

QUIZ HUBIO 541 - THE RESPIRATORY SYSTEM

Nov. 15, 2003

Use a number 2 pencil to mark your answer sheet.

Under ID NUMBER print your **UW student number** and under SPECIAL CODES print your **School of Medicine ID number**. Mark the corresponding grids.

Print your **name (LAST NAME FIRST)** in the spaces provided and mark the corresponding grid under each space.

Please use the **far right hand column of the name grid** to indicate your **GROUP**.

Grp 1 = A; 2 = B, 3 = C; 4 = D; 5 = E; 6 = F; 7 = G; 8 = H.

Mark the group you are attending. If not attending a group, mark **X**

Be certain that **ALL** information is correctly and completely gridded.

When marking an answer, be sure that you are marking beside the proper question number. Mark only one choice for each of the first 48 items. Erase completely if you change an answer. After completing the examination, check for and correct light or stray marks, poor erasures and multiple answers.

Questions 1-10 will count 2 points each; questions 11-40 will count 1 point each, and the last page will count 10 points for a total exam score of 60 points.

1. I have read the instructions above and
 - A. I didn't think they applied to me.
 - B. I figured my UW number was all you really needed.
 - C. I refuse to be identified by impersonal numbers.
 - D. I can't be bribed by a mere 2 points.
 - E. I have correctly entered name, UW number, SOM ID, and **Group** number.
(this answer will self-destruct if not proven true!)

2. If, during a breath delivered by positive pressure, a patient's lungs have an alveolar pressure of 10 cm H₂O at 2 liters and have a static recoil pressure of 10 cm H₂O at that volume, then the intrapleural pressure at that instant would be:
 - A. 10
 - B. 0
 - C. -5
 - D. -10
 - E. -20

3. The PO₂ in inspired air reaching the lower airways of an individual at an altitude where P_B = 650 is closest to:
 - A. 65
 - B. 85
 - C. 105
 - D. 125
 - E. 150

4. The key element to adjust in maintaining homeostasis for CO₂ with varying metabolic activity is maintenance of an appropriate:
- total ventilation per minute
 - fraction of wasted ventilation
 - CO₂ production rate
 - alveolar ventilation.
 - alveolar dead space.
5. Which of the following sets of values are most consistent with those expected while breathing air in an area of lung with low ventilation to perfusion ratio?:
- | | P _i O ₂ | alv PO ₂ | alv PCO ₂ | end capillary PO ₂ |
|----|-------------------------------|---------------------|----------------------|-------------------------------|
| A. | 150 | 100 | 40 | 90 |
| B. | 150 | 60 | 43 | 60 |
| C. | 150 | 60 | 43 | 50 |
| D. | 100 | 60 | 40 | 40 |
| E. | 100 | 40 | 60 | 40 |
6. The majority of the carbon dioxide in the blood is:
- in simple solution
 - in the form of bicarbonate ion
 - in the form of carbonic anhydrase
 - in association with hemoglobin as carbamino
 - bound to the heme portion of hemoglobin
7. The normal alveolar-arterial oxygen difference, the (A-a)ΔO₂, in healthy individuals is about 10mmHg. This is because
- Almost everyone has a small but significant and measurable diffusion limitation which increases (A-a)ΔO₂.
 - Most people do not live at sea level and therefore breathe air with a lower P_iO₂, and this increases their (A-a)ΔO₂.
 - High V/Q areas at the lung apices cause increased (A-a)ΔO₂.
 - A small amount of physiologic shunt and areas of low V/Q both contribute to this normal (A-a)ΔO₂
 - A right-to-left intracardiac shunt (eg, through a patent foramen ovale) is present in many healthy individuals

A 24 yo patient being evaluated in the ER has an arterial blood sample while breathing air showing

P_{aO_2} 55 P_{aCO_2} 56 pH 7.20 HCO_3^- 20 Hgb 10

Using this information answer the following three questions and the first in the next section.

8. The $(A-a)\Delta O_2$ is closest to:
- A. 5
 - B. 15
 - C. 25
 - D. 45
 - E. 80
9. The estimated Base Excess is closest to:
- A. -6 mEq/L
 - B. -2 mEq/L
 - C. 0 mEq/L
 - D. +2 mEq/L
 - E. +6 mEq/L
10. The acid-base derangement is best described as:
- A. respiratory acidosis, uncompensated.
 - B. respiratory acidosis, partially compensated.
 - C. metabolic acidosis, uncompensated.
 - D. metabolic acidosis, compensated.
 - E. respiratory acidosis and metabolic acidosis.

Questions 11-40 consist of a statement followed by numbered options, **any or all** of which may be correct. For each numbered option, answer **A** if the statement is **true** or answer **B** if the statement is **false**.

Regarding the oxygen level of the patient described above (questions 8-10):

- 11. The $(A-a)\Delta O_2$ indicates that hypoventilation is not contributing to hypoxemia.
- 12. The $(A-a)\Delta O_2$ is consistent with the presence of low V/Q areas.
- 13. An abnormal R-L shunt must be present.
- 14. The anemia is an important contributor to the P_{aO_2} observed.

A high dead space (V_D/V_T)

- 15. causes a reduction in the CO_2 level of mixed expired gas.
- 16. requires an increase in total ventilation to maintain alveolar ventilation.
- 17. contributes to a low V/Q ratio for the lung as a whole.

