Examination of Urine (Physical and Chemical)

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Clinical Pathology 4th Class

Examination of urine

Physical

1. Volume
2. Color
3. Odor
4. Turbidity
5. Foaming
6. Specific Gravity

Chemical

1. pH
2. Protein
3. Glucose
4. Ketone bodies
5. Blood
6. Bile salt
7. Bile pigment
8. Urobilinogen

Indications of urinary analysis

1. **Detection of Renal diseases like glomerular nephritis , pyelonephritis and renal failure**
2. **Detection of metabolic disorders like diabetes mellitus**

Preservation of Urine sample:

1. **Hydrochloric acid:** It is used for preservation of a 24-hour urine sample for adrenaline, noradrenaline, and steroids.

2. **Toluene:** It forms a thin layer over the surface and acts as a physical barrier for bacteria and air. It is used for measurement of chemicals.

3. **Boric acid:** A general preservative.

4. **Thymol:** It inhibits bacteria and fungi.

1. **Formalin:** It is an excellent chemical for preservation of formed elements.

What happens when urinary analysis is delayed?

1. **Increase in pH**: Due to production of ammonia from urea by urease producing bacteria.
2. **Formation of crystals**: Precipitation of phosphate and calcium.
3. **Loss of ketone bodies**: since they are volatile.
4. **Decrease in glucose**: Due to glycolysis and utilization of glucose by cells and bacteria.
5. **Oxidation of bilirubin to biliverdin**: false-negative test for bilirubin
6. **Bacterial proliferation**
7. **Disintegration of cellular elements**

Physical Examination of Urine

1. Urine volume

1) Polyuria	2) Oliguria	3) Anuria
Increase daily urine volume	Decrease daily urine volume	Absence of urine production
Diabetes mellitus	Acute interstitial nephritis	Dehydration

2. Urine Color

a) Normally the color of urine is water color to Amber color.

b) Hematuria and drugs like: Phenothiazine : Red color urine.

c) Hemoglobinuria: Brown to red color.

d) Icterus: Yellow brown color to greenish yellow.

e) Pyogenic infections of kidneys: Yellowish green color.

f) High fever/dehydration due to diarrhea/ vomiting: Yellow orange to reddish color.

g) Azoturia in horses: Brown to black color of urine.

h) Acriflavin treatment: Green colored urine.

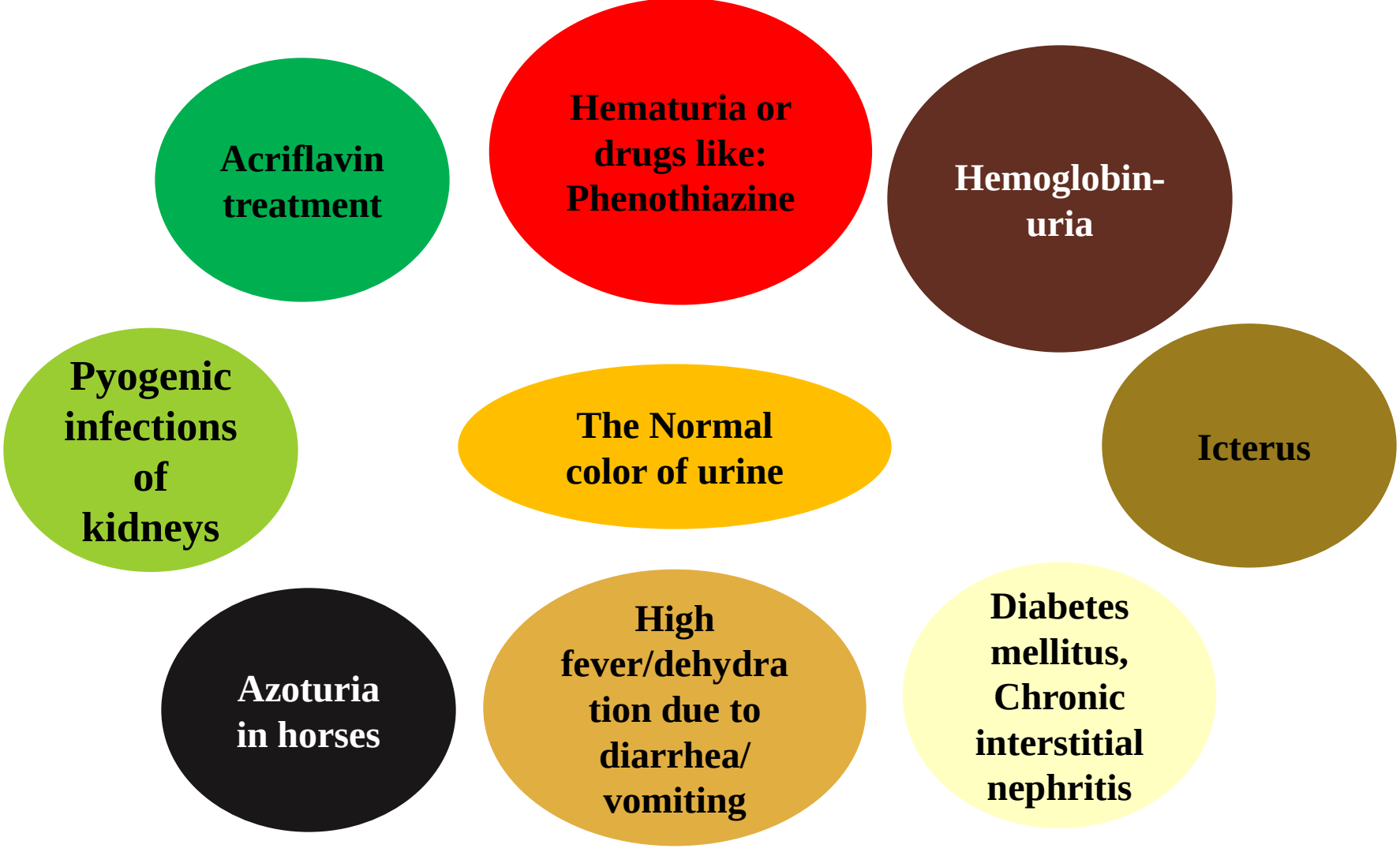
i) Pale colored urine in Diabetes mellitus, Increased water uptake and Chronic interstitial nephritis.

