THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

155/2 **FOOD AND HUMAN NUTRITION 2**

(For Both School and Private Candidates)

Time : 3 Hours **ANSWERS** **Year : 2011**

Instructions

1. This paper consists of sections **A** and **B**.
2. Answer all questions in section **A** and only **two (2)** question from section **B**.
3. Non-programmable calculators may be used.
4. Communication devices and any unauthorised materials are **not** allowed in the examination room.
5. Write your **Examination Number** on every page of your answer booklet(s).

1. You are provided with food samples M, N and O. Perform the experiments I and II as follows:
   In Experiment I:
   (i) Place 2 g of sample M into a test tube and add 5 ml of iodine solution. Shake gently and record the changes.
   (ii) Crush sample N in a mortar, add a little water and filter. Take 2 ml of the filtrate and add 3 drops of iodine solution. Record your observations.
   (iii) Heat 5 ml of the filtrate of sample N to boiling and allow to cool. Add 1 ml of Benedict's solution and heat again for 3 minutes. Record your observations.
   In Experiment II:
   (iv) Place 2 g of sample O into a porcelain dish and heat strongly over a Bunsen flame. Record the observations made.

Questions

(a) Identify the food nutrients tested in Experiment I, steps (i), (ii) and (iii).

Step (i) tested for starch. Step (ii) also tested for starch present in the filtrate. Step (iii) tested for reducing sugars in the sample.

(b) Explain the colour changes obtained in Experiment I.

In step (i) and (ii), the iodine solution changed to blue-black indicating the presence of starch. In step (iii), the Benedict's solution changed to brick-red upon heating, confirming the presence of reducing sugars.

(c) State the principle behind the Benedict's test.

The Benedict's test is based on the ability of reducing sugars to donate electrons to copper(II) ions in alkaline solution, reducing them to copper(I) oxide which forms a brick-red precipitate.

(d) Identify the residue obtained in Experiment II and outline its properties.

The residue obtained is charcoal, a form of carbon. It is black in colour, brittle, and porous. It is insoluble in water and represents the non-combustible part of organic matter.

(e) Briefly explain the importance of tests performed in Experiment I in food quality control.

The tests help in determining the carbohydrate content of foods. This is important in checking the nutritional value and in preventing adulteration of food products.

2. You are provided with fresh cow's milk, labelled sample P. Perform the experiments below:
   (i) Pour 10 ml of sample P into a test tube and add 5 ml of 10% acetic acid solution. Record observations.
   (ii) Filter the mixture in step (i) and wash the residue with distilled water. Dry the residue gently and describe its appearance.
   (iii) To 2 ml of the residue, add 1 ml of concentrated nitric acid. Boil gently, allow to cool and add excess ammonium hydroxide solution. Record the colour observed.

   Questions
   (a) Identify the residue obtained in step (ii).
   The residue obtained is casein, a milk protein.

   (b) Explain the scientific principle behind step (i).
   Acetic acid causes the milk protein casein to precipitate by lowering the pH, leading to coagulation.

   (c) What does step (iii) demonstrate?
   Step (iii) demonstrates the xanthoproteic test, which confirms the presence of aromatic amino acids in proteins by producing a yellow or orange colour.

   (d) State two industrial uses of the product identified in step (ii).
   Casein is used in cheese making. It is also used in the production of adhesives and paints.

3. You are provided with cooking oil labelled sample Q and chemicals R, S, and T. Carry out the following experiment:
   (i) Measure 10 g of sample Q into a conical flask.
   (ii) Add 25 ml of solution R (ethanol) and 25 ml of solution S (ether). Shake thoroughly to dissolve.
   (iii) Add 1 ml of solution T (phenolphthalein) and titrate with 0.1 M KOH until a faint pink colour persists. Record titre values and repeat to obtain concordant readings.

   Questions
   (a) Calculate the saponification value of sample Q.
   The saponification value is calculated from the volume of KOH used, its concentration, and the mass of oil. For example, if the titre is 5.0 ml:
   Moles of KOH = $0.1 \times 5.0 \div 1000 = 0.0005$ mol.
   Mass of KOH = $0.0005 \times 56.1 = 0.028$ g.

Saponification value = (0.028 ÷ 10) × 1000 = 2.8 mg KOH per g of oil.
(Exact value depends on measured titre.)

(b) State the significance of determining saponification value in oils and fats.
It indicates the average molecular weight of fatty acids in the oil. Higher values suggest shorter chain fatty acids.

(c) Explain the role of shaking in step (ii).
Shaking ensures the oil dissolves completely in ethanol and ether, forming a homogeneous mixture for titration.

(d) Outline one industrial importance of oils with high saponification values.
They are used in soap making because short-chain fatty acids are more suitable for producing quality soap.