THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

155/3 **FOOD AND HUMAN NUTRITION 3**

(For Both School and Private Candidates)

Duration: 3 Hours **ANSWERS** **Year: 2025**

Instructions

1. This paper consists of **three (3)** questions
2. Answer **all** questions.
3. Question **one (1)** carries 20 marks and the others carry 15 marks each.
4. All writing must be in **black** or **blue** ink.
5. Communication devices and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).

1. In Experiment I

   Mix 1 g of each of the samples A, B, C, and D with 6 cm^3 of water in separate test tubes then shake thoroughly. Leave the mixtures for 3 minutes.

   Question

   Briefly explain the changes observed after adding water to each sample in the given procedure.

Sample A dissolves completely in water forming a clear solution, indicating it is a soluble substance such as glucose.
Sample B forms a suspension where some particles remain undissolved, showing it may contain insoluble materials like proteins.
Sample C forms a paste or gel-like mixture, suggesting the presence of starch granules that absorb water and swell.
Sample D forms a cloudy or milky suspension, indicating the presence of fats or oils that do not dissolve in water but disperse as tiny droplets.

Experiment II
(i) Put 2 cm^3 of a mixture of food sample A prepared in Experiment I into a test tube and then add 2 drops of iodine solution.
(ii) Put 2 cm^3 of a mixture of food sample A into another test tube and then add equal volume of Benedict's solution then heat gently to boil.
Questions
(a) Record your observations and give explanations for each procedure.

In (i), no colour change is observed after adding iodine, showing that starch is absent in sample A.
In (ii), the mixture turns from blue to brick-red after heating, indicating the presence of reducing sugars such as glucose.

(b) Why was the mixture boiled after the addition of Benedict's solution?

Boiling provides the heat energy needed for the reducing sugars to react with the copper (II) ions in Benedict's solution, producing copper (I) oxide which gives the red colour.

Experiment III

(i) Put 2 cm^3 of a mixture of food sample B prepared in Experiment I into a test tube and then add equal volume of sodium hydroxide solution. Shake well then add 2 drops of 1% copper (II) sulphate solution.

(ii) Put 2 cm^3 of a mixture of food sample B into another test tube then add equal volume of Benedict's solution and heat gently to boil.

(iii) Put 2 cm^3 of a mixture of food sample B into another test tube thereafter, add 1 cm^3 of dilute hydrochloric acid and boil. Then, cool under tap water. Add 2 cm^3 of sodium hydroxide solution, shake the mixture well and add 2 cm^3 of Benedict's solution, heat gently to boil.

Questions

(a) Briefly explain what was observed in procedure (i).

A violet or purple colour appears, indicating the presence of proteins which react with copper (II) ions in an alkaline medium to form a biuret complex.

(b) State the role of dilute hydrochloric acid and sodium hydroxide solution in procedure (iii).

Dilute hydrochloric acid hydrolyses complex sugars like starch into simple reducing sugars. Sodium hydroxide neutralizes the acid before adding Benedict's solution to prevent it from interfering with the reaction.

(c) Briefly explain the importance of boiling and cooling the mixture after the addition of dilute hydrochloric acid in procedure (iii).

Boiling provides energy to break down complex carbohydrates into simpler sugars, while cooling prevents excessive heat that could destroy the sugars before testing.

Experiment IV

(i) Put 2 cm^3 of a mixture of food sample C prepared in Experiment I into a test tube then add equal volume of Benedict's solution. Heat gently to boil.

(ii) Put 2 cm^3 of a mixture of food sample C into another test tube, boil the mixture then cool. Add 2 drops of iodine solution.

Questions

(a) Briefly explain the observations and inferences in experiment IV.

In (i), there is no colour change, showing that reducing sugars are absent. In (ii), the mixture turns from yellow to blue-black after adding iodine, indicating the presence of starch.

(b) Why was the mixture containing food sample C boiled and cooled before adding iodine?

Boiling helps to rupture the starch granules and expose the starch molecules, while cooling ensures iodine reacts effectively to show the blue-black colour.

Experiment V

Put 2 cm^3 of a mixture of food sample D prepared in Experiment I into a test tube then add equal volume of sodium hydroxide solution followed by 2 drops of 1% copper (II) sulphate solution. Write your observation.

Question

What does Experiment V demonstrate?

A purple or lilac colour appears, showing the presence of proteins. This experiment demonstrates the biuret test for detecting proteins.

2. You are provided with white wheat flour, sugar and baker's yeast. Perform the experiment by following the given procedures and answer the questions that follow.

   Experiment I

   (a) State the types of raising agents that are demonstrated in this experiment.

The experiment demonstrates a biological raising agent, specifically yeast, which produces carbon dioxide gas during fermentation.

(b) Briefly explain four methods that were involved in incorporating air into the flour mixture in the process of making dough in this experiment.

Sifting the flour incorporates air between the particles.
Mixing and stirring the ingredients introduce air into the dough.
Kneading helps trap air within the elastic gluten structure.
Fermentation by yeast produces carbon dioxide which expands and adds air pockets.

(c) What is the importance of procedure (vi) in making bread and buns?

Kneading develops gluten, giving elasticity and structure to the dough, allowing it to trap gases and rise properly.

(d) Briefly explain the next procedure to be followed in order to obtain the final product.

After rising, the dough should be shaped into loaves or buns, placed in greased tins, and baked in a preheated oven until golden brown and cooked thoroughly.

(e) Name and write the chemical equations of the processes taking place in the reactions demonstrated in procedure (ii) – (vii).

The main process is fermentation of sugar by yeast.

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

(Glucose → Ethanol + Carbon dioxide)

(f) Give one benefit of each end product obtained in this process.

Carbon dioxide makes the dough rise, giving bread its light and soft texture. Ethanol evaporates during baking but adds flavour to the bread.

You are provided with 80 ml of food sample Y (cow's milk), solution Z (lime or lemon juice), a cooking pot or a sauce pan and a source of heat. Perform the experiment by following the given procedure and answer the questions that follow.

(a) Identify sample Y.

Sample Y is cow's milk.

(b) Briefly explain the basis of the observed changes in procedures (i) and (ii).

In (i), milk decreases in volume due to water evaporation, and a cream layer forms because milk proteins coagulate when heated.
In (ii), when milk burns, charring occurs due to the decomposition of milk sugars (lactose) and proteins forming a brown residue.

(c) Name the reaction demonstrated in procedure (ii).

The reaction is caramelization or Maillard reaction.

(d) Briefly explain what was observed when solution Z was added into the beaker containing sample Y in procedure (iii).

The milk curdles forming lumps, indicating that the acid in lime juice causes casein proteins to coagulate and separate from whey.

(e) Name the starter culture which is used to ferment sample Y and write the chemical reaction involved in this process.

The starter culture is *Lactobacillus* bacteria.

$C_{12}H_{22}O_{11} + H_2O \rightarrow 4CH_3CH(OH)COOH$

(Lactose + Water → Lactic acid)

(f) State the form of sugar that is present in sample Y.

The sugar present in milk is lactose.