

Chapter 2 Ventilation

MULTIPLE CHOICE

1. What instrument is used to measure P_{atm} ?
- a. barometer
 - b. hygrometer
 - c. altimeter
 - d. dynameter

ANS: A

	Feedback
A	A barometer is used to measure barometric (P_B) or atmospheric (P_{atm}) pressure.
B	A barometer is used to measure barometric (P_B) or atmospheric (P_{atm}) pressure.
C	A barometer is used to measure barometric (P_B) or atmospheric (P_{atm}) pressure.
D	A barometer is used to measure barometric (P_B) or atmospheric (P_{atm}) pressure.

PTS: 1 DIF: Recall REF: The Airways

2. What is the term for the movement of gas from the external environment to the alveoli ?
- a. ventilation
 - b. external respiration
 - c. internal respiration
 - d. osmosis

ANS: A

	Feedback
A	The movement of gas from the external environment to the alveoli is called ventilation.
B	The movement of gas from the external environment to the alveoli is called ventilation.
C	The movement of gas from the external environment to the alveoli is called ventilation.
D	The movement of gas from the external environment to the alveoli is called ventilation.

PTS: 1 DIF: Recall REF: Introduction OBJ: 1

3. At sea level under standard conditions, what would the P_B equal in mm Hg ?
- a. 760
 - b. 1034
 - c. 14.7
 - d. 29.9

ANS: A

	Feedback
A	At sea level under standard conditions, the normal barometric pressure is 760 mm Hg.
B	At sea level under standard conditions, the normal barometric pressure is 760 mm Hg.
C	At sea level under standard conditions, the normal barometric pressure is 760 mm Hg.
D	At sea level under standard conditions, the normal barometric pressure is 760 mm Hg.

PTS: 1 DIF: Recall REF: Mechanisms of Ventilation
OBJ: 2

4. What is the general term for a pressure difference between two points in a system?
- a. pressure gradient
 - b. diffusion
 - c. system pressure variation
 - d. osmotic gradient

ANS: A

7. Which gas law states that at constant temperature, a volume of gas varies inversely proportional to its pressure?
- a. Boyle's
b. Charles
c. Gay-Lussac's
d. Henry's

ANS: A

	Feedback
A	Boyle's law states that at a constant temperature $P_1 \times V_1 = P_2 \times V_2$.
B	Boyle's law states that at a constant temperature $P_1 \times V_1 = P_2 \times V_2$.
C	Boyle's law states that at a constant temperature $P_1 \times V_1 = P_2 \times V_2$.
D	Boyle's law states that at a constant temperature $P_1 \times V_1 = P_2 \times V_2$.

PTS: 1

DIF: Recall

REF: Boyle's Law and Its Relationship to Pressure Gradients

OBJ: 2

8. At what point in the respiratory cycle is the equilibrium point reached?

- I. Inspiration
II. End-inspiration
III. Expiration
IV. End-expiration

- a. II and IV only
b. II only
c. IV only
d. I and III only

ANS: A

	Feedback
A	At end-inspiration and end-expiration, no gas movement occurs because the pressure gradient is zero.
B	At end-inspiration and end-expiration, no gas movement occurs because the pressure gradient is zero.
C	At end-inspiration and end-expiration, no gas movement occurs because the pressure gradient is zero.
D	At end-inspiration and end-expiration, no gas movement occurs because the pressure gradient is zero.

PTS: 1

DIF: Recall

REF: The Primary Mechanism of Ventilation Applied to the Human Airways

OBJ: 3

9. What is the general term for the inward movement of tissue between the ribs during inspiration due to increased negative intrapleural pressure generated during respiratory distress?
- a. intercostal retractions
b. pectus excavatum
c. dyspnea
d. supraclavicular retractions

ANS: A

	Feedback
A	Intercostal retractions are the inward movement of tissue between ribs during inspiration due the high negative intapleural pressure generated during respiratory distress, especially in newborns and infants.
B	Intercostal retractions are the inward movement of tissue between ribs during

	inspiration due the high negative intapleural pressure generated during respiratory distress, especially in newborns and infants.
C	Intercostal retractions are the inward movement of tissue between ribs during inspiration due the high negative intapleural pressure generated during respiratory distress, especially in newborns and infants.
D	Intercostal retractions are the inward movement of tissue between ribs during inspiration due the high negative intapleural pressure generated during respiratory distress, especially in newborns and infants.

PTS: 1 DIF: Recall

REF: The Primary Mechanism of Ventilation Applied to the Human Airways|Clinical Connection
2-1: Inspiratory Intercostal Retractions OBJ: 4

10. What is the general term for the force required to move gas or fluid through a tube or vessel?
- a. driving pressure
 - b. transmural pressure
 - c. transpulmonary pressure
 - d. transthoracic pressure

ANS: A

	Feedback
A	The driving pressure is the pressure difference between two points in a tube or vessel.
B	The driving pressure is the pressure difference between two points in a tube or vessel.
C	The driving pressure is the pressure difference between two points in a tube or vessel.
D	The driving pressure is the pressure difference between two points in a tube or vessel.

PTS: 1 DIF: Recall REF: Driving Pressure

OBJ: 5

11. Which pressure is represented by $P_{rs} = P_B - P_{alv}$?
- a. transrespiratory pressure
 - b. transmural pressure
 - c. transthoracic pressure
 - d. transpulmonary pressure

ANS: A

	Feedback
A	Transrespiratory pressure is the difference between the atmospheric pressure and alveolar pressure.
B	Transrespiratory pressure is the difference between the atmospheric pressure and alveolar pressure.
C	Transrespiratory pressure is the difference between the atmospheric pressure and alveolar pressure.
D	Transrespiratory pressure is the difference between the atmospheric pressure and alveolar pressure.

PTS: 1 DIF: Recall REF: Transrespiratory Pressure

OBJ: 5

12. What is the term for the pressure difference that occurs across the airway wall ?
- a. Transmural pressure
 - b. Transrespiratory pressure
 - c. Transpulmonary pressure
 - d. Transthoracic pressure

ANS: A

	Feedback
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A	The transmural pressure is derived by subtracting the pressure on the inside of the airway from the pressure on the outside of the airway.
B	The transmural pressure is derived by subtracting the pressure on the inside of the airway from the pressure on the outside of the airway.
C	The transmural pressure is derived by subtracting the pressure on the inside of the airway from the pressure on the outside of the airway.
D	The transmural pressure is derived by subtracting the pressure on the inside of the airway from the pressure on the outside of the airway.

