Question 1

Musa Ndlovu is 40 years old and has Type 1 diabetes mellitus. He was diagnosed with this condition when he was 24 years old. He himself admits that for many years he was in denial about the seriousness of his condition, and that he has only lately begun to take his treatment seriously. This is because he is beginning to suffer from some of the complications of the disease. Dr Smith who looks after him is pleased that Musa has become more responsible.

A.1 Now after many years Musa is well motivated to control his glucose levels affectively. He has been taught how to measure his blood glucose regularly. Which insulin regime is the most appropriate for him? (NOTE: all insulins to be given by subcutaneous injection)

a. Half of the daily dose as soluble insulin 3 times daily before meals, the rest as isophane before bedtime
b. Isophane insulin once daily before breakfast combined with an oral hypoglycaemic agent
c. Insulin lispro 3 times daily, 2 hours after each meal
d. Premixed 30% soluble insulin/70% isophane insulin once daily, before breakfast
e. Premixed 50% soluble insulin/50% isophane insulin twice daily, before breakfast and lunch

One of the complications of his treatment that Musa has to guard against is hypoglycaemia.

A.2 Hypoglycaemia results in an increase in one of the following hormones. Which one?

a. Gastrin
b. Growth hormone
c. Luteinising hormone
d. Parathyroid hormone
e. Thyrotrophin releasing hormone

Dr Smith has to have a good understanding of all aspects of diabetes: for example its cause, the control of blood sugar in the body, and the anatomy of the pancreas which is a key organ in this disease.

X.1 Type 1 diabetes is a progressive autoimmune disease in which the β-cells in the pancreas are destroyed. Which of the following factors are most likely implicated in this pathogenesis and which are not?

a. A body-mass index (BMI) of more than 30 kg/m²
b. A genetic predisposition
c. A preceding viral infection
d. Environmental toxins such as lead
e. Excessive intake of high glycaemic index carbohydrates as an infant

X.2 Which of the following are effects of insulin, and which are not?

a. It decreases the cellular uptake of potassium
b. It stimulates glycolysis
c. It alters the permeability of the cell membrane to glucose
d. It increases protein synthesis
e. It stimulates the breakdown of glycogen.

X.3 Which of the following statements about the anatomy of the pancreas are correct, and which are not?
a. The head of the pancreas lies anterior to the inferior vena cava.
b. The inferior mesenteric artery delivers the main blood supply to the pancreas.
c. The islets of Langerhans are arranged as secretory acini which drain into a duct system.
d. The main pathway for pain transmission from the pancreas is via the splanchnic nerves.
e. The tail of the pancreas crosses the left kidney anteriorly.

Dr Smith also has patients with Type 2 diabetes, which is related to obesity and Syndrome X.

A.3 Which of the following is the most important factor in the pathogenesis of obesity?

a. Energy intake in excess of expenditure
b. Genetic predisposition
c. Insulin resistance
d. Intrauterine undernutrition
e. Leptin deficiency

A.4 One of Dr Smith’s patients is a 45 year old accountant with a total plasma cholesterol level of 7.7 mmol/L (RR < 5.0). He is started on an appropriate diet and a daily dose of simvastatin. Which of the following is the mechanism by which this agent improves the patient’s lipid profile?

a. Decreasing the number of LDL cholesterol receptors on the hepatocyte membrane
b. Inhibiting the activity of 3-hydroxy-3-methylglutaryl coenzyme A (HMG CoA) reductase
c. Increasing the GIT absorption of bile acids
d. Increasing the activity of lipoprotein lipase
e. Inhibiting the β-oxidation of fatty acids

X.4 Which of the following are causes of secondary dyslipidaemia, and which are not?

a. Diabetes mellitus
b. Nephrotic syndrome
c. FBD-B100 (familial binding defective apolipoprotein B-100)
d. Hypothyroidism
e. Familial hypercholesterolaemia

Patients with poorly controlled diabetes can become very ill, as in the following two cases.

