INSTRUCTIONS

This examination is composed of multiple choice questions. 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/Scr 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>
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<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>
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<tr>
<td>Cl⁻</td>
<td>95-105 mEq/L</td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>22-28 mEq/L</td>
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<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>
</tr>
<tr>
<td>Calcium</td>
<td>8.5-10.5 mg/dl</td>
</tr>
<tr>
<td>Phosphate (as phosphorus)</td>
<td>2.5-5.0 mg/dl</td>
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## Daily Urinary Excretion

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<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>0.5-12L</td>
</tr>
<tr>
<td>(1.5L)</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 healthy 26-year-old woman takes a 10 kilometer run on a hot day. She does not take drinking water with her and at the end of the run, she feels nauseated and vomits repeatedly, and is unable to take in any food or fluids. She goes to a local clinic, where she is noted to have a blood pressure of 88/40 mmHg, and to have dry mucous membranes, clear lungs, no edema, and dry skin. Labs show: Na+ 152 mEq/L, K+ 3.1 mEq/L, HCO3- 34 mEq/L, Cl- 110 mEq/L, BUN 27 mg/dL, Cr 1.1 mg/dL. The pH is 7.46. Which of the following is most likely to be true?

A. She has an elevation in her total body sodium
B. She has a very low level of ADH
C. Her urine osmolality is very high
D. At the renal tubular level, she will have increased water reabsorption in the ascending thick limb of the loop of Henle
E. Her tubular secretion of creatinine must be increased

THE FOLLOWING TWO QUESTIONS RELATE TO THE FOLLOWING CASE

After traveling in Southeast Asia, a 37-year-old woman is admitted to the hospital with a six day history of diarrhea. On exam, her blood pressure is 84/60, she has dry mucous membranes and decreased skin turgor, her lungs are clear, and there is no peripheral edema. Labs show: Na+ 118 mEq/L, K+ 3.3 mEq/L, Cl- 96 mEq/L, HCO3- 14 mEq/L, and BUN is 19 mg/dL and Cr is 1.2 mg/dL. An arterial pH is 7.30. The urine specific gravity is 1.030, with a urinary osmolarity of 1000 mOsm/L.

2. Why is the serum sodium abnormal?

A. There is decreased glomerular filtration of sodium
B. There has been excess sodium loss from her skin
C. She has a profound osmotic diuresis causing urinary sodium loss
D. There is excess reabsorption of water in the medullary collecting duct
E. There is a shift of sodium from the extracellular to the intracellular space

3. Why is the serum bicarbonate abnormal?

A. There is excess bicarbonate loss from the lower gastrointestinal tract
B. There is excess hydrochloric acid loss from the upper gastrointestinal tract
C. There is an increase in aldosterone production in the cortical collecting duct
D. The abnormal bicarbonate is a compensation for acute respiratory alkalosis
E. There is excess bicarbonate loss in the urine

4. A 5-year-old boy is admitted to the hospital with a headache and a stiff neck and is diagnosed with viral meningitis. He is treated with antibiotics. On the day after admission, his blood pressure is 112/50, his temperature is 101 F, skin turgor and mucous membranes are normal, his lungs are clear, and his abdomen is soft. He is lethargic and irritable and his neck is stiff. Labs show: Na+ 115 mEq/L, K+ 4.0 mEq/L, Cl- 80 mEq/L, HCO3- 25 mEq/L, BUN 4 mg/dL, and Cr 0.1 mg/dL. Urine sodium is 67 mEq/L. Why is the serum sodium abnormal?

A. He must be drinking large quantities of water
B. There is increased tubular secretion of sodium.
C. There is an increased synthesis of ADH
D. He probably has central diabetes insipidus
E. There is an increased glomerular filtration rate causing increased sodium filtration

5. A worried set of parents bring their 15 year old high school student daughter to see you because she is not feeling well. Her parents report that she has been trying to diet to lose weight. Her past medical history and the family history is negative, and you find no abnormalities on an initial physical examination. Lab tests show: Na+ 127 mEq/L, K+ 3.9 mEq/L, Cl- 96 mEq/L, HCO3- 23 mEq/L, BUN 7 mg/dL, and Cr 0.5 mg/dL. The urine specific gravity is 1.001 and the urine osmolality is 56 mOsm/kg. What is the most likely explanation for her hyponatremia?

A. Surreptitious use of diuretics
B. An early central nervous system malignancy
C. Ingestion of an extremely low sodium diet
D. Ingestion of very large volumes of water
E. Nephrogenic diabetes insipidus

6. A 90-year-old man with diabetes and advanced dementia is brought to the emergency room from his nursing home with a fever, which has been present for over a week. On exam, his blood pressure is 110/80. His temperature is 102 F, his heart rate is 100/minute and his respiratory rate is 40/minute. His mucous membranes are parched, and he has rales at both lung bases and no peripheral edema. His serum sodium level is 170 mEq/L. Why is the serum sodium level elevated?

A. Loss of water from his skin
B. Loss of water from his respiratory tract
C. Loss of water from his kidneys
D. Inability to drink water
E. All of the above factors are contributory

7. A 51-year-old man has been on the medication lithium carbonate for bipolar (manic-depressive) psychiatric disease for the past ten years. He is doing well with the diagnosis and works full time, but has been told he has nephrogenic diabetes insipidus as a result of lithium therapy. Which of the following findings would be consistent with a diagnosis of nephrogenic diabetes insipidus?

