Excretory System

1. a) Label the parts indicated above and give one function for structures Y and Z

b) Which of the following is not a function of the organ shown?
A. to produce urea
B. to excrete metabolic wastes
C. to regulate the acidity of the blood
D. to maintain a constant blood volume

2. The process that occurs at W is
A. tubular excretion.
B. pressure filtration.
C. reabsorption of water.
D. selective reabsorption.

The permeability of which structure is altered by secretions from the adrenal cortex?
A. W
B. X
C. Y
D. Z

3. The structure labelled X is the
A. ureter.
B. urethra.
C. bladder.
D. collecting duct.

The function of the structure labelled Y is to
A. store urine.
B. filter blood.
C. produce urine.
D. maintain blood volume.
4. Demonstrate your understanding of negative feedback by describing how the kidneys and the hypothalamus work together to regulate blood volume (5 marks)

5. a) Identify the parts of the nephron in the following diagram.
   W-
   V-
   U-
   Z-
   X-
   Y-

   b) Compare and contrast the composition of blood in V with Z (3 marks)

<table>
<thead>
<tr>
<th>V</th>
<th>Z</th>
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   c) In a healthy person, the sequence of structures through which most glucose molecules pass is

6. Plasma from a student was analyzed before and after a ten kilometer cross-country run. During the run, the student became dehydrated. Explain how the resulting lowered blood volume is detected by the body and describe a homeostatic mechanism by which it is returned to normal. (6 marks)
7. Describe the process by which each of the following affects the composition of filtrate in the nephron (4 marks, 2 marks each) a) proximal tubule  b) Loop of Henle

8. a) Using the following diagram, label the parts of a nephron in the blanks provided. (3 marks)

![Diagram]

b) Identify one hormone that responds to a decrease in blood volume and explain how this hormone functions to return blood volume to normal levels. (4 marks: 1 mark for name; 3 marks for explanation)

9. Give two functions of each of the following urinary system structures. (6 marks)
a) Kidney

b) Collecting duct

c) Proximal tubule

10. a) At which location would the greatest concentration of glucose be found?
A. W  B. X
C. Y  D. Z

b) The inability to regulate the concentration of sodium ions in the blood could be due to improper functioning of the
A. adrenal cortex, since it produces ADH.
B. adrenal cortex, since it produces aldosterone.
C. adrenal medulla, since it produces ADH.
D. adrenal medulla, since it produces aldosterone.
11. Identify the structures on the diagram and give a different function of each structure. (8 marks: 1 mark each for name; 1 mark each for function)
   X-
   W-
   Y-
   Z-

12. Give three functions of the bicarbonate ion $\text{HCO}_3^-$ in the body and identify one specific location of each function. (6 marks: 2 marks each)

13. The maintenance of optimum pH is essential to living systems. Give three different locations in the body where pH is regulated and explain how it is maintained. (6 marks: 1 mark each for locations; 1 mark each for explanations)

14. Describe the process by which each of the following affects the composition of filtrate in the nephron. (4 marks: 2 marks each)
   a) Proximal Tubule-
   b) Loop of Henle-

15. State one function of each of the following. (6 marks: 1 mark each)
   i) Glomerulus:
   ii) Aldosterone:
   iii) Ureter:
   iv) Distal convoluted tubule:
   v) Urinary bladder:
   vi) Peritubular capillary network:
16. a) List **two** substances that are selectively reabsorbed at the proximal convoluted tubule of a nephron.

b) List **two** substances that are excreted at the distal convoluted tubule of a nephron.

c) What effect does increased antidiuretic hormone (ADH) have on urine production? (1 mark)

17. The structure identified by X in the diagram below is the

A. adrenal gland.
B. thyroid gland.
C. hypothalamus.
D. pituitary gland.

a) High concentrations of ADH (antidiuretic hormone) in the blood will result in
A. increased excretion of H$_2$O.
B. decreased pressure filtration.
C. decreased reabsorption of glucose.
D. increased solute concentration of the urine.

b) Which of the following describes the tissues surrounding the loop of Henle?
A. High H$^+$ concentration, high K$^+$ concentration.
B. Low water concentration, low salt concentration.
C. High salt concentration, low water concentration.
D. High water concentration, low K$^+$ concentration.

c) If the blood is excessively acidic, it will **likely** lead to urine
A. of increased pH.
B. of decreased pH.
C. with increased Na$^+$ concentration.
D. with decreased NH$_3$ concentration.

d) Which of the following symptoms might be an indication of kidney failure?
A. Salt in the urine.                           B. Urea in the urine.
C. Protein in the urine.                       D. Uric acid in the urine.

18. The inner portion (labelled X) of the endocrine gland above secretes

A. insulin.
B. cortisol.
C. adrenalin.
D. aldosterone.
19. Use the following list to answer the next question.
Proximal tubule
Loop of Henle
Distal tubule
Bowman’s capsule
Collecting duct
Glomerulus

a) Label the structures indicated on the following diagram using the terms given above. (3 marks: ½ mark each)

b) Give ONE role of each of the following in the production of urine. (3 marks: 1 mark each)
   i) Glomerulus:
   ii) Proximal tubule:
   iii) Distal tubule:

20. Describe the negative feedback system for aldosterone and how it regulates the constant salt concentration in blood and blood volume in body (8 marks)

21. a) Name the parts X and Y in the diagram
   X-
   Y-

   b) List three ways that the blood in vessel Y differs from the blood in vessel X

   X -
22. The table shows the amounts of substances present in human blood plasma, tubular filtrate and urine. All are measured in grams per 100 cm$^3$ of fluid.

