

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Calcium, magnesium, bone disease

Question no: 1

Osteoporosis is a skeletal disease characterised by low bone mass and microarchitectural deterioration of bone tissue with a consequent increase in bone fragility and susceptibility to fracture.

a)	Give four major risk factors for osteoporotic fracture [4]	
b)	Name two of the most common sites for osteoporotic fracture? [4]	
c)	What technique is used to measure bone mass? [2]	
d)	What is a T-score? [2]	
e)	Give 4 secondary causes of low bone mass. [4]	
f)	Name 2 drugs used to treat postmenopausal osteoporosis. [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Calcium, magnesium, bone disease

Question no: 2

Osteoporosis is a progressive, systemic skeletal disease.	
a)	State four characteristics of osteoporosis? [4]
b)	What non-pathology test diagnoses osteoporosis? [2]
c)	Name three causes of secondary osteoporosis, and a biochemical test that may be used to exclude each of these [6]
d)	Name two of the most common sites for osteoporotic fractures? [2]
e)	What class of drug is used in the treatment of osteoporosis? [2]
f)	Give two examples of lifestyle advice is given to patients with osteoporosis? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Calcium, magnesium, bone disease

Question no: 3

Biochemical hypophosphataemia is common in hospitalised patients, but may not indicate phosphate depletion.	
a)	Name 4 causes of hypophosphataemia [4]
b)	State four consequences of severe, prolonged phosphate deficiency? [4]
c)	What muscular complication may arise at very low phosphate concentrations? [2]
d)	What bony complications may arise in adults and children with chronic phosphate depletion? [4]
e)	The most common method used to measure phosphate is based on the formation of a phosphomolybdate complex. Name the substrate used in this reaction [2]
f)	The phosphomolybdate complex may be measured directly, or reduced to molybdenum blue. What is the advantage of measuring the reduced complex? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Calcium, magnesium, bone disease

Question no: 4

Biochemical markers may be used in the assessment of metabolic bone diseases such as Paget's disease, osteoporosis and osteomalacia	
a)	Define osteoporosis (2)
b)	State four risk factors in the development of osteoporosis (4)
c)	State two markers of bone resorption (2)
d)	Explain the benefits of bone resorption markers in osteoporosis. (4)
e)	Name the class of drug used as first line treatment for post- menopausal osteoporosis and state its action in the bone remodelling process. (4)
f)	Describe two preanalytical factors that may influence the concentration of a marker (4).

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Calcium, magnesium, bone disease

Question no: 5

Phosphaturia is relatively common. Rare causes include genetic forms of hypophosphataemic vitamin-D resistant rickets		
a)	How does hypophosphataemic vitamin D-resistant rickets present? [4]	
b)	Indicate the expected biochemical abnormalities in serum/plasma observed in this condition. [5]	
c)	What is the major regulated step in renal phosphate handling and how is it thought to be regulated? [5]	
d)	What are the two main methods of treatment of hypophosphataemic vitamin D resistant rickets? [2]	
e)	State two the potential long-term complications of this treatment? [2]	
f)	What is the cause of vitamin-D resistant rickets when the serum 1,25-dihydroxyvitamin D is elevated? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Cancer

Question no: 1

A GP requests an alpha-feto protein, AFP, test on his patient.  
The Clinical details are “*Jaundice, query cause?*”

a)	What is the physiological function of AFP? [2]	
b)	State two causes of a raised serum AFP concentration in non-pregnant adults [2]	
c)	What two causes can result in an abnormally raised AFP during pregnancy? [4]	
d)	What is the half-life of AFP? [2]	
e)	Give two ways in which the laboratory do to aid clinicians in comparing AFP results across different hospitals [4]	
f)	Discuss the use of AFP in this GP patient’s investigation [6]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Cancer

Question no: 2

<p>A 56-year old woman with a history of alcohol abuse and liver cirrhosis attended A&amp;E with acute abdominal pains. A panel of tumour markers were requested with results as follows:          AFP = 5 kU/L (&lt;7)          CA125 = 48 kU/L (&lt;35)          CA199 = &lt;10 kU/L (&lt;33)          CEA = 3 µg/L (&lt;5)</p>	
a)	Name two possible causes of elevated CA125 in this lady [2]
b)	The biomarkers listed above are proteins produced by the tumour cell. State another class of molecule that is currently used as a tumour biomarker giving one example plus the malignancy it is most associated with. [2]
c)	Give two reasons why tumour markers should not be used in isolation to diagnose malignancy [4]
d)	Give two general examples of when the measurement of tumour markers is clinically useful [2]
e)	List three properties of the ideal cancer biomarker [6]
f)	Using hCG as an example, briefly discuss the analytical problems associated with tumour marker assays. [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Cardiovascular system

Question no: 1

Heart failure is a complex clinical condition in which a cardiac abnormality reduces the ability of the heart to pump blood.	
a)	State two causes of heart failure [4]
b)	Which system is activated in heart failure, as a result of diminished renal perfusion? [2]
c)	Measurement of B-type natriuretic peptide (BNP) may be used in the diagnosis of heart failure. State two actions of BNP. [4]
d)	State a cause of a false positive and a false negative BNP result. [4]
e)	With reference to standardisation, what advantage does measurement of BNP have over NT-pro- BNP? [4]
f)	What is the gold-standard test for heart failure? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Chromatography

Question no: 1

Liquid Chromatography (LC) is a separation technique used in the quantification of a wide variety of biological molecules.		
a)	Name four types of liquid chromatography (4)	
b)	Explain why sample preparation procedures may be required. (4)	
c)	List two methods of sample preparation (4)	
d)	Define gradient elution (2)	
e)	What is the benefit of gradient elution (2)	
f)	State two limitations of HPLC (4)	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Chromatography

Question no: 2

High performance liquid chromatography (HPLC) is a popular technique in the clinical chemistry laboratory	
a)	What is the difference between isocratic and gradient modes in HPLC? [4]
b)	What is the most widely used stationary phase for HPLC? [2]
c)	Describe the difference between normal phase and reverse phase HPLC. [4]
d)	Name two commonly used detectors in HPLC [2]
e)	State one modification that can be made to improve a) Sensitivity [2] and b) Specificity [2]
f)	Name two modifications that can be made to improve sample throughput [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Diabetes mellitus and glucose

Question no: 1

A 15-year-old boy, diagnosed with Type 1 diabetes mellitus 6 years previously, presented with a 36-hour history of malaise, abdominal pain, and a reduced conscious level. On examination he was drowsy and breathing rapidly and deeply. His biochemistry on admission was as follows:

Serum

sodium 122 mmol/L

potassium 5.8 mmol/L

bicarbonate 8.0 mmol/L

urea 15.6 mmol/L

creatinine 454  $\mu$ mol/L

Plasma

glucose 54.0 mmol/L

Urine

ketones +++

a)	Which ketone body species is likely to be present in the largest concentration? [2]	
b)	Which ketone body species is most readily detected by dipstick tests for ketone? [2]	
c)	What are the two most likely causes for the hyperkalaemia? (4)	
d)	Other than renal impairment, what is the most likely explanation for the high creatinine result, and how might this be differentiated? [4]	
e)	12 hours after the initiation of treatment with insulin, 0.9% saline and potassium chloride his sodium was 140mmol/L and his glucose was 6.0mmol/L. What is the explanation for the rise in his serum sodium? [4]	
f)	State two possible causes for this episode of diabetic ketoacidosis? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Diabetes mellitus and glucose

