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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Education

Design and Technology: Food Technology 6541

FTY6

Mark Scheme

2006 examination – June series

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

1 (a) Compare and discuss the nutritional composition of the foods in the table below.

Any relevant observations made from the table will be rewarded. Candidates may either answer this question by comparing and discussing the individual foods listed, or they may choose to collectively examine each of the nutrients listed. Either approach is acceptable. Marks are to be awarded for answers that look beyond the data given; for example, candidates may like to comment upon the fact that the energy content of the chicken would be significantly reduced if the skin were removed, as most of the fat in chicken lies under the skin. They may also mention the fact that dietary fibre only appears in those foods which originate from plant sources.

Energy Value: Mackerel is by far the richest source of energy, largely because of its high oil content: a good source of the Omega oils and the essential fatty acids (PUFAs), recommended to be eaten regularly as a part of a healthy diet. The lowest energy value foods are those that come from fungus/plant origins: Quorn and soya, though white fish is also low in energy, as the fat is stored separately in the fish liver. Lean beef and chicken would not read as highly in terms of energy value. Grilling rather than roasting would help reduce the fat content.

Protein: The richest source of protein per 100g is beef, closely followed by chicken and cod. The animal sources contain all the essential amino acids. Quorn contains egg, so it is a good source of protein, but it is not of a HBV. Soya is a HBV protein, but per 100g does not match the animal proteins in terms of volume present.

Carbohydrate: Soya and Quorn are the only foods to contain carbohydrate, both starch and sugars are present. This has an impact upon their energy values.

Dietary Fibre (NSP): This is only present in Quorn and Soya, as they originate from plant sources. The NSP content is a positive selling point for Quorn products.

Iron: Soya beans are richer in iron per 100g than beef, though the body more readily absorbs iron from animal sources than from plant sources. Of the animal foods listed, beef is by far the best source of iron. Quorn contains iron in significant amounts (quantities not readily available).

Calcium: Soya is by far the richest source of calcium. Of the animal foods, fish is the best source. Essential fatty acids aid the absorption of calcium, so mackerel may well be the best actual dietary source.

Sodium: The foods that have been in some way processed are higher in sodium levels: The smoking process dries foods slightly, resulting in a more concentrated mass, so increasing the already high levels of salt, which also aids the preservation of this fish. Sea fish naturally have high sodium content. Quorn has salt added during processing to enhance its naturally bland flavour. Soya contains only one mg of salt.
Beef and chicken are relatively low in sodium, though salt is often added during cooking.

Vitamin B_{12}: The richest source by far is smoked mackerel, though beef and cod are also good sources. Soya contains none and Quorn very little. Vegans may become deficient in this vitamin as its main source is from animal products.

Criteria for Marks Awarded	Mark Range
A basic answer, which merely transfers the information from the table. Little or no comparison is made. Only the most obvious points made.	0 – 3
Some effort to utilise the data and to draw upon individual knowledge and understanding. The most obvious points are covered sufficiently. Some evidence of original thought.	4 – 7
A full and detailed answer that makes full use of the data, coupling it with individual knowledge and understanding. Effective contrasts and comparisons are made between the foods and the nutrients they provide. The answer goes beyond the obvious, including original thought and observations.	8 – 10

(10 marks)

(b)

(i) State the meaning of the term 'Dietary Reference Values' (DRVs).

DRVs: This is a general term used to cover the various reference values for energy and nutrients for different purposes. The term includes the figures produced to calculate Reference Nutrient Intake (RNI); Lower Reference Nutrient Intake (LRNI); Estimated Average Requirement (EAR) and Safe Intake. Candidates will be rewarded for including any of these terms in their answer.

All DRVs are intended to apply to healthy people; they do not make allowances for the different energy and nutrient needs imposed by some diseases.

Criteria for Marks Awarded	Mark Range
The answer shows little or no understanding of the term.	0 – 1
A clear understanding of the term.	2

(2 marks)

(ii) Explain why Dietary Reference Values were introduced.

