

These review questions for the Respiratory system were adapted from our textbook and its website, and also from 1800+ Review Questions for Anatomy and Physiology II (2nd edition) by R. Michael Anson, Ph.D.

You are required to know and understand all the material on the respiratory system that is covered in the lecture and in the laboratory. Questions marked with an asterisk are from material presented in the laboratory section of the course.

Multiple choice review questions

- 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) O₂, PO₄
 - B) CO₂, H₂O₄
 - C) CO₂, O₂
 - D) O₂, CO₂

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

6) The list of conducting 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 conducting 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

7) 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

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

- A) Bronchi.
- B) Alveoli
- C) Tracheary elements
- D) Bronchioles

9) 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) 2
- B) 3
- C) 4
- D) 5

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

- A) External intercostals
- B) Bronchiolus
- C) Trachea major
- D) Diaphragm

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

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

12) The fluid-filled membrane that surrounds the lungs is the _____.

- A) Pleura
- B) Peritoneum
- C) Synovia
- D) Pneuminear membrane

13) A chest wound can introduce air into the pleura space, leading to...

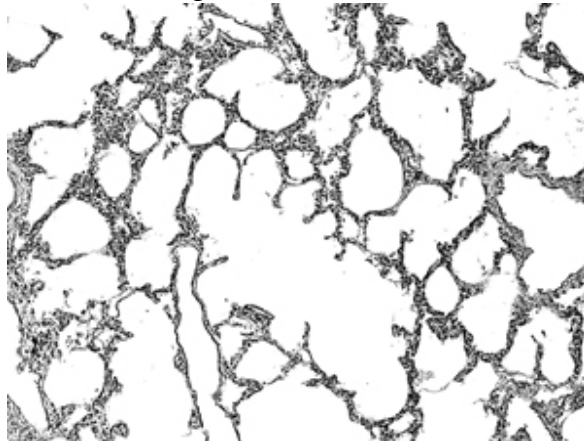
- A) Over oxygenation of the blood (due to air entering the lung through the hole)
- B) A collapsed lung
- C) Over oxygenation of the blood (due to air entering the blood in the wound)
- D) Lung filling with blood

14) The ability of the lung to return to its normal size after stretching is known as

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

15*) In laboratory, you viewed a microscope slide that looked similar to the one shown below. This slide was what part of the respiratory system? (Be as exact as possible).

- A) Trachea
- B) Bronchus
- C) Bronchioles
- D) Alveoli



16) The vocal cords are in which part of the respiratory system? (Be as exact as possible).

- A) Larynx
- B) Pharynx
- C) Oral cavity
- D) Trachea

17*) 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.

18*) 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.

- 19*) 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
- 20) 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
- 21) 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
- 22) Oxygen is carried in the blood on _____ ions.
- A) Calcium
 - B) Sodium
 - C) Iron
 - D) Bicarbonate
- 23) 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
- 24) 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
- 25) Bicarbonate ion (HCO_3^-) and hydrogen ion (H^+) are made when _____ reacts with water.
- A) oxygen
 - B) hydrogen
 - C) carbon dioxide
 - D) carbon monoxide

26) In the pulmonary loop, which reaction occurs?

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

27) Hypoventilation by a person with normal lung function tends to cause

- A) a rise in blood pH.
- B) increased CO_2 in the blood
- C) increased O_2 in the blood
- D) acidosis.
- E) both b and d

28) If a person with normal lung function started to hyperventilate, the _____ in their blood would _____.

- A) CO_2 , Increase
- B) O_2 , Decrease
- C) H^+ , Decrease
- D) Fe^{3+} , Decrease

29) Alkalosis can result from

- A) Hyperventilation.
- B) Increased iron in the diet
- C) Excessive exercise
- D) Hypoventilation.

30) An increase in the amount of _____ in the blood will result in _____ ventilation.

- A) H^+ ; increased
- B) acid; decreased
- C) O_2 ; increased
- D) CO_2 ; decreased

31) Normal breathing rate is _____ breaths per minute

- A) 6 - 10
- B) 12 - 18
- C) 30 - 36
- D) 80 - 120

32) The rate and depth of respiration are set by control centers located in the

- A) pleurae.
- B) lungs.
- C) brain stem.
- D) diaphragm.