Urine color

Hematuria

Hemoglobinuria

Normal Color


Acriflavin treatment
Hematuria or drugs like: Phenothiazine
Hemoglobin-uria
Pyogenic infections of kidneys
The Normal color of urine
Icterus
Azoturia in horses
High fever/dehydration due to diarrhea/ vomiting
Diabetes mellitus, Chronic interstitial nephritis

3) Urine Odor

*Normal odor of urine

- The normal odor is derived from volatile organic acids present
- Male of certain species (Feline, Canine and Caprine) has an especially strong odor

*Ketosis

- The odor of urine becomes sweetish or fruity

*Pyogenic infections of kidneys

- Fetid odor (ammonia)

4) Turbidity: Suspended materials can be sedimented by centrifugation and examined microscopically

Normal urine

Normal urine is clear when freshly collected in all animals except in the Horses which is normally thick and cloudy due to the presence of calcium carbonate crystals and mucus.

Turbid urine

Turbid or cloudy urine is observed when leukocytes, erythrocytes, epithelial cells, bacteria, mucus, fat and crystal are present

5) Foaming: On shaking, the normal urine produces white foams

Proteinuria	• The Amount of Foam is in Excess Which Remains for a Longer Duration
Yellow or Green foam	• In icteric animals due to bile salt
Red or Brown Foam	• Hemoglobinuria

Foam test

6) Specific Gravity: The specific gravity of urine is measured by urinometer. Urine specific gravity is 1.015-1.045.

Specific Gravity increase in Oliguria

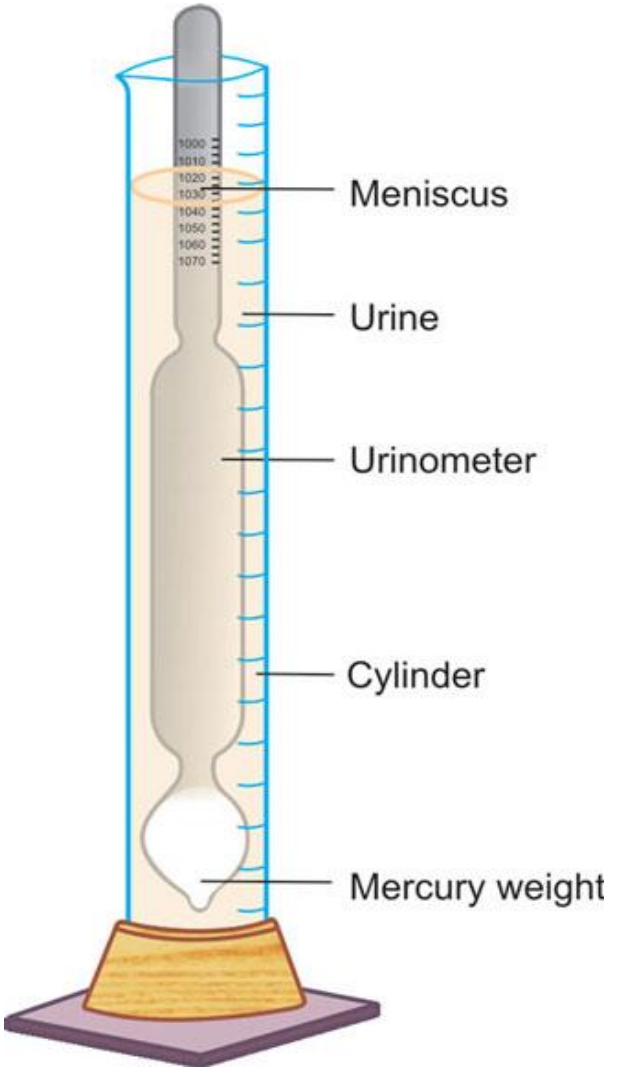
(Acute interstitial nephritis, cystitis, diabetes mellitus and dehydration)

