

Integrated Biochemistry & Pathology Practical Class

Liver Function Tests

Year Two, GASTROINTESTINAL & HAEMATOLOGY Block

Student's Tasks

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King Saud University
College of Medicine

Integrated Practical Class- Year 2
Gastrointestinal & Haematology Block
(Department of Medical Education
and the Department of Pathology (Biochemistry and Histopathology Units))

Design of the Practical Class:

Students will be divided into two equal groups (Groups 1 and 2). Group 1 students will start in the Pathology Laboratory at Level 1 and work on case scenarios for one hour. The case scenarios will provide students to integrate knowledge from Biochemistry and Pathology related to liver function tests. Group 2 will start in the Multipurpose Laboratory at level 2 and have interactive discussion related to serum bilirubin followed by hands-on training for measuring serum bilirubin for one hour. Then students will switch to the other Lab to complete the second task for another one hour.

Objectives of the Practical Class

This practical class aims at integration of knowledge from biochemistry and pathology in relation to interpretation of the liver function tests and associated pathological changes in a number of clinical situations. The aim is to enforce deep learning and use task-based learning, and student-centered learning approaches in the design of this practical class. It is expected that by the end of this practical class, students should be able to:

1. Understand the scientific basis of the measurement of serum bilirubin and practice the measurement of serum bilirubin by using a biochemical kit and the spectrophotometer.
2. Discuss the scientific principles behind the liver function tests with particular emphasis on bilirubin metabolism and application of knowledge.
3. Discuss and work on four cases covering interpretation of liver function tests and associated liver pathological changes in each case.

PART 1

Venue: Pathology Laboratory, Level 1 (Male)

Pharmacology Laboratory, Level 3 (Female)

(Group 1 will start by undertaking this part
for 60 minutes)

Case 1

A 22-year-old science student is travelling to a country in Africa where malaria is endemic. As a prophylaxis for malaria, his general practitioner prescribes him chloroquine tablets. A few days later and before his travel, he develops jaundice, feels tired and fatigued. He also looks pale.

There are no changes in the colour of his urine and he has no fever.

On examination, nothing significant is found apart from jaundice and pallor of his mucous membranes. The results of his blood tests are shown in the tables below:

Complete Blood Count:

Blood Test	Patient's results	Normal range
Haemoglobin	8.2	11.5-15.5 g/100ml
White blood cell count	$6 \times 10^9/L$	$4-11 \times 10^9/L$
Packed cell volume (PCV)	41	37-47%
Mean corpuscular volume (MCV)	90	80-96 fl
Platelet count	290,000	160,000-500,000 mm^3

Liver Function Tests

Test	Patient's Results	Normal Range
Serum bilirubin	26	0-19 $\mu\text{mol/L}$
Aspartate Aminotransferase (AST)	35	0-40 IU/L
Alanine Aminotransferase (ALT)	44	0-50 IU/L
Alkaline Phosphatase (ALP)	76	0-120 IU/L
Gamma Glutamyltranspeptidase (γ -GT)	34	0-50 IU/L
Serum albumin	40	35-50 g/L
Prothrombin time	12 seconds	10-14 seconds

Q4. Which one of the following is the most likely liver histological image for this patient? Select one only. Give a justification for your answer.

