INSTRUCTIONS

This examination is composed of one calculation question, and 26 multiple choice questions. These multiple choice questions include matching questions, ‘except’ questions, and ‘K’ questions. Several different, but equivalent, versions of the test are being used. The allotted time is 90 minutes. Write your name on both the question booklet and the answer sheet. The answers are to be written on the answer sheet preferably in pencil, since it is easier to change your answer. For each multiple choice question there is only one correct response, so write only one letter as an answer. At the end of the test, the answer sheet should be stapled to the question booklet and they both must be handed in.
# Normal Laboratory Values

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood, Serum or Plasma</td>
<td></td>
</tr>
<tr>
<td>Blood glucose</td>
<td>67-109 mg/dl</td>
</tr>
<tr>
<td>Scr</td>
<td>&lt;1.5 mg/dl</td>
</tr>
<tr>
<td>BUN</td>
<td>&lt;20 mg/dl</td>
</tr>
<tr>
<td>BUN/Ser ratio</td>
<td>10-15</td>
</tr>
<tr>
<td>Osmolality</td>
<td>280-290 mOsm/kg</td>
</tr>
<tr>
<td>Na⁺</td>
<td>135-145 mEq/L</td>
</tr>
<tr>
<td>K⁺</td>
<td>3.5-5 mEq/L</td>
</tr>
<tr>
<td>H⁺</td>
<td>38-43 nEq/L</td>
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<tr>
<td>pH (arterial)</td>
<td>7.37-7.42</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>95-105 mEq/L</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>22-28 mEq/L</td>
</tr>
<tr>
<td>pCO₂ (arterial)</td>
<td>37-43 mmHg</td>
</tr>
<tr>
<td>Albumin</td>
<td>4.5 gm/dl</td>
</tr>
<tr>
<td>Anion gap</td>
<td>8-12 mEq/L</td>
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<tr>
<td>Calcium</td>
<td>8.5-10.5 mg/dl</td>
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<tr>
<td>Phosphate (as phosphorus)</td>
<td>2.5-5.0 mg/dl</td>
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<tr>
<td>Daily Urinary Excretion</td>
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</tr>
<tr>
<td>Creatinine</td>
<td>1.0-2.0 gm/day</td>
</tr>
<tr>
<td>GFR or Ccr</td>
<td>80-150 ml/min (115-216 L/day)</td>
</tr>
<tr>
<td>Protein</td>
<td>&lt;150 mg/day</td>
</tr>
<tr>
<td>Water (average)</td>
<td>0.5-12 L</td>
</tr>
<tr>
<td>(1.5 L)</td>
<td></td>
</tr>
<tr>
<td>Na⁺ (average)</td>
<td>150 mEq/day</td>
</tr>
<tr>
<td>K⁺ (average)</td>
<td>60-120 mEq/day</td>
</tr>
<tr>
<td>H⁺ (average)</td>
<td>60-120 nEq/day</td>
</tr>
<tr>
<td>Osmoles (average)</td>
<td>600 mOsm/day</td>
</tr>
</tbody>
</table>
1. A 23-year-old woman has a Scr of 1.0 mg/dl. And a 24-hour urine containing 2740 cc and 648 mg of creatinine. Calculate the creatinine clearance.

B. Is this creatinine clearance normal or decreased?

C. Is renal function normal or decreased?

("K" Questions) For the following questions (2-5) select:

A) if 1, 2, 3 are true
B) if 1, 3, are true
C) if 2, 4 are true
D) if only 4 is true
E) if all are true

2. Which of the following may lead to hypovolemia?

1. Hemorrhage
2. Sepsis
3. Hyperglycemia
4. Myocardial infarction

3. A 24-year-old man develops a running nose, sneezing, and sore throat. Two days later his urine is red-brown in color and two days after that his feet swell. Examination shows blood pressure 160/100 mmHg, jugular venous distention and 1+ ankle edema. The urinalysis shows 100 mg/dl protein, 20-30 RBC/hpf and a rare RBC cast. Scr is 1.9 mg/dl. The most likely cause(s) is (are):

1. Lipoid nephrosis
2. Poststreptococcal glomerulonephritis
3. Crescentic glomerulonephritis
4. IgA nephropathy

4. Treatment of hyperkalemia associated with EKG changes of peaked T waves and a widened QRS complex may consist of which of the following?