PTS: 1 DIF: Recall REF: Transmural Pressure
 OBJ: 5

13. What is the term for the difference between the alveolar pressure and the pleural pressure?
- transpulmonary pressure
 - transmural pressure
 - transrespiratory pressure
 - transthoracic pressure

ANS: A

	Feedback
A	The transpulmonary pressure is the difference between the alveolar pressure and the pleural pressure.
B	The transpulmonary pressure is the difference between the alveolar pressure and the pleural pressure.
C	The transpulmonary pressure is the difference between the alveolar pressure and the pleural pressure.
D	The transpulmonary pressure is the difference between the alveolar pressure and the pleural pressure.

PTS: 1 DIF: Recall REF: Transpulmonary Pressure
 OBJ: 5

14. What is the term for the difference between the alveolar pressure and the body surface pressure?
- transthoracic pressure
 - transmural pressure
 - transrespiratory pressure
 - transpulmonary pressure

ANS: A

	Feedback
A	Transthoracic pressure is the difference between the alveolar pressure and the body surface pressure.
B	Transthoracic pressure is the difference between the alveolar pressure and the body surface pressure.
C	Transthoracic pressure is the difference between the alveolar pressure and the body surface pressure.
D	Transthoracic pressure is the difference between the alveolar pressure and the body surface pressure.

PTS: 1 DIF: Recall REF: Transthoracic Pressure
 OBJ: 5

15. In a flail chest, which pressure gradients are responsible for the inward movement on inspiration of the section of unattached ribs?

- I. Transpulmonary
- II. Transmural
- III. Transthoracic
- IV. Transrespiratory

- a. I and III only
- b. II and IV only
- c. I and II only
- d. II and III only

ANS: A

	Feedback
A	When a flail chest occurs, the section of unattached ribs moves inward on inspiration due to the transpulmonary and transthoracic pressure gradients.
B	When a flail chest occurs, the section of unattached ribs moves inward on inspiration due to the transpulmonary and transthoracic pressure gradients.
C	When a flail chest occurs, the section of unattached ribs moves inward on inspiration due to the transpulmonary and transthoracic pressure gradients.
D	When a flail chest occurs, the section of unattached ribs moves inward on inspiration due to the transpulmonary and transthoracic pressure gradients.

PTS: 1 DIF: Recall

REF: Lung Compliance|Clinical Connection 2-2: The Harmful Effects of Pressure Gradients When the Thorax is Unstable

OBJ: 6

16. Which clinical measurement is used to evaluate the elastic forces of the lungs?
- a. lung compliance
 - b. airway resistance
 - c. elastance
 - d. surface tension

ANS: A

	Feedback
A	The elastic forces of the lungs can be evaluated by measuring lung compliance.
B	The elastic forces of the lungs can be evaluated by measuring lung compliance.
C	The elastic forces of the lungs can be evaluated by measuring lung compliance.
D	The elastic forces of the lungs can be evaluated by measuring lung compliance.

PTS: 1 DIF: Recall

REF: Elastic Properties of the Lung and Chest Wall

OBJ: 7

17. What of the following is used to calculate lung compliance?
- a. $\Delta V / \Delta P$
 - b. $\Delta P / \Delta V$
 - c. $P_1V_1 = P_2V_2$
 - d. $P = (2ST) / r$

ANS: A

	Feedback
A	Lung compliance is defined as the change in lung volume per unit of pressure change.
B	Lung compliance is defined as the change in lung volume per unit of pressure change.
C	Lung compliance is defined as the change in lung volume per unit of pressure change.
D	Lung compliance is defined as the change in lung volume per unit of pressure change.

PTS: 1 DIF: Recall

REF: Lung Compliance

OBJ: 8

	trapping and hyperinflation.
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PTS: 1 DIF: Recall

REF: Lung Compliance|Clinical Connection 2-3: Pulmonary Disorders that Force the Patient to Breathe at the Top Flat Portion of the Volume Pressure Curve OBJ: 10

21. What effect do restrictive lung diseases have on lung compliance?
- Lung compliance decreases
 - Lung compliance increases
 - Lung compliance remains normal
 - Restrictive lung diseases do not affect lung compliance.

ANS: A

	Feedback
A	Restrictive lung diseases shift the volume-pressure curve to the right so lung compliance is reduced.
B	Restrictive lung diseases shift the volume-pressure curve to the right so lung compliance is reduced.
C	Restrictive lung diseases shift the volume-pressure curve to the right so lung compliance is reduced.
D	Restrictive lung diseases shift the volume-pressure curve to the right so lung compliance is reduced.

PTS: 1 DIF: Recall

REF: Lung Compliance|Clinical Connection 2-4: Pulmonary Disorders that Shift the Pressure Volume Curve to the Right OBJ: 11

22. Which of the following would shift the volume-pressure curve to the right?
- Acute asthma episode
 - Pneumothorax
 - Pleural effusion
 - Pulmonary edema

- II, II, and IV only
- I, II, and IV only
- I, III and IV only
- II and IV only

ANS: A

	Feedback
A	Restrictive lung conditions, including pneumothorax, pleural effusion, and pulmonary edema shift the volume pressure curve to the right.
B	Restrictive lung conditions, including pneumothorax, pleural effusion, and pulmonary edema shift the volume pressure curve to the right.
C	Restrictive lung conditions, including pneumothorax, pleural effusion, and pulmonary edema shift the volume pressure curve to the right.
D	Restrictive lung conditions, including pneumothorax, pleural effusion, and pulmonary edema shift the volume pressure curve to the right.

PTS: 1 DIF: Recall

REF: Lung Compliance|Clinical Connection 2-4: Pulmonary Disorders that Shift the Pressure Volume Curve to the Right OBJ: 11

23. What is the reciprocal of compliance?

- a. elastance
- b. resistance
- c. surface tension
- d. viscosity

ANS: A

	Feedback
A	The reciprocal of compliance is elastance.
B	The reciprocal of compliance is elastance.
C	The reciprocal of compliance is elastance.
D	The reciprocal of compliance is elastance.