Image A

Image B

Image C

Image A

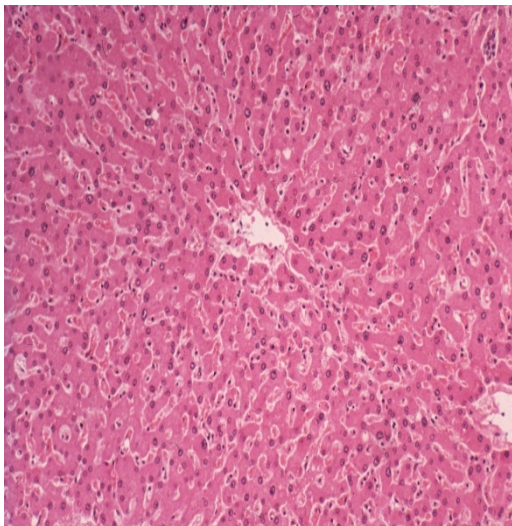


Image B

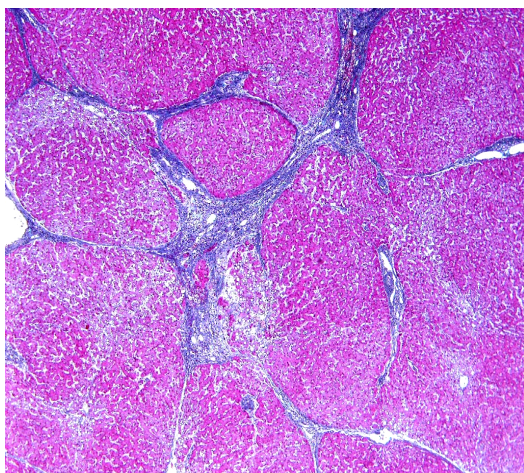
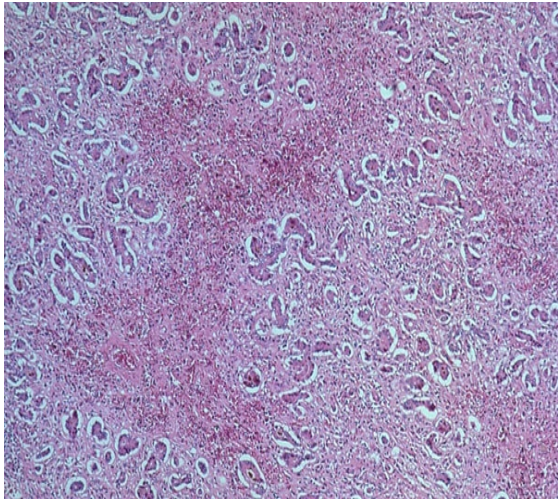


Image C



Justification:

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Case 2

An 27 years-old Indian worker who has arrived to Saudi Arabia about two weeks ago to work with a maintenance company, presents to the company doctor because of abdominal pain, loss of appetite, and changes in the colour of his urine for the last 24 -30 hours. His urine is as dark as black tea. He also has loose bowel motions and his stools are pale.

On examination, his body temperature is 38.5 °C (normal range: 36.6-37.2 °C), his pulse rate is 96/min (normal range: 60-100/min), his blood pressure is 120/80 mmHg (normal range: 100/60-135/80 mmHg), and his respiratory rate is 20/min (normal range: 12-16/min). He is jaundiced. There are no palpable lymph nodes. His abdomen is soft but there is tenderness over the right upper abdomen (most likely the liver). Auscultation of the abdomen: normal bowel sounds.

The results of his blood tests are shown the tables below:

Complete Blood Count:

Blood Test	Patient's results	Normal range
Haemoglobin	12.4	11.5-15.5 g/100ml
White blood cell count	2 x 10 ⁹ /L	4-11 x 10 ⁹ /L
Packed cell volume (PCV)	48	37-47%
Mean corpuscular volume (MCV)	90	80-96 fl
Platelet count	290,000	160,000-500,000 mm ³

Liver Function Tests

Test	Patient's Results	Normal Range
Serum bilirubin	45	0-19 µmol/L
Aspartate Aminotransferase (AST)	4000	0-40 IU/L
Alanine Aminotransferase (ALT)	5900	0-50 IU/L
Alkaline Phosphatase (ALP)	205	0-120 IU/L
Gamma Glutamyltranspeptidase (γ- GT)	37	0-50 IU/L
Serum albumin	38	35-50 g/L
Prothrombin time	15 seconds	10-14 seconds

. Stool Microscopic Examination:

No pus, no red blood cells, no mucous, no parasites or ova.

Urinalysis:

Bilirubin +++

Questions

Q1. In the light of his medical history, interpret the results of his complete blood tests and liver function tests.

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Q2. What are the most likely causes (hypotheses)

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Q3. What are the underlying mechanisms for his jaundice?

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Q4. Which one of the following is the most likely liver histological image for this patient? Select one only. Give a justification for your answer.

