1. What should be the approximate maximum heart rate for a 50 year old female?
   a. impossible to determine
   b. 150 bpm
   c. 50 bpm
   d. 120 bpm
   e. 170 bpm

2. If I am severely dehydrated, my blood ADH concentration will be
   a. high
   b. low
   c. normal

3. Myelin basic protein is being destroyed in
   a. type I diabetes
   b. lupus
   c. multiple sclerosis
   d. myasthenia gravis
   e. rheumatoid arthritis

   For questions 4 - 6, use the following. Each can be used once, more than once, or not at all.
   a. inulin
   b. penicillin
   c. PAH
   d. glucose
   e. Na+

4. This substance should have a clearance of about 1 ml / min.

5. This substance is freely filtered and mostly reabsorbed.

6. This substance is freely filtered and completely reabsorbed.

7. MAP (y or dependent variable) is a constant with respect to % of VO2max (x or independent variable).
   a. true
   b. false

8. B cells are tested for self-tolerance as they mature
   a. in the thymus
   b. in the bone marrow

9. Chief cells secrete H+.
   a. true
   b. false

10. Which GI tract location does NOT directly secrete amylase?
   a. salivary glands
   b. stomach
   c. small intestine

11. Theoretical maximum urine output is about
   a. 1.5 liters / day
   b. 2 liters / day
   c. 5 liters / day
   d. 10 liters / day
   e. 24 liters / day

12. A CD4 cell will have class _____ on its cell membrane.
   a. I
   b. II

13. Which of the following is NOT one of the targets of CCK?
   a. gallbladder
   b. pancreas
   c. CNS
   d. parietal cells

14. Which duct degenerates in females?
   a. Mullerian duct
   b. Wolffian duct

15. Which of the following types of contraception (birth control) is the most effective?
   a. vasectomy
   b. male condom
   c. hormone contraception
   d. IUD
   e. tubal ligation

16. During exercise females typically use less fat as an energy source, despite having higher percent body fat.
   a. true
   b. false

17. Which of the following is NOT part of the internal mechanisms of the innate immune system?
   a. inflammation
   b. MHCs
   c. NK cells
   d. interferon
   e. the complement system
18. The blastocyst will typically implant on day 25 of a 28 day cycle.
   a. true  
   b. false  

19. At what time in a female’s 28 day cycle are estrogens exhibiting positive feedback on the anterior pituitary?
   a. never  
   b. day 2  
   c. day 12  
   d. day 18  
   e. day 22  

20. Maximum sweat production is about
   a. 2 liters / hour  
   b. 3 liters / hour  
   c. 4 liters / hour  
   d. 5 liters / hour  
   e. 6 liters / hour  

21 (3 points each, 24 points total). Briefly define or describe the following words or biological ideas.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>a. inhibit</td>
<td>chemical messenger that inhibits the production of FSH (1 pt). Produced by the granulosa cells in females (1 pt) and by the sertoli cells in males (1 pt)</td>
<td></td>
</tr>
<tr>
<td>b. neutrophils</td>
<td>phagocytes (1 pt); part of the innate immune system (1 pt); most common leukocyte in the blood (1 pt); numbers increase substantially during infection (1 pt)</td>
<td></td>
</tr>
<tr>
<td>c. dialysate</td>
<td>a fluid (1 pt) that is used in dialysis (1 pt) to remove wastes (1 pt) from the body. Blood is one side of a semipermeable membrane, dialysate is on the other side (1 pt)</td>
<td></td>
</tr>
<tr>
<td>d. carboxypeptidase</td>
<td>enzyme that breaks peptide bonds (1 pt), removing terminal amino acids (1 pt; could also mention exopeptidase) from the protein on the carboxyl terminus (1 pt)</td>
<td></td>
</tr>
<tr>
<td>e. epitope</td>
<td>molecule on a antigen that is recognized by an antibody (3 pts)</td>
<td></td>
</tr>
<tr>
<td>f. external urinary (bladder) sphincter</td>
<td>ring of skeletal muscle (1 pt) that is controlled via motor neurons (1 pt) and must be relaxed to permit urination (1 pt)</td>
<td></td>
</tr>
<tr>
<td>g. guanylyl cyclase</td>
<td>enzyme that produces cGMP from GTP (2 pts) in the erection reflex pathway (1 pt)</td>
<td></td>
</tr>
<tr>
<td>h. working heart rate (WHR)</td>
<td>equal to MHR minus RHR (3 pts)</td>
<td></td>
</tr>
</tbody>
</table>
22 (15 points). What are the five types of immunoglobulins? Briefly give one characteristic of each.

<table>
<thead>
<tr>
<th>name of antibody class</th>
<th>one characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 IgG (1 pt)</td>
<td>most common type (2 pts)</td>
</tr>
<tr>
<td>2 IgA (1 pt)</td>
<td>common in external secretion (2 pts)</td>
</tr>
<tr>
<td>3 IgM (1 pt)</td>
<td>very large (2 pts)</td>
</tr>
<tr>
<td>4 IgE (1 pt)</td>
<td>involved in inflammatory responses (2 pts)</td>
</tr>
<tr>
<td>5 IgD (1 pt)</td>
<td>rare (2 pts)</td>
</tr>
</tbody>
</table>

23 (16 points). Suppose that a cellular poison is developed that immediately and irreversibly destroys all Leydig Cells. What would be the consequences of this poison on a male? Make sure you mention the endocrine, reproductive, and sexual effects.

