

Review Questions for Spirometry topic

Review questions will not be collected and are not worth any points. Doing them will, however, help you prepare for the midterms and quizzes in this course. Furthermore, some of these review questions will appear on the final exam (although the numbers within the questions may be changed).

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- 1) The respiratory system exchanges gases between the _____ and the _____.
 - A) Blood vessels, tissue fluids
 - B) Air in lungs, blood
 - C) Air in lungs, air in organs
 - D) Tissue fluid, blood

- 2) In the lungs, _____ gas enters the blood and _____ gas exits the blood.
 - A) O_2 , PO_4
 - B) CO_2 , H_2O_4
 - C) CO_2 , O_2
 - D) O_2 , CO_2

- 3) The term _____ means all the tubes that carry air into and out of the lungs.
 - A) Airway passages
 - B) Aerobic vessels
 - C) Wind pipes
 - D) Respiratory vasculature

- 4) The cilia hairs and mucus of the airway passages
 - A) filter impurities from the inspired air.
 - B) reduce pulmonary pressure.
 - C) reduce the surface tension in the alveoli.
 - D) keep the lungs moist so gas diffusion can occur.

- 5) The airway passages of the respiratory system do not
 - A) warm the inspired air.
 - B) exchange gases with the blood.
 - C) clean the inspired air.

6) What is the correct order of structures an oxygen molecule would pass through before it entered the blood?

- A) Bronchi, alveoli, bronchioles
- B) Trachea, alveoli, bronchioles
- C) Bronchi, bronchioles, alveoli
- D) Pulmonary loop, alveoli, bronchi

7) The list of airway passages below is **not** in the correct sequence that an oxygen molecule would pass through as it was moving into the lungs. What is the correct sequence of the airway passages?

- 1 = Trachea
- 2 = Pharynx
- 3 = Nasal cavity
- 4 = Bronchi
- 5 = Larynx
- 6 = Epiglottis

- A) 1, 3, 5, 6, 4, 2
- B) 6, 4, 3, 2, 5, 1
- C) 4, 1, 2, 3, 5, 6
- D) 3, 2, 6, 5, 1, 4

8) The ability of the lungs to return to its normal size after stretching is known as

- A) resilience.
- B) compliance.
- C) capacitance.
- D) elastic recoil

9) Gas exchange between the air in the lungs and the blood occurs only in the

- A) Bronchi.
- B) Alveoli
- C) Trachea
- D) Bronchioles

10) What process moves gases between the lungs and the blood?

- A) Diffusion
- B) Osmosis
- C) Membrane transport proteins in the alveolar membrane cells
- D) The ferric (iron ion) shuttle

11) The diffusion of oxygen from the alveoli into the blood of the alveolar capillaries is rapid and involves diffusion across how many layers of cells?

- A) 1
- B) 2
- C) 3
- D) 4

12) The muscles used for normal inspiration are (more than one answer is possible)

- A) External intercostals
- B) Abdominal muscles
- C) Sternocleidomastoids
- D) Diaphragm
- E) Internal intercostals

13) Use of the inspiratory muscles causes expansion of the lungs, which causes _____ pressure inside the lungs.

- A) increased
- B) decreased
- C) constant
- D) muscular

14) Forceful expiration requires the actions of the (more than one correct answer)

- A) Abdominal muscles
- B) external intercostals.
- C) internal intercostals.
- D) Diaphragm
- E) Sternocleidomastoids

15) The amount of air that is inspired or expired in one breath during unforced breathing is the

- A) residual volume.
- B) vital capacity.
- C) tidal volume.
- D) expiratory reserve volume.

16) During normal, relaxed respiration, about _____ ml of air enters and leaves the lungs with each respiratory cycle.

- A) 500
- B) 1100
- C) 2300
- D) 4800

17) The maximum amount of air that can be expired after a maximum inspiration is called the

- A) residual volume.
- B) vital capacity.
- C) tidal volume.
- D) expiratory reserve volume.

18) The air that remains in the lungs after a maximum expiration is called the

- A) Residual volume
- B) Reserve volume
- C) Tidal volume
- D) Reserve capacity

19) A purely restrictive breathing disorder is indicated by an abnormally low ____ but a normal ____.