Image A

Image B

Image C

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Image A

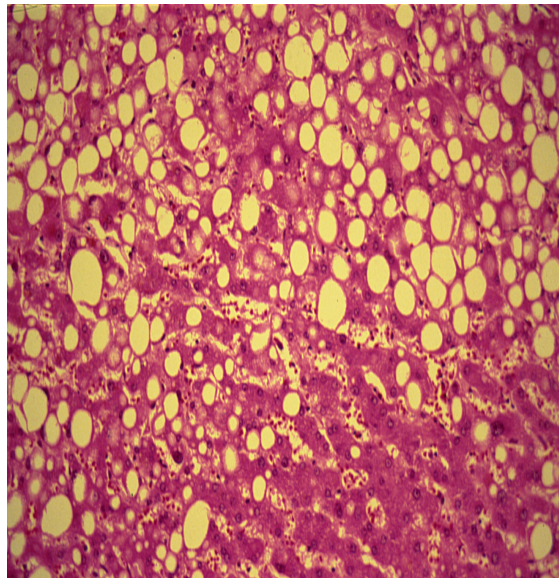


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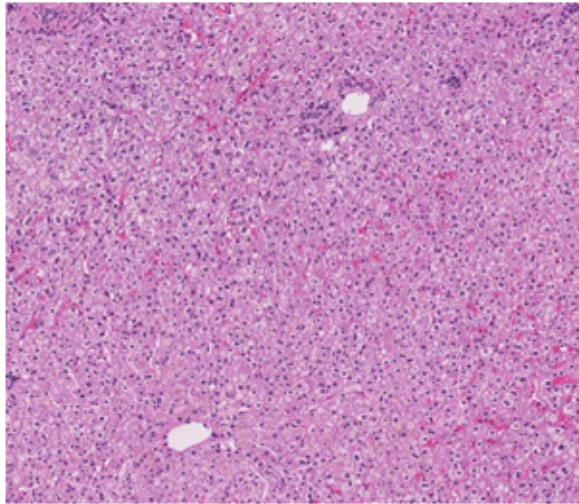
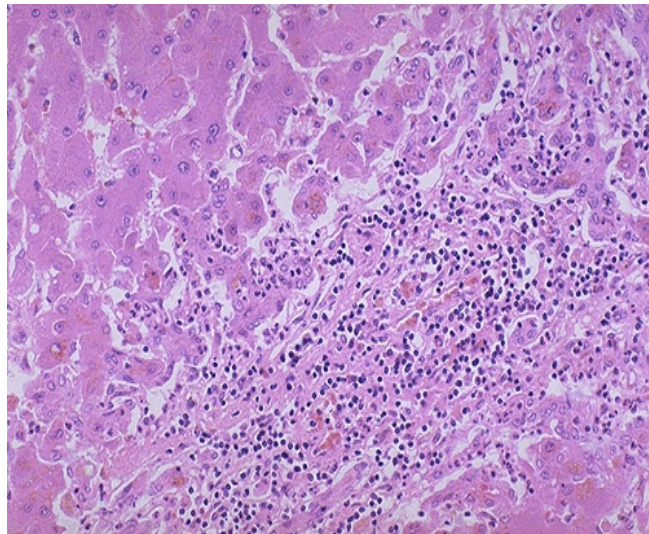


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Case 3

A 75 year-old retired worker presents to his general practitioner because of loss of appetite and a loss of 6 kg in his body weight for over the last 6-8 months. Recently he noticed that his urine has become a little dark and his daughter noticed that his eyes are yellow.

On examination, his blood pressure is 130/85 mmHg (normal range: 100/60-135/80 mmHg), his pulse is 90/min (normal range: 60-100/min), his body temperature is 37.1 °C (normal range: 36.6-37.2 °C), and his respiratory rate is 18/min (normal range: 12-16/min). On examination, there is jaundice of his eyes. He looks pale and a rounded mass is felt under the right costal margin. He is referred for blood tests and ultrasound examination of the abdomen.