A. a urine specific gravity of 1.035
B. a serum sodium level of 122 mEq/L
C. a urine volume of 7000 ml/day
D. a urine osmolality of 1300 mOsm/kg
E. a low plasma level of ADH

8. A middle aged male patient is brought to your emergency room after a cardiorespiratory arrest. She cannot give a history and no details about his medical history are available. An initial blood gas shows a pH of 6.90, a pCO2 of 100, and a HCO3- of 28 mEq/L. Which of the following is most consistent with his clinical presentation?

A. heroin overdose
B. ethylene glycol overdose  
C. salicylate (aspirin) overdose  
D. diuretic overdose  
E. diabetic ketoacidosis

9. A 38 year old woman comes to see you in your clinic. Before seeing her, you review her bloodwork. The Na+ is 134 mEq/L, the K+ is 4.4 mEq/L, the Cl- is 99 mEq/L, and the HCO3- is 16 mEq/L. The arterial blood gas is 7.28 and the pCO2 is 30 mmHg. Which of the following diagnoses is the most likely?

A. pregnancy  
B. distal renal tubular acidosis  
C. an aldosterone producing tumor  
D. chronic obstructive pulmonary disease  
E. kidney failure

10. A 75-year-old man is admitted to the hospital with worsening congestive heart failure. He has been taking increasing doses of diuretics—furosemide and metolazone, a thiazide like agent, as an outpatient. On exam, the blood pressure is 122/82. He has jugular venous distension, rales, and an S3 gallop. He has 2+ lower extremity edema. His labs show a Na+ of 125 mEq/L, K+ 3.4 mEq/L, Cl- 86 mEq/L, HCO3- 39 mEq/L, BUN 25 mg/dL, and Cr 1.6 mg/dL. The arterial pH is 7.47 and the pCO2 is 45 mmHg. Which of the following processes is the most important cause of his acid-base disturbance?

A. increased proximal tubular reabsorption of bicarbonate  
B. decreased diffusion of CO2 from the alveolar capillary to the alveolar space  
C. increased respiratory drive  
D. increased production of lactic acid  
E. decreased glomerular filtration rate

11. You receive the following set of laboratory tests on a patient. The arterial pH is 7.60. The pCO2 is 25 mmHg and the serum HCO3- is 25 mEq/L. What is the acid base disturbance that is present?

A. respiratory acidosis  
B. respiratory alkalosis  
C. metabolic acidosis  
D. metabolic alkalosis  
E. it is impossible to tell with the information given

12. A 35-year-old woman comes to see you for a physical exam. She is mildly obese, the blood pressure is 138/82, and the rest of the exam is normal. Over two ensuing visits, her blood pressure is 136/84 and 132/88. She has a normal electrocardiogram and urine analysis and the BUN is 11 mg/dL with a creatinine of 1.0 mg/dL. Which of the following statements is correct?

A. Her blood pressure is at an acceptable level of control.  
B. Compared to someone with a blood pressure of 120/80, this patient is at a higher risk for the development of kidney failure and congestive heart failure in the future  
C. A renal arteriogram will diagnose the elevation of the blood pressure
D. She should have serum and urinary catecholamines measured
E. She should begin therapy with antihypertensive medications

13. A 80-year-old man has a long history of smoking and also has a history of two myocardial infarctions, a cerebrovascular accident (stroke) and has recently had worsened hypertension; the blood pressure is now 200/110. A renal arteriogram shows severe left renal artery stenosis. Which of the following laboratory tests is likely to be present in this condition?

A. elevation in serum potassium
B. decrease in serum bicarbonate
C. increase in serum aldosterone
D. decrease in serum renin
E. increase in serum ADH level

14. A 67-year-old African American man has had hypertension for over 25 years, and has been treated with varying medications for that period of time, but because of the cost of medications and side effects, he has not been optimally compliant. Over the past five years at least, his blood pressure has always been over 160/100. When you see him on a routine visit, his blood pressure is 180/110 and his heart rate is 82/minute. Of the following, what would most likely be present if you perform a history, physical exam and laboratory tests?

A. abnormal liver function tests
B. elevated glucose level
C. a history of frequent headaches
D. left ventricular hypertrophy on electrocardiogram
E. peripheral edema
15. The above photo represents a form of hypertensive vascular disease. Which of the following statements about this lesion is true? (2 points)

A. This lesion is characteristic of malignant nephrosclerosis
B. The lesion is the result of antibodies formed against collagen IV
C. The lesion is strongly associated with hypertension but can also be seen in diabetes without hypertension
D. The lesion is almost always associated with membranoproliferative glomerulosclerosis

16. Which of the following changes would be expected to increase the glomerular filtration rate?

A. vasodilation of the efferent arteriole
B. increase in hydrostatic pressure in Bowman’s space
C. increase in glomerular hydrostatic pressure
D. increase in the capillary hydrostatic pressure
E. all of the above

17. Which of the following factors act as a vasodilator?

A. parathyroid hormone
B. angiotensin II
C. ADH
D. endothelin
E. nitric oxide

18. Which of the following laboratory values would be present in a patient with cirrhosis of the liver, who has a blood pressure of 90/60, ascites, and severe peripheral edema?