DRVs are used to:

- Assess the diets of groups of people
- Provide a guide to the adequacy, or otherwise, of individual diets
- Plan food supplies for large groups of people
- Nutritional labelling

They were introduced following the COMA report in an attempt to amalgamate dietary recommendations for health with nutrient requirements. They allow for the fact that there is individual variation in terms of nutrients and energy needed, and take account the variation in individual absorption rates for various nutrients. DRVs include estimates of average requirements but also offer reference nutrient intakes for low need groups and safe intake levels for those nutrients that can have undesirable effects in large quantities.

LRNI: is enough for only a small number of people in the population who have low needs (about 3%).
EAR: is the amount of nutrients or energy which any stated group of people on average will need.
RNI: is the amount of a nutrient which is enough for at least 97% of the population.

Candidates will be expected to clearly explain the term and provide evidence that they understand the usefulness of the calculations in assessing and providing adequate diets for the individual.

Criteria for Marks Awarded	Mark Range
The answer shows little or no understanding of why DRVs were introduced.	0 – 1
A reasonable explanation. Some supportive information is given. There may be some confusion or inaccuracies in the answer.	2 – 3
A full and detailed answer. The candidate shows a clear understanding of the reasons for introducing DRVs and is able to explain and justify the explanation of the various figures produced, such as EAR etc.	4

(4 marks)

(c) Explain the different nutritional issues for a vegan compared to a meat eater.

The candidate will be expected to make reference to the following:

Protein: Vegans need to ensure that they consume a 'mix' of protein foods from various plant sources. They will not consume any animal proteins at all. In order to achieve a full complement of all the essential amino acids, they need to eat a varied diet, complementing one protein with another.

Vitamin B12: This is readily found in seaweed. Vegans can obtain it from this source without the need to take supplements. It is possible to eat a vegan diet without the need for supplements. Yeast extract is a good source of other B group vitamins for vegans.

Iron: Though animal sources are more easily absorbed than plant sources, vegans can obtain a good supply of iron from foods such as Nori seaweed, lentils, curry powder, sesame and pumpkin seeds, haricot beans, breakfast cereals, kale, dried apricots, red kidney beans and cashew nuts. The body is able to adapt to absorbing iron from plant sources.

Calcium: This is found in sesame and poppy seeds, Kombu and Nori seaweed, Tofu, Soya beans, Figs, Spinach and other greens, Brazil nuts and chickpeas. The absorption of calcium is hindered by foods high in insoluble fibre such as bran and whole grains, due to the phytates they contain, if they are taken at the same time.

It is possible to eat a perfectly balanced vegan diet and remain healthy. However, a good knowledge of nutrition is essential. Many processed foods are not suitable for vegans as they more often than not contain additives or foods derived from animal sources, such as whey powder or the emulsifier lecithin. There may be a need for vegans to eat fortified foods (as long as it is taken from a non-animal source or supplements to B12).

Criteria for Marks Awarded	Mark Range
The answer shows little or no understanding of what a vegan diet involves.	0 – 2
A reasonable explanation. The candidate understands the basic diet but is unable to provide many examples of foods suitable. Not all the relevant nutritional details are given.	3 – 5
A full answer that demonstrates a sound knowledge and understanding of the topic. The dietary choices are well explained and the candidate supports the answer with a good range of examples.	6 – 8

(8 marks)

2 (a) Describe each of the following with reference to their chemical composition and physical characteristics:

Candidates are expected to have an understanding of the chemical composition of the saccharides. They may support their answer with diagrams and ring structures, where relevant. Any relevant point and appropriate use of terms, names and technical language will be rewarded.

