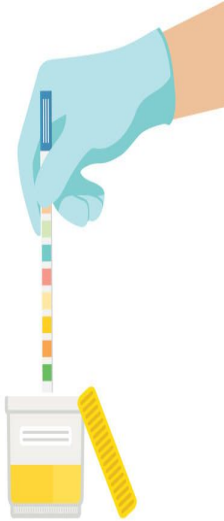




MED437  
KING SAUD UNIVERSITY



## Practical Biochemistry Urinalysis

Done by

**FATIMA BALSCHARAF**

**Moath Alhamoud**

- Haifa Alessa
- Faisal Altahan
- Razan Alzahrani
- Noura Alharbi

Objectives:

Understand the physical and chemical examinations of urine in health and disease.

- Perform urinalysis using Dipsticks.
- Recognize the value of urinalysis as a tool for diagnosis of diseases e.g. metabolic diseases, kidney disorders and for urinary tract infections (UTIs).
- Interpret the results of urinalysis and correlate it with the patient's clinical findings.

**WISHING YOU THE BEST OF LUCK ...**

**Color Index :-**

**•VERY IMPORTANT**

**•Extra explanation**

## Urine:

- Urine is a fluid excreted by most of mammals including humans.
- It is formed in the kidneys (renal glomeruli).
- The fluid undergoes chemical changes before it is excreted as urine.
- Normal urine excretion by a healthy person is about **1.5 L** per day.

Physical Properties of urine			
PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES you have to know at least 2
Volume	0.4-2.0 L/day	Polyuria	Diabetes, chronic renal failure
		Oligouria	Dehydration, Acute renal failure
Appearance	Clear(it means no particles)	Cloudy(all solution is unclear)	Presence of pus cells, bacteria, salt or epithelial cells
Colour	Pale Yellow (Amber)	Colorless	Excessive fluid intake, uncontrolled DM, DI, chronic renal failure
		Orange	Dehydration, carotenoid ingestion
		Yellow-Green	Jaundice
		Red	Blood, drugs etc
		Dark brown-black	Methemoglobin, alkaptonuria, melanoma, black water fever
		smoky(means proteins+all solution is unclear,except some area will show clear)	glomerulonephritis
Odor	Urineferous	Fruity	Diabetic ketoacidosis
		Ammoniacal	Contaminated and long standing exposed urine
		Mousy	Phenylketonuria
		Burnt sugar	Maple syrup urine disease
Deposits	None	Crystals, salts or cells	Blood clots, necrotic tissues and urinary stones
Reaction (pH)	4.6 - 7.0	Acidic	ketosis (diabetes mellitus & starvation), severe diarrhea, metabolic and respiratory acidosis, excessive ingestion of meat and certain fruits
		Alkaline	Respiratory and metabolic alkalosis, Urinary tract infection, Vegetarians

## Chemical Properties of urine

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES you have to know at least 2
Protein	< 200mg/day	Proteinuria	Nephrotic syndrome, glomerulonephritis,, multiple myeloma, lower UTI, tumors or stones
Glucose	None	Glucosuria	Uncontrolled DM, gestational diabetes, Fanconi's syndrome
Ketones	None	Ketonuria	Diabetic ketoacidosis, Glycogen storage disease, starvation, Prolonged vomiting, Unbalanced diet: high fat & Low CHO diet
Nitrite	None	Detected	UTI
Bilirubin	None	Detected	Hepatic and post-hepatic jaundice
Urobilinogen	Normal Trace (1mg/dl)	> 2 mg/dl	Jaundice
Blood	None	Hematuria	Acute & chronic glomerulonephritis, <i>Trauma</i> , <i>cystitis</i> , <i>renal calculi and tumors</i> , Bleeding disorders ( <i>Hemophilia</i> ).
		Hemoglobinuria	Hemoglobinopathies, Malaria, Transfusion reaction ( <i>Blood Incompatibility</i> )

## Proteins:

Normally **less than 200 mg** protein is excreted in the urine daily; more than this level leads to a condition called “**Proteinuria**”.

- **Glomerular proteinuria:**

It is due to ↑ glomerular permeability → filtration of high molecular weight proteins ( e.g. glomerulonephritis).

- **Tubular proteinuria:**

It occurs as a result of ↓ tubular reabsorption with normal glomerular permeability → excretion of low molecular weight proteins (e.g. chronic nephritis)

### **Nephrotic syndrome:**

Large amounts of protein are lost in the urine and hypoproteinaemia develops.

Increase protein excretion in urine can be one of the following two types:

A: High molecular weight protein excretion: Glomerular proteinuria due to increase glomerular permeability leading to filtration of high molecular weight proteins

B: Low molecular weight protein excretion: Tubular proteinuria due to decrease reabsorption with normal glomerular permeability

## Urinalysis (using dipstick): Principle:

- ❖ Dipsticks are plastic strips impregnated with chemical reagents which react with specific substances in the urine to produce color-coded visual results.
- ❖ They provide quick determination of pH, protein, glucose, ketones, urobilinogen, bilirubin, blood, hemoglobin, nitrite, and specific gravity. The depth of color produced relates to the concentration of the substance in urine.
- ❖ Color controls are provided against which the actual color produced by the urine sample can be compared. The reaction times of the impregnated chemicals are standardized.