- 33) The molecule in the blood that is measured by our breathing control centers and that is the major determinant of our breathing rate is:
- A) Bicarbonate ion
 - B) O₂
 - C) H⁺
 - D) CO₂
- 34) In response to acidosis, ventilation will _____. This change in ventilation is called _____.
- A) decrease; hypoventilation
 - B) decrease; hyperventilation
 - C) increase; hypoventilation
 - D) increase; hyperventilation
- 35) Which of the following is caused by destruction of the alveolar walls?
- A) asthma.
 - B) emphysema
 - C) chronic bronchitis.
 - D) lung cancer
- 36) Which of the following is caused by conducting passages becoming swollen or blocked? (More than one answer is possible).
- A) asthma.
 - B) emphysema
 - C) chronic bronchitis.
 - D) lung cancer
- 37) Glucocorticoids, which are steroids that reduce the immune response, are most effective in treating
- A) asthma.
 - B) emphysema.
 - C) lung cancer
 - D) collapsed lung

Answers to multiple choice review questions:

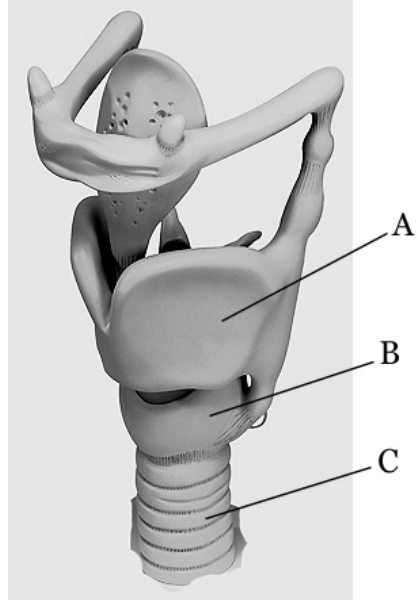
- | | | |
|--------------|--------------|--------------|
| 1 = B | 14 = D | 27 = E |
| 2 = D | 15* = D | 28 = C |
| 3 = A | 16 = A | 29 = A |
| 4 = A | 17* = C | 30 = A |
| 5 = B | 18* = B | 31 = B |
| 6 = D | 19* = A | 32 = C |
| 7 = C | 20 = A | 33 = C |
| 8 = B | 21 = A | 34 = D |
| 9 = A | 22 = C | 35 = B |
| 10 = A and D | 23 = C | 36 = A and C |
| 11 = B | 24 = A and B | 37 = A |
| 12 = A | 25 = C | |
| 13 = B | 26 = C | |

Fill-in-the-blank review questions

- 1) The main function of the respiratory organ system is _____ exchange between the _____ and the _____.
- 2) 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.
- 3) In the lungs, the gas _____ enters the blood and the gas _____ exits the blood.
- 4) _____ means to breathe in, while _____ refers to breathing out.
- 5) The conducting passages not only conduct air to and from the lungs, they also _____ and _____ the before it reaches the lungs.
- 6) The conducting passages remove dust and other particles from the inspired air in this way: The particles become trapped on _____ in the conducting passages.
- 7) The mucus with the trapped dust particles is pushed upward, away from the lungs, by _____.
- 8) What happens to the mucus that is pushed to the top of the respiratory tract? _____.
- 9) The _____ is the hollow structure at the top of the windpipe. It contains several cartilage structures and also the vocal cords.
- 10) The _____ is another term for the windpipe, a sturdy tube supported by rings of cartilage.
- 11) The correct anatomical term for the 'voice box' is the _____.
- 12) At the top of the larynx, the _____ acts as a flexible flap that prevents food from entering the larynx.
- 13) The structure on the neck commonly called the Adam's apple is the _____ of the larynx.

14*) In lab, you studied a model of the larynx like the one shown on the right. Name structures A, B, and C on the model.

