CUET PG 2025 Food Science and Technology Question Paper with Solutions

Time Allowed :1 Hour 30 Mins	**Maximum Marks :**300	**Total Questions :**75

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The examination duration is 90 minutes. Manage your time effectively to attempt all questions within this period.
2. The total marks for this examination are 300. Aim to maximize your score by strategically answering each question.
3. There are 75 mandatory questions to be attempted in the Atmospheric Science paper. Ensure that all questions are answered.
4. Questions may appear in a shuffled order. Do not assume a fixed sequence and focus on each question as you proceed.
5. The marking of answers will be displayed as you answer. Use this feature to monitor your performance and adjust your strategy as needed.
6. You may mark questions for review and edit your answers later. Make sure to allocate time for reviewing marked questions before final submission.
7. Be aware of the detailed section and sub-section guidelines provided in the exam. Understanding these will aid in effectively navigating the exam.

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1. The addition of aluminium to the packaging materials for better conduction in microwave is known as _____

(A) Susceptors
(B) Docking
(C) Coating
(D) Lamination

Correct Answer: (A) Susceptors

Solution:

Conceptual Understanding

Microwave ovens revolutionize heating by using microwave radiation, a form of non-ionizing electromagnetic radiation, typically at a frequency of 2.45 GHz. This process, known as **dielectric heating**, primarily targets polar molecules within the food, most notably water. The

oscillating electric field of the microwaves causes these polar molecules to rapidly rotate and align themselves with the field. This constant agitation and collision create intermolecular friction, which generates heat efficiently throughout the food's volume.
However, this method heats the food from the inside out and does not typically raise the surface temperature high enough to initiate the Maillard reaction or caramelization—the chemical reactions responsible for the browning, crisping, and flavor development characteristic of conventional ovens (which use conduction and convection). To bridge this gap, specialized packaging technology is employed.

Expanded Explanation: The Role of a Susceptor

To achieve the desirable browned and crisped texture in microwavable foods like pizza, popcorn, or French fries, a special material called a **susceptor** is integrated into the packaging.

- **Composition and Structure:** A susceptor is a micro-thin layer of metallized film. It typically consists of minute aluminum particles that are vacuum-deposited onto a heat-stable plastic polymer film, such as polyethylene terephthalate (PET). This metallized film is then laminated onto a paper or paperboard substrate for structural support.
- **Mechanism of Action:** When exposed to microwave radiation, this thin metallic layer behaves differently than a bulk piece of metal (which would dangerously reflect microwaves). Instead, it absorbs a significant amount of microwave energy. This absorbed energy rapidly excites the metallic particles, causing the susceptor's temperature to soar, often reaching over 200°C (392°F).
- **Achieving Conventional Effects:** This intense heat is then transferred directly to the food's surface via **conduction** and **infrared radiation**. This high-temperature contact mimics the effects of a hot pan or baking sheet, searing the food's exterior. This searing process drives away moisture and triggers the Maillard reaction and caramelization, resulting in the desired browning and crisping that microwave heating alone cannot produce.

Comparison with Other Terms:

- **Docking:** This is a mechanical process used in baking, where dough (like pizza crust or crackers) is pierced with small holes. This prevents the dough from forming large blisters or pockets of air during baking, ensuring a flat, even surface. It is unrelated to the heating mechanism.
- **Coating and Lamination:** These are general packaging terms. While a susceptor film is laminated to paperboard, these terms do not specifically describe the unique microwave-interactive technology used for browning and crisping.

Final Answer

The addition of a thin, microwave-interactive aluminum layer to packaging material for the specific purpose of converting microwave energy into intense thermal energy for browning and crisping is correctly identified as a **susceptor**.

Quick Tip

Remember that susceptors are designed to create a "conventional oven" effect (browning and crisping) for foods like popcorn, pizza, and french fries when cooked in a microwave. The keyword is converting microwave energy to thermal energy.

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2. Red muscle fibres have _____ myoglobin than white muscle fibre.

(A) higher
(B) lower
(C) dense
(D) thin

Correct Answer: (A) higher

Solution:

Conceptual Understanding

Vertebrate skeletal muscle is not uniform; it is a composite of different muscle fiber types, each specialized for a particular function. These fibers are primarily categorized based on their speed of contraction and their principal method of ATP (adenosine triphosphate) production. The two main categories are Type I fibers, known as red or slow-twitch muscle, and Type II fibers, known as white or fast-twitch muscle. A key distinguishing molecule between these types is **myoglobin**, an iron- and oxygen-binding protein found within the muscle cells themselves.

Expanded Explanation: Physiological and Metabolic Differences

0.0.1 Red Muscle Fibers (Type I / Slow-Twitch)

- **Function:** These fibers are engineered for sustained, long-duration activities and are highly resistant to fatigue. They are essential for endurance activities like marathon running, cycling, or maintaining posture.
- **Metabolism:** They rely almost exclusively on **aerobic respiration** for ATP production. This highly efficient process occurs in the mitochondria and requires a constant, abundant supply of oxygen.
- **Key Features:**
  - **High Myoglobin Content:** To ensure a ready supply of oxygen, these fibers have a high concentration of myoglobin. Myoglobin has a higher affinity for oxygen than hemoglobin, allowing it to efficiently pull oxygen from the bloodstream and store it within the muscle cell until needed by the mitochondria. This high concentration of the iron-containing myoglobin protein gives the muscle its characteristic red color.
  - **Rich Blood Supply:** They are surrounded by a dense network of capillaries to ensure a continuous delivery of oxygen and nutrients.

- **Numerous Mitochondria:** They are packed with mitochondria, the "powerhouses" of the cell, where aerobic respiration takes place.

0.0.2 White Muscle Fibers (Type II / Fast-Twitch)

- **Function:** These fibers are adapted for short, rapid, powerful bursts of activity. They contract quickly but also fatigue rapidly. They are crucial for activities like sprinting, weightlifting, and jumping.
- **Metabolism:** They primarily rely on **anaerobic glycolysis** for their energy needs. This process breaks down glucose into ATP without the need for oxygen, but it is far less efficient and produces lactic acid as a byproduct, which contributes to muscle fatigue.
- **Key Features:**
  - **Low Myoglobin Content:** Since they do not rely heavily on oxygen for their primary function, they have a much lower concentration of myoglobin.
  - **Paler Appearance:** The lower myoglobin content, combined with a less dense capillary network, gives these fibers a paler or white appearance.
  - **Fewer Mitochondria:** They contain fewer and smaller mitochondria compared to red fibers.

Final Answer

Red muscle fibers are specialized for aerobic, endurance-based activities. This specialization necessitates a high concentration of the oxygen-storing protein **myoglobin** to maintain a steady supply of oxygen for aerobic respiration. In contrast, white muscle fibers, built for anaerobic bursts of power, have a significantly lower myoglobin content.

> Quick Tip
>
> Associate the color with the function: **Red** = Rich in myoglobin/oxygen = Endurance (slow-twitch). **White** = Low in myoglobin/oxygen = Speed/Power (fast-twitch). Think of the dark meat (legs) vs. white meat (breast) in a chicken.

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3. Foaming is a functional property attributed to the _____ component of food.

(A) protein
(B) fat
(C) minerals
(D) sugars

Correct Answer: (A) protein

Solution:

Conceptual Understanding

The functional properties of food components dictate their behavior in food systems. **Foaming** is a key functional property defined as the ability to create a stable dispersion of a gas (like air) in a liquid. In the culinary world, the primary molecular components responsible for creating and stabilizing foams are proteins.

Expanded Explanation: The Mechanism of Protein Foaming

- **Amphiphilic Nature:** Protein molecules are large polymers of amino acids. Some of these amino acids have side chains that are hydrophilic (water-attracting), while others have side chains that are hydrophobic (water-repelling). This dual nature makes proteins **amphiphilic**, meaning they are attracted to both water and oil/air.
- **Migration to the Interface:** When a protein solution (like egg whites) is subjected to mechanical energy (agitation, whipping, or bubbling), air is incorporated. The proteins naturally migrate to the boundary between the liquid (water) and the gas (air bubbles), known as the air-liquid interface.
- **Unfolding and Denaturation:** The mechanical stress and the presence of the interface cause the proteins to partially unfold, or **denature**. Their complex three-dimensional structures unravel, exposing more of their hydrophobic and hydrophilic regions.
- **Film Formation:** At the interface, the proteins arrange themselves in an energetically favorable orientation: their hydrophobic parts face the air bubble, and their hydrophilic parts face the surrounding liquid. This orientation allows the protein molecules to interconnect, forming a stable, viscoelastic, and cohesive film around each air bubble. This film effectively traps the air, creating the structure of the foam. A classic example is the transformation of liquid egg whites (rich in the protein albumin) into a stable, voluminous meringue.

0.0.3 Roles of Other Components

- **Fats:** Fats and oils are generally **foam inhibitors**. They are surface-active and compete with the proteins for a position at the air-liquid interface. By adsorbing onto the surface of the bubbles, fat molecules disrupt the cohesive protein network, weakening the film and causing the foam to collapse. This is why even a trace of egg yolk (which contains fat) can prevent egg whites from whipping properly.
- **Sugars:** Sugars are not primary foaming agents, but they act as **stabilizers**. When added to an already-formed foam, sugar dissolves in the liquid phase, significantly increasing its viscosity. This thicker liquid drains more slowly from the foam structure, enhancing its stability and longevity.
- **Minerals:** Minerals do not possess the necessary molecular structure or surface-active properties to create or stabilize foams.