PTS: 1 DIF: Recall REF: Hooke's Law
 OBJ: 12

24. Which physical law explains elastance?
- a. Hooke's law
 - b. Boyle's law
 - c. Gay-Lussac's law
 - d. Charles' law

ANS: A

	Feedback
A	Hooke's law explains elastance.
B	Hooke's law explains elastance.
C	Hooke's law explains elastance.
D	Hooke's law explains elastance.

PTS: 1 DIF: Recall REF: Hooke's Law
 OBJ: 12

25. When a positive pressure breath is delivered from a mechanical ventilator, how would intra-alveolar and intrapleural pressures be affected during inspiration?
- a. Both would increase
 - b. The intra-alveolar pressure would rise while the intrapleural pressure remains subatmospheric
 - c. Both would decrease
 - d. Both would remain constant at their resting levels

ANS: A

	Feedback
A	The intra-alveolar and intrapleural pressures would increase during a positive pressure breath from a mechanical ventilator.
B	The intra-alveolar and intrapleural pressures would increase during a positive pressure breath from a mechanical ventilator.
C	The intra-alveolar and intrapleural pressures would increase during a positive pressure breath from a mechanical ventilator.
D	The intra-alveolar and intrapleural pressures would increase during a positive pressure breath from a mechanical ventilator.

PTS: 1 DIF: Recall
 REF: Hooke's Law|Clinical Connection 2-5: Positive Pressure Ventilation
 OBJ: 13

26. When a tension pneumothorax occurs during positive pressure ventilation, how will the cardiac output and blood pressure affected?
- Both will decrease
 - Both will increase
 - The cardiac output will increase but the BP will decrease
 - The BP will increase but the BP will decrease

ANS: A

	Feedback
A	When a tesnion pneumothorax occurs, the cardiac output and blood pressure decrease due to compression of major vessels from accumulated gas in the pleural cavity.
B	When a tesnion pneumothorax occurs, the cardiac output and blood pressure decrease due to compression of major vessels from accumulated gas in the pleural cavity.
C	When a tesnion pneumothorax occurs, the cardiac output and blood pressure decrease due to compression of major vessels from accumulated gas in the pleural cavity.
D	When a tesnion pneumothorax occurs, the cardiac output and blood pressure decrease due to compression of major vessels from accumulated gas in the pleural cavity.

PTS: 1 DIF: Recall

REF: Hooke's Law|Clinical Connection 2-6: Hazards of Positive Pressure Ventilation

OBJ: 14

27. Which law best explains the basic operation of the negative pressure ventilator?
- Boyle's
 - Dalton's
 - Charles'
 - Hooke's

ANS: A

	Feedback
A	The basic pressure and volume relationships described by Boyle's law are implemented by negative pressure ventilators.
B	The basic pressure and volume relationships described by Boyle's law are implemented by negative pressure ventilators.
C	The basic pressure and volume relationships described by Boyle's law are implemented by negative pressure ventilators.
D	The basic pressure and volume relationships described by Boyle's law are implemented by negative pressure ventilators.

PTS: 1 DIF: Recall

REF: Hooke's Law|Clinical Connection 2-7: Negative Pressure Ventilation

OBJ: 15

28. Which of the following are periods of no gas flow during negative pressure ventilation?
- Inspiration
 - End inspiration
 - Expiration
 - End expiration
- II and IV only
 - II only
 - IV only
 - I and III only

ANS: A

	Feedback
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A	During negative pressure ventilation, no gas flow occurs at end-expiration and end-inspiration.
B	During negative pressure ventilation, no gas flow occurs at end-expiration and end-inspiration.
C	During negative pressure ventilation, no gas flow occurs at end-expiration and end-inspiration.
D	During negative pressure ventilation, no gas flow occurs at end-expiration and end-inspiration.

PTS: 1 DIF: Recall
REF: Hooke's Law|Clinical Connection 2-7: Negative Pressure Ventilation
OBJ: 15

29. What is the term for the molecular cohesive force at a liquid-gas interface?
- a. surface tension
 - b. compliance
 - c. resistance
 - d. elastance

ANS: A

	Feedback
A	Surface tension is the molecular, cohesive force that occurs at a liquid-gas interface.
B	Surface tension is the molecular, cohesive force that occurs at a liquid-gas interface.
C	Surface tension is the molecular, cohesive force that occurs at a liquid-gas interface.
D	Surface tension is the molecular, cohesive force that occurs at a liquid-gas interface.

PTS: 1 DIF: Recall REF: Surface Tension and its Effect on Lung Expansion
OBJ: 16

30. Who is credited with the following equation : $P = (2ST)/r$?
- a. LaPlace
 - b. Hooke
 - c. Dalton
 - d. Boyle

ANS: A

	Feedback
A	The equation for LaPlace's law with one liquid-gas interface is written as $P=(2ST)/r$.
B	The equation for LaPlace's law with one liquid-gas interface is written as $P=(2ST)/r$.
C	The equation for LaPlace's law with one liquid-gas interface is written as $P=(2ST)/r$.
D	The equation for LaPlace's law with one liquid-gas interface is written as $P=(2ST)/r$.

PTS: 1 DIF: Recall REF: Laplace's Law
OBJ: 17

31. Which substance in the alveoli is responsible for lowering the surface tension?
- a. pulmonary surfactant
 - b. mucus
 - c. saline
 - d. plasma

ANS: A

	Feedback
A	Surfactant helps to reduce alveolar surface tension and helps prevent alveoli from collapsing.
B	Surfactant helps to reduce alveolar surface tension and helps prevent alveoli from collapsing.

C	Surfactant helps to reduce alveolar surface tension and helps prevent alveoli from collapsing.
D	Surfactant helps to reduce alveolar surface tension and helps prevent alveoli from collapsing.

