



General Certificate of Education (A-level)
June 2011

Design and Technology: Food **FOOD3**
Technology

(Specification 2540)

Unit 3: Design and Manufacture

Final

Mark Scheme

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GCE Food 3

General Note: For the long questions which are responses to an article or statement, candidates will be rewarded for each separate point made, including explanations, examples given with justification or clarification, original argument and observations drawn from the material. Reward will only be given to realistic argument which is substantiated. In general terms, one mark is allocated to each new point made or example cited. Repetition of the information given in the article will not be rewarded.

SECTION 1

Question 1

01 With reference to the article above, to what extent do you think that people are misunderstanding what it means to eat healthily? (16 marks)

Any well argued and well substantiated point will be credited:

- Discussion about what it means to eat 'healthily', making reference to DRV's etc., including specific reference to the recommended daily amounts of nutrients for pre-school children.
- Examples of common misinterpretation of 'healthy eating', as part of an argument.
- Discussion about general lack of nutritional knowledge and understanding amongst adults and suggested reasons for this.
- Any other well explained point.

Criteria for marks awarded	Mark range
A limited response which gives only the most obvious points. The student displays only a basic knowledge and understanding of the topic. The article may not be referred to.	0 - 5
A reasonable response which makes several significant points, which may not be original or well substantiated, but does show a sound understanding of the topic. Reference may be made to the article.	6 - 11
An excellent response which covers all the issues effectively, showing insight, knowledge and understanding of the topic and originality. Good reference is made to the article.	12 - 16

Describe the following processes:

02 gelatinisation of starch

(4 marks)

- When a suspension of starch in liquid is heated, the liquid penetrates the outer layers of the granules and the granules begin to swell.
- This occurs from 60°C to 80°C
- The granules swell until they are as much as 5 times the original
- At 80°C the starch granules begin to break up dispersing the contents into the liquid
- The long chain molecules unfold and the mixture becomes more viscous
- The mixture thickens, forming a sol

03 retrogradation of starch

(4 marks)

- Starches containing *amylose* gel best because the molecules are spiral shaped and form a network in which water is trapped. This produces a rigid gel.
- Amylose molecules tend to unwind in time however, producing a watery deposit, an opaque gel and a pulpy, spongy texture.
- This process is known as *retrogradation* and it occurs mainly when foods are frozen and thawed.
- High *amylopectin* starches do not retrograde easily
-

04 syneresis of protein

(4 marks)

- Syneresis is the shrinkage of a gel and the subsequent loss of liquid
- Gels affected by syneresis can be based upon protein
- An example of syneresis is scrambled egg, which if overcooked, shrinks and produces a liquid
- Another example is jelly left to stand, producing a pool of water around the base

Criteria for marks awarded	Mark range
There is little or no understanding of the term and minimal description.	0 - 1
A reasonable understanding, though the description is lacking in detail. There may be some errors.	2 - 3
A full understanding of the term. Most, if not all points are covered. Thorough description.	4

Question 2

**05 Discuss why there is still a need to use food additives in commercial food products.
(16 marks)**

Any well argued and substantiated point will be rewarded:

- Food safety, for example, use of preservatives, to prevent food poisoning
- Food spoilage, for example, use of anti-oxidants, to prevent enzymic oxidation and rancidity occurring
- Shelf life, for example use of emulsifiers, stabilisers and humectants, to ensure food products remain palatable
- Sensory appeal, for example in the use of colourings, flavourings, to attract the consumer to the product
- Large scale manufacturing, for example use of anti-foaming and anti-caking agents, to ensure the successful production of products in the commercial setting
- General observations about the importance of food additives commercially, with example(s)
- General observations about the consumer's needs and wants (good or bad)

Candidates may discuss health issues associated with certain food additives or groups of additives. Examples should be given. (Maximum of 4 marks).

Candidates may argue against the statement. Give credit for valid points, well substantiated.

