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Family Name					
Given Name/s					
Student Number					
Teaching Period	Semester 1, 2018				

PHA311 – Clinical Biochemistry	DURATION	
	Reading Time:	10 minutes
	Writing Time:	180 minutes
INSTRUCTIONS TO CANDIDATES		
<p>The examination has A and B sections</p> <p>Section A: Suggested Time: 90 minutes Answer ALL 7 questions on the booklet provided. Marks: 50</p> <p>Section B: Suggested Time: 90 minutes Answer ALL 3 questions in the booklet provided. Marks: 50</p> <p>Note that questions ARE NOT of equal value.</p> <p>Read ALL questions carefully.</p>		
EXAM CONDITIONS		
<p><u>You may begin writing from the commencement of the examination session.</u> The reading time indicated above is provided as a guide only.</p>		
This is a CLOSED BOOK examination		
Any non-programmable calculator is permitted		
No handwritten notes are permitted		
No dictionaries are permitted		
ADDITIONAL AUTHORISED MATERIALS	EXAMINATION MATERIALS TO BE SUPPLIED	
No additional printed material is permitted	1 x 20 Page Book 1 x Scrap Paper Reference Information	

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DOUBLE-SIDED.**

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Section A

Short Essay Questions

Total Number of Marks for this section: 50 Marks

This section should be answered in the Answer Booklet provided.

Marks for each question are indicated.

Suggested Time allocation for Section A: **90 minutes**

Question 1

Discuss the following components of liver function test. What information may they provide regarding the health of liver? Use examples to illustrate your answer.

- I. ALT
- II. ALP
- III. Bilirubin
- IV. Albumin

(2x4= 8 Marks)

Question 2

A) Discuss the clinical importance of each component of the lipid test (total cholesterol, LDL, HDL and TG).

(4 Marks)

B) Comment on the following results of fasting serum lipid levels:

- | | | |
|------|-------------------|------------|
| I. | Total cholesterol | 6.3 mmol/L |
| II. | LDL | 4.8 mmol/L |
| III. | HDL | 1.3 mmol/L |
| IV. | Triglyceride | 2.0 mmol/L |

(4 Marks)

(Total: 8 Marks)

Question 3

Discuss any TWO (2) of the following biochemistry tests. What information can they provide regarding the health of an individual? Use examples to illustrate your answer.

- I. Troponin T
- II. Thyroid stimulating hormone (TSH)
- III. Serum creatinine

(2x4= 8 Marks)

Question 4

Regarding diagnosis of diabetes mellitus or its complications, write short notes on ANY FOUR (4) of the following:

- I. Fasting blood glucose level (BGL)
- II. Oral Glucose Tolerance Test (OGTT)
- III. HbA1c
- IV. Serum insulin and c-peptide
- V. Urinary ketones

(2x4= 8 Marks)

Question 5

A) For detection of acute cardiac injury, list THREE (3) most commonly used biomarkers. Draw a table/chart to show the approximate timeline of these markers.

(3 Marks)

B) Which of these biomarkers is the BEST in detecting acute cardiac injury and WHY?

(3 Marks)

(Total: 6 Marks)

Question 6

Regarding a routine Full Blood Examination (FBE) report, discuss the importance of following parameters. Give TWO (2) clinical examples for an abnormal count/reading for each.

- I. Haematocrit
- II. MCV (Mean corpuscular volume)
- III. Reticulocyte count

(Total: 6 Marks)

Question 7

A new orally administered drug has been introduced in the hospital. It is unclear whether Therapeutic Drug Monitoring (TDM) is needed for this drug.

A) What factors should be taken into consideration when addressing this question?

(2 Marks)

B) If you decide to monitor this drug, what are the key steps? You can use a diagram or flowchart to explain your answer.

(4 Marks)

(Total: 6 Marks)

END OF SECTION A

Section B

Case Study Based Questions

Total Number of Marks for this section: 50 Marks

This section should be answered in the Answer Booklet provided.

