Higher Specialist Diploma

Clinical Chemistry

Examination - September 2021

Short Answer Questions

60 minutes

Attempt all four questions

<u>Instructions to candidates</u>

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 a total of 25 marks

1. Your laboratory receives an external quality assurance report for the 'Serum Rhubarb' test, for which two samples were processed:
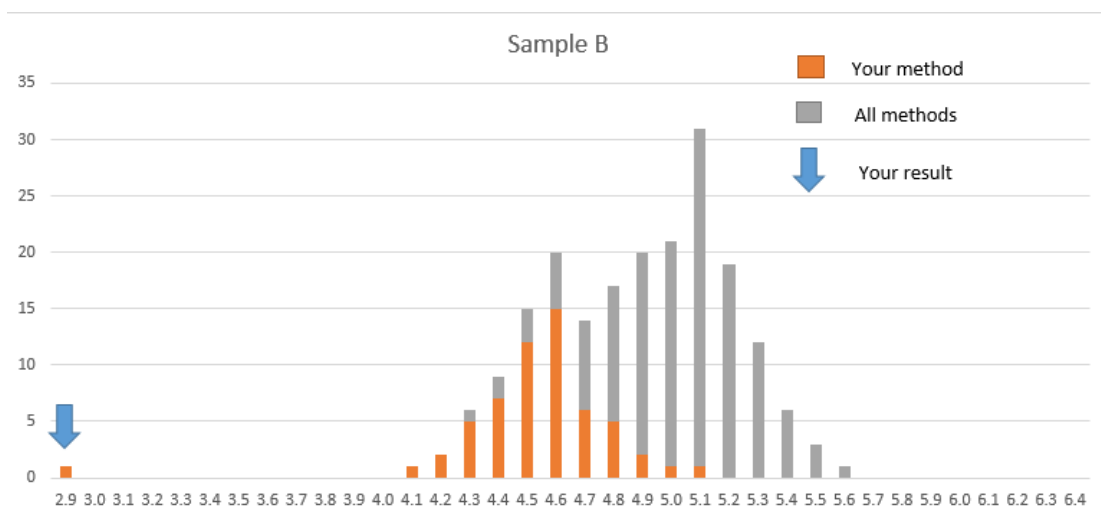
Sample A:

Your result	4.6mg/L

	n	Mean	SD	CV
All method	198	3.3	0.3	9.1%
Your method	58	2.9	0.2	6.9%
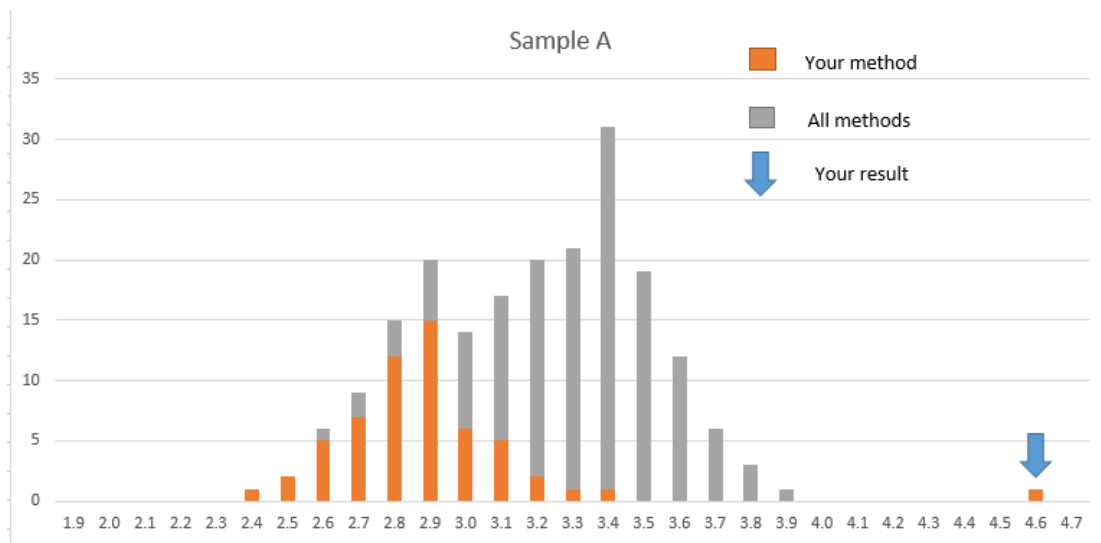
Sample B:

Your result	2.9mg/L

	n	Mean	SD	CV
All method	198	5	0.3	6.0%
Your method	58	4.6	0.2	4.3%

Based on the data observed in this distribution:
   a. Please comment on the performance of the method that your laboratory uses against other methods. (5 marks)
   b. Please comment on your laboratory's performance in comparison to your own method and other methods. (5 marks)
   c. How would you investigate your laboratory's performance in this distribution? What corrective action would you take? (15 marks)

2. 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)

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 are required to put together a tutorial on therapeutic drug monitoring. Provide a brief description of the key learning outcomes and terminology you consider important to include in a tutorial on pharmacokinetics and therapeutic drug monitoring.

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Essay Paper

120 minutes

Attempt 2 out of 5 questions

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

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3. Begin each new answer on a new page

4. Each question is worth 100 marks

1a. Describe the role creatinine plays in chronic and acute renal disease diagnosis and monitoring. (50 marks)

1b. Critically discuss the different laboratory methods for its measurement. (50 marks)

2. Critically discuss the role of the laboratory in the diagnosis, monitoring and treatment of GI health conditions.

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

4. Critically evaluate the role of clinical chemistry and POCT in Covid-19 patient monitoring.

5. Provide detailed accounts of acute diabetic conditions and critically evaluate the role of the laboratory in the diagnosis and monitoring of these.

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Case studies

120 minutes

Attempt all case studies

<u>Instructions to candidates</u>

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 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 67 year old man attended his GP with the clinical details of tiredness and back pain. He previously saw a colleague with the same problem 6 weeks ago, He was advised to take ibuprofen and return if symptoms did not settle.

He has taken ibuprofen and paracetamol in combination with some relief but the pain is increasing.

The following results were obtained:

Sodium	133	132-144	mmol/L
Potassium	4.5	3.2-4.8	mmol/L
Chloride	93	95-108	mmol/L
Bicarbonate	26	22-29	mmol/L
Urea	10.1	3.0-8.0	mmol/L
Creatinine	211	60-120	µmol/L
Albumin	39	34-50	g/L
Bilirubin	18	<17	µmol/L
Alk phos	74	35-120	IU/L
ALT	7	<45	IU/L
Total protein	87	60-80	g/L
Globulin	48		g/L
Calcium	2.74	2.12-2.60	mmol/L
Corrected calcium	2.82	2.12-2.60	mmol/L
Phosphate	1.35	0.80-1.50	mmol/L
Magnesium	0.71	0.70-1.00	mmol/L
CRP	180	<5	mg/L
Glucose	5.1		mmol/L

His haemoglobin is found to be 106g/L, (130-160g/L) with an MCV of 92 (80-100fl)

a. Comment on these results, provide some possible diagnosis and discuss what further tests might be requested.   (20 marks)

At follow-up the following obtained:

Sodium	132	132-144	mmol/L
Potassium	4.0	3.2-4.8	mmol/L
Urea	8.9	3.0-8.0	mmol/L
Creatinine	147	60-120	µmol/L
Albumin	32	34-50	g/L
Calcium	2.57	2.12-2.60	mmol/L
Corrected calcium	2.73	2.12-2.60	mmol/L
CRP	110	<5	mg/L
PTH	1.5	1.6-6.9	pmol/L
ESR	72	2-10	mm/h
Haemoglobin	94	130-180	g/L
White blood cells	2.5	3.6-11.0	10^9/L
Red blood cells	3.0	4.50-6.50	10^12/L

Immunoglobulin and protein electrophoresis analyses were performed.

Immunoglobulin results of IgG 2.0 g/L, IgA 5.2 g/L, and IgM 0.69 g/L were measured (Normal Ranges: IgG 6.0 - 16.0g/L. IgA 0.8 - 3.0g/L. IgM 0.4 - 2.5g/L).

b. Comment on these results.   (15 marks)

c. Capillary and gel electrophoresis are the two types of electrophoresis used in clinical laboratories, briefly describe the differences between these two techniques. (20 marks)

d. Following these results, what further investigations would this patient now have?
                                                                           (15 marks)

Before treatment can begin this patient needs to be staged.

e. Describe the International Staging System (ISS) for multiple myeloma.   (10 marks)

f. What are the possible treatment options for Multiple Myeloma?   (10 marks)

The patient was admitted two months later with a severe infection and subsequently died.

g. Suggest a reason why the immune system in this patient was compromised.
                                                                           (10 marks)

UNSEEN CASE STUDIES

2.
A 35 year old female presents to A&E with acute abdominal pain and vaginal bleeding.

a. What initial screening tests would be carried out, provide reasons for your answers?