Criteria for Marks Awarded	Mark Range
Little or no understanding of the chemical or physical composition of the saccharides.	0 – 1
A basic answer. Some attempt is made to describe the chemical and physical characteristics, but the answer may be inaccurate and lacks detail.	2 – 3
A sound answer that reflects a good knowledge and understanding. Good use of terms. Effective explanations. May include diagrams of ring structures, accurately drawn.	4

(i) monosaccharides,

These sugars contain 2 to 7 carbon atoms (most commonly 6, 'hexoses' and occasionally 5 carbon atoms, 'pentoses'). The formula is $C_6H_{12}O_6$. This formula applies to any monosaccharide with 6 carbon atoms, not just to glucose. The monosaccharides are glucose, galactose and fructose. Glucose is found in either the alpha or beta form. It is a reducing sugar, having the ability to break Fehlings solution down to form a brick red precipitate. Fructose is about one and a half times sweeter than glucose. It is also a reducing sugar. A mixture of glucose and fructose is known as invert sugar. The structure of fructose is complex, but in it's free state it looks similar to glucose with a 6-sided structure. When combined with other sugars it has a 5-sided structure. (Candidates will only be expected to know the ring structure of glucose).

(4 marks)

(ii) disaccharides,

These are formed from two monosaccharides that may be the same or different. Two monosaccharides condense together and eliminate water. The general formula for all disaccharides is $C_{12}H_{22}O_{11}$. The disaccharides are *maltose, lactose and sucrose.* Maltose is made from 2 glucose units linked across carbon atoms 1 and 4. When the two glucoses condense together water is eliminated and the remaining oxygen forms a bridge between the two glucoses. This bridge is known as a *glycosidic link*. Maltose is a reducing sugar and is broken down by the action of amylases. Lactose is only found in milk. It constitutes 5% in cow's milk and 7% in human milk. Lactose is a reducing sugar and is composed of the two monosaccharides glucose and galactose. Sucrose is produced from either sugar beet or sugar cane. It is not a reducing sugar. It is built from alpha glucose and beta fructose.

(4 marks)

(iii) simple polysaccharides.

Simple polysaccharides are long chains of one type of monosaccharide joined together. They are thus big molecules and are insoluble in water. They usually exist as a long chain. Occasionally there are branches formed by 1-6 glycosidic links. The general formula is $(C_6H_{10}O_5)n$ where *n* can be many thousands of monosaccharide units. The main polysaccharides in this group are *starch, cellulose and glycogen.* Starch is the energy reserve of plants. It is always accompanied by enzymes, which readily break it down. It can be recognised under microscope by its shape that is granular. It exists in two forms: amylose (straight chain of alpha glucose units) and amylopectin (many shorter, branched chains of alpha glucose). Amylose has good gel qualities. Cellulose has the ability to hold water and thus aids peristalsis. Cellulose gives plants structure in the form of long fibres. It is a very large molecule, often made up of several thousands of monosaccharide units: beta glucose (as opposed to alpha glucose in starch). These units are joined together by 1-4 glycosidic links. Heating may soften the cellulose, but it does not gelatinise as starch does. Glycogen is found in animals. It is readily broken down to maltose and alpha glucose, which is used up rapidly during muscular activity. Glycogen is a large molecule closely resembling amylopectin, but with very short branched chains.

(4 marks)

(b) Explain why the following are used in large-scale manufacture:

The candidate is expected to clearly explain the need for and function of the additives. Answers with relevant examples will be rewarded.

Criteria for Marks Awarded	Mark Range
Little or no understanding of the term. Points made are basic and possibly inaccurate.	1
A reasonable understanding of the term. Some accurate points made. Little evidence of technical language.	2
Sound understanding of the term. Good chemical knowledge and understanding of the principles involved. Good use of technical language.	3

(i) anti-caking agents,

These absorb moisture from dried foods without themselves becoming wet. They are used in dry products to ensure the substances flow freely, for example, salt. Examples of anti-caking agents include: silicates, calcium phosphates, magnesium oxide, salts from some long chain fatty acids such as stearic and palmitic.

(3 marks)

(ii) antioxidants,

These prevent rancidity developing in fats by either absorbing oxygen or preventing chemical changes involved in rancidity. Vitamin C (ascorbic acid) is an antioxidant that absorbs oxygen, as does vitamin E (tocopherols). Hydrolytic rancidity cannot be prevented by antioxidants. Chemical reactions involved in rancidity are prevented by using butylated hydroxyanisole (BHA) or butylated hydroxytoluene (BHT).