1. Calcium gluconate to decrease cardiac excitability
2. Polystyrene sodium sulfate (Kayexalate) to increase stool K⁺ loss
3. Insulin and glucose to shift K⁺ to the intracellular compartment
4. Inhaled beta agonists to shift K⁺ to the intracellular compartment

5. An increase in angiotensin II level will:

1. Decrease efferent arteriolar resistance
2. Decrease glomerular capillary hydraulic pressure
3. Decrease GFR
4. Decrease glomerular plasma flow
(Questions 6-22) Choose the one most appropriate answer.

6. Most filtered sodium is reabsorbed in the
   A. Proximal tubule
   B. Descending loop of Henle
   C. Ascending loop of Henle
   D. Distal convoluted tubule
   E. Collecting duct

7. A 68-year-old psychotic man still eats normally but refuses to drink. Water balance
   A. Cannot be maintained
   B. Can be maintained by reducing insensible losses
   C. Can be maintained by reducing urine output below 500 cc/day
   D. Can be maintained by reducing water in stool
   E. Can be maintained by increasing water of metabolism

8. A 27-year-old healthy medical student checks her urine osmolality after being home all day. She has been relaxing, watching television, and eating and drinking to her heart’s content. To her surprise, the urine osmolality is measured at 60 mOsm/L. What is most likely to be true?
   A. The student must have reduced total body sodium.
   B. The student’s blood pressure is almost certainly elevated
   C. The student must have a relative depletion of total body water.
   D. The student must have a decreased glomerular filtration rate.
   E. The student has a maximally suppressed level of ADH.

THE FOLLOWING TWO QUESTIONS REFER TO THE FOLLOWING CASE.

9. A 30-year-old man has chronic renal failure due to focal and segmental glomerulosclerosis, which has been progressively worsening over 8 years. His blood pressure is 170/110. His BUN is 75 mg/dL and the creatinine level is 8.0 mg/dL. Which of the following is most likely to be present?
   A. A normal hemoglobin of 14.0 gm/dL
   B. Hypernatremia
   C. Metabolic acidosis
   D. Hypophosphatemia, with a phosphate level of 2.0 mg/dL
   E. Hypokalemia, with a serum potassium level of 2.8 mEq/L.

10. What is the principal reason that his blood pressure is elevated?
    A. The stress of his chronic illness
    B. Direct effect of elevated BUN and creatinine on arterial smooth muscle
    C. Decreased glomerular filtration of sodium and water
    D. A high level of ADH
    E. An increase in the heart rate
THE FOLLOWING TWO QUESTIONS REFER TO THE NEXT CASE.

A 48-year-old man comes to the emergency room with abdominal pain and vomiting. He has a history of peptic ulcer disease and admits to heavy intake of alcohol over the last few weeks; he has been unable to eat much. His blood pressure is 80/40, the heart rate is 120/minute, and he has a dry mouth and mucous membranes, clear lungs, a tender abdomen, and no edema. Labs show: Na+ 127 mEq/L, Cl- 83 mEq/L, K+ 3.2 mEq/L, HCO3- 36 mEq/L, BUN 26 mg/dL, creatinine 1.7 mg/dL. The arterial pH is 7.50.

11. What is the best explanation for the low serum sodium level?

A. Decreased renal tubular absorption of sodium
B. Increased water intake into the intracellular space
C. Decreased dietary intake of sodium
D. Increased water reabsorption in the collecting duct
E. Increased glomerular filtration of sodium

12. What is the best explanation for the abnormal bicarbonate level?

A. Increased reabsorption of bicarbonate in the proximal tubule
B. Increased production of bicarbonate in the small and large intestine
C. Decreased aldosterone production
D. Decreased glomerular filtration of bicarbonate
E. Increased ADH effect

13. A 90-year-old man with advanced dementia and diabetes mellitus lives in a state mental health facility. Because of his deteriorated mental status, he is unable to care for himself. He develops a fever and a cough, and then has blood tests done, which show: Na 160 mEq/L, Cl 130 mEq/L, K 2.8 mEq/L, HCO3 19 mEq/L, BUN 49 mg/dL, and creatinine 2.2 mg/dL. The glucose is 300 mg/dL. The arterial pH is 7.34, with a pCO2 of 36 mmHg. The urine osmolality is 900 mOsm/L. Which one factor is most responsible for his hypernatremia?

