

1. Explain what happens to respiration when CO<sub>2</sub> and other sources of acids buildup in your bloodstream and why.  
**First off, as these accumulate - they lower the blood's pH which left unchecked will lead to acidosis. The body compensates by causing you to breathe more deeply and more rapidly. This 'blows off' more carbon dioxide and will decrease the amount of carbonic acid which will bring your blood pH back to normal.**
2. Explain what happens to respiration when alkaline/basic compounds buildup in the bloodstream and why.  
**As these accumulate - they raise the blood's pH which left unchecked will lead to alkalosis. The body compensates by causing breathing to slow down and breaths to become more shallow. This 'blows off' less carbon dioxide which will, in turn, increase the amount of carbonic acid which will then lower the pH bringing your blood pH back to normal.**
3. What is the difference between hyperventilation and hypoventilation?  
**Hyperventilation is very fast, deep breathing whereas hypoventilation is extremely slow or shallow breathing. These two terms also apply to the scenarios in questions 1 and 2 above.**
4. What is apnea? What usually causes it?  
**Apnea is the cessation (stopping) of breathing, sometimes to allow carbon dioxide to build back up in the blood after a period of hyperventilation. It is often caused by high anxiety attacks.**
5. Explain what cyanosis is and some of the effects of cyanosis.  
**Cyanosis is a bluish color to the skin because of the insufficient oxygen levels in the blood. It can be the result of periods of extended apnea. It can cause a person to start hyperventilating and later become dizzy or even faint because the alkalosis triggers the cerebral (brain) blood vessels to constrict, cutting off blood flow to the cerebrum.**
6. Why do they have people who are hyperventilating breathe into a paper bag?  
**If a person is hyperventilating, they usually are in a state of alkalosis because they are ventilating off too much carbon dioxide and blood pH rises. When a person breathes in a paper bag, they are breathing in the carbon dioxide they exhaled already which will diffuse back into the blood causing the formation of carbonic acid thus lowering blood pH again to the normal range. This will then cause the person to breathe slower and more shallower reversing the hyperventilation.**
7. Why is the respiratory system so vulnerable to infection?  
**It is open to many airborne pathogens (flu, cold viruses, fungal spores, etc.)**
8. What does COPD stand for? Chronic Obstructive Pulmonary Disorder
9. Using figure 13.14, distinguish between chronic bronchitis and emphysema.  
**Chronic bronchitis is continual bronchial irritation and inflammation which can, in turn, lead to excessive mucus production, a chronic but productive cough, and bronchospasm (narrowing of the air passages). Emphysema is a condition caused by the breakdown of the protein called elastin in the lungs which will lead to a destruction of the alveolar walls (making diffusion almost impossible), lung fibrosis (hardening of lung tissue and loss of elasticity), and air trapping inside the lungs overall.**

10. Both chronic bronchitis and emphysema make the effects of COPD much worse and can lead to death and disability for many Americans. What are the four features that most COPD disorders have in common with each other?
- Patients almost always have a history of smoking**
  - Dyspnea or “air hunger” occurs and becomes progressively worse.**
  - Coughing and frequent pulmonary (lung) infections are common**
  - Most COPD patients are hypoxic, retain CO<sub>2</sub>, and have respiratory acidosis which can lead to respiratory failure overall.**
11. What is dyspnea?  
**It is difficult or labored breathing; aka “air hunger”**
12. What happens to a person when they have emphysema? What do we call people with this disease?  
**We call people with emphysema “pink puffers” because air is retained in lungs and oxygen exchange is very efficient. Cyanosis does not usually appear until late in the disease’s progression. People with emphysema experience “barrel-chesting” because air is retained and not exhaled very well. The alveoli enlarge because adjacent chambers break through and the chronic inflammation can lead to lung fibrosis which means the lungs become less elastic and the airways collapse during expiration causing the air flow out of the lungs to become impaired. Consequently, these individuals have to breathe very hard to exhale enough air out of the lungs to survive and are often very exhausted.**
13. What are some of the key symptoms of emphysema?  
**Barrel-Chests, fatigue, very labored expirations, air retention in the lungs, and later cyanosis.**
14. What happens to a person when they have chronic bronchitis? What do we call people with this disease?  
**The mucosa (mucus producing tissues) of the lower respiratory passages become significantly inflamed and start producing excessive amounts of mucus. The accumulating mucus impairs normal ventilation and gas exchange but also increases the risk for infection, including severe ones like pneumonia. These individuals are often called “blue bloaters” because hypoxia (low blood oxygen) and carbon dioxide retention occur leading to cyanosis (blue skin color).**
15. What are some of the key symptoms of chronic bronchitis?  
**Chronic, productive cough; fatigue, hypoxia (insufficient oxygen level), airway obstruction, dyspnea, and frequent infection.**
16. What fraction of cancer deaths can be attributed to lung cancer alone? 1/3
17. Most lung cancers are strongly associated with cigarette smoking.
18. Why are most lung cancers notoriously hard to treat?  
**This is because most people with lung cancer die within 1 year of the initial diagnosis which does not allow for much time for proper treatment; furthermore, lung cancer metastasizes (spreads) very rapidly and widely to many other parts of the body. Finally, most cases are not diagnosed until the disease is very advanced.**
19. What is metastasis?  
**Metastasis is when malignant cancer spread to other tissues or other areas of the body that were not initially affected in the early stages of the disease. aka - cancer spreading.**

