Key

Exam 3 Review Worksheet

Cardiovascular

1) What are the two divisions of the circulatory system? What does each one do?

Systematic: Exchange between heart and tissues

Pulmonary: Exchange between heart and lungs

2) What are the two vascular systems?

Lymph & Blood

3) What are the types of blood vessels, and what are the characteristics/functions of each?

Arteries
- Oxygenated blood AWAY from heart
- High pressure, elastin, muscular walls
- Continous blood flow & no valves

Veins
- Deoxygenated blood TOWARD heart
- Lower pressure & less elastin
- Valves (prevent backflow)

Capillaries
- Connect arteries and veins
- one cell thick
- low pressure & no valves

4) Explain how electrical conduction works in the heart.

a. Sinoatrial (SA) node
- *Origin of impulse
- Located in the right atrium
- Atrial contraction

b. Atrioventricular (AV) node
- Receives impulse from SA node
- *Sends impulse to Purkinjie fibers & bundle of His

c. Purkinjie fiber
- *Sends Impulse to ventricular myocardium

d. Bundle of His
- *Sends Impulse to apical ends of L&R ventricles

5) What are the four valves in the heart, what do they separate, and which type of value are they (AV/SL valve)?

AV
- Tricuspid (R) → Right Atrium & Right Ventricle
- Mitral (L) → Left Atrium & Left Ventricle

SL
- Pulmonary (R) → Right Ventricle & Pulmonary Arteries
- Aortic (L) → Left Ventricle & Aorta

6) What are the layers of the heart? Layers of the outer layer?

Superficial → Deep

- *Pericardium
  - Fibrous Pericardium
  - Parietal Serous Pericardium
  - Space
  - Visceral Serous Pericardium (Epicardium)
- *Myocardium (Heart Muscle)
- *Endocardium (inner endothelial lining)

Deep

7) What is the equation for cardiac output?

$Q = SV \times HR$ ← Heart Rate

Cardiac Output ↑ Stroke Volume

8) How can the cardiac output be increased?

- ↑SV
- ↑HR
- ↑SV & ↑HR

9) What is the Frank Starling Relationship?

Relationship between stroke volume and contraction strength [Direct]

Positive Intropic Effect

- ↑strength of contraction & ↑SV
  - ↳Sympathetic Nervous System
  - ↳ Digoxin

Negative Intropic Effect

- ↓strength of contraction & ↓SV
  - ↳ β-Blockers

10) Blood is a type of connective tissue. What are the functions of blood?

- Transport
- Body Defense
- Fluid balance & pH

11) What makes blood red?

Hemoglobin

↳ Oxygenated Red Blood Cells

12) Blood is about 9-10% of our body weight. What are the four components of blood?

- Plasma
- RBC
- WBC
- Platelets

13) What is plasma composed of?

- 92% water
- 6% protein
- Dissolved substances

Pulmonary Anatomy

1) Cells continually use O_2 and release CO_2. The respiratory system is in charge of gas exchange. Gasses are transported in the blood which is part of the cardiovascular system. Failure of either system leads to rapid cell death from O2 starvation.

2) What are the two sections of the respiratory system and what are the structures in each part?

Upper (Above Vocal Cords)
Nostrils → Pharynx → Larynx

Lower (Below Vocal Cords)
Larynx → Trachea → Bronchi → Lungs

3) What are the external nasal structures?
- Skin
- Nasal Bones
- Cartilage lined with mucos membrane
- Nares (Nostrils)

4) What are the internal nasal structures?
- Roof = Ethmoid
- Floor = Hard Palate
- Internal nares (choane) = openings to the pharynx
- Nasal Septum

5) What are the functions of the nasal structures (olfactory epithelium, pseudostratified ciliated columnar with goblet cells, and paranasal sinuses)?

↳ smell

↳ Warms air (highly vascular)
- Mucous moistens air & traps dust
- Cilia moves mucous towards pharynx

- Found in the maxilla
- Lightens the skull
- Resonates the voice

6) What are the three regions of the pharynx?