Criteria for marks awarded	Mark range
Only the most obvious points are made and the argument lacks structure. Explanation is weak and lacking substance.	0 - 5
A reasonable attempt to cover the major issues. Some sound explanation supported by largely relevant examples.	6 - 11
A detailed and very well considered approach. The topic is thoroughly examined, explanation is well substantiated with evidence of original thought.	12 - 16

06 Explain what is meant by the term fatty acids.

(3 marks)

Any relevant point will be credited. There may be some overlap in answers about fatty acids and triglycerides. The same point will not be credited twice. Note that candidates will not be expected to include all of the points listed below to gain full marks.

1. Lipids are esters of glycerol and fatty acids.
2. Fatty acids have the general formula RCOOH where R represents a hydrocarbon chain.
3. There are about 40 different fatty acids found in foods and of these there are basically two types: *saturated fatty acids* and *unsaturated fatty acids*.
4. In saturated fatty acids, the hydrocarbon chain is saturated with hydrogen, but in unsaturated fatty acids the hydrocarbon chain is not saturated with hydrogen and therefore has one or more double bonds.
5. Unsaturated fatty acids may be either *monounsaturated* (containing one double bond) or *polysaturated* (containing more than one double bond).
6. Saturated fatty acids include *butyric* (found in milk fat, butter), *palmitic* (found in animal fats) and *stearic* (found in beef fat).
7. Monounsaturated fatty acids include *oleic* (found in cooking fats and oils).
8. Polunsaturated fatty acids include *linoleic* and *linolenic* (found in vegetable and fish oils).

Do not allow individual marks for the names of each fatty acid or mono., poly and saturated etc. The point must be significant and well explained e.g. allow a mark for the type of fatty acid and an example, as in 5 or 6, 7, 8.

07 Explain what is meant by the term triglycerides.

(3 marks)

1. Fats and oils are a mixture of triglycerides, which consist of one molecule of glycerol combined with three fatty acids. (Diglycerides combine with two fatty acid molecules and monoglycerides combine with one).
2. The simplest type of triglyceride is one in which all three fatty acids are the same, though they usually contain two or three different fatty acids and are known as mixed triglycerides.
3. Naturally occurring fats and oils are mixtures of different mixed triglycerides and therefore contain a number of different fatty acids.

Criteria for marks awarded	Mark range
Little or no understanding of the term. Only one significant point given.	0 - 1
Some understanding of the term. Two significant points given.	2
Excellent understanding of the term. At least three significant points given.	3

08 Describe the process of hydrogenation in relation to the production of trans fats.

Any of the points below to be credited. (Allow one mark for recognition of the health risks associated with trans fats).

1. Hydrogenation (hardening) is undertaken to remove some of the double bonds in the fatty acids and effectively to make them more saturated.
2. It turns a liquid into a solid by adding hydrogen across the double bonds in the unsaturated fatty acid molecules.
3. Trans fatty acids are unsaturated fats that have been hydrogenated, usually in food processing, and become hard at room temperature. They then become like saturated fats in the manner in which they act in the body.
4. In margarine production hydrogenation is carried out by heating the oil in large sealed vessels under pressure. Hydrogen is bubbled into the oil with finely divided nickel (which acts as a catalyst and is subsequently removed by filtration).
5. The arrangement of the atoms at the double bond can take on a 'trans' formation, with the two hydrogen atoms on geometrically opposite sides of the double bond (as opposed to 'cis' formation, where the two hydrogen atoms are on the same side of the double bond).
6. Trans fatty acids may be more damaging for the body than saturated fats because they not only raise levels of LDL blood cholesterol but also lower levels of the good (HDL) cholesterol. There are more sinister associations with Trans fats possibly triggering some cancers.