- A) vital capacity, residual volume.
- B) forced expiratory volume, vital capacity
- C) residual volume, forced expiratory volume
- D) inspiratory reserve volume, expiratory reserve volume
- E) vital capacity, forced expiratory volume
- F) forced expiratory volume, tidal volume
- G) tidal volume, forced expiratory volume
- H) tidal volume, vital capacity
- I) expiratory reserve volume, inspiratory reserve volume

20) A purely obstructive breathing disorder is indicated by an abnormally low ____ but a normal ____.

- A) vital capacity, residual volume.
- B) forced expiratory volume, vital capacity
- C) residual volume, forced expiratory volume
- D) inspiratory reserve volume, expiratory reserve volume
- E) vital capacity, forced expiratory volume
- F) forced expiratory volume, tidal volume
- G) tidal volume, forced expiratory volume
- H) tidal volume, vital capacity
- I) expiratory reserve volume, inspiratory reserve volume

- 21) Any lung disease that reduces the forced expiratory volume (FEV), but does not significantly affect the vital capacity is categorized purely as a(n)
- A) restrictive lung disorder.
 - B) pulmonary fibrosis.
 - C) chronic obstructive pulmonary disease.
 - D) obstructive lung disorder.
- 22) Which of the following is caused by scar tissue in the lungs?
- A) pulmonary fibrosis
 - B) COPD
 - C) lung cancer
 - D) chronic bronchitis
 - E) acute bronchitis.
- 23) Which of the following is caused by destruction of the alveolar walls?
- A) asthma.
 - B) emphysema
 - C) chronic bronchitis.
 - D) lung cancer
- 24) Which of the following is caused by airway passages becoming swollen or blocked? (More than one answer is possible).
- A) asthma.
 - B) emphysema
 - C) chronic bronchitis.
 - D) lung cancer
 - E) pulmonary fibrosis
- 25) Glucocorticoids, which are steroids that reduce the immune response, are most effective in treating
- A) asthma.
 - B) emphysema.
 - C) lung cancer
 - D) pulmonary fibrosis
- 26) Oxygen is carried in the blood on _____ ions.
- A) Calcium
 - B) Sodium
 - C) Iron
 - D) Bicarbonate

27) The iron ions that carry oxygen are part of the protein _____, which is found inside red blood cells.

- A) Albumin
- B) Erythropoitin
- C) Hemoglobin
- D) Glucose

28) Carbon dioxide travels in the blood as which molecule(s)? (More than one answer is possible).

- A) Carbonic acid.
- B) Bicarbonate ion.
- C) Carbon monoxide
- D) Glucose

29) Bicarbonate ion (HCO_3^-) and hydrogen ion (H^+) are made when _____ reacts with water.

- A) oxygen
- B) hydrogen
- C) carbon dioxide
- D) carbon monoxide

30) In the pulmonary loop, which reaction occurs?

- A) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$
- B) $\text{CO}_2 + \text{H}^+ \rightarrow \text{HCO}_3^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
- C) $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- D) $\text{HCO}_3^- + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}^+$

31) The breathing control centers will increase breathing rate in response to (more than one correct answer)

- A) Low blood O_2
- B) Low blood CO_2
- C) High blood O_2
- D) High blood CO_2

32) An obstructive lung disorder is indicated by an abnormally low

- A) vital capacity.
- B) forced expiratory volume.
- C) residual volume.
- D) inspiratory reserve volume.

33) Define the following terms as they were defined in lab. For the spirometry volumes marked with an asterisk, include that predicted volume as part of your answer.

- a) Spirometry
- b) Tidal volume*
- c) Expiratory reserve volume*
- d) Inspiratory reserve volume*
- e) Vital capacity
- f) Residual volume
- g) Total lung capacity
- h) Forced expiratory volume (FEV₁)
- i) Diffusion

34) The main function of the respiratory organ system is _____ exchange between the _____ and the _____.

35) In the lungs, _____ gas enters the blood and _____ gas exits the blood.

36) In the systemic loop, CO₂ moves out of/into (circle one) the blood and oxygen moves out of/into (circle one) of the blood.

37) In the pulmonary loop, CO₂ moves out of/into (circle one) the blood and oxygen moves out of/into (circle one) of the blood.