Nasopharynx ↳ Near the nose

Oropharynx ↳ Near the mouth

Laryngopharynx ↳ Near the larynx

7) What are the functions of the pharynx?
- Passage way for both food and air
- Resonating chamber for sound production
- Tonsils in the walls protect the entryway to the body

8) What tissue types make up the pharynx?

Skeletal Tissue & Mucous Membranes

9) What are the 5 cartilages found in the larynx?

① Thyroid Cartilage

② Epiglottis

③ Cricoid Cartilage

④&⑤ (Pair of) Arytenoid Cartilage

10) What is the function of the epiglottis?

- Moves upward when swallowing to prevent food/water from entering the lungs
- Bends to cover the glottis

11) What do the vocal cords attach to?

Arytenoid Cartilage

12) What are the 3 layers of the trachea? What cells/tissues are associated with each one?

Mucosa
- Psudeostratified columnar with cilia and goblet cells

Submucosa
- Loose connective tissue & seromucous glands

Hyaline Cartilage
- Incomplete rings
- Allows for flexibility while staying open

13) What is the bronchial tree in order?

Trachea → Primary Bronchi → Secondary Bronchi → Tertiary Bronchi → Bronchioles → Terminal Bronchioles

14) What type of tissue is the bronchial tree made of?

Cartilage

15) Epithelium changes from psudeostratified ciliated columnar cells to non-ciliated simple cuboidal cells as pass deeper into lungs.

16) The trachea has incomplete rings of cartilage that are replaced by rings of smooth muscle and connective tissue as we follow the bronchial tree deeper into the lungs. The sympathetic NS and adrenal

glands release epinephrine that relaxes the smooth muscle, resulting in dilation of the airways.

17) What are the pleural cavity, visceral pleura, and parietal pleura?

Space between ribs and lungs

Membrane covering the lungs

Membrane that lines and covers the upper surface of the diaphragm

18) How many lobes does each lung have? Why?

Right: 3

Left: 2 ← Space for the heart

19) Why do capillaries wrap around the alveolar sacs?

gases are exchanged between the blood supply and air in the alveolar sacs

20) The alveolar membrane is very thin, this allows for gas exchange.

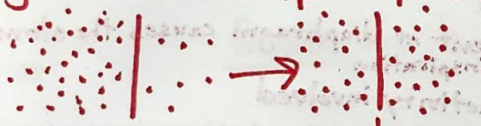
Inside the alveoli there are monocytes and macrophages.

21) What is a concentration gradient?

Spectrum of most concentrated area to area least concentrated with molecules

22) How do concentration gradients work?

high concentrations/partial pressure → low concentrations/partial pressure



23) Respiration is gas exchange.

Pulmonary Physiology

1) Diffusion is the process of moving down the concentration gradient.

2) Define

a. Pulmonary Respiration

Exchange of O_2 & CO_2 between pulmonary circulation and outside air

b. Pulmonary Ventilation

Air moves into lungs when pressure inside lungs is less than atmospheric pressure

c. Cellular Respiration

Exchange of O_2 & CO_2 between a cell and its environment

3) Compare and contrast the amounts of O_2, CO_2, and N_2 in air, alveolar air, and expired air.

Most: Air

Most: Alveolar Air

Same in all 3

Least: Alveolar Air

Least: Air

4) Inspiration is a(n) active process. As the ribs are lifted by the intercostal muscle, the diagram contracts and intrathoracic pressure falls. Expiration is a(n) passive process. The is no muscle action. Air is pushed out as alveolar pressure increases.

5) Labored breathing is a(n) active process. It involves forced expiration and forced inspiration.

6) Define

a. Tidal volume: Amount of air moved during quiet (normal) breathing

b. Minute Ventilation Rate: (MVR) Amount of air moved in one minute

c. Reserve Volume: Amount you can breathe in or out above the tidal volume

d. Residual Volume: Air permanetly trapped in the system (amount)

e. Eupnea: Normal 'quiet' breathing

f. Apnea: Temporary cessation of breathing

g. Dyspnea: Difficult or labored breathing

h. Tachypnea: Rapid breathing

i. Diaphragmatic Breathing: Descent of diaphragm causes the stomach to bulge during ~~respiration~~ inspiration

j. Costal Breathing: Just rib activity involved

7) What is Boyle's Law? ($P_1V_1 = P_2V_2$)

• In closed container: ↓space → ↑Pressure OR ↑space → ↓Pressure

8) What is Henry's Law?

