SYSTEMIC PUMP

List the route of one RBC bringing oxygenated blood from the lungs to the left side of the heart, and returning deoxygenated blood to the right side of the heart. Include blood vessels, chambers and valves.

1. ____________________________________________________________________
   ____________________________________________________________________
   ____________________________________________________________________

2. What process causes gas exchange at the tissues? ____________________________

3. The ______________________________ prevent prolapse of the atrioventricular valves.  
   Prolapse on the right side of the heart results in ________________ edema.
   Prolapse on the left side results in ________________ edema.

4. _________________ circulation supplies the heart muscle with O₂ and removes CO₂.

CORONARY CIRCULATION

5. Coronary arteries:

   L coronary artery  ➔ anterior (A) ____________ artery ➔ anterior ventricles and interventricular septum
     ➔ (B) ________________ artery ➔ L atrium and posterior L ventricle

   R coronary artery  ➔ R atrium and R ventricle ➔ posterior (C) ________________ artery ➔ posterior ventricles
     ➔ marginal artery ➔ lateral R heart

6. Coronary veins:

   (A) ____________ vein (from anterior heart)
   Middle cardiac vein (from posterior heart)
   Small cardiac vein (from lateral heart)
   Anterior cardiac veins (from anterior heart) ➔ (B) ____________ ➔ R atrium

7. ___________________________ is due to buildup of plaque in coronary arteries.
   ___________________________ is due to hardening and thickening of the coronary arteries.

8. An elevated level of the amino acid, ____________________________, can lead to cardiovascular disease.
   Lining of arteries inflamed ➔ ________________ ➔ ________________ ➔ ________________
   Name 3 important vitamins that decrease homocysteine levels. ___________________________
9. _______________ are molecules with unpaired electrons that damage cells.

Name some antioxidants that will decrease these molecules. ________________________

CARDIAC CONDUCTION SYSTEM

10. The myocardium contains _______________ cells that are self-excitable, and
depolarize spontaneously without stimulation from a neuron.

The _______________ is the pacemaker of the heart, and is located in the ________ .

11. List the 5 components of the conduction system.

_________________ → ___________________ → ________________________________ →
_________________ → ______________________

12. What happens when the electrical activity reaches the AV node? _________________

Why is there a slight delay at the AV node? _________________________________

13. What happens when the electrical activity reaches the Purkinje fibers? _________________

14. The parasympathetic nervous system _______________ heart rate.

The sympathetic nervous system _______________ heart rate.

ABNORMAL HEART FUNCTION

15. Define bradycardia ______________________________________________________

Define tachycardia ______________________________________________________

16. Define fibrillation. ______________________________________________________

What happens to blood flow during ventricular fibrillation? _________________________

17. Define heart block. ______________________________________________________

1st degree heart block ______________________________________________________

2nd degree ________________________________________________________________

3rd degree ________________________________________________________________

What happens to the size of the heart and thickness of the heart walls?

18. Name 3 things that can cause heart failure. ________________________________
19. Define these terms and explain how they affect heart function.

Hypercalcemia

Hypocalcemia

Hypercapnia

Hyperkalemia

Hypokalemia

20. Define endocarditis

21. Define cardiomyopathy

22. List risk factors for a myocardial infarction.

EKG

23. What is the function of an EKG?

24. Summarize EKG and activity in heart

<table>
<thead>
<tr>
<th>Movement of ions (depolarization &amp; repolarization of chambers)</th>
<th>P WAVE</th>
<th>QRS COMPLEX</th>
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<tbody>
<tr>
<td>Electrical activity (conduction system)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical activity in heart (systole/contraction &amp; diastole/relaxation of chambers)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Pressure in chambers (increased or decreased in chambers)</td>
<td></td>
<td></td>
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</table>

EVENTS IN CARDIAC ACTION POTENTIALS

25. Depolarization is _______ (fast or slow). _______ ions are moving into cells.

26. Plateau is _______ (fast or slow). _______ ions are moving into cells.

27. Repolarization is _______ (fast or slow). _______ ions are moving out of cells.
REFRACTORY PERIODS
28. During the ______________ refractory period, the cells cannot respond to another stimulus, and another action potential cannot occur.
   During the ______________ refractory period, the cells will respond to a stronger stimulus, and an action potential can occur.

PHASES OF CARDIAC CYCLE
29. The cardiac cycle is everything that happens during _________________.
30. Indicate stages (systole or diastole) and chambers.
   _______________ → _______________ → _______________ → 
   _______________ → all chambers relaxed

31. Indicate when the valves are open or closed.

<table>
<thead>
<tr>
<th></th>
<th>ATRIOVENTRICULAR VALVES</th>
<th>SEMILUNAR VALVES</th>
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<td>Ventricular filling</td>
<td></td>
<td></td>
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<tr>
<td>Isovolumetric contraction</td>
<td></td>
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</tr>
<tr>
<td>Ventricular ejection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isovolumetric relaxation</td>
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</table>

32. ______________ pressure occurs in the ventricles when the valves are closed and the ventricles are contracting, but there is not enough pressure to open the semilunar valves.