A.5 A teenage diabetic attends a match of his rugby team (the Lions) with his friends. They drink lots of beer and eat biltong and sweets. Shortly after the match he is admitted to hospital in a confused state. Special investigations reveal the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma glucose</td>
<td>17.8 mmol/L</td>
<td>3.6-5.8</td>
</tr>
<tr>
<td>Arterial pH</td>
<td>7.15</td>
<td>7.34-7.44</td>
</tr>
<tr>
<td>Serum HCO₃⁻</td>
<td>13.2 mEq/L</td>
<td>18-23</td>
</tr>
<tr>
<td>Serum osmolality</td>
<td>292 mOsm/kg</td>
<td>275-295</td>
</tr>
<tr>
<td>Serum anion gap</td>
<td>14.5 mEq/L</td>
<td>3-11</td>
</tr>
<tr>
<td>Urine ketones</td>
<td>+++</td>
<td>negative</td>
</tr>
</tbody>
</table>

Which of the following is the most likely diagnosis in this case??

a. Acute prerenal failure
b. Chronic renal failure
c. Diabetic keto-acidosis
d. Hypoglycaemic coma
e. Hyperosmolar hyperglycaemic (non-ketotic) state

A.6 An overweight 43 year old diabetic patient develops pneumonia accompanied by severe nausea and vomiting. He is admitted to hospital in a confused state. Special investigations reveal the following:

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma glucose</td>
<td>36.7 mmol/L</td>
<td>3.6-5.8</td>
</tr>
<tr>
<td>Arterial pH</td>
<td>7.38</td>
<td>7.34-7.44</td>
</tr>
<tr>
<td>Serum ( \text{HCO}_3^- )</td>
<td>17.4 mEq/L</td>
<td>18-23</td>
</tr>
<tr>
<td>Serum osmolality</td>
<td>336 mOsm/kg</td>
<td>275-295</td>
</tr>
<tr>
<td>Serum anion gap</td>
<td>10 mEq/L</td>
<td>3-11</td>
</tr>
<tr>
<td>Urine ketones</td>
<td>trace</td>
<td>negative</td>
</tr>
</tbody>
</table>

Which of the following is the most likely diagnosis in this case??

a. Acute prerenal failure
b. Chronic renal failure
c. Diabetic keto-acidosis
d. Hypoglycaemic coma
e. Hyperosmolar hyperglycaemic (non-ketotic) state

X.5 Which of the following would form part of the treatment of a patient in a coma due to hyperosmolar non-ketotic state (HONK)?

a. Administering glibenclamide
b. Administering intravenous fluids
c. Administering intravenous insulin
d. Anticoagulation with Warfarin to prevent deep vein thrombosis
e. Correction of potassium depletion

Patients with diabetes can develop a variety of long-term complications for which they have to be assessed regularly. This means that continuity of care is essential for them.

A. Chronological dimension
B. Family dimension
C. Geographic dimension
D. Informational dimension
E. Interdisciplinary dimension
F. Interpersonal dimension
G. Spatial dimension

Listed above are 8 dimensions of continuity of care, as described by Hennen. For each of the statements below choose the dimension which best matches the scenario.

R.1 Musa has been consulting Dr Smith for the last 16 years, ever since the diagnosis of diabetes was made.

R.2 Dr Smith has tried to make sure that Musa goes to the Ophthalmology and Nephrology clinics regularly for screening.

A.7 At Musa’s last checkup at the Eye Clinic the doctor told him that there is some damage to his eyes due to the poor control. This is what the doctor sees on fundoscopy:
There are many small new blood vessels growing in the region of the macula.

http://eyephoto.ophth.wisc.edu/ResearchAreas/Diabetes/DiabStds/DStd6b.htm

What is this stage of diabetic retinopathy called?

a. Background retinopathy  
b. Mild nonproliferative retinopathy  
c. Moderate nonproliferative retinopathy  
d. Severe nonproliferative retinopathy  
e. Proliferative retinopathy

A few years later it becomes clear that Musa’s kidneys have been severely affected by his diabetes.

A. Strength of the association: how large is the effect?  
B. The consistency of the association: has the same association been observed by others, in different populations, using a different method?  
C. Specificity: does altering the cause alter the effect?  
D. Temporal relationship: does the cause precede the effect?  
E. Biological gradient: is there a dose response?  
F. Coherence: does the evidence fit with what is known regarding the natural history and biology of the outcome?  
G. Experimental evidence: are there any clinical studies supporting the association?  
H. Reasoning by analogy: is the observed association supported by similar associations?

The Bradford-Hill criteria for determining the cause of disease are listed above. Which of these causal criteria is operating in the scenario below?

R.3 Diabetes mellitus is one of the principal causes of chronic kidney disease. High blood sugar causes the walls of capillaries, including those of the glomeruli, to thicken and eventually degrade.