A. fractional excretion of sodium of < 1 %
B. urine sodium concentration of 100 mEq/L
C. serum BUN/creatinine concentration ratio of 5
D. urine specific gravity of 1.002
E. all of the above

19. A 19-year-old male college student decides to eat chicken soup and chips for lunch. He is late for track practice, so he has no time to drink water and forgets to bring any with him. The weather is warm (70 F) and dry. He doesn’t sweat much but feels very thirsty. What do you expect to occur?

A. Total urinary Na excretion will fall because of his lack of water.
B. On exam, he has orthostatic hypotension (fall in blood pressure with standing), because of large insensible losses.
C. The ascending loop of henle will turn off allowing for concentration of urine and maximal water retention.
D. The collecting tubules receive diluted urine, then reabsorbs water to allow for concentration of urine.
E. Because he is unable to drink water, the fall in GFR will allow for production of dilute urine.
20. A 53-year-old female has vomiting and diarrhea for 2 days and is only able to keep fluids down for the last day. On examination, her blood pressure is 120/60 mmHg and heart rate 60 bpm. She is not dizzy or lightheaded because:

A. Excretion of urea is enhanced to prevent symptoms of uremia.
B. Baroreceptors stimulate urea reabsorption which expands intravascular space
C. Norepinephrine enhances sodium reabsorption, which expands the ECF.
D. Plasma sodium concentration increases therefore expanding the intravascular space.
E. The expansion of intravascular space is maintained primarily by continued water intake.

21. In normal renal function sodium excretion is dependent on:

A. The amount sodium ingested
B. Antidiuretic hormone (ADH)
C. Blood pH
D. Plasma sodium concentration
E. Plasma potassium concentration

22. Glomerular filtration rate:

A. Falls when the efferent arteriole is vasoconstricted
B. Is overestimated by urea clearance as calculated by (Urine urea concentration x Urine volume)/ Plasma Urea
C. Will vary significantly according to amount of Na intake in patients with normal kidney function
D. Cannot be estimated with acute renal failure
E. Normally ranges from 30-60 ml/min in a 20 year old male

23. Renal handling of solutes occur in the following manner:

A. Small substances which have a positive charge are poorly filtered through the glomerulus
B. Urea is partially filtered through the glomerulus.
C. All proteins are freely filtered but reabsorbed proximally
D. Water is reabsorbed along with sodium throughout the entire length of the tubule
E. Glucose is freely filtered and reabsorbed proximally

24. A 68-year-old man has dementia and is lives in a nursing home. His confusion has worsened over the last couple of days. Laboratory data shows that the plasma Na is 150 mEq/L. On examination, weight is 60 kg, and BP is 130/70, HR 70.

How much water is required to restore his sodium to normal (140 mEq/L)?

A. 1 L
B. 2.5 L
C. 3.5 L
D. 5 L
E. Insufficient data to calculate
25. A 17 year-old female presents with sudden onset edema with hypertension. Kidney function is abnormal with a creatinine of 2.6 mg/dl and albumin is 2.3 g/dl. She reports urinary foaming, but denies gross hematuria or other urinary symptoms including dysuria or frequency. Which of the following urinalysis and sediment is most consistent with the above clinical presentation?

A. Specific gravity 1.015/ pH 5/ 4+ protein / no cells or casts
B. Specific gravity 1.010/ pH 5/ 4+ protein / 25-50 dysmorphic RBCs/ one RBC cast
C. Specific gravity 1.020/ pH 5/ trace protein / 5 RBCs/ 50-100 WBCs/ no casts
D. Specific gravity 1.020/ pH 5/ no protein / no cells or casts
E. Specific gravity 1.020/ pH 5/ no protein / 5-10 RBCs/ hyperpigmented (dark) granular casts

(RBC= red blood cell, WBC= white blood cell)

26. Urine dipstick shows a specific gravity of 1.015, pH 5.5/ negative protein/ no blood or leukocyte esterase and sediment reveals no cells or casts. Creatinine is 2.0 mg/dl. The following clinical presentation is most consistent with the above urine findings:

A. 64-year-old female with a 20 year history of diabetes mellitus and diabetic retinopathy
B. 23-year-old female diagnosed with lupus nephritis
C. 38-year-old female with dysuria, urinary frequency and foul smelling urine
D. 40-year-old male with no medical history now with septic shock complicated by oliguric (150 ml/24 hr) acute renal failure
E. 65-year-old male with back pain, anemia and spine X-ray revealing lytic lesions suggestive of multiple myeloma with tubular proteinuria (light chains).

27. Which one of the following urine sediment findings is NOT correctly matched?

A. Hyaline cast- Tamm Horsfall Protein produced by tubular cells
B. Red blood cells- Bladder cancer
C. Coarse hyperpigmented granular cast- acute glomerulonephritis
D. White blood cell casts- acute interstitial nephritis
E. White blood cell casts- pyelonephritis

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE
A 67-year-old female has a 15 year history of hypertension which has been poorly controlled with past medical history including hypercholesterolemia, CAD (coronary artery disease), s/p CABG (coronary artery bypass graft), atrial fibrillation and ischemic cardiomyopathy. Creatinine measured 2 years ago is 1.8 mg/dl. She is chronically on oxygen at home.