Question no: 2

Diabetes Mellitus (DM) is a metabolic disorder of multiple aetiology characterised by chronic hyperglycaemia with disorders of carbohydrate, protein and fat metabolism resulting from defects in insulin secretion, insulin action, or both

a)	Diabetes can be categorised as Type 1 and type 2 diabetes. List 3 clinical features that suggest a diagnosis of Type 1 rather than type 2 [6]	
b)	The incidence of Type 2 diabetes is rising. Give 2 possible reasons for this [2]	
c)	List 2 chronic complications of Type 2 diabetes [2]	
d)	State the biochemical WHO diagnostic criteria for diagnosis of diabetes [6]	
e)	What antibodies may be measured to assist in diagnosis of Type 1 diabetes [2]	
f)	Maturity onset diabetes of the young (MODY) is a relatively rare familial form of diabetes. What is its most common mode of inheritance? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Electrophoresis

Question no: 1

Capillary electrophoresis is electrophoresis in capillary format. It is the most efficient and versatile separation technique for analysis of small and large molecules and is commonly used in clinical laboratories.

a)	List two modes of separation used in capillary electrophoresis [2]	
b)	State how capillary zone electrophoresis separates species [2]	
c)	Outline what is meant by the term electro-osmosis [6]	
d)	State four components of a capillary zone electrophoresis system [4]	
e)	State two advantages of capillary zone electrophoresis over standard electrophoretic separation techniques? [4]	
f)	Describe two applications of capillary zone electrophoresis in the clinical laboratory [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Electrophoresis

Question no: 2

Electrophoresis is a common technique utilised in the clinical laboratory for a wide range of applications.	
a)	Define the principles behind electrophoretic separation [4]
b)	State two different mediums used in electrophoresis [2]
c)	State two related electrophoretic techniques [2]
d)	List two stains commonly used to visualise bands of interest [4]
e)	Name two applications of electrophoresis in the clinical laboratory [4]
f)	State two advantages of capillary zone electrophoresis over standard electrophoretic separation techniques [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 1

A woman aged 50y visits her GP complaining that she feels tired all the time, that she is experiencing symptoms suggestive of the menopause and that her periods have become intermittent. The GP takes blood and tells her that he is going to assess both the likelihood that she is in transition to menopause and her thyroid function status.

Thyroid function test results are FT4 14pmol/L (9-25) and TSH 8.5mU/L (0.40-4.50)

a)	Which single biochemical test is most useful in assessing menopausal transition? [2]	
b)	What is this biochemical pattern of thyroid function tests called? [2]	
c)	What strategy would you advise the GP to pursue to follow up the patient and decide if/when to commence thyroxine therapy? [6]	
d)	Describe the TSH levels typically found in patients with primary hypothyroidism, secondary hypothyroidism and hyperthyroidism [6]	
e)	What is the most important biochemical objective of thyroxine replacement therapy in primary hypothyroidism? [2]	
f)	When assessing thyroid replacement in primary hypothyroidism, what is the minimum acceptable period between biochemical tests of thyroid? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 2

The hormones of the adrenal cortex are essential for survival		
a)	Name the two major hormones produced in the adrenal cortex. [2]	
b)	Summarise the main physiological actions of each of these hormones [4]	
c)	Give two clinical symptoms or signs for acute and for chronic adrenal insufficiency. [4]	
d)	List two causes of primary adrenal insufficiency? [2]	
e)	List two causes of secondary adrenal insufficiency? [2]	
f)	Name three laboratory tests that are used in the diagnosis of glucocorticoid deficiency? [6]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 3

A 55-year old Caucasian lady is seen by her GP for tiredness. Her thyroid function results are as follows: <ul style="list-style-type: none"><li>• Free T4 12 pmol/L (7.5 – 21.0)</li><li>• TSH 9 mU/L (0.3 – 4.0)</li></ul>		
a)	How would you define these results? [2]	
b)	List two risk factors for developing hypothyroidism? [4]	
c)	What autoantibody is of value in further investigation of this case? [2]	
d)	Give two other diseases that might be associated with these results [4]	
e)	Describe the probable mechanism behind this condition [4]	
f)	When should treatment start in this patient? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 4

A 23-year old lady presents to her GP complaining of anxiety and has recently suffered a family bereavement. Her thyroid function test results are as follows: <ul style="list-style-type: none"><li>• Free T4 80 pmol/L (7.5 – 21.0)</li><li>• Free T3 40 pmol/L (3.8 – 6.0)</li><li>• TSH &lt; 0.1 mU/L (0.3 – 4.0)</li></ul>		
a)	What is the most likely diagnosis based on these results? [2]	
b)	List four causes or triggers for this condition? [4]	
c)	Give two further investigations you would recommend [2]	
d)	List four diseases might be associated with this condition[4]	
e)	Describe the possible mechanism behind the commonest cause of this condition [4]	
f)	List the possible treatment options [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 5

The most common cause of congenital adrenal hyperplasia (CAH) is a deficiency of the enzyme 21-hydroxylase.		
a)	What is the gene which is affected in this condition? [2]	
b)	Describe the mechanism of the adrenal hyperplasia in this condition. [6]	
c)	Why are do some people with 21-hydroxylase deficiency get salt-wasting and hypotension while others do not?[4]	
d)	Which steroid would be measured as a first line screen in a neonate suspected of having classical CAH? [2]	
e)	What physical sign would be present at birth in a girl with severe CAH? [2]	
f)	11 $\beta$ -hydroxylase deficiency results in a form of CAH with salt-retention and hypertension. What is the basis for this? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 6

With regard to the investigation of infertile couples	
a)	What test is used to confirm ovulation in females, and when should the sample be taken? [4]
b)	List 2 causes of amenorrhoea in the female [2]
c)	What metabolic complication is associated with PCOS? [2]
d)	Uterine dysfunction is a rare cause of amenorrhoea – what test is used in its investigation? [4]
e)	List 2 causes of male infertility [4]
f)	Name 4 laboratory investigations that should be carried out in the male being investigated for infertility? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 7

A male patient is found to have a serum prolactin concentration of 843mIU/L, a macroprolactin is added by the Clinical Biochemist.	
a)	What is macroprolactin? [2]
b)	Why is it important to screen for macroprolactin? [6]
c)	Name the common method for macroprolactin detection? [2]
d)	Name the definitive method for macroprolactin detection? [4]
e)	What immune disease has been shown to affect macroprolactin estimates? [2]
f)	State two other possible reasons, apart from pituitary disease, for this prolactin result [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 8

<p>A 25 year old woman was referred to an endocrinologist for investigation of oligomenorrhoea, hirsutism and easy bruising. The endocrinologist noted increased abdominal fat and raised blood pressure. A diagnosis of Cushing's syndrome was suspected.</p>		
a)	State two possible causes of increased cortisol secretion. [2]	
b)	State two biochemical tests that can be used to screen for Cushing's syndrome. [2]	
c)	What is meant by the term 'circadian rhythm' and what happens to this in Cushing's syndrome. [4]	
d)	State two causes of pseudo-cushings. [2]	
e)	Describe the high dose dexamethasone suppression test and the cortisol result you would expect if the tumour originates in the pituitary. [6]	
f)	Having identified a patient with Cushing's syndrome name two non-biochemical investigations that are available to aid the diagnosis [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 9

A one-year old girl is seen in A&E. She has ambiguous genitalia and abnormal serum electrolytes. Previously undiagnosed congenital adrenal hyperplasia (CAH) is suspected.		
a)	Which enzyme in the steroid pathway is defective in the majority of cases of CAH in the UK? [2]	
b)	Why are the electrolytes affected in this condition and what are the electrolyte disturbances commonly found? [4]	
c)	State two other enzyme deficiencies which cause CAH. [2]	
d)	What biochemical blood test is used to aid the diagnosis of CAH and may be used for neonatal screening for the condition. State one cause of false positive results? [4]	
e)	What is the cause of late onset female CAH? [2] State two clinical effects of this condition [4]	
f)	Genetically, what is the pattern of inheritance for this condition? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Endocrinology