PTS: 1 DIF: Recall
REF: LaPlace's Law Applied to the Alevolar Fluid Lining OBJ: 18

32. What is the primary surface tension lowering chemical in pulmonary surfactant?
- a. DPPC
 - b. CPPD
 - c. PCP
 - d. BPD

ANS: A

Feedback	
A	Dipalmitoyl phospatidycholine (DPPC) is the primary surface tension lowering component of pulmonary surfactant.
B	Dipalmitoyl phospatidycholine (DPPC) is the primary surface tension lowering component of pulmonary surfactant.
C	Dipalmitoyl phospatidycholine (DPPC) is the primary surface tension lowering component of pulmonary surfactant.
D	Dipalmitoyl phospatidycholine (DPPC) is the primary surface tension lowering component of pulmonary surfactant.

PTS: 1 DIF: Recall
REF: How Pulmonary Surfactant Regulates Alveolar Surface Tension
OBJ: 19

33. IWhen the average alveolus is fully distended,, what is the approximate surface tension?
- a. 50 dynes/cm
 - b. 50 cm H20
 - c. 5-15 dynes/cm
 - d. 5-15 cm H20

ANS: A

Feedback	
A	When the average alveolus is inflated, the surface tension is approximately 50 dynes/cm.
B	When the average alveolus is inflated, the surface tension is approximately 50 dynes/cm.
C	When the average alveolus is inflated, the surface tension is approximately 50 dynes/cm.
D	When the average alveolus is inflated, the surface tension is approximately 50 dynes/cm.

PTS: 1 DIF: Recall
REF: How Pulmonary Surfactant Regulates Alveolar Surface Tension
OBJ: 19

34. Which of the following can cause pulmonary surfactant deficiency?
- I. Pulmonary embolism
 - II. Pulmonary edema
 - III. Atelectasis

IV. ARDS

- a. I, II, III, and IV
- b. II and IV only
- c. I, II, and III only
- d. II and III only

ANS: A

	Feedback
A	All of the factors listed can cause pulmonary surfactant deficiency.
B	All of the factors listed can cause pulmonary surfactant deficiency.
C	All of the factors listed can cause pulmonary surfactant deficiency.
D	All of the factors listed can cause pulmonary surfactant deficiency.

PTS: 1 DIF: Recall REF: Summary of the Lung's Elastic Properties
 OBJ: 20

35. What is the treatment of choice for the early stages of RDS in premature infants?
- a. CPAP
 - b. oxygen therapy
 - c. steroids
 - d. long acting bronchodilators

ANS: A

	Feedback
A	CPAP is the treatment for the early stages of RDS.
B	CPAP is the treatment for the early stages of RDS.
C	CPAP is the treatment for the early stages of RDS.
D	CPAP is the treatment for the early stages of RDS.

PTS: 1 DIF: Recall
 REF: Summary|Clinical Connection 2-8: Pulmonary Surfactant Deficiency
 OBJ: 21

36. What term is used in respiratory care to describe the movement of gas in and out of the lung and the pressure changes required to move the gas?
- a. dynamic
 - b. static
 - c. passive
 - d. respiration

ANS: A

	Feedback
A	Dynamic refers to movement of gas in and out of the lungs and the accompanying pressure changes.
B	Dynamic refers to movement of gas in and out of the lungs and the accompanying pressure changes.
C	Dynamic refers to movement of gas in and out of the lungs and the accompanying pressure changes.
D	Dynamic refers to movement of gas in and out of the lungs and the accompanying pressure changes.

PTS: 1 DIF: Recall REF: Dynamic Characteristics of the Lungs
 OBJ: 22

37. When Poiseuille's law is rearranged for flow with pressure remaining constant, what impact would reducing the radius of a tube by 50% have on the gas flow?

- a. It would be reduced to 1/16 of the original flow
- b. It would increase to 16 times more than the original flow
- c. It would increase to 16 times more than the original flow
- d. It would be reduced to 1/4 the original flow

ANS: A

	Feedback
A	When the radius of a tube is halved, the flow will decrease to 1/16 of the original output.
B	When the radius of a tube is halved, the flow will decrease to 1/16 of the original output.
C	When the radius of a tube is halved, the flow will decrease to 1/16 of the original output.
D	When the radius of a tube is halved, the flow will decrease to 1/16 of the original output.

PTS: 1 DIF: Application REF: Poiseuille's Law Arranged for Flow
 OBJ: 23

38. When Poiseuille's law is rearranged for pressure, what adjustment must be made in driving pressure to maintain the same flowrate when the radius of the tube is reduced by 50% ?
- a. The pressure must be increased to 16 times the original
 - b. The pressure must be doubled
 - c. The pressure must be reduced by 50%
 - d. The pressure must be increased to 4 times the original pressure

ANS: A

	Feedback
A	Pressure is a function of the radius to the fourth power so 16 times the original pressure would be required to restore the flowrate when the radius of the tube is halved.
B	Pressure is a function of the radius to the fourth power so 16 times the original pressure would be required to restore the flowrate when the radius of the tube is halved.
C	Pressure is a function of the radius to the fourth power so 16 times the original pressure would be required to restore the flowrate when the radius of the tube is halved.
D	Pressure is a function of the radius to the fourth power so 16 times the original pressure would be required to restore the flowrate when the radius of the tube is halved.

PTS: 1 DIF: Application REF: Poiseuille's Law Arranged for Pressure
 OBJ: 25

39. When the radius of the bronchial airways decreases during exhalation, what change must occur to maintain a constant gas flow?
- a. The transthoracic pressure must vary inversely with the fourth power of the radius
 - b. The transthoracic pressure must vary directly with the fourth power of the radius
 - c. The transthoracic pressure must remain constant
 - d. The transthoracic pressure must vary inversely with the second power of the radius

ANS: A

	Feedback
A	As the radius of the bronchial airways decrease during exhalation, the transthoracic pressure must vary inversely with the fourth power of the radius.

B	As the radius of the bronchial airways decrease during exhalation, the transthoracic pressure must vary inversely with the fourth power of the radius.
C	As the radius of the bronchial airways decrease during exhalation, the transthoracic pressure must vary inversely with the fourth power of the radius.
D	As the radius of the bronchial airways decrease during exhalation, the transthoracic pressure must vary inversely with the fourth power of the radius.

