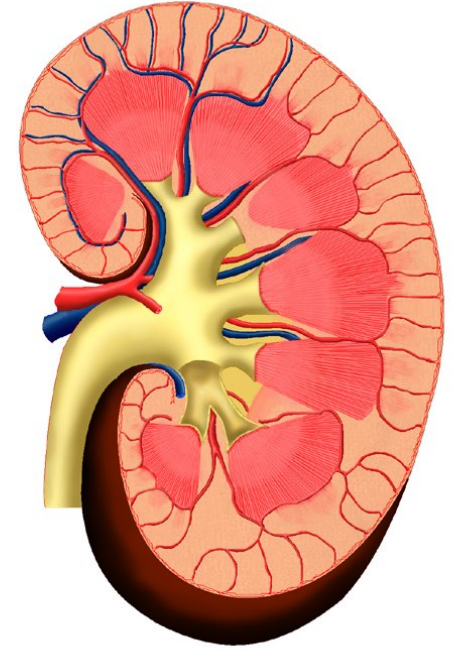


Urinalysis

Practical session

Renal Block

Biochemistry433@hotmail.com



Dr.Amr: The question may come in two forms:

- 1- He will give you the chemical and physical characteristics and you should write the differential diagnosis.
- 2- He will give you the diagnosis and you should write the characteristics.

We advice you to revise the lecture "chemical examination of urine"

SOME ADDITIONAL NOTE TO UNDERSTAND

- Diabetes insipidus is a condition in which the kidneys are unable to conserve water due to ADH deficiency.
- Diabetes insipidus patients have polyuria manifestation. So, the urine will be highly diluted and have low specific gravity.
- Specific gravity is the measures solids in the fluid.

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.
- The normal range of urine excretion depends on age, weather and fluid intake.

PHYSICAL PROPERTIES OF URINE

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Volume	0.4-2.0 L/day	Polyuria	Diabetes (mellitus/insipidus), chronic renal failure
		Oligouria	Dehydration, a Stage of acute renal failure
Appearance	Clear	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells
Colour	Pale Yellow	Colorless	Excessive fluid intake, uncontrolled DM, diabetes insipidus, chronic renal failure
		Orange	Dehydration, carotenoid ingestion
		Yellow-Green	Jaundice
		Red	Blood, drugs etc
		Dark brown-black	Methemoglobin, alkaptonuria, melanoma, black water fever (malaria)
		smoky	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
Specific gravity	1.015 to 1.024	hypersthenuria	dehydration, diarrhea, UTI, glucosuria, Heart failure & excess of ADH
		hyposthenuria	Renal failure, diabetes insipidus, & excessive fluid intake

N.B. Very important table + Specific gravity has been mentioned just orally.

CHEMICAL PROPERTIES OF URINE

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
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 (positive)	UTI
Bilirubin	None	Detected (positive)	Hepatic and post-hepatic jaundice
Urobilinogen	Normal Trace (1mg/dl)	> 2 mg/dl	Jaundice
Blood	None	Hematuria	Acute & chronic glomerulonephritis, Trauma , cystitis , renal calculi and tumors, Bleeding disorders (Hemophilia).
		Hemoglobinuria	Hemoglobinopathies, Malaria, Transfusion reaction (Blood Incompatibility)

N.B. Very important table

PROTEINS IN URINE

- 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)

Principles

- 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

1. Dip the strip in the urine sample provided then remove it immediately.
2. Remove the excess urine and keep the strip in a horizontal position.
3. Read the color produced within 30-60 seconds (Color changes after more than 2 minutes are of no significance).
4. Match the color changes to the color scale provided.
5. Give a full report about:
 - Physical examination
 - Chemical examination