Endocrine:
- No testosterone would be produced (4 pts)
- No negative feedback onto the anterior pituitary and hypothalamus (2 pts)
- High FSH and LH (2 pts)

Reproductive
- No control of sertoli cells (2 pts)
- No gametogenesis (sterility) (2 pts)

Sexual
- Loss of some male secondary sexual characteristics (2 pts)
- Accessory organs no longer maintained (2 pts)

24 (10 points). What are the five factors that cause EPOC (excess post exercise oxygen consumption)?

<table>
<thead>
<tr>
<th>EPOC causative factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 increased body temperature</td>
</tr>
<tr>
<td>2 restore ATP and phosphocreatine</td>
</tr>
<tr>
<td>3 restore O2 on myoglobin and hemoglobin</td>
</tr>
<tr>
<td>4 increase Na/K pump activity</td>
</tr>
<tr>
<td>5 metabolize lactate</td>
</tr>
</tbody>
</table>

25 (10 points). Briefly describe how chyme (acidic partially digested food in the stomach) is neutralized in the small intestine. Make sure you include the reaction and transport processes that must occur.

Within the cells of the pancreas or small intestine (1 pt) the following reaction occurs: CO2 + H2O --> H2CO3 --> H+ + HCO3- (3 pts), which is catalyzed by carbonic anhydrase (2 pts). The HCO3 is then exchanged with a Cl- across the apical surface (2 pts) and protons are exchanged with Na+ into the blood (2 pts)

26 (10 points). Describe the specific results from the study that looked at insulin sensitivity in exercising and non-exercising type II diabetics. What is the significance of this study?

- Type II diabetics that exercise have a higher sensitivity to insulin (5 pts)
- Type II diabetics that exercise won’t be as reliant on insulin injections and drugs that increase their insulin sensitivity (5 pts)
- Additionally, exercise promotes weight loss, which should result in less severe diabetes (2 pts bonus)
27 (18 points). Describe the process of fat digestion and absorption in the small intestine.

- Lipase (1 pt) is secreted in the saliva (1 pt), stomach (1 pt), and the pancreas (1 pt).
- Bile salts (1 pt) from the gall bladder (1 pt) increase SA/VOL of fat droplets (1 pt).
- Lipase produces monoacylglycerol (1 pt) and free fatty acids (1 pt).
- Monoacylglycerol and free fatty acids are absorbed across the apical surface of intestinal cells (1 pt) via diffusion (1 pt).
- Triacylglycerols are reconstituted within intestinal cells (1 pt).
- Triacylglycerols are packaged with protein (1 pt), producing chylomicrons (1 pt) in the Golgi (1 pt).
- Chylomicrons are exocytosed (1 pt) across the basolateral surface (1 pt).
- Chylomicrons are absorbed into lacteals (1 pt).

28 (8 points). What are F, E, S, and R for water on a per minute basis (i.e., give your answer in ml / min)?

- F = 125 ml / min (2 pts)
- E = 1 ml / min (2 pts)
- S = 0 ml / min (2 pts)
- R = 124 ml / min (2 pts)

29 (16 points). An individual produces 120 ml of urine in one hour. The concentration of molecule “X” in their urine is 25 mM. The concentration of molecule “X” in their blood is 50 mM. What is the clearance of “X” from the blood plasma of this individual? Show your work for partial credit. How is this substance being processed by the nephrons of the kidneys, assuming this substance is freely filtered? HINT: The math on this question is very simple if you just set it the quantities correctly.

\[ V = 120 \text{ ml urine / hr or } 2 \text{ ml urine / min} \]
\[ U_x = 25 \text{ mM = } 25 \text{ mmol of X/l urine} = 25 \text{ mmol of X / 1000 ml urine} \]
\[ P_x = 50 \text{ mM = } 50 \text{ mmol of X / l plasma} = 50 \text{ mmol of X / 1000 ml of plasma} \]
\[ \text{clearance} = U_x \times V / P_x = (25 \text{ mmol of X / 1000 ml urine}) \times (2 \text{ ml urine / min}) / 50 \text{ mmol of X / 1000 ml of plasma} = 1 \text{ ml plasma / min} (6 \text{ points for the correct answer}) \]

-X is mostly reabsorbed (4 points)
-working out the numbers above; partial credit (6 pts)

30 (6 points). Draw a graph that shows the relationship between day (x or independent variable) and basal body temperature (y or dependent variable) for a female’s with a 28 day cycle.

2 points for showing lower temperature for the first half of cycle, 2 points for showing the abrupt decrease in temperature around day 14, and 2 points for showing the higher temperature for the last half of the cycle.
31 (18 points). Describe humoral immunity.

Produced by B cells (2 pts) that produce antibodies (2 pts).

Up by exposed to a pathogen, B cells with the correct specificity will divide (2 pts), producing plasma (effector) cells (2 pts) and memory cells (2 pts). Effector cells will secrete antibodies to fight off the current infection (2 pts).

Antibodies work via:
- agglutination (1 pt)
- neutralization (1 pt)
- opsonization (1 pt)
- NK activation (1 pt)
- complement system activation (1 pt)

Memory cells will persist in the body, providing long-term immunity (2 pts).

(1 bonus pt)

32 (9 points). What is the relationship between GFR (dependent or y variable) and MAP (independent or x variable)? Show that relationship by drawing a graph that plots these two variables.

4 pts for showing constant GFR of 125 ml / min at intermediate MAP
2 pts for showing increasing GFR at very high MAP
2 pts for showing decreasing GFR at very low MAP