Higher Specialist Diploma

Clinical Chemistry

September 2024

Short Answer Questions

60 minutes

Attempt all Four Questions

Instructions to Candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet.

2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets.

3. Begin each new answer on a new page.

4. Each question is worth 25 marks.

1. You are asked by your trainee to help them understand some of the terminology used in the validation and verification process. Provide a brief explanation of the following terms and how they are assessed:

   a. Linearity (5 marks)

   b. Specificity/Interference (10 marks)

   c. Limit of Detection (LoD) (10 marks)

2a. You have a new member of staff that has never been involved in Drugs of Abuse screening. You decide to put a tutorial together on this topic. What would you need to include in the tutorial? (15 marks)

2b. Provide a brief overview of the different methodologies used in screening and confirmation of Drugs of Abuse. (10 marks)

3a. A newly registered biomedical scientist comes to you with some abnormal results which include a significant drop in creatinine and TP. What is the possible cause of this change in results and what other abnormal results would you expect to see? (15 marks)

3b. What are the other typical causes of spurious results and what effects would this have? (10 marks)

4. You experience a breakdown of a specialist piece of equipment in the laboratory section you are responsible for. Explain the process you would follow and any actions you would take.

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Essay Paper

120 minutes

Attempt 2 out of 5 Questions

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3. Begin each new answer on a new page.

4. Each question is worth 100 marks.

1. Critically discuss the main methodologies of Creatinine measurement and how and why Creatinine is used with renal function calculations.

2. Critically review the role of the reference range, considering both its limitations and usefulness within Clinical Chemistry.

3. Critically discuss the role the laboratory in the diagnosis, monitoring and treatment of Diabetes.

4. Using named examples, describe and evaluate the 'Westgard' rules and discuss laboratory application and strategy requirements with regards to UKAS accreditation.

5. Critically evaluate the usefulness of inflammatory biomarkers for disease diagnosis and prognosis.

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Case Studies

120 minutes

Attempt all Case Studies

Instructions to Candidates

1. Record your candidate number and HSD discipline on the front sheet of the answer booklet.

2. Record your candidate number, the question number and the page number in the spaces provided on the answer sheets.

3. Begin **each new case study** on a new page.

4. Each case study is worth 100 marks.

5. For these case study questions you are strongly advised to answer the questions as they arise during the case study to avoid later information impacting adversely on your answers to the earlier questions by presuming an "outcome".

SEEN CASE STUDY

1.

A 55 year old female was referred to the endocrine clinic because of skin pigmentation, obesity, hypertension and muscle weakness. Results of initial blood sample investigations were as follows;

Investigation	Result	Reference Range
Serum		
Sodium	149 mmol/L	135 – 145 mmol/L
Potassium	2.8 mmol/L	3.3 – 4.9 mmol/L
Urea	6.5 mmol/L	2.6 – 6.7 mmol/L
Creatinine	75 µmol/L	60 – 125 µmol/L
Calcium	2.25 mmol/L	2.15 – 2.55 mmol/L
Albumin	42 g/L	35 – 45 g/L
Glucose	13.8 mmol/L	5.5 – 11.1 mmol/L

A preliminary diagnosis of Cushing's syndrome was made.

a. Outline the causes of Cushing's syndrome. (20 marks)

b. On the assumption that this initial diagnosis is correct, explain the physiological causes of the abnormal results shown above. (10 marks)

c. What other diagnoses should be considered? (15 marks)

d. What investigations can be carried out to confirm or rule out these differential diagnoses? (15 marks)

e. Critically evaluate the investigations available to confirm or rule out a diagnosis of Cushing's syndrome. (40 marks)

UNSEEN CASE STUDIES

2.

A 78-year-old woman presents to A&E with a one-week history of diarrhoea & vomiting and constipation. She complains of generalised malaise and fatigue over the last month, and a slight tendency to breathlessness over the last three months. Her past medical history is unremarkable. Results from investigations are listed below;

Investigation	Result	Reference Range
Serum		
Sodium	129 mmol/l	135 -145 mmol/l
Potassium	3.3 mmol/l	3.5 - 5.0 mmol/l
Urea	13.4 mmol/l	2.5 - 7.5 mmol/l
Creatinine	92 µmol/l	40 - 120 µmol/l
eGFR	54 ml/min/1.73m^2	> 80 ml/min/1.73m^2
Albumin	37 g/L	35 -50 g/L
Calcium	3.29 mmol/L	2.20 - 2.60 mmol/L
Phosphate	0.75 mmol/L	0.70 - 1.50 mmol/L
ALP	174	30 - 150
Blood		
Haemoglobin	135 g/l	115 - 165 g/l
RBC	6.1 x 10^{12}/L	4.5 - 6.5 x 10^{12}/L
WBC	9.7 x 10^9 /L	4.0 - 10.0 x 10^9 /L

a. What are the two most common causes of hypercalcaemia? Which investigation(s) are of most use in distinguishing between these two causes? (15 marks)

