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COLLEGE OF HEALTH, AGRICULTURE AND NATURAL SCIENCES

DEPARTMENT OF BIOMEDICAL AND LABORATORY SCIENCES

BACHELOR OF MEDICAL LABORATORY SCIENCES HONOURS DEGREE

NSLS403: CLINICAL CHEMISTRY II

END OF SEMESTER EXAMINATIONS

NOVEMBER 2025

LECTURER: PROF. C. EZEALA

DURATION: 3 HOURS

Section A (40 Marks)

This section comprises 40 multiple choice items with options “A” to “D”. There is only one best answer for each question. Answer all questions. Tick or circle the correct answer.

1. What is the primary defect in type 2 diabetes mellitus?

A. Absolute insulin deficiency

- B. Insulin resistance and relative insulin deficiency
- C. Autoimmune destruction of beta cells
- D. Excessive glucagon secretion

2. Which of the following hormones is most responsible for increasing blood glucose levels?

- A. Insulin
- B. Glucagon
- C. Somatostatin
- D. Amylin

3. What is the most common cause of hypoglycemia in diabetic patients?

- A. Insulinoma
- B. Excessive insulin or oral hypoglycemic agent use
- C. Addison's disease
- D. Liver failure

4. Impaired glucose tolerance (IGT) is diagnosed by which of the following?

- A. Fasting blood glucose 100-125 mg/dL
- B. 2-hour postprandial glucose 140-199 mg/dL during an oral glucose tolerance test (OGTT)
- C. HbA1c 5.7-6.4%
- D. Random blood glucose > 200 mg/dL

5. Which of the following is the most abundant serum protein in healthy individuals?

- A. Albumin
- B. Globulin
- C. Fibrinogen
- D. Immunoglobulin G (IgG)

6. Which serum protein is primarily responsible for maintaining oncotic pressure in the blood vessels?

- A. Alpha-1 antitrypsin
- B. Albumin

C. Transferrin

D. Ceruloplasmin

7. Which of the following patterns on serum protein electrophoresis (SPEP) is characteristic of multiple myeloma?

A. Polyclonal gammopathy

B. Monoclonal gammopathy (M-spike)

C. Hypogammaglobulinemia

D. Increased alpha-1 globulin

7. Which of the following is a cause of hypergammaglobulinemia?

A. Chronic liver disease

B. Nephrotic syndrome

C. Malnutrition

D. Severe burns

8. Which of the following is a characteristic feature of cirrhosis on serum protein electrophoresis (SPEP)?

A. Monoclonal gammopathy

B. Beta-gamma bridging

C. Increased alpha-1 globulin

D. Decreased gamma globulin

9: Which of the following tumor markers is most commonly associated with prostate cancer?

A. CA-125

B. PSA

C. AFP

D. CEA

10: Elevated levels of CA-125 are most commonly associated with which type of cancer?

A. Ovarian cancer

- B. Breast cancer
- C. Colorectal cancer
- D. Lung cancer

11: Which tumor marker is used to monitor hepatocellular carcinoma (HCC) and germ cell tumors?

- A. CEA
- B. AFP
- C. CA 19-9
- D. hCG

12: Which of the following tumor markers is elevated in patients with germ cell tumors and trophoblastic diseases?

- A. CA 19-9
- B. hCG
- C. PSA
- D. CA-125

13: CEA is most commonly associated with which type of cancer?

- A. Breast cancer
- B. Colorectal cancer
- C. Lung cancer
- D. Pancreatic cancer

14. Gamma-Glutamyl Transferase (GGT) is most commonly associated with:

- A. Bone disorders
- B. Liver and biliary tract diseases
- C. Myocardial infarction
- D. Pancreatic disorders

15. Which enzyme is used as a marker for prostate cancer?

- a) Acid Phosphatase (ACP)
- b) Alkaline Phosphatase (ALP)

- c) Lactate Dehydrogenase (LDH)
- d) Amylase

16. Which enzyme is most specific for hepatocellular injury?

- a) Alanine Aminotransferase (ALT)
- b) Aspartate Aminotransferase (AST)
- c) Alkaline Phosphatase (ALP)
- d) Gamma-Glutamyl Transferase (GGT)