Specific Gravity decrease in Polyuria

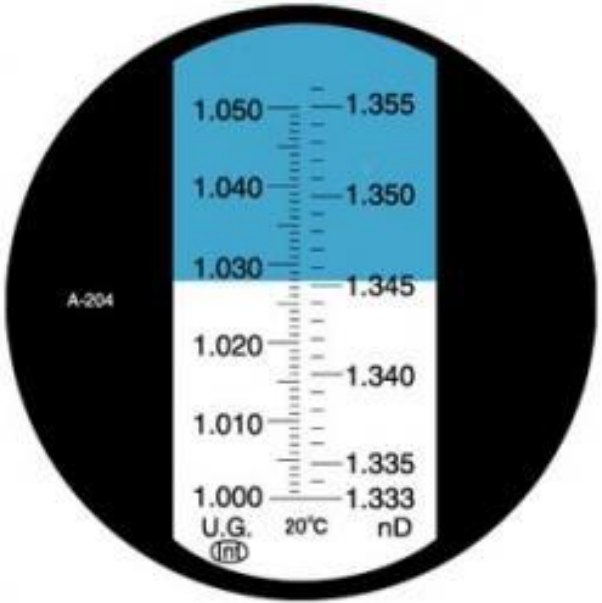
(Chronic interstitial nephritis, pyometra and diabetes insipidus)

Procedure of Specific Gravity

1) Urinometer



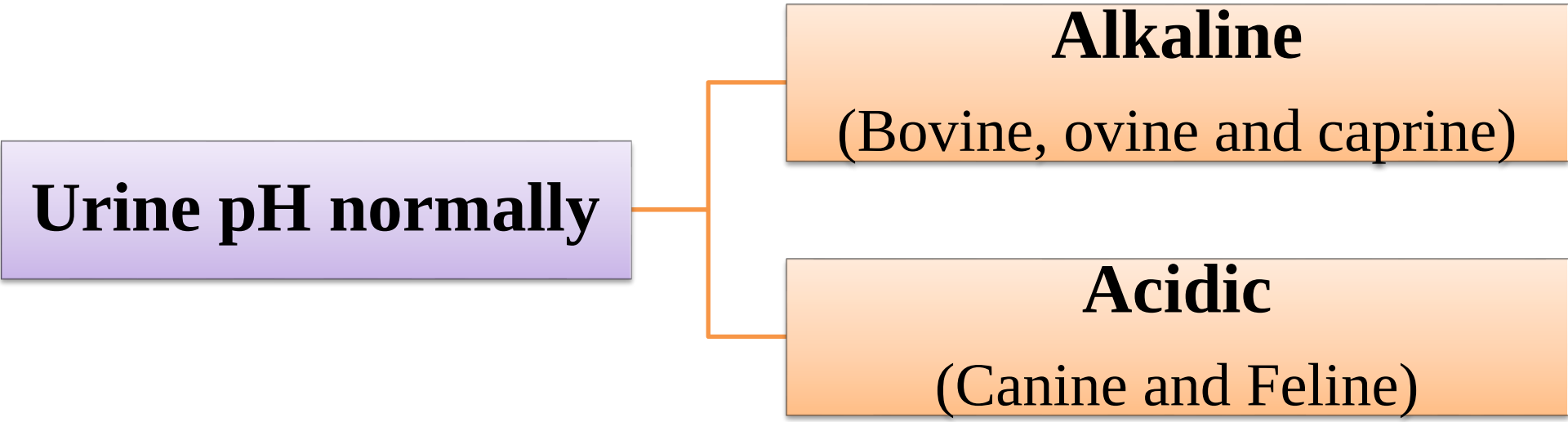
2) Refractometer (TS meter)



