



UNIVERSITY OF
BIRMINGHAM

STUDENT BOOKLET

Name: _____

ID No: _____

College of Medical and Dental Sciences

MSc in Clinical Biochemistry

Course Code 5602

Year 2

SHORT ANSWER PAPER

Friday 26th June 2009

Room WF15
Medical School
University of Birmingham

Enter your name and student ID number in the space provided on this answer booklet

Answer all Questions

Time Allowed: 2 hours 30 minutes (0930 – 1200)

You will need to pass each module

Please write final answers to calculations in the boxes provided below the question

For examiners use only

Module 1		Module 2		Module 4		Module 5		Module 6	
Question	Mark	Question	Mark	Question	Mark	Question	Mark	Question	Mark
1				1		1		1	
2				2		2		2	
3				3		3		3	
4				4		4		4	
5				5		5		5	

Module 1

1. A 42 year old woman has persistent hypertension and hypokalaemia. Following withdrawal of medication and correction of the hypokalaemia, plasma investigations were as follows:

	Aldosterone (pmol/L)	Renin (nmol/L/hr)	Cortisol (nmol/L)
08.00h Recumbent	1270 (100-450)	0.1 (1.1 – 2.7)	700
12.00h Ambulant	1006 (200-800)	0.1 (2.8 -4.5)	300

a) What is the diagnosis? (4 marks)

b) What is the underlying cause? (4 marks)

c) Why is plasma cortisol measured? (2 marks)

2. 60 yr old smoker with manic-depression on lithium presents to her GP with thirst and polyuria. Her serum biochemistry results are:

Calcium	3.16	mmol/L	
Albumin	40	g/L	
Phosphate	0.60	mmol/L	
Creatinine	116	µmol/L	
Alkaline Phosphatase	111	IU/L	(30-130)
Parathormone	5.3	pmol/L	(0.5 –5.5)
Glucose	4.8	mmol/L	
TSH	9.6	mU/L	
Free Thyroxine	14.5	pmol/L	

- a) Why is the patient hypercalcaemic? (3 marks)
- b) Describe her thyroid status. (3 marks)
- c) Give **ONE** underlying cause for both the hypercalcaemia and abnormal thyroid function. (2 marks)
- d) What other endocrine/metabolic disorder may be associated with the underlying cause and contribute to the thirst and polyuria? (2 marks)

3. A 30 yr old woman has had a total thyroidectomy for a benign goitre following which she was commenced and stabilised on 150ugs of thyroxine daily. Three years later, a serum thyroglobulin (RIA) was measured at 55ug/L (0-34). There was no abnormal uptake on a ¹²³Iodine Body Uptake Scan and in particular absent uptake into the thyroid gland.

a) Explain the thyroglobulin result. (4 marks)

b) List three further investigations which may help confirm your explanation. (6 marks)

4. A 57 year old woman known to have hypercalcaemia had the following serum biochemistry results:

Calcium	2.75 mmol/L
Phosphate	0.85 mmol/L
Alkaline Phosphatase	92 mmol/L
Albumin	40 g/L
Urea	5.7 mmol/L
Creatinine	72 μ mol/L

A 24 hour urine collected at the same time as the blood specimen gave the following results:

24 hour volume	2112 mL
Creatinine	3.8 mmol/L
Calcium	3.4 mmol/L

Calculate the calcium to creatinine clearance ratio. (8 marks)

Ca/Cre clearance ratio

To exclude familial hypocalcuric hypercalcaemia, the clearance ratio should be >0.01 . Comment on your results. What further test would be helpful in deciding the cause of the hypercalcaemia? (2 marks)

5. A laboratory wishes to check that its equation for adjusting calcium for albumin is correct for its current methods. A large dataset of paired calcium and albumin results is obtained from the laboratory computer, and a scatter plot of calcium (y-axis) versus albumin (x-axis) is graphed. The linear correlation is confirmed with an equation (in the form of $y = ax+b$):

$$\text{Calcium} = 0.019x \text{ Albumin} + 1.64$$

- a) Using the equation and the desired reference range of 2.15-2.65 mmol/l, calculate the adjustment equation for this laboratory, expressed in the form:

$$\text{Adjusted Ca} = \text{calcium} + a (b - \text{albumin}) \quad (5 \text{ marks})$$

Adjustment Equation:

What assumptions about the dataset do you need to make for the equation to be valid?

(1 mark)

b) The equation previously used by the laboratory was:

$$\text{Adjusted calcium} = \text{calcium} + 0.025 (42 - \text{albumin}).$$

A patient had the results:

Adjusted Ca 2.31mmol/L

Albumin 28g/L

What would the new adjusted calcium result be for the same patient?

(4 marks)

Adjusted Calcium =

Module 2

1. The following results were obtained in the serum from a 56 year old man with back pain:

Sodium	130	mmol/L	
Potassium	3.1	mmol/L	
Chloride	113	mmol/L	
Bicarbonate	11	mmol/L	
Urea	4.1	mmol/L	
Creatinine	100	μ mol/L	
Glucose	5.6	mmol/L	
Osmolality	294	mmol/kg	
Bilirubin	12	μ mol/L	
Alkaline Phosphatase	126	IU/L	(30 –130)
Alanine aminotransferase	41	IU/L	
Protein	104	g/l	
Albumin	44	g/l	

- a) Calculate the osmolar gap (write down any formula you use for the calculations) (4 marks)
- b) What is the cause of the low serum sodium in this case? (4 marks)
- c) Give two further biochemical investigations. (2 marks)

2. List five secondary causes of hyperlipidaemia. (2 marks each)

3. Outline the hexokinase method for the determination of plasma glucose (10 marks)

4. Given the following results, calculate the LDL-cholesterol concentration.

Total Cholesterol	5.8 mmol/L	
HDL Cholesterol	0.8 mmol/L	
Triglyceride	2.1 mmol/L	(10 marks)

LDL-Cholesterol Concentration =

5. The imprecision of an assay for glucose has a coefficient of variation of 5.4% between 6.0 and 8.0 mmol/L. A fasting glucose result of 7.4 mmol/L is obtained on a patient sample. Assuming that this is the true result give an estimate of the probability that reanalysis of the sample would give a result below the decision point for diabetes mellitus.