N.B. the procedure is for your understanding,

DIPSTICK'S PICTURE

This column is for the normal values

The rest of the columns are for the abnormal values

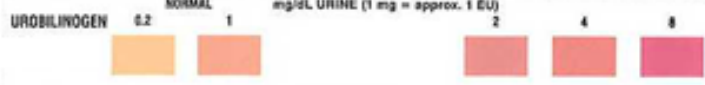
Nitrate

NIT



Urobilinogen

URO



Protein

PRO



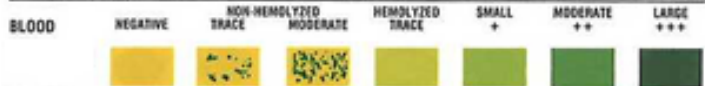
PH

pH



Blood

BLO



Ketone

KET



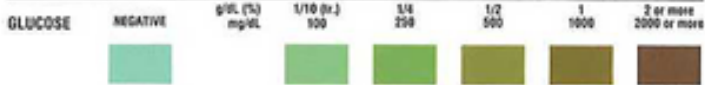
Bilirubin

BIL



Glucose

GLU



Case 1:

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.

1- Do urinalysis using dipsticks and give a full report regarding:

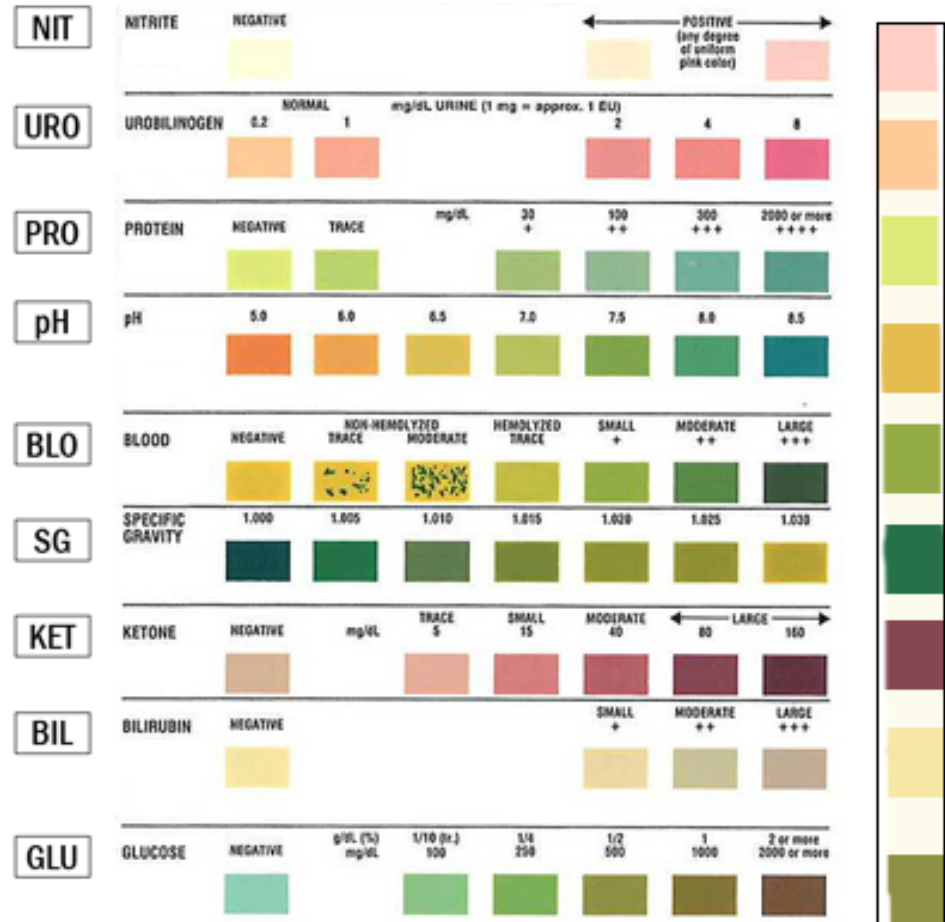
A- Physical examination.

B- Chemical examination.

2- What is the most likely diagnosis?