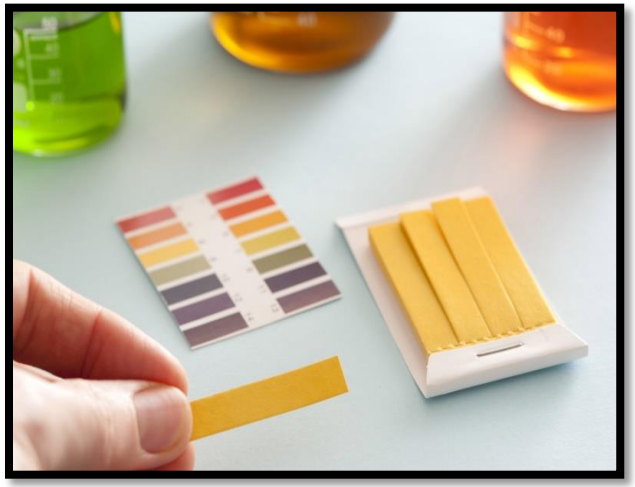
Chemical Examination

1) Urine pH

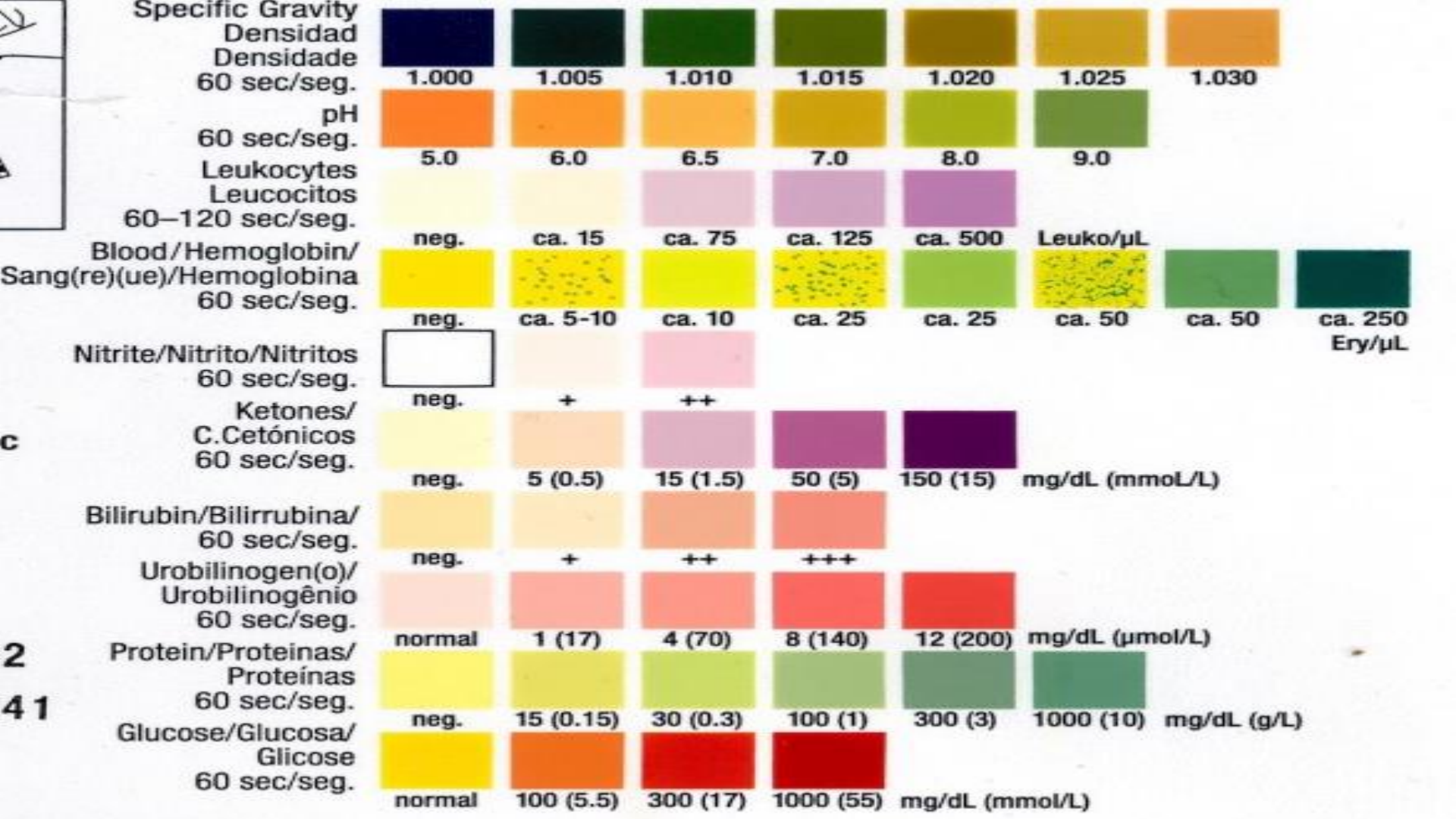
Normal value of urine pH in any animal species depend on the diet and state of metabolism. Urine pH can be determined by pH paper strips



