stress of blood flow.
B. release of endothelin.
C. cyclic AMP concentration in vascular smooth muscle.
D. release of nitric oxide by endothelial cells.
E. cyclic GMP concentration in vascular smooth muscle.

40. Complete the **FALSE** statement. Reactive hyperemia

A. is induced by a temporary occlusion of an artery.
B. continues until tissue oxygen debt is paid back.
C. depends on the intact endothelium.
D. is a local mechanism which can be overriden by neurogenic control.
E. is due to accumulation of vasodilator metabolites.

41. Complete the **FALSE** statement. The myogenic reflex

A. is activated by increased transluminal pressure and leads to vasoconstriction.
B. is induced by shear-stress of flow and leads to membrane depolarization and influx of calcium into the vascular smooth muscle cells.
C. maintains normal flow at the expense of increased vascular resistance.
D. is responsible for blood flow autoregulation.
E. is more active in the coronary than in the cutaneous blood vessels.

42. Complete the **FALSE** statement. Vasomotor tone is

A. completely abolished by the spinal cord transection.
B. dependent on tonic sympathetic nerve activity.
C. modulated by baroreceptor activity.
D. elevated during hemorrhage.
E. greater in the vessels of the skin than of the skeletal muscle.

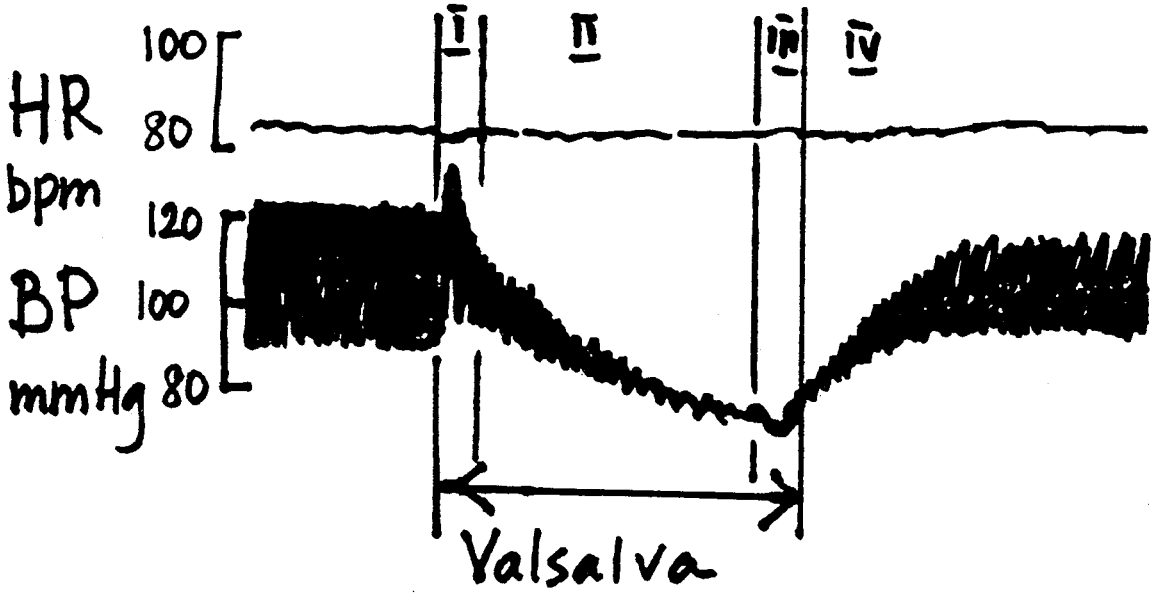
43. Which of the following conditions would **NOT** lead to fainting during standing?

A. decreased blood volume
B. hypersensitive arterial baroreceptors
C. treatment with drugs which block alpha$_1$-adrenergic receptors
D. venodilation
E. vagal activation

44. Norepinephrine was infused into a patient with a mean arterial pressure of 90 mmHg. Which of the following would **NOT** normally occur as a result of this intervention?

A. Heart rate would decrease due to activation of efferent vagal activity.
B. Coronary blood flow would increase due to increased metabolic activity of the heart.
C. Splanchnic and cutaneous vascular resistance would increase.
D. Baroreceptor firing would increase leading to stimulation of the nucleus of the solitary tract.
E. Mean arterial pressure would increase due to increased systolic and decreased diastolic pressure.