~~Boyle's~~ Amount of gas that will disolve depends on the amount of gas present and its solubility coefficient

↳ willingness/ability to dissolve

9) What is Dalton's Law?

Each gas in a gas mixture will apply its own pressure on the container

($P_T = P_1 + P_2 + P_3 + P_4 + \ldots$)

10) What is the Bohr effect?

↑acidity (↓pH) → ↓O_2 affinity for hemoglobin

11) What are the three ways that CO_2 is transported?

1) Dissolved in plasma

2) In the globin part of hemoglobin (carbaminohemoglobin)

3) Part of the bicarbonate ion
↳ $CO_2 + H_2O \rightarrow H^+ + HCO_3^-$

12) What is the external respiration?

↳ Pulmonary respiration

* Exchange of gas between air & blood (breathing)
* Deoxygenated blood becomes saturated
* Gasses diffuse from high partial pressure to low partial pressure

13) What is ~~cellular~~ internal respiration?

↳ cellular respiration

* Exchange of gases between blood and tissues (oxygenated to deoxygenated)
* Diffusion of O_2 inwards
  - More O_2 absorbed during exercise than rest

14) How does the nervous system control the respiratory system?

Pons & Medulla Oblongata
- Central chemoreceptors [CNS]
  ↳ Respond to changes in H^+ and/or pCO_2

Cardiac
- Peripheral chemoreceptors [PNS]
  ↳ Respond to changes in H^+, pO_2, or pCO_2
  - Aortic Body (Aorta Walls)
    → Nerves join vagus
  - Carotid Body (Common Cartoid Artery Walls)
    → Nerves join glossopharyngeal nerve

Respiratory Muscles

Hematology

1) Blood is considered to be a type of connective tissue. Because it...
   1) Derived from Mesenchymal Stem Cell
   2) Highly cellularized
   3) Connects, Protects, & Supports
   4) Vascular
   5) Extracellular Fibers
   6) Ground substance (plasma)

2) What are the functions of blood?
   1) Transportation & distribution
   2) Assists in maintenance of body temp & pH
   3) Prevention of excessive blood loss (platelets)
   4) Immune defense (WBC)

3) What are the components of blood?

   Cells
   - Erythrocytes
   - Leukocytes
   - Platelets

   Plasma
   - Fluid component
   - Suspension of cells & other substances

4) The normal pH of blood is 7.35 - 7.45. A higher or lower pH can lead to death.
   The acidity of blood found in veins is higher than the pH of blood in arteries

because dissolved CO_2 forms carbonic acid. pH buffers help to maintain a neutral pH by not allowing excessive hydrogen (H^+) or hydroxyl (OH^-) ions to accumulate. The lungs helps maintain pH by removing CO_2 and the kidneys help through the excretion of H+ in the form of NH+. pH that is too low is called acidosis while a pH that is too high is called alkalosis.

5) What bones contain high concentration of red bone marrow?

Axial Skeleton — Femurs — Pelvis

- Skull
- ~~Vertebrae~~ Vertebral Colum
- Sternum
- Ribs

6) What does red bone narrow produce?

Blood

7) What is hemostasis? → constant process

Blood ↵

*Homeostasis in the blood

8) What cell turns into blood cells?

Hematopoietic Stem Cells

- Erythropoiesis
- Leukopoiesis
- Thrombopoiesis

9) Erythropoiesis is Red Blood Cell formation

10) Leukopoiesis is White Blood cell formation

11) Thrombopoiesis is Platelet formation

12) The most plentiful type of blood cell is the RBC. The main function if this type of blood cell is to oxygenate tissues (hemoglobin) and remove CO_2 from tissues

13) The primary intracellular component in RBCs is hemoglobin. It is composed of four amino acid groups and a heme group. The heme group contains iron. Why is iron important to the function of RBCs?

