2914/304
IMMUNOLOGY AND BIOCHEMISTRY
Oct./Nov. 2022
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN APPLIED BIOLOGY

MODULE III

IMMUNOLOGY AND BIOCHEMISTRY

3 hours

INSTRUCTIONS TO CANDIDATES

*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** questions in section **A** and any **THREE** questions from section **B** in the answer booklet provided.*
*Each question in section **A** carries **4** marks while each question in section **B** carries **20** marks.*
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 7 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A (40 marks)

Answer ALL questions in this section.

1. Match the condition in Column A with immune deficiency disorder in column B.

	Column A		Column B
(a)	Recurrent bacterial infection	(i)	T lymphocyte deficiency
(b)	Increased susceptibility to viral, fungal and protozoal infection	(ii)	Phagocytic cell deficiency
(c)	Systemic infections with bacteria	(iii)	Complement components deficiency
(d)	Bacterial infection; autoimmunity	(iv)	B-lymphocyte deficiency

(4 marks)

2. Explain the role of Major Histocompatibility Complex (MHC) molecules. (4 marks)

3. List any **four** classes of vaccines. (4 marks)

4. Explain each of the following characteristics of acquired immune response:

   (a) specificity; (1 mark)

   (b) adaptiveness; (1 mark)

   (c) discrimination between self and non-self; (1 mark)

   (d) memory. (1 mark)

5. State any **four** causes of ineffectiveness of the immune response to tumors. (4 marks)

6. State the role of each of the following classes of enzymes:

   (a) lyases; (1 mark)

   (b) isomerases; (1 mark)

   (c) ligases; (1 mark)

   (d) hydrolyses. (1 mark)

7. (a) Name **four** fat soluble vitamins. (2 marks)

   (b) List **two** categories of enzyme inhibition. (2 marks)

8. Draw a graph to illustrate energy changes which would take place in a catalyzed reaction and a non-catalyzed reaction. (4 marks)

9. Figure 1 illustrates the metabolism of three sources of energy in a cell.

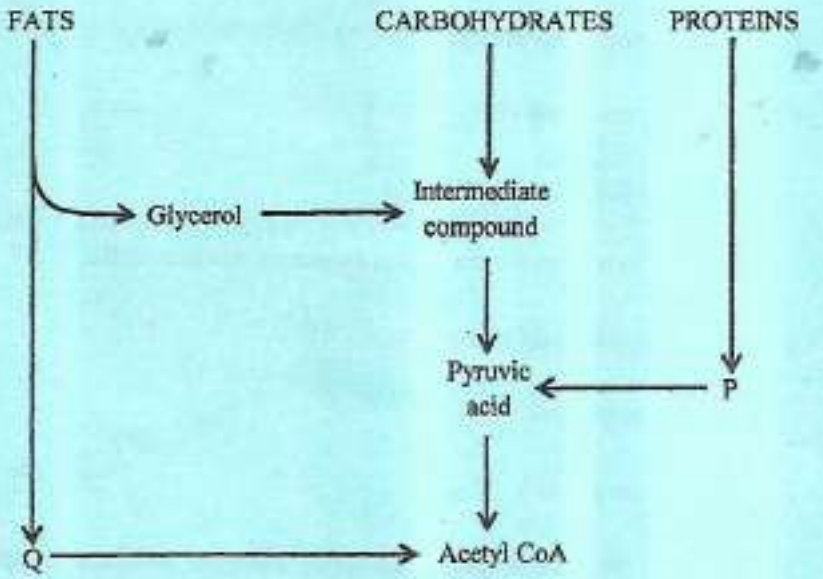


Fig. 1

(a) Name intermediate molecules labelled **P** and **Q**. (2 marks)

(b) Name the polysaccharide stored in:

(i) animals; (1 mark)

(ii) plants. (1 mark)

10. Distinguish between:

(a) glycolysis and glycogenolysis; (2 marks)

(b) glycogenesis and gluconeogenesis. (2 marks)

SECTION B (60 marks)

*Answer any **THREE** questions from this section.*

11. (a) Name the immunoglobulin(s) that exhibit the following properties:

(i) presence in all secretions; (1 mark)

(ii) presence in milk; (2 marks)

(iii) activate complement; (2 marks)

(iv) bind to macrophages and polymorphonuclear cells; (1 mark)

(v) has agglutinating capacity; (3 marks)

(vi) antibacterial activity; (3 marks)

(vii) allergic activity. (1 mark)

(b) Describe the 'membrane attack complex' phase of classical complement pathway. (7 marks)

12. (a) Explain each of the following allograft rejection reactions of a kidney:

(i) hyper acute rejection; (8 marks)

(ii) chronic rejection. (6 marks)

(b) Table I illustrates blood transfusion between individuals. Copy and complete the table.

Table I

	Donor genotype	Recipient genotype	Accept / Reject	Reason
(i)	AB	AA	-	-
(ii)	BB	AA	-	-
(iii)	AA	AB	-	-

(6 marks)

13. (a) Draw a labelled diagram of a cross-section of thymus gland. (10 marks)

(b) State **four** biological activities of named complement components. (8 marks)

(c) Name the scientist who:

(i) discovered human ABO blood group system; (1 mark)

(ii) developed a virulent BCG vaccine. (1 mark)

14. (a) Figure 2 represents Beta oxidation pathway of fatty acids.