1) pH paper strips



2) pH Meter


Specific Gravity
Densidad
Densidade
60 sec/seg.
1.000
1.005
1.010
1.015
1.020
1.025
1.030
pH
60 sec/seg.
5.0
6.0
6.5
7.0
8.0
9.0
Leukocytes
Leucocitos
60–120 sec/seg.
neg.
ca. 15
ca. 75
ca. 125
ca. 500
Leuko/µL
Blood/Hemoglobin/
Sang(re)(ue)/Hemoglobina
60 sec/seg.
neg.
ca. 5-10
ca. 10
ca. 25
ca. 25
ca. 50
ca. 50
ca. 250
Ery/µL
Nitrite/Nitrito/Nitritos
60 sec/seg.
neg.
+
++
Ketones/
C.Cetónicos
60 sec/seg.
neg.
5 (0.5)
15 (1.5)
50 (5)
150 (15)
mg/dL (mmoL/L)
Bilirubin/Bilirrubina/
60 sec/seg.
neg.
+
++
+++
Urobilinogen(o)/
Urobilinogênio
60 sec/seg.
normal
1 (17)
4 (70)
8 (140)
12 (200)
mg/dL (µmol/L)
Protein/Proteinas/
Proteínas
60 sec/seg.
neg.
15 (0.15)
30 (0.3)
100 (1)
300 (3)
1000 (10)
mg/dL (g/L)
Glucose/Glucosa/
Glicose
60 sec/seg.
normal
100 (5.5)
300 (17)
1000 (55)
mg/dL (mmol/L)

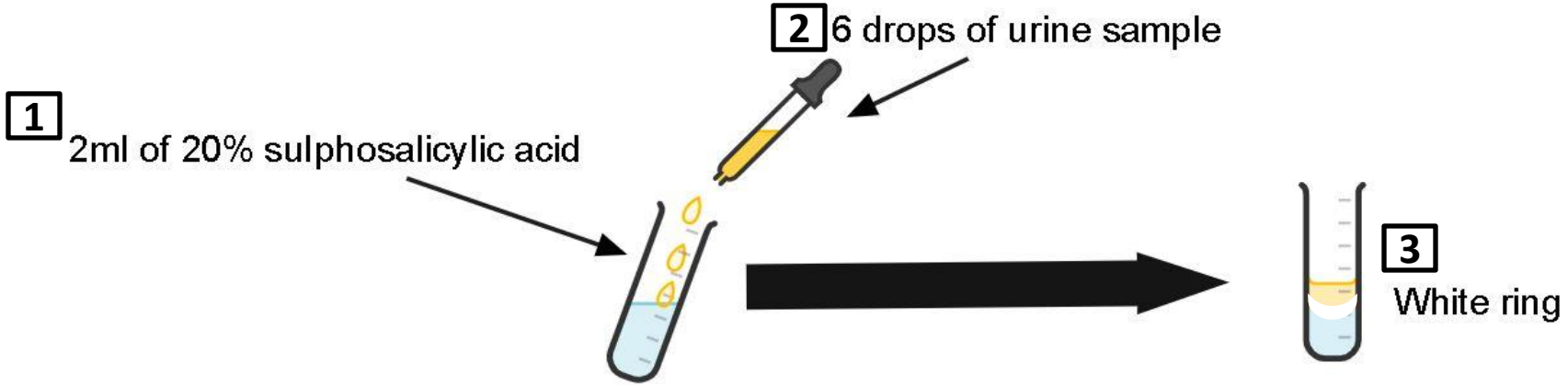
Interpretation

Alkaline urine occur in cystitis, ingestion of salts such as sodium lactate, sodium bicarbonate, metabolic and respiratory alkalosis and when urine allowed to stand open to air at room temperature

Acidic urine: result from starvation, fever and metabolic or respiratory acidosis

2) Protein in Urine

Protein in urine can be estimated through Roberts' test as follows:



Development of white ring at the junction between the acid and urine sample indicates the presence of protein

