# Food

Sub-Topics:

- The need for food
- Carbohydrates
- Proteins
- Lipids
- Minerals
- Vitamins
- Water
- Experiments
- Sample Answers

Food comes up **every year** as a short question which is worth 20 marks i.e. 5% of your exam. Usually is either question 1, question 2 or question 3.

It sometimes comes up as well as part of an experiment question (question 7,8 or 9), usually 6-9 parks if it does so.

It can also get a full experiment question 30 marks which is worth 7.5% of your exam but this has never happened.

#### Previous exam questions on food include:

- 2019 question 1 (20 marks)
- 2019 question 7a (6 marks)
- 2018 question 1 (20 marks)
- 2018 question 7b(iv) (6 marks)
- 2017 question 1 (20 marks)
- 2016 question 2 (20 marks)
- 2016 question 7b(i) (6 marks)
- 2015 question 1 (20 marks)
- 2014 question 1 (20 marks)
- 2013 question 1 (20 marks)
- 2012 question 1 (20 marks)
- 2011 question 1 (20 marks)
- 2011 question 8a and b(i) (12 marks)
- 2010 question 1 (20 marks)
- 2010 question 8b(v) (6 marks)
- 2009 question 1 (20 marks)
- 2008 question 1 (20 marks)
- 2007 question 1 (20 marks)
- 2006 question 1 (20 marks)
- 2006 question 1a (6 marks)
- 2000 question 1a (0 marks)
  2005 question 1 (20 marks)
- 2003 question 1 (20 marks)
  2004 question 1 d and f (6 marks)

All living organisms require food:

- 1. For energy (for heat and to drive chemical reactions and for continuity of life).
- 2. To provide the necessary building **materials** for growth, maintenance and repair of cells.
- 3. Involved in metabolic reactions i.e. to control chemical reactions in cells.

Food is made up of:

- Six chemical elements
- Carbon (C)
- Hydrogen (H)
- Oxygen (O)
- Nitrogen (N)
- Phosphorous (P)
- Sulphur (S)
- Salts
- Sodium (Na)
- Magnesium (Mg)
- Chlorine (Cl)
- Potassium (K)
- Calcium (Ca)
- Three trace elements
- Iron (Fe)
- Copper (Cu)
- Zinc (Zn)

Trace elements are found in small minute amounts



Appropriate amount of Zinc (top-left). Copper (bottom-left) and Iron (top-right) in the average human body .

# **Biomolecules:**

Biomolecules are organic compounds made in living organisms.

There are four types of biomolecules in food:

- 1. Carbohydrates
- 2. Proteins
- 3. Lipids
- 4. Vitamins

### **Carbohydrates**

Carbohydrates are made up of the elements Carbon, Hydrogen and Oxygen (C,H,O)

#### Structure:

Carbohydrates consist of simple sugars.

General formula = Cx(H2O)y

They are in the ratio of 1:2:1

- The Ratio of Carbon to Hydrogen = 1:2
- The Ratio of Hydrogen to Oxygen = 2:1
- The Ratio of Hydrogen to Oxygen = 1:1

There is always twice as many hydrogens as there are carbons and oxygens. Glucose has the formula  $C_6H_{12}O_6$ .

#### Monosaccharides are single sugar units.

They are reducing sugars. They are sweet to taste and they are soluble in water.

**Example:** Glucose  $(C_6H_{12}O_6)$  which is found in fruit e.g. grapes Fructose which is found in honey and sweet fruits

Monosaccharides have the same molecular formula but different structural formulas

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Fructose is found in honey:



Disaccharides are 2 sugar units joined together.

Some are reducing sugars e.g. maltose and lactose but sucrose is not a reducing sugar.

They are sweet to taste and they are soluble in water.

**Example:** Sucrose which is found in table sugar. Lactose which is found in milk.. Maltose which is found in germinating seeds.



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Polysaccharides are many sugar units joined together.

They are not reducing sugars, They are not soluble in water and they are not sweet to taste.

#### **Example:**

• Starch: found in bread, pasta and potatoes

Starch is stored by plants as a storage polysaccharide e.g. potatoes. It broken down by the enzyme Amylase into Maltose.