(6 marks)

Criteria for marks awarded	Mark range
There is a basic description of the process of hydrogenation in relation to the production of trans fats, which may contain errors and omissions.	0 - 2
A reasonable description of the process of hydrogenation in relation to the production of trans fats, which contains the main points.	3 - 4
A full description of the process of hydrogenation in relation to the production of trans fats, which is accurate and detailed, making excellent use of terminology.	5 - 6

Question 3

09 To what extent do the food choices of ethnic and religious groups influence the type of food products available on the market in Britain today?
(16 marks)

Any significant and relevant point will be credited. The candidates are expected to discuss the topic: ('To what extent....'), thus marks will be given for well constructed and explained points, with relevant examples.

- Mediterranean influences e.g. pasta, olive oil, wine, basil etc.
- Indian influences e.g. curries, naan bread, lentils, vegan dishes
- Chinese influences e.g. fried rice, chop suey, chow mein etc.
- A wide variety of other national and cultural influences: Thai, Vietnamese, Mexican, Cantonese, German, Spanish Tapas, French, American, Japanese Polish etc
- Establishment of 'Corner Shops' for immigrant nationalities, e.g. Polish stores
- Introduction of a wide variety of bread based products e.g. pizza, baguette, bagels etc.
- Halal and Kosher butchery – provision of meat slaughtered by different methods (some say it tastes better)
- Pork free products, including use of lard for frying
- Different cooking methods and techniques e.g. stir frying
- Importing ethnic food products and ingredients which adds variety
- Varied take-away food products which become part of our own diet
- Types and combinations of ingredients different to our own, which may become popular
- Wider variety of sauces, ethnic food products in supermarkets
- A return to 'traditional' British foods in contrast to popular ethnic foods
- Adopting some of the positives from other cultures, such as low saturated fat diets, more salad, vegetarian options
- The appeal of new flavours (possibly reminiscent of a holiday abroad), which encourages the whole family to cook
- Celebrity chefs opening up new ideas for cooks making use of ethnic ingredients and recipes.
- Media coverage of people and their roots, where food plays an important role

Criteria for marks awarded	Mark range
The points made are likely to be the most obvious. Some examples given, but discussion of the topic is limited.	0 - 5
A reasonable response which covers the major issues. Examples are good and there is discussion of the topic, though this may lack originality.	6 - 11
An excellent response, which covers many areas. Very good use of examples and original thinking evident.	12 - 16

10 Describe the effect of heat, mechanical action and acids on egg white, making reference to the chemical structure of protein. (12 marks)

- Egg whites, which are globular proteins called ovalbumin, consist of long chains of amino acids chemically combined by peptide links.
- **Heat** causes the secondary structure of egg whites to *denature*, where the molecule unfolds and changes shape but the sequence of amino acids remains the same. This occurs at about 60°C.
- Denaturation breaks the cross-linkages which maintain the shape of the molecule. It is usually irreversible.
- As a result of denaturation, the properties of proteins alter: they become less soluble and more viscous. The unfolded molecules tend to form clumps, as they bond with each other. This results in the setting or hardening of the egg white, known as *coagulation*, and the change of colour from opaque to white.
- **Mechanical action** or violent agitation, such as whisking, can cause a partial coagulation of the protein in egg whites. The protein molecules unfold and form a reinforcing network round the air bubbles, thus stabilising the foam. This can be used in making meringues and soufflés.
- **Acids**, such as lemon juice, can be used to denature proteins and to speed up the time it takes for egg whites to foam.

NB Accurately drawn and annotated diagrams which represent the structure of protein in relation to denaturation should be rewarded up to 3 marks.

Criteria for marks awarded	Mark range
A basic understanding of the effects of heat, mechanical action and acid on protein. Little or no reference to the structure of the protein molecule. Examples may not be relevant.	0 – 4
A reasonable understanding of the effects of heat, mechanical action and acid on the protein molecules. Diagram and examples may be included. There may be omissions and some confusion in places.	5 – 8
An excellent understanding of the topic. Detailed description of the changes that take place, possibly supported by accurate diagrams. Very good use of scientific terminology. Examples given.	9 – 12

SECTION 2

Question 4

11 Read the article above. How might the risk from Listeria be minimised in the production of ready-to-eat-foods? (16 marks)

Any well considered and relevant point made will be credited: Candidates do not need to make reference to the article in their answer.