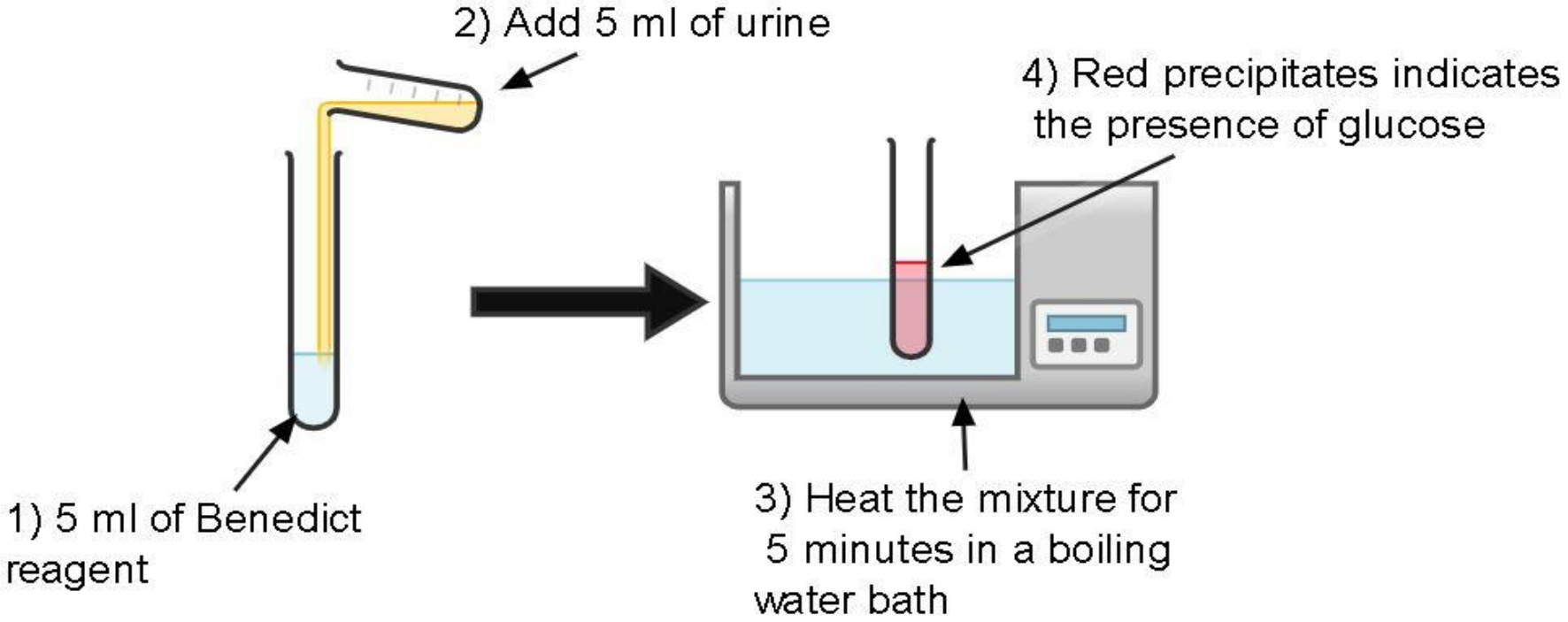
Interpretation

Causes of Proteinuria:

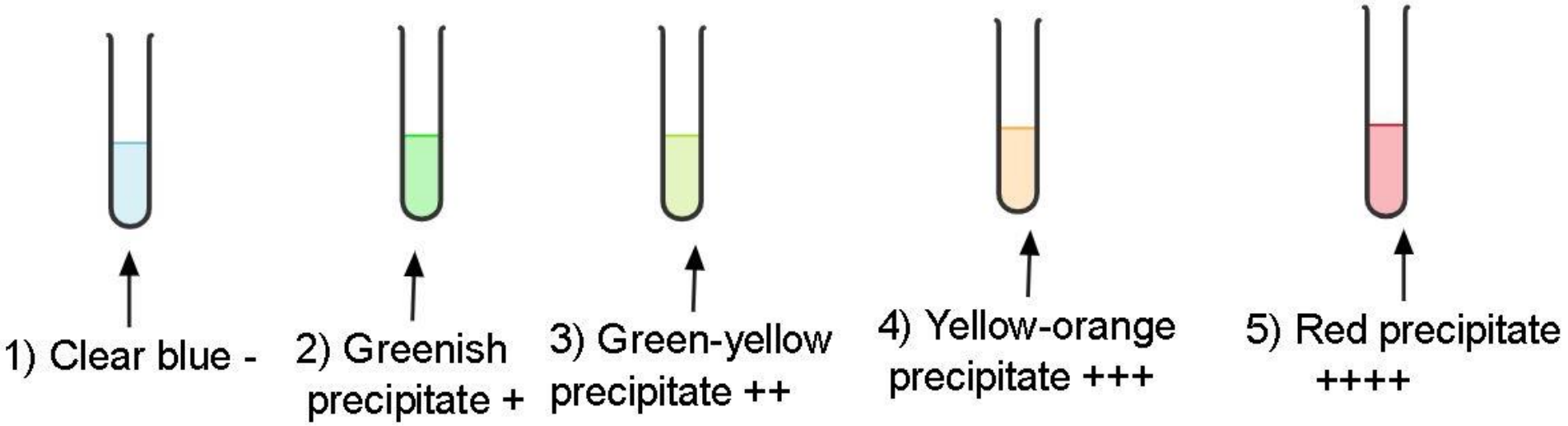
1. **Tissue destruction and necrosis**
2. **Fever & sever inflammatory processes**
3. **Renal diseases (Increased glomerular filtration of protein, failure of tubular reabsorption of protein, tubular secretion of protein, protein leakage from damaged tubular cells).**
4. **Diabetes mellitus**

3) Glucose in urine:

Several methods are available for both qualitative and quantitative estimation of glucose in the urine. The simplest method is the use of Benedict reagent.