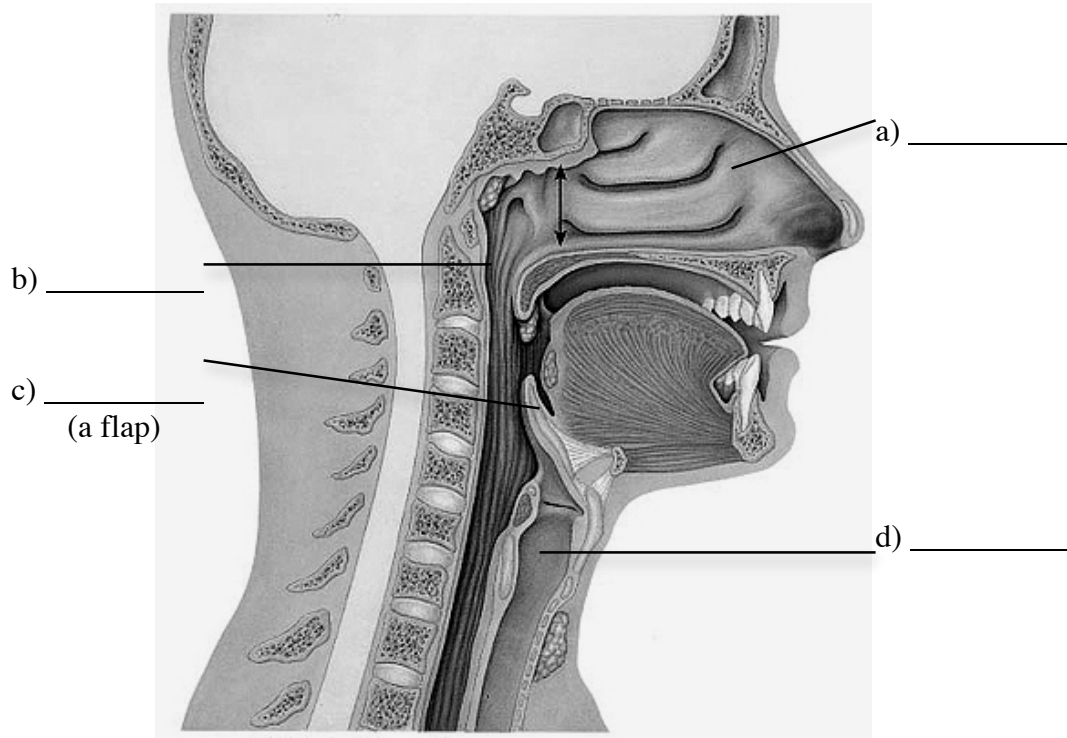
38) One function of breathing is to add oxygen to the blood. Why does the body require that oxygen be present in the blood? Your answer should include the specific name of the process that the body uses the oxygen for.

39) The partial pressure (a term which means the concentration of a gas) of carbon dioxide in the alveoli is higher/lower (circle one) than its partial pressure in the blood of the pulmonary loop arteries. This is why CO₂ diffuses out of the blood and into the alveoli.

40) The partial pressure of carbon dioxide in the tissues is always higher/lower (circle one) than in the blood of the systemic loop arteries. This is why CO₂ diffuses out of the tissues and into the blood.

41) The two major parts of the respiratory system are the _____, which are tubes that carry air, and the _____, which is where gases are exchanged with the blood.

42) Label the parts of the upper airway passages. Use the correct anatomical terms.



43) In the blank spaces after the respiratory system structures listed below, write a number (from 1 – 7) to show the order that you would encounter them if you were an inspired molecule of O₂.

- Bronchiole _____
- Epiglottis _____
- Pharynx _____
- Alveoli _____
- Bronchi _____
- Trachea _____
- Capillary _____

44) The airway passages not only conduct air to and from the lungs, they also _____ and _____ the before it reaches the lungs.

45) The airway passages remove dust and other particles from the inspired air in this way: The particles become trapped on _____ that coats the passage walls.

46) The mucus with the trapped dust particles is pushed upward, away from the lungs, by _____.

47) What happens to the mucus that is pushed to the top of the respiratory tract? _____.

48) Just posterior to the trachea is another tube passing through the thoracic cavity. This other tube is called the _____. It carries food downward to the stomach.

49) The trachea (windpipe) descends from the epiglottis into the _____ (a body cavity), where it ends by dividing into the two _____, which are the conducting passages that enter the lungs.