45. In a cardiovascular physiology laboratory, medical students were performing the Valsalva maneuver and were recording their heart rate and blood pressure responses. One of the students reported the following responses - see figure below. Which mechanisms could explain these observations?



A. lack of increase in intrathoracic pressure
B. fall in sympathetic nerve activity in phase II
C. fall in total peripheral resistance in phase III
D. vagal inhibition in phase IV
E. impaired baroreceptor function

46. Skeletal muscle vasodilation due to isotonic exercise is **NOT** mediated by

A. release of acetylcholine from parasympathetic nerves innervating skeletal muscle blood vessels.
B. epinephrine secreted by the adrenal medulla.
C. inhibition of sympathetic adrenergic nerves innervating skeletal muscle arterioles.
D. release of adenosine from working muscle.
E. reduced skeletal muscle oxygen tension.

47. Compared with a person leading a sedentary life, a well-trained individual of the same age and gender would be expected to respond to a treadmill exercise test with

A. greater activation of the sympathetic nervous system and greater increase in total peripheral resistance.
B. lower resting heart rate but greater exercise-induced tachycardia at the same work load.
C. greater increase in total peripheral resistance.
D. greater maximal oxygen uptake by skeletal muscle.
E. greater release of adrenomedullary catecholamines.

For questions 48 - 51, select one of the following choices (A - E).

A. Onset of exercise
B. Emphysema
C. Shunt
D. Diffuse interstitial fibrosis
E. Steady state

48. In this situation the composition of alveolar gases is the same as of mixed venous blood.

49. In this condition the respiratory quotient is larger than 1.

50. In this condition the elastic recoil pressure of the lung is increased.

51. In this condition the airway resistance is increased because of reduced radial traction.

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52. Select the **FALSE** statement regarding regional ventilation of the lung.

A. It shows a lesser gradient from top to bottom than perfusion.
B. It is affected by the forces of gravity.
C. It is lower at the bottom third than at the top third of the lung.
D. It is influenced by body position.
E. The pleural pressure is more negative at the top than at the bottom of the lung.

53. Hypoxemia can **NOT** be caused by

A. alveolar-capillary block.
B. V_A/Q imbalance.
C. hypoventilation.
D. increased utilization of oxygen by the tissues.
E. venous admixture.

For questions 54 - 58, select the correct answer (A-E).

A. metabolic alkalosis
B. acute metabolic acidosis
C. respiratory alkalosis induced by hyperventilation
D. chronic compensated respiratory acidosis
E. acute respiratory acidosis

	PaO_2	$PaCO_2$	pH	$-HCO_3$
54.	increased	decreased	decreased	decreased
55.	decreased	increased	near normal	increased
56.	normal	near normal	increased	increased
57.	decreased	increased	decreased	near normal
58.	increased	decreased	increased	near normal

59. In a healthy 70 Kg man, arterial O_2 content will be highest under which of the following conditions?

	Alveolar Ventilation (L/min)	Hemoglobin Content (g/dL)	PIO_2 (mmHg)	Saturation (%)
A.	6	17	150	95
B.	6	7	300	100
C.	6	15	80	75
D.	3	14	600	100
E.	3	21	150	85

60. Complete the **FALSE** statement. A healthy 70 Kg man is resting and breathing a mixture of 60% O_2 and 40% N_2 at an altitude where atmospheric pressure is 450 mmHg. He has

A. mixed venous O_2 content of about 15 ml/dL.
B. arterial PO_2 of about 200 mmHg.
C. alveolar PO_2 of about 190 mmHg.
D. arterial O_2 saturation of about 100%.
E. arterial O_2 content of about 20 ml/dL.

61. Select the **FALSE** statement.

A. The highest resistance to airflow is in the bronchioli.
B. Total airway cross-sectional area increases toward the alveoli.
C. Cartilage is found only to the 8th generation of airways.
D. Collagen fibers are responsible for the limited distensibility of the lung.
E. Type II cells comprise about 10% of all lung cells.

62. Select the **FALSE** statement.

A. The difference in O_2 content between venous and arterial blood is about 5 ml/dL at rest.
B. The ventilation/perfusion (V_A/Q) ratio in shunt equals zero.
C. The ventilation/perfusion ratio is smaller at the bottom than at the top of the lung.
D. The alveolar-arterial gradient for O_2 pressure is mainly due to physiological dead space.
E. There is normally no pressure gradient between alveolar and arterial PCO_2.