- Binds to O_2 to carry it to tissues
- Without iron: Anemia
  - Hemoglobin can't be made
  - RBC count decreases

14) What is hemoglobin bound to O2 and CO2 called?

Oxyhemoglobin ↙ ↘ Carbaminohemoglobin

15) 1 % of blood cells are removed daily. Senescence is the process of aging. The spleen is a non-vital organ that removes RBCs from circulation using macrophages. RBCs are broken down into amino acids, iron, and heme. Where do each of these products go?

- Back to red bone marrow
  - ↳ recycled during erythropoiesis
- Broken down
- Back to the liver
  - ↳ Makes more protein

16) Where do extravascular and intravascular hemolysis occur?

Outside of the vascular system (spleen) ↳ Inside the vascular system

17) What is thrombopoietin and what does it do?

- Hormone produced by the liver
  - ↳ Regulates number of platelets in circulation

18) How do thrombin, fibrinogen, and fibrin work together to form a blood clot?

Thrombin converts ~~fibrin~~ fibrinogen into fibrin to form a blood clot

19) [redacted] dissolves the clot after a blood vessel has healed.

↑ Fibrinolysis

20) Leukocytes are generally larger than RBCs and have a role in immune function. There are two types of them granulocytes and agranulocytes. What are two characteristics of each type?

- granulocytes
  - Contains granules
  - Innate Immunity
- agranulocytes
  - Mononuclear
  - Adaptive Immunity

21) There are 5 types of leukocytes. What do they look like, what type of immunity is it associated with, and what is important to know about each one?

a. Neutrophils [Granulocyte] → Mostly transparent with highly visible, multisegmented nucleus
- Innate immunity
- Phagocytosis
  - ↳ Degraded during immune response [pus]
- Primary Granulocyte (largest number)

b. Basophils [Granulocyte] → Dark blue or purple granules with barely visible nucleus
- Innate immunity
- Found during allergic responses (indicator of inflamation)
  - ↳ Modulate inflammation
  - ↳ Histamine (vasodialation) → increases bloodflow & fluid production
  - ↳ Heparin (blood thinner) → faster, more efficient blood flow
- Not normally found in high quantities

c. Eosinophils [Granulocyte] → Pink or Red granules with visible nucleus
- Innate immunity
- Found during allergy responses (inflamatory response)
  - ↳ Parasites (increase in number of eosinophils = parasite/allergic response)
- Not Normally found in large quantities

d. Monocytes [Agranulocyte] → Kidney bean shaped nucleus with no granules (Largest WBC)
- Phagocytosis of foregin substances and dead (or dying) cells
- Innate Immunity
- Monocyte v. Macrophage [Monocyte = baby macrophage]
  - Monocyte → Found in circulation (blood stream)
  - Macrophage → Resident to lymphoid tissues (spleen, kidneys, tonsils, lungs, etc.)

e. Lymphocytes [Agranulocyte] → Very large, round nucleus with a halo of cytoplasam
- Cellular & Humoral Immunity
- ONLY Adaptive RBC
- Part of the "memory response"
- 3 types:
  1) B-cells
  2) T-cells
  3) NK-cells

Lymphatics

1) Compare innate and adaptive immunity.

Born with it
- Genetic
- Passed from mother during gestation
- 1st line of defense
- Phagocytosis
- ★ Quick response

Develops over time
- Cells "learn" how to fight off antigens thru exposure
- ★ Slow response

2) What are the functions of the lymphatic system?

1) Removal of excess tissue fluid (plasma)
2) Waste material transport
3) Filtration of Lymph
4) Protein [& enzyme] transport

3) Lymph is fluid carried by the lymphatic system. It is a transparent fluid that primarily contains lymphocytes. What other parts of blood are found in lymph?

More than in blood
- Water
- Sugar
- Electrolytes

Less than in blood
- Large proteins
  - ↳ albumin
  - ↳ globulin
  - ↳ fibrinogen

& plasma

4) What is lymph composed of?