PTS: 1 DIF: Recall
REF: Poiseuille's Law Rearranged to Simple Proportionalities OBJ: 25

40. What is derived when the pressure difference between the mouth and alveoli is divided by the flowrate?
- a. airway resistance
 - b. surface tension
 - c. lung compliance
 - d. chest wall compliance

ANS: A

Feedback	
A	Airway resistance is defined as the change in transrespiratory pressure divided by flow rate.
B	Airway resistance is defined as the change in transrespiratory pressure divided by flow rate.
C	Airway resistance is defined as the change in transrespiratory pressure divided by flow rate.
D	Airway resistance is defined as the change in transrespiratory pressure divided by flow rate.

PTS: 1 DIF: Recall REF: Airway Resistance
OBJ: 27

41. If an individual generates a flow rate of 4 L/sec by generating a transrespiratory pressure of 6 cm H₂O, what would Raw equal?
- a. 1.5 cm H₂O/L/sec
 - b. 0.67 cm H₂O/L/sec
 - c. 2.4 L/sec/ cm H₂O
 - d. 1.5 L/sec/cm H₂O

ANS: A

Feedback	
A	Airway resistance would be derived as 6 cm H ₂ O/4 L/sec to equal 1.5 cm H ₂ O/L/sec.
B	Airway resistance would be derived as 6 cm H ₂ O/4 L/sec to equal 1.5 cm H ₂ O/L/sec.
C	Airway resistance would be derived as 6 cm H ₂ O/4 L/sec to equal 1.5 cm H ₂ O/L/sec.
D	Airway resistance would be derived as 6 cm H ₂ O/4 L/sec to equal 1.5 cm H ₂ O/L/sec.

PTS: 1 DIF: Application REF: Airway Resistance
OBJ: 28

42. If a patient who generates an intrapleural pressure of -4 mmHg to inhale 450 mL experiences inflammation and bronchospasm that reduce the radius of the bronchial airways to one-half of their original size, what pressure must the patient generate to inhale the same tidal volume?
- a. 64 mm Hg
 - b. 48 mm Hg
 - c. 20 mm Hg
 - d. 16 mm Hg

ANS: A

	Feedback
A	To maintain the same tidal volume when the radius of the bronchial airways is reduced by one half, the intrapleural pressure must increase by a factor of 16 so the required pressure would be 4 x 16 or 64 mm Hg.
B	To maintain the same tidal volume when the radius of the bronchial airways is reduced by one half, the intrapleural pressure must increase by a factor of 16 so the required pressure would be 4 x 16 or 64 mm Hg.
C	To maintain the same tidal volume when the radius of the bronchial airways is reduced by one half, the intrapleural pressure must increase by a factor of 16 so the required pressure would be 4 x 16 or 64 mm Hg.
D	To maintain the same tidal volume when the radius of the bronchial airways is reduced by one half, the intrapleural pressure must increase by a factor of 16 so the required pressure would be 4 x 16 or 64 mm Hg.

PTS: 1

DIF: Application

REF: Poiseuille's Law Arranged for Simple Proportionalities|Clinical Connection 2-9: Respiratory Disorders that Decrease the Radius of the Airways

OBJ: 26

43. Which flow pattern occurs in airways at low flow rates and low pressure-gradients?
- laminar flow
 - turbulent flow
 - transitional flow
 - tracheobronchial flow

ANS: A

	Feedback
A	Laminar flow occurs in airways where flow rate and pressure gradients are both low.
B	Laminar flow occurs in airways where flow rate and pressure gradients are both low.
C	Laminar flow occurs in airways where flow rate and pressure gradients are both low.
D	Laminar flow occurs in airways where flow rate and pressure gradients are both low.

PTS: 1

DIF: Recall

REF: Laminar Flow

OBJ: 27

44. Which flow pattern occurs in airways at high flow rates and high pressure gradients?
- turbulent flow
 - laminar flow
 - tracheobronchial flow
 - transitional flow

ANS: A

	Feedback
A	Turbulent flow occurs in airways at high flow rates and high pressure gradients.
B	Turbulent flow occurs in airways at high flow rates and high pressure gradients.
C	Turbulent flow occurs in airways at high flow rates and high pressure gradients.
D	Turbulent flow occurs in airways at high flow rates and high pressure gradients.

PTS: 1

DIF: Recall

REF: Turbulent Flow

OBJ: 27

45. What is defined as “the time required to inflate a lung region to 60% of its filling capacity”?
- time constant
 - dynamic compliance
 - inspiratory time
 - maximum inspiratory time

ANS: A

	Feedback
A	A time constant is the amount of time required to inflate a lung region to 60% its potential filling capacity.
B	A time constant is the amount of time required to inflate a lung region to 60% its potential filling capacity.
C	A time constant is the amount of time required to inflate a lung region to 60% its potential filling capacity.
D	A time constant is the amount of time required to inflate a lung region to 60% its potential filling capacity.

PTS: 1 DIF: Recall REF: Time Constants
 OBJ: 29

46. When lung compliance is reduced by half, how will time constants be affected?
- The time constant will be reduced by half
 - The time constants will double
 - The time constant will be reduced to one-fourth of the original
 - The time constant will increase to four times the original

ANS: A

	Feedback
A	When lung compliance is halved, the time constant will also be halved.
B	When lung compliance is halved, the time constant will also be halved.
C	When lung compliance is halved, the time constant will also be halved.
D	When lung compliance is halved, the time constant will also be halved.

PTS: 1 DIF: Recall REF: Time Constants
 OBJ: 29

47. What effect will increased R_{aw} and increased C_L have on the time constants in the affected lung regions?
- Both factors require more time for the affected region to inflate.
 - Both factors require less time for the affected lung region to inflate
 - Time constants are unaffected by R_{aw} but will require less time to inflate due to the increased C_L .
 - Time constants are unaffected by C_L but will require more time to inflate in the affected region due to the increased R_{aw} .