Which of the following are true regarding airway resistance?

18. If an airway were to triple in length, the airway resistance would increase 3 fold.
19. If an airway were to narrow to 1/3 its original diameter, the resistance would increase by 9 fold.
20. Resistance is greater during a forceful exhalation than during a forceful inhalation.
21. Greater than 90% of the vital capacity should normally be exhaled during the first second of a forced vital capacity maneuver.

Which of the following is/are true of O₂ transfer from the alveolar space to the capillary blood?

22. O₂ diffuses from higher to lower concentration.
23. The driving pressure for O₂ diffusion is greater in high V/Q regions
24. O₂ is actively transported into the alveolar capillary blood by endothelial receptors.
25. Under normal conditions, capillary blood is fully oxygenated within a third of the time blood is in the alveolar capillaries.

During the passage of blood through the lungs, all of the following normally occur:

26. a fall in CO₂ partial pressure in the blood.
27. an increase in plasma bicarbonate
28. O₂ binding to hemoglobin hinders CO₂ exchange.

Alveoli near the top of the lung in an upright subject:

29. are more widely distended than those near the base (at FRC).
30. receive more ventilation per unit volume during a tidal breath than those lower in the lung.
31. will be unperfused if alveolar pressure exceeds capillary pressure.
32. have a higher V/Q ratio than those near the base.

Which of the following are true of the pulmonary circulation:

33. regional blood flow is influenced by hydrostatic pressures
34. vascular geometry influences regional blood flow distribution
35. vascular resistance changes with lung volume and is greatest at FRC

Which of the following are true regarding airway defenses?

- 36. Most inhaled particles larger than 10 μm are deposited in the upper airway.
- 37. Inhaled particles deposited in the alveoli are removed by mucociliary clearance.
- 38. The type 1 epithelial cell is the primary phagocytic cell in the alveoli..

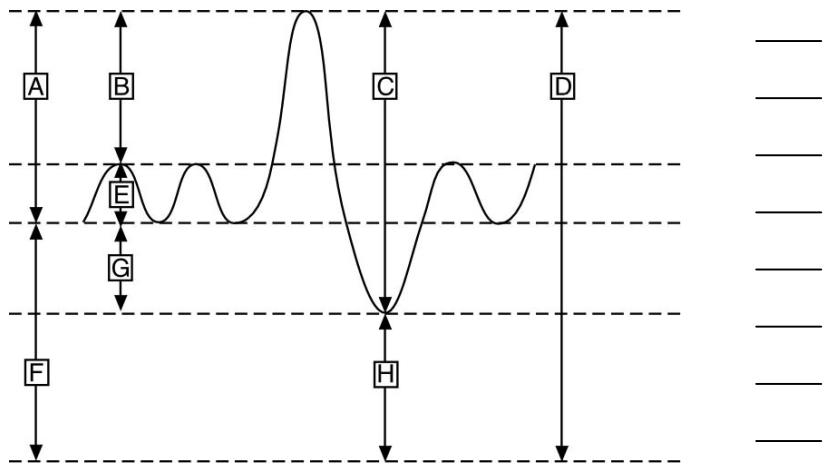
On a chest radiograph

- 39. it is rarely possible to visualize the interlobar fissures.
- 40. an "air bronchogram" indicates alveolar filling in adjacent lung.

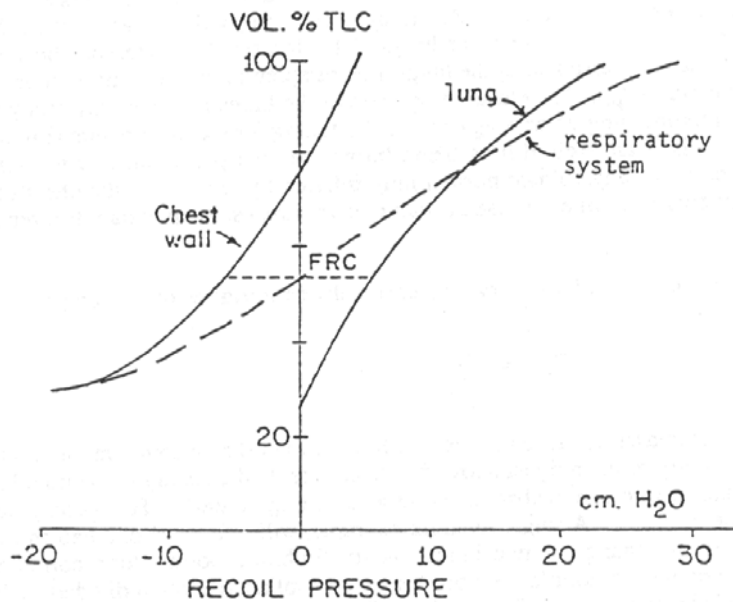
Name _____ Student No. _____

The following questions are a **required** portion of this quiz, worth 10 points.

1. Correctly match the subdivisions of the spirogram below with the correct name:



2.



The patient whose lung-chest wall mechanics are depicted above has a total lung capacity of 10 liters. If he is intubated, remains relaxed, and end expiratory airway pressure is zero, estimate the pressure that must be applied to the airway to achieve a 2 liter inhalation above FRC. Show the initial and end-inspiratory points on the diagram.

..... cm H₂O

Calculate the compliance observed over this 2 liter volume change.

Is this the compliance of the chest wall, lung, or respiratory system.

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