## Procedure:

- ❖ Dip the strip in the urine sample provided then remove it immediately.
- ❖ Remove the excess urine and keep the strip in a horizontal position.
- ❖ **Read the color produced after 1 minute and read in the next 1 minute (Color changes after more than 2 minutes are of no significance).**
- ❖ Match the color changes to the color scale provided. ( Compare it to control sample )
- ❖ Give a full report about:
  - Physical examination - Chemical examination



## Case I (Urine Sample I)

A 12-year-old girl, a known patient with T1DM, presented to Emergency drowsy with short history of vomiting and abdominal pain. On examination:

- Tachycardia
- Tachypnea with a **fruity smell of breath.**
- BP: 85/50 mmHg (Ref range: 100/66-135/85 mmHg)
- Blood sugar: **26.7 mmol/L** (Ref range: 3.9-5.6 mmol/L)
- HbA1C: 9.9% (Ref range: 5.7-6.4%)
- Blood pH: **7.1** (Ref range: 7.35-7.45)
- **Circulating Ketone bodies: positive**

A mid stream Urine sample was collected for complete urinalysis.

**Q1) Do urinalysis using dipsticks and give a full report regarding:**

**A- Physical examination.** Polyuria, **Fruity Odor**, Acidic PH, colorless (usually the rest are normal)

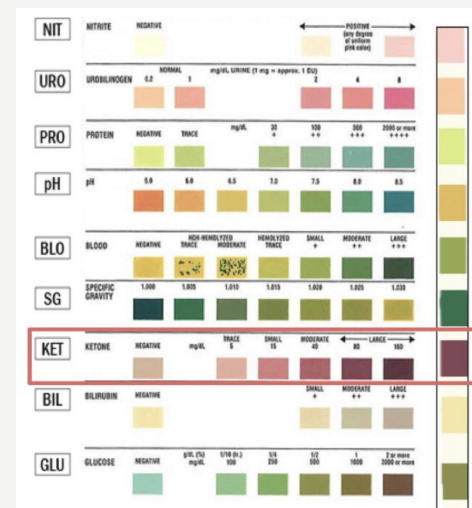
**B- Chemical examination.**

**Ketonuria , Glucosuria** elevated amount of keton and glucose in urine . (usually the rest are normal)

**Q2) What is the most likely diagnosis?**

**Diabetic with ketonuria (diabetic ketoacidosis)**

Usually under 25 years patient with type I diabetes When there is no enough Insulin, the patient can not use the glucose as a fuel so the body breaks down fat instead, lead to acid(ketones) build up.



## Case II (Urine Sample II)

- A 49-old woman with a history of DM came to hospital with **fever**, weakness and **dysuria** (pain during urination) for the last three days.
- The results of her laboratory tests were as follows:

Test	Result	Reference range
Fasting blood glucose	7.5	3.9-5.8 mmol/L
Creatinine	75	55-120 mmol/L
Urea	3.7	2.5-6.4 mmol/L
Sodium	140	135-145 mmol/L
Potassium	3.9	3.5-5.1 mmol/L

A mid stream Urine sample was collected for complete urinalysis.

Microscopic examination of urine showed:-

- **WBCs:** > 100/HPF (Ref range: 2-3/HPF)
- **RBCs:** 50 /HPF (Ref range: 0-2/HPF)

Q1) Do urinalysis using dipsticks and give a full report regarding:

A- Physical examination.

(**Alkaine**, cloudy) (usually the rest are normal)

B- Chemical examination.

(**Proteinuria**, Hematuria, Nitrite detected)  
(usually the rest are normal)

Q2) What is the most likely diagnosis?

**Urinary tract infection**

UTI patients usually have: 1- Pain or burning feeling during urination. 2- feeling of urgency. 3- feeling the need to urinate frequently. 4- altered appearance of the urine, either bloody (red) or cloudy. 5- pain or pressure in the rectum.

<b>NIT</b>	NITRATE	NEGATIVE	POSITIVE					
<b>URO</b>	UROBILINOGEN	0.2	1	2	4	8		
<b>PRO</b>	PROTEIN	NEGATIVE	TRACE	10	30	100	300	500
<b>pH</b>	pH	5.0	6.0	7.0	8.0	9.0		
<b>BLO</b>	BLOOD	NEGATIVE	NON-HEMOLYZED	MODERATE	PROFOUND	SMALL	MODERATE	LARGE
<b>SG</b>	SP. GRAVITY	1.000	1.005	1.010	1.015	1.020	1.025	1.030
<b>KET</b>	KETONE	NEGATIVE	mg/dL	TRACE	SMALL	MODERATE	LARGE	
<b>BIL</b>	BILIRUBIN	NEGATIVE	SMALL	MODERATE	LARGE			
<b>GLU</b>	GLUCOSE	NEGATIVE	mg/dL	100	200	300	500	1000

## Case III (Urine Sample III)

A 6-year-old boy, developed marked **edema** over a period of few days. His mother had noticed **puffiness** around the eyes, characteristically in the morning. She also noticed that his urine had become **frothy**. His general practitioner ordered the following investigations:

Test	Result	Reference range
Creatinine	58	55-120 mmol/L
Urea	3.4	2.5-6.4 mmol/L
Sodium	136	135-145 mmol/L
Potassium	4.0	3.5-5.1 mmol/L
<b>Total protein</b>	<b>34</b>	<b>60-80 g/L</b>
<b>Albumin</b>	<b>14</b>	<b>35-50 gmL</b>
<b>Cholesterol</b>	<b>11</b>	<b>3.2-5.2 mmol/L</b>
Triglycerides	15	0.5-2.27 mmol/L

A mid stream Urine sample was collected for complete urinalysis.