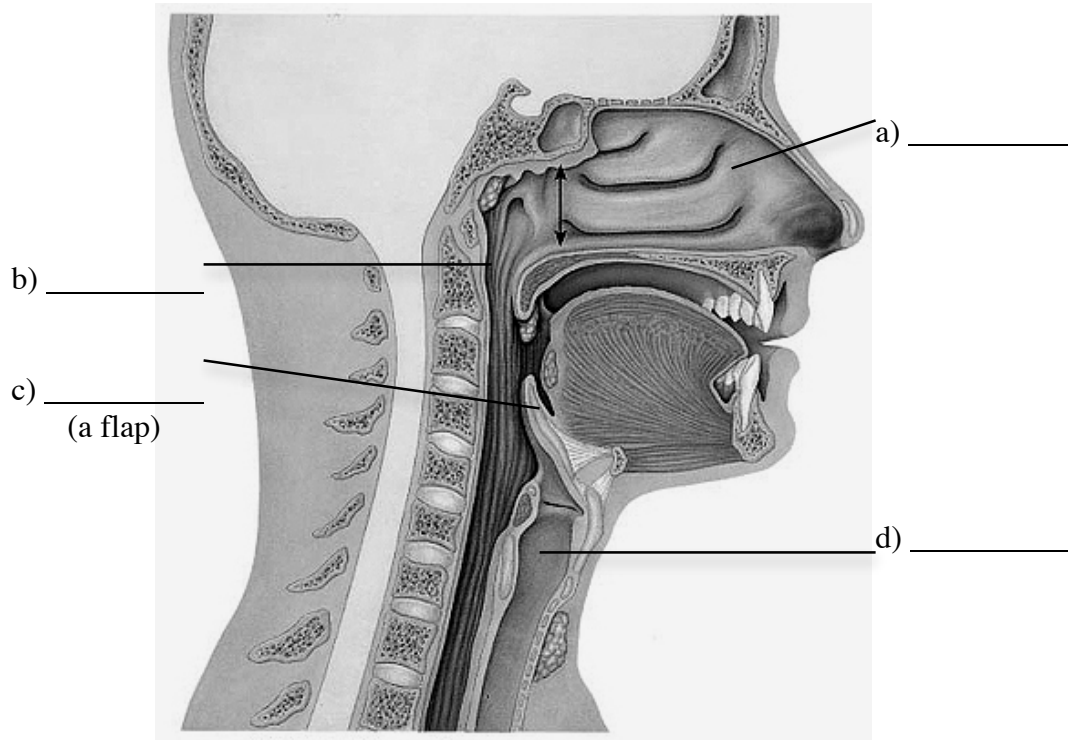
A = _____
 B = _____
 C = _____



15) The trachea, or windpipe, descends from the larynx into the _____ body cavity, where it ends by dividing into the two _____, which are the conducting passages that enter the lungs.

16) Just posterior to the trachea is another tube passing through the thoracic cavity, the _____, a tube which carries food downward to the stomach.

17) Label the parts of the upper respiratory tract. Use the correct anatomical terms.



18) Lungs have the property of _____ which is 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.

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

20) Bubble-like 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.

21) 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.

22) In the blank spaces after the respiratory system structures below, write a number (from 1 – 8) to show the order that you would encounter them if you were an inspired molecule of O₂.

Bronchiole _____

Epiglottis _____

Pharynx _____

Alveoli _____

Bronchi _____

Trachea _____

Larynx _____

Capillary _____

23) An unforced, or quiet, inspiration results primarily from the contraction of the _____ muscle and the _____ muscles, which expand the volume of the lungs.

24) Contraction of the diaphragm causes it to move _____, resulting in a(n) _____ in the size of the thoracic cavity and a(n) _____ in pressure within the lungs.

25) Contraction of the _____ elevates the ribs and sternum, resulting in an increase in the size of the thoracic cavity and a(n) _____ in pressure within the lungs.

26) 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.

27) Unless forced, expiration is caused by the _____ of the lung tissue. This occurs during relaxation of the _____ and _____ (muscles).

28) Many organs in the body (such as the heart, lungs, and digestive organs) are surrounded by a fluid-filled membrane. What is the term for any fluid filled membrane in the body? _____

29) Answer the following questions about the serosa that surrounds the lungs.

a) What is the name of the serosa that surrounds the lungs? _____

b) The side of the lung serosa that attaches to the lungs is called its _____ face.

c) The side of the lung serosa that attaches to the walls of the thoracic cavity is called its _____ face.