(3 marks)

(iii) emulsifiers,

These are substances, which allow water and oil to mix. They enable the production of a stable dispersion of oil in water or vice versa. Examples include glycerol monostearate (GMS), lecithin, egg yolk and whey protein. All of these prevent droplets of oil from coalescing and separating.

(3 marks)

(iv) stabilisers.

These are substances that have the ability to absorb considerable quantities of water. This property makes them good thickening agents, many being able to produce gels. Most can act as *emulsifiers* and prevent fat separation. Examples are *gums, cellulose* derivatives and gelatine.

(3 marks)

3 **"Food manufacturers have many opportunities to develop food products."**

Discuss this statement with reference to:

Candidates will be rewarded for any significant point made and justified and examples given to support the answer. Candidates will be credited for original thinking.

(4 x 6)

Criteria for Marks Awarded	Mark Range
A very basic answer that provides only the most obvious points. Little explanation or justification for any of the points made.	0 – 2
A reasonable answer. Some originality is evident and several points are explained and justified. This answer may lack detail.	3 – 4
A fluent answer that shows originality and diverse thought. The points are well considered and justified.	5 – 6

(a) **travel and migration,**

The frequency of family holidays abroad and the increasing range of exotic destinations means that many people are experiencing new foods and tastes. Supermarket NPD teams are constantly looking to produce new dishes or buy in new products to meet this growing trend. Air travel is cheap so many foods can be flown in. Many people move around the world to work. English is a commonly spoken language, so immigrants can settle here to work, bringing with them their own cultures, including food. This permeates our culture as people try and like new tastes e.g. Indian, Chinese, Thai, Italian, Japanese, Greek dishes. Candidates may give examples to support their answer.

(6 marks)

(b) **disposable income and consumer expectations,**

A generally higher standard of living means that many people are able to spend more on food. Many families have higher incomes because both partners work, so consequently have less time to shop and cook. Shopping has changed. Ready meals and supermarket 'take-aways' are available, for nearly instant meals. Take-away outlets are to be found in every high street and the prices are affordable. Many households eat at different times of day and rely upon freezer to microwave meals or take-aways. Many parents are de-skilled when it comes to cooking. Cooking takes time and many don't want to spend the little leisure time they have in the kitchen. Ready meals give a guaranteed result.

(6 marks)

(c) specific dietary needs,

Many people suffer from diet related disorders, allergies or sensitivity to certain foods. The supermarkets have acknowledged this. Consumers are increasingly discerning about the food they buy. In spite of this, many people in our nation are obese and the government have highlighted this in numerous campaigns. Food manufacturers have been criticised for adding too much salt and sugar to processed foods. Consumers are suspicious of GM crops and the organic movement is gaining a higher profile. Because so many families rely upon the supermarket for ready meals and other instant foods, they are attracted to the packages which say they are 'healthy' or 'lower in fat' or 'sugar free' etc.

(6 marks)

(d) different types of retailing outfits.

Many people rely upon the retailers for food, meals, snacks etc. whilst they are 'on the go'. Thus food can be purchased in a wide variety of outlets and throughout the day. Many people don't bother to make sandwiches any more at home. They simply purchase one on their way to work, either from the supermarket or from a small retailer, such as a small bakers shop, branching out into the sandwich market. Routine travel by train, car and plane has lead to many food outlet chains appearing on train platforms, in airports and on the motorways. Many of these outlets are franchised, offering a wide variety of products from burgers, to sandwiches, to soups and bagels. Drive-in take-away outlets follow the American tradition and in each town (however small) or city a wide variety of different nationality restaurants can be found e.g. Jordanian food in Edinburgh. Pubs now routinely offer food. Large-scale wholesale food processors such as 'Brake Brothers' supply many outlets, making it possible for them to operate, even on a small scale. Other methods include internet shopping at work and sandwich companies coming into offices.

(6 marks)

4 (a) What are the arguments for and against the use of Genetically Engineered (Genetically Modified) crops in food products?