Final Answer

The ability to form and stabilize foams in food is a key functional property of **proteins**, owing to their amphiphilic nature and their ability to denature and form a viscoelastic film at the air-liquid interface.

Quick Tip

Associate key food functional properties with their primary macronutrient: Foaming & Gelation → Proteins; Emulsification → Proteins & Fats; Browning → Sugars & Proteins.

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4. Pectin is primarily composed of_____

(A) galactose and glucose
(B) fructose
(C) galacto-pyranosyl uronic acid
(D) amylose

Correct Answer: (C) galacto-pyranosyl uronic acid

Solution:

Conceptual Understanding

Pectin is a complex structural polysaccharide (a large carbohydrate polymer) found in the primary cell walls and middle lamella of terrestrial plants, particularly abundant in fruits like apples and citrus peels. In the food industry, it is widely utilized for its ability to form gels, making it an essential gelling agent, thickener, and stabilizer in products like jams, jellies, and fruit preparations.

Expanded Explanation: The Building Block of Pectin

The molecular structure of pectin is intricate, but its primary backbone is a linear chain composed of a single type of monomer unit.

- **The Monomer Unit:** The fundamental building block of the pectin backbone is **D-galacturonic acid**. Galacturonic acid is a sugar acid, which is an oxidized form of the simple sugar D-galactose. Specifically, the carbon at the C-6 position is oxidized from an alcohol group (-CH_2OH) to a carboxylic acid group (-COOH).
- **The Glycosidic Bond:** These galacturonic acid units are linked together in a chain by **α-(1→4) glycosidic bonds**. This notation means the C-1 carbon of one galacturonic acid unit is linked to the C-4 carbon of the next unit through an oxygen atom, with a specific stereochemistry (alpha).
- **Formal Nomenclature:** When a galacturonic acid unit is incorporated into this polymer chain and exists in its stable six-membered ring form, its formal chemical name is **galacto-pyranosyl uronic acid**.
- **Degree of Esterification:** A key feature of pectin is that the carboxylic acid groups can be esterified with methanol. The extent of this esterification, known as the Degree of Esterification (DE), determines pectin's properties.

- **High-Methoxyl (HM) Pectin** (DE ¿ 50%) requires a high concentration of sugar and an acidic environment to form a gel, typical for traditional jams.
- **Low-Methoxyl (LM) Pectin** (DE ¡ 50%) does not require sugar but needs the presence of divalent cations, typically calcium ions (Ca^{2+}), to form a gel, making it ideal for low-sugar products.

0.0.4 Analysis of Incorrect Options

- **Galactose, Glucose, Fructose:** These are all simple sugars (monosaccharides) and are not the primary structural unit of the pectin polymer itself, although they may be present in the side chains of the pectin molecule.
- **Amylose:** Amylose is a polysaccharide, but it is a component of starch. Its structure is fundamentally different, consisting of a linear chain of D-glucose units linked by α-(1→4) glycosidic bonds.

Final Answer

The primary building block that polymerizes to form the backbone of pectin is **galacturonic acid**.

> Quick Tip
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> For exams, connect "Pectin" directly with "Galacturonic Acid". This is the fundamental structural unit responsible for its gelling properties.

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5. Candling of egg reveals the presence of _____

(A) blood spot
(B) hazards
(C) vitelline membrane
(D) microorganisms

Correct Answer: (A) blood spot

Solution:

Conceptual Understanding

Candling is a simple, non-destructive method used in the egg industry to assess the internal and external quality of an egg. The process involves illuminating an egg with a bright light source in a darkened environment. The light passes through the semi-translucent shell, revealing details about the contents and the shell itself. Historically done with candles, modern commercial operations use automated equipment with high-intensity lights and sensors.

Expanded Explanation: What Candling Reveals

During the candling process, an inspector can observe several key quality factors:

- **Shell Integrity:** The light makes it easy to spot hairline cracks, star cracks, or thin spots in the shell that might be invisible to the naked eye. Cracked eggs are removed as they pose a food safety risk by allowing bacteria to enter.
- **Air Cell Size:** A small air cell at the large end of the egg indicates freshness. As an egg ages, moisture evaporates through the porous shell, causing the air cell to enlarge.
- **Yolk Condition:** In a fresh, high-quality egg, the yolk is centered, its outline is indistinct, and it shows limited movement when the egg is rotated. As the egg ages, the albumen (egg white) thins, allowing the yolk to move more freely and appear flatter.
- **Albumen (White) Condition:** The white should appear clear and firm. Cloudiness can indicate freshness (due to dissolved CO_2), while a thin, watery white is a sign of aging.
- **Internal Defects:** Candling is highly effective at detecting abnormalities within the egg. The most common defects found are:
  - **Blood Spots:** Small red or brown spots on the yolk surface, caused by the rupture of a tiny blood vessel in the hen's ovary or oviduct during egg formation.
  - **Meat Spots:** Pieces of tissue from the hen's oviduct that become trapped inside the egg during its formation.

  While these spots are generally harmless, they are considered cosmetically undesirable, and eggs containing them are typically graded lower or removed from retail sale.
- **Microbial Spoilage:** While individual microorganisms are far too small to be seen by candling, the effects of advanced spoilage caused by bacteria or mold (e.g., a "black rot" or "green rot") are visible as colored patches or mixed contents.

0.0.5 Analysis of Other Options

- **"Hazards"**: This term is too general. While a crack is a safety hazard and a blood spot is a quality hazard, candling identifies specific, observable defects.
- **Vitelline Membrane:** The vitelline membrane is the thin layer that encloses the yolk. It is a normal part of every egg. Candling assesses its integrity (a weak membrane allows the yolk to flatten), not its mere presence.

Final Answer

Candling is an effective method for identifying various internal quality factors and defects, the most common of which are abnormalities like **blood spots** and meat spots.

Quick Tip

Think of candling as an "X-ray" for eggs. It's used to find internal flaws. Blood spots are a key defect that graders look for during this process.

6. The standard weight of extra large size grade hen eggs, ranges _____ g

(A) 38 - 44
(B) More than 60
(C) 53 - 59
(D) 45 - 52

Correct Answer: (B) More than 60

Solution:

Conceptual Understanding

Eggs are sorted and sold based on grades for quality (e.g., Grade AA, A, B) and classes for size. Size is determined not by dimensions but by weight per egg or per dozen. These weight standards can vary slightly by country or region (e.g., USDA in the United States, EU standards, AGMARK in India), but they all follow a consistent pattern of increasing weight for each progressively larger size class.

Expanded Explanation: Common Weight Standards

While specific numbers may differ, a general and widely recognized classification system for hen eggs, measured in grams per egg, is as follows. The USDA standards are often used as a benchmark:

- **Peewee/Pullet:** Typically below 42-45 g
- **Small:** 45 g to 52 g (approx. 1.5 oz)
- **Medium:** 53 g to 59 g (approx. 1.75 oz)
- **Large:** 60 g and above in many systems (USDA standard is 57g or 2 oz)
- **Extra Large:** Generally encompasses the heaviest eggs, typically starting above 60 g and often specified as 63-65 g or more.
- **Jumbo:** An even larger category, often starting at 70g or more.

0.0.6 Analyzing the Options Based on General Standards

Let's evaluate the given weight ranges against this common classification:

- **(A) 38 - 44 g:** This range corresponds squarely with the Peewee or Pullet size class.
- **(C) 53 - 59 g:** This range is the classic definition of a Medium egg.
- **(D) 45 - 52 g:** This range aligns perfectly with the Small egg size class.
- **(B) More than 60 g:** This range is the only one that encompasses the weight for Large and, most definitively, **Extra Large** eggs. In many international systems, the threshold for Large eggs begins around 58-60g, and Extra Large eggs are always above this mark.

Final Answer

Given the standard weight classifications for hen eggs, the range for an **Extra Large** egg is correctly identified as being above 60 grams. Therefore, the option "More than 60 g" is the most appropriate answer.

> Quick Tip
>
> For exam purposes, remember a "standard large" egg is about 55-60 grams. Anything above that falls into the "extra large" or "jumbo" category. This is a useful benchmark to have.

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7. The major microorganism responsible for food infection transmitted through eggs is _____

(A) E. coli
(B) Salmonella
(C) Pseudomonas
(D) Clostridium botulinum

Correct Answer: (B) Salmonella

Solution:

Conceptual Understanding

A food infection is a type of foodborne illness caused by ingesting food contaminated with living pathogenic microorganisms. These pathogens survive the digestive process, establish themselves in the gastrointestinal tract, and multiply, causing illness. When considering eggs and egg products, one bacterium is overwhelmingly recognized as the primary cause of food infections.

Expanded Explanation: Salmonella and Eggs

The major and most well-known microorganism causing food infection transmitted through eggs is ***Salmonella***, particularly the serotype *Salmonella* Enteritidis.

0.0.7 Modes of Contamination

Egg contamination with *Salmonella* can occur via two primary pathways:

1. **Vertical Transmission (Transovarian):** This is the most insidious route. An infected hen can carry *S. Enteritidis* in her reproductive organs, specifically the ovary or oviduct. The bacteria can then be deposited directly into the yolk or albumen *before* the shell is formed. This results in an egg that is internally contaminated despite having a clean, intact shell.

2. **Horizontal Transmission (Trans-shell):** The bacteria can be present in the hen's feces or in a contaminated environment (e.g., nest, processing equipment). It can then penetrate the eggshell, which is porous, to contaminate the contents. This risk is higher if the shell is cracked or not cleaned and refrigerated properly.