30) The pleura allows the lungs to _____ inside the thoracic cavity during breathing.

31) The disorder _____ is painful breathing due to too little pleural fluid.

32) If air bubbles enter the pleural fluid (as might happen by a stab wound to the chest), the result is _____.

33*) Pulmonary function tests evaluate respiratory function using a _____, a device that measures respiratory volumes and capacities.

34) The maximum amount of air that can be forcefully expired after a maximum inspiration is called the _____.

35) The normal volume of air that is inspired and expired during normal breathing is called the _____. Its average volume is _____ ml.

36) 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.

37) 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.

38) The alveoli never fully empty and air there remains in the lungs even after maximal, forcible expiration. This is the _____, and in an average adult is about _____ ml.

39*) The _____ is the maximum of air that can fill the lungs.

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

41) Suppose you get bored and yawn during lecture (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? _____

42) 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 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.

43*) The police find a man of average size drowned in the ocean, his lungs completely filled with water (no air at all). How many liters of water are in his lungs? _____.
Hint: This volume is the same as the _____, which is the vital capacity plus the residual volume.

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

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

46) The partial pressure (concentration) of carbon dioxide in the alveoli is higher/lower (circle one) than in the blood of the pulmonary loop. This is why CO₂ diffuses out of the blood and into the alveoli.

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

48) One of the functions of the blood is to transport O₂ from the lungs to the other tissues. Answer the following questions about how the blood carries the oxygen.

a) The blood cell that carries O₂: _____

b) The protein in (a) above that carries O₂: _____

c) The metal atom on (b) above that carries O₂: _____

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

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

- 51) The benefit of converting the carbon dioxide in the blood into bicarbonate ion is _____.
- 52) For every molecule of CO_2 that becomes a bicarbonate ion in the blood, another ion (other than bicarbonate ion) is also produced in the blood. What is that other ion? _____.
- 53) Making H^+ ion can change the _____ of the blood (hint: A term that describes the H^+ content, or the acidity, of a solution).
- 54) When CO_2 enters the blood in the systemic loop and becomes HCO_3^- , this will increase/decrease (circle one) the H^+ content of the blood. This can increase/decrease (circle one) the pH of the blood.
- 55) If there is an increase in CO_2 in the blood, the blood's H^+ concentration will increase/decrease (circle one). This will increase/decrease (circle one) the pH of the blood.
- 56) If there is a decrease in CO_2 in the blood, the blood's H^+ concentration will increase/decrease (circle one). This can increase/decrease (circle one) the pH of the blood.
- 57) Before CO_2 becomes bicarbonate ion, it first becomes a carbon-containing acid called _____. Write the molecular formula for this acid: _____.
- 58) Carbonic acid dissociates to form _____ and _____. The chemical equation for this reaction is written as _____.
- 59) Write out the full and balanced chemical reaction for conversion of CO_2 into HCO_3^- . (Hints: The CO_2 reacts with water in the blood to form carbonic acid, then the carbonic acid dissociates into bicarbonate ion and another ion).
- 60) The carbonic acid, bicarbonate ion, and H^+ in the blood come from CO_2 that is made by the cells. The cells make CO_2 as a waste product of the metabolic process called _____, which is the main process cells use to produce energy for themselves from glucose.
- 61) In the pulmonary loop (the blood vessels of the lungs), _____ ion and _____ ion in the blood combine to form carbon dioxide. The CO_2 then exits the blood and enters the lungs.
- 62) Write the chemical reaction for bicarbonate ion and hydrogen ion becoming carbon dioxide in the lungs.