Question no: 10

Maintenance of normal potassium levels is essential to the life of cells. The distribution of potassium is such that 90% of total body potassium is intracellular and only 2% is extracellular.		
a)	Name the pump that maintains this intracellular to extracellular potassium ratio [2]	
b)	Name the major route of potassium output and the adrenal hormone involved in its regulation [2]	
c)	Name three other physiological factors that modulate potassium excretion [6]	
d)	Name the syndrome of primary hyperaldosteronism [2]	
e)	Explain the effects of primary hyperaldosteronism on potassium concentration [4]	
f)	Describe 2 adrenal causes of primary aldosteronism [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Enzymology

Question no: 1

A 36-year old woman experiences prolonged apnoea following surgery. Her Doctor is concerned that she may be sensitive to muscle relaxants and collects a sample for Cholinesterase phenotyping the following day.	
a)	What enzyme forms the basis of cholinesterase phenotyping, and what other form of this enzyme is there? [2]
b)	What two factors are important in determining the patient's level of risk? [2]
c)	List three reasons that could potentially cause a secondary increase in a person's risk of sensitivity to muscle relaxants. [6]
d)	Describe the basis of the phenotyping assay. [4]
e)	Why did the doctor wait until the following day to collect the sample? [2]
f)	The patient is told that she has an UA phenotype and family studies are recommended. She has a five-year old daughter who is found to have a 'Usual' phenotype, what advice would you give to the requesting clinician and why? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Gas transport and H<sup>+</sup> metabolism

Question no: 1

An elderly man was admitted to hospital by his GP for exacerbation of his COPD and LVF. He was treated on the ward with bendrofluazide and iv furosemide where it was noted that he had developed a metabolic alkalosis.		
a)	State 2 risk factors for developing COPD [4]	
b)	What biochemical findings indicate a metabolic alkalosis? [2]	
c)	State 2 causes of metabolic alkalosis. [2]	
d)	What is likely to have precipitated this patient developing a metabolic alkalosis? [2]	
e)	What will the pH of his urine be and why? [6]	
f)	Outline the principles of the measurement of H <sup>+</sup> . [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Gas transport and H<sup>+</sup> metabolism

Question no: 2

The interpretation of blood gas measurements can be challenging. Assume the following reference ranges: H <sup>+</sup> 38-43 nmol/L pCO <sub>2</sub> 4.6-6.0 kPa Serum bicarbonate 21-28 mmol/L.		
a)	What kind of acid-based disorder would be associated with the following results H <sup>+</sup> 89nmol/L; pCO <sub>2</sub> 2.8kPa; Bicarbonate 11 mmol/L. [4]	
b)	Suggest a clinical condition that could explain the results in a). [2]	
c)	What kind of acid-base disorder would be associated with the following results H <sup>+</sup> 26 nmol/L; pCO <sub>2</sub> 2.8kPa; Bicarbonate 20 mmol/L. [4]	
d)	Suggest a clinical condition that could explain the results in c) [2]	
e)	What is the Henderson Hasselbach equation? [4]	
f)	What is the anion gap and give one example of how it could be useful? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Genetics and molecular biology

Question no: 1

In the last 20 years, molecular genetics and diagnostics have been improved due to developments of PCR.	
a)	What does PCR stand for? [2]
b)	What are the four critical components (ingredients) needed for a PCR to be carried out? [4]
c)	What is the purpose of including a negative control in a PCR run, and how is it created? [2]
d)	What is reverse transcriptase? Name a use for this. [4]
e)	What does SNP stand for? [2]
f)	Explain the meanings of the terms 'mutation' and 'polymorphism'. [6]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Genetics and molecular biology

Question no: 2

Hereditary Haemochromatosis is normally an autosomal recessive condition due to mutations in a gene known as the HFE gene.		
a)	Which ethnic population has the highest prevalence of predisposing genotype? [2]	
b)	What diagnostic tests are carried out? [4]	
c)	What is the classic triad of signs when the condition is expressed? [6]	
d)	What is the basis of treatment of this condition? [2]	
e)	Both parents have symptomatic haemochromatosis. What are the chances of the girl child (age 16) expressing the condition? Or the older son (age 22)? Explain your reasoning. [4]	
f)	A mutation associated with hereditary haemochromatosis is referred to as C282Y. What does this terminology define? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Immunochemical techniques and radioisotopes

Question no: 1

Two-site immunometric assays are used for the measurement of a wide range of biochemical analytes	
a)	What does 'two-site' mean in the context of an immunometric assay? [2]
b)	In a typical two-site immunometric assay: Are the antibodies present in excess or are concentrations limiting? [2] Is the assay design competitive or non-competitive? [2]
c)	List three benefits to assay performance arising from the two-site immunometric assay compared to the single-site immunoassay? [6]
d)	Describe the relationship between analyte concentration and signal in an immunometric assay and indicate why in general this assay format has greater sensitivity than a competitive immunoassay
e)	Why does the number of wash steps used in a two-site immunometric assay influence the minimum detection limit of the assay? [2]
f)	Why does the two-site immunometric assay design not lend itself to the measurement of steroid hormones (e.g. cortisol)? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Inherited metabolic disorders

Question no: 1

A 4-day old baby boy presents with poor feeding, vomiting, and reduced level of consciousness. He was born at term and was initially well. You are duty biochemist and receive a phone call from paediatric admissions wanting to add on ammonia to the U&Es and LFTs already sent to the laboratory.

a)	Can the ammonia be added on? Explain your answer [4]	
b)	State 2 other EMERGENCY tests that you would recommend? [2]	
c)	State two further crisis samples that should be collected to investigate for a metabolic disorder [2]	
d)	Name three groups of metabolic disorders that may result in a raised ammonia level [6].	
e)	What acid-base disorder would you expect to see if the child had a urea cycle defect? [2]	
f)	What is the most common urea cycle disorder, and what is its mode of inheritance? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Inherited metabolic disorders

Question no: 2

A 9-day old term baby boy, born to healthy parents, presented to A&E floppy, with a history of poor feeding. On admission both ammonia and lactate were normal. A urine specimen showed gross ketosis and had a sweet odour. A diagnosis of Maple Syrup Urine Disease is considered.

a)	What is the enzyme defect in Maple Syrup [2]	
b)	What findings would you expect to see on an amino acid profile [6]	
c)	What further analyses would you perform to confirm the diagnosis [4]	
d)	What is the treatment regime for this disorder during the acute phase [4]	
e)	What is the principle neurotoxin [2]	
f)	What is the mode of inheritance and the likelihood of his subsequent siblings having the same condition [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Inherited metabolic disorders

Question no: 3

A 13-year old boy has become increasingly drowsy and ataxic. On admission his UE, LFT are unremarkable, but his ammonia is 550 $\mu\text{mol/l}$ with a markedly increased urinary orotic acid.	
a)	What is the most likely diagnosis? [2]
b)	What findings would you expect in an amino acid profile? [4]
c)	How would you confirm the diagnosis? [2]
d)	State the mode of inheritance of this condition and indicate the risk that his female cousin is a carrier who has previously been entirely well. [4]
e)	What biochemical test may help address this? [4]
f)	What implications are there for this cousin and her baby, should she become pregnant? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Inherited metabolic disorders