ANS: A

	Feedback
A	Lung regions with increased airway resistance and increased lung compliance require more time to inflate
B	Lung regions with increased airway resistance and increased lung compliance require more time to inflate
C	Lung regions with increased airway resistance and increased lung compliance require more time to inflate
D	Lung regions with increased airway resistance and increased lung compliance require more time to inflate

PTS: 1 DIF: Recall REF: Time Constants
 OBJ: 29

48. What term is defined as “the change in volume of the lungs divided by the change in transpulmonary pressure during the time required for one breath”?
- dynamic compliance
 - static compliance
 - airway resistance
 - time constant

ANS: A

	Feedback
A	Dynamic compliance is the change in volume of the lungs divided by the change in transpulmonary pressure during the time required for one breath.
B	Dynamic compliance is the change in volume of the lungs divided by the change in transpulmonary pressure during the time required for one breath.
C	Dynamic compliance is the change in volume of the lungs divided by the change in transpulmonary pressure during the time required for one breath.
D	Dynamic compliance is the change in volume of the lungs divided by the change in transpulmonary pressure during the time required for one breath.

PTS: 1
OBJ: 30

DIF: Recall

REF: Dynamic Compliance

49. In the presence of restrictive lung disorders, how do patients typically offset the decreased time constants?
- They adopt an increased respiratory rate
 - They adopt a decreased respiratory rate
 - They adopt a decreased respiratory rate and add a breath hold
 - They adopt a decreased respiratory rate with an increased tidal volume

ANS: A

	Feedback
A	With restrictive lung disorders, patients typically adopt an increased respiratory rate.
B	With restrictive lung disorders, patients typically adopt an increased respiratory rate.
C	With restrictive lung disorders, patients typically adopt an increased respiratory rate.
D	With restrictive lung disorders, patients typically adopt an increased respiratory rate.

PTS: 1

DIF: Recall

REF: Dynamic Compliance|Clinical Connection: Restrictive Lung Disorders, Time Constants, and Breathing Pattern Relationships

OBJ: 31

50. What changes in breathing patterns do patients with obstructive pulmonary disorders with increased R_{aw} and increased time constants typically adopt?
- They decrease their respiratory rate and increase their tidal volume
 - The decrease their respiratory rate and tidal volume
 - They increase their respiratory rate and tidal volume
 - They increase their respiratory rate and decrease their tidal volume

ANS: A

	Feedback
A	Patients with obstructive pulmonary disorders with increased R_{aw} and increased time constants typically decrease their respiratory rates and increase their tidal volumes.
B	Patients with obstructive pulmonary disorders with increased R_{aw} and increased time constants typically decrease their respiratory rates and increase their tidal volumes.

C	Patients with obstructive pulmonary disorders with increased R_{aw} and increased time constants typically decrease their respiratory rates and increase their tidal volumes.
D	Patients with obstructive pulmonary disorders with increased R_{aw} and increased time constants typically decrease their respiratory rates and increase their tidal volumes.

PTS: 1 DIF: Recall

REF: Dynamic Compliance|Clinical Connection 2-11: Obstructive Lung Disorders. Time Constants and Breathing Pattern Relationships OBJ: 32

51. When rapid ventilatory rates occur, what is the term for the condition in which positive pressure remains in the alveoli during exhalation due to the insufficient expiratory time?
- auto-PEEP
 - WOB
 - pendulluft
 - frequency dependence

ANS: A

Feedback	
A	Auto-PEEP is the condition in which positive pressure remains in the alveoli during exhalation due to insufficient expiratory time.
B	Auto-PEEP is the condition in which positive pressure remains in the alveoli during exhalation due to insufficient expiratory time.
C	Auto-PEEP is the condition in which positive pressure remains in the alveoli during exhalation due to insufficient expiratory time.
D	Auto-PEEP is the condition in which positive pressure remains in the alveoli during exhalation due to insufficient expiratory time.

PTS: 1 DIF: Recall

REF: Dynamic Compliance|Clinical Connection 2-12: Auto-PEEP and its Relationship to Raw During Rapid Ventilatory Rates OBJ: 33

52. What is the term for the volume of gas that is typically measured during exhalation of one quiet breath?
- tidal volume
 - expiration
 - minute volume
 - expiratory reserve volume

ANS: A

Feedback	
A	The amount of gas exhaled from one quiet breath is the tidal volume.
B	The amount of gas exhaled from one quiet breath is the tidal volume.
C	The amount of gas exhaled from one quiet breath is the tidal volume.
D	The amount of gas exhaled from one quiet breath is the tidal volume.

PTS: 1 DIF: Recall REF: The Normal Ventilatory Patterns
OBJ: 34

53. What is the average respiratory rate for an adult at rest?
- 12-18 breaths/min
 - 5-12 breaths/min
 - 14-24 breath/min
 - 19-26 breaths/min

ANS: A

Feedback	
A	The average respiratory rate for an adult at rest is 12-18 breaths/min.

C	A 5 ft tall female's IBW would be approximately 100-105 pounds or 47 kg, so 47 x 6mL/kg would equal approximately 290 mL.
D	A 5 ft tall female's IBW would be approximately 100-105 pounds or 47 kg, so 47 x 6mL/kg would equal approximately 290 mL.

PTS: 1 DIF: Application

REF: The Normal Ventilatory Patterns|Clinical Connection 2-14: Tidal Volume and Breathing Rate Strategies for Mechanical Ventilation OBJ: 36

57. What are the boundaries of anatomic dead space?
- nose and mouth through the terminal bronchioles
 - nose and mouth to the alveolar sacs
 - nose and mouth to the segmental bronchi
 - nose and moth to the bronchioles

ANS: A

	Feedback
A	Anatomic deadspace extends from the nose and mouth through the terminal bronchioles.
B	Anatomic deadspace extends from the nose and mouth through the terminal bronchioles.
C	Anatomic deadspace extends from the nose and mouth through the terminal bronchioles.
D	Anatomic deadspace extends from the nose and mouth through the terminal bronchioles.

PTS: 1 DIF: Recall REF: Anatomic Deadspace
OBJ: 37

58. What is the approximate volume of anatomic deadspace?
- 1 mL/lb of ideal body weight
 - 2.2 mL/lb of ideal body weight
 - 2.2 mL/kg actual body weight
 - 1 mL/kg of ideal body weight

ANS: A

	Feedback
A	The volume of anatomic deadspace is approximately 1mL/lb of ideal body weight.
B	The volume of anatomic deadspace is approximately 1mL/lb of ideal body weight.
C	The volume of anatomic deadspace is approximately 1mL/lb of ideal body weight.
D	The volume of anatomic deadspace is approximately 1mL/lb of ideal body weight.