On exam, BP 100/70, HR 60, RR 12. O2 saturation 94% on 2 L of oxygen by nasal canula. Heart with irregularly irregular beat and systolic murmur, Lung with crackles on right lower base and LE with 1-2+ edema.

She is on furosemide (loop diuretic) and metolazone (thiazide diuretic), lisinopril (ACE inhibitor), metoprolol (beta-blocker), aspirin, digoxin

Laboratory data: Na 135, K 5.4, Cl 102, HCO3 26, BUN 50, Creatinine 2.4, Albumin 3.4, Ca 7.0, phos 7.4.
28. Which of the following statements best describes the abnormal laboratory data?

A. The diuretic is contributing to her urinary protein loss resulting in a low albumin
B. She has hyperphosphatemia due to vitamin D deficiency
C. Hyponatremia occurs due to the ACE inhibitor
D. Hyperkalemia arises due to hyperaldosteronism
E. Creatinine is elevated as a result of progression of her underlying renal disease

29. She is hospitalized numerous times over the next year for congestive heart failure requiring intravenous loop diuretics and BUN rises to 165 mg/dl and creat 3.8 mg/dl. Additionally, she has chronic dyspnea on exertion, declining appetite, pruritis, hiccups and profound fatigue. What is likely to be true regarding her condition?

A. Hypernatremia develops due to poor excretion of sodium resulting in fatigue
B. Metabolic acidosis contributes to hypokalemia and weakness
C. Secondary hyperparathyroidism causes hypercalcemia
D. 1,25-(OH)₂ vitamin D (activated vitamin D) deficiency causes worsening hyperparathyroidism and pruritis
E. Anemia develops primarily due to nutritional deficiency

30. A 64-year-old man has chronic kidney disease due to diabetic nephropathy with an estimated GFR of 15 ml/min. Other medical history includes coronary artery disease (CAD) and HTN(hypertension). He is found to have 3 vessel coronary artery disease and is planned for CABG (coronary artery bypass graft) next week. On exam, BP 140/70, HR 80, Heart RRR, Lung decreased BS at bases and clear apically, LE with 2+ edema. Laboratory data: Na 138, K 5.9, Cl 104, HCO₃ 24, BUN 54, Creat 3.5, glucose 230, Alb 3.2, WBC 8, Hgb 10.6, platelet 260.

Which of the following complications may be anticipated?

A. He is at high risk for developing renal failure and may require dialysis
B. Excessive bleeding may occur due to platelet dysfunction
C. Congestive heart failure may occur due to poor Na excretion after IVF administration during surgery
D. Cardiac arrest may occur due to the hyperkalemia
E. All of the above

THE NEXT TWO QUESTIONS REFER TO THE FOLLOWING CASE

A 76-year-old male with a baseline creatinine level of 1.6 mg/dL complains of severe abdominal pain and fever to 40° C. Past medical history includes, diabetes mellitus, HTN, osteoarthritis and peripheral vascular disease. On examination, BP is 80/50, HR 120. He has rebound tenderness and no bowel sounds are present. He is taken emergently to the OR that evening and is found to have perforation of the colon with fecal contamination requiring partial colectomy. He receives 2L of isotonic solution and is immediately started on ampicillin/subactam (antibiotic), however becomes oliguric. His medications include the following: Metoprolol (beta-blocker), Lisinopril (ACE inhibitor), Aspirin, glipizide (sulfonylurea), Ibuprofen (NSAID) Laboratory data on post-operative day #1 is as follows: Na 133, K 5.7, Cl 105, HCO₃ 18, BUN 22, Creat 2.6. WBC 15, Hgb 10, Hct 30, platelet 250.
Urine Na 50, Urine creat 35.

31. Which of following explanations for the electrolyte abnormalities found above is correct?

A. Sodium concentration falls due to excess colonic losses of sodium
B. Urea concentration is rising due to free water losses
C. Potassium rises due to inhibition of tubular secretion and decline in GFR
D. Urine Na is quite low suggestive of hypoperfusion to the kidney
E. All of the above.

32. The above photo is from the patient’s kidney. The pathologic mechanism of oliguria in this patient is most likely: (2 points)

A. Acute tubular necrosis due to hypotension and consequence ischemia of the kidney
B. Glomerular sclerosis
C. Crescentic glomerular nephritis
D. Chronic pyelonephritis

33. A 15-year-old male describes “bloody urine” and is found to have an elevated creatinine of 1.7 mg/dl. He feels well but recalls having a fever and sore throat a couple of weeks ago.

What would you expect to see on further examination and laboratory determination?

A. Serum complements should be depleted as this is an immune mediated glomerulonephritis
B. 24 hr urine protein level is 8 grams daily
C. Urine sediment evaluation will reveal large blood but no or few RBC’s
D. Protein is not detectable on urine dipstick but is 2 gram/day as measured by 24 hr urine.
E. None of the above.
34. Which of the photos below is most consistent with the scenario in the previous question? (2 points)

A. Antibody-antigen complexes may form or deposit in various places in the glomerulus. Clinical manifestations reflect the location in the glomerulus of the complexes. For the following questions, match the site of complex deposition with the clinical features: (1 point each)

A. Endothelial side of the GBM
B. Epithelial side of the GBM
C. Mesangium
D. Intramembranous (dense deposit)

35. IgA nephropathy
36. Post-streptococcal glomerulonephritis
37. Membranoproliferative glomerulonephritis, type II
38. Membranoproliferative glomerulonephritis, type I