0.0.8 The Resulting Illness: Salmonellosis

Consuming raw or undercooked eggs contaminated with *Salmonella* can lead to an infection called salmonellosis. Symptoms typically appear 6 to 72 hours after ingestion and include diarrhea, fever, abdominal cramps, and vomiting. While most people recover without treatment, the infection can be severe or even life-threatening for young children, the elderly, and individuals with weakened immune systems.

0.0.9 Analysis of Other Microorganisms

- ***E. coli*:** While certain strains of *E. coli* (like O157:H7) are significant foodborne pathogens, they are most commonly associated with undercooked ground beef, contaminated water, and unpasteurized produce, not eggs.
- ***Pseudomonas*:** Species of *Pseudomonas* are well-known spoilage bacteria. They can grow on eggs, especially in moist conditions, causing off-odors and discoloration (e.g., green rot). However, they are primarily a cause of spoilage, not a primary cause of food infection.
- ***Clostridium botulinum*:** This is an anaerobic bacterium that produces a potent neurotoxin. It is associated with improperly canned or preserved low-acid foods and is not a typical contaminant of fresh eggs.

Final Answer

The principal and most notorious microorganism responsible for causing food infections transmitted through contaminated eggs is ***Salmonella***.

> Quick Tip
>
> In any food safety question involving eggs and bacterial infection, *Salmonella* is almost always the correct answer. Associate "raw eggs" with the risk of "Salmonella".

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8. Match List-I with List-II

List-I **Cake defects**	**List-II** **Causes**
(A) Too light crust	(I) Too high baking temperature
(B) Dense texture	(II) Too much shortening
(C) Too dark crust	(III) Too little sugar
(D) Crumbly texture	(IV) Too much liquid

Choose the most appropriate answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:

Conceptual Understanding

Successful cake baking is a matter of chemistry, requiring a precise balance of ingredients and correct baking conditions (temperature and time). An imbalance in the formula or a deviation in the process will lead to predictable and specific defects in the final product. Matching the defect to its most likely cause is a key skill in baking.

Expanded Explanation: Analyzing the Pairings

- **(A) Too light crust → (III) Too little sugar Science:** The browning of a cake's crust is primarily due to two chemical reactions: the **Maillard reaction** (a reaction between amino acids and reducing sugars) and **caramelization** (the thermal decomposition of sugar). Sugar is a crucial reactant in both processes. Insufficient sugar in the recipe means there isn't enough substrate for these browning reactions to occur properly, resulting in a pale, anemic crust.
- **(B) Dense texture → (IV) Too much liquid Science:** The structure of a cake is built by a network of proteins from flour (gluten) and eggs. This network needs to be strong enough to trap the gases produced by leavening agents (like baking powder) as they expand during baking. Adding too much liquid (e.g., milk, water) dilutes the structural components, weakening the protein network. The batter becomes too thin to hold the air bubbles, causing the cake to be heavy, dense, and poorly risen.
- **(C) Too dark crust → (I) Too high baking temperature Science:** This is the opposite of a light crust. While excess sugar can also cause a dark crust, a more common cause is an oven temperature that is too high. The high heat accelerates the Maillard reaction and caramelization on the exterior of the cake, causing it to brown and even burn long before the interior has had time to cook through and set. This often leads to a cake that is dark on the outside and raw in the middle.
- **(D) Crumbly texture → (II) Too much shortening Science:** Shortening (fat) is a **tenderizer**. Its primary role is to coat the flour particles, which physically shortens the gluten strands that can form when flour is mixed with liquid. This process inhibits excessive gluten development, resulting in a tender crumb. However, an excessive amount of shortening over-tenderizes the cake. It weakens the structure to the point where it cannot hold together properly, resulting in a texture that is dry, weak, and falls apart easily—in other words, crumbly.

Final Answer

Based on the chemical functions of the ingredients and the physics of baking, the correct pairings are:

- (A) Too light crust - (III) Too little sugar
- (B) Dense texture - (IV) Too much liquid
- (C) Too dark crust - (I) Too high baking temperature
- (D) Crumbly texture - (II) Too much shortening

This corresponds to option (D).

Quick Tip

To solve baking problems, understand the function of each ingredient:

- **Sugar:** Browning, moisture, tenderness.
- **Fat/Shortening:** Tenderness. (Too much = crumbly)
- **Liquid:** Hydration, structure. (Too much = dense)
- **Temperature:** Sets structure, causes browning. (Too high = dark crust)

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9. Match List-I with List-II

List-I **Ingredients for bread manufacture**	**List-II** **Role of ingredients**
(A) Shortening	(I) Texture
(B) Yeast	(II) Flavour
(C) Sugar	(III) Loaf volume
(D) Flour	(IV) Fermentation substrate

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

Each ingredient in a bread recipe plays a specific and crucial role in the final product's characteristics, including its structure, texture, flavor, and volume. This question requires matching the ingredient to its primary function from the given list.

Expanded Explanation: Analyzing the Roles

- **(A) Shortening → (I) Texture Function:** Fat, such as shortening or butter, is a primary tenderizer in bread dough. It coats the gluten strands, preventing them from forming an overly tough and extensive network. This action results in a softer crumb and a more tender final **texture**. Additionally, fat lubricates the gluten network, improving the bread's volume, and it helps to extend shelf life by slowing down the process of staling.
- **(B) Yeast → (II) Flavour Function:** While yeast's most obvious role is leavening (producing carbon dioxide gas to make the dough rise), it is also the primary source of the complex, characteristic **flavour** and aroma of bread. During fermentation, yeast produces not only CO_2 but also a wide array of secondary metabolites, including ethanol, esters, aldehydes, and other volatile organic compounds. These compounds are directly responsible for the rich, fermented taste and smell that is unique to yeast-leavened breads.
- **(C) Sugar → (IV) Fermentation substrate Function:** The principal role of sugar in a yeast-leavened dough is to act as food for the yeast. Yeast metabolizes these simple sugars in a process called fermentation. Therefore, sugar is the primary **fermentation substrate**. This metabolic process produces the carbon dioxide needed for leavening and the alcohol and other compounds that contribute to flavor. Secondary roles of sugar include adding sweetness and contributing to crust browning through caramelization and the Maillard reaction.
- **(D) Flour → (III) Loaf volume Function:** Flour, specifically the gluten-forming proteins (glutenin and gliadin) within wheat flour, provides the essential structure of the bread. When mixed with water and kneaded, these proteins form a strong, elastic, and viscoelastic network called gluten. This network traps the carbon dioxide gas produced by the yeast during fermentation. The ability of this network to stretch and hold gas is the single most important factor determining the final **loaf volume** and the open, airy structure of the crumb.

Final Answer

Based on the analysis, the correct matches for the primary functions are:

- (A) Shortening - (I) Texture
- (B) Yeast - (II) Flavour
- (C) Sugar - (IV) Fermentation substrate
- (D) Flour - (III) Loaf volume

This combination corresponds to option (C).

Quick Tip

To solve matching questions about ingredients, focus on the most unique and primary role of each component. For example, while yeast affects volume and sugar affects flavour, sugar's most critical role is being the yeast's food (substrate), and flour's primary role is providing the structure for volume.

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10. Match List-I with List-II

List-I Product	**List-II Related temperature (°C)**
(A) Syrup	(I) 112-115
(B) Fondant	(II) 110-112
(C) Caramel	(III) 118-120
(D) Toffee	(IV) 132-143

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

The manufacturing of sugar confectionery is a precise science based on the principle of boiling a sugar and water solution. As the solution boils, water evaporates, the sugar concentration increases, and the boiling point of the solution rises. Each specific temperature range corresponds to a particular sugar concentration and results in a distinct texture when the syrup is cooled. These temperature ranges are known as the **stages of sugar cookery**.

Expanded Explanation: Matching Confections to Temperatures

To match the products correctly, we must understand the texture required for each and align it with the appropriate sugar stage and temperature. Temperatures can be verified with a candy thermometer or approximated using the cold water test.

0.0.10 Logical Matching Based on the Options

- **(A) Syrup:** Matches the **Soft-Ball stage (I) 112–115 °C**.
- **(B) Fondant:** Matches the **Thread stage (II) 110–112 °C**.

S.No.	Stage	Temperature Range	Sugar Conc.	Description & Corresponding Confectionery
1	**Thread**	110–112 °C (230–235 °F)	∼80%	Syrup dropped in cold water forms fine, liquid threads. Used for syrups, glazes. Closest match for **(B) Fondant**, which starts at this stage before crystallization.
2	**Soft-Ball**	112–115 °C (235–245 °F)	∼85%	Syrup forms a soft, pliable ball in cold water that flattens when removed. Ideal for fudge, pralines, and buttercream bases. Matches **(A) Syrup** with body.
3	**Firm-Ball**	118–120 °C (245–250 °F)	∼87%	Syrup forms a firm ball that holds its shape but is still malleable. Typical for chewy confections such as caramels and aligns with **(D) Toffee**.
4	**Hard-Ball**	121–130 °C (250–265 °F)	∼92%	Syrup forms a hard, rigid ball that is still slightly pliable. Used for nougat, marshmallows, and rock candy.
5	**Soft-Crack**	132–143 °C (270–290 °F)	∼95%	Syrup forms threads that are flexible but will bend before breaking. Used for butterscotch and taffy. Appropriate for hard **(C) Caramel**.
6	**Hard-Crack**	149–154 °C (300–310 °F)	∼99%	Syrup forms hard, brittle threads that snap easily. The point where caramelization begins. Used for lollipops, brittles, and hard candies.

- **(C) Caramel:** Matches the **Soft-Crack stage (IV) 132–143 °C**.
- **(D) Toffee:** Matches the **Firm-Ball stage (III) 118–120 °C**.