Benedict test gives the following results:



Interpretation

Glucosuria occurs in the case of:

a. Diabetes mellitus

b. Excessive administration of glucose-containing fluids

c. Renal tubular disorders

d. Stress or sever excitement

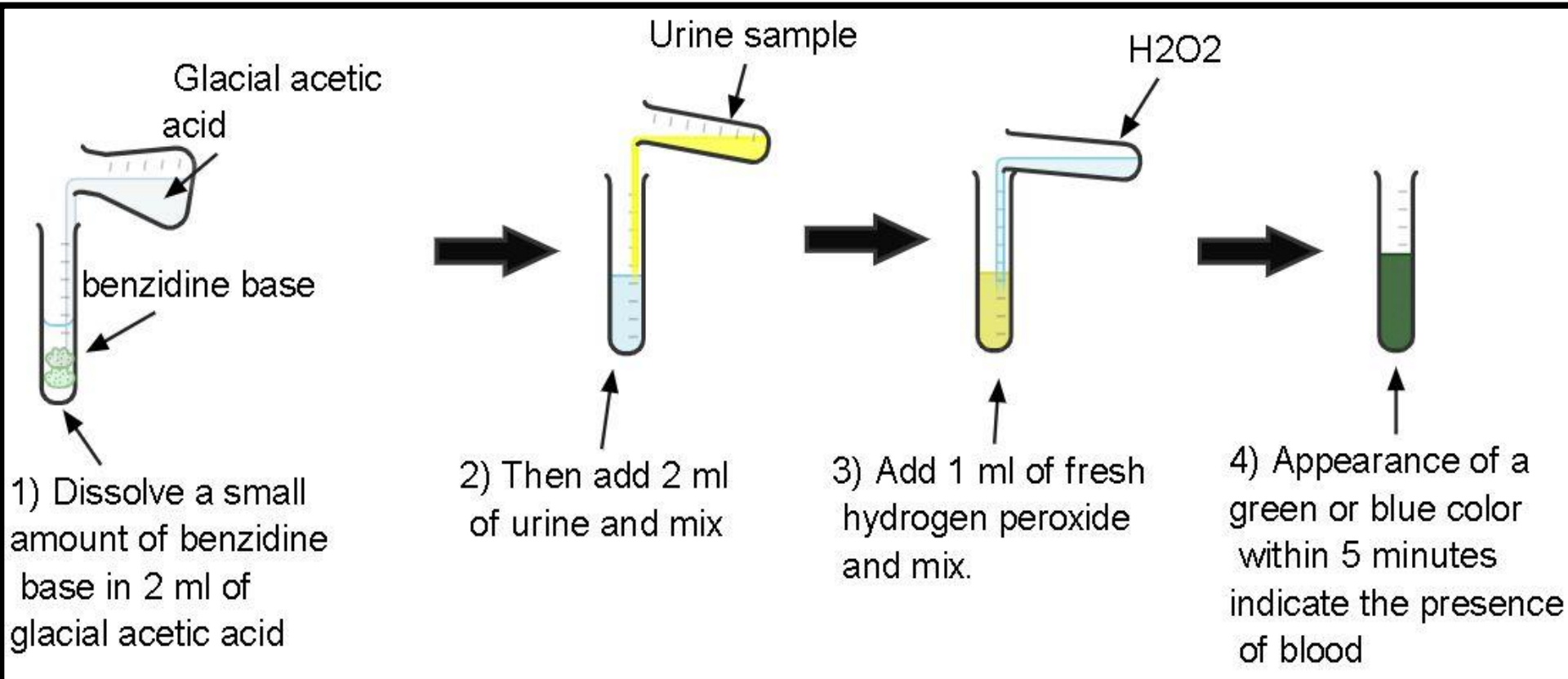
4) Ketones in Urine

Sodium Nitroprusside Test has been widely utilized for the detection of ketone bodies in the urine, Ketonuria occur in:

1. **Diabetic ketoacidosis**
2. **Prolonged fasting or starvation**
3. **Low carbohydrate diet**
4. **Persistent fever**