Marks for each question are indicated.

Suggested Time allocation for Section B: **90 minutes**

Case study 1

A general practitioner was called to see a 21-year-old female student who had been complaining of a flu-like illness for 2 days. The illness had become worse, with symptoms of fever, vomiting, and abdominal tenderness in the right upper quadrant. On examining the patient, the doctor found she was pyrexial and jaundiced. The liver was enlarged and tender. On questioning her, the doctor found that she had recently returned from a long holiday in Asia. A sample of urine appeared dark, and bilirubin was present, and urobilinogen was increased. A blood sample was taken for liver function tests, the results of which were as follows:

Plasma analysis	Result	Reference range
[Albumin] (g/L)	40	32-45
ALP activity (U/L)	190	40-125
ALT activity (U/L)	560	10-40
[Bilirubin, total] ($\mu\text{mol/L}$)	110	2-17
GGT activity (U/L)	60	10-35

Questions:

1. What is the most likely diagnosis? Describe each component of LFTs (shown in the table) to support your diagnosis. (5 Marks)
2. What can be the possible causes of such illness? (4 Marks)
3. If you suspect a viral cause, which further tests would you perform? (6 Marks)

(Total: 15 Marks)

Case study 2

A 30-year-old housewife attended her general practitioner. She had lost weight (6 kg in the previous 3 months), was irritable and felt uncomfortable in the recent spell of hot weather. She was taking an oestrogen-containing oral contraceptive. On clinical examination, her palms were sweaty, and she had a fine tremor of the fingers when her arms were outstretched. The following results were reported for thyroid function tests:

Plasma analysis	Result	Reference range
[TSH] (mU/L)	< 0.1	0.4-4.5
[Free T4] (pmol/L)	20	10-27
[Total T4] (nmol/L)	160	70-150
[Free T3] (pmol/L)	20	3.0-9.0
[Total T3] (nmol/L)	6	1.2-2.8

Questions:

1. What is the diagnosis in this patient, and on which results was this diagnosis based? (5 Marks)
2. Which further study/studies would you like to perform, and why? (5 Marks)

After establishing the diagnosis, patient was started on Carbimazole (15 mg three times/day). One month later, the lab results were as follows:

Plasma analysis	Result	Reference range
[TSH] (mU/L)	< 0.1	0.4-4.5
[Free T4] (pmol/L)	< 5	10-27
[Free T3] (pmol/L)	2.5	3.0-9.0

Question:

3. Comment on these results. Is this treatment working? If not, what will you suggest? (5 Marks)

(Total: 15 Marks)

Case study 3

Camilla, a 19-year-old pregnant insulin-dependent (type 1) diabetic patient, was admitted with a history of polyuria and thirst. She now felt ill and presented to hospital. There was a history of poor compliance with medical therapy. She was afebrile. The chest was clear. Circulation was adequate. Patient, however, was little disoriented.

Biochemistry on admission

Investigation	Result	Reference range
Sodium	136 mmol/l	135-155 mmol/l
Potassium	4.8 mmol/l	3.5-5.5 mmol/l
Chloride	101 mmol/l	100-108 mmol/l
Glucose	19.0 mmol/l	3.9-6.1 mmol/l (fasting)
Urea	8.1 mmol/l	2.9-6.9 mmol/l
Creatinine	0.09 mmol/l	0.05-0.13 mmol/l
Bicarbonate	7.1 mmol/l	22-24 mmol/l
<u>Urinalysis</u>		
Ketones	2+	Nil
Glucose	4+	Nil

Arterial blood gases were also collected on arrival

Arterial Blood Gases		Reference range
pH	7.26	(7.35-7.45)
pCO ₂	16 mmHg	(40 mmHg)
pO ₂	128 mmHg	(90-100 mmHg)
HCO ₃ ⁻	8 mmol/l	(22-29 mmol/l)

Camilla recovered with adequate management but compliance with diabetic therapy continued to be poor. An intrauterine fetal death occurred four months after this admission.