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• Cellulose is found in vegetables and wholemeal bread.

It is made of long chains of glucose that are cross-chained and therefore harder to break apart and harder to digest.

It is used as fibre or roughage in the diet. -Cellulose is a structural polysaccharide in plants e.g. cell walls.

• Glycogen is stored in the liver, brains and the muscles

It is used as a storage polysaccharide in animals. It is broken down to release glucose for energy in muscles.

### Role of carbohydrates in cell structure and metabolism:

#### **Structural Role:**

- · Cellulose Plant cell walls
- · Chitin Fungi cell walls and exoskeleton of insects

#### **Metabolic Role:**

- Catabolic Reactions e.g. respiration
- Anabolic Reactions e.g. photosynthesis

### **Energy Storage**

- Stored in plants as starch.
- Stored in animals as glycogen.

The **basic unit** of a carbohydrate is a **monosaccharide**.

### **Proteins**

Proteins consist of the **elements** carbon, hydrogen, oxygen, nitrogen and/or sulphur and phosphorous.

#### Structure:

Proteins are composed of **amino acids.** There are **20** common types of amino acids.

Amino acids are held together by a peptide bond.

- A **peptide** is made of 20 or less amino acids.
- A **polypeptide** has more than 20 amino acids.
- A protein is a long chain polypeptide with over 200 amino acids.

#### Types of protein:

Some polypeptide chains become:

- Twisted e.g. fibrous protein i.e. keratin in hair, nails and feathers.
- Folded e.g. globular proteins in enzymes and hormones.
- Folded and in addition have another chemical in the fold e.g. haemoglobin in red blood cells and glycoprotein on cell membranes.

**Prions** are proteins that do not fold correctly. They can cause BSE, nvCJD and scrapie.

### Food Sources:

Lean meat, egg white, fish, soya, pulses, nuts and cheese.



• Amino acids are not stored in the body and have to be broken down. The liver pulls amino acids apart by **deamination.** The amine part is converted to urea, which is then carried by the blood to the kidneys where it becomes urine. The urines is then excreted.

### Roles of proteins in cell structure and metabolism:

### Structural role:

Found in cell membranes, hair/nails (keratin), myosin in muscles/skin.

### Metabolic role:

The following are all made from protein:

- Enzymes (Control chemical reactions)
- Antibodies (Fight infections)
- Haemoglobin
- Hormones (Regulate body functions e.g. insulin controls glucose levels in the blood)
- Chlorophyll (photosynthesis)



The **basic unit** of a protein is an amino acid.

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# <u>Lipids</u>

### Lipids = fats and oils

They are composed of the **elements** carbon, hydrogen and oxygen.

### Structure:

The **basic unit** of a lipid is a **triglyceride**.

Triglyceride is the way lipids are structured.

- Triglycerides have 1 glycerol with 3 fatty acids
- Saturated fats have single bonds only in fatty acids e.g. animal fat (hards e.g. butter)
- Unsaturated fats have double of triples bond in fatty acids e.g. vegetable fat (soft e.g. oils)

**Oils** are lipids that are liquid at room temperature. **Fats** are lipids that are solid at room temperature.

Saturated fats can be more easily converted into cholesterol. Too much cholesterol sticks to and thickens the lining of the blood vessels and may lead to heart attacks.

### Diagram of a triglyceride:

Must be able to draw and label



A **phospholipid** consist of one glycerol, 2 fatty acids and one phosphate.

-They have one of their fatty acids replaced with a phosphate.

### Phospholipids make up cell membranes.

#### Diagram of a phospholipid:

• Must be able to draw and label



### Role of lipids in living organisms:

### Structural role:

- Phospholipids and lipoproteins are components of cell membranes.
- Heat Insulation Stored in the body as adipose tissue under the skin.
- **Protect** organs e.g. the kidney and the heart.
- **Waterproofing** e.g. sebum (oil) on human skin and bird's feathers, the cuticles on leaves, seeds and fruits.
- Found on **myelin sheath** on some nerves- increases speed at which electrical messages are carried.

### Metabolic role:

• Reserve source of energy - has twice the energy value of carbohydrates.

### Food Sources:

Butter, oils, margarines, cream, olives, avocado and animal fat.