A. Decreased urinary excretion of sodium
B. Shift of sodium into the extracellular space due to a high glucose level
C. Inability to drink fluids
D. Increased gastrointestinal losses of water
E. Acute renal failure

14. A young boy is brought into the emergency room with severe lethargy. His distraught parents are unable to give much of a history. While you and others are attempting to gather more history, the following blood tests become available. The Na is 135 mEq/L, Cl- is 99 mEq/L, K+ is 3.5 mEq/L, HCO3 is 30 mEq/L. The arterial pH is 7.10, and the pCO2 is 85 mmHg. Which of the following is the most likely diagnosis?

A. Severe vomiting
B. Acute renal failure
C. Overdose of sleeping pills
D. Diabetic ketoacidosis
E. Aldosterone secreting tumor
15. A patient has the following laboratory tests done: Na 135 mEq/L, Cl 105 mEq/L, HCO3 20 mEq/L, K 3.4 mEq/L, BUN 19 mg/dL, creatinine 1.2 mg/dL. The arterial blood shows a pH of 7.46, and a pCO2 of 30 mmHg. What is the most likely diagnosis?

A. Diarrhea  
B. Normal pregnancy  
C. Muscular dystrophy  
D. Renal tubular acidosis  
E. Vomiting

16. A 50-year-old man comes to the Emergency Room not feeling well. He has no past medical history and takes no medications. Before examining the patient, you review the laboratory tests that have been obtained. The arterial pH is 7.20, pCO2 is 25 mmHg, Na 136 mEq/L, Cl 100 mEq/L, K 4.9 mEq/L, HCO3 10 mEq/L. Based upon this partial information, which of the following diagnoses are most likely?

A. Renal failure  
B. Pneumonia  
C. Heroin overdose  
D. Gastroenteritis and diarrhea  
E. Surreptitious use of diuretics

17. A 38-year-old African-American woman presents for a general physical examination. Her father and her mother have hypertension and are receiving pharmacologic treatment. She has a negative past medical history, other than three normal pregnancies, she takes no medications, does not drink or smoke, and exercises regularly. She admits to some mild stress at home and at work. Her blood pressure is 140/86. The rest of the examination is completely normal. An electrocardiogram is normal. Renal function tests and a urine analysis are normal. Which of the following statements is most correct?

A. She should be reassured and told that her blood pressure is normal.  
B. Compared to an individual with a blood pressure of 110/70, she has a statistically significantly higher future risk of both renal failure and cardiovascular disease  
C. She should have a renin, an aldosterone level, serum catecholamine levels, and thyroid function tests checked.  
D. She should be placed immediately on pharmacologic therapy.  
E. Anti-anxiety therapy and psychotherapy should be prescribed.

18. A 16-year-old girl has painful joints of the hands and fever and as high as 100.6 F° for 3 weeks and then notices a 10-lb. weight gain. She attempts to lose weight by dieting for two weeks without success and sees her doctor. An examination reveals a diffuse rash, blood pressure 130/80 mm Hg, normal heart and lungs and 2+ edema of the lower extremities. The urinalysis shows SG 1.012, protein 4+, 0-2 RBC/hpf, oval fat bodies, and occasional hyaline and granular casts/lpf. The Scr is 0.9 mg/dL.

A likely diagnosis is:
A. Acute tubular necrosis
B. Acute interstitial nephritis
C. Lipoid nephrosis
D. IgA nephropathy
E. Membranous form of lupus nephritis

THE FOLLOWING TWO QUESTIONS REFER TO THE NEXT CASE.

A 54 YO diabetic male presented with a 1-day history of severe cough, chills, high fever, vomiting and diminished urine output. Physical exam revealed a confused ill-appearing gentleman. His temperature was 105°F, respiratory rate 30/min, pulse 120/min and blood pressure 100/50 mm Hg. Lungs showed diffuse rales and there was no audible murmur. Chest X-ray revealed a patchy pneumonia. Shortly following admission, his blood pressure had dropped to 80/50 and IV normal saline and antibiotics were initiated. His BUN was 24 mg/dl and Scr 1.2 mg/dl. Twenty-four hours later, the patient remained hypotensive and urine output was 10-15 cc/hr. BUN had risen to 32 mg/dl and the Scr was 2.9 mg/dl. Despite normalization of his blood pressure, his urine output remains unchanged and his serum creatinine continue to rise.