- 63) HCO_3^- becoming CO_2 in the lungs increases/decreases (circle one) the H^+ content of the blood. This can increase/decrease (circle one) the pH of the blood.
- 64) What physiological process controls how fast HCO_3^- reacts with H^+ to become CO_2 in the lungs? _____.
- 65) If there is an increase in breathing rate, the blood's H^+ concentration will increase/decrease (circle one). This will increase/decrease (circle one) the pH of the blood.
- 66) If there is an decrease in breathing rate, the blood's H^+ concentration will increase/decrease (circle one). This will increase/decrease (circle one) the pH of the blood.
- 67) The breathing control centers are located in the _____ and _____ regions of the _____ (a major brain region).
- 68) Normal breathing rate for an adult is ____ to ____ breaths per minute.
- 69) The sensory neurons that monitor the O_2 content of the blood are located in two blood vessels: The _____ and the _____ .
- 70) When the blood levels of CO_2 rise above normal, the pH of the blood begins to increase/decrease (circle one).
- 71) Abnormally fast breathing is called _____, whereas abnormally slow breathing is called _____.
- 72) Hypoventilation will cause the CO_2 levels to rise/fall (circle one) in the plasma producing a(n) increase/decrease (circle one) in H^+ concentration and a(n) increase/decrease (circle one) in blood pH.
- 73) Hyperventilation will cause the CO_2 levels to rise/fall (circle one) in the plasma producing a(n) increase/decrease (circle one) in H^+ concentration and a(n) increase/decrease (circle one) in blood pH.
- 74) In alkalosis, the pH of the blood is too high/low (circle one). To correct this pH imbalance, the breathing control centers will increase/decrease (circle one) the breathing rate.
- 75) In acidosis, the pH of the blood is too high/low (circle one). To correct this pH imbalance, the breathing control centers will increase/decrease (circle one) the breathing rate.
- 76) The two gases whose levels in the blood control breathing rate are _____ and _____.

77) The blood molecule that is measured by the breathing control center and that has the greatest effect on breathing rate is $O_2/CO_2/H^+$ (circle one of the three).

78) When the sensory neurons in the breathing control center sense a decrease in the pH of the blood, they signal the inspiratory muscles (the diaphragm and external intercostals muscles) to increase/decrease (circle one) the breathing rate.

79) When blood pH decreases, breathing rate must be _____ to help return the pH to its normal value.

80) When blood pH increases, breathing rate must be _____ to help return the pH to its normal value.

81) 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?
- 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?

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

_____ & _____

Circle the one that is usually related to smoking.

83) As of the year 2000, one third of all cancer deaths are due to _____ cancer: only one in ten affected individuals is a non-smoker, highlighting the contribution of smoking to the development of this disease.

Answers to fill-in-the-blank review questions

- 1) Gas
Air in lungs
Blood
- 2) Conducting passages
Lungs
- 3) Oxygen (O₂)
Carbon dioxide (CO₂)
- 4) Inspiration
Expiration
- 5) Warm
Clean
- 6) Sticky mucus
- 7) Cilia on the cells that line the passage
- 8) It is swallowed
- 9) Larynx
- 10) Trachea
- 11) Larynx
- 12) Epiglottis
- 13) Thyroid cartilage
- 14*) A = Thyroid cartilage
B = Cricoid cartilage
C = Trachea
- 15) Thoracic
Bronchi
- 16) Esophagus
- 17) A = Nasal cavity
B = Pharynx
C = Epiglottis
D = Trachea
- 18) Elasticity
- 19) Bronchioles
- 20) Alveoli
Alveolus
- 21) Simple squamous epithelial
- 22) 6
2
1
7
5
4
3
8
- 23) Diaphragm
External intercostal
- 24) Downward
Increase
Decrease
- 25) External intercostal muscles
Decrease
- 26) Lower
- 27) Elastic recoil
Diaphragm
External intercostals muscles
- 28) Serosa
- 29) Pleura
Visceral
Parietal
- 30) Slide
- 31) Pleurisy
- 32) Collapsed lung (Pneumothorax)
- 33*) Spirometer
- 34) Vital capacity
- 35) Tidal volume
500 ml
- 36) Inspiratory reserve volume
3000 ml
- 37) Expiratory reserve volume
1100 ml
- 38) Residual volume
1000 ml
- 39*) Total lung capacity
- 40*) Inspiratory reserve volume
Tidal volume
Expiratory reserve volume
- 41) a) 3000 ml
b) Inspiratory reserve volume
- 42) a) Residual volume
b) Tidal volume (circled)
c) Inspiratory reserve volume
- 43*) About 5 liters (5000 ml)
Total lung capacity
- 44) Into
Out of
- 45) Out of
Into
- 46) Lower
- 47) Higher