63. Select the **FALSE** statement.

A. CO_2 reserves in the body are substantially higher than O_2 reserves.
B. Under normal resting conditions the pressure gradient for O_2 between alveolar air and venous capillary blood after 0.25 second of contact is zero.
C. A decrease in cardiac output might result in increased contact time between alveolar gas and capillary blood.
D. The diffusion of carbon monoxide across the alveolar-capillary membrane is perfusion limited.
E. The mean gradient for O_2 diffusion in the normal lung is about 11 mmHg.

64. Select the **FALSE** statement.

A. The CO_2 content of systemic arterial blood is about 52 ml/dL.
B. The total pressure of the gases in the blood at sea level is about 713 mmHg .
C. An increase in hydrogen ion concentration will increase the affinity of hemoglobin for O_2.
D. The partial pressure of O_2 in the pulmonary capillary (after gas exchange) is always higher than in the systemic arteries.
E. Gases in the lung expand with increasing body temperature.

65. Airway resistance is **NOT** affected by

A. cross sectional area of the airways.
B. arterial PCO_2.
C. the lung volume at which it is measured.
D. aggregated mucus secretion.
E. radial traction on the airways.

66. Maximal expiratory flow (MEF) is **NOT** dependent on

A. the formation of a choke point.
B. airway resistance in the small airways.
C. elastic recoil pressure of the lung.
D. the cross-sectional area of the large airways.
E. dynamic airway compression.

67. Chronic obstructive lung disease is **NOT** characterized by

A. hypertrophy of the mucus glands.
B. coughing with production of large amount of sputum.
C. right heart failure.
D. reduced FEV1/FVC ratio.
E. shortened expiratory time.

FOR QUESTIONS 68 -71.

A newborn weighing 800 grams is brought by MEDEVAC helicopter to the neonatal intensive care unit. The child is cyanotic in spite of getting oxygen via a mask and is breathing with difficulty. The infant's condition is rapidly deteriorating and in spite of administering 100% oxygen, the arterial blood gases are:

PaO_2	=	150 mmHg
$PaCO_2$	=	55 mmHg
pH	=	7.28
HCO_3	=	28 mEq/L

68. Select the **FALSE** statement regarding this infant.

A. The infant has no tissue hypoxia.
B. The infant has acute respiratory failure.
C. The very large (A-a)O_2 gradient is due to hypoventilation.
D. Measurements will reveal a decreased FRC.
E. The X-ray will most probably show areas of hyperinflation alternating with areas of atelectasis.

69. On further examination one would **NOT** find

A. an increase in Type II cells and lamellar bodies.
B. abnormal breathing pattern (grunting).
C. increased respiratory rate.
D. decreased compliance.
E. decreased surfactant in lung lavage fluid.

70. The **BEST** treatment would be

A. intravenous feeding and fluids.
B. reduced oxygen concentration in inspired air.
C. continuous positive airway pressure (CPAP).
D. artificial surfactant.
E. antibiotics.

71. The infant is treated with positive pressure ventilation and 100% oxygen. Which of the following could **NOT** be a complication?

A. Pneumothorax
B. Retinopathy of the newborn
C. Bronchopulmonary dysplasia
D. Interstitial emphysema
E. Interstitial fibrosis

FOR QUESTIONS 72 - 73.

A 50 year old West Virginia coal miner is admitted for dry cough, weakness and shortness of breath. The X-ray of the chest reveals widespread infiltrates suggestive of diffuse interstitial fibrosis.

72. Which of the following is **NOT** probable regarding this patient?

A. All lung volumes will be proportionally reduced.
B. The FEV1/FVC ratio will be normal.
C. Expiration time will be shortened.
D. Diffusing capacity will be increased.
E. Respiratory rate will be rapid and the breathing shallow.

The patient has the following arterial blood gas values:

PaO_2	=	50 mmHg
$PaCO_2$	=	25 mmHg
pH	=	7.46
HCO_3	=	17 mEq/L

73. Which of the following does **NOT** apply to this patient?

A. There is probably a combination of diffusion barrier and V_A/Q imbalance.
B. This patient is hypoventilating.
C. The PO_2 is low enough to increase hematopoiesis.
D. The patients increased ventilatory drive is due to hypoxia.
E. The patient has chronic respiratory alkalosis.

FOR QUESTIONS 74 -76.

A 60 year old man is admitted to the emergency room with severe dyspnea and a history of chronic cough, weight loss and increasing weakness over the last few weeks. He has blood in the sputum. He was a two-pack smoker for forty years before he quit a year ago. Examination and subsequent X-ray show in the left lung a lesion suggestive of tumor.