- Listeria can be found in many natural environments such as soil, water, vegetation, sewage, farm environments, food factories and in the home.
- It is destroyed by normal cooking processes (i.e. reaching at least 70°C at the centre of the food for 2 minutes)
- It can be found in refrigerators and can survive and grow at refrigeration temperatures. Being able to multiply at low temperatures enables it to grow to dangerous levels.
- Many ready-to-eat foods are stored in the 'fridge before consumption and are not re-heated.
- Vulnerable groups can avoid listeria by avoiding long shelf-life or delicatessen products such as soft cheeses, smoked fish and meat products.
- Never eat food after the use by date.
- Always read the label and follow the storage instructions.
- Keep 'fridges at no more than 5°C
- If in doubt, throw it out.
- Follow the basic general rules for good food hygiene, such as regular hand washing, especially after handling uncooked foods; keeping ready-to-eat foods separate from uncooked foods; cooking to at least 70°C for 2 minutes at the core; keeping hot foods above 63°C.

NB Reward will only be given to points that are well explained and substantiated, e.g. general food hygiene points must be explained to gain a mark.

Criteria for marks awarded	Mark range
Only the most obvious points are made and the argument lacks structure. Explanation is weak and lacking substance.	0 - 5
A reasonable attempt to cover the major issues. Some good points are made, which are generally well explained.	6 - 11
A detailed and very well considered approach. The topic is thoroughly examined, explanation is well substantiated and there is evidence of original thought.	12 - 16

12 Explain how Modified Atmosphere Packaging (MAP) and vacuum packaging extend the shelf life of food products. Make reference to the packaging materials used.

Modified atmosphere packaging is also known as 'Controlled atmosphere packaging'.

- It preserves food in sealed gas flushed packs.
- In the packs the oxygen level can be lowered or the carbon dioxide level or nitrogen levels increased.
- CO₂ retards the growth of bacteria. Oxygen helps retain the colour of the food, e.g. meat stays red and Nitrogen is used to reduce the rate of oxidation. The ratio of these gasses depends upon the food being packaged.
- The food is prepared and placed in the container.
- The container is then flushed with the selected gas for the food type and is then hermetically sealed.
- MAP is often carried out in conjunction with chilling in the case of chilled meals or prepared salads.
- Once the packaging is opened the food has a normal shelf life and must be stored accordingly.
- The packaging used must be non reactive and sufficiently strong to resist damage through piercing or splitting.
- The most commonly used materials are plastics, which may be ovenable, with a film cover.
- **Vacuum packaging** is a method that removes all oxygen so that the organisms requiring it to reproduce are inhibited.
- The materials used for vacuum packing should be resistant to piercing and splitting, but equally, be resilient to the process and able to comfortably form around the food.
- Suitable materials for vacuum packing dry goods are foil packages, e.g. ground coffee and nuts or robust plastics, suitable for storage in a refrigerator, e.g. for cooked meats or smoked fish.
- The material should be non reactive with the food.

Criteria for marks awarded	Mark range
A basic understanding of the two methods of preservation. Little or no reference to the underlying scientific principles or to packaging materials. Examples may not be relevant.	0 – 4
A reasonable understanding of the two methods of preservation. The scientific principles are understood though there may be omissions and some confusion in places. Packaging materials are identified, some examples given.	5 – 8
An excellent understanding of the topic. Detailed explanation of the methods, packaging materials and the underlying scientific principles. Very good use of scientific terminology. Examples given.	9 – 12

Question 5

13 Read the article above. To what extent do you agree with the suggestion that date stamping produces food waste? (10 marks)

Any well reasoned and argued point will be credited, so long as it is relevant to the question. Allow credit to those candidates who do not agree with the article and are able to justify why.