Sample B

most probably, there won't be a scenario in the exam, but direct questions



Physical examination		Cause
Appearance	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells
Color	Colorless	polyuria
Odor	Fruity	Diabetic ketoacidosis
Deposits	None	
Specific gravity	1.005	Presence of glucose
Reaction (pH)	Acidic	Presence of Ketone bodies

there is not enough Insulin, so glucose can not be used as a fuel so the body breaks down fat instead, and that leads to acid (ketones) build up.

Chemical examination		Cause
Protein	+	UTI
Glucose	+	Uncontrolled DM
Ketones	+	Uncontrolled DM
Nitrate	+	UTI
Bilirubin	-	
Urobilinogen	Normal	
Blood	+	UTI

Most likely diagnoses is **Diabetic ketoacidosis with infection**

Case 2:

A 49-year-old woman 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	5.0	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: over 100/HPF (Ref range: 2-3/HPF)

RBCs: 10 /HPF (Ref range: 0-2/HPF)

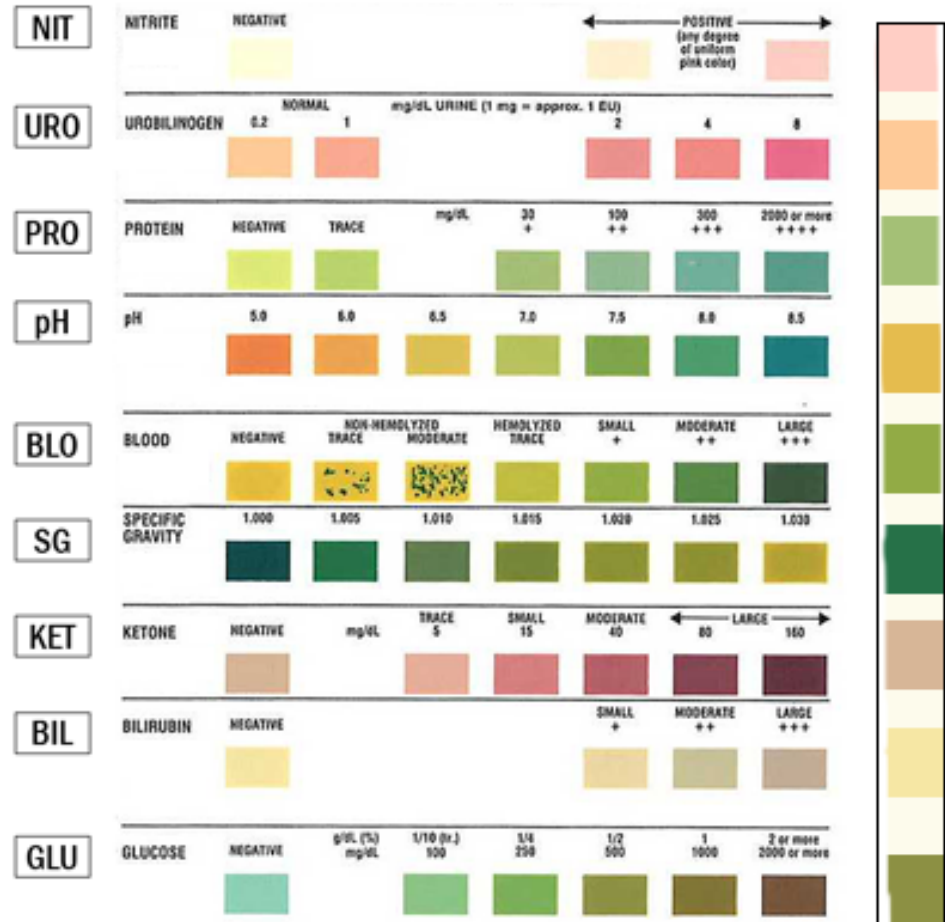
1- Do urinalysis using dipsticks and give a full report regarding:

A- Physical examination.

B- Chemical examination.

2- What is the most likely diagnosis?

