Q.1 Your clinical laboratory is undergoing the process of accreditation by Pakistan National Accreditation Council (PNAC) and the assessors will be visiting your laboratory for inspection shortly.

a) Name ISO Standard under which this inspection will take place.
b) Name ISO standard which is used for accreditation of calibration laboratory.
c) Write two main requirements of document control.
d) Write two standard requirements for placement of new equipment in your laboratory.
e) What procedure you will adopt to control the environmental conditions?

Q.2 During an inspection Chemical Pathology Laboratory of a tertiary-care hospital, you have noted that water used for analytical work had following specifications:
- Colony Forming units per ml: 7
- Resistivity: 3 (moham/cm)
- Conductivity: 21 (microsiemens/cm)

a) Is this Clinical Laboratory Reagent Water (CLRW) as per CLSI specifications, Please write the criteria too?
b) Name three processes which you will recommend for production of CLWR.
c) Name of the type of water used in the reagents preparations for confirmation of drug in toxicology laboratory.
Q.3 Various forms of Chemiluminescence are now widely used in Clinical Chemistry laboratories. Please answer following basic questions related to these techniques:

a) What is chemiluminescence, bioluminescence and electrochemiluminescence?
b) Name any two compounds which have pivotal role in the basic reaction produced in these techniques.
c) Write three advantages of these techniques over traditional radioimmunoassay.
d) Write two important technical limitations of these techniques (Please do not mention logistic or cost etc).

Q.4 You are pathologist in a 100 bedded hospital and want to start electrolyte estimation facility.

a) Which method will you prefer in the laboratory with justification?
b) Name four different methods of electrolyte estimation available in clinical laboratory.
c) Name two methods available for total CO₂ (HCO₃⁻) estimation in serum.

Q.5 You want to start Vitamin D estimation in your laboratory as its deficiency has become endemic all over the world including Pakistan. Please answer following questions in this regard:

a) Which of the metabolites of Vitamin D you will like to measure to assess vitamin D status? Give three reasons to support your answer.
b) Various commercial firms offer total Vitamin D or Vitamin D3 assays. Which assay you will prefer and why?
c) What cut-off limits you will use for reporting vitamin D status? Give any of the internationally recommended set of values.
d) Name analytical techniques which are said to be the Gold Standard for Vitamin D assay.
Q.6 A non-Chemical Pathologist is working in a busy medium-sized private laboratory. He has some concerns about Haemoglobin (A1C) results, mainly poor clinical correlation and poor agreement with other laboratories. The method used for A1C analysis in his laboratory is affinity chromatography. He has called you for solutions of his problems related to A1C.
Please answer following queries in this regard:

a) Is the method used by this laboratory the major cause of the problem faced by the pathologist. If yes, why?
b) Name two international organizations which provide technical standardization of this test.
c) Name two techniques widely used now for this test at many well-reputed laboratories in Pakistan.
d) Can this test be used for the diagnosis, if so what should be the cut-off values for DM and pre-diabetes?
e) Name two major advantages of using this test.
f) Name two haemoglobinopathies in which A1C may be falsely high.

Q.7 As Consultant Chemical Pathologist you have been assigned the task of starting a Therapeutic Drug Monitoring (TDM) service for a tertiary care hospital.

a) Write two main criteria for selection of drugs requiring TDM.
b) Lithium shows first order linear kinetics. Its levels are monitored for toxicity. When you will like to collect blood sample for this drug in relation to the time of the dose?
c) How will you ensure that TDM is done in steady state of the drug?
d) Name two drugs which require whole blood sample for TDM.
e) Which type of tubes you will prefer for collection of serum samples for anti-epileptics?
Q.8 Diagnostic criteria of Myocardial Infarction (MI) have been revised after consensus of many International Organizations. How will you diagnose MI in following conditions based on results of cardiac Troponins (Please DON’T mention other investigations).

a) A 61 years old male has reported in an Emergency with chest pain and ECG changes consistent with MI.
b) A 52 years old male has just undergone Primary Coronary Intervention (angioplasty). His clinical features and ECG changes suggest a fresh attack of MI.
c) A 42 years old male has undergone Coronary Artery Bypass Surgery about 6 hours ago. His clinical features and ECG changes suggest a fresh attack of MI.

Q.9 A 59 years old male has dyspnoea for the last about three months. His physician has advised ABGs and some imaging investigations of the lung on finding rhonchi in the chest. He is otherwise normal. His Biochemical Profile is as following:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.40</td>
<td>(7.35 – 7.45)</td>
</tr>
<tr>
<td>HCO3^-</td>
<td>19 mmol/L</td>
<td>(23 – 28)</td>
</tr>
<tr>
<td>BE</td>
<td>-1.1</td>
<td>&lt;+3- -3</td>
</tr>
<tr>
<td>PO2</td>
<td>113 mmHg</td>
<td>(80 – 110)</td>
</tr>
<tr>
<td>PCO2</td>
<td>30 mmHg</td>
<td>(35-45)</td>
</tr>
<tr>
<td>Na^+</td>
<td>142 mmol/L</td>
<td>(135-150)</td>
</tr>
<tr>
<td>K^+</td>
<td>4.6 mmol/L</td>
<td>(3.5 – 5.0)</td>
</tr>
</tbody>
</table>

