1. List, in sequence, the functional events of respiration.

   Movement of air into lungs via ventilation to areas of gas exchange (alveoli)
   O2 diffuses from alveolar space into pulmonary capillaries
   O2 transported in blood to tissues of the body, and diffuses into cells
   CO2 diffuses from tissues to hemoglobin in blood
   CO2 diffuses from blood to alveolar space, and is exhaled

2. Identify the changes in pleural pressure, alveolar pressure, transpulmonary pressure, and lung volume during inspiration and expiration. Discuss how pleural pressure, alveolar pressure, and transpulmonary pressure contribute to the movement of air into and out of the lungs.

   ...

3. Describe the relationship between pleural pressure, lung volume, lung compliance, airflow rate and airway resistance.

   ...

4. List the conduction pathways present in the lungs, and describe the relevant features (tissue layers, etc).

   ...

5. Describe the relationship between pressure, flow rate, and resistance in the form of an equation (an analog of Ohm’s Law).

   \[ \text{Flow rate} = \frac{\text{Pressure difference}}{\text{Airflow resistance}} \]

6. Describe the equation that drives gas exchange in the alveoli.

   ...

7. Define laminar flow and turbulent flow.
Turbulent flow: Re # > 4000. Chaotic flow, high rates of convection, high degree of mixing. (Non-parabolic velocity profile in a pipe flow, etc.)
Laminar flow: Re # < 2300. Fluid flows in parallel ‘layers’; parabolic velocity profile; no mixing, low convection coefficient.

\( Re = \frac{\rho V D}{\mu} \)

8. Describe the differences in cross-sectional area, velocity of airflow, resistance to airflow, and airflow patterns throughout the respiratory system.

Upper airways (trachea, bronchi): characterized by large diameter, high flow rates, low resistance -> turbulent flow

Lower airways (bronchioles, alveolar ducts, alveoli): small diameter, low flow rates, higher resistance -> laminar flow

9. If given a data set that measures the instantaneous velocity of airflow through a chamber, what manipulations are necessary to convert these data to measure volume?

Velocity data can be numerically integrated to obtain a volumetric trace of inhalation/exhalation.

10. Describe the mode of gas exchange between the alveoli to RBCs. Include the tissue layers that the exchange occurs across, in order from the alveolar space to hemoglobin molecules.

11. Define sensitivity and dynamic range for measurement devices.

Sensitivity describes the ability of a device to distinguish between different states of a system. Dynamic range is the range of states of the system over which the device remains accurate/sensitive.

12. How does the nervous system exert control over the respiratory system? That is, what regions of the brain/CNS are responsible for this control, and what do they stimulate/regulate?
13. Explain the integration of regulatory mechanisms involved in the ventilation response to exercise.

14. {Draw a normal spirogram labeling the four lung volumes and four capacities. List the volumes that comprise each of the four capacities.}

15. Define compliance (lung and chest wall). Describe how clinical conditions such as fibrosis and emphysema affect the compliance properties of the lung.

16. Define and contrast the following terms: alveolar ventilation, dead space air, anatomic dead space, alveolar dead space, and physiologic dead space.

17. Define partial pressure and fractional concentration as they apply to gases. List typical values for oxygen, carbon dioxide, and nitrogen gases in atmospheric air.

18. Compare and contrast atmospheric air, humidified air, alveolar air and expired air with respect to gas content and water content.


20. Define oxygen content, oxygen capacity, and oxygen saturation. How do these terms pertain to the blood?

21. Define P50. Know how P50 varies among species. (...and tissue layers to aid in oxygen transport.)