The ultrasound shows a dilatation of the gallbladder and a mass in the head of the pancreas. The results of his blood tests are shown in the tables below:

Complete Blood Count:

Blood Test	Patient's results	Normal range
Haemoglobin	8.2	11.5-15.5 g/100ml
White blood cell count	6 x 10 ⁹ /L	4-11 x 10 ⁹ /L
Packed cell volume (PCV)	42	37-47%
Mean corpuscular volume (MCV)	90	80-96 fl
Platelet count	290,000	160,000-500,000 mm ³

Liver Function Tests

Test	Patient's Results	Normal Range
Serum bilirubin	37	0-19 µmol/L
Aspartate Aminotransferase (AST)	55	0-40 IU/L
Alanine Aminotransferase (ALT)	79	0-50 IU/L
Alkaline Phosphatase (ALP)	980	0-120 IU/L
Gamma Glutamyltranspeptidase (γ-GT)	60	0-50 IU/L
Serum albumin	29	35-50 g/L
Prothrombin time	13 seconds	10-14 seconds

Questions

Q1. In the light of his medical history, interpret the results of his complete blood tests and liver function tests.

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Image A

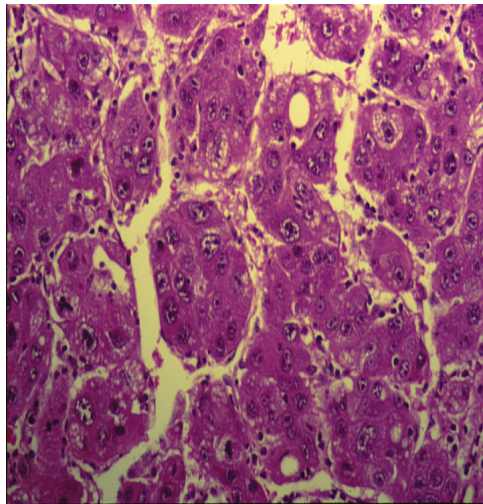


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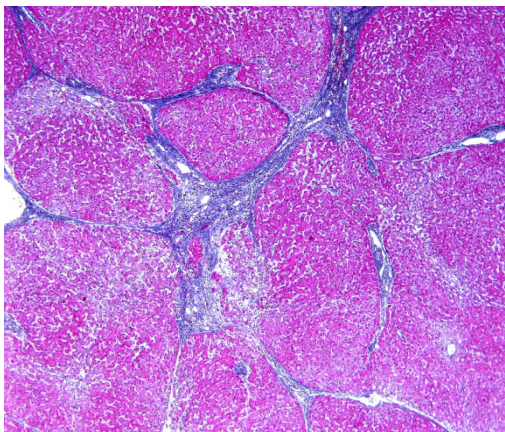
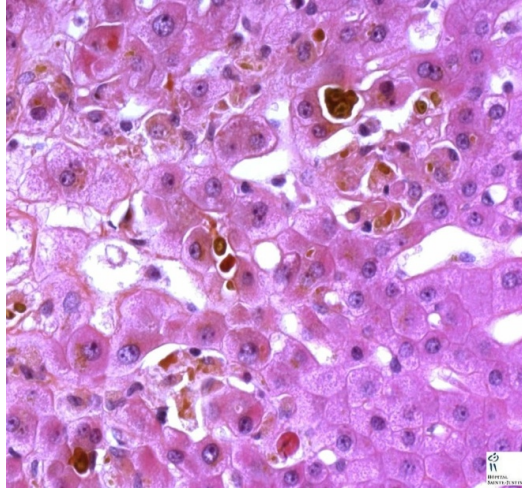


Image C



Justification:

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Case 4

A 27-year-old female who has several problems with her family and is depressed for over a year, is brought by the ambulance to the Accident & Emergency Department semiconscious. Her parents say that she swallowed over 20 tablets a few hours ago. The empty package found beside her bed is for paracetamol tablets. On examination, she is semiconscious and has jaundice in her eyes. The emergency registrars do all emergency measures and send blood samples for laboratory tests. Toxicology blood test confirms the presence of paracetamol metabolites in her blood.