- People have been warned not to eat food that has gone past the use by date.
- Some people confuse 'sell by' and 'use by'.
- Many people over shop, over-estimating the amount of food they will actually need.
- Many people have a high disposable income and it does not matter to them if they buy too much food.
- Many consumers shop weekly and don't plan for the use of leftovers, so they buy new and throw away the old.
- Many consumers are de-skilled (lack cooking skills) and rely upon packaged food and ready meals, which they are afraid to eat once the product goes out of date. If they used fresh ingredients, the amount of disposable packaging would drastically be reduced.
- Disposing of waste is easy and cheap, so people tend not to act responsibly in minimising waste.
- If there were no date stamps, there may be less waste, but more incidences of food poisoning and food manufacturers would be at risk of being blamed if people got ill.
- Some people argue that the dates make people buy more food products, which in turn is of benefit to the manufacturer.
- Perhaps the government should try to reduce ready-meals production and promote more home cooked food.

Criteria for marks awarded	Mark range
A limited response which covers only the most obvious points. The answer lacks strong and relevant argument.	0 - 3
A reasonable answer which covers the main issues. A good level of argument with examples.	4 – 7
An excellent understanding of the issues. The argument is well considered, with relevant examples and original thought.	8 - 10

**14 What do you understand by the terms 'HACCP' and 'Safer Food Better Business'?
(10 marks)**

Candidates responses do not have to cover both initiatives equally, though to gain marks in the top band, both must be discussed.

HACCP (Hazard Analysis and Critical Control Points) is a system designed to break a process down in order to identify any possible hazards (physical, chemical or micro-biological). The potential hazards are then rated according to whether they are low, medium or high risk and controls are put in place to prevent the hazard occurring. The whole system is monitored. Critical Control Points (CCP's) are identified. At these points, some preventative action must be taken, e.g. a temperature check, and details of monitoring and corrective action stated. It enables manufacturers to prove 'due diligence' if taken to court on food safety matters.

'Safer Food Better Business' This is a food safety management pack which has been developed to help small catering businesses such as restaurants, cafés and takeaways comply with food hygiene regulations introduced in January 2006.

This pack has been developed by the Food Standards Agency, working with catering businesses, to be practical and easy to use.

It helps food businesses to:

- comply with food hygiene regulations
- show what they do to make food safely
- train staff
- protect their business's reputation
- improve their business, such as by wasting less food.

The areas it covers include:

Cross contamination: Personal hygiene, Cloths, Separating foods, Pest control, Maintenance, Food allergies, Physical and chemical contamination

Cleaning: Cleaning effectively, Clear and clean as you go, Your cleaning schedule, Chilled storage and display, Chilling down hot food, Defrosting, Freezing

Cooking: Cooking safely, Foods that need extra care, Reheating, Ready-to-eat foods, Checking your menu, Hot holding

Management: (Training staff, Suppliers)

Any relevant and well explained point will be credited

Criteria for marks awarded	Mark range
Some general points are made, with little or no understanding of the initiatives.	0 - 3
A reasonable attempt to explain the initiatives. The main points are covered, with some justification. There may be less emphasis or one or other of the initiatives, but both should be referred to in the response.	4 - 7
A very good understanding of both of the initiatives and what they stand for. A thorough explanation which is perceptive.	8 - 10

**15 Why do manufacturers study existing food products as a part of their market research?
(8 marks)**

Any well explained and relevant point will be credited.

- Studying existing products is often used by product development teams to find new ideas for new products.
- Competitors products provide a useful source of information for manufacturers, who carry out 'in house' testing on them. Such tests will include sensory evaluation and identification of ingredients, portion size, packaging, value for money and so on.
- They may look for emerging social, cultural and lifestyle trends, gaps in the market, new technologies, new ingredients, new packaging and promotional techniques, new recipe ideas, emerging health and nutritional trends etc.