Sample A



Physical examination		Cause
Appearance	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells
Color	Colorless	polyuria
Odor	Fruity	Diabetes
Deposits	-	
Specific gravity	1.005	Presence of glucose
Reaction (pH)	7 (acidic because of DM and alkaline because of the infection)	acidic because of DM and alkaline because of infections

Most likely diagnoses is **Diabetes with UTI**

Chemical examination		Cause
Protein	+	UTI
Glucose	+	Uncontrolled DM
Ketones	-	
Nitrate	+	UTI
Bilirubin	-	
Urobilinogen	Normal	
Blood	+	UTI

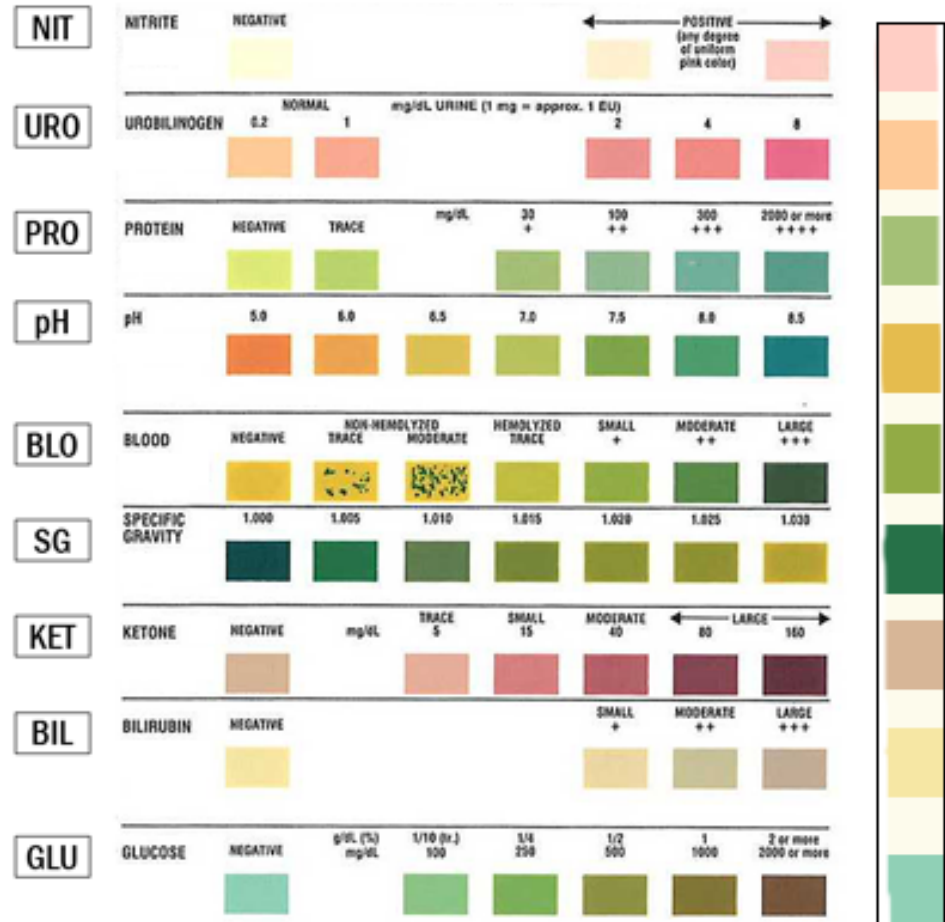
Case 3:

A 6-year-old boy, developed marked edema over a period of few days. His mother had noted puffiness around the eyes, characteristically in the morning. She also noted 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
Total protein	34	60-80 g/L
Albumin	14	35-50 gm/L
Cholesterol	11	3.2-5.2 mmol/L
Triglycerides	1.5	0.5-2.27 mmol/L

A mid stream Urine sample was collected for complete urinalysis.
 1- Do urinalysis using dipsticks and give a full report regarding:
 A- Physical examination.
 B- Chemical examination.
 2- What is the most likely diagnosis?