Complete Blood Count:

Blood Test	Patient's results	Normal range
Haemoglobin	12.0	11.5-15.5 g/100ml
White blood cell count	$6 \times 10^9/L$	$4-11 \times 10^9/L$
Packed cell volume (PCV)	35	37-47%
Mean corpuscular volume (MCV)	83	80-96 fl
Platelet count	200,000	160,000-500,000 mm^3

Liver Function Tests

Test	Patient's Results	Normal Range
Serum bilirubin	33	0-19 $\mu\text{mol/L}$
Aspartate Aminotransferase (AST)	370	0-40 IU/L
Alanine Aminotransferase (ALT)	460	0-50 IU/L
Alkaline Phosphatase (ALP)	260	0-120 IU/L
Gamma Glutamyltranspeptidase (γ -GT)	102	0-50 IU/L
Serum albumin	38	35-50 g/L
Prothrombin time	20 seconds	10-14 seconds

Q4. Which one of the following is the most likely liver histological image for this patient? Select one only. Give a justification for your answer.

Image A

Image B

Image C

Image A



Image B

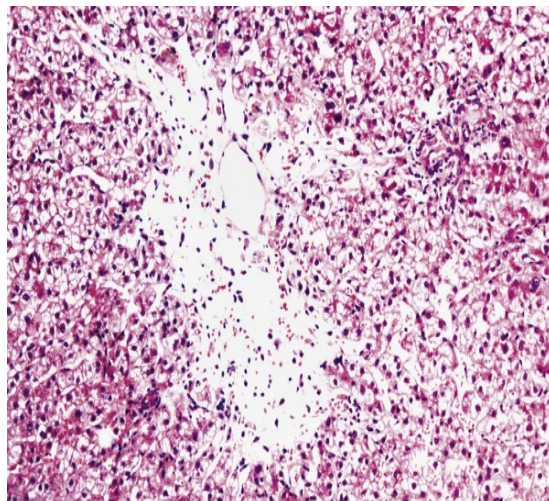
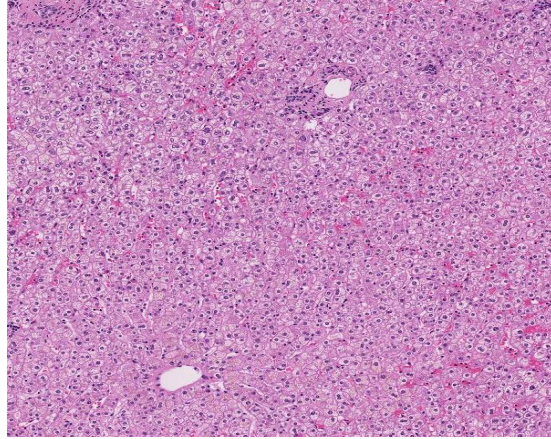


Image C



Justification:

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PART 2

Venue: Multipurpose Laboratory,
Medical Biochemistry Unit,
Level 2

(Group 2 will start by undertaking this part
for 60 minutes)

Q.4

- How and why is bilirubin conjugated?
- On the picture below, mark the intracellular location for the process of conjugation.
- Mention 2 syndromes due to congenital deficiency of the conjugating enzyme (bilirubin glucuronyl-transferase).