Answers should be well explained and justified. Marks will be awarded for original ideas and well-substantiated argument.

Points for GM crops: to include such things as:

- Scientists can identify genes and transplant those with certain 'desirable' characteristics from one plant or animal to another.
- GM offers a short cut to improving crops and livestock.
- Developing world farmers are readily adopting GM technology to produce more food from the same area of land and in adverse conditions.
- In the future, GM crops could help alleviate malnourishment and illness.
- GM products such as 'Golden Rice' are being developed that are rich in carotenoids, which humans convert to Vitamin A.
- GM crops could lead to a vast reduction in the use of farm chemicals.
- Economic benefits are growing.

Points against GM crops: to include such things as:

- No one really knows what the long-term effects may be on health and the environment.
- There are no easy controls to prevent GM crops spreading and 'contaminating' farmland.
- Organic farm businesses could be threatened by contamination from GM crops.
- The argument that GM farmers need fewer chemicals is in dispute.
- The introduction of GM crops means the eradication of consumer choice.
- GM crops will not feed the world, but will make a few GM companies very rich. Only 1% of GM research is aimed at crops used by farmers in poor countries
- Is it ethical? What about food safety? Could GM ever be reversed?
- Who will be liable for possible harm to health or the environment in the future?

Criteria for Marks Awarded	Mark Range
A basic answer demonstrating a sketchy knowledge of the subject. Only the most obvious points made for and against GM crops.	0 – 4
Some effort to discuss the topic clearly. The most obvious points are covered sufficiently. Some evidence of original thought in the arguments for and against.	5 – 8
A full and detailed answer that makes effective use of an individual knowledge and understanding of the topic. Effective argument is exhibited. The answer goes beyond the obvious, including original thought and observations.	9 – 12

(12 marks)

(b) Describe how food manufacturers and consumers can reduce the volume of packaging waste.

Manufacturers: The number of packaging layers could be reduced. Bio-degradable plastics could be more widely used. New biodegradable materials could be developed. More 'just-in-time' products that require less substantial packaging. Clearer recycling instructions on packages. More recycling points established, e.g. for plastics. Easy to dismantle packages, designed for recycling (e.g. easy to separate plastic stoppers from cardboard drinks cartons).

Consumers: More foods could be purchased from 'deli counters', wrapped in thin packaging materials. Shoppers could be encouraged to re-use their plastic bags. Regular and disciplined use of the recycling bins provided by the district councils. Training children to recycle materials. Making use of plastic and glass packaging around the house, e.g. for packed lunches, storage containers. To carry out more home cooking, reducing the need to purchase heavily packaged foods such as ready meals. Taking home-prepared meals to work in a re-useable box. Freezing homegrown produce in re-useable containers.

Criteria for Marks Awarded	Mark Range
A basic answer in which the obvious points are made. Much of the response is generalised and the answer may not make much distinction between consumer and manufacturer.	0 – 4
A reasonable attempt to distinguish between consumer and manufacturer. The most obvious points are covered sufficiently. Some evidence of original thought.	5 – 8
A full and detailed answer that makes full use of original ideas. Excellent thought processes evident which make a clear distinction between the consumer and the manufacturer. The answer goes beyond the obvious.	9 – 12

(12 marks)

5 (a) Describe how the following food legislation protects the consumer.

- **1990 Food Safety Act**
- **1985 Weights and Measures Act and amendments.**

The Food Safety Act 1990: The main aim of this act is to protect the health of consumers and to prevent food fraud. This Act is the primary legislation in the UK, applying to England, Wales and Scotland. The intention of the Act is that food shall be in as wholesome a condition as possible when it is eaten. The Act came first, but has been followed by subsequent secondary legislative measures. All of this legislation prescribes legally enforceable standards of composition and treatment and renders infringement a criminal offence. The Act prohibits the addition to food any substance that would make it 'injurious to health'. It is also required that Ministers 'have regard to the desirability of restricting, so far as practicable, the use of substances of no nutritional value as foods or ingredients of foods'. The Act empowers Food and Health Ministers to make regulations concerning foods and, once approved by Parliament, these are published as legally binding Statutory Instruments.

