NAME _____

DATE _____

Carolina BioKits™

Urinalysis and Examination

Background

Normally, urine consists of approximately 95% water and 5% dissolved solids such as urea and sodium chloride. Almost all substances found in urine also are found in blood, but at different concentrations. Some substances, such as glucose, have a threshold that must be exceeded before the substance is excreted in the urine. The presence of such substances in the urine usually indicates disease.

Normal urine colors range from light yellow to amber, depending upon the concentration of urochrome, the urinary pigment. Food, drugs, and disease can cause lighter or darker urine. The pH of a solution is a measure of its free hydrogen ion (H^+) concentration, which indicates acidity or alkalinity. A solution with a pH of 7.0 is neutral. A solution with a pH less than 7.0 is acidic, and a solution with a pH greater than 7.0 is basic. Typically, the pH of normal urine is 6.0, which is slightly acidic. Foods and diseases that can affect urine pH are listed in the following chart.

Table 1. Urine Color and Possible Causes

Color	Diet	Drugs	Disease
light yellow to amber	normal	none	none
clear to light yellow	increased fluid intake	alcohol, phosphate, carbonate	uncontrolled diabetes mellitus
yellow orange to dark green	carrots	antibiotics	bilirubin from obstructive jaundice
red to red brown	beets	laxatives	hemoglobin in urine
smoky red	beets	anticonvulsants	unhemolyzed red blood cells from urinary tract
dark wine	beets	anti-inflammatory drugs	hemolytic jaundice
brown black	rhubarb	antidepressants	melanin pigment from melanoma
brown	rhubarb	barbiturates	anemia or liver infections
green	green food dyes	diuretics	bacterial infection

Specific gravity is the density of a solution relative to water, which has a specific gravity of 1.000. The specific gravity of normal urine ranges from 1.010 to 1.025. Specific gravity varies according to fluid intake and can be affected by disease.

Glucose (sugar) should not be detected in normal urine; its presence usually indicates diabetes mellitus, a severe metabolic disorder caused by defective carbohydrate utilization. Glucose may also be present in the urine after a big meal or during times of emotional stress.

A very small amount of protein is normally present in the urine. Any change in the color of a protein test strip indicates an elevated level of protein in urine. Diet and disease can affect protein levels in urine. For example, patients with severe anemia usually excrete protein in their urine.

Table 2. Abnormal Urinalysis Results and Possible Causes

	Possible Causes	
Test Result	**Diet**	**Disease**
Low pH (<5)	high protein diet; cranberry juice	uncontrolled diabetes mellitus
High pH (>8)	diet rich in vegetables; dairy products	severe anemia
Low Specific Gravity (<1.025)	increased fluid intake	severe renal damage
High Specific Gravity (>1.025)	decreased fluid intake; loss of fluids	uncontrolled diabetes mellitus; severe anemia
Glucose Present	large meal	uncontrolled diabetes mellitus
Protein Present	high-protein diet	severe anemia

Pre-laboratory Questions

1. What are the normal results for urine tests in regards to:
   a. color:
   b. pH:
   c. glucose:
   d. protein:
   e. specific gravity:
2. What test results would you expect from a person with diabetes mellitus?
   a. color:
   b. pH:
   c. glucose:
   d. protein:
   e. specific gravity:

For Pre-Lab questions 3 & 4, *please cite any outside reliable sources used in APA citation*

3. Since proteins cannot pass across the basement membrane during ultrafiltration, proteins are present in blood plasma, but should not be present in glomerular filtrate or urine. Describe what occurs then when a person has **proteinuria**, an abnormal accumulation of protein in the urine.

4. Why is it necessary to record the specific gravity using a hydrometer when during urinalysis?

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Urinalysis and Examination

Activity 1

In this activity, you will perform five important tests routinely done in clinical urinalysis: color, pH, specific gravity, glucose, and protein. The Low, Normal, and High simulated urine samples are designed to produce results indicative of those characteristics.