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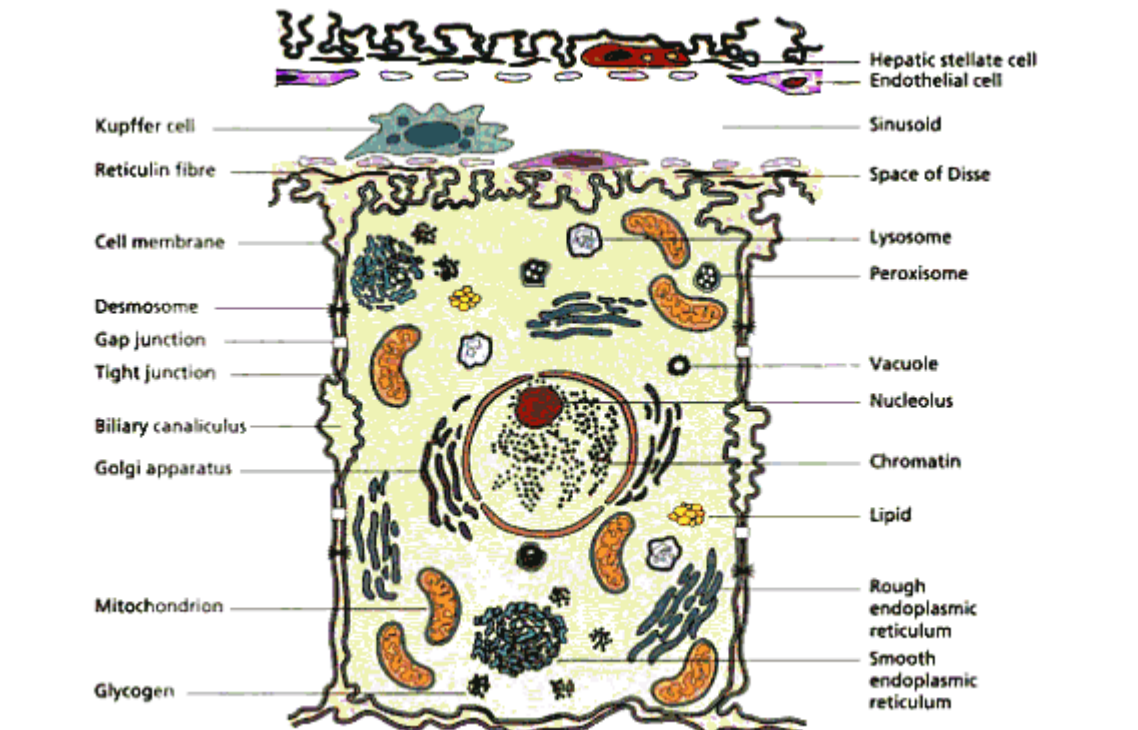
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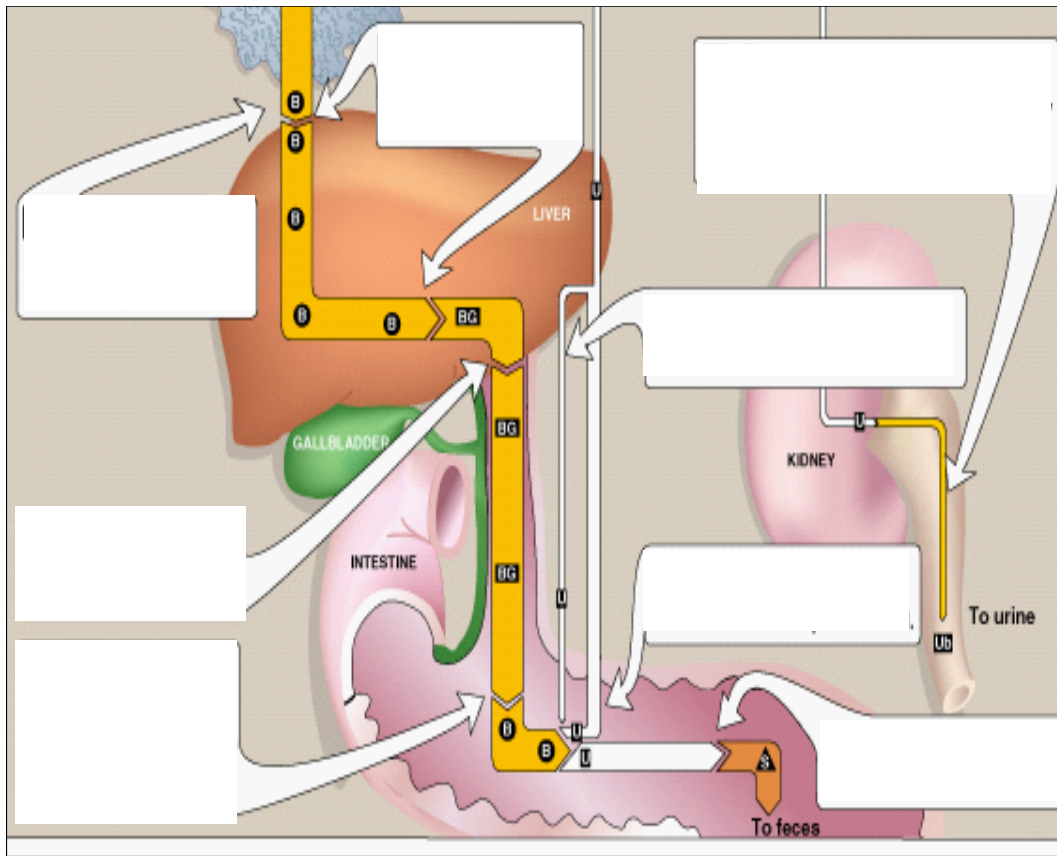
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Schematic illustration of a hepatocyte