39. Each of the following patients has a creatinine of 4.6 mg/dl. Which patient will most likely have complete renal recovery?
   A. 24-year-old female with lupus nephritis
   B. 65-year-old male with obstructive uropathy for the past 6 months
   C. 56-year-old female with sepsis and hypotension resulting in ATN
   D. 46-year-old male with diabetic nephropathy
   E. 36-year-old male with polycystic kidney disease

Match the embryological structure of origin with the definitive structure (1 point each)

   A. Müllerian duct
   B. Urogenital sinus
   C. Mesonephric duct
   D. None of the above

40. Prostate (the major portion)

41. Uterus

42. Urinary bladder

43. Proximal convoluted tubule

44. Vas deferens
45. The abnormality depicted above is the result of: (2 points)

A. Abnormal migration of the metanephros
B. Abnormal migration of the mesonephros
C. Early embryonal obstruction of the prostatic urethra
D. A mutation in the PKD-1 gene

46. A 58-year-old man is found to have cold, cyanotic toes and renal failure following a procedure. The renal biopsy reveals the presence of emboli in branches of the renal artery. Cholesterol crystals are present. Which of the following is most likely to cause this scenario? (2 points)

A. Paradoxical embolism
B. Use of an intra-aortic balloon
C. Mitral valve replacement
47. The above blood smear is from a woman with renal failure coming on 5 days after delivery. Which of the following statements is true? (2 points)

A. It is certain that abruption, intrapartum hemorrhage, amniotic fluid embolism, or puerperal sepsis occurred
B. The patient must have eaten contaminated fresh spinach
C. The blood smear shows schistocytes, spherocytes, and a deficient quantity of platelets
D. The patient almost certainly does not have neurological symptoms and signs
The above EM photo is of a glomerular capillary wall with the lumen lowermost. Match the labels, A (the large oval), B (the rectangle), C (the small circle), with the following ultramicroscopic structures. (1 point each)

48. Foot process
49. Fenestra in endothelium
50. Basement membrane

Indicate whether the following statements are true (A) or false (B). (1 point each)

51. The constellation of findings in von-Hippel-Lindau syndrome includes cerebellar hemangioblastomas and renal cell carcinomas.

52. The malignant cell in renal cell carcinoma (clear cell type) is a round to polygonal cell with clear to granular cytoplasm.

53. Wilms tumor has a classic biphasic histological pattern and is most likely to present in the early teen age period.
54. The most important prognostic factor in Wilms tumor is the degree of anaplasia seen histologically.

55. The most likely scenario to explain the findings below on renal biopsy is: (2 points)

A. The patient suffers from mercury poisoning.
B. The patient was treated three weeks ago with ampicillin and now has peripheral eosinophilia.
C. The patient is 15 years of age and had a recent streptococcal throat infection.
D. The patient recently underwent treatment which included the use of an intraaortic balloon.

56. Which of the following interventions will have the greatest efficacy at preventing future calcium oxalate kidney stones?

A. Increase fluid intake to 2.5-3L per day
B. Dietary calcium restriction
C. Low carbohydrate, high protein diet
D. Addition of a loop diuretic
E. Vitamin C supplementation

57. Which of the following is the most reliable test for distinguishing acute renal failure due to obstruction from other causes of acute renal failure?

A. Fractional excretion of sodium
B. Ultrasound of kidneys and bladder
C. Urine sodium concentration
D. Digital rectal exam to look for prostatic enlargement
E. Examination of urine sediment

58. Which of the following mechanisms is the best explanation for the polyuria observed after relief of acute obstruction (post-obstructive diuresis)

A. Decreased sympathetic tone
B. Suppression of the renin-angiotensin-aldosterone axis
C. Accumulation of atrial natriuretic peptide
D. Decreased sensitivity to ADH
E. High serum glucose causing osmotic diuresis

59. Which of the following scenarios presents the greatest threat to perfusion of vital organs?

A. 750ml blood loss during surgery
B. 2kg weight loss from sweating after spending 30 minutes in a sauna
C. 1.5L voluminous diarrhea
D. 1L urine output after taking a high dose loop diuretic
E. Nausea/vomiting resulting in 1kg weight loss

60. A 24-year-old medical student develops acute gastroenteritis with nausea/vomiting and diarrhea before taking the renal pathophysiology exam. He notes a feeling of dizziness when standing up and a classmate documents the presence of orthostatic hypotension. He decides to rehydrate himself with ginger ale (0 meq/L Na) and Gatorade (19meq Na per L). Which of the following scenarios is most likely to occur as a result?

A. Successful restoration of intravascular volume
B. Hyponatremia from excessive free water intake in a high ADH state  
C. Fluid shift from intracellular to extracellular compartment  
D. Metabolic acidosis from increased aldosterone activity  
E. Central pontine myelinolysis

61. Which of the following occurs during moderate volume depletion (15% loss of circulating volume)

A. Vasodilation of the afferent glomerular arteriole from angiotensin 2 activity  
B. Suppression of antidiuretic hormone (ADH) by the pituitary axis  
C. Loss of aldosterone responsiveness in the cortical collecting duct  
D. Increase GFR in order to retain more sodium  
E. Enhanced proximal tubule reabsorption of urea

62. A 24-year-old Asian woman and former intravenous drug addict has peripheral edema, 4g/day of proteinuria and a fall in serum albumin to 2.6g/dL. Serum creatinine is 0.7mg/dL, cholesterol 290mg/dL, C3 and C4 normal, and hepatitis B surface antigen is positive. Urinalysis shows 1.020, 4+ protein and 1-2 RBC/hpf.