- Water
- Sugar
- Electrolytes
- Lymphocytes
- Plasma
- Nutrients
- Hormones
- few large proteins
  - ↳ albumin
  - ↳ globulin
  - ↳ fibrinogen

5) What tissues/organs/cells are associated with the lymphatics system?

- Lymph Nodes
- Lymphatic Vessels
- Spleen
- Thymus
- Mucous Associated Lymphoid Tissue (MALT)
  - Tonsils
  - Peyer's Patches
  - Appendix (rabbit)
- Lymphocytes
  - T cells, B cells, & NK cells

6) Lymph Nodes drain fluid from a specific area. This means that lymph form specific areas will ALWAYS pass thru the same nodes. As lymph passes thru lymph nodes, macrophages will remove microorganisms or foreign matter.

7) Lymph enters thru the afferent vessel and exits through the efferent vessel. Cortex (↳ Outside) is the site of lymphocyte (nodules). Medulla (↳ Inside) contains macrophages embedded in dense mesh (scaffolding).

8) The spleen is located near the stomach or rumen (ruminants). It is also associated with the external hemolysis process of red blood cells. The spleen is NOT essential for life. It is the largest lymphoid organ. The spleen is covered with a protective fibrous CT capsule and is made of smooth muscle.

9) The spleen contains red and white pulp. What do they do and what system is each associated with?

White Pulp (Immune Component)
- Lymphoid tissue
- Site of lymphocytes which clone themselves during an immune response

Red Pulp (Hematology Component)
- Blood vessels
- Blood storage space
- Macrophages

10) What does the thymus do? Which cells are produced? → T cells
- Shrinks with age
- Helps kickstart the adaptive immune system in young animals

11) What do the tonsils do? What do they contain? → Mature lymphocytes
- Prevent spread of infection into the respiratory or digestive tract
- Lacks protective capsule

12) The three lymphatic cells are T cells, B cells, and NK cells. T cells circulate back and forth between lymph and blood. B cells are mainly found in lymph. NK cells are classified as both innate and adaptive immunity. B cells differentiate from stem cells found in adult red bone marrow. T cells differentiate from stem cells in the thymus.

13) T cells are the majority of lymphocytes found in peripheral blood circulation. Where are they produced? Where are they stored?

Thymus → Lymph Nodes

14) What do T cells do?

- Launch the adaptive immune response
  - ↳ (immune response specific to an infectious agent)
- Cell-mediated immunity activators
  - ↳ (do not interact with antigens directly)

15) What are the 3 types of T cells and what do they do?

- Cytotoxic "killer" T cells: Attach to antigen complex & destroy them
  - ↳ Aren't destroyed themselves
- Helper T cells: Most numerous, secrete cytokines (cell signaling proteins) to activate macrophages [specific ones for specific products]
- Suppressor T cells: Regulate production of T&B cells by negative feedback

16) B cells are produced in red bone marrow. Where are inactive B cells found?

- Circulating in lymphatic system
- Lymph Nodes
- Spleen

17) What do B cells do?

Produce anti-bodies to help fight

- Bacteria
- Fungi
- Viruses
- other pathogens

★ Antibodies are specific

18) NK cells are stimulated by cytokines. What do NK cells do?

Identify & kill

- Viruses
- Stressed cells
- Tumor cells

19) How does apoptosis induced by NK cells work?

↳ programmed cell death

★ No lysis in viruses
↳ Why?
↳ [redacted] Virions

- Release perforins and protedytic enzymes
  - perforins → creates tiny holes
  - protedytic enzymes → break down proteins

20) How does a memory response work?

- Both B cells and T cells can become memory cells
- Antigens induce an immune response in the body
- Memory cells wait in circulating blood or lymph nodes & wait for a second infection caused by the same antigen that initially caused their formation

* Secondary response is faster and uses more force

→ Lifespan of memory cell = days to years

21) What are different ways to develop passive and active immunity?

(Innate) ↓

Colostrum: Antibody rich first milk

Plasma Transplant: Immunoglobulins

(Adaptive) →

Vaccines: Exposes animal to small amount of an antigen to create a memory immune response