Reference: Diseases of the liver and biliary system, by Sheila Sherlock, Sheila Sherlock (Dame.), James Dooley



Q. 5A How is bilirubin eliminated from the body?

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Q.5 B What are the fates of bilirubin in the intestine?

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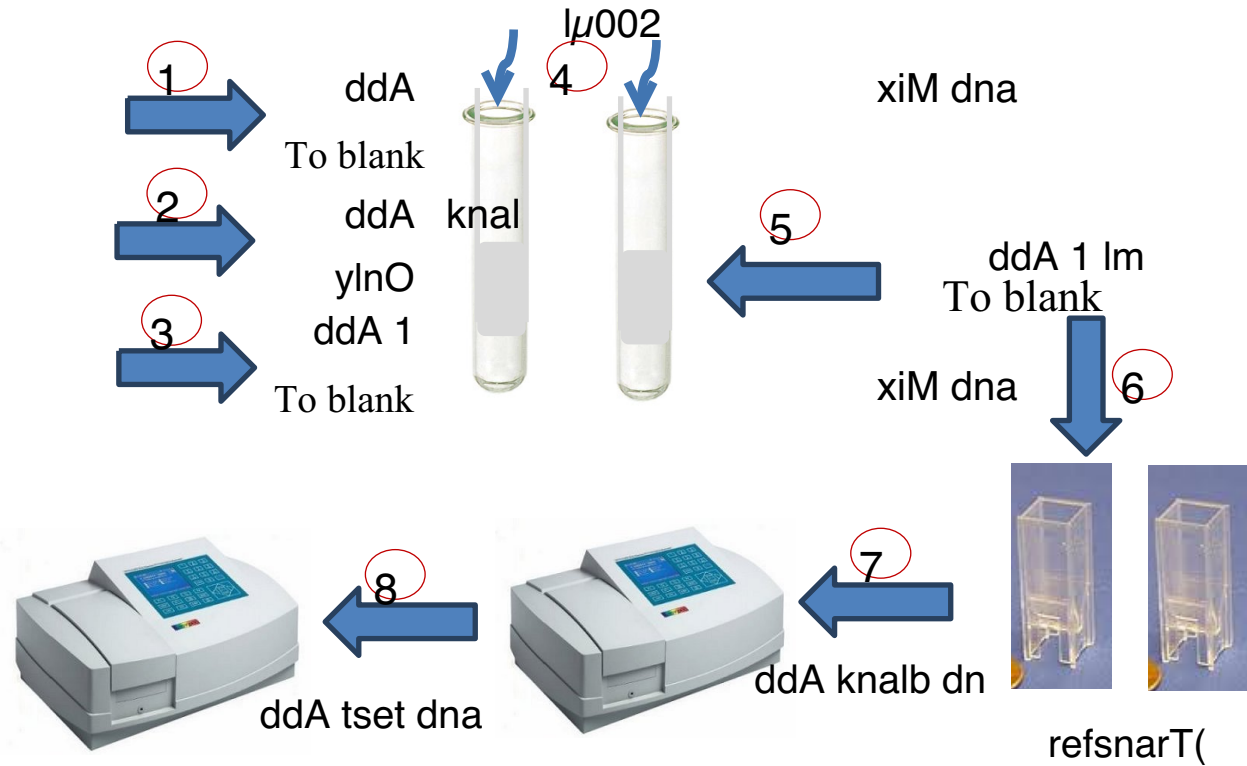
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Measurement of Total



Calculation of total bilirubin concentration

Conc. of serum total bilirubin: $A \times 185 = \dots \mu\text{mol/L}$

(Normal range: 2 – 17 $\mu\text{mol/L}$)