The Act covers such issues as:

- Food safety (it is unlawful to sell food unfit for human consumption, or rendered harmful by the addition or removal of constituents, or by subjecting it to processes or treatments that are unreasonable. This covers microbial, foreign body or chemical contaminants).
- Substance, nature or quality (it is illegal to sell food which is inferior or substantially different to what it is purported to be, e.g. setting minimum amounts of foods for products such as fruit in fruit cocktails).
- Misleading descriptions (an offence to make a false or misleading claim on a food label or in an advertisement for a food, e.g. describing something as British when the main ingredient comes from abroad).
- Misleading presentation (this covers shape, appearance, packaging, the way things are presented for sale and the setting in which it is displayed e.g. fatty mince under red lighting to mislead consumers about its fat content).
- Individual legislation to include such things as additives, compositional standards, contaminants, hygiene and labelling.

In 1995 The Food Safety (General Food Hygiene) Regulations 1995 were introduced to ensure that the same food hygiene rules are applied in all European countries. The Regulations must be adhered to by anyone who owns, manages or works in a food business.

Weights and Measures Act: This applies to England, Wales and Scotland. It is of particular interest to consumers because it deals with short weight (or volume). It is an offence to deliver to the buyer a lesser quantity than purported to be sold or a lesser quantity than corresponds with the price charged. Matters related to the 'Average Weight System' (e mark) are also covered. Packers are allowed a tolerance on the actual weight / volume provided the average weight in a bulk lot does not fall below that stated on the package (tolerances may be +/- 15g). This ensures the consumer gets a fair deal. Some packs may be below the tolerance, but equally, some may be above it.

NB* Allow more marks for the Food Safety Act if necessary, as this Act is more involved

Criteria for Marks Awarded	Mark Range*
A very basic answer that provides only the most obvious points. The candidate has a very sketchy knowledge of the Acts.	0 – 4
A reasonable answer. Understanding of the Acts is evident and several points are explained and justified. The answer may lack detail and there may be some errors.	5 – 8
A fluent answer that shows a clear understanding of both Acts. A clear response showing excellent understanding of the principles underlying the legislation.	9 – 12

(12 marks)

(b) Why do manufacturers of ready meals carry out regular microbiological tests on product batches?

Manufacturers have a statutory responsibility to their consumers to ensure that the products they produce are of a high standard and are fit for human consumption. They also have a commercial interest in ensuring that their reputation remains untarnished. They must avoid incidents of food contamination leading to possible food poisoning outbreaks. In order to regulate their practices, microbiological testing is built into the manufacturing process as part of the Quality Assurance programme. This enables the manufacturer to sample each batch of ready meals to check for any contamination and, using the HACCP program, identify its source. If a batch proves to produce too many undesirable bacteria, producing dangerous levels of toxins, the batch can be removed from the shelves until the contamination source is identified and the problem rectified.

Criteria for Marks Awarded	Mark Range
A very basic answer that provides only the most obvious points. Little explanation or justification for any of the points made.	0 – 2
A reasonable answer. The candidate has a good understanding of the reasons, but the answer may lack detail.	3 – 4
A fluent answer that demonstrates the candidate's clear understanding of the reasons. The points made are well considered and justified.	5 – 6

(6 marks)

(c) Describe how a microbiological test is carried out and how the results are used.

A sample is taken from one batch. This sample is then made into a liquid solution in a laboratory using a machine called a 'stomacher', which pulverises the food with distilled water to produce an opaque liquid. This is then smeared onto an agar medium and the plates containing the substance are left to incubate for several days. This procedure is carried out in a clean laboratory, using sterile techniques. When the incubation period is reached, the dishes are placed under a strong microscope and colonies of micro-organisms are identified and counted. A grid is placed over the plates to aid counting. The colonies are counted using a 'clicker' pen. This is a laborious process, which needs to be carried out by a specially trained technician. Microbiologists are employed by many large food processors for this purpose. If any large quantities of pathogenic bacteria are found, the product may be deemed to be unsafe for human consumption and the contaminated batches will have been removed from circulation. Use by and Sell by dates are calculated in this way by the micro-biologists, who plot the rate of microbial growth of certain foods, in certain conditions and mathematically predict the point at which a product becomes unfit for human consumption. They will always be cautious in this estimation, allowing a certain amount of 'safe time' to compensate for situations such as transportation time from shop to home refrigerator in temperatures within the danger zone, allowing for accelerated rates of microbial growth to occur.