PTS: 1 DIF: Recall REF: Anatomic Deadspace
OBJ: 37

59. What does frequency multiplied by ($V_T - V_D$) equal?
- minute alveolar ventilation
 - minute ventilation
 - physiologic deadspace ventilation
 - alveolar deadspace

ANS: A

	Feedback
A	The minute alveolar ventilation equals the frequency multiplied by (tidal volume minus anatomic deadspace).
B	The minute alveolar ventilation equals the frequency multiplied by (tidal volume minus anatomic deadspace).
C	The minute alveolar ventilation equals the frequency multiplied by (tidal volume minus anatomic deadspace).

D	The minute alveolar ventilation equals the frequency multiplied by (tidal volume minus anatomic deadspace).
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PTS: 1 DIF: Recall REF: Anatomic Deadspace
 OBJ: 37

60. What is the term for alveolar ventilation without pulmonary capillary perfusion?
- a. alveolar deadspace
 - b. anatomic deadspace
 - c. physiologic deadspace
 - d. minute alveolar ventilation

ANS: A

	Feedback
A	Alveolar deadspace is alveolar ventilation without pulmonary capillary perfusion
B	Alveolar deadspace is alveolar ventilation without pulmonary capillary perfusion
C	Alveolar deadspace is alveolar ventilation without pulmonary capillary perfusion
D	Alveolar deadspace is alveolar ventilation without pulmonary capillary perfusion

PTS: 1 DIF: Recall REF: Anatomic Deadspace
 OBJ: 37

61. What does the sum of anatomic deadspace and alveolar deadspace equal?
- a. physiologic deadspace
 - b. minute ventilation
 - c. alveolar ventilation
 - d. total gas exchange

ANS: A

	Feedback
A	Anatomic deadspace plus alveolar deadspace equals physiologic deadspace.
B	Anatomic deadspace plus alveolar deadspace equals physiologic deadspace.
C	Anatomic deadspace plus alveolar deadspace equals physiologic deadspace.
D	Anatomic deadspace plus alveolar deadspace equals physiologic deadspace.

PTS: 1 DIF: Recall REF: Physiologic Deadspace
 OBJ: 37

62. How would the addition of a length of tubing between a ventilator and the endotracheal tube affect on dead space?
- a. It would increase the deadspace
 - b. It would decrease the deadspace
 - c. It would have no effect on deadspace
 - d. It would have no effect on deadspace but would increase the tidal volume

ANS: A

	Feedback
A	When a length of tubing is added between the ventilator and endotracheal tube, the deadspace increases.
B	When a length of tubing is added between the ventilator and endotracheal tube, the deadspace increases.
C	When a length of tubing is added between the ventilator and endotracheal tube, the deadspace increases.
D	When a length of tubing is added between the ventilator and endotracheal tube, the deadspace increases.

PTS: 1 DIF: Recall
 REF: Physiologic Deadspace|Clinical Connection 2-15: A Giraffe's Neck: Alveolar Ventilation vs Dead-space Ventilation OBJ: 40

63. Which of the following can cause pulmonary emboli?

- I. Prolonged inactivity
- II. Pregnancy and childbirth
- III. Obesity
- IV. Hypercoagulation disorders

- a. I, II, III, and IV
- b. I and IV only
- c. I, III, and IV only
- d. I, II, and III only

ANS: A

	Feedback
A	Pulmonary emboli can result from prolonged inactivity, pregnancy and childbirth, obesity, and hypercoagulation disorders.
B	Pulmonary emboli can result from prolonged inactivity, pregnancy and childbirth, obesity, and hypercoagulation disorders.
C	Pulmonary emboli can result from prolonged inactivity, pregnancy and childbirth, obesity, and hypercoagulation disorders.
D	Pulmonary emboli can result from prolonged inactivity, pregnancy and childbirth, obesity, and hypercoagulation disorders.

PTS: 1 DIF: Recall
 REF: Physiologic Deadspace|Clinical Connection 2-16: Pulmonary Embolus and Dead-space Ventilation OBJ: 41

64. What would the minute alveolar ventilation equal if a 6 ft tall, 170 lb male has a VT of 550 mL and a respiratory rate of 11 breaths/min?

- a. $(550-170) \times 11 = 4.18 \text{ L}$
- b. $(550 + 170) \times 11 = 7.9 \text{ L}$
- c. $550 + (170 \times 11) = 1.87 \text{ L}$
- d. $550 - (170/2.2) \times 11 = 4.65 \text{ L}$

ANS: A

	Feedback
A	The alveolar ventilation would be $[550 \text{ mL tidal volume}-170 \text{ anatomic dead space volume}] \times 11 \text{ breaths/min} = 4.18 \text{ L /min}$.
B	The alveolar ventilation would be $[550 \text{ mL tidal volume}-170 \text{ anatomic dead space volume}] \times 11 \text{ breaths/min} = 4.18 \text{ L /min}$.
C	The alveolar ventilation would be $[550 \text{ mL tidal volume}-170 \text{ anatomic dead space volume}] \times 11 \text{ breaths/min} = 4.18 \text{ L /min}$.
D	The alveolar ventilation would be $[550 \text{ mL tidal volume}-170 \text{ anatomic dead space volume}] \times 11 \text{ breaths/min} = 4.18 \text{ L /min}$.

PTS: 1 DIF: Application REF: Anatomic Deadspace
 OBJ: 39

65. In the upright position, which portion of the lungs has the most negative pleural pressure?

- a. apex
- b. base

- a. ventilatory efficiency
- b. metabolic efficiency
- c. hyperventilation
- d. Hyperefficiency

ANS: A

	Feedback
A	Alteration of the ventilatory pattern to minimize dead space ventilation is called ventilatory efficiency.
B	Alteration of the ventilatory pattern to minimize dead space ventilation is called ventilatory efficiency.
C	Alteration of the ventilatory pattern to minimize dead space ventilation is called ventilatory efficiency.
D	Alteration of the ventilatory pattern to minimize dead space ventilation is called ventilatory efficiency.