33. Define these terms related to cardiac output.
   Cardiac output_______________________________________________________
   Heart rate__________________________________________________________
   Stroke volume_______________________________________________________
   End diastolic volume_________________________________________________
   End systolic volume__________________________________________________

34. Give the equation for calculating cardiac output________________________________________

35. Define preload _________________________________________________________
   How does the EDV affect preload? _________________________________________
   How does this affect the force of contraction? ____________________________
   How does this affect SV? _______________________________________________
   What law defines this relationship? ______________________________________
36. Define afterload. ________________________________________________________

How does this affect stroke volume? _________________________________________

How does this affect ESV? ________________________________________________

How does this affect SV? _________________________________________________

37. Give the equation showing the relationship between SV, EDV, ESV. __________

38. List some factors that affect CO. __________________________________________

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
1. right and left pulmonary veins → left atrium → through bicuspid (mitral) valve →
   left ventricle → aortic semilunar valve → aorta → aortic arch and descending aorta →
   body tissues (gas exchange) → superior and inferior vena cava → right atrium
2. simple diffusion
3. chordae tendineae; pulmonary; systemic
4. coronary
5. (A) interventricular; (B) circumflex; (C) interventricular
6. (A) great cardiac; (B) coronary sinus
7. atherosclerosis; arteriosclerosis
8. homocysteine; thrombosis; embolus; infarct; folic acid, B6 and B12
9. free radicals; vitamins C and D, SOD (superoxide dimetase), CoQ10
10. autorhythmic; sinoatrial node (SA); roof of right atrium
11. sinoatrial node → atrioventricular node → AV bundle (bundle of His) → R and L bundle
   branches → Purkinje fibers
12. atria contract; to allow atria to complete contraction before ventricles contract
13. ventricles contract
14. decreases; increases
15. bradycardia – heart rate slower than normal; tachycardia – heart rate faster than normal
16. fibrillation – cardiac muscle does not contract correctly;
   ventricular fibrillation - blood flow is not adequate to meet needs of body
17. disruption to electrical activity
   1st degree - long PR interval; AV node and AV bundle electrical activity slows; due to infarction
   2nd degree - not enough stimulation of ventricles; ventricle contraction follows every other or
   every third atrial contraction
   3rd degree - complete heart block; atria beat, but ventricles do not get enough stimulation so
   heart rate slows
   heart enlarges and walls get thinner
18. disease of the valves; myocardial infarction; chronic hypertension
19. hypercalcemia - increased calcium; stimulates muscle cells
   hypocalcemia - decreased calcium; weaker heart beat
   hypercapnia - increased carbon dioxide; longer contractions
   hyperkalemia - increased potassium; hyperpolarization
   hypokalemia - decreased potassium; depolarizes too soon, so weaker contractions
20. inflamed lining of heart
21. heart muscle degenerates
22. males - accumulates more plaque due to lack of estrogen;
   males and females - smoking leads to atherosclerosis and arteriosclerosis;
   increased cholesterol due to diet or heredity; diabetes mellitus; chronic stress; obesity;
   genetic predisposition; sedentary lifestyle;
   fat from yellow bone marrow if it leaves the long bones
23. shows electrical activity through the heart
24. summary of EKG and activity in heart

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<td>Ventricular depolarization</td>
<td>Ventricular repolarization</td>
<td></td>
</tr>
<tr>
<td>Electrical activity</td>
<td>SA → AV</td>
<td>AV → Bundle of His → bundle branches → Purkinje</td>
<td></td>
</tr>
<tr>
<td>Physical activity in heart</td>
<td>Atrial systole (contraction)</td>
<td>Ventricular systole (contraction)</td>
<td>Ventricular diastole (relaxation)</td>
</tr>
<tr>
<td>Pressure in chambers</td>
<td>Increased in atria</td>
<td>Increased in ventricles</td>
<td>Decreased in atria</td>
</tr>
</tbody>
</table>

25. fast; sodium
26. slow; calcium
27. fast; potassium
28. absolute; relative
29. one heartbeat
30. atrial systole → atrial diastole → ventricular systole → ventricular diastole → all relaxed

31. atrioventricular valves

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<th>Closed</th>
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<td>Closed</td>
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</table>

32. isovolumetric
33. Cardiac output - amount of blood pumped from both ventricles in one minute
   Heart rate - beats per minute
   Stroke volume - amount of blood pumped by one ventricle during contraction.
   End diastolic volume - amount of blood in ventricles before ventricular contraction (at end of ventricular relaxation)
   End systolic volume - amount of blood in ventricles at end of ventricular contraction
34. \[
   CO (ml/min) = HR (beats/min) \times SV (ml/beat)
   \]
   \[
   CO = 75 \text{ beats} \times 75 \text{ ml} = 5250 \text{ ml/min} = 5.25 \text{ L/min}
   \]
   Total blood volume is approx. 5 L; therefore, under normal conditions, the entire volume of blood is pumped to lungs and body tissues each minute.
35. amount of stretch on heart muscle during ventricular diastole; increased EDV increases preload; greater preload before contraction = stronger contraction; increases SV; Starling's law of the heart
36. pressure from blood in aorta and pulmonary trunk that must be overcome for semilunar valves to open; increased afterload decreases stroke volume; ESV increases; decreases SV
37. \[
   SV = EDV - ESV
   \]
   \[
   SV (avg at rest) = EDV (120 \text{ ml/beat}) - ESV (50 \text{ ml/beat}) = 70 \text{ ml/beat} (60\% \text{ of vent. vol.})
   \]
38. sympathetic NS, epinephrine, norepinephrine, thyroxine increase HR and CO;
   parasympathetic NS decreases HR and CO; increased venous return increases HR and CO;
   increased EDV increases SV and CO; increased ESV decreases SV and CO;
   increased contractility (force of contraction) increases SV and CO