Question no: 4

<p>A 25 year old female presents to A&amp;E with severe abdominal pain and peripheral neuropathy. Her father has previously been diagnosed with acute intermittent porphyria (AIP).</p>		
a)	A simple urine test for which porphyrin precursor should be available to screen for acute porphyrias? [2]	
b)	What enzyme is deficient in AIP and what reaction does it catalyze. [4]	
c)	Name the 2 other most common acute porphyrias in the UK. [4]	
d)	How could AIP be distinguished from the other acute porphyrias biochemically? [6]	
e)	State 2 common precipitants of an acute attack in young women. [2]	
f)	What is the rationale for prescribing haem arginate during an acute attack? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Inherited metabolic disorders

Question no: 5

A female patient age 32 years presented at A&E with acute abdominal pain, nausea and vomiting. No obvious cause could be found for the symptoms. Her mother was said to have been diagnosed with porphyria some years ago

a)	Of the various types of porphyria which is the likeliest to cause this type of presentation? [2]	
b)	What biochemical test is useful in the initial investigation of this case? [2]	
c)	Name two precipitating factors that can cause the development of these symptoms? [4]	
d)	What is the nature of the inheritance of this type of porphyria? [2]	
e)	How should studies be carried out on the patient's family? [4]	
f)	What biochemical tests should be available locally, and when should sample be sent to a reference laboratory? [6]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory instrumentation

Question no: 1

A consultant nephrologist telephones you while duty biochemist, concerned that the bicarbonate results being produced by your lab are lower than normal.	
a)	What two pieces of lab data would you examine to determine if this was the case? [4]
b)	Suggest two actions you could take if the assay was not in control [4]
c)	The UK NEQAS return for the assay shows a poor 'C score'. What does 'C score' mean? [2]
d)	The assay uses a "one point calibration". What is the second point used? [2]
e)	State two acid-base disorders in which bicarbonate may be low. [4]
f)	What would you advise the nephrologist to do if the assay was not in control? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory instrumentation

Question no: 2

The UK Departments of Health have determined that all medical laboratories should be enrolled with an approved accreditation body.	
a)	Most NHS laboratories choose to be enrolled with CPA. What is the full name of the organization abbreviated to CPA? [2]
b)	What is the timetable used by CPA for full accreditation assessments and surveillance visits? [4]
c)	The CPA standards for laboratory accreditation are based on which international standard for the accreditation of medical laboratories? [2]
d)	The CPA standards place great emphasis on the laboratory service meeting the needs and requirements of its users. List four ways in which a laboratory may demonstrate that it is complying with this standard. [4]
e)	Quality management is central to CPA laboratory accreditation. List three features of an effective quality management system. [6]
f)	Name one other body approved for accreditation of UK medical laboratories. [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory instrumentation

Question no: 3

An understanding of evidence-based medicine (EBM) is fast becoming an essential requirement for the clinical biochemist as we move towards an era of knowledge management. One component of EBM is the level of research evidence from the literature.

a)	Describe a meta-analysis. [4]	
b)	Describe a systematic review. [4]	
c)	Describe a cohort study [4]	
d)	Which of the above a) to c) would yield the lowest level of research evidence? [2]	
e)	The Cochrane Library has an important role to play in EBM. What is that role? [2]	
f)	Apart from research evidence describe two other factors that should be taken into account when practicing EBM [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 1

Dipsticks can be used at the point-of-care to test for a number of analytes in urine.		
a)	Name the two enzymes used in the urine dipstick test for glucose. [4]	
b)	Name two substances which may interfere with the urine dipstick test for glucose. [4]	
c)	Explain why the urine dipstick test for glucose is a poor screening test for diabetes mellitus. [4]	
d)	Name 2 physiological states which may result in a positive urine dipstick test for ketones. [4]	
e)	What is the reaction used in the urine dipstick test for bilirubin. [2]	
f)	A urine dipstick shows bilirubin ++ and urobilinogen negative. Would this picture be associated with biliary obstruction or haemolytic anaemia? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 2

The most common methods for bilirubin measurement use diazo reagents		
a)	Which fraction of bilirubin reacts with diazo in the absence of an accelerator? [2]	
b)	Name one accelerator that can be used in the diazo reaction [2]	
c)	What would be your response, if asked to add a bilirubin measurement to an existing 3 day old sample Explain why and what you would recommend [6]	
d)	List 2 of the 4 bilirubin fractions in plasma [4]	
e)	Which common interferent is the direct spectrophotometry method for bilirubin sensitive to? [2]	
f)	Explain why use of a bilirubinometer should be restricted to newborns [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 3

60 year old man on admission to A&E has the following test results.  
Sodium 130 mmol/L, potassium 5.6 mmol/L, urea 35.0 mmol/L, creatinine 104  $\mu$ mol/L  
Bilirubin 728  $\mu$ mol/L, ALP 402 U/L, ALT 241 U/L, GGT 987 U/L

The comment attached to the results was: NB-Icteric sample.

a)	Which creatinine method is affected by icteric samples? [2]	
b)	What effects do icteric samples have on the creatinine result? [2]	
c)	Name and outline a creatinine method that overcomes interference from bilirubin and state how it achieves this [4]	
d)	State 2 other possible interferences in serum creatinine measurement [2]	
e)	Explain briefly how the colourimetric creatinine assay can be adapted to minimise these the effect of these interferants. [6]	
f)	State two other possible clinical causes of the raised urea in this case? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 4

A serum sample from a patient who had multiple myeloma was received from a GP surgery.

Urea and electrolytes results were as follows:

Sodium	110 mmol/L
Potassium	3.2 mmol/L
Chloride	105 mmol/L
Urea	6 mmol/L
Creatinine	80 µmol/L

Sodium was initially measured indirectly using an ion selective electrode (ISE). Reanalysis by direct ISE generated a sodium result of 137 mmol/L.

a)	Name the phenomenon underlying the differences between direct and indirect serum sodium results. [2]	
b)	State 2 biochemical abnormalities that may cause the discrepancies between the above serum sodium results. [2]	
c)	Other than direct ISE, what additional laboratory serum or plasma test is useful in the investigation/verification of such sodium results and how is this interpreted? [4]	
d)	Excluding gas sensing electrodes, name two types of membrane contained within an ISE. [4]	
e)	Describe the principle of measurement of carbon dioxide by gas sensing ISE. [6]	
f)	Define the term electrochemical cell. [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 5

Sodium concentration in plasma or serum is commonly measured by ion-selective electrode (ISE) methods. In the presence of severe hyperlipidaemia or hyperproteinaemia, indirect ISE methods underestimate sodium concentration.	
a)	What is the name given to this effect? [2]
b)	Briefly explain the basis of this effect. [6]
c)	Name one other method that can be used for sodium estimation that also demonstrates this effect. [2]
d)	List two ways of overcoming this effect. [4]
e)	Hyperglycaemia causes a reduction in serum sodium concentration. Briefly explain the mechanism involved. [4]
f)	Which drug can have a similar effect to that of hyperglycaemia on serum sodium concentration? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Laboratory methods

Question no: 6

The IFCC has recently recommended that all HbA1c analysis be standardised to an IFCC recommended reference method.		
a)	What is meant by the term reference method? [4]	
b)	Name the two reference methods recommended by IFCC for HbA1c standardisation [4]	
c)	Explain how reference methods are used to standardise laboratory based routine methods?[4]	
d)	Define HbA1c[2]	
e)	Name one method routinely used for HbA1c analysis[2]	
f)	What problems may the switch to IFCC standardisation cause and state two ways in which they will be overcome[4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Lipids

Question no: 1

Lipid measurement has become increasingly important in characterising the cardiovascular risk as well as in the diagnosis and management of disorders of lipoprotein metabolism.