Final Answer

The correct logical matching sequence based on the principles of sugar cookery is:

$$(A) - (I), \quad (B) - (II), \quad (C) - (IV), \quad (D) - (III)$$

This corresponds to option (C).

Quick Tip

Remember the general order of sugar cooking stages by increasing temperature: Thread → Soft Ball → Firm Ball → Hard Ball → Soft Crack → Hard Crack → Caramel. Match the products based on their hardness: Fondant (softest) → Toffee → Caramel (hardest/highest temp).

11. The term "GRAS" stands for:

(A) Generally Recognized As Stable
(B) Generally Recommended As Safe
(C) Generally Regarded As Stable
(D) Generally Recognized As Safe

Correct Answer: (D) Generally Recognized As Safe

Solution:

Conceptual Understanding

In the United States, any substance intentionally added to food is classified as a food additive and is subject to premarket review and approval by the Food and Drug Administration (FDA), as mandated by the Food Additives Amendment of 1958. However, this amendment included a crucial exemption for substances that are "generally recognized, among qualified experts, as having been adequately shown to be safe under the conditions of their intended use." This exemption created the regulatory designation known as **GRAS**.

Expanded Explanation: The GRAS Designation

The acronym **GRAS** stands for **Generally Recognized As Safe**. This is not just a casual term but a formal regulatory status.

- **Basis of Recognition:** The "general recognition" of safety is based on two potential pathways:
  1. **Scientific Procedures:** Through the same quantity and quality of scientific evidence that would be required to approve a food additive. The key difference is that this data must be publicly available and generally accepted by the scientific community; it cannot be proprietary.
  2. **Experience Based on Common Use:** For substances used in food prior to January 1, 1958, a long history of common use without evidence of harm can be used to establish GRAS status.
- **Distinction from "Food Additive":** A substance with GRAS status is legally distinct from a "food additive." While both are deemed safe, a food additive requires a formal petition and approval process by the FDA before it can be used. A GRAS substance is exempt from this mandatory premarket approval process because its safety is already widely accepted by qualified experts.
- **Scope and Context:** The GRAS status is specific to the "conditions of its intended use." This includes factors like the concentration of the substance in the food and the types of food it will be added to. A substance could be GRAS for one use (e.g., as a preservative at low levels) but not for another (e.g., as a bulking agent at high levels).
- **Classic Examples:** Many of the most common ingredients in our food supply have GRAS status based on their long history of safe use. These include salt (sodium chloride), sugar (sucrose), vinegar (acetic acid), caffeine, and many common spices and oils.

Final Answer

The acronym GRAS is an official regulatory term that correctly expands to "Generally Recognized As Safe." This designation exempts a substance from the formal food additive approval process based on a consensus of expert opinion regarding its safety for its intended use.

> Quick Tip
>
> In food science and regulation, GRAS is a fundamental concept. Memorize the exact wording: "Generally Recognized As Safe." Pay attention to each word, as incorrect options often use similar words like "Regarded," "Recommended," or "Stable."

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12. Match List-I with List-II

List-I **Product**	**List-II** **Property**
(A) Biscuit	(I) Low sugar and fat
(B) Cracker	(II) Flat crisp
(C) Hard dough biscuit	(III) Partially developed gluten
(D) Soft dough biscuit	(IV) Flowy dough

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (A) (A) - (II), (B) - (I), (C) - (III), (D) - (IV)

Solution:

Conceptual Understanding

The terms "biscuit" and "cracker" encompass a vast range of baked goods. Their classification depends heavily on the recipe formulation (especially the ratio of fat, sugar, and water to flour), the resulting properties of the dough, and the final product's texture and characteristics. This question requires matching specific biscuit types to their defining properties.

Expanded Explanation: Dough and Product Characteristics

Final Answer

The most logical matching based on formulation and rheology is (A) Biscuit - (II) Flat crisp baked product; (B) Cracker - (I) Low sugar and fat; (C) Hard dough biscuit - (III) Partially developed gluten; and (D) Soft dough biscuit - (IV) Flowy. This corresponds to option (A).

Quick Tip

Remember the key distinction between biscuit doughs: Soft dough has high fat/sugar and is flowy (like cookie dough). Hard dough has low fat/sugar and is tough/elastic (like for Marie biscuits). Crackers are an extreme case of hard dough, very low in fat/sugar.

---

13. The sequence of biscuit manufacturing process generally involves:
(A). Cooling and packing
(B). Forming
(C). Baking
(D). Mixing
Choose the most appropriate answer from the options given below:

(A) (D), (B), (C), (A).
(B) (A), (B), (C), (D).
(C) (B), (A), (D), (C).
(D) (C), (B), (D), (A).

Correct Answer: (A) (D), (B), (C), (A).

Solution:

Conceptual Understanding

The production of biscuits, like most processed foods, follows a standardized and logical sequence of unit operations. The goal is to transform raw ingredients into a finished product that is safe, stable, and has the desired quality attributes (texture, flavor, appearance). The task is to arrange the fundamental steps of this process in the correct chronological order.

Expanded Explanation: The Chronological Flow

1. **(D) Mixing:** This is the foundational first step where all the raw ingredients—flour, fat, sugar, water, leavening agents, flavorings, etc.—are combined in a large-scale mixer. The objectives of mixing are twofold:
   - To uniformly disperse all ingredients to create a single, homogenous mass (the dough).
   - To develop the gluten network to the desired extent, which varies depending on whether it's a hard or soft dough biscuit.
2. **(B) Forming:** Once the dough has the correct consistency, it must be shaped into individual pieces. This is a critical step that defines the final size, shape, and thickness of the biscuit. Common forming methods include:

- **Sheeting and Cutting:** Used for hard doughs and crackers. The dough is passed through rollers to form a continuous sheet, which is then cut into shapes by a stamping or cutting mechanism.
- **Rotary Moulding:** Used for some hard doughs. The dough is forced into engravings on a rotating cylinder, and the excess dough is scraped off.
- **Depositing/Extruding:** Used for soft, flowy doughs. The dough is forced through a nozzle onto the baking band to form individual cookies.

3. **(C) Baking:** The formed dough pieces are conveyed through a long, temperature-controlled tunnel oven. Baking is a complex heat and mass transfer process with several objectives:
   - To cook the dough and solidify its structure.
   - To drive off moisture, reducing the water activity and creating the characteristic crisp texture.
   - To activate leavening agents to achieve the desired lift and texture.
   - To develop color (through Maillard reaction and caramelization) and the final baked flavor.
4. **(A) Cooling and packing:** After exiting the oven, the biscuits are extremely hot and very fragile. They cannot be packaged immediately. They are passed along a long cooling conveyor to allow them to cool down to ambient temperature. During cooling, the sugars and starches recrystallize, and the remaining moisture re-equilibrates. This makes the biscuits firm, crisp, and stable. Once cooled, they are immediately packaged to protect them from moisture uptake (which would make them soft) and physical damage.

Final Answer

The correct and logical sequence of operations in biscuit manufacturing is: **Mixing** → **Forming** → **Baking** → **Cooling and packing**. This corresponds to the order (D), (B), (C), (A).

Quick Tip

For any process sequencing question, think logically from start to finish. You always start by combining ingredients (Mixing) and end with the finished product ready for sale (Packing). The processing steps (Forming, Baking) must happen in between.

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14. The process for the development of cocoa mass follows a sequence of
(A). Milling
(B). Cleaning and roasting
(C). Breaking and winnowing
(D). Fermentation of dried beans
Choose the most appropriate answer from the options given below:

(A) (A), (B), (C), (D).
(B) (D), (B), (C), (A).
(C) (B), (A), (D), (C).

(D) (C), (B), (D), (A).

Correct Answer: (B) (D), (B), (C), (A).

Solution:

Conceptual Understanding

The creation of chocolate begins with the transformation of raw, harvested cocoa beans into cocoa mass (also known as cocoa liquor or unsweetened chocolate). This is a multi-step process designed to develop the characteristic flavor, aroma, and texture associated with chocolate. Each step has a specific and critical function.

Expanded Explanation: The Bean-to-Mass Journey

1. **(D) Fermentation:** This is the first and arguably most critical step for flavor development, occurring on the farm immediately after the cocoa pods are harvested. The beans, still covered in their sweet, white pulp, are placed in piles or boxes and covered. A complex microbial succession takes place over several days:

   - **Yeast** ferment the sugars in the pulp into ethanol.
   - **Lactic acid bacteria** convert sugars and citric acid into lactic acid.
   - **Acetic acid bacteria** then convert the ethanol into acetic acid.

   This process generates significant heat, which kills the cocoa bean's germ and breaks down cell walls within the bean. This allows enzymes to mix with substrates, initiating complex biochemical reactions that produce the essential flavor precursors—the building blocks of chocolate flavor. After fermentation, the beans are dried, usually in the sun.

2. **(B) Cleaning and Roasting:** The dried beans arrive at the processing plant and are first thoroughly cleaned to remove stones, twigs, and other foreign matter. They are then roasted. Roasting is a critical heat treatment step that accomplishes several goals:

   - **Flavor Development:** The heat drives the Maillard reaction between the flavor precursors (amino acids and reducing sugars) developed during fermentation, creating the rich, complex chocolate aroma and flavor.
   - **Moisture Reduction:** Further reduces the moisture content.
   - **Shell Loosening:** The heat causes the bean to expand and dry out, making the outer shell brittle and easy to remove.

3. **(C) Breaking and Winnowing:** After roasting and cooling, the beans are fed into a breaking machine that cracks them into smaller pieces. This process separates the brittle outer shell from the inner kernel, which is now called the "cocoa nib." The mixture of shell fragments and nibs is then subjected to winnowing, where strong air currents blow the lighter shell pieces away, leaving behind the heavier, denser cocoa nibs.