**Q1) Do urinalysis using dipsticks and give a full report regarding:**

**A- Physical examination.**

**Frothy urine.** (usually the rest are normal)

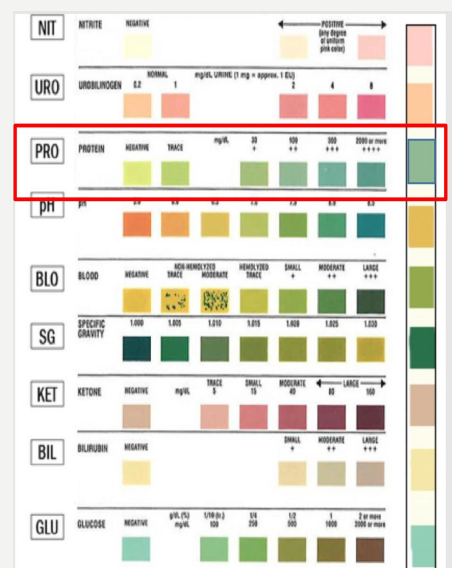
**B- Chemical examination.**

**Heavy proteinuria.** (usually the rest are normal)

**Q2) What is the most likely diagnosis?**

**Nephrotic Syndrome**

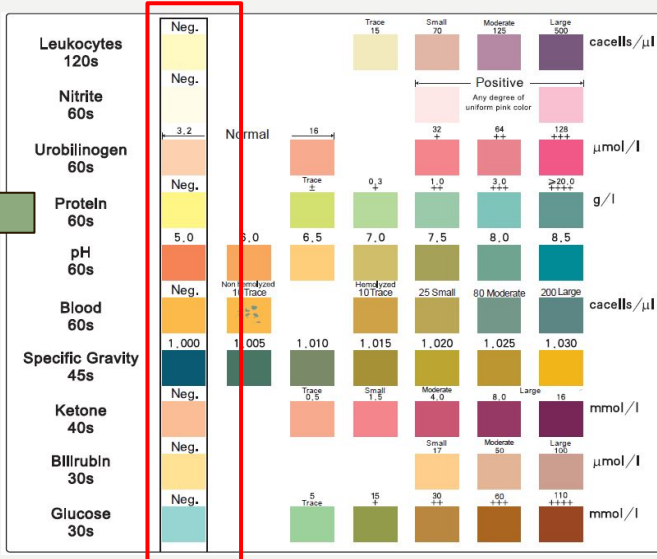
Nephrotic Syndrome Is A Kidney Disease With: Proteinuria ,Hypoalbuminemia ,Edema ,Hyperlipidemia ,Hypercholesterolemia



Urine dipstick must show proteinuria



## How the questions will be in the exam?



١- الصورة راح تكون في الاختبار ملونة  
 ٢- في المستطيل الأحمر هذه عينة المريض لكن في هذه الصورة طبيعي افترضوا جاء بالإختبار واحد عنده بروتينيوريا - بدل الأصفر نفترض راح يحطون المربع الأخضر اللي مدرج جنبه الحين راح تعبي البيانات المريض على هذا الأساس  
 ٣- راح ينكتب السؤال ع شكل يعني لازم نعرف الكلمات Case المفتاحية حتى يصير أسهل مثل  
 لكن معاها صورة case I,II,III

### Task I. Physical Examination :

**Appearance:** you will write ( clear normal / cloudy according to the case )

**Color:** according to the case

**Odor:** smell according to the case

**Deposits:** None / crystals according to the case

**Specific gravity:** look in the picture go to Specific gratify then write the number that is similar to the color

**Reaction ( pH ):** look in the picture go to PH then write the number that is similar to the color

### Task II. Chemical Examination :

<u>Item</u>	<u>Observation( you must write number) !!!!! From the pic</u>	<u>Comment</u>
<u>Protein</u>	For example in our case it is 8.0	Proteinuria
<u>Glucose</u>	If it present here	Glucosuria
<u>Ketones</u>		Ketonuria
<u>Nitrite</u>		Detected
<u>Bilirubin</u>		Detected
<u>Urobilinogen</u>		> 2 mg/dl
<u>Blood</u>		Hematuria

What is the most likely diagnosis? According to you findings

Don't forget most likely mistakes in exam !!

- always when you mention pH, include if it acid / base
- Mention the specific gravity
- Mention each disease with its criteria, for example :
- diabetic with ketones ✘
- Diabetic ketoacidosis ✓