A renal biopsy would likely show which of the following:
63. A 30-year-old African American heroin user has been HIV positive since 1996, and had not taken her HIV medications in several years. She is admitted to the hospital with pneumocystis pneumonia and high HIV viral titers. In addition, she has a urinalysis showing 1.010, 3+ protein and hyaline casts, serum creatinine of 1.1mg/dL, serum albumin 3.2g/dL, C3 and C4 normal, and a 24H urine protein of 17g.

A renal biopsy would likely show which of the following:
64. A 59-year-old man has had diabetes mellitus for 21 years complicated by retinopathy and peripheral neuropathy. He has also had hypertension, proteinuria and mild renal failure for five years. His medications are amlodipine, doxazosin and glypizide. Serum creatinine is 1.9mg/dL, and potassium 5.6mEq/L (compared with 1.8mg/dL and 5.4mEq/L six months earlier). Serum glucose is 183 mg/dL.

The potassium level is probably explained by:
   A. amlodipine
   B. doxazosin
   C. hyporeninemic hypoaldosteronism
   D. depressed glomerular filtration rate
   E. osmotic diuresis

65. One cause of an elevated serum potassium concentration is:
   A. hemolysis induced by drawing the blood sample
   B. excess insulin effect
   C. central α-blockers, like clonidine
   D. pheochromocytoma of the adrenal gland
   E. potassium shifts due to alkalosis

66. Vomiting causes hypokalemia through increased renin secretion and:
   A. high urine flow
   B. catecholamines
   C. lactic acidosis
   D. reduced potassium intake
   E. non-reabsorbable anion in the urine
67. Each of the following diuretics is paired with a candidate side-effect. Which of the following diuretics is correctly paired with an associated side effect?

A. Furosemide : ototoxicity
B. Hydrochlorothiazide : hypoglycemia
C. Triamterene : hypokalemia
D. Bumetanide : hyperkalemia
E. Acetazolamide: metabolic alkalosis

A 61-year-old man with a lengthy history of type I diabetes mellitus develops significant water retention and symptoms suggestive of pulmonary congestion. Laboratory studies show:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum creatinine</td>
<td>7 mg/dL</td>
</tr>
<tr>
<td>BUN</td>
<td>75 mg/dL</td>
</tr>
<tr>
<td>Serum sodium</td>
<td>145 mEq/L</td>
</tr>
<tr>
<td>Serum potassium</td>
<td>7.2 mEq/L</td>
</tr>
<tr>
<td>Serum chloride</td>
<td>100 mEq/L</td>
</tr>
</tbody>
</table>

68. Other lab data support a diagnosis of advanced renal disease, possibly as a result of long-standing diabetes. Shortly after the patient begins treatment with a diuretic, he exhibits cardiac conduction changes that progress to heart block and then to cardiac arrest. Which of the following diuretics is most likely responsible for the cardiac effects in this patient?

A. Ethacrynic acid
B. Furosemide
C. Amiloride
D. Mannitol
E. Metolazone

69. Which of the following diuretics is most likely to result in hyperuricemia?

A. Acetazolamide
B. Glycerol
C. Spironolactone
D. Hydrochlorothiazide
E. Triamterene

70. Which of the following diuretics does not require access to the tubule to reach its site of action?

A. Metolazone
B. Spironolactone
C. Furosemide
D. Hydrochlorothiazide
E. Amiloride

71. A 57-year-old woman weighs 80 kg (176 lb), and her blood pressure is 140/96 mm Hg. She has pitting edema in both legs. Her physician prescribes exercise, restricted sodium intake, and a diuretic agent. Taking inappropriately high doses of which of the following diuretics would be most likely to produce profound diuresis and vascular collapse?

A. Hydrochlorothiazide
B. Spironolactone
C. Triamterene
D. Acetazolamide
E. Furosemide

72. Which of the following would be most likely to be useful as a diuretic in a patient with a history of extreme allergic sensitivity to sulfonamides?

A. Acetazolamide
B. Furosemide
C. Hydrochlorothiazide
D. Ethacrynic acid
E. Torsemide

73. Which of the following diuretics would be most likely to be used to alkalinize the urine?

A. Acetazolamide
B. Furosemide
C. Hydrochlorothiazide
D. Ethacrynic Acid
E. Spironolactone

74. A 35-year-old, otherwise healthy, Asian man has blood pressures of 142/92, 134/85 and 137/86 on different office visits over four months. The patient has:

A. Hypertension and requires drug therapy
B. Hypertension and requires lifestyle modifications
C. Pre-hypertension and requires lifestyle modifications
D. Pre-hypertension with no additional risk for cardiovascular events
E. Normal blood pressure with no additional risk for cardiovascular events

75. A 35-year-old obese white woman has new onset diabetes mellitus and an average blood pressure of 137/88. With lifestyle modification, blood pressure averages 134/82. Urinalysis shows 100mg/dL protein. Estimated GFR is 60ml/min. You should:
A. Encourage continued lifestyle modification
B. Add relaxation therapy and antioxidant vitamins
C. Use drug therapy to bring blood pressure below 130/80
D. Look for left ventricular hypertrophy with an electrocardiogram
E. Look for coronary calcification with electron-beam computed tomography

76. Which class of drugs reduce heart rate, cardiac output, peripheral vascular resistance and renin secretion?

A. Diuretics
B. \( \beta \)-blockers
C. \( \alpha_1 \)-blockers
D. Calcium channel blockers
E. ACE inhibitors

77. A 62-year-old man has systolic heart failure and takes low doses of furosemide, spironolactone, metoprolol, amlodipine and captopril. Blood pressure is 142/95. Serum potassium is 5.6mEq/L. You should increase the dose of which drug to reduce blood pressure?