(10 marks)

Probability

Module 4

1. Define the following genetic terminology
 - a) Recessive
 - b) Polygenic
 - c) Phenotype
 - d) Somatic Mutation
 - e) Hemizygous.

(2 marks each).

2. Match the purine disorder to its clinical features. (2 marks each)

- a) Adenosine deaminase deficiency.
 - b) Phosphoribosyl pyrophosphate synthetase superactivity.
 - c) Myoadenylate deaminase deficiency.
 - d) Xanthine oxidase deficiency (Molybdenum cofactor deficiency).
 - e) Adenylosuccinase deficiency.
-
- i) Isolated muscle weakness, cramps, fatigue, myalgia post exercise.
 - ii) Neonatal feeding difficulties, intractable seizures, lens dislocation, severe retardation.
 - iii) 90% presentation in neonatal period. Presentation in infancy with failure to thrive, diarrhoea, prominent costochondral junctions.
 - iv) Stones, gouty arthritis, sensorial deafness.
 - v) Moderate/severe psychomotor retardation, neurological disease with seizures and hypotonia, variable lissencephaly, autism.

3. List five factors that influence the affinity of haemoglobin for oxygen. (2 marks each)

4. The following results were found on an internal quality control sample:

Haemoglobin g/dL 10.2 11.3 9.8 9.6 10.1 11.0 9.9 11.0 9.5 10.8
10.7

Calculate the median, mean, variance, standard deviation (SD) and
standard error of the mean (SEM). (2 marks each)

Median =

Mean =

Variance =

SD =

SEM =

5. A method for measuring iron involves adding 0.2 mL of sample (serum, water or standard) to 2.8 mL of reagent then after 10 min incubation at room temperature, measuring the absorbance at 570 nm in a cuvette with a 1 cm path length using an identical cuvette containing distilled water as a reference. The readings using serum, standard or water as sample were 0.53, 0.41 and 0.08 respectively. If the concentration of iron in the standard was $10\mu\text{mol/L}$, calculate the iron concentration in the serum. (10 marks)

Serum Iron Concentration

Module 5

1. List five factors which affect the measurement and interpretation of bilirubin in cerebrospinal fluid (CSF) from a patient with suspected subarachnoid haemorrhage.
(2 marks each)

2. Define the following terms:

Pharmacokinetics
Pharmacodynamics
Pharmacogenetics
Pharmacogenomics
Bioavailability

(2 marks each)

3. A 40 year old woman presented to her GP with severe itching and xanthelasmata. The GP thought she looked slightly jaundiced. Serum biochemistry results were:

Albumin	38 g/L	
Alkaline Phosphatase	405 IU/L	(38-126)
Alanine Aminotransaminase	65 IU/L	
Bilirubin	55µmol/L	
Gamma Glutamyltransferase	145 IU/L	(6-42)

What is the most likely diagnosis? (4 marks)

Give one key investigation which may help in the diagnosis of the patient. (4 marks)

What is the cause of the itching? (2 marks)

4. To measure LDH activity 10 μL serum and 0.2 mL pyruvate are added to 2 mL NADH solution (0.17mmol/L) and the absorbance monitored at 340 nm in a cuvette with a path length of 0.5 cm. The absorbance readings at 30 seconds and 60 seconds are 0.291 and 0.243 respectively. Calculate the LDH activity in the serum (molar absorptivity of NADH at 340 nm = 6.30×10^3 L/mol/cm).
(10 marks)

LDH activity

5. Calculate the theoretical maximum plasma concentration if 250 mg of the monosodium salt of a drug is administered to a 70 kg male. Assume the drug is only distributed throughout the extracellular fluid (the volume of which is 20% of the body weight) and its bioavailability is 0.9. The molecular weight of the parent drug is 300 Daltons.

(10 marks)

Plasma Concentration

Module 6

1. Briefly describe what A, B and C represent in the context of a UKNEQAS External Quality Assurance Scheme. (10 marks)

2. List five causes (excluding drugs) of persistent mildly raised serum transaminase results. (2 marks each)

3. Match the following vitamins with their commonly used alternative name.
(2 marks each)

- a) Cholecalciferol
- b) Thiamine
- c) Ergocalciferol
- d) Cyanocobalamin
- e) Ascorbic acid

- i) Vitamin D1
- ii) Vitamin D2
- iii) Vitamin D3
- iv) Vitamin K1
- v) Vitamin C
- vi) Vitamin B1
- vii) Vitamin B12

4. A laboratory using a method with an analytical coefficient of variation of 5% at a concentration of 100 mmol/L for a serum constituent examined samples from a healthy population and found a Gaussian distribution with 95% reference range of 74-126 mmol/L. If the method coefficient of variation had been 22%, what reference range would the laboratory have found?

(10 marks)

Reference Range

5. Your laboratory is now measuring a new analyte - analyte Y. You have determined that the within subject variation is 8% and between subject variation is 12%. The total CV for analyte Y is 20%. What is the:

Analytical goal for imprecision?

(2 marks)

Analytical goal for imprecision
=

Predicted standard deviation at 75 units of Y?

(2 marks)

Predicted standard deviation at 75
units of Y =

Index of individuality?

(3 marks)

Index of Individuality =

Critical difference for assay assuming homogeneity of variance? (3 marks)

Critical difference =