4. **(A) Milling:** This is the final step to produce cocoa mass. The cocoa nibs, which are roughly 50-55% fat (cocoa butter), are ground into an extremely fine paste. This is typically done in a series of mills that apply intense friction and shear. The heat generated by this process melts the cocoa butter, transforming the solid nibs into a thick, dark, viscous liquid. This liquid is the **cocoa mass**, the fundamental ingredient for all chocolate products.

Final Answer

The correct chronological sequence to convert raw cocoa beans into cocoa mass is: **Fermentation → Cleaning and roasting → Breaking and winnowing → Milling**. This corresponds to the order (D), (B), (C), (A).

Quick Tip

Remember the cocoa process flow: It starts with raw beans (Fermentation), then they are prepared (Roasting), then the shell is removed (Winnowing), and finally, the core (nib) is ground (Milling) to get the mass.

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15. Syneresis or weeping is a defect in_____

(A) Jelly
(B) Pickles
(C) Juices
(D) Jam

Correct Answer: (A) Jelly

Solution:

Conceptual Understanding

Syneresis, often called "weeping," is a common defect in food gels. It is the process by which the gel network, which is a three-dimensional structure of polymers trapping a liquid (usually water), contracts over time. This contraction squeezes out the trapped liquid, causing it to pool on the surface or separate from the gel. This phenomenon is a sign of gel instability.

Expanded Explanation

To understand syneresis, one must first understand the structure of the food in question. The defect can only occur in a food that is a gel.

- **What is a Gel?** A food gel consists of a continuous solid network of interconnected polymers (like pectin, gelatin, or coagulated proteins) that immobilizes a large volume of a liquid, typically water. This gives the food its characteristic solid-like, yet soft, texture.

- **Analyzing the Options:**
  - **(A) Jelly:** A jelly is the quintessential example of a food gel. It is made from fruit juice, sugar, acid, and pectin. The pectin molecules form a three-dimensional network that traps the sweetened juice. If this pectin network is unstable—due to incorrect pH, insufficient sugar, or over-cooking—the polymer chains can tighten and realign over time, shrinking the network and forcing out the trapped liquid. This makes syneresis a very common and highly visible defect in clear jellies.
  - **(B) Pickles:** Pickles are solid vegetables (like cucumbers) preserved in a liquid brine or vinegar. They are not a gel system.
  - **(C) Juices:** Juices are liquids. They do not have a gel structure from which liquid can separate.
  - **(D) Jam:** A jam is also a pectin gel, but it differs from jelly because it contains solid pieces of fruit pulp and fiber. While syneresis can and does occur in jam, the presence of the solid fruit matter can sometimes mask the effect or interfere with the gel structure in a different way. Jelly, being a pure, clear gel, is the most precise example where syneresis is a primary and prominent defect.

Final Answer

Syneresis is a defect defined by the separation of liquid from a gel. Among the choices provided, **jelly** is the best example of a product whose very identity is its gel structure and where syneresis is a well-known and classic quality defect.

Quick Tip

Associate the term "syneresis" or "weeping" with any food that is a gel. Common examples in exams include jelly, jam, yogurt, and custards. The key is the presence of a 3D network that traps liquid.

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16. Arrange the processing steps of Jelly marmalade in a proper sequence:
(A). Selection and preparation of fruit
(B). Preparation of sherds & peels
(C). Boiling and cleaning of pectin
(D). Canning and sterilization
Choose the most appropriate answer from the options given below:

(A) (A), (B), (D), (C).
(B) (A), (B), (C), (D).
(C) (A), (C), (B), (D).
(D) (C), (B), (D), (A).

Correct Answer: (B) (A), (B), (C), (D).

Solution:

Conceptual Understanding

Jelly marmalade is a specific type of fruit preserve, a gel made from citrus fruit. What distinguishes it from a simple jelly is the inclusion of shreds of the citrus peel suspended within the gel. Its production follows a logical sequence of steps to ensure the final product has the correct gel set, flavor, and shelf stability.

Expanded Explanation: The Chronological Flow

1. **(A) Selection and preparation of fruit:** This is the logical starting point for any food production process. It involves sourcing high-quality citrus fruit (often Seville oranges, known for their high pectin content and bitter flavor). The fruit is then thoroughly washed to remove any dirt or residues, and typically cut in half to prepare it for juice extraction and peel preparation.
2. **(B) Preparation of sherds & peels:** This step is the defining characteristic of marmalade. After the initial preparation, the peels are separated from the fruit. They are then carefully cut or sliced into thin strips, known as "sherds" or shreds. This step must logically follow the initial selection and washing of the whole fruit.
3. **(C) Boiling and clearing of pectin:** This is the crucial cooking stage. The prepared juice, water, sugar, and the prepared peel shreds are combined in a large kettle and boiled. This boiling process serves multiple critical functions:
   - **Pectin Extraction:** The heat and acid from the juice extract the natural pectin from the fruit's peel and membranes.
   - **Concentration:** Water is boiled off, concentrating the sugar to the level required for gel formation and preservation ($\sim$65% soluble solids).
   - **Sterilization:** The high temperature kills spoilage microorganisms.
   - **Gel Formation:** The combination of pectin, sugar, and acid at this high concentration creates the conditions necessary for the mixture to form a gel upon cooling. "Clearing of pectin" refers to the entire process of dissolving and setting up the gel network.
4. **(D) Canning and sterilization:** This is the final preservation step. Once the marmalade reaches the correct setting point (determined by temperature or a gel test), it must be packaged to make it shelf-stable. While still hot, the marmalade is filled into clean jars or cans, which are then immediately sealed. The sealed containers are often processed further (e.g., in a boiling water bath) to ensure a vacuum seal and commercial sterility, preventing microbial growth during storage. This step must always be the last in the sequence.

Final Answer

The logical and necessary sequence for producing marmalade is: **Selection and preparation of fruit** $\rightarrow$ **Preparation of sherds & peels** $\rightarrow$ **Boiling** $\rightarrow$ **Canning and sterilization**. This corresponds to the order (A), (B), (C), (D).

Quick Tip

For process sequencing, always identify the absolute first step (raw material preparation) and the absolute last step (packaging/preservation). Then, arrange the intermediate steps logically. For marmalade, remember you must prepare the peels before you can cook them in the mixture.

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17. Natural carotenes can be extracted from_____

(A) saffron
(B) soyabean
(C) beans
(D) pear

Correct Answer: (A) saffron

Solution:

Conceptual Understanding

Carotenes are a class of organic pigments that belong to the broader family of carotenoids. They are tetraterpenoids, meaning they are synthesized from 8 isoprene units. These compounds are produced by plants, algae, and some fungi and bacteria. They are responsible for many of the yellow, orange, and red hues seen in nature. In addition to providing color, many carotenes (most famously β-carotene) are important as precursors to Vitamin A in the human diet. The question asks to identify the most significant source of these pigments among the options.

Expanded Explanation: Evaluating the Sources

- **(A) Saffron:** Saffron is a spice derived from the dried stigmas of the *Crocus sativus* flower. Its intense crimson color and flavor are due to a high concentration of specific carotenoid compounds. The primary pigment is **crocin**, which is a water-soluble carotenoid ester. Saffron also contains its precursor, crocetin, as well as other carotenes like alpha- and beta-carotene and lycopene. Saffron is one of the most concentrated and potent natural sources of carotenoid pigments known, making it highly valued as both a colorant and a spice.
- **Soyabean:** Soybeans are legumes prized for their high protein and oil content. They are typically pale yellow or light tan in color and are not considered a rich source of carotenes. Their nutritional profile is dominated by macronutrients, not pigments.
- **Beans:** While some types of beans do contain carotenoids (e.g., green beans contain lutein and beta-carotene, but their color is masked by chlorophyll), they are generally not concentrated sources. Compared to brightly colored vegetables like carrots or spices like paprika and saffron, the carotenoid content in most beans is relatively low.

- **Pear:** Pears are fruits with typically pale white or greenish flesh. This pale color is a direct indication of a very low concentration of carotenoid pigments.

Final Answer

Comparing the given options, **saffron** stands out as an exceptionally potent and significant source for the extraction of natural carotenoid pigments, specifically crocin. Its vibrant color is a direct result of its high concentration of these compounds.

Quick Tip

Associate vibrant natural colors (deep reds, yellows, oranges) with carotenoids. Foods like carrots, sweet potatoes, tomatoes, and intensely colored spices like paprika and saffron are rich sources.

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18. The process of yoghurt manufacture involves the following sequence
(A). Homogenization of milk
(B). Standardization of milk
(C). Pasteurization, cooling followed by addition of starter culture
(D). Fermentation, packaging and storage
Choose the most appropriate answer from the options given below:

(A) (C), (A), (B), (D)
(B) (B), (C), (A), (D)
(C) (B), (A), (C), (D)
(D) (A), (B), (C), (D)

Correct Answer: (C) (B), (A), (C), (D)

Solution:

Conceptual Understanding

Yoghurt is a fermented dairy product created by the bacterial fermentation of milk. The transformation of liquid milk into the semi-solid, tangy product we know as yoghurt requires a series of carefully controlled steps performed in a specific order to ensure safety, quality, and the desired final texture and flavor.

Expanded Explanation: The Chronological Flow

1. **(B) Standardization of milk:** The process begins with raw milk, which is first "standardized." This involves adjusting the milk's composition to meet legal requirements and product specifications. The most important components adjusted are:
    - **Fat content:** Cream is either added or removed to achieve the desired level (e.g., full-fat, low-fat, non-fat).