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### **Minerals**

**Minerals** are essential inorganic elements required by the body in minute amounts to function properly.

\*Need to know 2 plant minerals and two animal minerals\*

### **Animal Minerals:**

### Calcium:

• **Source** = Dairy products such as cheese and milk, hard water and fish



- Use = Bones and teeth
- Deficiency disease = Osteoporosis- the weakening of bones

#### Iron:

• Source: Liver, meat, spinach, nuts, egg yolk and legumes.



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- Use: form haemoglobin.
- **Deficiency disease** = Anaemia

### **Plant Minerals:**

### **Calcium:**

- Source for plants = soil water
- Use in plants = Calcium pectate in middle lamella- holds cell walls together.

### Magnesium:

- Source for plants = soil water
- Use in plants = Makes ATP and Chlorophyll
- Deficiency Disease = Poor Growth

\*Source of Plant Minerals = Soil Water\*

### <u>Vitamins</u>

**Vitamins** are complex organic compounds needed in small amounts for normal health and growth.

- Many vitamins are co-enzymes i.e. needed in order for enzymes to work.
- Fat-soluble vitamins are ones that dissolve in fat e.g. vitamin D.
- Water-soluble vitamins are ones that dissolve in water e.g. vitamin C.

Vitamins are made in plants, bacteria and fungi but not animals (except for vitamin D- synthesised through the skin on exposure to sunlight).

**Deficiency Diseases** are cause by a lack of or reduced intake of one or more vitamins resulting from: inadequate diet, pregnancy and lactation, infection of the gastrointestinal tract, antibiotics, anti vitamins e.g. raw fish binds vitamin B1.

\*Need to know one water-soluble vitamin and one fat-soluble vitamin\*

### Vitamin C:

- Vitamin C is water-soluble.
- Food source: citrus fruits e.g. oranges.
- **Use:** -Make collagen for connective tissue- skin, bones, cartilage, ligaments and lining of blood vessels.

- Iron absorption

- Chemical Name = Ascorbic Acid
- Deficiency disease: Scurvy
- **Symptoms of Scurvy =** bleeding of mouth and gums, loose teeth and slow healing of wounds.



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### Vitamin D:

- Vitamin D is fat- soluble.
- Food Source: Dairy products, fish, liver oils, sunshine on skin and egg yolk.
- Use- Allow body to absorb calcium- Ca is needed in bone formation.
- Chemical Name = Calciferol
- Deficiency disease: Rickets in children and Osteomalacia in adults
- Symptoms of Rickets are bones do not form properly- bow-legs and knock-knees.



### Rickets

• **Symptoms of Osteomalacia** are bones lose calcium and become weak- painful and liable to fracture easily.

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### <u>Water</u>

- Approx. 70-95% of water in normal body cell.
- 90% body mass in plants.
- Blood Plasma is approx. 90% water.

#### Test for water:

- Dry Copper (II) Sulphate
- White to Blue

### Properties of water and why it is important to living organisms:

- **Good solvent:** Many substances dissolve in water allowing the transport of dissolved substances in plants and animals
- Water is a medium for chemical reactions to take place in cells.
- Water is a good absorber of energy providing stable temperatures (Temperature control)- which provides stable temperatures for living things and their reactions.
- Water maintain turgidity in plants as water is present in vacuoles.



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# **Experiments: Chemical Food Tests**

### 1. Test for Starch:

### Apparatus:

- Bread or potato
- Dropper
- Iodine

### Method:

- · Add three drops of iodine to the bread or pasta or potato
- Observe any changes

### Result/ Colour change:

Reddish-Brown to Blue-Black

### **Conclusion:**

• Bread, pasta and potatoes contain starch.