50) A friend of yours, who is into body piercings, says she wants to get her epiglottis removed because “cool people everywhere are doing it!” What lifestyle changes would she have to do if she did have it removed?

51) When viewed under a microscope, lung tissue has a “spongy” appearance (full of tiny round open spaces). What is the name of these round open spaces in the lungs? _____

52) Lungs have the property of _____ which means the tendency to return to its initial size after being stretched (like a rubber band); This property assists in pushing air out of the lungs during expiration.

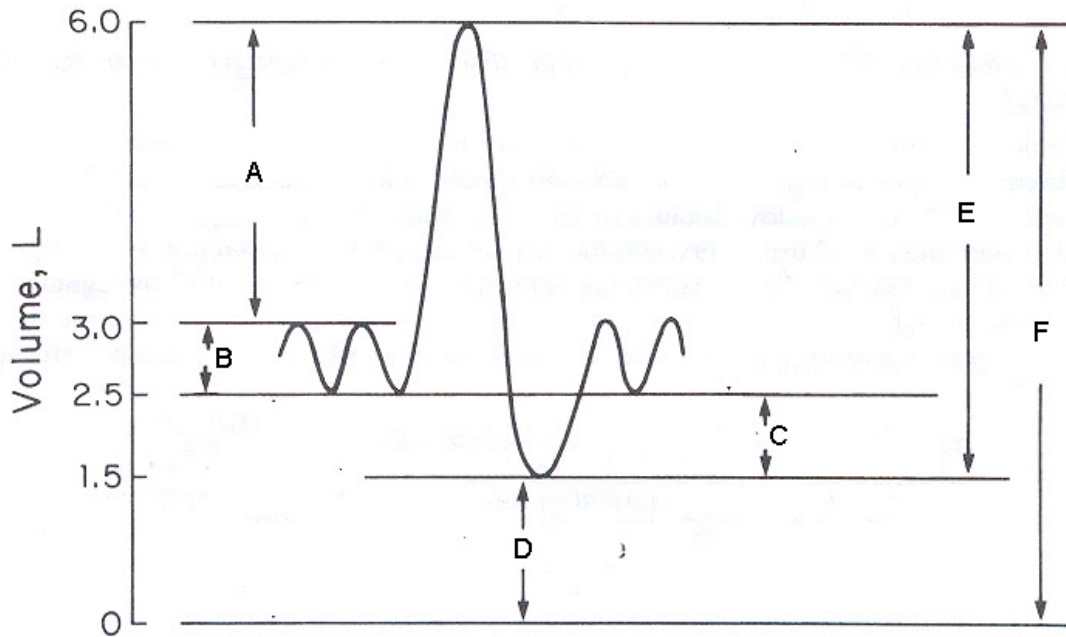
53) Bronchi in the lungs continuously branch until they form _____, the smallest conducting passages in the lungs.

54) Round structures called _____ (singular: _____) are the only lung structures in which gas exchange with the blood occurs. Air in the bronchi and bronchioles cannot exchange gases with the blood.

- 55) The walls of the alveoli are _____ tissue (be as specific as possible). This is a very thin tissue, so that gases can diffuse easily between the alveoli and the blood.
- 56) _____ means to breathe in, while _____ refers to breathing out.
- 57) An unforced, or quiet, inspiration results primarily from the contraction of the _____ muscle and the _____ muscles, which expand the volume of the lungs.
- 58) Contraction of the diaphragm causes it to move _____, resulting in a(n) _____ in the size of the thoracic cavity and therefore a(n) _____ in pressure within the lungs.
- 59) The _____ muscles are used for forceful inspiration. They assist the diaphragm and the external intercostal muscles expand the thorax by elevating the ribs and sternum.
- 60) Two important groups of muscles involved in forced expiration are the _____ muscles and the _____ muscles.
- 61) Air enters the lungs during inspiration because the air pressure in the lungs is higher/lower (circle one) than the atmospheric air pressure outside the lungs.
- 62) Unless forced, expiration is caused by the _____ of the lung tissue. This occurs during relaxation of the _____ and _____ (muscles).
- 63) Name all the inspiratory muscles involved in forced inspiration.
- 64) Explain why no muscle contraction is needed for normal expiration.
- 65) We contract muscles to inspire. Explain exactly how contraction of these muscles leads to inspiration of air. Your answer must include a discussion of air pressures inside and outside of the lungs.
- 66) Does your chest expand because your lungs inflate, or do your lungs inflate because your chest expands? Justify your answer.