- **Milk Solids-Not-Fat (MSNF):** The protein content is often increased by adding skim milk powder or by using ultrafiltration. Higher protein content leads to a firmer, more stable yoghurt gel.

2. **(A) Homogenization of milk:** The standardized milk is then homogenized. This is a physical process where the milk is forced under high pressure through very small orifices. This breaks down the large fat globules into much smaller ones. The primary purpose of homogenization in yoghurt production is to:
   - Prevent cream separation (creaming) during incubation and storage.
   - Create a thicker body, a smoother texture, and a whiter color in the final yoghurt.
3. **(C) Pasteurization, cooling followed by addition of starter culture:** This is a critical three-part step.
   - **Pasteurization:** The homogenized milk is heated to a high temperature (typically 85-95°C) for a set time. This has two crucial purposes: killing any pathogenic and spoilage bacteria present in the milk, and denaturing the whey proteins (like β-lactoglobulin). The denatured whey proteins interact with the casein proteins, which significantly enhances the stability and water-holding capacity of the final yoghurt gel, preventing syneresis.
   - **Cooling:** The milk must then be cooled down to the optimal incubation temperature for the starter culture, usually between 40-45°C. If the culture were added to hot milk, the bacteria would be killed.
   - **Addition of Starter Culture:** The specific yoghurt culture, a symbiotic blend of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*, is added to the cooled milk.
4. **(D) Fermentation, packaging and storage:** The inoculated milk is held at the incubation temperature for several hours. During this **fermentation**, the bacteria metabolize the milk sugar (lactose) and produce lactic acid. The increasing acidity causes the pH of the milk to drop. At a critical pH (around 4.6), the casein proteins coagulate, forming the characteristic soft gel network of yoghurt. Once the desired acidity is reached, the fermentation is stopped by rapidly cooling the yoghurt. It is then packaged and stored under refrigeration to maintain its quality and safety.

Final Answer

The correct chronological sequence for yoghurt manufacturing is: **Standardization → Homogenization → Pasteurization, cooling, and inoculation → Fermentation, packaging, and storage**. This corresponds to the order (B) → (A) → (C) → (D).

Quick Tip

For dairy processing sequences, always start with adjusting the raw material (Standardization). Heat treatment (Pasteurization) comes before adding live cultures, and the biological process (Fermentation) is the core manufacturing step before final packaging.

19. Toxic constituent in *Vicia faba* may cause _____ pathological disorder.

(A) Favism
(B) Lathyrism
(C) Rickets
(D) Blindness

Correct Answer: (A) Favism

Solution:

Conceptual Understanding

Vicia faba, commonly known as the fava bean or broad bean, is a nutritious legume. However, for a subset of the population with a specific genetic condition, consuming these beans can trigger a severe and dangerous medical reaction due to the presence of certain natural compounds within the bean.

Expanded Explanation

- **Favism:** This is the correct pathological disorder associated with *Vicia faba*. Favism is a clinical term for acute hemolytic anemia that occurs in individuals with a hereditary deficiency of the enzyme **glucose-6-phosphate dehydrogenase (G6PD)**.
  - **G6PD Deficiency:** This enzyme is crucial for protecting red blood cells from damage by oxidative stress.
  - **Causative Agents:** Fava beans contain high concentrations of the pyrimidine glycosides **vicine** and **convicine**. When ingested, these compounds are metabolized into highly oxidizing agents (divicine and isouramil).
  - **Mechanism:** In individuals with G6PD deficiency, their red blood cells cannot cope with this sudden, high oxidative load. The cells are damaged and rapidly destroyed (hemolysis), leading to anemia, jaundice, and other severe symptoms.
- **Lathyrism:** This is a neurological disorder characterized by paralysis of the lower limbs. It is caused by consuming certain legumes from the genus *Lathyrus* (grass pea), not *Vicia faba*. The causative neurotoxin is oxalyldiaminopropionic acid (ODAP). It is an entirely different condition caused by a different plant and toxin.
- **Rickets:** This is a bone disorder in children caused by a deficiency of vitamin D, calcium, or phosphate, leading to weak and soft bones. It has no direct relationship to the consumption of fava beans.
- **Blindness:** While blindness can result from severe nutritional deficiencies (notably Vitamin A deficiency), it is not a pathological disorder associated with the toxic constituents of fava beans.

Final Answer

The specific pathological disorder triggered by the toxic constituents (vicine and convicine) in *Vicia faba* in genetically susceptible individuals is known as **Favism**.

> Quick Tip
>
> Memorize the specific pairings of food toxins and the diseases they cause: *Vicia faba* (Fava beans) → Favism; *Lathyrus sativus* (Grass pea) → Lathyrism; Improperly processed cassava → Konzo.

---

20. Which of the following legume is considered as the poor man's pulse?

(A) Field bean
(B) Horse gram
(C) Green gram
(D) Lentil

Correct Answer: (B) Horse gram

Solution:

Conceptual Understanding

Certain staple crops, particularly in developing nations, earn colloquial titles like "poor man's crop" or "poor man's pulse." These names reflect the crop's vital role for subsistence farmers and low-income populations. The title is typically bestowed upon a crop that combines three key attributes: affordability, high nutritional value, and resilience in challenging agricultural conditions.

Expanded Explanation: The Case for Horse Gram

Horse gram (*Macrotyloma uniflorum*) is widely and specifically known in regions like South India as the "poor man's pulse" or "poor man's superfood." It has earned this title for several compelling reasons:

- **Exceptional Resilience and Hardiness:** Horse gram is renowned for its ability to thrive where other crops fail. It is highly **drought-resistant** and can be cultivated in poor, marginal soils with low rainfall. This makes it a dependable and crucial crop for farmers in arid and semi-arid regions.
- **Low Cost of Cultivation:** Due to its hardiness, it requires minimal inputs in terms of fertilizer and irrigation, making it very affordable for subsistence farmers to grow. This low cost of production translates to a low market price, making it an accessible source of nutrition for low-income households.

- **High Nutritional Value:** Despite its low cost, horse gram is a powerhouse of nutrition. It is an excellent source of plant-based **protein** (typically 22-25%), dietary fiber, and essential minerals, particularly **iron**, molybdenum, and **calcium**. This makes it invaluable for combating malnutrition in rural populations.

0.0.11 Comparison with Other Legumes

While other legumes like field bean, green gram, and lentil are also nutritious and important staples, the specific combination of exceptional drought tolerance, ability to grow in poor conditions, and high nutritional density is what has specifically earned horse gram the title of the "poor man's pulse." It serves as a lifeline crop in regions where agricultural conditions are harsh and resources are limited.

Final Answer

Horse gram is widely recognized as the "poor man's pulse" because of its unique combination of agricultural resilience (especially drought resistance), low cost of cultivation, and excellent nutritional profile, making it a vital food source in marginal farming areas.

> Quick Tip
>
> For questions about colloquial crop names, think about the crop's economic and agricultural role. "Poor man's crop" usually refers to something very hardy and inexpensive. For example, potato is the "poor man's friend," and pearl millet is the "poor man's food."

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21. Which of the following are polyunsaturated fatty acids (n-6)?
(A). Linoleic
(B). γ- Linolenic
(C). Arachidonic
(D). Oleic
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (D) only.
(B) (A), (B) and (C) only.
(C) (A), (B), (C) and (D).
(D) (B), (C) and (D) only.

Correct Answer: (B) (A), (B) and (C) only.

Solution:

Conceptual Understanding

Fatty acids, the building blocks of fats, are classified using a nomenclature that describes their structure. This includes their chain length, the number of double bonds (degree of saturation), and the position of these bonds.

- **Nomenclature:** A common notation is C:D(n-x), where C is the number of carbon atoms, D is the number of double bonds, and (n-x) indicates the position of the first double bond, counting from the methyl end (ω or n-end) of the fatty acid chain.
- **Polyunsaturated Fatty Acid (PUFA):** A fatty acid with two or more double bonds in its carbon chain.
- **n-6 (or Omega-6) Fatty Acid:** A PUFA where the first double bond is located between the 6th and 7th carbon atoms from the methyl end.

The question asks to identify the n-6 PUFAs from a given list.

Expanded Explanation: Analysis of Fatty Acids

- **(A) Linoleic acid (LA):** Its notation is **18:2(n-6)**.
  - It has 18 carbons and 2 double bonds, so it is a **PUFA**.
  - The first double bond is at the 6th carbon, making it an **n-6** fatty acid.
  - *Conclusion: Fits the description.*
- **(B) γ-Linolenic acid (GLA):** Its notation is **18:3(n-6)**.
  - It has 18 carbons and 3 double bonds, so it is a **PUFA**.
  - The first double bond is at the 6th carbon, making it an **n-6** fatty acid.
  - *Note:* This is distinct from its isomer, α-Linolenic acid (ALA), which is 18:3(n-3) and a primary omega-3 fatty acid.
  - *Conclusion: Fits the description.*
- **(C) Arachidonic acid (AA):** Its notation is **20:4(n-6)**.
  - It has 20 carbons and 4 double bonds, so it is a **PUFA**.
  - The first double bond is at the 6th carbon, making it an **n-6** fatty acid.
  - *Conclusion: Fits the description.*
- **(D) Oleic acid (OA):** Its notation is **18:1(n-9)**.
  - It has only 1 double bond, making it a **monounsaturated fatty acid (MUFA)**, not a PUFA.
  - Its double bond is at the 9th carbon, making it an n-9 fatty acid.
  - *Conclusion: Does not fit the description.*

Final Answer

The fatty acids that are correctly classified as n-6 polyunsaturated fatty acids are Linoleic acid, γ-Linolenic acid, and Arachidonic acid.