17. Which enzyme is most commonly associated with bone disorders?

- a) Alkaline Phosphatase (ALP)
- b) Acid Phosphatase (ACP)
- c) Lactate Dehydrogenase (LDH)
- d) Creatine Kinase (CK)

18. Which of the following is a characteristic feature of inborn errors of metabolism?

- a) They are always autosomal dominant disorders
- b) They result from defects in biochemical pathways
- c) They are acquired during adulthood
- d) They are caused by environmental factors

19. Phenylketonuria (PKU) is caused by a deficiency of which enzyme?

- a) Phenylalanine hydroxylase
- b) Tyrosinase
- c) Homogentisate oxidase
- d) Galactose-1-phosphate uridyltransferase

20. Maple Syrup Urine Disease (MSUD) is caused by a defect in the metabolism of:

- a) Fatty acids
- b) Branched-chain amino acids
- c) Aromatic amino acids
- d) Urea cycle intermediates

21. Which of the following is the primary regulator of phosphorus homeostasis?

- A) Parathyroid hormone (PTH)
- B) Calcitonin
- C) Vitamin D
- D) Fibroblast growth factor 23 (FGF-23)

22. Which of the following is a characteristic feature of osteomalacia?

- A) Increased bone density
- B) Decreased serum alkaline phosphatase
- C) Defective bone mineralization
- D) Elevated serum calcium

23. Which of the following hormones is primarily responsible for increasing serum calcium levels?

- A) Calcitonin
- B) Parathyroid hormone (PTH)
- C) Thyroxine (T4)
- D) Insulin

24. Hypocalcemia is most commonly associated with which of the following conditions?

- A) Hyperparathyroidism
- B) Vitamin D deficiency
- C) Hypercalcemia of malignancy
- D) Excessive calcium supplementation

25. Which of the following is the most appropriate test to assess long-term vitamin D status?

- A) Serum 25-Hydroxyvitamin D
- B) Serum 1,25-Dihydroxyvitamin D
- C) Serum calcium
- D) Serum phosphorus

26. A patient presents with painless jaundice, steatorrhea, and weight loss. Their LFTs show a markedly elevated ALP and GGT with a mild elevation in AST and ALT. This pattern is most suggestive of:

- a) Acute viral hepatitis
- b) Alcoholic liver disease
- c) Cholestatic liver disease
- d) Uncomplicated Gilbert's syndrome

27. In a hemolyzed specimen, which LFT result is most likely to be falsely elevated?

- a) Albumin
- b) Alanine Aminotransferase (ALT)
- c) Alkaline Phosphatase (ALP)
- d) Total Bilirubin

28. A patient's LFT results show: AST 450 U/L, ALT 100 U/L. This AST:ALT ratio is most classically associated with:

- a) Acute Hepatitis A infection
- b) Non-Alcoholic Fatty Liver Disease (NAFLD)
- c) Alcoholic Liver Disease
- d) Biliary obstruction

29. A Medical Laboratory Scientist notices that a patient's serum has a greenish tint. Which analyte should they suspect is significantly elevated?

- a) Albumin
- b) Alkaline Phosphatase
- c) Bilirubin
- d) Ammonia

30. Which LFT pattern would you most expect to see in a patient with advanced cirrhosis and failing synthetic function?

- a) Elevated ALT and AST with normal Albumin and PT
- b) Markedly elevated ALP and GGT
- c) Moderately elevated Bilirubin, low Albumin, and prolonged PT
- d) Isolated elevation of Unconjugated Bilirubin

31. The primary extracellular cation responsible for regulating water distribution between fluid compartments is:

- a) Potassium
- b) Chloride
- c) Sodium
- d) Bicarbonate

32. A patient's arterial blood gas shows: pH 7.28, pCO₂ 55 mm Hg, HCO₃⁻ 25 mMol/L. What is the interpretation?

- a) Respiratory Acidosis
- b) Respiratory Alkalosis
- c) Metabolic Acidosis
- d) Metabolic Alkalosis