PTS: 1 DIF: Recall
 REF: The Effect of Airway Resistance and Lung Compliance on Ventilatory Pressure
 OBJ: 43

69. How does the normal adult's respiratory pattern change when lung compliance decreases?
- a. respiratory rate increases and tidal volume decreases
 - b. respiratory rate decreases and tidal volume increase
 - c. respiratory rate and tidal volume increase
 - d. respiratory rate and tidal volume decrease.

ANS: A

	Feedback
A	When lung compliance decrease, the respiratory rate increases and tidal volume decreases.
B	When lung compliance decrease, the respiratory rate increases and tidal volume decreases.
C	When lung compliance decrease, the respiratory rate increases and tidal volume decreases.
D	When lung compliance decrease, the respiratory rate increases and tidal volume decreases.

PTS: 1 DIF: Recall
 REF: The Effect of Airway Resistance and Lung Compliance on Ventilatory Patterns|Clinical Connection 2-17: How the Adopted Breathing Pattern Changes in COPD when Compromised by a Restrictive Disorder
 OBJ: 44

70. How does the breathing pattern change when a patient with COPD develops a secondary restrictive lung condition such as pneumonia?
- a. respiratory rate increases
 - b. respiratory rate decreases and tidal volume increase
 - c. respiratory rate and tidal volume decrease.
 - d. no breathing pattern changes would occur.

ANS: A

	Feedback
A	When a patient with COPD develops pneumonia, one would expect hyperventilation to occur.

B	When a patient with COPD develops pneumonia, one would expect hyperventilation to occur.
C	When a patient with COPD develops pneumonia, one would expect hyperventilation to occur.
D	When a patient with COPD develops pneumonia, one would expect hyperventilation to occur.

PTS: 1 DIF: Recall
 REF: The Effect of Airway Resistance and Lung Compliance on Ventilatory Patterns|Clinical Connection 2-17: How the Adopted Breathing Pattern Changes in COPD when Compromised by a Restrictive Disorder
 OBJ: 44

71. Which ventilatory pattern is defined as the complete absence of spontaneous breathing?
- a. apnea
 - b. apneusis
 - c. eupnea
 - d. dyspnea

ANS: A

Feedback	
A	The absence of spontaneous breathing is called apnea.
B	The absence of spontaneous breathing is called apnea.
C	The absence of spontaneous breathing is called apnea.
D	The absence of spontaneous breathing is called apnea.

PTS: 1 DIF: Recall REF: Overview of Specific Breathing Conditions
 OBJ: 45

72. What is the term for the breathing condition in which short episodes of rapid, uniform deep breaths are followed by 10-30 seconds of apnea?
- a. Biot's
 - b. Cheyne-Stokes
 - c. Kussmaul's
 - d. Levy's

ANS: A

Feedback	
A	Biot's breathing is characterized by short episodes of uniform, rapid deep breaths followed by 10-30 seconds of apnea.
B	Biot's breathing is characterized by short episodes of uniform, rapid deep breaths followed by 10-30 seconds of apnea.
C	Biot's breathing is characterized by short episodes of uniform, rapid deep breaths followed by 10-30 seconds of apnea.
D	Biot's breathing is characterized by short episodes of uniform, rapid deep breaths followed by 10-30 seconds of apnea.

PTS: 1 DIF: Recall REF: Overview of Specific Breathing Conditions
 OBJ: 45

73. What is the term for a rapid respiratory rate?
- a. tachypnea
 - b. hyperpnea
 - c. hyperventilation
 - d. eupnea

ANS: A

Feedback	
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A	A rapid respiratory rate is called tachpnea.
B	A rapid respiratory rate is called tachpnea.
C	A rapid respiratory rate is called tachpnea.
D	A rapid respiratory rate is called tachpnea.

PTS: 1 DIF: Recall REF: Overview of Specific Breathing Conditions
 OBJ: 45

74. What is the term for the breathing pattern in which the depth of breathing increases?
- a. hyperpnea
 - b. tachypnea
 - c. hyperventilation
 - d. Kussmaul's

ANS: A

	Feedback
A	Hyperpnea is an increase in the depth of breathing.
B	Hyperpnea is an increase in the depth of breathing.
C	Hyperpnea is an increase in the depth of breathing.
D	Hyperpnea is an increase in the depth of breathing.

PTS: 1 DIF: Recall REF: Overview of Specific Breathing Conditions
 OBJ: 45

75. In which breathing pattern is an individual only able to breathe comfortably in the upright position?
- a. orthopnea
 - b. tachypnea
 - c. eupnea
 - d. hyperpnea

ANS: A

	Feedback
A	When one can only breathe comfortably while in the upright position, it is called orthopnea.
B	When one can only breathe comfortably while in the upright position, it is called orthopnea.
C	When one can only breathe comfortably while in the upright position, it is called orthopnea.
D	When one can only breathe comfortably while in the upright position, it is called orthopnea.

PTS: 1 DIF: Recall REF: Overview of Specific Breathing Conditions
 OBJ: 45

76. Which abnormal breathing pattern is most commonly associated with ketoacidosis?
- a. Kussmaul's
 - b. Biot's
 - c. Cheyne Stokes
 - d. Hypopnea

ANS: A

	Feedback
A	Kussmaul's breathing is most often associated with ketoacidosis.
B	Kussmaul's breathing is most often associated with ketoacidosis.
C	Kussmaul's breathing is most often associated with ketoacidosis.
D	Kussmaul's breathing is most often associated with ketoacidosis.

PTS: 1
OBJ: 45

DIF: Recall

REF: Overview of Specific Breathing Conditions

77. What is the only absolute way of confirming hyperventilation?
- a. monitor the PaCO₂
 - b. assess the respiratory rate
 - c. assess the tidal volume
 - d. ask the patient

ANS: A

	Feedback
A	The absolute confirmation of hyperventilation is made by assessing the PaCO ₂
B	The absolute confirmation of hyperventilation is made by assessing the PaCO ₂
C	The absolute confirmation of hyperventilation is made by assessing the PaCO ₂
D	The absolute confirmation of hyperventilation is made by assessing the PaCO ₂

PTS: 1

DIF: Recall

REF: Overview of Specific Breathing Conditions|Clinical Connection 2-18: The Arterial Carbon Dioxide Level and its Relationship to the Clinical Verification of Hyperventilation and Hypoventilation