### **Control = Water**



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### 2. Test for Reducing Sugar e.g. glucose

### Apparatus:

- Benedict's Solution
- Hotplate
- Glucose powder/ Orange juice
- 3 Test Tubes
- Dropper

### Method:

- Prepare a 1% glucose solution
- Add 1 ml or the glucose solution and 1ml of orange juice and water to three test tubes respectively
- Add 1ml of Benedict's Solution to each test tube
- · Heat all the test tubers in a. Beaker of hot water
- Observe any changes

### Result/ Colour Change:

Blue to Brick-Red/ Orange

### Conclusion:

Orange juice contains a reducing sugar

### Control = Water





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### 3. Test for Protein:

### Apparatus:

- Biuret Reagent
- Milk
- 2 Test Tubes
- Water
- Dropper

### Method:

- Add 3 ml of milk into a test tube
- Add 3 ml of water into another test tube
- Add a few drops of biuret into each test tube
- Observe any changes

### **Results/ Colour Change**

- A colour change of blue to violet/ purple occurs in the test tube contain milk
- The test change containing water remains blue- no colour change occurs

### Conclusion:

• Milk contains protein

### Control = Water



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### 4. Test for Lipid/ Fat:

### Apparatus:

- Brown Paper
- Butter/ Olive Oil

### Method:

- Rub the butter into brown paper
- · Add a few drops of water to another piece of brown paper (Control)
- · Allow the papers to dry on a radiator
- · Hold up the papers to light
- Observe any changes

#### Result:

- The piece of brown paper containing butter has a translucent spot
- The brown paper with water did not have a translucent spot

### **Conclusion:**

· Butter contains fat





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### **Sample Answers:**

#### 2019 Question 1

- 1. Answer any five of the following parts (a) to (f):
- (a) State the two main reasons why food is required by all living organisms.
- (b) What is the ratio of hydrogen atoms to oxygen atoms in a carbohydrate?
- (c) Give a structural role of lipids in cells.
- (d) Give a metabolic role of lipids in cells.
- (e) Give an example of a fat-soluble vitamin.
- (f) Name a disorder due to a dietary deficiency of the vitamin referred to in (e).

#### Sample Answer:

- (a): For energy
  - To provide the necessary building materials for growth, repair and maintenance of cells
- (b): 2:1
- (c): Component of cell membranes
- (d): energy source or storage
- (e): Vitamin D
- (f): Rickets in children or Osteomalacia in adults

### 2019 Question 7 (a)

7(a)

State a use of each of the following in the biology laboratory.

- (i) Biuret reagent (a solution containing copper sulfate and sodium hydroxide).
- (ii) Benedict's (or Fehling's) solution.

#### Sample Answer:

(i): Test for protein

(ii): Test for a reducing sugar

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### 2018 Question 1:

1. Answer any five of the following parts (a) to (f):

(a) Give the two main reasons why living organisms require food.

1.		_ 2.	
(b)	What is a polysaccharide?		

(c) Name the main structural polysaccharide in plants.

(d) Describe the composition of a triglyceride molecule.

(e) Give a structural role of lipids in the human body.

(f) Name a test or give the chemicals used to demonstrate the presence of protein in a food sample.

- (a) i: For energy
  - ii: To provide the necessary building materials for growth, maintenance and repair of cells
- (b): Many sugar units joined together
- (c): Cellulose
- (d): One glycerol and 3 fatty acids
- (e): Component of cell membranes
- (f): Biuret Reagent

### 2018 Question 7 (b) iv:

(iv) In relation to investigations you carried out on food, state:

1. Why the brown paper used to test for the presence of fat should be allowed to dry out.

2. Which other food test required the application of heat.

- (1): To ensure the translucent stain is not just water
- (2): Test for reducing sugar

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### 2017 Question 1:

1. Answer any five of the following parts (a) to (f):

(a) Name a protein that has a fibrous structure.

(b) Where in the human body would you expect to find the fibrous protein referred to above?

(c) Give a role of a named mineral, other than calcium, which is required by plants.

Role in plants:

(d) State two reasons why water is required by living organisms.

(i) \_\_\_\_\_

(ii) \_\_\_

(e) Name the metallic element present in haemoglobin.

(f) Which type of food biomolecule may be identified by the use of Benedict's or Fehling's solution?

- (a): Keratin
- (b): Hair/ Nails
- (c): Name: Magnesium Role: Make chlorophyll
- (d) i: Medium for chemical reaction to take place ii: Temperature Regulation
- (e): Iron
- (f): Reducing Sugar

### 2016 Question 2:

2. (a)

Identify a non-metallic element, other than C, H, O and N, commonly found in proteins.

