Part I. Clinical Applications

1. A person with ketoacidosis may hyperventilate. Explain why this occurs, and explain why this hyperventilation can be stopped by an intravenous fluid containing bicarbonate.

Ketoacidosis is a type of metabolic acidosis, and the fall in arterial pH stimulates the aortic and carotid bodies to increase ventilation. Although the hyperventilation was not caused initially by a rise in blood PCO2, the increased breathing results in more CO2 being exhaled and causes an abnormally low arterial PCO2 to be produced. This, by definition, is hyperventilation. Administration of bicarbonate can buffer the H+ released from the ketoacidosis and help to return the blood pH to normal. As this occurs, the amount of hyperventilation will decrease.

2. Barbara is rushed to the emergency room after an auto accident. The 8th through 10th ribs on her left side have been fractured and have punctured the lung cavity. What term is used to indicate lung collapse and why does it collapse? Will both lungs collapse? Why or why not?

A Pneumothorax is the presence of air in the pleural cavity (i.e., the potential space between the visceral and parietal pleura of the lung). This air pushes on the outside of your lung and makes it collapse. The clinical results are dependent on the degree of collapse of the lung. Pneumothorax can impair oxygenation and/or ventilation. When the pleural cavities fill with blood it is called a hemothorax. The lungs are in separate pleural cavities, so only the left lung will collapse.

3. A young boy is diagnosed with cystic fibrosis. What effect will this have on his respiratory system?

The mucus secreted by the respiratory mucosa will be abnormally thick and difficult to clear. As a result, respiratory passages will become blocked with mucus, which favors respiratory infections.

4. As a second-year nursing student you are asked to explain how each of the following might interfere with a patient’s gas exchange.

   A) Iron deficiency that causes a decrease in the number of red blood cells.

   Hemoglobin, which transports most of the oxygen carried in the blood, is found in RBCs, so if the number of RBCs drops, the amount of oxygen transported drops as well.

   B) Cystic fibrosis in which the surfaces of the alveoli become coated with thick, sticky mucus.

   The mucus increases the thickness of the respiratory membrane, impairing the efficiency of gas diffusion and exchange.

   C) A history of heavy smoking.

   Smoking paralyzes the cilia, increasing the patient’s risk of passageway obstruction by mucus and infection. Also, the carbon monoxide in cigarette smoke competes with
oxygen for binding sites on hemoglobin and thus the RBCs carry less oxygen. Note: We will cover this in greater detail when we study the blood.

5. I. M. Good decides to run outside all winter long in spite of the cold weather. How does running in cold weather affect the respiratory passageways and the lungs?

Running usually requires breathing rapidly through the mouth, which eliminates much of the preliminary filtration, heating, and humidifying of the inspired air. When these conditions are eliminated by breathing through the mouth, the delicate respiratory surfaces are subject to chilling, drying out, and possible damage.

6. R. U. Hurt is a 68-year-old man who has been a two-pack-a-day smoker for the last 20 years. After a series of pulmonary tests his doctor informs him that he has emphysema. Explain what emphysema is and why it results in difficulty in breathing.

Emphysema is a disorder characterized by destruction of the walls of the alveoli, producing abnormally large air spaces that remain filled with air during exhalation. Lung elastic recoil decreases due to loss of elastic fibers, and an increasing amount of air becomes trapped in the lungs at the end of exhalation. Destruction of the alveolar walls results in less surface area for gas exchange and oxygen diffusion across the damaged respiratory membrane is reduced. Blood oxygen level is lowered, and any mild exercise that raises the oxygen requirements leaves the patient breathless.

7. Why does an EMT administering a Breathalyzer test for alcohol ask the person begin tested to expel one deep breathe instead of several shallow ones?

Shallow breaths flush air out of the dead space (areas where the air does not participate in gas exchange). A deeper breath is more likely to contain air containing alcohol that is vaporizing from the blood into the alveoli.

8. What effect does respiratory acidosis have on the respiratory process and what compensatory mechanisms operate to bring the body back into homeostatic pH value?

When respiratory acidosis is due to reduced elimination of carbon dioxide from the body (i.e., increasing arterial PCO2, decreasing blood pH), the respiratory center is stimulated and hyperventilation results. Hyperventilation attempts to reduce blood CO2 levels and to cause an increase in blood pH.
Part II
1. apnea
2. eupnea
3. dyspnea
4. hypoxia
5. emphysema
6. chronic bronchitis
7. asthma
8. chronic bronchitis and emphysema
9. lung cancer
10. tuberculosis
11. infant respiratory distress syndrome or hyaline membrane disease
12. surfactant
13. lower the surface tension of the watery film in the alveolar sacs
14. It keeps the lungs inflated so that gas exchange can continue
15. tidal volume
16. dead space volume
17. vital capacity
18. residual volume
19. expiratory reserve volume

Part III
1. F
2. G
3. H
4. B
5. E
6. J
7. D
8. C
9. I
10. hemoglobin
11. bicarbonate ions
12. plasma
13. oxygen
14. bronchioles (terminal)
15. palate
16. phrenic
17. esophagus
18. epiglottis
19. trachea
20. alveoli
21. parietal pleura
22. visceral pleura
23. glottis
24. chonchae
25. vocal cords
26. intrapleural pressure
27. atmospheric pressure
28. intrapulmonary pressure or intra-alveolar pressure
29. intrapulmonary pressure or intra-alveolar pressure
30. intrapleural pressure
31. intrapulmonary pressure or intra-alveolar pressure
32. intrapulmonary pressure

Part IV
1. D
2. A
3. D
4. C
5. B
6. A
7. Correct Sequence: 3, 8, 6, 4, 1, 5, 7, 2, 9

Part V
1. Inspiratory reserve volume
2. tidal volume
3. expiratory reserve volume
4. residual volume
5. vital capacity
6. total lung capacity
7. functional residual capacity
8. D
9. C
10. B
11. D
12. A
13. D
14. E
15. E
16. K
17. D
18. I
19. G
20. B
21. E
22. M
23. A
24. J
25. F
26. L
27. C
28. H
Part VI
1. D
2. A
3. E
4. E
5. D
6. A
7. B, C
8. B
9. nicotine
10. carbon monoxide
11. emphysema
12. chronic bronchitis
13. carcinogens
14. medulla; phrenic; 2; increasing; enters
15. relaxes; 3; passively recoil
16. expiratory; internal intercostals; abdominal
17. H+; increase in pCO2
18. medulla
19. hypercapnia
20. B
21. D
22. B
23. A
24. A
25. B
26. C
27. B

Part VII
1. B
2. C
3. D
4. C
5. D
6. B
7. D
8. A
9. B
10. D
11. Explain the factors that will shift the oxygen hemoglobin dissociation curve to the right and to the left.

Factors that shift the curve to the right and increase the release of oxygen from hemoglobin
- pH of the tissues decreases (increased H+) due to an increase in CO2 concentration.
- Increased temperature
- Increased 2-3 DPG

Factors that shift the curve to the left and decrease the release of oxygen from hemoglobin
- pH of the tissues increases (decreased H+) due to a drop in CO2 concentration
- Decreased temperature
- Decreased 2-3 DPG