Arterial blood gases are drawn and they show:

PaO_2	=	50 mmHg
$PaCO_2$	=	65 mmHg
pH	=	7.35
HCO_3	=	33 mEq/L
Hb	=	18.5 g/dL
Saturation	=	85%

74. After reading this history and findings, select the **FALSE** statement.

A. The patient has chronic hypoventilation.
B. The patient probably has a significant shunt in the left lung.
C. The patient has acute respiratory acidosis.
D. The patient probably has chronic obstructive pulmonary disease.
E. The oxygen carrying capacity of this patient's arterial blood is above normal.

The patient's condition deteriorates and he is put on a respirator and O_2 therapy. Three days later an attempt is made to wean the patient from the respirator and 40% O_2 is given through a nasal catheter. An hour later he is in obvious distress and the arterial blood gases are:

PaO_2	=	80 mmHg
$PaCO_2$	=	78 mmHg
pH	=	7.12
HCO_3	=	34 mEq/L

75. After analyzing these data, select the **FALSE** statement.

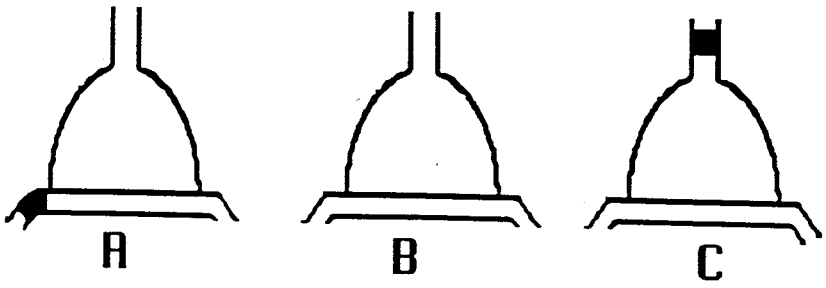
A. The patient is hypoventilating because the hypoxic respiratory drive is suppressed.
B. The patient now has acute respiratory acidosis superimposed on chronic respiratory acidosis.
C. The patient is expected to have a normal CO_2 response.
D. The PaO_2 for this patient should be maintained about 60 mmHg, since he is used to this level of hypoxemia.
E. The patient will require the respirator for correction of this condition.

It is established that the patient has pneumonia and after vigorous antibiotic treatment his condition improves to the level before admission. Bronchoscopy reveals obstruction of the main left bronchus by tumor. In the absence of spread, it is decided to remove the left lung. A week after surgery the arterial blood gases show:

PaO_2	=	65 mmHg
$PaCO_2$	=	65 mmHg
pH	=	7.32
HCO_3	=	30 mEq/L
Hb	=	16.0 g/dL
Saturation	=	93%

76. This surprising improvement in PO_2 is most likely due to

A. improved ventilation.
B. elimination of a large shunt in the removed left lung.
C. increased lung volumes.
D. improved respiratory drive.
E. reduced O_2 consumption.



77. Using the above diagrams select the **FALSE** answer:

A. The V_A/Q relationship in situation **C** is zero.
B. The composition of alveolar air in situation **A** resembles that of room air.
C. The gas content of perfused blood will not change in situation **C**.
D. In situation **B** (normal), the alveolar air will contain about 5.6% CO_2.
E. The blood leaving the gas exchange area in **A** will be saturated.

FOR QUESTIONS 78 - 80.

A 30 year old previously healthy man is brought to the Baltimore shock-trauma center a couple of hours after sustaining chest and head injuries in a car accident. He is unconscious, cyanotic and his breathing is shallow and rapid.

Initial arterial blood gases show:

PaO2	=	50 mmHg
PaCO2	=	65 mmHg
pH	=	7.11
HCO3	=	25 mEq/L
Hb	=	12 g/dL

78. Based on the history and the blood gases, select the **FALSE** statement:

A. The patient has acute respiratory acidosis.
B. The increased $PaCO_2$ is a result of venous admixture.
C. The patient is hypoventilating.
D. Giving 100% O_2 will not restore his arterial O_2 content to normal.
E. The blood oxygen carrying capacity is reduced.

The patient is immediately ventilated with a respirator, however, the right lung does not expand and the diagnosis of a right pneumothorax is made.