A. Furosemide
B. Spironolactone
C. Metoprolol
D. Amlodipine
E. Captopril

78. The patient in the previous question (immediately before this one) develops a dry cough. Lungs sound clear. Chest x-ray is normal. Pulmonary function tests exclude asthma. Which drug should you stop?

A. Furosemide
B. Spironolactone
C. Metoprolol
D. Amlodipine
E. Captopril

79. A 48-year-old African-American woman has chronic diarrhea from ulcerative colitis. As a result, she has episodes of mild volume depletion and takes potassium supplements for hypokalemia. The patient also has bilateral leg edema from venous insufficiency and takes sertraline for depression. You would treat mild hypertension with:

A. A thiazide
B. A \( \beta \)-blocker
C. An $\alpha_1$-blocker  
D. A calcium channel blocker  
E. An ARB

80. A 63-year-old white male dialysis patient has difficult-to-control hypertension. He makes no urine. His medications include maximum doses of atenolol, doxazocin, minoxidil, diltiazem and captopril. BP is 180/100. He has mild jugular venous distension and 1+ leg edema. Regarding the hypertension, you should:

A. Accept the current BP  
B. Refer the patient to a hypertension specialist  
C. Remove more fluid at dialysis to correct hypervolemia  
D. Add valsartan  
E. Add nifedipine

81. Meperidine is a poor choice for postoperative analgesia because:

A. It is extremely potent.  
B. It is not a mu receptor agonist.  
C. It forms a neuroexcitatory metabolite.  
D. It cannot be given intramuscularly.  
E. It has a very prolonged elimination half-life.

82. Pain intensity can:

A. Be accurately assessed by changes in blood pressure.  
B. Be accurately assessed by nurse observation of patient behavior.  
C. Only be estimated using a numeric pain scale.  
D. Be determined in young children using the faces pain scale.  
E. Be used to determine the exact amount of opioids to be prescribed.

83. Local anesthetic agents:

A. Enter the cell in the uncharged form, but bind to the sodium channel in the charged form.  
B. Enter the cell through the sodium channel.  
C. Inhibits only sodium channels in skeletal muscle.  
D. Block sensation but not motor function when applied in high doses.  
E. Are seldom used for surgery.

84. The advantage of delivering opioids into the spinal canal (intrathecal or epidural) is that:
A. Fewer opioid side effects, such as nausea and vomiting, occur.
B. Much smaller doses of opioids can be administered, reducing sedation and providing improved pain control.
C. The risk of respiratory depression is less than with intravenous opioids.
D. It is technically easier to perform than patient controlled analgesia.
E. You get more selectivity for the type of opioid receptor that is activated.

85. COX-2 inhibitors and nonsteroidal anti-inflammatory agents:
A. Should be avoided in patients with renal insufficiency.
B. Are more potent analgesic agents than the most potent opiates
C. Add little benefit when combined with opioids for pain control.
D. Cause respiratory depression.
E. Must be administered intravenously.

86. Patients who have been receiving opioids for extended periods for the management of chronic pain should:
A. Require less opioids postoperatively.
B. Have their opioid medication held the week prior to surgery.
C. Be expected to require two to three times more opioids than they usually take.
D. Be considered to be addicted to narcotics.
E. Receive a leather strap to bite on after surgery.

87. Oxycodone is available in an immediate release and sustained release dose forms. Patients taking the sustained release dose form should be warned to:
A. Save any unused medication for family members with aches and pains.
B. Always chew their tablets before swallowing.
C. Avoid chewing or crushing their tablets.
D. Finish all their medication even if their pain resolves.
E. Combine their medication with an alcoholic drink to enhance the pain relief.

A 23-year-old man took 200 aspirin tablets (a very dangerous dose – over 60 grams). He is brought into the emergency room by his girlfriend, who says that he told her he was trying to kill himself but thought better of it. He therefore called her and told her that he had taken the aspirin about 12 hours before calling her. When he arrives in the emergency room, he is awake but disoriented (he doesn’t know where he is), he has a temperature of 102 degrees, and he appears to be hyperventilating. Based on your understanding of salicylate poisoning, answer the following questions, each of which has a single best answer.

88. Given this patient’s age, the most likely reason he is hyperventilating is that:
A. He is agitated and upset.
B. His blood sugar is low.
C. The aspirin is directly stimulating his respiratory center.
D. His blood ammonia is high.
E. He is compensating for severe metabolic acidosis.

89. The most likely explanation for his fever is which of the following?

A. He has an intercurrent infection that is causing his fever.
B. The aspirin is causing widespread uncoupling of oxidative phosphorylation, which results in the generation of excess heat.
C. His agitation is leading to increased muscle activity, leading to fever.
D. He took a drug other than aspirin, one that has fever as a side effect.
E. He has Reye syndrome.