The patient is admitted, and blood samples are taken 48 hours later. These show an increase of serum creatinine to 135 µmol/l, and a decrease in GFR to 38 ml/min/1.73m^2.

b. Comment on these changed results. (10 marks)

Over the next couple of days further investigations are carried out, with results as follows:

Investigation	Result	Reference Range
Serum		
Albumin	38 g/L	35 - 50 g/L
Calcium	3.33 mmol/L	2.20 - 2.60 mmol/L
TSH	1.24 mU/L	0.35 - 4.10 mU/L
25 Hydroxy Vitamin D	70 nmol/L	75 - 200 nmol/L
PTH	< 1.2 pmol/L	1.6 - 6.9 pmol/L
Cortisol (at 09:00)	583 nmol/L	140 - 690 nmol/L

c. Explain why each of these investigations were carried out. Which causes of hypercalcaemia may now be excluded? (50 marks)

d. What further investigations should now be carried out to make a final diagnosis? Where appropriate, include any common investigations that may be carried out outside of Pathology. (25 marks)

3.

A 35-year-old male was admitted to A&E. Clinical details of Fast AF, the following blood sample results were obtained:

Investigation	Result	Reference Range
Serum		
Sodium	134 mmol/L	133 - 146 mmol/L
Potassium	6.2 mmol/L	3.5 - 5.3 mmol/L
Chloride	104 mmol/L	95 -108 mmol/L
Bicarbonate	20 mmol/L	22 - 29 mmol/L
Urea	6.3 mmol/L	2.5 - 6.4 mmol/L
Creatinine	102 µmol/L	55 - 95 µmol/L
Albumin	46 g/L	34 - 50 g/L
Bilirubin	22µmol/L	< 17 µmol/L
Alkaline phosphatase	99 U/L	35 - 130 U/L
Alanine transaminase	86 U/L	<40 U/L
Total protein	76 g/L	60 - 80 g/L
C Reactive Protein	4 mg/L	< 5 mg/L
Thyroid stimulating hormone	2.3 mU/L	0.35 - 3.5 mU/L

a. Identify any abnormal results and provide possible causes. (15 marks)

A follow up sample taken by his GP a few months later gave the following:

Investigation	Result	Reference Range
Serum		
Albumin	44 g/L	34 - 50 g/L
Bilirubin	16 µmol/L	< 17 µmol/L
Alkaline phosphatase	96 U/L	35 - 130 U/L
Alanine transaminase	44 U/L	<40 U/L
Total protein	72 g/L	60 - 80 g/L
Thyroid stimulating hormone (TSH)	4.2 mU/L	0.35 - 3.5 mU/L
Free Thyroxine (fT4)	18.2 pmol/l	7.8 - 17 pmol/l

b. Discuss these results and with reasons, suggest further tests which would be useful to aid diagnosis. (10 marks)

c. What are the possible diagnosis, and what typical symptoms would you also expect to be present. (15 marks)

d. Describe the physiological regulation of Thyroid homeostasis. (20 marks)

A further follow up sample was received a week later, with the clinical details raised TSH

Investigation	Result	Reference Range
Serum		
Thyroid stimulating hormone	3.7 mU/L	0.35 - 3.5 mU/L
Free Thyroxine (fT4)	16.9 pmol/l	7.8 - 17 pmol/l

e. Why is it inappropriate to repeat TSH within a short time frame in cases like this? (5 marks)

A year later:

Investigation	Result	Reference Range
Serum		
Sodium	137 mmol/L	133 - 146 mmol/L
Potassium	3.9 mmol/L	3.5 - 5.3 mmol/L
Urea	5.8 mmol/L	2.5 - 6.4 mmol/L
Creatinine	95 µmol/L	55 - 95 µmol/L
Albumin	44 g/L	34 - 50 g/L
Bilirubin	32 µmol/L	< 17 µmol/L
Alkaline phosphatase	226 U/L	35 - 130 U/L
Alanine transaminase	65 U/L	<40 U/L
Total protein	75 g/L	60 - 80 g/L
Gamma-glutamyl transferase	495 U/L	<70 U/L
NT pro BNP	532 ng/L	< 50 ng/L

f. Discuss these results. (5 marks)

g. What is the significance of the NT pro BNP result? (5 marks)

The most recent sample came with the clinical details “amiodarone”.

Investigation	Result	Reference Range
Serum		
TSH	0.02 mU/L	0.35 - 3.5 mU/L
fT4	48 pmol/l	7.8 - 17 pmol/l
Free tri-iodothyronine (fT3)	8.1pmol/L	3.1 - 6.8 pmol/l
Albumin	44 g/L	34 - 50 g/L
Bilirubin	55 µmol/L	< 17 µmol/L
Alkaline phosphatase	263 U/L	35 - 130 U/L
Alanine transaminase	124 U/L	<40 U/L
Total protein	82 g/L	60 - 80 g/L

h. Discuss these results and potential causes. (10 marks)

i. Using disease examples, describe the value of Liver enzymes and Bilirubin in the investigation of liver (dis)function. (15 marks)