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Family Name	
Given Names	
Student Number	
Teaching Period	Semester 1, 2017

FINAL EXAMINATION	DURATION				
PHA311 – Clinical Biochemistry	<table border="1"> <tr> <td>Reading Time:</td> <td>10 minutes</td> </tr> <tr> <td>Writing Time:</td> <td>180 minutes</td> </tr> </table>	Reading Time:	10 minutes	Writing Time:	180 minutes
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INSTRUCTIONS TO CANDIDATES

The examination has TWO (A and B) Sections:

Section A contains short essay questions: Answer All questions. Total marks allocated: Ninety (90).
Suggested time allocation: Ninety (90) minutes

Section B contains case studies questions: Answer All questions. Total marks allocated: Ninety (90).
Suggested time allocation: Ninety (90) minutes

EXAM CONDITIONS

You may begin writing from the commencement of the examination session.

The reading time indicated above is provided as a guide only.

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

**THIS EXAMINATION IS PRINTED
DOUBLE-SIDED.**

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Section A
Short Essay Questions
Total No of Marks for this section: 90 marks

This section should be answered on the Answer Booklet provided.
Please ensure that your name and student number have been written on the Answer Booklet.

Marks for each question are indicated.
Suggested Time allocation for Section A: **90 minutes**

Question 1

- a. List and describe the causes of variation in clinical laboratory test results.
- b. List and explain the properties of an ideal marker to distinguish health and disease in humans.

(5+ 5= 10 Marks)

Question 2

- a. Explain the difference between laboratory measured osmolality and calculated osmolality.
- b. Describe TWO clinical examples where a significant difference can be observed in the two values.

(5+5=10 Marks)

Question 3

Discuss any FOUR of the following components of liver function testing. For each component, explain what information the test provides and use examples to illustrate your answers.

- a. Alkaline phosphatase (ALP)
- b. Alanine aminotransferase (ALT)
- c. Gamma glutamyl transpeptidase (GGT)
- d. Bilirubin
- e. Prothrombin time (PT)

(5+5+5+5=Marks: 20)

Question 4

Discuss the clinical application of any TWO of the following cardiac biomarkers. For each biomarker, explain what information the test provides and any observed limitations. Use examples to illustrate your answer.

- a. Troponin T
- b. NT-proBNP
- c. hs-CRP

(7.5+7.5=15 Marks)

Question 5

Discuss the common mechanisms which can lead to the following electrolyte disturbances. Use examples to illustrate your answers.

- a. Hyponatraemia
- b. Hypercalcaemia

(7.5+7.5= 15 Marks)

Question 6

A 45 year old patient presents for a routine checkup. He has no known medical conditions. He is not on any medication. He is a smoker and his father died of a heart attack aged 55.

- a. Comment on the following fasting serum lipid levels.

Total Cholesterol	7.1
LDL	5.2
HDL	0.8
Triglyceride	2.5
- b. What further tests would you recommend?

(5+5=10 Marks)

Question 7

Discuss any TWO creatinine based methods of assessing renal function. For each method, include any advantages or disadvantages that have been observed.

(10 Marks)

END OF SECTION

Section B
Case Study Based Questions
Total No of Marks for this section: 90 Marks

This section should be answered in the Answer Booklet provided.

Marks for each question are indicated.
Suggested Time allocation for Section B: **90 mins**

Question 8

Case 1

A 22 year old patient has had severe diarrhea for 3 days. He has become increasingly lethargic and complains of weakness. He does not have any other known medical conditions.

His doctor orders the following blood tests: full blood examination (FBE), UEC, LFT, ABG.

The results are shown below:

U&E		LFT		FBE		ABG	
Na	138	ALP	60	Hb	165	pH	7.29
K	3.1	ALT	35	RCC	5.1	pCO ₂	26
Cl	114	GGT	37	Hct	61%	O ₂	92
Urea	1.8	Bilirubin (total)	17	MCV	91	Bicarbonate	11
Cr	100	Albumin	30	WCC	8.5		
AG	16			Platelet	395		

Considering the case and the results provided, answer the following questions:

- a. What do the ABG results indicate?
(10 Marks)

- b. What is the most likely cause of any abnormalities observed in the ABG results?
(2 Marks)

- c. Briefly describe 4 other conditions can cause the observed ABG results?
(8 Marks)

- d. Describe the factors that may have influenced the U/E results
(5 Marks)

- e. What do the other laboratory results (LFT & FBE) indicate?
(5 Marks)

(Total Marks: 30)

Question 9

Case 2

A 35 year old woman presented to her GP, complaining of fatigue, weight gain (6kg in the previous 3 months), and feeling excessively cold. She has also noticed that her monthly period has been heavier than usual.

Some blood tests are ordered and the results are shown below:

U&E		LFT		FBE		Iron Studies		TFT	
Na	139	ALP	45	Hb	80	Serum Iron	4ug/L	TSH	45
K	4.1	ALT	23	RCC	2.8	Transferrin Saturation	10%	Free T4	8
Cl	106	GGT	34	Hct	28%	TIBC	86ug/L	Free T3	2.3
Urea	5.2	Bilirubin(total)	16	MCV	60	Serum Ferritin	6ug/L		
Cr	98	Albumin	56	Reticulocytes	1.5%				
eGFR	>90			WCC	6.6				
				Platelet	320				

Considering the case and results provided, answer the following questions:

- What do the TFT results indicate?
(5 Marks)
- How would you confirm the likely cause of any abnormalities in the TFTs?
c.
(5 Marks)
- What do the FBE results indicate?
(5 Marks)
- What is the most likely cause of the observed FBE results? Justify your answer.
(10 Marks)
- Following appropriate treatment of her condition, which follow up tests would be most appropriate?
(5 Marks)

(Total Marks: 30)

Question 10

Case 3

A 50 year old man is admitted to hospital with septicaemia. He is unwell, dehydrated and only passing a small volume of urine (oliguria).

His laboratory results are shown below:

U&E		LFT		FBE		Others	
Na	138	ALP	35	Hb	158	Blood glucose	5.6
K	5.0	ALT	26	RCC	4.8		
Cl	98	AST	29	Hct	50%		
Bicarbonate	22	Bilirubin(total)	17	Platelet	160		
Urea	26	Albumin	33	MCV	88		
Cr	200			WCC	20		
AG	23						

Considering the case and results provided, answer the following questions:

- What do the U&E results indicate? **(5 Marks)**
 - What does the anion gap indicate? **(5 Marks)**
 - What further tests would be appropriate? **(2 Marks)**
 - Calculate his plasma osmolality and what does this indicate? **(8 Marks)**
 - Explain how the urine osmolality would compare to the plasma osmolality? **(10 Marks)**
- (Total Marks 30)**

END OF SECTION B

Reference Ranges

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

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 umol/L
Bilirubin (conjugated)	<4.0 umol/L
Albumin	32-45 g/L
Total protein	63-80 g/L
Pancreatic lipase	8 – 78 U/L

Full blood examination (FBE)

Hb	140-174 g/L (male) 120-160 g/L (female)
RCC	4.50-5.50 x10 ¹² /L (male) 4.0- 5.0 x10 ¹² /L (female)
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% 2.0-7.5 x10 ⁹ /L
Lymphocytes	20-40% 1.5-4.0 x10 ⁹ /L
Monocytes	2-10% 0.2-0.8 x10 ⁹ /L
Eosinophils	1-6% 0.0-0.4 x10 ⁹ /L
Basophils	<2% 0.0-0.1 x10 ⁹ /L

Thyroid function test (TFT)

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