20. Explain why smokers are at a greater risk of cancer overall. See 2<sup>nd</sup> paragraph on page 405. Be specific. **The nicotine paralyzes the ‘cleansing devices’ of the respiratory system (nasal hairs, mucosa, and the cilia) and depresses the lung macrophages (white blood cells) which does not allow them to remove foreign particles from the lungs or fight infection in the respiratory system. This leads to mucus build-up, frequent infections, and a chronic cough. However, the biggest reason is the many irritation chemicals found in the cigarettes as well like formaldehyde, tar, and other free radicals and carcinogens that interfere with normal cell division of the mucosa eventually developing into lung cancer.**
21. What are the three most common types of lung cancer? Briefly describe each.
- Squamous cell carcinoma – usually 30-32% of lung cancer cases; arises in the epithelium of larger bronchi and forms masses (tumors) that hollow-out and bleed frequently.**
  - Adenocarcinoma – usually 33-35% of lung cancer cases; it originates in the lung periphery as solid nodules that develop from bronchial glands and alveolar cells.**
  - Small cell or Oat cell carcinoma – usually 20-25% of lung cancer cases; this cancer consists of lymphocyte-like cells that originate in the primary bronchi and grow aggressively in cords or small, grapelike clusters within the mediastinum (membrane that separates the two lungs).**
22. What is the most effective treatment for lung cancers, in general?  
**The most effective treatment is the complete removal of the diseased lung or lung lobe.**
23. Why is the treatment option in the previous question not often feasible for most lung cancer patients?  
**It is often not feasible because most lung cancers spread too aggressively and too fast to other areas of the body before diagnosis. Most of these other areas are places where organ removal is not possible.**
24. Explain the importance of the molecule surfactant in maintaining respiratory health both in recent newborns and adults.  
**Surfactant is a fatty, lipid-based molecule produced by the cuboidal alveolar cells that decreases the surface tension of the thin film of water coating the inside of each alveolar sac to prevent the alveoli from collapsing in between each breath. Surfactant does not develop in sufficient amounts in a fetus until late in pregnancy (28-30 weeks). See question below.**
25. What is infant respiratory distress syndrome and what causes it?  
**It is when infants are born premature (before week 28) and have inadequate surfactant production. They experience dyspnea (difficult or labored breathing) and have to use a tremendous amount of energy trying to re-inflate the alveoli which collapse after each breath. Fortunately, with new medicines and equipment, these infants are surviving at larger rates than in years past.**
26. What is cystic fibrosis? What type of disorder is it?  
**Cystic fibrosis is a genetic disorder and is the most common, lethal genetic disorder. It is the result of a faulty gene that causes the CFTR protein to not be produced. This protein works as a chloride channel for cells. Because it is not present, chloride and water do not flow normally resulting in the build-up of a heavy thick mucus. This over-production of thick mucus occurs both in the respiratory and digestive tracts in humans and puts the person at risk for fatal respiratory infections and impairs food digestion.**

27. What are the major symptoms of cystic fibrosis?

**An extremely salty perspiration from sweat glands, impaired food digestion because pancreatic ducts are clogged and cannot deliver enzymes to small intestine, and a thick build-up of mucus in the lungs which significantly obstructs air flow in and out of lungs causing hypoxia. These people also have to cough a lot to try and remove thick mucus.**

28. At what age do humans experience the highest respiratory rate? What is the respiratory rate at this age?

**Humans have the highest respiratory rate as newborn infants with about 40-80 respirations per minute. It continues to decrease throughout life.**

29. What is normal respiration rate in the average adult?

**The normal respiration rate in adults is 12-18 respirations per minute.**

30. Why is more detrimental to teens to start smoking early on in life as opposed to starting as an adult?

**Since the lungs continue to mature throughout childhood and more alveoli are formed until young adulthood, smoking as a teenager prevents the lungs from completely maturing, and the potential alveoli that would have formed are lost forever.**

31. What is Sudden Infant Death Syndrome (SIDS)? What appears to be the major underlying cause of this?

**Sudden Infant Death Syndrome (SIDS) is a phenomenon in which an infant that appears to be healthy stops breathing and dies during sleep. The major underlying cause in more than 1/3 of SIDS cases appears to be a heart rhythm abnormality, although some cases may result from problems with respiratory neural control centers in the brain.**

32. What is asthma and what causes it in most individuals? What are the major symptoms?

**Asthma is a disease or allergic response characterized by bronchial spasms, difficult breathing, dyspnea, coughing, and wheezing due to chronically inflamed, hypersensitive bronchial passages that respond to irritants such as dust, dog dander, and fungi.**

33. What two major respiratory disorders were major killers in early American history? What treatment reduced the risk of these diseases by a large extent?

**Tuberculosis and pneumonia were the major killers in early American history. Treatment with antibiotics has decreased their lethal threat, but they are still dangerous.**

34. List/explain what often happens to our respiratory system as we age.

- **Chest wall becomes more rigid, lungs lose elasticity, decreased ability to ventilate the lungs**
- **Vital capacity decreases by 1/3 by age 70**
- **Blood oxygen levels decrease**
- **Sensitivity to changes in carbon dioxide levels decrease, especially in a reclined position**
- **Hypoxia and apnea are common during sleep**
- **Ciliary action of the mucosa decreases**
- **Phagocytes in lungs become sluggish, risk for respiratory tract infections increases, especially pneumonia and influenza**