a) What is the biochemical diagnosis?
b) Name three most probable causes of these biochemical findings.
c) Write one most likely mechanism of low PCO2 in this patient.
Q. 10 A 64-year-old woman admitted in the medical ward with acute pain in abdomen for last two days. She had recurrent convulsion attacks for five hours after admission. She had past history of three admissions with pain abdomen during last one year. On examination, Chvostek’s and Trousseau’s tests were positive. Pulse 90/min, blood pressure of 150/95 mmHg, temperature of 38°C and respiratory rate of 20/minute were observed. Laboratory investigations confirmed hypocalcemia in two different blood samples.

a) What is the most likely clinical diagnosis of the case?
b) Write four most probable cause of hypocalcemia in this patient.
c) Write eight laboratory investigations for confirmation of the cause of hypocalcaemia.
Q.11 A 10 years old male child presented with gradually worsening weakness of whole body and inability to move his limbs. He is also having loose motions for the last a few days but no vomiting. Clinician has referred the patient to you for expert opinion. His biochemical profile showed:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>4.5 (3.3-6.7 mmol/l)</td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>75 (55-100 μmol/l)</td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.32 (7.35-7.45)</td>
<td></td>
</tr>
<tr>
<td>PCO₂</td>
<td>29 (35 - 45 mm of Hg)</td>
<td></td>
</tr>
<tr>
<td>HCO₃</td>
<td>14.0 (22 - 28 mmol/l)</td>
<td></td>
</tr>
<tr>
<td>Serum Sodium</td>
<td>137 (136-149 mmol/l)</td>
<td></td>
</tr>
<tr>
<td>Serum Potassium</td>
<td>1.8 (3.5-5.0 mmol/l)</td>
<td></td>
</tr>
<tr>
<td>Serum Chloride</td>
<td>121 (97-106 mmol/l)</td>
<td></td>
</tr>
</tbody>
</table>

a) Name two most probable differential diagnoses in this patient.
b) How will you differentiate these two conditions based on a simple laboratory test?
c) Write biochemical mechanism causing hyperchloridemia in this patient.

Q.12 A 69 years old male is admitted in a surgical ward for the last one week. His LFTs are as following:

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Normal Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conjugated Bilirubin</td>
<td>335 μmol/L</td>
<td>(&lt;4)</td>
</tr>
<tr>
<td>Unconjugated Bilirubin</td>
<td>34 μmol/L</td>
<td>(&lt;14)</td>
</tr>
<tr>
<td>ALT</td>
<td>81 U/L</td>
<td>(&lt; 42)</td>
</tr>
<tr>
<td>ALP</td>
<td>1874 U/L</td>
<td>(85- 306)</td>
</tr>
<tr>
<td>Albumin</td>
<td>37 g/L</td>
<td>(35-50)</td>
</tr>
</tbody>
</table>

a) What is the most probable biochemical diagnosis in this patient?
b) What is the most probable mechanism of rise of ALP in this patient?
c) Name two more liver enzymes which will be raised in tandem with ALP in this patient.
Q.13 A 51 years old male suffering from lung carcinoma was admitted to hospital for assessment. Examination revealed widespread skin pigmentation, mild hepatomegaly and blood pressure of 180/95 mm of Hg. The laboratory results were.

**Plasma/Serum**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
<th>Reference Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>142 mmol/L</td>
<td>(136-145)</td>
</tr>
<tr>
<td>K</td>
<td>2.2 mmol/L</td>
<td>(3.5-5.1)</td>
</tr>
<tr>
<td>Cl</td>
<td>92 mmol/L</td>
<td>(98-108)</td>
</tr>
<tr>
<td>HCO₃</td>
<td>37 mmol/L</td>
<td>(23-33)</td>
</tr>
<tr>
<td>Urea</td>
<td>6.6 mmol/L</td>
<td>(3.3-6.7)</td>
</tr>
<tr>
<td>Creatinine</td>
<td>112 µmol/L</td>
<td>(80-115)</td>
</tr>
<tr>
<td>Cortisol</td>
<td>1580 nmol/L</td>
<td>(140-690)</td>
</tr>
</tbody>
</table>

**Urine**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>22 mmol/L</td>
</tr>
<tr>
<td>K</td>
<td>35 mmol/L</td>
</tr>
</tbody>
</table>

Plasma ACTH was requested after seeing high plasma cortisol values.

ACTH 39 pmol/L (upto 26 pmol/L)

a) What is your diagnosis?
b) Write down the cause of hypokalemia in this case.
c) Write two important precautions of sample collection of cortisol and ACTH for monitoring of this patient.
Q.14 A 72 years old female has following thyroid profile:

Serum fT3      2.26 pg/ml     (1.60-4.20)
Serum TSH      0.11 mIU/L     (0.30-4.0)

Your Physician colleague has referred the case to you with following queries:

a) What is the most probable diagnosis in this case?
b) What are the three most important risk factors which must be considered in this patient for start of the anti-thyroid treatment?
c) What are the three most important complications which can arise in this patient if diagnosis and treatment is delayed?