19. Which urinalysis is most consistent with his clinical scenario?
A. S.G. 1.015, 4+ protein, microscopic hematuria, RBC casts
B. S.G. 1.015, 1+ protein, granular and WBC casts, 10-20 WBC/hpf with eosinophils
C. S.G. 1.012, 1+ protein, muddy brown granular casts, tubular epithelial cells
D. S.G. 1.020, negative protein, occasional hyaline casts
E. S.G. 1.030, negative glucose and protein, occasional hyaline and granular casts

20. Which of the following laboratory studies are most consistent with his diagnosis.
A. Urine Na 40 mEq/L, ultrasound: dilated calyces and ureters
B. Urine Na 19 mEq/L, ultrasound: normal-sized kidneys, ANA 1:640, renal biopsy: widespread immune complex deposits, diffuse proliferation of cells in glomeruli
C. Urine Na 5 mEq/L, ultrasound: normal-sized kidneys
D. Urine Na 40 mEq/L, ultrasound: normal-sized kidneys, WBC and differential count; 10% eosinophilia, renal biopsy: normal glomeruli, inflammatory cells in interstitium
E. Urine Na 60 mEq/L, blood cultures: (+)Strep pneumonia, ultrasound: normal-sized kidneys

21. In adults with kidney stones, which of the following substances are found in over 70% of stones:
A. Magnesium ammonium phosphate
B. Cystine
C. Cysteine
D. Calcium
E. Uric Acid
22. A urinalysis shows the following results:

Urine Color: Brownish red
Urine appearance: not cloudy

Urine dipstick
Specific Gravity: 1.020
Protein: Negative
Glucose: Negative
Blood: 3+
Ketones: Negative

Microscopy: no wbc's, rbc's, or casts

The most likely cause of this finding would be:

A. An uric acid stone obstructing the ureter
B. Rapidly progressive glomerulonephritis
C. Pregnancy
D. Radiocontrast media in the urine
E. Intravascular hemolysis and hemoglobinuria

(EXCEPT Questions 22-28) Choose the one most appropriate answer.

23. In primary hyperaldosteronism all of the following are seen EXCEPT:

A. High collecting duct reabsorption of sodium
B. High glomerular filtration of sodium
C. High plasma renin concentrations
D. High extracellular volume
E. High arterial filling

24. The following factors may result in K⁺ shift from the intracellular to the extracellular space EXCEPT:

A. Hypertonicity
B. Acidosis
C. Insulin
D. Exercise
E. Beta adrenergic blockers

25. All of these statements are true EXCEPT:

A. Bicarbonate (HCO₃⁻) is filtered by the glomerulus, reabsorbed in the proximal tubule, and generated in the cortical collecting duct.
B. Potassium (K⁺) is filtered by the glomerulus, reabsorbed in the proximal tubule, loop of Henle, distal convoluted tubule, and is secreted in the collecting duct.
C. Sodium (Na⁺) is filtered by the glomerulus, reabsorbed in the loop of Henle, and secreted in the distal convoluted tubule and collecting duct.
D. Water (H2O) is filtered by the glomerulus, and reabsorbed in the medullary collecting duct
E. Creatinine (Cr) is filtered by the glomerulus, and secreted in the proximal convoluted tubule

26. A 25-year-old man comes to the clinic with a blood pressure of 200/120. He declines medical treatment because he cannot pay for it. You explain to him that without therapy he will be at risk for all of the following complications EXCEPT:

A. Intracerebral bleeding
B. Blindness
C. Chronic renal failure
D. Congestive heart failure
E. Cirrhosis of the liver

27. An individual with prerenal azotemia might display all of the following findings EXCEPT:

A. A urine sodium concentration of 10 mEq/L
B. A urine specific gravity of 1.010
C. Dry mucous membranes
D. A diminished central venous pressure
E. BUN to Scr ratio >20

28. Patients with uric acid kidney stones, might exhibit all of the following features EXCEPT:

A. Evidence of stone on CT scan but not on abdominal X-ray.
B. A history of urinary tract infections and high urinary pH
C. A history of chronic diarrheal states
D. A history of gout
E. A history of lymphoproliferative disorder
ANSWER SHEET

RENALE PATHOPHYSIOLOGY EXAMINATION

December 16, 2002

Student's name: Shirley MacLean

("K" Questions)

A) if 1, 2, 3 are true
B) if 1, 3, are true
C) if 2, 4 are true
D) if only 4 is true
E) if all are true

1. A. 45 mL/min mg/dl
   B. decreased
   C. normal

2. B
3. D
4. E
5. D
6. A
7. A
8. E
9. C
10. C
11. D
12. A
13. C
14. C
15. B
16. A
17. B
18. E
19. C
20. E
21. D
22. E
23. C
24. C
25. C
26. E
27. B
28. B