Musa is referred to a nephrologist and undergoes a series of tests to judge the level of functioning of his kidneys.

A.8 Musa is catheterised as part of his detailed renal function workup. Which region of the urethra is most vulnerable to damage during the insertion of a catheter?
a. Intrabulbar fossa  
b. Membranous (intermediate)  
c. Navicular fossa  
d. Prostatic  
e. Spongy (penile)

A.9 Which of the following findings in urine microscopy are most likely to support the diagnosis of end-stage renal disease?

a. Broad waxy casts  
b. Calcium oxalate crystals  
c. Gram negative bacteria  
d. Hyaline casts  
e. Red blood cells

A.10 Which of the following acid-base disturbances is most likely due to be present with end-stage renal disease (GFR<15ml/min/1.73m²)?

a. Decreased pH, decreased HCO₃⁻, decreased PCO₂  
b. Decreased pH, increased HCO₃⁻, increased PCO₂  
c. Decreased pH, decreased HCO₃⁻, increased PCO₂  
d. Increased pH, decreased HCO₃⁻, decreased PCO₂  
e. Increased pH, increased HCO₃⁻, increased PCO₂

X.6 Which of the following findings are likely in Stage 4 chronic kidney disease (GRF 15-29 ml/min/1.73m²), and which are not?

a. Anaemia  
b. Hypercalcaemia  
c. Hypokalaemia  
d. Increased serum creatinine concentration  
e. Increased serum triglyceride concentration

To make a correct diagnosis of Musa’s kidney condition the nephrologist needs a thorough understanding of renal physiology.

X.7 Which of the following statements about the way in which water is reabsorbed in the kidneys are correct, and which not?

a. It is greatest in the proximal tubule  
b. It occurs in the thick ascending loop of Henle  
c. It is increased by a high concentration of solute in the collecting duct  
d. It causes an increase in the specific gravity of urine  
e. It is increased by the action of aldosterone on the collecting duct.

X.8 Phosphates play a crucial role in kidney functioning. Which of the followings statements about phosphates and the kidney are correct, and which are not?

a. Chronic renal failure leads to hyperphosphataemia  
b. Low serum phosphate levels inhibit conversion of Vitamin D to calcitriol  
c. Phosphate is a major buffer in the urine  
d. Phosphate reabsorption is stimulated by parathyroid hormone  
e. When the glomerular filtration rate falls phosphate excretion decreases
Musa’s nephrologist also manages a number of other patients with renal conditions, both acute and chronic.

A. Acute diffuse proliferative glomerulonephritis
B. Amyloid nephropathy
C. Benign prostatic hypertrophy
D. Carcinoma of the prostate
E. Chronic glomerulonephritis
F. Chronic pyelonephritis
G. Diabetic nephropathy
H. Mesangial proliferative glomerulonephritis
I. Nephroblastoma
J. Renal cell carcinoma
K. Transitional cell carcinoma
L. Schistosomiasis

From the list of diagnoses above select the one which applies to each of the scenarios below.

R.4 A 10 year old boy presents with a brief history of increasing tiredness. More recently his mother noticed that his eyes were ‘puffy’. On examination he had mild hypertension and his urine tested positive for protein and blood.

R.5 A 65 year old woman is being investigated for anaemia and it is found that she is suffering from nephrotic syndrome. A bone marrow biopsy is done which shows marked plasma cell proliferation.

A. Acute interstitial nephritis
B. Acute tubular necrosis
C. Adrenal insufficiency
D. Congestive cardiac failure
E. Diabetes insipidus
F. Multiple myeloma
G. Primary hyperaldosteronism
H. Syndrome of inappropriate ADH secretion (SIADH)

From the list of diagnoses above, select the one most appropriate to each of the scenarios below.

R.6 A 70 year old man diagnosed with pulmonary carcinoma has no oedema or dehydration and his blood pressure is normal. The following laboratory results are obtained:

<table>
<thead>
<tr>
<th>Item: serum/ plasma</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na⁺</td>
<td>126 mmol/L</td>
<td>135-147</td>
</tr>
<tr>
<td>K⁺</td>
<td>4.8 mmol/L</td>
<td>3.3-5.3</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>102 mmol/L</td>
<td>99-113</td>
</tr>
<tr>
<td>TCO₂</td>
<td>22 mmol/L</td>
<td>18-29</td>
</tr>
<tr>
<td>Urea</td>
<td>3.5 mmol/L</td>
<td>2.7-7.0</td>
</tr>
<tr>
<td>Creatinine</td>
<td>78 μmol/L</td>
<td>60-100</td>
</tr>
<tr>
<td>Glucose</td>
<td>5.2 mmol/L</td>
<td>3-6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item: urine</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmolality</td>
<td>531 mOsmol/kg</td>
<td>-</td>
</tr>
</tbody>
</table>