a)	What absorbance is used in the measurement of cholesterol? [2]	
b)	Name 2 enzymes that are most commonly used in the determination of cholesterol? [2]	
c)	Name 2 common interferants in the measurement of cholesterol & describe how they cause interference. [6]	
d)	Give the Friedwald equation used to calculate LDL-cholesterol concentration. [2]	
e)	Name two circumstances when this equation must not be used [4]	
f)	What is the main problem with the LDL fraction when determined indirectly? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Lipids

Question no: 2

<p>A 40-year-old man is referred to dermatology outpatients because he is suffering from yellow papules with erythematous bases on the buttocks and elbows. The dermatologist recognises the lesions as eruptive xanthomata and wonders if the man has type III hyperlipidaemia. Blood taken after an overnight fast shows:</p> <ul style="list-style-type: none"> <li>• Cholesterol            7.9 mmol/L</li> <li>• Triglycerides        7.3 mmol/L</li> </ul>	
a)	State one type of lipoprotein that is increased in the serum of patients with this condition [2]
b)	State one other clinical feature of this condition [2]
c)	Which apoprotein genotype is associated with this condition? [2]
d)	State the first-line drug treatment for this type of hyperlipidaemia and the metabolic target of this drug [4]
e)	Describe the characteristic appearance of serum lipoprotein electrophoresis in this condition [6]
f)	List two common causes of secondary hypertriglyceridaemia [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Lipids  
Question no: 3

You are phoned by a nurse from the Coronary Care Unit who wishes to perform lipid investigations on a patient who suffered a myocardial infarction 3 days ago.		
a)	How long should the clinical team wait before they can reliably assess the patient's cholesterol status? [2]	
b)	Write down the Friedewald equation used to calculate LDL cholesterol in mmol/L. When is this equation not valid? [4]	
c)	State two other methods for measuring LDL cholesterol [4]	
d)	What is the current Joint British Societies target for lowering LDL cholesterol in a patient who has had a myocardial infarction? [4]	
e)	State the predominant type of apoprotein present in LDL-cholesterol [2]	
f)	State the first-line drug treatment in hypercholesterolaemia and name one other alternative drug treatment [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Liver

Question no: 1

A request for plasma copper is received for investigation of suspected Wilson Disease. The analysis is carried out using inductively couple plasma mass spectrometry (ICP-MS) and produces a low result of 5 $\mu$ mol/L (reference range: 10 to 22 $\mu$ mol/L).		
a)	What symptoms and signs might raise the diagnostic possibility of Wilson Disease? [4]	
b)	What is the reason for the low plasma copper concentration usually found in Wilson Disease? [2]	
c)	What other explanations might account for low plasma copper? [2]	
d)	Describe further diagnostic tests that would support a diagnosis of Wilson Disease. [4]	
e)	Describe the principle of ICP-MS and the benefits it offers over alternative techniques for measuring trace elements. [6]	
f)	Explain how a co-existing systemic inflammatory condition could affect the plasma copper concentration? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Liver

Question no: 2

<p>A GP patient has a persistently raised ALT result, greater than three times the upper limit of normal on several occasions over a 6 month period. The GP wishes to explore the possibility of hereditary haemochromatosis.</p>	
a)	What reaction is catalysed by the ALT enzyme? [4]
b)	Compare the use of AST with that of ALT as a liver function test in terms of sensitivity and specificity. [4]
c)	State 2 organs, other than the liver, which are commonly damaged by haemochromatosis. [2]
d)	Describe two other biochemical abnormalities that could be used to support a diagnosis of iron overload. [2]
e)	Which gene is most commonly mutated in cases of haemochromatosis in the UK and what is the most common mutation? [4]
f)	Discuss when it is appropriate to screen for hereditary haemochromatosis using this mutation and why. [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Liver

Question no: 3

At a private work related “Executive Health Screen” a 46 year old man was found to have a random serum cholesterol = 6.9mmol/L; triglyceride = 0.9mmol/L and HDL cholesterol = 1.2mmol/L.

His U&Es were all within their respective reference intervals.

His LFT were as follows. Bilirubin - 12 $\mu$ mol/L; ALT = 72 U/L (RI < 50); AST = 58 U/L (RI < 35) Alk Phos = 186 U/L (RI 40-150);  $\gamma$ GT = 177 U/L (RI < 90).

He was reported that he was fit and healthy and totally asymptomatic.

His father died at 62 and his brother at 23 from what was believed to be alcoholic liver disease, though he said that he did not believe these diagnoses.

He said he was virtually teetotal and physical examination was unremarkable. His BMI = 24Kg/m<sup>2</sup>; BP 125/75mmHg : Pulse – sinus rhythm 60 min<sup>-1</sup>.

a)	Give two other routinely available laboratory investigations could be used to help shed light on the veracity of his reported alcohol intake? [2]	Urate Macrocytosis (allow FBC indices)
b)	The clinician requests that his plasma carbohydrate deficient transferrin is measured. What is the biological basis of this test? [2]	
c)	Briefly indicate the problems of using carbohydrate transferrin in the detection and monitoring of ethanol consumption in clinical practice. [6]	
d)	On further investigation his C-reactive protein – 1mg/L and his $\alpha$ 1-antitrypsin = 0.46g/L (RI = 1.1 – 2.1 g/L).  Very briefly indicate the significance of these results. [2]	
e)	You suspect that he may have partial $\alpha$ 1AT deficiency. What is the most likely genotype he is likely to suffer from and very briefly outline the pathobiochemical consequences of this genotype? [6]	
f)	Briefly, giving your reasons, how would you recommend that he is followed up ‘biochemically’? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Liver

Question no: 4

A 52 year old man has been found to have a persistently elevated ALT of 55-70 IU/l.  
Further investigations are obtained by the General Practitioner.

Serum iron 45  $\mu\text{mol/L}$  (10 - 35)

Serum TIBC 65  $\mu\text{mol/L}$  (35 – 70)

Serum ferritin 1150  $\mu\text{g/L}$  (25 – 330)

a)	What is the most likely underlying condition and, in the UK, which gene is affected in the most common form of the condition?[2]	
b)	What is the mechanism of iron overload in this condition? [4]	
c)	List four other clinical manifestations of this condition. [4]	
d)	How can liver iron overload be assessed? [4]	
e)	What is the mainstay of treatment for this condition and how is the response to treatment assessed? [4]	
f)	How should the patient's siblings be screened for the condition? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Liver

Question no: 5

<p>A 38 year old woman visits her GP requesting screening for haemochromatosis because she has been worried following a 54 year old male colleague being diagnosed with the condition.</p>		
a)	What initial screening test should the GP advise? [2]	
b)	Which gene is affected in genetic haemochromatosis and what is the mode of inheritance? [4]	
c)	Name two organ systems potentially affected in genetic haemochromatosis and the clinical consequences that may result [4]	
d)	What is the treatment for hereditary haemochromatosis and how can the efficacy of this treatment be monitored? [4]	
e)	List four causes of iron overload other than genetic haemochromatosis [4]	
f)	Name an agent used for the elimination of iron from the body and what is its mode of action [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Metabolic response to disease

Question no: 1

A 60 yr old male is in HDU three days after undergoing an elective aortic aneurysm repair operation.	
a)	Describe the changes in CRP concentration after major surgery [4]
b)	Explain the changes that occur in serum albumin concentration [2]
c)	Thyroid function tests are often abnormal in acutely ill patients. What term is used to describe this? [2] Describe the changes in thyroid hormone metabolism [4]
d)	State two of the classical signs of the inflammatory response [2]
e)	The inflammatory response causes changes in the concentration of certain proteins. List two proteins that increase and two that decrease during inflammation [4]
f)	What acute phase protein can be used to differentiate infectious from non-infectious causes of inflammation [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Neuromuscular system