67) Inspect the spirometry results chart below. Provide the names of spirometry measurements A – F. Also, based on the volumes shown on the Y-axis of the chart estimate the patient’s volume (in ml) for each of the spirometry measurements.

- a) Measurement A: Name: _____ Volume: _____ mL
- b) Measurement B: Name: _____ Volume: _____ mL
- c) Measurement C: Name: _____ Volume: _____ mL
- d) Measurement D: Name: _____ Volume: _____ mL
- e) Measurement E: Name: _____ Volume: _____ mL
- f) Measurement F: Name: _____ Volume: _____ mL



68) In lab, you measured the volumes of air using a _____, which is a device that measures the volumes of air breathed.

- 69) a) The maximum amount of air that can be forcefully expired after a maximum inspiration is called the _____.
- b) The normal volume of air that is inspired and expired during normal breathing is called the _____. Its predicted volume is ____ ml.

70) The _____ is the amount of additional air that can be inspired if, after normal inspiration, one breathes in as deeply as possible. In an average adult this is about _____ ml volume.

71) The _____ is the maximum amount of air that can be forced out of the lungs after one has finished a normal expiration, and in an average adult is about _____ ml volume.

72) The alveoli never fully empty. Some air remains in the lungs even after maximal, forcible expiration. This air is called the _____ volume.

73) The _____ is the maximum volume of air that can fill the lungs.

74) The vital capacity is equal to the _____ volume plus the _____ volume plus the _____ volume.

75) Suppose you get bored and yawn during lab (as impossible as that may seem). While yawning, you inhale as much air as you can.

a) About what extra volume of air did you inhale? _____

b) What is this extra volume of air called? _____

76) Answer the following questions about air volumes in the lungs.

a) If you exhaled (expired) as much air from your lungs as you were able to, some air would still remain in your lungs. This remaining air is called your _____ volume.

b) The volume of air that you breathe in and out under normal relaxed conditions is called your _____ volume.

c) The volume of air that you can force yourself to inhale (beyond the amount that you normally inhale) is called your _____ volume.

Circle the lung volume above (a, b, or c) that is the smallest volume of air.

77) As small child person grows to a larger adult height, their vital capacity increases/decreases/stays the same (circle one of the three answers).

78) Your patient, a man named Richard, is 30 years old and 5 feet 10 inches tall. Using a spirometer, you find that Richard inspires and expires an average of 375 ml of air with every breath. When you ask Richard to expire as deeply as possible after inspiring as deeply as possible, you find that he expires at total of 3986 ml of air. During the first one second of this expiration, he expired 3008 ml of air. When you ask Richard to expire as deeply as possible after a normal expiration, you find he expires 1146 ml of air. When you ask Richard to inspire as deeply as possible after a normal inspiration, you find he inspires 2465 ml of air. Using the above information and the tables in the lab manual spirometry exercise, calculate the following.

- a) Richard's vital capacity: _____
- b) Richard's predicted vital capacity: _____
- c) Richard's percent of predicted for vital capacity: _____
- d) Richard's tidal volume: _____
- e) Richard's predicted tidal volume: _____
- f) Richard's percent of predicted for tidal volume: _____
- g) Richard's expiratory reserve volume: _____
- h) Richard's predicted expiratory reserve volume: _____
- i) Richard's percent of predicted expiratory reserve volume: _____
- j) Richard's inspiratory reserve volume: _____
- k) Richard's predicted inspiratory reserve volume: _____
- l) Richard's percent of predicted inspiratory reserve volume: _____
- m) Richard's residual volume: _____
- n) Richard's total lung capacity: _____
- o) Richard's forced expiratory volume (FEV₁) : _____
- p) Richard's forced expiratory volume (FEV₁) as a percent of his vital capacity : _____
- q) Richard's predicted forced expiratory volume (FEV₁) as a percent of his vital capacity : _____

79) As an adult ages and becomes senior citizen, their vital capacity increases/decreases/stays the same (circle one of the three answers).

80) Comparing a woman and a man of equal age and size, the woman has a larger/smaller/equal (circle one word) vital capacity.