Quick Tip

Remember the three key fatty acid families:

- **n-6 Family Head:** Linoleic Acid (LA)
- **n-3 Family Head:** α-Linolenic Acid (ALA)
- **n-9 Family Head:** Oleic Acid (OA)

Arachidonic acid and γ-linolenic acid are derived from linoleic acid, so they are also in the n-6 family.

---

22. Durum wheat is used for the making of _____

(A) Pasta
(B) Cake
(C) Pastry
(D) Cookies

Correct Answer: (A) Pasta

Solution:

Conceptual Understanding

Wheat varieties are classified based on properties like hardness (hard vs. soft), color (red vs. white), and growing season (winter vs. spring). These characteristics, particularly hardness and protein content, determine the flour's properties and its suitability for different baked goods.

Expanded Explanation

- **Durum Wheat (*Triticum durum*):** This variety possesses a unique and specific set of characteristics that distinguish it from common bread wheat (*Triticum aestivum*).
  - **Hardness:** It is the hardest of all wheat varieties. This means the endosperm is very dense and resists breaking down during milling.
  - **Protein Content:** It has a very high protein content, typically 13-16% or more.
  - **Gluten Quality:** The gluten formed from durum wheat protein is exceptionally strong and extensible, but not very elastic.

- **Milling Product:** When milled, the hard endosperm does not pulverize into a fine powder but rather into a coarse, granular flour called **semolina**, which has a natural golden-amber color.

- **Ideal Use in Pasta:** These properties make durum wheat semolina the ideal, and traditional, choice for high-quality pasta and couscous.
  - The strong gluten network allows the pasta dough to be extruded into complex shapes without tearing.
  - Crucially, this robust protein structure allows the pasta to maintain its shape and firmness during cooking. It creates the desirable *al dente* ("to the tooth") texture, meaning it is cooked through but still firm.

- **Unsuitability for Other Products:**
  - **Cake, Pastry, and Cookies:** These products require a soft, tender, and often crumbly texture. They are made from **soft wheat**, which has low protein content and forms a weak gluten network. Using strong durum wheat semolina would result in a tough, dense, and unpleasantly chewy product.

Final Answer

The unique combination of extreme hardness, high protein content, and strong gluten makes **Durum wheat** the primary and superior choice for manufacturing high-quality **Pasta** that maintains its texture and integrity after cooking.

Quick Tip

A simple rule for wheat types: **Hard/Strong Wheat** (like Durum) is for bread and pasta. **Soft/Weak Wheat** is for cakes, cookies, and pastries.

---

23. Freshly milled wheat flour used for bread making is matured for _____ months during storage.

(A) 3 to 4
(B) 2 to 3
(C) 1 to 2
(D) 5 to 6

Correct Answer: (C) 1 to 2

Solution:

Conceptual Understanding

Freshly milled wheat flour is referred to as "green" flour. While usable, its functional properties, particularly for bread making, are not yet optimal. The flour requires a period of aging or maturation to develop its full baking potential. This can be achieved through natural aging or accelerated with chemical treatments.

Expanded Explanation: The Process of Natural Maturation

Natural aging is a slow process where the flour is stored and allowed to interact with atmospheric oxygen. This interaction causes oxidative changes that significantly improve the flour's performance.

- **Mechanism of Improvement:**
  1. **Gluten Strengthening:** The primary benefit of oxidation is the strengthening of the gluten-forming proteins (glutenin and gliadin). Oxygen facilitates the formation of disulfide bonds (-S-S-) between protein chains. This cross-linking creates a stronger, more elastic, and more cohesive gluten network.
  2. **Baking Benefits:** A stronger gluten network is better able to trap the carbon dioxide gas produced by yeast during fermentation. This leads to improved dough handling properties, better gas retention, greater loaf volume, and a finer, more uniform crumb structure in the final bread.
  3. **Natural Bleaching:** The oxygen also oxidizes the natural carotenoid pigments (like xanthophyll) present in the flour. This breaks down the pigments, gradually bleaching the flour from its natural creamy-yellow color to a brighter white.
- **Optimal Duration:** This natural process takes time. A storage period of **1 to 2 months** is generally considered the optimal duration for natural maturation. This provides sufficient time for the oxidative changes to significantly improve the flour's baking quality without significant risk of deterioration.
- **Risks of Prolonged Storage:** If flour is stored for too long (e.g., 5-6 months or more), especially in poor conditions, negative effects can occur. The natural fats (lipids) in the flour can undergo oxidative rancidity, leading to off-flavors and odors.

Final Answer

The standard recommended duration for naturally aging or maturing freshly milled wheat flour to optimize its properties for bread making is approximately **1 to 2 months**.

> Quick Tip
>
> Remember that flour maturation is an oxidative process. While modern mills often use chemical agents (like ascorbic acid) to speed this up, natural aging is still a key concept. For exams, associate "freshly milled flour" with the need for a short aging period to improve gluten strength.

24. The yellow colour of the cow milk is due to the presence of_____

(A) sterols
(B) albumin
(C) phospholipids
(D) carotenoids

Correct Answer: (D) carotenoids

Solution:

Conceptual Understanding

The color of cow's milk, and more specifically its fat component, is not inherent to the milk itself but is directly derived from the cow's diet. Certain fat-soluble pigments present in the animal's feed are transferred into the milk.

Expanded Explanation

- **The Pigment Source:** The yellow-orange color is caused by a group of natural pigments called **carotenoids**. The most prominent of these is **beta-carotene** (β-carotene), which is also a precursor to Vitamin A.
- **Dietary Origin:** Carotenoids are abundant in green plant matter. A cow's diet, particularly one that includes fresh grass, pasture, or green forage like silage, is rich in beta-carotene.
- **The Transfer Mechanism:**
  1. Beta-carotene is a **fat-soluble** (lipophilic) molecule.
  2. When a cow consumes this green forage, the beta-carotene is absorbed from its digestive tract into the bloodstream.
  3. During the process of milk synthesis in the udder, this fat-soluble pigment naturally partitions into and dissolves within the fat globules of the milk.
- **Factors Affecting Color Intensity:**
  - **Diet:** The more green forage a cow eats, the more beta-carotene it ingests, and the yellower its milk fat will be. Milk from 100% grass-fed cows is often a deep golden yellow.
  - **Breed:** Certain breeds, like Guernsey and Jersey, are genetically less efficient at converting beta-carotene into Vitamin A in their bodies. As a result, more of the original pigment is deposited in the milk fat, making their milk noticeably more yellow than that of breeds like Holstein.
  - **Fat Content:** The color is concentrated in the fat. Therefore, high-fat dairy products like cream and butter show a much more intense yellow color than the milk itself.
- **Other Milk Components:** Sterols, albumin (a whey protein), and phospholipids are all natural components of milk, but they are colorless and do not contribute to the yellow hue.

Final Answer

The characteristic yellow color of cow's milk fat is caused by the presence of dietary **carotenoid pigments**, primarily beta-carotene, which are fat-soluble and originate from the green forage consumed by the cow.

> Quick Tip
>
> Associate carotenoids with yellow/orange colors in nature (e.g., carrots). Remember that since beta-carotene is fat-soluble, the yellow color in milk is more prominent in the cream or butter. This is why butter from grass-fed cows is more yellow.

---

25. Sequentially arrange the processing steps involved in the manufacturing of cheddar cheese
(A). Standardization
(B). Pre-heating
(C). Addition of starter culture
(D). Pasteurization
Choose the most appropriate answer from the options given below:

(A) (A), (B), (D), (C).
(B) (A), (B), (C), (D).
(C) (B), (A), (D), (C).
(D) (C), (B), (D), (A).

Correct Answer: (A) (A), (B), (D), (C).

Solution:

Conceptual Understanding

Cheesemaking is a controlled process that concentrates milk fat and protein (specifically casein) to create a stable and flavorful product. The initial steps are crucial as they prepare the milk, ensure its safety, and create the optimal environment for the subsequent coagulation and fermentation stages.

Expanded Explanation: The Chronological Sequence

1. **(A) Standardization:** This is the very first step after the raw milk is received. The milk's composition is adjusted to a specific fat-to-protein ratio (or more accurately, casein-to-fat ratio). This is critical for ensuring consistency in the final cheese's quality, texture, and yield from batch to batch. It is typically done by adding cream or removing fat (as skim milk).

2. **(B) Pre-heating and (D) Pasteurization:** After standardization, the milk undergoes heat treatment. This is a single, continuous process where the milk is first pre-heated and then held at a specific temperature for a specific time to achieve pasteurization (e.g., 72°C for 15 seconds). This is a critical food safety step to eliminate pathogenic bacteria and also kills most spoilage organisms and deactivates native enzymes that could cause defects during cheese ripening.
3. **Cooling (Implicit Step):** Following pasteurization, the milk must be cooled. It is brought down to the precise temperature required for the starter culture to grow and thrive. For cheddar cheese, this is typically around 30-32°C (86-90°F).
4. **(C) Addition of starter culture:** Once the milk is at the correct temperature, it is inoculated with a starter culture of specific lactic acid bacteria (LAB). This step is fundamentally important for several reasons:
    - The primary function of the starter is to ferment lactose (milk sugar) into lactic acid.
    - This drop in pH is essential for the subsequent step of enzyme coagulation (renneting), promotes the shrinking of the curd (syneresis), and creates an acidic environment that inhibits the growth of spoilage bacteria.