Criteria for Marks Awarded	Mark Range
A very basic answer that provides only the most obvious points. Little explanation or justification for any of the points made.	0 – 2
A reasonable answer. The candidate is able to provide some explanation of how the test is carried out and the results read. The answer may lack detail.	3 – 4
A fluent answer in which the candidate displays an excellent understanding of the methods involved for microbial testing and reading the results. The explanations made are well considered and justified.	5 – 6

(6 marks)

6 (a) Describe the ingredients and processes used in the manufacture of yoghurt.

Yoghurt is the Turkish name for milk fermented by a lactic acid bacteria starter culture. It is prepared from milk, slightly concentrated, with added milk powder. The bacteria used in fermenting the milk to make yoghurt are Lactobacillus bulgaricus and Streptococcus thermophilus. They convert lactose into lactic acid. The two organisms must be in equal amounts and one must not outgrow the other or a bitter or too acid product will result.

There are two categories of yoghurt: set yoghurt, where the fermentation is allowed to take place in the container in which the yoghurt is sold, and stirred yoghurt, which is fermented in bulk and packed later.

Yoghurt Processing:

1. The milk is pasteurised for 15 to 30 minutes at temperatures ranging from 85°C to 95°C. This heat treatment has the effect of stabilising the proteins in the milk and creates an almost sterile environment.
2. The milk is cooled to between 40°C and 43°C. This is an ideal temperature for the optimum growth of bacteria.
3. Described as 'inoculation', the starter is added and is usually between 0.5% and 2%. The starter is a mixed culture of Lactobacillus bulgarius and Streptococcus thermophilus. The streptococci grow and ferment the lactose in the milk to give lactic acid and diacetyl, which gives yoghurt its creamy, buttery flavour. This has to go on until a pH of 5.5 is reached and the oxygen level in the mixture is reduced. In these conditions, Lactobacillus bulgarius thrive and they grow to produce the acetaldehyde, which contributes to the characteristic flavour of yoghurt.
4. The inoculated milk is incubated for 4 to 6 hours at 37°C to 44°C or 12 hours at 32°C. This timing is crucial to the acidity of the final product. The desired level of acidity is between 0.8% and 1.8% lactic acid. The yoghurt thickens during incubation because of the coagulation of the proteins.
5. The yoghurt is then cooled to 4.5°C, which helps to prevent more lactic acid being formed. This temperature is maintained throughout storage and distribution. Bacteria are still alive, though their activity is reduced, unless the yoghurt is subjected to heat treatment, when they are destroyed.
6. Colourings and flavourings may be added. In stirred yoghurt this occurs after cooling. In set yoghurt this takes place after the starter is added.
7. Stabilisers and thickeners may be added to help maintain viscosity during processing, to prevent the yoghurt from separating during transport and storage and to assist in the suspension of added ingredients.

Emulsifiers and preservatives, retinol and Vitamin D may be added.

Criteria for Marks Awarded	Mark Range
A basic answer, which merely outlines the ingredients and stages of processing. Only the most obvious points made and there may be inaccuracies.	0 – 4
The candidate has a fair knowledge and understanding of the topic and is able to outline the key ingredients and stages of processing. There may be some omissions and some inaccuracy.	5 – 8
A full and detailed answer. The candidate displays an excellent knowledge and understanding of the topic and is able to accurately explain the ingredients used and the manufacturing process for yoghurt.	9 – 12

(12 marks)

(b) **Preservation can cause sensory, physical or nutritional changes to food quality. Describe the specific changes that the following preservation methods could cause:**