Questions:

1. Discuss the laboratory findings in this case. (4 Marks)
2. What is your diagnosis? Justify your diagnosis. (4 Marks)

3. Calculate the anion gap. Interpret the results. (4 Marks)
4. What are the causes of high anion gap metabolic acidosis (HAGMA)? Which of these would fit with Camilla's case? (4 Marks)
5. Discuss the development of diabetic complications in Camilla's case. (4 Marks)

(Total: 20 Marks)

END OF EXAM

Reference ranges for regular lab tests

Urea and electrolytes (U&E)

Na ⁺	135.0-145.0 mmol/L
K ⁺	3.50-4.50 mmol/L (plasma) 3.8-4.9 mmol/L (serum)
Cl ⁻	95-110 mmol/L
Urea	3.8-8.0 mmol/L
Creatinine	60-100 µmol/L
eGFR	> 90 mL/min/1.73 m ²
Osmolality (serum)	275-295 mOsm/kg
Anion gap	13-17 mEq/L

Calcium, magnesium and phosphate (CMP)

Ca ²⁺ (total)	2.1-2.6 mmol/L
Ca ²⁺ (ionised)	1.16-1.3 mmol/L
PO ₄ ³⁻	0.8-1.5 mmol/L
Mg ²⁺	0.8-1.0 mmol/L

Arterial blood gas (ABG)

pH	7.35-7.45
pO ₂	80-110 mmHg
pCO ₂	35-45 mmHg
Bicarbonate (HCO ₃ ⁻)	22-33 mmol/L

Full blood examination (FBE)

Hb	140-174 (male); 120-160 (female) g/L
RCC	4.50-5.50 (male); 4.0-5.0 (female) x10 ¹² /L
Haematocrit	0.42-0.52 or 42-52 % (male); 0.36-0.48 or 36-48% (female)
MCV	80.0-100.0 fL
RDW	11.5-14.5 %
Platelets	150-450 (x10 ⁹ /L)
WCC	4.0-11.0 (x10 ⁹ /L)
Neutrophil	40-80%; or 2.0-7.5 (x10 ⁹ /L)
Lymphocytes	20-40%; or 1.5-4.0 (x10 ⁹ /L)
Monocytes	2-10%; or 0.2-0.8 (x10 ⁹ /L)
Eosinophils	1-6%; or 0.0-0.4 (x10 ⁹ /L)
Basophils	<2%; or 0.0-0.1 (x10 ⁹ /L)

Liver function test (LFT)

ALT	<30 U/L
AST	<40 U/L
ALP	30-100 U/L
GGT	<30 U/L (female); <50 U/L (male)
Bilirubin (total)	<20 micromol/L
Bilirubin (conjugated)	<4.0 micromol/L
Albumin	32-45 g/L
Total protein	63-80 g/L
Pancreatic lipase	8 – 78 U/L

Thyroid function test (TFT)

TSH	0.4-5.0 mU/L
T4 (free)	10-25 pmol/L
T3 (free)	3.0-6.5 pmol/L

Carbohydrate metabolism

BSL (random)	3.0-7.7 mmol/L
BSL (fasting)	3.0-5.5 mmol/L
HbA1c (non-DM)	4.3-5.7% (NGSP); 23-39 mmol/mol (IFCC)
HbA1c (DM) therapeutic target	<7% *

Fasting lipid biochemistry

Total cholesterol	<5.5 mmol/L
LDL	2-3.4 mmol/L
HDL	>1 mmol/L
Non-HDL cholesterol	<2.5 mmol/L
TG	<1.7 mmol/L

Others

Troponin T	<0.01 µg/L
CRP	<3 mg/L
D-dimer	<500 µg/L
BNP	<20 nmol/L