79. Select the **FALSE** statement:

A. The patient will most likely have a significant shunt in the left lung.
B. The pressure in the right pleural cavity will be atmospheric.
C. The pressure in the left pleural cavity will be negative at FRC.
D. If the patient could breathe on his own, the ventilation of the left lung would increase.
E. The perfusion of the left lung will increase.

Two weeks after the operation the patient is free of respiratory problems, but during a strenuous physiotherapy session suddenly complains of left chest pain and the diagnosis of a massive pulmonary embolism is made.

80. Select the **FALSE** statement:

A. There is an immediate increase in the ventilation of the right lung.
B. The left lung has increased physiological dead space ventilation.
C. If cardiac output is maintained, the perfusion of the right lung will increase significantly.
D. There will be a shunt in the left lung.
E. Treatment with anticoagulants is recommended.

FOR QUESTIONS 81 - 83.

A 73 year old male is admitted with a history of sleep apnea. He is moderately obese and has a questionable history of a stroke a year ago.

81. Which of the following tests will you perform to get a precise diagnosis (obstructive or central or mixed apnea)?

A. CO_2 response curve.
B. Measure respiratory flow during sleep.
C. Measure arterial blood gases and EKG during sleep.
D. Measure respiratory flow and diaphragmatic function simultaneously.
E. Obtain an EEG and EMG during waking hours.

82. Which of the following would **NOT** be associated with this condition?

A. Pulmonary hypertension
B. Snoring
C. Memory problems
D. Emphysema
E. Daytime sleepiness

83. After it is established that the patient has central apnea, which of the following approaches would be most likely to improve his condition?

A. Injection of diuretics
B. Tracheostomy.
C. Diaphragmatic pacemaker.
D. Positive airway pressure.
E. Plastic surgery on the palatal pharynx.

FOR QUESTIONS 84 - 85.

A 37 year old female is admitted to the hospital with dyspnea. Her pattern of breathing is rapid and shallow. On examination she has enlarged lymph nodes in the neck and hepatomegaly. The X-ray shows diffuse infiltrates and enlarged hilar lymph nodes, compatible with the diagnosis of sarcoidosis.

84. Which of the following will be the most likely pattern of lung volumes and capacities?

A. Increased FVC, decreased FEV1, increased RV.
B. Increased TLC, normal RV, decreased FEV1/FVC ratio.
C. Decreased FVC, decreased RV, normal FEV1/FVC ratio.
D. Increased FEV1/FVC ratio, increased TLC, increased RV.
E. Normal TLC, decreased FEV1/FVC ratio, decreased RV.

85. Further tests are performed. Which combination of findings is most likely?

A. Increased recoil pressure of the lung, decreased diffusing capacity, hypoxemia, hypocapnia.
B. Increased compliance, decreased diffusing capacity, hypoxemia, hypocapnia.
C. Reduced compliance, normal diffusing capacity, normal PaO2, hypercapnia.
D. Decreased recoil pressure, increased diffusing capacity, normal blood gases.
E. Normal compliance, normal lung volumes, increased diffusing capacity.

FOR QUESTIONS 86 -87.

A 17 year old male in severe respiratory failure is admitted to the hospital. There is a family history of cystic fibrosis and his diagnosis was confirmed ten years ago by a positive sweat test. He has advanced disease and has been hospitalized a total of 24 times. This time he has fever and his breathing is very shallow (tidal volume is 230 mL, respiratory rate is 32). He is given 40% O_2 and his alveolar CO_2 fraction is 9%.

86. Which of the following is likely?

A. acute respiratory acidosis
B. hypoxemia with normal $PaCO_2$
C. acute respiratory acidosis superimposed on chronic respiratory acidosis
D. combined respiratory acidosis and metabolic alkalosis
E. normal pH, hypocapnia and hypoxemia

87. Regarding the above patient, select the **FALSE** answer.

A. Alveolar PO_2 is about 206 mmHg.
B. Arterial PCO_2 is about 64 mmHg.
C. Alveolar PCO_2 is about 40 mmHg.
D. Alveolar ventilation is about 2.56 L/min.
E. Dead space ventilation is about 4.8 L/min.

88. Which of the following may be the circulating stem cell?

A. CFU-GEMM
B. Monocyte
C. Mast cell
D. Plasma cell
E. Null lymphocyte

89. Select the **FALSE** statement. The reticulocyte

A. contains ribonucleoprotein.
B. can bind iron.
C. has less active metabolism than the erythrocyte.
D. has transferrin receptors.
E. is the erythroid stage that leaves the marrow.