Question no: 1

It is important to detect Subarachnoid haemorrhage (SAH) in all patients with the condition. A CT-scan is only positive in 50% of patients within one week of the event. CSF bilirubin is used to help in the diagnosis of SAH.

a)	For how long after the SAH event may a CSF bilirubin remain positive? [2]	
b)	What special transport arrangements should be made for the CSF samples? [4]	
c)	Why should CSF taken before 2 hours not be analysed for CSF bilirubin? [4]	
d)	Briefly describe the analysis of the CSF bilirubin [6]	
e)	Why is it important to visually inspect the sample before analysis? [2]	
f)	What blood test should be requested at the same time, which may aid interpretation of the CSF bilirubin? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Neuromuscular system

Question no: 2

Subarachnoid haemorrhage (SAH), arterial bleeding into the subarachnoid space, is a difficult condition to diagnose clinically; diagnostic tests are relied on heavily in the confirmation or exclusion of the diagnosis. Spectrophotometric scanning of CSF for the presence of bilirubin and oxyhaemoglobin is a second line test used in the investigation of suspected SAH.

a)	What is the first-line test carried out when SAH is suspected clinically? [2]	
b)	What pre-analytical factors are important in ensuring reliable results from spectrophotometric scans for suspected SAH? [6]	
c)	What are the absorption maxima that indicate the presence of (a) bilirubin, and (b) oxyhaemoglobin [2]	
d)	Is the presence of oxyhaemoglobin alone diagnostic of SAH? Explain your answer. [4]	
e)	Give 2 instances where CSF bilirubin concentration may be increased, that are not due to SAH. [4]	
f)	What is the effect of oxyhaemoglobin with a net absorbance of >0.1 AU on the detection of absorbance due to bilirubin [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Neuromuscular system

Question no: 3

A 51-year old man referred to a specialist clinic with a complaint of leg weakness. He has had a history of 6-7 years difficulty climbing stairs. On examination he was overweight with proximal weakness of the limbs. Biochemical tests showed a mildly elevated CK. After a thorough investigation, a diagnosis of Pompe disease was made.

a)	Which enzyme deficiency is associated with this disease and what is the role of the enzyme [4]	
b)	What three sample types can be used for measuring these enzymes? [6]	
c)	State two non-biochemical tests can be used to assists with the diagnosis [4].	
d)	What is the main difference between the infantile and adulthood onset forms? [2]	
e)	State the inheritance pattern of this disease [2]	
f)	Which two groups of muscles are most affected in the adult form? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Nutrition and gastrointestinal tract

Question no: 1

Optimal tissue stores of water soluble vitamins are essential for normal growth and development and for maintenance of health	
a)	List 4 water soluble vitamins of interest to human health [2]
b)	List 2 functions of water soluble vitamins [4]
c)	State 3 clinical syndromes associated with deficiency of water soluble vitamins and describe how these syndromes can arise [6]
d)	Giving examples, state 2 biochemical methods for assessing water soluble vitamin status. [4]
e)	What are the limitations of the biochemical methods used for assessing vitamin status? [2]
f)	State 2 water-soluble vitamins that may be toxic following chronic excessive intake? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Nutrition and gastrointestinal tract

Question no: 2

A 58-year-old male is admitted to Intensive care following gastrointestinal surgery. He is commenced on Total Parenteral Nutrition (TPN) and the following day his biochemistry results are as follows.

Na 129 mmol/L

K 2.3 mmol/L

Urea 11.4 mmol/L

Creatinine 156 mmol/L

Ca 1.77 mmol/L

Albumin 22 g/L

Mg 0.4 mmol/L

a)	What is his adjusted calcium result detailing the formula you used? [4]	
b)	What anion might it be useful to measure in this sample and his pre-feeding sample. [2]	
c)	How is this 'syndrome' often described, and an increase in the secretion of which hormone might give rise to these low electrolyte results. [4]	
d)	List two possible clinical symptoms associated with this syndrome. [2]	
e)	Briefly explain the mechanism which is most likely to explain why the Calcium low in this patient [4]	
f)	List two different methods of measuring Magnesium. [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Nutrition and gastrointestinal tract

Question no: 3

A 22 year old woman underwent a jejunoileal resection and a jejunocolic anastomosis for severe Crohns' disease. In the months after surgery she complained of severe diarrhoea and was noted to be losing weight despite a good oral intake. A diagnosis of Short Bowel Syndrome is made.

She is cared for by the Nutrition Team and regains a healthy weight. 2 years after her surgery, however, she is readmitted to hospital with severe loin pain. Investigations attribute this to renal calculi and laboratory analysis show these to be principally composed of calcium oxalate.

a)	Define Short Bowel Syndrome [2]	
b)	State two deficiencies which may occur in patients who have undergone ileal resection [4]	
c)	The clinicians wish to exclude D-Lactic acidosis. What is this and why may it occur after this type of surgery? [4]	
d)	Why are requests to clinical laboratories for renal stone analysis becoming less frequent? [2]	
e)	Give the main chemical component of 2 other types of renal stone [4]	
f)	Give two reasons why patients who have undergone jejunoileal resection are prone to calcium oxalate renal stone formation? [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Nutrition and gastrointestinal tract

Question no: 4

<p>A 45 year old man with a known history of chronic excess alcohol consumption was admitted to hospital. He was noted to be unkempt and appeared underweight. The admitting doctor prescribed i.v. thiamine supplementation as part of his immediate treatment. 2 days after admission the medical team were contacted by the department of biochemistry to highlight a sudden drop in the patient's serum phosphate, magnesium and potassium levels to below their reference ranges.</p>	
a)	Thiamine was prescribed as prophylaxis against which syndrome [2]
b)	Describe 2 functions of thiamine in human metabolic pathways [4]
c)	Why was i.v. thiamine prescribed for this patient. [4]
d)	The biochemical changes noted 2 days after admission might be associated with this patient developing what syndrome? [2]
e)	List 4 other groups of patients who are at increased risk of developing this syndrome [4]
f)	Outline the causes of the major metabolic manifestations of this syndrome. [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Nutrition and gastrointestinal tract

Question no: 5

A 33 year-old female is admitted after a collapse. She has been feeling increasingly tired over the past week.

Initial investigations reveal:

Hb 7.3 g/dL

White cell count  $6.4 \times 10^9/L$

Platelets  $210 \times 10^9/L$

Haematinics have been requested.

a)	Describe two findings on haematinics that might occur if the anaemia is due to iron-deficiency [4]	
b)	State one feature that might be seen on the blood film of a patient with haemolysis [2]	
c)	List three causes of inherited haemolytic anaemia [6]	
d)	State two routine laboratory tests that are useful in the initial investigation of macrocytic anaemia [4]	
e)	If pernicious anaemia is suspected, state one immunological test that might aid diagnosis [2]	
f)	In which part of the gut is vitamin B12 absorbed [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy  
Question no: 1

A 3 week old neonate presents with jaundice, hepatomegaly, dark urine and pale stools. The differential diagnosis includes biliary atresia.		
a)	Jaundice is considered prolonged if presenting or persisting after how many days? [2]	
b)	Is hyperbilirubinaemia associated with biliary atresia conjugated or unconjugated? [2]	
c)	Why doesn't hyperbilirubinaemia in biliary atresia lead to kernicterus [4]	
d)	What surgical procedure is used to treat biliary atresia? [2]	
e)	State 2 investigations that can be used to help differentiate biliary atresia from neonatal <a href="#">hepatitis</a> ? [4]	
f)	Explain why an infant with biliary atresia becomes jaundiced? [6]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry  
Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy  
Question no: 2