81) Which two respiratory system disorders that we discussed in class are characterized by inflammation of the bronchi?

_____ & _____

Circle the one that is usually caused by smoking.

82) About one third of all cancer deaths are due to _____ cancer: only one in ten affected individuals was a non-smoker, highlighting the contribution of smoking to the development of this type of cancer.

83) You are taking care of two patients in the respiratory ward of the hospital. One of your patients has emphysema and the other has chronic bronchitis.

- a) What activity did both patients probably engage in that caused these diseases?
- b) What part of the respiratory system is damaged in emphysema? Be as specific as possible.
- c) What part of the respiratory system is damaged in chronic bronchitis?
- d) Which patient would be able to inspire more easily than expire?
- e) Which patient would have equal difficulty inhaling and exhaling?

84) Vital capacity is reduced below normal in all _____ breathing disorders, such as pulmonary fibrosis.

85) One of the functions of the blood is to transport O_2 from the lungs to the other tissues. Answer the following questions about how the blood carries the oxygen.

- a) The blood cell that carries O_2 : _____
- b) The protein in (a) above that carries O_2 : _____
- c) The metal atom on (b) above that carries O_2 : _____

86) Each molecule of hemoglobin can carry _____ <how many?> molecules of oxygen.

87) Lack of iron in the diet is one cause of _____, which is the inability of the blood to carry sufficient oxygen.

88) Most of the carbon dioxide in the blood is transported as _____ (write the name of the molecule); The molecular formula for this molecule is _____.

89) The breathing control centers are located where? Be as specific as possible.

90) The breathing control centers will change the breathing rate most quickly and most dramatically in response to changes in the _____ of the blood.

91) [This question deleted]

92) Explain why you could not measure residual volume in lab. Also, explain how you obtained a value for residual volume in lab, even though you could not directly measure it.

93) Explain why you could not measure total lung capacity in lab. Also, explain how you obtained a value for total lung capacity in lab, even though you could not directly measure it.

94) Suppose that more than one person in your lab group wanted to measure their spirometry volumes. What part of the lab equipment prevents passing germs between all the volunteers who used the spirometer?

95) Maricela's tidal volume (TV) was measured using one of our spirometers. Just as we did in lab, three tidal volume measurements were done. The results were 340 ml, 345 ml, and 435 ml. Using this information, fill in the two results below.

Maricela's average TV: _____ Maricela's percent of predicted TV: _____

96) Explain briefly (3-4 sentences) how the respiratory airway passages keep the lungs free of bacteria and dust. Explain all aspects of this process.

97) Describe the major symptoms if a person...

- a) Stopped making airway passage mucus.
- b) Had their epiglottis stuck in the closed position.
- c) Had lungs that could expand no bigger than their tidal volume.

98) In the pulmonary loop, CO₂ exits the blood and O₂ enters the blood, whereas in the systemic loop CO₂ enters the blood and O₂ exits the blood. What ensures that each gas molecule moves in the proper direction (exiting vs. entering the blood) in each loop?

99) Briefly explain exactly why lack of iron in the diet causes low energy:

100) Compare asthma and emphysema in terms of what parts of the respiratory system are not functioning correctly.

Answers for Review Questions for Spirometry topic:

1) B

2) D

3) A

4) A

5) B

6) C

7) D

8) D

9) B

10) A

11) B

12) A and D

13) B

14) A and C

15) C

16) A

17) B

18) A

19) E

20) B

21) D

22) A

23) B

24) A and C

25) A

26) C

27) C

28) A and B

29) C

30) C

31) A and D

32) B

- 33) a) The measurement of air volumes breathed in and out.
- b) The volume of air breathed in and out in a normal relaxed breath. The predicted volume is 500 ml.
- c) The maximum volume of air that can be expired after a normal expiration. The predicted volume is 1200 ml.
- d) The maximum volume of air that can be inspired after a normal inspiration. The predicted volume is 2300 ml.
- e) The maximum volume of air that can be expired after a maximum inspiration.
- f) The volume of air that remains in the lungs after a maximum expiration.
- g) The total volume of air in the lungs after a maximum inspiration.
- h) The volume of air that can be forcibly expired during the first one second of maximum expiration following a maximum inspiration.
- i) The movement of solute molecules from areas of their high concentration to areas of their low concentration.