Criteria for marks awarded	Mark range
A limited response which considers only the most obvious points, with little justification.	0 - 2
A reasonable response which covers the most important points and provides a good level of explanation and justification.	3 - 5
An excellent response which covers all the main issues, is perceptive and original, with sound explanation and justification	6 - 8

Question 6

16 Read the article above. Why do you think that such a high proportion of newly developed products, such as functional foods, fail within their first year of being on the market?
(16 marks)

Any relevant and well justified point will be credited.

- It is not just newly developed functional food products that fail. More newly developed products launched onto the market fail than succeed.
 - With functional foods, the failure may be related to cost, economics, fashion, expectation, promotion, fitness for purpose, trust in scientific developments etc.
 - Many wider issues may be discussed, such as lifestyles, disposable incomes, media hype, the 'keep-fit' society, health fears, trust in modern-day scientists, the argument that an informed diet is equally as good, people are being pushed into trying out new products as a 'quick-fix' rather than adopting a healthier lifestyle etc. Then, they find these products don't do what they had expected, so they stop buying them.
 - Mass media (advertisements) can affect the popularity of products
 - Marketing products correctly and aiming them at the correct target group.
 - Pricing products correctly.
 - Successful production methods and distribution networks
- Etc.

Criteria for marks awarded	Mark range
A limited response in which only the most basic points are made. The candidate may not fully understand the term 'functional' food.	0 - 5
A reasonable response. The candidate has a good grasp of the topic and is able to explain the reasons for the failure of newly developed functional foods. There may be omissions and errors.	6 - 11
An excellent response. The candidate is able to identify all or most of the issues and can present a very good argument for the failure of newly developed functional foods. The answer shows understanding and original thought.	12 - 16

Explain how the methods of preservation listed below preserve food and extend shelf life.

17 bottling

(4 marks)

- Toughened glass is used because it can be taken to high temperatures for heat treatment methods such as bottling fruit and vegetables. It is easy to sterilise glass.
- The bottle (or jar – often referred to as a Kilner Jar) can be filled either with raw foods and then heated slowly to boil the foods, destroying bacteria and spores. Air is expelled through a specially designed lid, and as the jar cools down, a vacuum is formed. The sealed jar prevents the re-entry of bacteria. As there is no oxygen present, bacteria are unable to multiply.
- Bottling can also be used for high temperature methods such as jamming, pickling and chutney production. Glass is non-reactive and therefore suitable for use with acidic mixtures. Bottled food has a very long shelf life at ambient temperatures.

18 Canning

(4 marks)

- Food is packed into a can and then heat processed until the contents are 'commercially sterile' at 121°C by passing the can into a special steamer where a vacuum is applied to draw the air from the can as the lid is sealed into place. A double seam is made by rolling the metal edges together in the shape of a hook. Air is driven out by the steam, preventing bacteria from surviving.
- The severity of the heat treatment can be lessened if the food contains acid, salt or sugar. The most important pH is 4.5, as below this the very dangerous organism *Clostridium botulinum* is inhibited.
- Cans are cooled in chlorinated water (bacteria free) to prevent any possible contamination in cans which may have a slight defect. This could infect the food and cause an outbreak of food poisoning some time later. Canned food has a very long shelf life at ambient temperatures.

19 Ultra Heat Treatment (UHT)

(4 marks)

- Food is heated to temperatures in excess of 100°C in plate heat exchangers to ensure that spores are destroyed. In the case of milk the product is heated to not less than 132.2°C for one second and is packaged under aseptic conditions.
- Packages are hermetically sealed. The packaging materials used are robust and prevent entry of air unless opened or pierced. The products can be stored in ambient temperatures for up to 6 months usually and do not require refrigeration.
- Until the package is opened the product remains in sterile conditions and is therefore preserved.

Criteria for marks awarded	Mark range
A limited understanding of the method and the underlying principles of food preservation. Only one significant point made.	0 - 1
A reasonable understanding of the method and the underlying principles of food preservation. Two or three good points made.	2 - 3
An excellent understanding of the method and the underlying principles of food preservation. Good use of terminology. Four or more significant points made.	4

End of Mark Scheme