- 48) a) Red blood cell (Erythrocyte)
 b) Hemoglobin
 c) Iron (Fe^{3+})
- 49) Anemia
- 50) Bicarbonate ion
 HCO_3^-
- 51) The blood can carry more HCO_3^- than CO_2 .
- 52) H^+
- 53) pH
- 54) Increase
 Decrease
- 55) Increase
 Decrease
- 56) Decrease
 Increase
- 57) Carbonic acid
 H_2CO_3
- 58) HCO_3^-
 H^+
 $\text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$
- 59) $\text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{HCO}_3^- + \text{H}^+$
- 60) Cellular aerobic respiration
- 61) HCO_3^-
 H^+
- 62) $\text{HCO}_3^- + \text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- 63) Decreases
 Increase
- 64) Breathing rate
- 65) Decrease
 Increase
- 66) Increase
 Decrease
- 67) Pons
 Medulla oblongata
 Brain stem
- 68) 12 – 18 breaths per minute
- 69) Aorta
 Carotid artery
- 70) Decrease
- 71) Hyperventilation
 Hypoventilation
- 72) Rise
 Increase
 Decrease
- 73) Fall
 Decrease
 Increase
- 74) High
 Decrease
- 75) Low
 Increase
- 76) CO_2
 O_2
- 77) H^+
- 78) Increase
- 79) Increase
- 80) Decrease
- 81) a) Smoking
 b) The alveoli of the lungs
 c) The conducting passages
 d) The emphysema victim
 e) The chronic bronchitis victim
- 82) Chronic bronchitis (circled)
 Asthma
- 83) Lung cancer

Short answer review questions:

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

2) 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?

3) Your cool body piercing friend now says she wants to get the folds in the inner wall of her larynx removed. What lifestyle changes would she have to do if she did have them removed?

4) Name the inspiratory muscles (the muscles involved in normal inspiration).

5) Explain why no muscle contraction is needed for normal expiration.

6) What are two functions of the serosa that surrounds the lungs?

7) What is the condition called when the pleura to a lung is punctured (as might happened from a stab wound to the chest)? _____. Describe briefly (2 –3 sentences) what happens to the lung when the pleura is punctured and explain why it happens.

8) What is the condition called when too little pleural fluid is made? _____. Describe briefly (2 –3 sentences) what happens if too little pleural fluid is made and why it happens.

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

a) Stopped making pleural fluid.

b) Stopped making conducting passage mucus.

c) Had their epiglottis stuck in the closed position.

d) Had lungs that could expand no bigger than their tidal volume.

10) 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?

11) Explain briefly exactly why lack of iron in the diet causes low energy:

12) Use a chemical equation to show how carbonic acid and bicarbonate ion are formed from carbon dioxide entering the blood.

13) Why does holding your breath cause the blood to get acidic?

- 14) Describe the effects of hyperventilation on blood CO₂, blood O₂, and blood pH.
- 15) Describe the effects of hypoventilation on blood CO₂, blood O₂, and blood pH.
- 16) If some evil person injected you with a strong acid, one of the ways your body would react would be to hyperventilate. Explain why this would occur. Your answer must include which part of the body and which chemicals in the body regulate breathing rate.
- 17) Briefly explain (3 or 4 sentences) How hyperventilation causes a increase in blood pH. (Your explanation must include a certain chemical equation we discussed in lecture.)
- 18) Define the term alkalosis and the term acidosis. Your definitions should include exact pH values.
- 19) Compare asthma and emphysema in terms of what parts of the respiratory system are not functioning correctly.

Answers to short answer review questions:

- 1) The air we breathe in contains many contaminating particles (such as dust, soot, spores, pollen, etc.). The conducting passages are lined with a sticky mucus that traps most of the particles before they reach the lungs, To remove the mucus, the cells that line the passages have cilia (small hair-like extensions) that slowly push the mucus upward where it is eventually swallowed.
- 2) She would not be able to eat or drink because the epiglottis keeps food and beverages from entering the windpipe!
- 3) These folds are the vocal cords. Their vibrations are what allow us to say words and make sounds. If they were removed, the person would no longer be able to speak. (Aside: Some dog owners have their dog's vocal cords removed to stop incessant barking).
- 4) The diaphragm and the external intercostals.
- 5) The lungs are elastic organs, meaning they can be stretched to a larger size like a rubber band. When we inspire, the inspiratory muscles do exactly that. When we expire, we simply relax those muscles. The lung's elastic recoil (the rubber band-like tendency to snap back to a smaller size) returns the lungs to their smaller size without the contraction of any muscles.
- 6) The serosa that surrounds the lungs keeps the lungs attached to the wall of the thoracic cavity and the serosa also allows the lungs to slide and expand as we breathe in and out.