34) Gas
The lungs
The blood

35) Oxygen
Carbon dioxide

36) Into
Out of

37) Out of
Into

38) The body requires oxygen in the blood so that cells throughout the body can perform cellular aerobic respiration. This process allows the cells to generate the energy they require for survival.

39) Lower

40) Higher

41) Airway passages
Lungs

42) a) Nasal cavity

b) Pharynx

c) Epiglottis

d) Trachea

43) 5
2
1
6
4
3
7

44) Warm
Clean

45) Sticky mucus

46) Cilia on the epithelial cells that line the airway passages

47) The mucus is swallowed and destroyed by the digestive system

48) Esophagus

49) Thorax
Primary bronchi

50) She could not eat or drink anything without choking, because the epiglottis is responsible for blocking swallowed food and water from entering the trachea.

51) Alveoli

52) Elasticity

53) Bronchioles

54) Alveoli
Alveolus

55) Simple squamous epithelial tissue

56) Inspiration
Expiration

57) Diaphragm
External intercostal muscles

58) Downward
Increase
Decrease

59) Sternocleidomastoid muscles

60) Abdominal muscles
Internal intercostal muscles

61) Lower

62) Elastic recoil
Diaphragm
External intercostal muscles

63) Diaphragm

External intercostals
Sternocleidomastoid muscles

64) The lungs are elastic in nature. This means that they have a natural tendency to recoil back to their initial size if they have been stretched to a larger size. No muscle contraction is required for the elastic recoil of the lungs. All that is required is relaxation of the inspiratory muscles.

65) When we contract the inspiratory muscles, these muscles expand the size of the lungs. When a chamber (such as the lungs) are expanded in size, the air become spread out over a larger volume and therefore there is a decrease in air pressure within the lungs. Air always flows from high pressure areas to low pressure areas, so outside atmospheric air (at higher pressure) flows into the lungs to fill the lower pressure there.

66) Your lungs inflate because your chest expands. By expanding the chest with the inspiratory muscles, the air pressure in the lungs is reduced to below atmospheric pressure. Higher pressure air from outside the lungs therefore rushes into the lungs to fill the partial vacuum.

- 67) a) Inspiratory reserve volume (3000 ml)
 b) Tidal volume (500 ml)
 c) Expiratory reserve volume (1000 ml)
 d) Residual volume (1500 ml)
 e) Vital capacity (4500 ml)
 f) Total lung capacity (6000 ml)

68) Spirometer

- 69) a) Vital capacity
 b) Tidal volume.
 500 ml

70) Inspiratory reserve volume
2300 ml

71) Expiratory reserve volume
1300 ml

72) Residual volume

73) Total lung capacity

74) Inspiratory reserve volume
Expiratory reserve volume
Tidal volume

75) 2300 ml
The inspiratory reserve volume

76) a) Residual volume
b) Tidal volume (circled)
c) Inspiratory reserve volume

77) Increases

78) a) 3986 ml
b) 4325 ml (from table 8.2 for a 30 year old of 178 cm height)
c) 92% (3986 ml / 4325 ml)
d) 375 ml
e) 500 ml (given in lab)
f) 75% (375 ml / 500 ml)

g) 1146 ml

h) 1200 ml (given in lab)

i) 95.5% (1146 ml / 1200 ml)

j) 2465 ml

k) 2300 ml (given in lab)

l) 107% (2465 ml / 2300 ml)

m) 997 ml (3986 ml x 0.25. The 3986 is Richard's VC. The 0.25 factor comes from table 8.3 for a 30 year old)

n) 4982 ml (3986 ml x 1.25. The 3986 is Richard's VC. The 1.25 factor comes from table 8.3 for a 30 year old)

o) 3008 ml

p) 75% (3008 ml / 3986 ml)

q) 77% - 78% (from table 8.4 for a 30 year old man)

79) Decreases

80) Smaller

81) Asthma

Chronic bronchitis (circled)

82) Lung cancer

- 83) a) Smoking
b) The walls of the alveoli
c) The airway passages
d) The patient with emphysema
e) The patient with chronic bronchitis

84) Restrictive

- 85) a) Red blood cells
b) Hemoglobin
c) Iron

86) Four

87) Anemia

88) Bicarbonate ion
 HCO_3^-

89) In the pons and medulla oblongata of the brain stem

90) pH (H^+ concentration or CO_2 concentration are also acceptable answers)

91) [Question 91 deleted]

The value for the inspiratory reserve volume (IRV) was calculated from the following equation: $\text{IRV} = \text{VC} - \text{TV} - \text{ERV}$. All three of the spirometry volume on the right side of the equation (VC, TV, and ERV) are expiratory volumes and therefore can be measured with our spirometers.