Q.15 A 32 years old male has a unilateral swelling of his left testis and symptoms of hyperthyroidism. His thyroid profile was as following:

- Serum Free T3      5.23 ng/ml     (1.60-4.20)
- Serum T4          3.97 pg/ml     (0.70-1.68)
- Serum TSH        0.01 mIU/L     (0.30-4.0)

His physician has sought your advice regarding the diagnosis of testicular swelling in this patient.

a) Name the type of testicular tumour this patient is most probably suffering from.
b) Name one most important biochemical test which will be helpful in confirming the diagnosis.
c) Write in two lines the mechanism leading to thyroid dysfunction in this patient.
Q.16 On two different days, two young female patients were brought in your Endocrine procedure Room with following features:

Patient No 1: A 19 year old grossly obese girl having Primary Amenorrhea:
- FSH: 1.2 mlU/mL (1.5 - 9.9)
- LH: 1.0 mlU/mL (1.7 - 15)
- Oestradiole: 20 pmol/L (147 - 1505)
- Progesterone: 0.31 ng/ml (<11.9 )

Patient No 2: A 17 year old girl with anosmia and having Primary Amenorrhea:
- FSH: 0.9 mlU/mL (1.5 - 9.9)
- LH: 1.3 mlU/mL (1.7 - 15)
- Oestradiol: 27 pmol/L (147 - 1505)
- Progesterone: 0.23 ng/ml (<11.9 )
- Anosmia: confirmed in ENT Department

a) What is the most probable diagnosis in these two patients?
b) Name one laboratory investigation which can be helpful in both these patients?
Q.17 A 62 year male patient is being monitored by his renal profile. His serial levels are given below:

<table>
<thead>
<tr>
<th>Analytes</th>
<th>22 Dec 2014</th>
<th>23 Dec 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Urea</td>
<td>5.6 mmol/L</td>
<td>33.6 mmol/L</td>
</tr>
<tr>
<td>Serum Creatinine</td>
<td>82 µmol/L</td>
<td>987 µmol/L</td>
</tr>
<tr>
<td>Urinary output</td>
<td>1645 ml/24 h</td>
<td>102 ml/24 h</td>
</tr>
</tbody>
</table>

a) What is the diagnosis based on his 23 Dec 2014 laboratory findings?
b) Name the criteria you will like to use for staging of the patient.
c) Name a newer marker which can be used in this patient for the diagnosis.

Q.18 A 49-year old female has been suffering from chronic kidney disease for last six years. For last one year she is complaining of generalized bone pains, pain in epigastrium, constipation and hypertension. She has following biochemical profile:

<table>
<thead>
<tr>
<th>Analytes</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum Calcium</td>
<td>3.23 mmol/L</td>
<td>(2.10-2.65)</td>
</tr>
<tr>
<td>Serum Urea</td>
<td>29.7 mmol/L</td>
<td>(3.6-6.6)</td>
</tr>
<tr>
<td>Serum Phosphorus</td>
<td>2.52 mmol/L</td>
<td>(1.75-1.9)</td>
</tr>
<tr>
<td>Blood PTH</td>
<td>231 pmol/L</td>
<td>(15-62)</td>
</tr>
</tbody>
</table>

a) What is the most probable biochemical diagnosis?
b) Write three steps of the natural course of this illness.
c) Write one biochemical cause of his following symptoms:
   - Bone pains
   - Pain in epigastrium
Q. 19 A 32 years male is admitted in a medical ward for the investigation of hypertension and of episodes of tachycardia with sweating. 24 hour urinary VMA was within normal limits. His treating physician wants to exclude catecholamine secreting tumours as cause of hypertension more confidently in this patient.

a) Name two catecholamine secreting tumours which can present with similar clinical features.
b) Name four urinary tests which can be used for the detection of catecholamine secreting tumours.
c) How various catecholamine levels can help the physician to differentiate these two tumors?
d) Name two analytical techniques used for estimation of catecholamines and their metabolites.
Q.20 Hepcidin is an upcoming marker for the diagnosis and monitoring of disorders of iron metabolism. Please specify the status of Hepcidin in the following patients with one line of justification.

a) A 36 years old female with general weakness without any hepatosplenomegaly with following laboratory features:

- Haemoglobin : 7.4 g/dl
- Serum ferritin : 4.9 ng/ml
- Transferrin saturation : 37%
- Peripheral blood film shows hypochromic microcytic anaemia

b) A 53 years old male has diabetes mellitus and darkening of skin and following biochemical features:

- Serum ferritin : 2910 ng/ml (Iron Overload > 400)
- Transferrin saturation : 61%
- ALT : 213 U/L

c) A 23 years old female is suffering from fever, cough and haemoptysis for the last many months. Her laboratory investigations show:

- Haemoglobin : 8.6 g/dl
- Serum ferritin : 144 ng/ml
- ESR : 102 mm at the end of 1st hour

The End