90. Which is **NOT** associated with the developing blood cells?

A. an intrasinusoidal location
B. fibronectin
C. receptors for adhesion molecules
D. proximity to stromal cells
E. large diameter

91. Complete the FALSE statement. After a large hemorrhage,

A. renal vascular dilation occurs.
B. much heme is in the deoxy state.
C. PGI_2 production increases.
D. CFU-E cells divide.
E. increased numbers of new red cells enter the blood about a week later.

92. Select the correct sequence concerning inflammation. (Ignore any omitted stages.)

A. diapedesis, margination, phagocytosis
B. lymphocytes, neutrophils, monocytes
C. diffusion along a gradient, endotoxin, bacteria
D. chemotaxis, adherence to endothelium, phagosome formation
E. cytokine release, rolling, selectin release

93. Select the **FALSE** statement. Phagocytosis by a neutrophil is particularly likely if a bacterium is coated by

A. opsonins.
B. immunoglobulins.
C. antibodies.
D. a lipid capsule.
E. plasma fibronectin.

94. Which is present in the characteristic granules of eosinophils?

A. G-CSF
B. Major Basic Protein
C. Lactoferrin
D. Defensins
E. Heparin

95. Select the correct sequence concerning the immune response. (Ignore any omitted stages.)

A. B cells, antigen processing, macrophages
B. antigen recognition, macrophage, T cells
C. antigen binding, T cells, fragmentation of antigen
D. major histocompatibility complex, B cells, T cells
E. macrophage, B cells, fragmentation of antigen

96. A person is unlikely to get a second attack of many viral diseases because of the presence of

A. plasma cells.
B. NK cells.
C. ADCC cells.
D. memory cells.
E. type 1 helper cells.

97. Thrombopoietin

A. acts at multiple stages in platelet development.
B. is made in the liver.
C. acts only on the early progenitor cell, BFU-Mk.
D. acts only on the late progenitor cell, CFU-Mk.
E. does not promote budding.

98. Which of the following affects hemostasis in the opposite direction to that of the others?

A. serotonin
B. smooth muscle contraction
C. nitric oxide
D. high tissue pressure
E. thromboxane A_2

99. von Willebrand Factor is associated with

A. adherence of platelets to collagen.
B. primary aggregation of platelets.
C. the platelet release reaction.
D. secondary aggregation of platelets.
E. clot formation.

100. Which is **LEAST** dependent on the keratin content of the epidermis?

A. the usefulness of leather for clothing
B. the need for application of a gel before recording an electrocardiogram
C. the resistance of the skin surface to infection
D. the absorption of "rubbing alcohol"
E. transepidermal water loss

101. A reduction in the numbers of Langerhans cells in the epidermis is associated with

A. skin cancer.
B. albinism.
C. inability to tan evenly after sun exposure.
D. immunotolerance.
E. increased destruction of folates in the cutaneous capillaries.

102. Among the following sites, aging of the skin is most apparent in the

A. face.
B. shoulders.
C. chest.
D. buttocks.
E. knees.

103. Which of the following vasoactive agents released in areas of sweating acts locally to produce dilation of the arterioles of the cutaneous circulation?

A. neuropeptide Y
B. prostaglandin E2
C. vasopressin
D. angiotensin II
E. bradykinin

104. The arteriovenous anastomoses of the cutaneous circulation

A. are found primarily in the skin of the chest and abdominal regions.
B. exhibit autoregulation.
C. do not exhibit basal tone.
D. are primarily under the control of local metabolic factors.
E. are innervated by both parasympathetic and sympathetic nerve fibers.

105. Select the **FALSE** statement.

A. Sweat is formed by the epithelial cells in the coiled portion of the sweat glands and is modified as it passes through the duct portion of the gland.
B. Sweat production is the only means of heat loss when ambient temperature exceeds body surface temperature.
C. Sweat is initially secreted as a primary or precursor secretion which is identical to plasma.
D. Sweat production is stimulated by activation of sympathetic cholinergic nerves.
E. Sweat production is substantially increased in individuals who are acclimatized to working at high temperatures.

****

IT'S OVER. FILL OUT YOUR EVALUATION SHEETS. PLACE YOUR ANSWER SHEETS AND EVALUATION SHEETS IN THE APPROPRIATELY MARKED BOXES THEN PICK UP YOUR LAST SET OF LECTURE HANDOUTS.

REVISED HUMAN PHYSIOLOGY

EXAM #2 - ANSWERS

3/13/95

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