R.7 A 23 year old woman presents to Casualty after taking part in a marathon. She is lethargic and hypotensive. The following laboratory results are obtained:

<table>
<thead>
<tr>
<th>Item: serum</th>
<th>Value</th>
<th>Reference range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Osmolality</td>
<td>531 mOsmol/kg</td>
<td>-</td>
</tr>
<tr>
<td>Na⁺</td>
<td>140 mmol/L</td>
<td>135-147</td>
</tr>
<tr>
<td>--------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>K⁺</td>
<td>5.4 mmol/L</td>
<td>3.3-5.3</td>
</tr>
<tr>
<td>Cl⁻</td>
<td>102 mmol/L</td>
<td>99-113</td>
</tr>
<tr>
<td>TCO₂</td>
<td>12 mmol/L</td>
<td>18-29</td>
</tr>
<tr>
<td>Urea</td>
<td>23 mmol/L</td>
<td>2.7-7.0</td>
</tr>
<tr>
<td>Creatinine</td>
<td>382 μmol/L</td>
<td>60-100</td>
</tr>
<tr>
<td>Osmolality</td>
<td>325 mOsmol/kg</td>
<td>275-295</td>
</tr>
</tbody>
</table>

**Item: urine**

<table>
<thead>
<tr>
<th>Na⁺</th>
<th>65 mmol/L</th>
<th>-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>4 mmol/L</td>
<td>-</td>
</tr>
<tr>
<td>Osmolality</td>
<td>276 mOsmol/kg</td>
<td>-</td>
</tr>
</tbody>
</table>

A.11 A patient is suspected to be suffering from prerenal failure following an injury. Which of the following biochemical findings is most likely to confirm this diagnosis?

a. A serum urea:creatinine ratio of 124:1 (RR: 40-100)
b. A spot urine sodium concentration of 8 mmol/L (RR: 15-250)
c. A urine fractional excretion of sodium (FeNa) of 1%
d. A urine:plasma osmolality ratio of 3
e. A urine:plasma creatinine ratio of 9

Diuretics are commonly used in the management of chronic kidney disease.

X.9 Which of the following mechanisms of action of diuretics are correctly given and which not?

a. Acetazolamide decreases bicarbonate secretion
b. Amiloride blocks the action of aldosterone
c. Furosemide increases potassium excretion
d. Indipamide inhibits NaCl reabsorption at the distal convoluted tubule
e. Spironolactone increases serum potassium levels

Musa’s kidney function continues to deteriorate.

X.10 Since a donor for a kidney transplant cannot be found for Musa at this stage the only option for him is dialysis. Which of the following statements about dialysis are correct and which are not?

a. Ambulatory haemodialysis requires fewer sessions per week than peritoneal dialysis
b. Chronic ambulatory peritoneal dialysis is usually carried out at home by the patient.
c. Dialysis is an effective means of curing end-stage renal failure
d. Severe hyperkalaemia is an indication for starting dialysis.
e. Transplantation is restricted to patients with end stage renal disease who fail to respond to dialysis.

The course of Musa’s life has been heavily influenced by the diabetes and the resulting kidney disease.

The crises in each of Erikson’s psychosocial stages are listed below.

A. Trust vs. Mistrust
B. Autonomy vs. Shame and Doubt
C. Initiative vs. Guilt
D. Industry vs. Inferiority
E. Identity vs. Role Confusion
F. Intimacy vs. Isolation/Self-absorption
G. Generativity vs. Stagnation
H. Integrity vs. Despair

For each of the scenarios below, choose the crisis that it exemplifies from the list above.

R.8 Musa fell in love with Thandi a few years after he learnt that he had insulin-dependent diabetes. At that time he confided in his doctor that he just couldn’t bring himself to tell her about his condition in case she rejected him.

R.9 After years of battling with his deteriorating kidney function the 55 year old Musa confides in his doctor that he feels his life is just not working out. Thandi left him a few years ago taking the children with her and his career isn’t taking off as he intended.