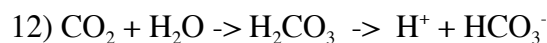
7) The lung collapses (a condition called Pneumothorax) when the pleura has been punctured. This occurs because the pleural fluid (the fluid that fills the pleura) is required to keep the lungs attached to the wall of the thoracic cavity. When the pleura is punctured, air enters the pleura and replaces part of the fluid. The air can't keep the lung attached to the cavity all so the lungs collapses.

8) Pleurisy is the condition where too little pleural fluid is made. Pleurisy causes painful breathing because one function of the pleural fluid is to lubricate the lungs as they slide inside the thoracic cavity during breathing. The lungs scrape against the inner thoracic cavity with every breath if not enough pleural fluid is present.

- 9) a) Painful breathing
 b) Increased lung infections from inspiration of bacterial and fungal spores.
 c) Asphyxiation (suffocation) because a closed epiglottis blocks the windpipe.
 d) The person could not breath any deeper than a normal breath. They would not be able to exercise or do any activity that required deep breathing.

10) Diffusion ensures that all gas molecules move in the proper direction (exiting vs. entering the blood) in each loop. The principle of diffusion is that all dissolved molecules spontaneously move from areas where they are at a high concentration to areas where they are at a low concentration. In the pulmonary loop, CO₂ is at a higher concentration in the blood then in the alveoli of the lungs, therefore it spontaneously diffuses out of the blood. Oxygen, on the other hand, is at a higher concentration in the alveoli than in the blood. This causes it to diffuse into the blood. In the systemic loop the situation is reversed. CO₂ is a higher concentration in the tissues than in the blood, so it enters the blood. Oxygen is at a higher concentration in the blood than in the tissues, so it exits the blood.

11) Iron is used by hemoglobin protein to carry oxygen in the blood. If a person has below normal levels of iron in the blood, their cells will receive less oxygen. Since cells use oxygen to make energy for themselves (by the process of cellular aerobic respiration) an iron shortage leads to an energy shortage in the body. This series of events is called iron-poor anemia.



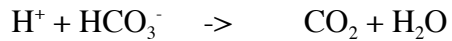
13) One function of breathing is to remove carbon dioxide from the blood. If a person holds their breath, CO₂ levels in the blood will therefore increase. Because CO₂ reacts with the water in the blood to form H⁺ (acid), an increase in blood CO₂ leads to an increase in the blood's acidity.

14) Hyperventilation will decrease blood CO₂, increase blood O₂, and decrease blood H⁺.

15) Hypoventilation will increase blood CO₂, decrease blood O₂, and increase blood H⁺.

16) Being injected with acid would cause an increase in the blood's H⁺ concentration. The breathing control centers in the brain stem monitor the blood's H⁺ concentration to set breathing rate. An increase in H⁺ concentration causes the breathing control center to increase the breathing rate (hyperventilation).

17) In the pulmonary loop, bicarbonate ion (HCO_3^-) in the blood is converted to CO_2 . The CO_2 then exits the blood and moves into the alveoli. The chemical reaction for this process is:



Notice that converting the bicarbonate ion into CO_2 also removes an H^+ from the blood. The faster a person breathes (such as during hyperventilation), the faster this chemical reaction occurs, and therefore the more H^+ is removed from the blood. Removing H^+ from the blood (or any liquid) will increase that liquid's pH.

18) Alkalosis is blood that is more basic than normal blood. The normal pH range of blood is 7.35 – 7.45, so alkalosis means blood above pH 7.45. Acidosis is blood that is more acidic than normal blood. The normal pH range of blood is 7.35 – 7.45, so acidosis means blood below pH 7.35.

19) In asthma, the conducting passages (especially the bronchi and trachea) are inflamed and swollen. In emphysema, the alveoli in the lungs are damaged.