(b) Give a metabolic role of proteins in the human body.

(c) Give a structural role of proteins in the human body.

(d) Name the two different biomolecular components of a lipid.

(i)\_\_\_\_ (ii)

(e) Where would you expect to find phospholipids in human cells?

(f) Give a role of a named mineral, other than iron which is required in the human body.

Named mineral:

Role:

(g) What is the approximate percentage of water, by mass, in a human cell?

- (a): Sulphur
- (b): Enzymes
- (c): Keratin in hair/nails
- (d) i:Glycerol
  - ii: Fatty Acids
- (e): Cell Membrane
- (f): Name: Calcium Role: Strengthen bones and teeth
- (g): 70-95%

### 2016 Question 7(b)i(:

When testing a solution for the presence of a reducing sugar, you used either Benedict's or Fehling's test. A control was included. 1. Name the substance which you used as a control.

2. What colour were the contents of the control tube at the end of the test?

#### **Sample Answer:**

(1): Water(2): Brick-Red

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### 2015 Question 1:

1. Answer any five of the following parts (a) to (f):

(a) What name is given to the simplest units of carbohydrates?

(b) Name a catabolic process that produces these simplest units.

(c) The general formula of carbohydrates is Cx(H2O)y. What is the most common value of y in the carbohydrates used for energy by human cells?

(d) Name a structural polysaccharide found in plants.

(e) Name a polysaccharide, other than the one referred to in part (d), commonly found in plants.

(f) Which carbohydrate is always found in DNA?

### Sample Answer:

(a): Monosaccharide
(b): Respiration
(c): 6
(d): Cellulose
(e): Starch
(f): Deoxyribose

### 2014 Question 2:

#### 2. (a)

The following biochemical reactions took place in some living cells: (i)  $A \rightarrow B+C+D$ 

(i) Is this an example of anabolism or catabolism?

(iv):Give any two functions of minerals in organisms.

2.

### Sample Answer:

(a) i: Catabolism
ii: x= Lipase y= Glycerol
(b) i: Phospholipid has 1 glycerol, 2 fatty acids and 1 phosphate
Fat has 1 glycerol and 3 fatty acids
ii: D
iii: Rickets in children
iv: Rigid structure, Formation of fluid/ pigment e.g. haemoglobin, Formation of soft tissue.

### 2013 Question 1:

In the case of any five of the following pairs of terms, clearly **distinguish between** the first term and second term by writing a brief sentence about each.
 (a) Starch.

Glucose.	
(b) Amino acids.	
Proteins.	
(c) Cellulose.	
Keratin.	
(d) Enzymes.	
Hormones.	
(e) Biuret test.	
Benedict's (Fehling's) test.	
(f) Fats.	
Oils.	

#### Sample Answer:

(a): Starch is a storage polysaccharide in plants, glucose is a monosaccharide

(b): Amino Acids are the building blocks of a protein, Protein is a long chained polypeptide consisting of at least 200 amino acids.

(c): Cellulose is a structural polysaccharide found in plant cell walls, Keratin is a fibrous protein found in hair/nails

(d): Enzymes are biological protein catalysts, Hormones are chemical messengers produced by an endocrine glands and are released directly into the blood where they are transported to another part of the body where they cause specific effects. (e): Biuret Test: Test for protein, Benedict's Test: Test for a reducing sugar.

(f): Fats are lipids that are solid at room temperature, oils are lipids that are liquid at room temperature.

### 2012 Question 1:

1. Answer five of the following

(a): Name a monosaccharide.

(b): Give the formula of the monosaccharide referred to in (a).

(c): Name a polysaccharide that can be formed from the monosaccharide referred to in (a).

(d): Give one way in which an amino acid differs from a monosaccharide, in terms of chemical composition.

(e): What do carbohydrates and fats have in common, in terms of chemical composition?

(f): How may one fat differ from another, in terms of chemical composition?

### Sample Answer:

(a): Glucose

(b):  $C_6H_{12}O_6$ 

(c): Cellulose

(d): Amino acids contain nitrogen **whereas** monosaccharides do not contain nitrogen

(e): They both contain the elements carbon, hydrogen and oxygen

(f): Some have a phosphate or have different amino acids