33. Hyponatremia is MOST commonly associated with:

- a) Dehydration
- b) Syndrome of Inappropriate ADH (SIADH) Secretion
- c) Diabetes Insipidus

d) Cushing's syndrome

34. A calculated anion gap of 22 mMol/L (high) suggests the presence of which type of acid?

- a) Carbonic acid (H_2CO_3)
- b) Hydrochloric acid (HCl)
- c) Unmeasured anions (e.g., ketones, lactate)
- d) Bicarbonate (HCO_3^-)

35. Hypochloremia is often associated with which acid-base disorder?

- a) Metabolic Acidosis
- b) Metabolic Alkalosis
- c) Respiratory Acidosis
- d) Respiratory Alkalosis

36. The most sensitive and commonly used calculated index to assess glomerular filtration rate (GFR) and overall kidney function is:

- a) Serum Creatinine
- b) Blood Urea Nitrogen (BUN)
- c) Creatinine Clearance
- d) Estimated GFR (eGFR) using the CKD-EPI formula

37. A patient has a BUN of 50 mg/dL and a serum creatinine of 1.0 mg/dL. This BUN: Creatinine ratio is most suggestive of:

- a) A normal state of hydration
- b) Prerenal azotemia
- c) Intrinsic renal disease like glomerulonephritis
- d) Rhabdomyolysis

38. A patient's thyroid function tests (TFTs) reveal: TSH - 0.02 mIU/L (low), Free T4 - 22 pmol/L (high), Total T3 - 4.5 nmol/L (high). This pattern is most consistent with:

- a) Primary Hypothyroidism
- b) Secondary Hypothyroidism

- c) Primary Hyperthyroidism
d) Subclinical Hypothyroidism

39. The "Dawn Phenomenon" in diabetic patients refers to:

- a) A dangerous overnight peak in insulin levels causing hypoglycemia.
b) An early morning rise in blood glucose due to hormonal surges (e.g., cortisol, growth hormone).
c) The ideal time of day to administer a long-acting insulin dose.
d) A sudden drop in blood glucose upon waking.

40. A newborn screening test gives a positive result with significantly elevated levels of 17-hydroxyprogesterone. This finding is most indicative of which condition?

- a) Phenylketonuria (PKU)
b) Cystic Fibrosis
c) Congenital Hypothyroidism
d) Congenital Adrenal Hyperplasia (CAH)

SECTION B: ESSAY QUESTIONS (60 MARKS)

This section contains five (5) essay type questions. Answer any three (3) using the provided AU answer booklet. Start each question on a new page. Each question carries 20 marks.

Question 1: Using a suitable diagram, explain the following:

- a. Monoclonal gammopathy
- b. Polyclonal gammopathy

- c. Lag storage curve
- d. Biphasic insulin secretion

(5 marks each)

Question 2:

(a) Write an essay on the principles of serum protein electrophoresis (10 marks).

(b) Draw the electrophoresis patterns seen in normal, Liver cirrhosis, chronic infection, and nephrotic syndrome (10 marks).

Question 3: A 65-year-old male with a history of chronic obstructive pulmonary disease (COPD) presents with worsening shortness of breath, confusion, and drowsiness. Arterial blood gas (ABG) analysis reveals pH: 7.28 (Ref Val 7.35 – 7.45), PCO₂: 65 mmHg (ref value 35 - 45) and HCO₃⁻: 30 mmol/L (ref value 22 - 29)

(a) Provide clinical interpretation of the laboratory data (12 marks).

(b) How will the kidneys compensate for this? (8 marks)

Question 4: A 60-year-old male with a history of chronic hepatitis C presents with ascites, confusion, and hematemesis. Outline 5 key chemical pathology tests you would carry out and the expected results. (20 marks)

Question 5:

(a) Describe the laboratory investigation of thyroid dysfunction (10 marks).

(b) Discuss the interpretation of TSH, free T4, and free T3 in hyperthyroid and hypothyroid disorders (10 marks).

END