A 1month old jaundice neonate has the following blood results, adult reference ranges are shown;

Bilirubin	150 umol/L	(<20 umol/L)
Albumin	<2 g/L	(32-45 g/L)
ALP	432 IU/L	(35-104 IU/L)
ALT	21 IU/L	(10-35 IU/L)
GGT	Regret, insufficient sample	(9-35 IU/L)

a)	Is this likely to be a cholestatic or hepatic liver pathology? (2)	
b)	Why are insufficient samples more likely to occur in neonates? (2)	
c)	Which fraction of bilirubin is potential life threatening and why? (4)	
d)	What is the significance of the albumin result in relation to the other tests? (6)	
e)	How do you interpret the ALP result? (4)	
f)	In what way can the laboratory help the interpretation of these results? (2)	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy  
 Question no: 3

Neonatal screening programmes exist throughout the world to allow early detection of disease.	
a)	State two diseases which are detected throughout the UK by neonatal screening. [2]
b)	State two pre-analytical factors which may invalidate the neonatal blood screen [4]
c)	State three criteria which must be considered when evaluating whether a disease should be screened for [6]
d)	In some countries, Duchenne Muscular dystrophy is screened for. a) What test is used to screen [2] b) What is the mode of inheritance of this condition [2]
e)	Medium chain Acyl Coenzyme A dehydrogenase deficiency (MCADD) is screened for in parts of the UK. What biochemical test is used to screen? [2]
f)	If a child is diagnosed with MCADD what is the chance that a sibling will also have this condition? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy

Question no: 4

A number of maternal biochemical changes and adaptations occur during healthy and complicated pregnancies. The laboratory may be called upon to support the antenatal care in either circumstance.

a)	The foeto-placental unit produces human chorionic gonadotrophin (hCG). What is the approximate expected rate of change in maternal serum hCG in the first trimester of an uncomplicated pregnancy? [2]	
b)	State two causes of raised serum or urine hCG, other than the normal progression of an uncomplicated pregnancy. [4]	
c)	Describe the pattern of change of maternal serum gonadotrophins, oestrogen, progesterone and prolactin during a normal, uncomplicated pregnancy. [6]	
d)	Name the chromosomal defect associated with Down's Syndrome. [2]	
e)	Name the ultrasound scan abnormality that supports an increased risk of a foetus being born with Down's Syndrome. [2]	
f)	What panel of serum markers are recommended for screening for Down's syndrome risk for a pregnancy presenting a) between 11 and 14 weeks and b) between 15 and 20 weeks [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy

Question no: 5

Antenatal screening is offered to pregnant women at the appropriate gestational age to allow parents to make informed choices regarding pregnancy outcome. Down's syndrome is one of the conditions tested for.		
a)	What chromosomal abnormality is present in Down's syndrome? [2]	
b)	What three biochemical markers are used for the Triple test (2 <sup>nd</sup> trimester screening)? [3]	
c)	State three pre-analytical factors which may affect the results of the Triple test. [4]	
d)	Apart from Down's syndrome what other condition can be detected through antenatal screening? [2]	
e)	What pattern of biochemical results would you expect to find if a fetus had Down's syndrome? [3]	
f)	Why do we use multiples of medians to assist the calculation of risk in antenatal screening? [6]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Paediatric biochemistry and pregnancy

Question no: 6

The clinical laboratory has an important role to play in the management of pregnancy. Laboratory tests are used to detect, evaluate and monitor pregnancy		
a)	The concentration in plasma of many analytes increases during pregnancy. List 2 analytes whose concentration increases during pregnancy [2]	
b)	How are laboratory tests used in the management of suspected ectopic pregnancy? [6]	
c)	What analyte is measured in serum as an early indicator of pre-eclampsia? [2]	
d)	What does the abbreviation HELLP syndrome stand for? [2]	
e)	List three complications associated with poorly controlled maternal diabetes during pregnancy [6]	
f)	What is the most common cause of isoimmunisation disease (Rhesus disease)? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Proteins

Question no: 1

An 80-year old female presented with back pain and weight loss. She had suffered a recent chest infection and had remained short of breath after recovering from this.

Investigations revealed:

Hb 8.1 g/dL, ESR 84 mm/h

Urea 12.2 mmol/L, Creatinine 304  $\mu$ mol/L

Albumin 24 g/L, Total protein 90 g/L

Serum electrophoresis revealed a paraprotein in the  $\lambda$ -globulin region

a)	State two further investigations that are used to confirm the diagnosis of myeloma and the characteristic findings from these investigations [8]	
b)	Which immunoglobulin subtype is the most common serum paraprotein present in myeloma? [2]	
c)	State <u>one</u> feature that may be evident on the blood film of this patient [2]	
d)	Bence Jones protein may be present in the urine of patients with myeloma. Which immunoglobulin component does this represent? [2]	
e)	State two causes of renal failure in myeloma [4]	
f)	Why are patients with myeloma susceptible to bacterial infections? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Renal biochemistry and urogenital tract

Question no: 1

<p>A Caucasian man aged 55y is waiting on the result of his 24h creatinine clearance before a decision is taken on the administration of the next dose of chemotherapy. The serum creatinine is 120<math>\mu</math>mol/L, the urine creatinine is 6.0mmol/L and the 24h urine volume is 1440 mL.</p>	
a)	<p>What is the formula for calculation of creatinine clearance. [4]</p>
b)	<p>Creatinine clearance is calculated to be 50ml/min. Interpret this creatinine clearance result in the context of a healthy adult population. [2]</p>
c)	<p>Give two advantages and two disadvantages of creatinine clearance measurement in comparison to a single serum creatinine result. [4]</p>
d)	<p>What does the abbreviation eGFR stand for? [2]</p>
e)	<p>The eGFR for the patient was 58 ml/min/1.73m<sup>2</sup>. How would this result be classified by the UK Chronic Kidney Disease Guidelines? [2]</p>
f)	<p>The eGFR result depends to some extent on the method used to measure creatinine. What is the most commonly employed method for measuring creatinine and what is the principle behind this method? [4]          What alternative method could be used to improve specificity and the uniformity of creatinine results? [2]</p>

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Renal biochemistry and urogenital tract

Question no: 2

Glomerular Filtration Rate (GFR) is normally 120mL/min and is used to assess renal function. The quantity of a substance excreted in the urine in 1 minute is equal to the quantity removed from the plasma by filtration in 1 minute, assuming neither reabsorption nor secretion occurs. There are different ways of measuring or calculating this.	
a)	Name two endogenous markers used to assess GFR [2]
b)	List two exogenous markers used to assess GFR [2]
c)	Which exogenous substance is used to assess renal plasma flow, and what property does it have to enable this to occur? [4]
d)	The 4v-MDRD formula is used to screen for chronic kidney disease (CKD). What does MDRD mean and which variables are used in its calculation? [6]
e)	What endogenous substance is used as an indication of tubular function, and how is this usually expressed? [4]
f)	What is the diagnostic test for type I renal tubular acidosis? [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Renal biochemistry and urogenital tract