92) The residual volume is the volume of air that remains in the lungs after a maximum forceful expiration. Since the residual volume is a volume of air that is not expired, it

cannot be measured with a spirometer (spirometers can only measure air volumes that can be breathed in or out). The residual volume, however, can be estimated because it is usually a certain percent of a person's vital capacity. Table 8.3 in the lab manual lists the residual volume as a percent of vital capacity for various age groups. The value for the victim's residual volume was calculated by multiplying the victim's vital capacity by the residual volume percentage factor from table 8.3.

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93) The total lung capacity is the total volume of air contained in the lungs after a maximum inspiration. It is equal to the vital capacity plus the residual volume. Since the residual volume is part of total lung capacity and since residual cannot be measured with a spirometer, the total lung capacity also cannot be measured with a spirometer. The total lung capacity, however, can be estimated because it is usually a certain percent of a person's vital capacity. Table 8.3 in the lab manual lists the total lung capacity as a percent of vital capacity for various age groups. The value for the victim's total lung capacity was calculated by multiplying the victim's vital capacity by the total lung capacity percentage factor from table 8.3.

94) The disposable cardboard mouth tube. Each volunteer who uses a spirometer is supposed to use their own disposable cardboard mouth tube. This prevents spreading of germs between people who use the same spirometer. Also, the electronic spirometers that we use have a filter that prevents bacteria from the person's breath from entering the spirometer.

95) $TV = 373 \text{ ml } (340 \text{ ml} + 345 \text{ ml} + 435 \text{ ml}) / 3$

$$74.6\% (373 \text{ ml} / 500 \text{ ml})$$

96) The cells that line the airways secrete a sticky mucus that traps bacteria, fungi, dust, and other contaminants in the air which is inspired. The airway cells also have cilia which slowly push the mucus upward, away from the lungs. The contaminated mucus eventually reaches the pharynx, where it is swallowed and destroyed by the digestive system.

- 97) a) If a person stopped making airway passage mucus, the air that they inspired would not be cleaned before it reached the lungs. The person would have a high rate of lung infection from the inspired bacterial and fungal spores that reach the lungs.
- b) The epiglottis covers the trachea when we swallow to prevent food and water from entering the trachea. If the epiglottis was stuck in the closed position, the person would not be able to breathe.
- c) The person could only breathe the small volume of air of a normal relaxed breath. They would not be able to do any activity that required larger than normal volumes of air, such as exercise or blowing out a candle.

98) The movement of all gases in the body occurs by diffusion, which means substances moving from areas of their high concentration to areas of their low concentration. In the pulmonary loop, the blood that arrives at the lungs is high in CO_2 but low in O_2 . The air in the lungs is high in O_2 and low in CO_2 . By diffusion, the CO_2 therefore exits the blood and enters the lungs, and the O_2 exits the lungs and enters the blood.

In the systemic loop, the gas concentrations are reversed. The blood at the start of the systemic loop is high in O_2 and low in CO_2 . The tissue fluids are low in O_2 and high in CO_2 .

By diffusion, the oxygen exits the blood and moves into the tissue fluid. The CO_2 exits the tissue fluid and enters the blood.

99) Iron in the blood carries the oxygen. If a person does not get enough iron in their diet, their blood is not able to carry sufficient levels of oxygen. Since the oxygen in the blood is required for cells to make energy by cellular aerobic respiration, the cells of the body become low in energy, and so the person has an overall feeling of weakness and fatigue.

100) In asthma, the airway passages are not functioning correctly. In particular, the airways have become contracted to a smaller diameter. This makes breathing in and out more difficult.

In emphysema, some of alveoli walls have been destroyed. This destabilizes the alveoli so that they collapse during expiration, trapping air in the lungs and making expiration more difficult. During inspiration, the inspired air keeps the alveoli inflated, so the person with emphysema does not have any difficulty inspiring.