90. Four hours after arriving the initial salicylates level was obtained, a repeat level is measured. During the interval, it has gone from 130 mg/dl to 111 mg/dl. The correct interpretation of the fall in the level is which of the following?

A. The falling level is reassuring and is primarily a function of the renal excretion of intact salicylate.
B. The falling level is reassuring and is primarily a function of the hepatic metabolism of the salicylates.
C. Although the level is falling, tissue levels might be rising. The decrease is not reassuring.
D. Since the level is falling (for whatever reason), further observation is warranted prior to considering an aggressive approach to treatment.
E. The blood levels are not interpretable.

91. Six hours after coming to the emergency room, the patient’s clinical status progresses to frank coma. A decision is made to reduce the patient’s total body aspirin burden. Which of the following is the most effective way to do this?

A. Give steroids to induce the P450-dependent routes of salicylate metabolism.
B. Administer of IV fluids and bicarbonate (to alkalinize the patient’s urine) to promote salicylate excretion.
C. Give acetazolamide (Diamox) until his arterial pH rises above 7.5 (normal is approximately 7.4) in order to alkalinize the patient’s serum and urine.
D. Start peritoneal dialysis.
E. Start hemodialysis.

92. If this patient had taken a smaller amount of aspirin, the calculated volume of distribution would have been _________ that associated with the higher dose.

A. … the same as …
B. … lower than …
C. … higher than …

93. The action of salicylate that best accounts for its severe toxicity is:

A. Its ability to uncouple oxidative phosphorylation.
B. Its action of inhibiting platelet aggregation and hemostasis.
C. Its propensity for causing cardiac arrhythmias.
D. Its ability to cause membrane depolarization in neurons.
E. Its ability to profoundly inhibit renal tubular function.

94. KT/V is the current standard for dialysis adequacy. Which of the following statements is true?

A. KT/V is dimensionless
B. V stands for patient weight in kilograms
C. K stands for urea mass transfer coefficient in min/cm
D. T stands for the number of dialysis treatments per week

95. In order to provide a 90 Kilo dialysis patient a KT/V of 1.2 in a five hour dialysis treatment, the hemodialyzer urea clearance must be at least:

A. 280 ml/min
B. 168 ml/min
C. 138 ml/min
D. Not enough information is given to calculate this answer

96. Which of the following will not increase urea clearance during dialysis?

A. Increasing the length of the treatment
B. Increasing the blood flow rate
C. Increasing the dialysate flow rate
D. None of the above

97. The preferred vascular access for hemodialysis is:

A. A fistula
B. A graft
C. Subclavian
D. All three are equivalent

98. Mortality rates for dialysis patients in the United States is:
A. The same as that reported in Europe  
B. Significantly less than that reported in Europe  
C. Significantly greater than that reported in Europe

99. Which major breakthrough accounted for the greatest improvement in transplantation results?  
A. The ability to create a vascular anastomosis.  
B. Improved understanding of human leukocyte antigens (HLA) – T-cell receptor complex interactions.  
C. The discovery of cyclosporine.  
D. The application of cross match testing.

100. Which of the following statements about current immunosuppressive medications is true?  
A. The mechanism of action of prednisone is based on its ability to interfere with NF-κB  
B. Tacrolimus blocks signal transduction from the IL-2 receptor.  
C. Mycophenolate mofetil inhibits the production of pyrimidine nucleotides.  
D. None of the above.

101. Regarding protein immunosuppressive drugs, which is false?  
A. Thymoglobulin is a polyclonal IgG that blocks T-cell membrane proteins.  
B. Basiliximab (IL-2R mAb) is a nondepleting antibody that lowers the risk of acute rejection.  
C. A side effect of OKT3 is the cytokine-release syndrome.  
D. Since induction therapy is only used in the early period after transplantation, there is no increased long-term cancer risk associated with these agents.

102. Cyclosporine is difficult to use in kidney transplantation because:  
A. The primary adverse effect is nephrotoxicity  
B. It has a narrow therapeutic index  
C. Administration is prophylactic, rather than therapeutic  
D. All of the above.

103. Regarding tacrolimus (Prograf), which of the following statements is true?  
A. Tacrolimus is a cyclic peptide derived from soil fungus, whose primary action is to limit γ-interferon production.  
B. Clinical side effects commonly include neutropenia, stomach upset and diarrhea.
C. The major advantage of tacrolimus is inhibition of immunologic memory.
D. High levels of tacrolimus predispose to neurotoxicity and post-transplant diabetes mellitus.

104. After transplant a patient presents to clinic with headaches, tremor and hyperkalemia. The blood pressure is 180/100. Renal function is marginally worse with a creatinine of 1.8 mg/dl. Which drug most likely contributes to this constellation of complaints?

A. Azathioprine
B. Tacrolimus
C. Mycophenolate mofetil
D. Prednisone

105. Regarding sirolimus (Rapamune), which statement is false?

A. Binds to the immunophilin FKBP.
B. Exerts its effect by inhibiting the mammalian Target of Rapamycin.
C. Cannot be used with cyclosporine.
D. Is an antimetabolite that inhibits wound healing and predisposes to lymphoceles.