Materials

At the lab station:

5 plastic urine specimen containers
6 disposable pipets
5 Urine Reagent strips
5 pH strips
absorbent paper towel

At the central materials station:

hydrometer and jar
distilled or deionized water
pH chart
2 marking pens
5 simulated urine specimens
5 10-mL graduated cylinders

Procedure

1. Take three plastic urine specimen containers to the central materials station. Use a marking pen to label the containers *Low*, *Normal*, and *High*. Use the labeled graduated cylinders at the central materials station to transfer 10 milliliters of Low, Normal, and High Simulated Urine to the appropriate labeled containers.
2. Return to your lab station. Place the containers of simulated urine on the absorbent paper towel. Observe the samples, and record the color of each sample in your Laboratory Data table.
3. Use a pen or pencil to label one end of three of the pH test strips *L*, *N*, and *H*.
4. Holding the labeled end, dip the *L* strip into the Low sample. Shake off any excess liquid. Lay the pH strip in front of the Low sample on the absorbent paper towel. Repeat the process with the Normal (*N* strip) and High (*H* strip) samples.
5. Compare the color of the test trip to the pH color chart at the central materials station. In your Laboratory Data table, record the pH of each sample.
6. Label the plastic portion of three Urine Reagent strips *L*, *N*, and *H*, respectively.
7. Test each sample for glucose and protein using a Urine Reagent strip, as follows:
   a. Observe the color of the test squares that are attached at one end of the Urine Reagent strip. The greenish square nearest the tip will be used for testing the glucose in the sample; the yellow square will detect protein in the sample.

b. Dip the end of the strip with the test squares into the urine sample, and then withdraw it. Run the end of the strip against the rim of the urine container to remove excess urine.

c. Wait 30 seconds, then observe and record the color of the test squares.

- *Green square:* A negative result produces no color change, indicating normal or low urine glucose. A darkening of the square indicates a higher than normal urine glucose level; the darker the color, the higher the glucose level.
- *Yellow square:* A negative result produces no color change, indicating the absence of protein in the urine. A green or blue color indicates the presence of protein in the urine sample.

8. If your teacher has not already done so, calibrate the hydrometer, as follows:

a. Rinse the urine hydrometer and jar thoroughly.

b. Use a clean pipet to fill the jar slightly more than half-full with distilled or deionized water.

c. Insert the hydrometer as shown in the figure. The hydrometer should not touch the bottom of the jar. If it does touch, use a pipet to add water to the jar until the hydrometer floats.

d. Read the water level on the hydrometer scale, and record the value in your Laboratory Data table. Units on the hydrometer scale are 1.000, 1.020, 1.040, and 1.060. If the measured value is not 1.000, the standard specific gravity for water, you will need to adjust your urine measurements to compensate. The calibration factor is the value that must be added to or subtracted from the measurement to equal 1.000.

e. Record the calibration factor for the hydrometer in your data table.

f. Remove the hydrometer from the jar. Mark the level of the water remaining in the jar. You will use this line as the fill line when analyzing your samples.

g. Empty the jar.

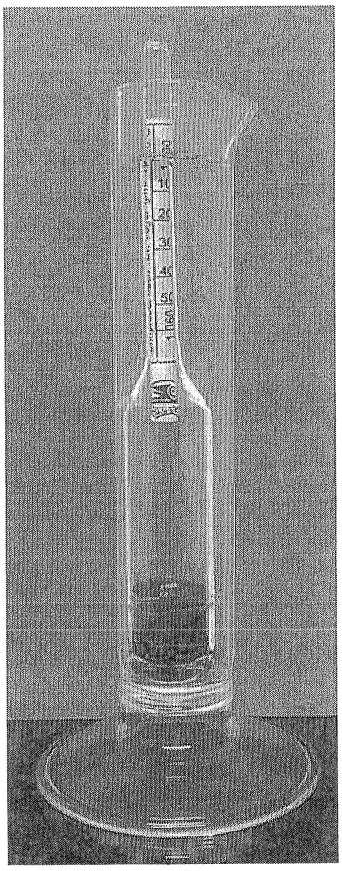

Figure 1. Calibration of the hydrometer

9. Measure the specific gravity of Simulated Urine Low.

a. Rinse the urine hydrometer and jar thoroughly.

b. Use a clean pipet to fill the jar to the fill line with the sample.

c. Insert the hydrometer into the jar as shown in the figure.

d. Read the fluid level on the hydrometer scale, and record the value in your Laboratory Data table.

e. Add or subtract the calibration factor from your measurement. Record the adjusted value in your Laboratory Data table.

10. Repeat the specific gravity test for the Normal and High samples, and record the results in your Laboratory Data table.

11. Repeat the procedure for samples Unknown A and Unknown B. Analyze the color, pH, glucose, protein, and specific gravity of these samples, and record the results in your Laboratory Data table.