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>PLASMA</th>
<th>FILTRATE</th>
<th>URINE</th>
</tr>
</thead>
<tbody>
<tr>
<td>glucose</td>
<td>0.10</td>
<td>0.10</td>
<td>Nil</td>
</tr>
<tr>
<td>amino acids</td>
<td>1.05</td>
<td>1.05</td>
<td>Nil</td>
</tr>
<tr>
<td>proteins</td>
<td>8.00</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>inorganic salts</td>
<td>0.72</td>
<td>0.72</td>
<td>1.50</td>
</tr>
<tr>
<td>urea</td>
<td>0.03</td>
<td>0.03</td>
<td>2.00</td>
</tr>
<tr>
<td>uric acid</td>
<td>0.004</td>
<td>0.004</td>
<td>0.05</td>
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</tbody>
</table>

a) Account for the differences in the levels of proteins in the plasma and filtrate. (1 mark)

b) The concentration of inorganic salts in urine is approximately double that present in the filtrate. Explain this difference. (3 marks)

23. Alcohol appears to inhibit the secretion of anti-diuretic hormone (ADH). Predict the results of alcohol intake on the following. Include in your answer a description of the mechanism responsible for the resulting concentration.

a) solute concentration of the blood plasma (3 marks)

b) urine production (2 marks)

24. Assume that a bacterial infection results in large perforations in the glomerulus and the Bowman’s capsule of a patient.

a) How will the glomerular filtrate in the diseased person compare to the glomerular filtrate of a healthy person? (2 marks)

b) What effect will this have on the level of antidiuretic hormone (ADH) circulating in the bloodstream? (1 mark)

c) A person with this disease would experience swelling of the body tissues. Using your knowledge of kidney function and the blood tonicity, explain the mechanism that accounts for this swelling. (3 marks)
25. What effect will anti-diuretic hormone (ADH) not being produced in the hypothalamus have on the normal body functions in humans? (2 marks)

26. Trace the flow of urine from the kidney to the outside of the body by listing the following structures in the correct order and state a function of each: urethra, ureter, urinary bladder. (2 marks each)

27. | SUBSTANCE | CONCENTRATION IN PLASMA g/100 mL | CONCENTRATION IN FILTRATE g/100 mL | CONCENTRATION IN URINE g/100 mL |
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<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>a. Glucose</td>
<td>0.100</td>
<td>0.100</td>
<td>0.000</td>
</tr>
<tr>
<td>b. Protein</td>
<td>8.00</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>c. Ammonia</td>
<td>0.004</td>
<td>0.004</td>
<td>0.07</td>
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</table>

a) Account for the filtrate and urine concentrations in each of the above substances by stating the part of the nephron and the process or processes responsible for producing each of the concentration values. (9 mark)

b) Explain what could cause high levels of glucose in the urine. (2 marks)

28. Give one function for each of the following parts of the excretory system. (5 marks: 1 mark each)
   a) Ureter—
   b) glomerulus –
   c) distal tubule –
   d) bladder –
   e) proximal tubule –

29. What are the three possible routes through the kidney of a glucose molecule after it enters the renal artery? (3 marks)

b) Which one of the routes through the kidney would a urea molecule NOT take? (1 mark)

c) How does the kidney respond when the blood is too acidic? (4 marks)
30. Explain how aldosterone helps to maintain blood volume. Detail the steps associated with the release of aldosterone, as well as the feedback loop associated with the control of its release. (8 marks)

31. The anterior pituitary gland has been called the "master gland." Justify this claim using two specific examples. (4 marks)

32. What effect will each of the following have on the quantity and the composition of urine? Give an explanation for each effect. (6 marks)
   a) Low arterial blood pressure. (3 marks)
   b) Impaired function of the posterior lobe of the pituitary gland. (3 marks)

33. Describe how the brain and the endocrine system work together to maintain homeostasis when the osmotic pressure (high solute concentration) of the blood increases. (8 marks)
Using human subjects, an investigation was carried out to look at the effect of drinking distilled water on the production and composition of the urine. At the start of the experiment the subjects emptied their bladders and then rapidly drank 800 mL of distilled water. The subjects then emptied their bladders at regular intervals and the volume of urine and its salt concentration were recorded. The results are shown on the chart below.

By referring to the charts and by using your knowledge of kidney function, answer the following:

a) Explain why the volume of urine has changed between 30 and 90 minutes. (2 marks)

b) Explain why the volume of urine has changed between 90 and 150 minutes. (2 marks)

c) In another similar experiment the subjects consumed 200 mL of isotonic saline, but the volume of urine remained normal. Explain why. (2 marks)

d) Explain why the salt concentration of urine changed between 30 and 90 minutes (2 marks)

e) State two factors (regarding human subjects) that would have to be kept constant during this experiment. (2 marks)