Question no: 3

A 19 year old man presented to his GP with bilateral pitting oedema of his lower limbs and had felt unwell for 4 weeks. Urinalysis showed ++++ protein and the sample was sent to the biochemistry for analysis.	
a)	Define proteinuria in Nephrotic syndrome. [2]
b)	Name three complications of the nephrotic syndrome. [6]
c)	Pathological proteinurias can be glomerular, tubular or overflow. Define glomerular proteinuria. [2]
d)	Proteinuria is a risk factor for progressive decline in renal function. Name the two common causes of chronic kidney disease in the UK. [2]
e)	Myeloma patients characteristically have Bence-Jones proteinuria. What are Bence-Jones proteins and how do they cause renal damage? [4]
f)	Albumin excretion is expressed as a ratio to creatinine. What level indicates an increased albumin excretion in males and in females? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Renal biochemistry and urogenital tract

Question no: 4

Inherited abnormalities of renal tubular function comprise a heterogeneous set of disorders, with manifestations ranging from an asymptomatic biochemical disturbance to end-stage renal failure in childhood	
a)	Name 2 indicators that may suggest further investigation for a renal tubular disorder is warranted [2]
b)	Name 2 exogenous causes that may produce a biochemical picture similar to that of a renal tubulopathy [2]
c)	In a patient presenting with persistent hypokalaemia, state two further investigations that should be carried out to determine the cause [6]
d)	What are the clinical consequences of Fanconi syndrome [4]
e)	What are the clinical and biochemical features of Bartter's syndrome? [4]
f)	Name 2 biochemical features that distinguish Bartter's and Gitelman's syndromes [2]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Spectrophotometric methods

Question no: 1

Spectrophotometry is an analytical technique that is widely used in the clinical chemistry laboratory. It is applied throughout the core chemistry laboratory and in many of the specialist analytical areas.	
a)	Define the term “transmittance” and state its mathematical relationship to absorbance. [2]
b)	Give the Beer-Lambert equation and state each term in words. [2]
c)	State two analytical applications of the molar absorptivity. [4]
d)	What material may be used to calibrate the wavelength accuracy of a spectrophotometer and what property makes it fit for this purpose? [4]
e)	Describe an analytical problem relating to the specimen that may be encountered with a UV-visible light spectrophotometer. Give one way in which this problem be overcome or minimised? [4]
f)	Many analytes do not demonstrate a detectable absorbance yet are measured using spectrophotometry. Explain one way that this may be achieved giving one example analyte. [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Therapeutic drug monitoring and toxicology

Question no: 1

With regards to anticonvulsant drug therapy		
a)	Relative to the time of administration of the drug, when should a sample for phenytoin be collected and why? [2]	
b)	List two factors that could increase the concentration of free phenytoin over total phenytoin. [2]	
c)	Phenytoin can exhibit zero order kinetics above a certain concentration. Describe briefly what zero-order kinetics means [4]	
d)	Outline the two pharmacokinetic consequences of zero-order metabolism [4]	
e)	Valproic acid is a first line anticonvulsant treatment. Give two reasons why does it not make a good candidate for TDM? [4]	
f)	List four criteria for valid therapeutic drug monitoring. [4]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Therapeutic drug monitoring and toxicology

Question no: 2

Digoxin is a frequently requested analyte in therapeutic drug monitoring	
a)	In which two clinical conditions is digoxin used as treatment? [2]
b)	Changes in which 2 pharmacokinetics parameters alter the half life of digoxin in a patient? How do each of these influence the time taken to reach a steady state? [4]
c)	What characteristic of digoxin pharmacokinetics influences the timing of blood sampling when monitoring serum digoxin concentrations? [2]
d)	Name two alterations in serum biochemistry that can influence patients' sensitivity to digoxin [4]
e)	Name two potential interferences in digoxin immunoassays [4]
f)	In severe digoxin toxicity what influences the decision to treat with digibind (anti digoxin antibody)? What precautions are necessary in the biochemical monitoring of a patient treated with digibind? [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Therapeutic drug monitoring and toxicology

Question no: 3

An 18 year old female presents to Accident and Emergency reporting an overdose of paracetamol tablets 2 hours previously. Her serum paracetamol concentration on admission is 100mg/L.	
a)	What advice would you give regarding interpretation of this paracetamol result? [4]
b)	List two categories of patients who should be treated according to the high-risk treatment line on the plasma paracetamol nomogram. [4]
c)	Which intravenous preparation is recommended for treatment of paracetamol overdose if the paracetamol concentration is above the treatment line? [2]
d)	Briefly outline the mechanism of action of this antidote. [4]
e)	Which oral antidote may be used in remote areas if the intravenous antidote cannot be given promptly? [2]
f)	In paracetamol-induced liver necrosis, list two features that indicate a poor prognosis. [4]

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Therapeutic drug monitoring and toxicology

Question no: 4

A 43 year-old man is brought to Accident and Emergency by ambulance. He was found collapsed at home. The following blood results are obtained:

Na 140 mmol/L  
 K 3.9 mmol/L  
 Cl 111 mmol/L  
 Bicarbonate 6 mmol/L  
 Urea 3.4 mmol/L  
 Creatinine 87  $\mu$ mol/L  
 Glucose 4.1 mmol/L  
 Osmolality 323 mmol/kg

The junior doctor contacts you to discuss the possibility of ethylene glycol analysis.

a)	Stating the formula used, calculate the anion gap. [4]	
b)	Which method should be used for measurement of serum osmolality in this situation? [2]	
c)	Stating the formula used, calculate the osmolal gap. [6]	
d)	Which further analyte should be measured and its concentration added to the calculated osmolality before deciding if ethylene glycol analysis is appropriate? [2]	
e)	If ethylene glycol is detected, name two antidotes which may be used. [4]	
f)	Which metabolite of ethylene glycol may cause hypocalcaemia? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Water and electrolytes

Question no: 1

A 20-year old male is admitted to hospital with serious head injuries following a motorcycle accident. Over the next few days he produces >3L of urine each day and his serum sodium rises from 130 to 145 mmol/L.

a)	What is the most likely diagnosis in this man? [2]	
b)	What two biochemical tests should be performed to add weight to your diagnosis? [2]	
c)	What dynamic function test could be performed to confirm the diagnosis? [2] Outline the way in which this test is performed and how you would interpret the results? [6]	
d)	Measurement of the analyte responsible for this condition is rarely of clinical use. Give two reasons for this [4]	
e)	Assuming that your diagnosis is confirmed what treatment would you expect the young man to receive [1] and what biochemical monitoring would you recommend? [1]	
f)	Apart from trauma give one other cause of this condition. [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*

**FRCPath Part 1 Examination in Clinical Biochemistry**  
**Specimen Short Answer Question**

Topic area: Water and electrolytes

Question no: 2

A 70-year old woman is currently an in-patient on the oncology ward. The registrar calls you for advice on the following results for the patient:

Na 115 mmol/L

K 3.4 mmol/L

Cl 87 mmol/L

Urea 1.5 mmol/L

Creatinine 32  $\mu$ mol/L

She is currently taking bendroflumethiazide, amlodipine, amitriptyline and aspirin.

a)	List 2 pieces of clinical information that should be sought from the clinician when attempting to deduce the cause of this patient's hyponatraemia. [4]	
b)	Which 2 drugs listed above may be contributing to the patient's hyponatraemia? [4]	
c)	List 2 urine tests which may be helpful in clarifying the cause of this patient's hyponatraemia. [4]	
d)	In general, name two endocrine conditions that should be excluded before a diagnosis of the Syndrome of Inappropriate Antidiuretic Hormone (SIADH) can be formally made in a patient. [4]	
e)	Name one analyte which, if significantly elevated, can cause a pseudohyponatraemia. [2]	
f)	If treating a symptomatic acute dilutional hyponatraemia, what is the maximum rate at which the serum sodium concentration should be raised? [2]	

*Question provided for illustrative and educational purposes. It has not undergone the full quality assurance process of live FRCPath questions and additional or alternative answers may apply in some cases.*