Sample C



Physical examination		Cause
Appearance	Clear	
Color	Colorless	polyuria
Odor	Uriferous	
Deposits	-	
Specific gravity	high	Usually it is high due to proteinuria
Reaction (pH)	6.5	

Chemical examination		Cause
Protein	+	UTI
Glucose	+	
Ketones	-	
Nitrate	+	UTI
Bilirubin	-	
Urobilinogen	Normal	
Blood	+	UTI

Most likely diagnoses is **Nephrotic syndrome**

Summary of SOME Disease

	Physical appearance	Chemical appearance
Diabetes insipidus	<ul style="list-style-type: none"> 1- Polyuria 2- Clear appearance 3- Colorless 4- Hyposthenuria (low Specific gravity) 	
Diabetes mellitus	<ul style="list-style-type: none"> 1- Polyuria 2- Clear appearance 3- Colorless 4- Increase specific gravity 5- Fruity odor 	<ul style="list-style-type: none"> 1- Glucosuria 2- Ketonuria
Dehydration	<ul style="list-style-type: none"> 1- Oliguria 2- Orange color 3- Hypersthenuria (High specific gravity) 	
Urinary tract infection	<ul style="list-style-type: none"> 1- Cloudy appearance 2- Alkaline 	<ul style="list-style-type: none"> 1- Nitrate 2- Hematuria (cystitis) 3- Proteinuria (Lower UTI)
Excessive fluid intake	<ul style="list-style-type: none"> 1- Polyuria 2- Colorless 3- Low specific gravity 	
Tumor	<ul style="list-style-type: none"> 1- Red 	<ul style="list-style-type: none"> 1- Blood 2- protein
Malaria	<ul style="list-style-type: none"> 1- Dark brown-black color 	<ul style="list-style-type: none"> 1- Hemoglobinuria
Glomerulonephritis (including nephrotic and nephritic syndromes)	<ul style="list-style-type: none"> 1- Smoky color 	<ul style="list-style-type: none"> 1- Proteinuria 2- Hematuria
Starvation	<ul style="list-style-type: none"> 1- Acidic urine 	<ul style="list-style-type: none"> Ketonuria

QUESTIONS

1- Describe The Physical properties of a urine sample that has been taken from a diabetes insipidus patient.

1- Polyuria 2-clear appearance 3- colorless 4-low specific gravity.

2- patient has Mousy odor of his urine sample. So, the most likely diagnosis is

Phenylketonuria

3- Describe the properties of urine sample has been taken from patient with UTI.

Physical prosperities: 1- Cloudy appearance 2- Alkaline

Chemical prosperities: 1- Nitrate 2- Blood (in case of cystitis)

4- Describe The Physical properties of a urine sample that has been taken from dehydrogenated patient?

Oliguria, orange color and it has high specific gravity.

5- What is the abnormality of a urine sample of a patient with multiple myeloma?

Proteinuria.

6- Describe all prosperities in urine sample of patient has renal failure?

Chronic renal failure: 1- Polyuria 2- colorless

Acute renal failure: 1- In stage he will have oliguria

7- Describe the chemical and physical properties of jaundice patients?

Urobilinogen is more than 2 mg/dl / yellow to green color of urine.

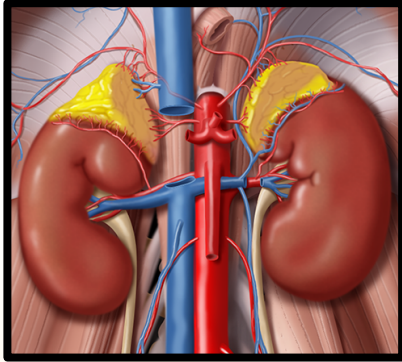
8- 'Dark to black urine' indicates which disease?

Alkaptonuria

9- 24-old healthy male doesn't drink water for 24. What do you expect of his urine sample?

1- Oliguria 2- Orange color 3- High specific gravity

GOOD LUCK



Done by:
Sara alDokhayel
Ahmed Al-Hussien
Mojahed Otyef
Maha AlRajhi