(15 marks)

The following result was obtained:
HCG: 121,000 IU/L

b. What are the possible causes for this raised result?   (10 marks)

c. What further tests or clinical investigations would help to determine the cause? What patterns would you expect to see?   (12 marks)

d. What are the different treatment and follow up requirements for the different potential diagnosis?   (20 marks)

Examine these series of blood hCG measurements made in three different female patients, after a positive pregnancy test. (Series 1, 2 and 3).

	hCG Levels (IU/L)		
	Series 1	Series 2	Series 3
Day 16	7.5	7.5	7.5
Day 19	15	15	20
Day 21	27	27	35
Day 27	107.5	110	120
Day 52	3438	3500	4000
Day 60	27,500	29,000	29,000
Day 70	110,000	120,000	130,000
Day 80	95,000	25	300,000

e. How can these differences in results (series 1, 2 and 3) be explained?   (15 marks)

f. What immunoassay problem may be the cause of the result on day 80 in series 2? How can this problem be overcome?   (8 marks)

Ten years later the women visited her GP with hot flushes, mood swings and tiredness.

g. What is likely cause of these symptoms and what tests can be used to confirm this diagnosis?   (10 marks)

h. What other test might you expect to outside the reference range?   (10 marks)

3.

A 33 year old female presented to her GP having lost weight (10 kg) in the past three months despite a normal diet and no significant exercise. She reported that her family had noticed that she had become more irritable, and she had felt uncomfortable in a recent spell of hot weather.

On clinical examination her palms were sweaty, and she had a fine tremor of the fingers when her arms were outstretched. Results of investigations were as follows:

	10th Jan	12th Feb	Reference range
FT4	27.0	30.0	11.0-25.0 pmol/L
TSH	0.20	0.09	0.20-5.00 mU/L

a. What is the diagnosis for this patient?   (10 marks)

b. Outline the changes in the hypothalamus/pituitary/thyroid endocrine axis.   (20 marks)

c. What are the most common causes of this disease?   (10 marks)

d. What further investigations would you propose to make a differential diagnosis?
                                                                                 (10 marks)

The patient is treated with carbimazole, and thyroid function is monitored.

	10th Jan	12th Feb	26th Mar	8th Apr	12th May	Reference range
FT4	27.0	30.0	33.0	21.0	18.0	11.0-25.0 pmol/L
TSH	0.20	0.09	0.09	0.10	0.13	0.20-5.00 mU/L
Treatment			Carbimazole →→→→→→→			

e. Comment on the results for the 26th March, 8th April and 12th May.   (10 marks)

Three months later the patient makes an urgent appointment with her GP with symptoms of a sore throat and fever. She was in fast atrial fibrillation, and distressed.

Further investigations revealed the following:

	10th Jan	12th Feb	26th Mar	8th Apr	12th May	10th Aug	Reference range
FT4	27.0	30.0	33.0	21.0	18.0	72.0	11.0-25.0 pmol/L
TSH	0.20	0.09	0.09	0.10	0.13	0.03	0.20-5.00 mU/L
WBC						0.2×10^9	$4.0\text{-}11.0 \times 10^9$
Neutrophils						0.1×10^9	$2.0\text{-}7.5 \times 10^9$
Treatment			Carbimazole →→→→→→→→→→→→				

f. Comment on these results.   (10 marks)

The patient's carbimazole was discontinued. She received intravenous propranolol, hydrocortisone, broad-spectrum antibiotics, digoxin and Lugols iodine via a nasogastric tube along with G-CSF for neutropenia. TFT's normalised over 8 days and WBC over 6 days. When euthyroid she underwent a total thyroidectomy and was commenced on Thyroxine replacement.

Six months later the patient developed symptoms of numbness and 'pins and needles' in her fingers and toes, muscle cramping in her calves, and dry skin.

Investigations revealed that the patient had developed hypocalcaemia; adjusted calcium was 1.72 mmol/L (reference range 2.05-2.60 mmol/L).

g. Explain the possible cause of this hypocalcaemia, and outline the changes in calcium homeostasis which have lowered calcium levels.   (20 marks)

h. What further investigations would you suggest to confirm this diagnosis?   (10 marks)