(4 x 3)

Criteria for Marks Awarded	Mark Range
Little or no understanding of the term or of the preservation principles underlying the process. Points made are basic and possibly inaccurate. May only mention one of the categories listed.	1
A reasonable understanding of the term and of the processing principles involved. Some accurate points made, though not all the categories may be covered. An example may be given to support the answer.	2
Sound understanding of the term. Good chemical knowledge and understanding of the principles involved. Good use of technical language. Example(s) given to support the answer.	3

(i) freeze-drying,

This is not to be confused with AFD, which produces a product of inferior quality. Any drying process causes shrinkage of a food product, but this is minimal with freeze-drying. Rapid drying systems cause the outer edges and corners of the food to become dried out and rigid and thus fix the shape of the dried food pieces early in the process. Water is removed from the centre of the food to produce a light honeycomb product, which readily rehydrates when added to water (Slow drying allows the product to shrink further and produce a dense dried food, which is difficult to rehydrate). The resulting product is porous but differs little from its original form. Because it is porous the food is excellent for rehydration. Examples include coffee, meat, fruit and vegetables. This process alters the cellular structure of food: compare fresh with dried coffee, but it produces an effective convenient and relatively fresh version of the original, e.g. instant coffee. The water-soluble vitamins may be lost from freeze-dried foods. Some odours are lost as a result of this process. Of all the drying processes, this is the most effective way of maintaining the original characteristics of a product. This is a more costly process, but where colour, flavour, texture, shape and reconstitutability properties are of paramount importance (e.g. coffee, cup-a-soups, snack pots and dried fruits such as strawberries in cereals), this process gives the most desirable organoleptic results.

(3 marks)

(ii) irradiation,

This process destroys micro-organisms but has no effect upon the enzymes in the food, so degradation is not prevented. It can only be used on certain foods. It extends the shelf life in certain fruits and vegetables by delaying ripening (bananas), inhibiting sprouting (potatoes and onions) and killing moulds (strawberries). It reduces significantly the numbers of pathogenic bacteria and spoilage organisms in shellfish, chicken and spices. It controls insect infestation in grain and other stored products and destroys parasites in meat. There are no visible changes to a food that is irradiated, other than the reduction of the undesirable factors above. The food is not radioactive after irradiation, nor is it cooked as no heating occurs. At permitted doses of irradiation, the organoleptic properties of most foods are unaffected.

(3 marks)

(iii) smoking,

This process is primarily used for meat and fish in combination with salt to add flavour and to delay spoilage. The degree of preservation is minimal with this process, because high levels of salt and smoke make the food less palatable and not so good for health reasons. Therefore in order to preserve smoked products, additional methods such as chilling and vacuum packing are used. Smoking is either cold or hot. In cold smoking the product remains uncooked. The temperature does not exceed 30°C. Most products are then cooked, except salmon, which is eaten raw. The organoleptic qualities are considered to be desirable. In hot smoking the temperature is allowed to rise so that the food cooks. Smoked foods are often coloured yellowy as a result of the process. They are partially dried and salty, so the texture and flavour are distinctive. This is a positive organoleptic selling point for these products.

(3 marks)

(iv) Ultra Heat Treatment.

Food is heated to temperatures in excess of 100°C to ensure that spores are destroyed. In the case of milk the product is heated to not less than 132.2°C and is packaged under aseptic conditions. It is similar to pasteurised milk in terms of nutritive value and the heat is so quick that the colour and flavour changes are not so obvious as in sterilised milk. The storage life is vastly longer however. For all products that are heated there will be some loss of colour, flavour and texture to a greater or lesser extent. Heat sensitive vitamins such as thiamine, riboflavin, niacin and Vitamin C will be affected. There will be a reduction of 10 to 20% of the amino acid lysine in high protein foods. Fruit juices that are subjected to this treatment may be fortified with additional Vitamin C. Some people are discerning about the organoleptic effects of UHT however, and maintain that there is a significant difference in the taste and texture of milk processed by this method.

(3 marks)