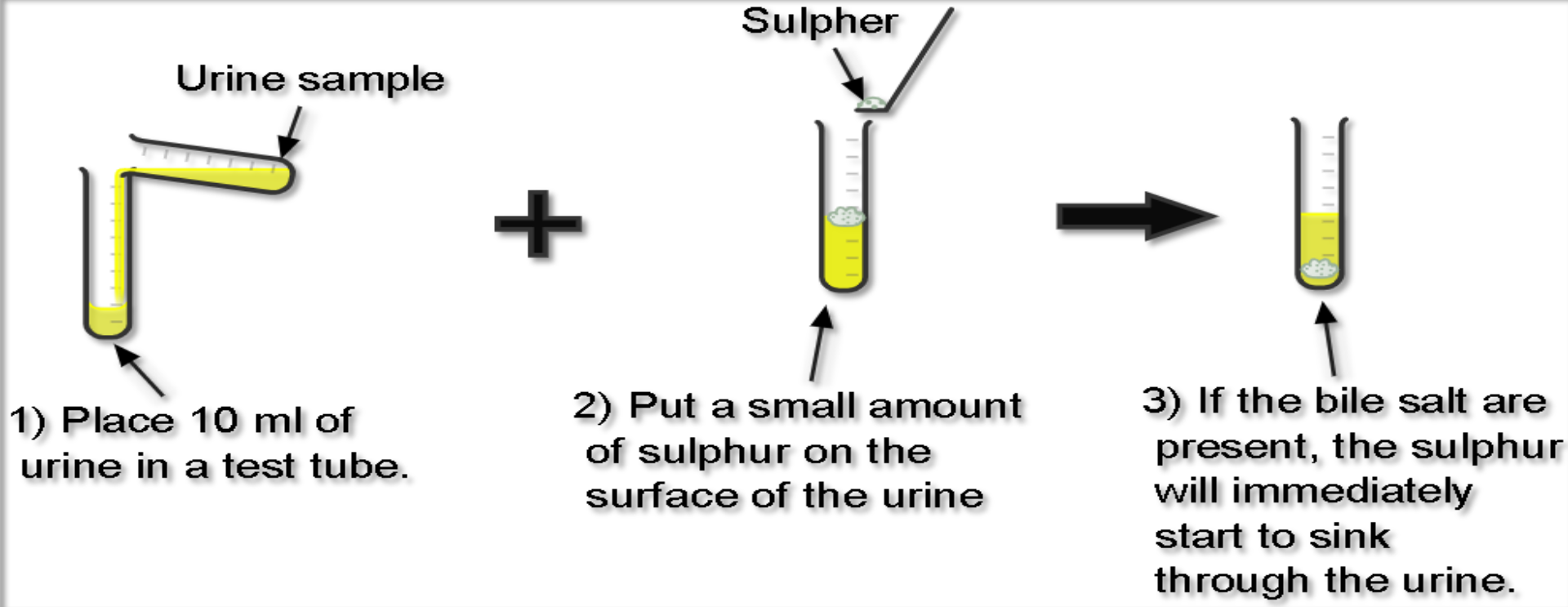
5) Blood in Urine

Blood may be present in the urine in the form of non-districted erythrocytes (Hematuria) or the pigment hemoglobin (Hemoglobinuria)



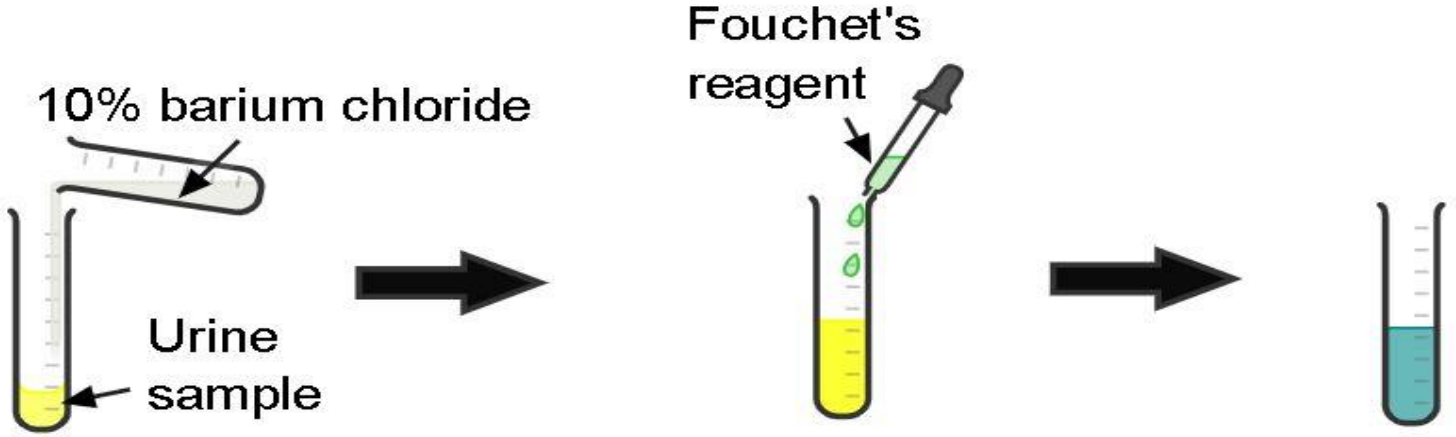
6) Urine Bile salt:

This test is based on the fact that bile salt when present in the urine lower the surface tension Hay's test, Bile salts are present together with bile pigments in the urine in obstructive jaundice.



7) Urine bile pigments:

Harrison test is used to detect the presence of bile pigments in urine. Urine bile pigments occurs in Moderate to severe hepatocellular damage and obstruction of bile duct.



1) Take 3 ml of urine and add 3 ml of 10% barium chloride in a test tube

2) Mix and centrifuge, then Discard the superannuate fluid and add 1 to 2 drops of Fouchet's reagent

3) If bilirubin is present greenish blue color will apear

8) Urobilinogen in urine:

Ehrlicks' benzaldehyde test:

1. **In hemolytic jaundice urobilinogen presence in high amounts.**
2. **In obstructive jaundice complete absence of urine urobilinogen.**