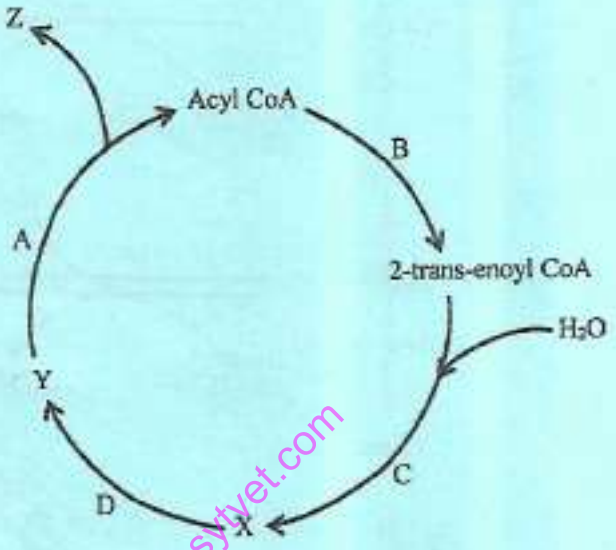


Fig. 2

(i) Identify the enzymes labelled A, B, C and D. (4 marks)

(ii) Identify the substances labelled X, Y, Z. (3 marks)

(iii) Apart from substance Z, name **three** other products of β-oxidation of fats. (3 marks)

(b) List **four** stages of carbohydrate cellular respiration. (4 marks)

(c) Name the enzymes involved in each of the following reactions in cellular respiration:

(i) glucose phosphorylation to glucose-6-phosphate; (1 mark)

(ii) conversion of glucose-6-phosphate to fructose-6-phosphate; (1 mark)

(iii) cleavage of fructose 1, 6, biphosphate; (1 mark)

(iv) conversion of 3-phosphoglycerate to 2-phosphoglycerate; (1 mark)

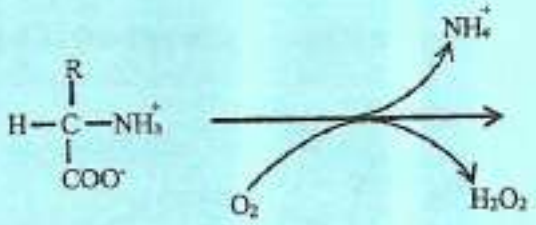
(v) conversion of 2-phosphoglycerate to phosphoenol pyruvate; (1 mark)

(vi) conversion of phosphoenol pyruvate to pyruvate. (1 mark)

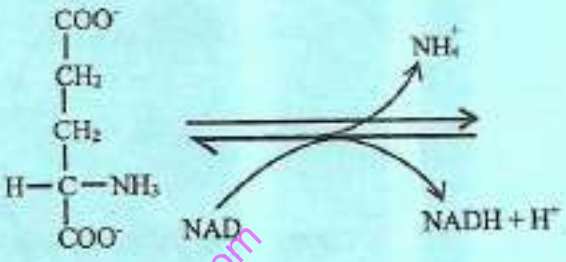
15. (a) Define the term 'deamination of amino acid'. (2 marks)

(b) The equations W, X, Y and Z illustrate deamination of amino acids.

W

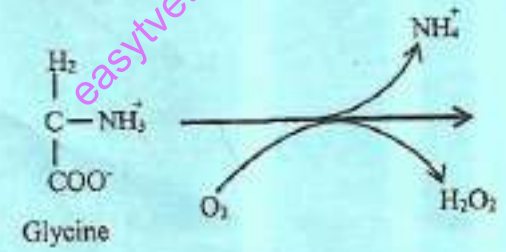


X



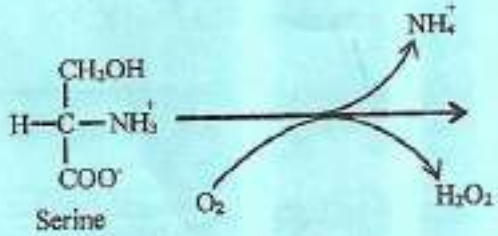
Glutamate

Y



Glycine

Z



Serine

(i) Complete each equation. (4 marks)

(ii) Name the product in each equation. (4 marks)

(iii) Name the enzyme that catalyses each reaction. (4 marks)

(c) Figure 3 illustrates urea cycle.

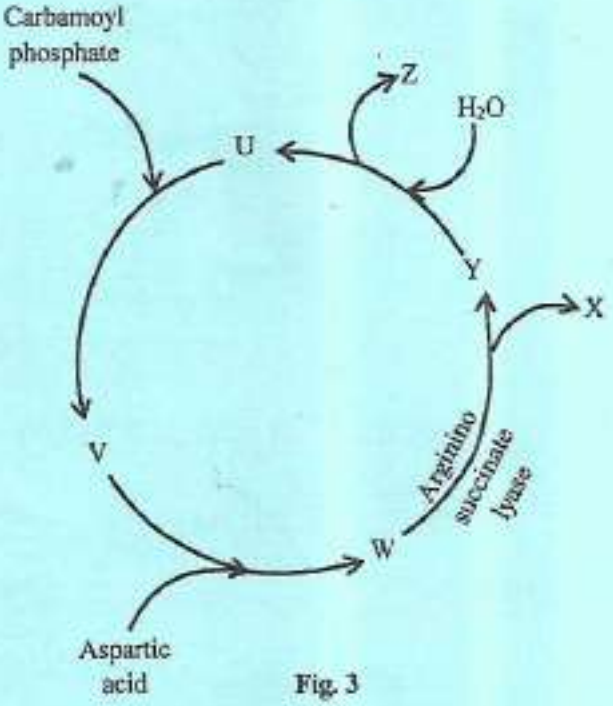


Fig. 3

Identify the substances labelled U, V, W, X, Y, Z. (6 marks)

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