Logical Necessity: The sequence is logically fixed. Pasteurization, a heat-kill step, must always be performed *before* the addition of the live starter culture. If the order were reversed, the heat would destroy the beneficial bacteria, rendering them useless.

Final Answer

The correct and only logical sequence for the initial steps of cheddar cheese manufacturing is: **Standardization → Pre-heating → Pasteurization → Addition of starter culture**. This corresponds to the order (A), (B), (D), (C).

Quick Tip

In any dairy fermentation process, remember the rule: "Prepare, Kill, Inoculate". First, prepare the milk (standardize). Then, kill unwanted microbes (pasteurize). Finally, inoculate with the desired microbes (add starter culture).

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26. Foods which are specially processed or formulated to satisfy a particular dietary requirement which exists due to a disease or disorder are known as _____

(A) Healthy foods
(B) Nutraceuticals
(C) Balanced foods
(D) Special foods

Correct Answer: (D) Special foods

Solution:

Conceptual Understanding

Food regulations worldwide include specific categories for products that are not intended for the general consumer but are designed to meet the particular nutritional needs of individuals with specific health conditions, diseases, or disorders.

Expanded Explanation

- **The Official Terminology:** The definition provided in the question—"specially processed or formulated to satisfy a particular dietary requirement which exists due to a disease or disorder"—directly corresponds to the formal regulatory category known as **Foods for Special Dietary Use (FSDU)**. In some jurisdictions, a closely related term is "Medical Foods."
- **Purpose and Examples:** The primary purpose of FSDU is to provide a safe and effective dietary management option for individuals who cannot consume a normal diet. Well-known examples include:
  - **Gluten-free products** for the dietary management of celiac disease.
  - **Lactose-free milk** for individuals with lactose intolerance.
  - **Low-protein foods** for patients with chronic kidney disease.
  - **Specialized infant formulas** for those with inherited metabolic disorders like Phenylketonuria (PKU).
- **Analysis of Other Options:**
  - **Healthy foods / Balanced foods:** These are general, non-specific marketing terms. They lack a formal regulatory definition and do not specifically refer to foods for disease management.
  - **Nutraceuticals:** This term refers to products, often derived from food sources, that are claimed to provide additional health benefits beyond basic nutrition. They are typically sold in concentrated or medicinal forms (e.g., fish oil capsules, probiotic pills). While health-related, the term is not used for whole food formulations intended as the sole or primary dietary management for a specific disease.
  - **Special foods:** This is the best and most appropriate simplified term among the choices. It serves as a clear and accessible proxy for the more technical regulatory term "Foods for Special Dietary Use."

Final Answer

The most fitting term for foods formulated for the dietary management of a specific disease or disorder is **"Special foods,"** which acts as a common name for the official category of Foods for Special Dietary Use (FSDU).

Quick Tip

In food regulation, specific definitions are key. Foods for a general healthy population are different from those designed to manage a medical condition. The latter are "special" because they cater to non-standard dietary needs.

27. The colour permitted in cheddar cheese as per FSS Act, 2006 is _____

(A) Annatto
(B) Anthocyanin
(C) Riboflavin
(D) Chlorophyll

Correct Answer: (A) Annatto

Solution:

Conceptual Understanding

The natural color of cheddar cheese, derived from the milk it is made from, is a pale, off-white to light yellow. The iconic bright orange or deep yellow color of many commercially available cheddars is the result of adding a specific, permitted food colorant during the manufacturing process.

Expanded Explanation

- **The Colorant: Annatto** The colorant traditionally and most commonly used to give cheddar cheese its characteristic orange hue is **Annatto**.
- **Natural Origin:** Annatto is a natural colorant derived from the reddish pericarp of the seeds of the achiote tree (*Bixa orellana*), a shrub native to tropical regions of the Americas.
- **Chemical Pigments:** The principal coloring compounds in annatto are carotenoids, primarily **bixin** (which is oil-soluble) and **norbixin** (which is water-soluble). Since cheese is an emulsion with a significant fat phase, the oil-soluble nature of bixin makes it particularly effective at coloring the product uniformly.
- **Historical Use and Regulation:** Annatto has been used for centuries to color dairy products. The practice originally started to give cheese a consistent yellow color year-round, mimicking the deeper yellow of milk from cows grazing on beta-carotene-rich summer pasture. Its use is regulated by food safety authorities, such as the Food Safety and Standards Authority of India (FSSAI) under the FSS Act, 2006, which permit its use in cheese up to a specified maximum level.
- **Incorrect Options:**
  - **Anthocyanins:** These are water-soluble pigments responsible for red, purple, and blue colors in fruits like berries and grapes. They are not used in cheese.
  - **Riboflavin (Vitamin B2):** This vitamin has a yellow color, but it is not used as a primary food colorant to produce the orange hue in cheddar.
  - **Chlorophyll:** This is the green pigment found in plants and is not used to color cheese.

Final Answer

The permitted, natural colorant used to impart the characteristic orange color to cheddar cheese is **Annatto**.

> Quick Tip
>
> For questions about food colors, remember the classic associations: Annatto → Orange Cheese/Butter; Turmeric → Yellow Curries; Caramel → Brown Colas/Sauces; Saffron → Yellow Rice.

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28. The rate of food spoilage is not dependent on _____

(A) Water activity
(B) Package size
(C) OR potential
(D) Temperature

Correct Answer: (B) Package size

Solution:

Conceptual Understanding

The rate at which food spoils is governed by a complex interplay of factors. These can be categorized as **intrinsic factors** (properties inherent to the food itself) and **extrinsic factors** (conditions of the storage environment). These factors directly influence the rate of microbial growth and detrimental chemical reactions. The question asks to identify which option is not a direct controlling factor.

Expanded Explanation: Analysis of Factors

- **(A) Water activity (a_w):** This is a critical **intrinsic factor**. Water activity measures the amount of "free" or unbound water in a food that is available to support the growth of microorganisms and participate in chemical reactions. Below a certain a_w threshold, microbial growth is inhibited. Therefore, a_w is a *direct and primary* factor controlling spoilage.
- **(C) OR potential (Oxidation-Reduction potential):** This is an important **intrinsic factor**. The OR potential of a food measures its tendency to gain or lose electrons. It directly determines the type of microbial community that can thrive. A high (oxidizing) potential favors aerobic microorganisms, while a low (reducing) potential favors anaerobes. It is a *direct* controlling factor that selects the spoilage pathway.
- **(D) Temperature:** This is a key **extrinsic factor**. The rate of nearly all microbial growth, enzymatic activity, and chemical reactions is highly dependent on temperature.

Low temperatures (refrigeration) slow these processes down, while high temperatures (cooking) can stop them entirely. Temperature is arguably the most important *direct* environmental factor controlling spoilage.

- **(B) Package size:** This is **not a direct controlling factor**. While aspects of packaging—such as the material's permeability to gases and moisture, or the atmosphere inside the package (e.g., modified atmosphere packaging)—are critical extrinsic factors, the absolute size of the package itself (e.g., 100g vs 1kg) is not a fundamental scientific parameter that governs the spoilage rate. Assuming all other conditions (temperature, atmosphere, surface-area-to-volume ratio) are identical, the intrinsic rate of spoilage of the food per unit mass would be the same. Package size is an indirect variable at best, not a primary controlling factor like a_w or temperature.

Final Answer

Water activity, OR potential, and temperature are all direct scientific factors that control the rate of food spoilage. **Package size** is not a direct controlling factor.

Quick Tip

Remember the FATTOM acronym for factors affecting microbial growth: Food, Acidity (pH), Time, Temperature, Oxygen (OR potential), Moisture (Water Activity). Any factor not on this fundamental list, like "package size," is likely to be the incorrect option in a question like this.

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29. Match List-I with List-II

List-I **Raw foods**	**List-II** **Storage temperature range (°C)**
(A) Banana	(I) 13 - 15.6
(B) Lemon	(II) 0 - 2.2
(C) Nuts	(III) 12.8 - 14.4
(D) Tomato	(IV) 4.4 - 10

Choose the most appropriate answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)

Solution:

Conceptual Understanding

Maintaining food quality and maximizing shelf life requires storing foods at their optimal temperature. Storing produce outside its ideal range can lead to rapid spoilage or physiological disorders. A common disorder in tropical and subtropical produce is **chilling injury**, which occurs at temperatures that are cool but above freezing.

Expanded Explanation: Matching Foods to Temperatures

- **(A) Banana:** A tropical fruit that is extremely sensitive to cold. Storing bananas below approximately 12°C causes chilling injury, which manifests as a failure to ripen, a mushy texture, and enzymatic browning that blackens the peel. The ideal storage temperature is in a cool room, which corresponds perfectly with **(I) 13 - 15.6°C**.
- **(C) Nuts:** Shelled nuts are low in moisture, making them resistant to microbial spoilage, but their high content of unsaturated oils makes them highly susceptible to oxidative rancidity, which produces off-flavors. The rate of this chemical reaction is significantly slowed by low temperatures. Therefore, storing nuts in a cool, near-freezing environment is ideal for long-term preservation of quality. This matches perfectly with **(II) 0 - 2.2°C**.
- **(B) Lemon:** A subtropical citrus fruit. Lemons are less sensitive to cold than bananas but can still suffer from chilling injury (skin pitting, browning) if stored at temperatures that are too low for extended periods. They are best stored at cool, but not cold, temperatures to prolong shelf life by reducing water loss and decay. The range of **(III) 12.8 - 14.4°C** is an excellent match for this requirement.
- **(D) Tomato:** Tomatoes are fruits that develop their complex flavor profiles at room temperature. Refrigeration below about 12°C permanently halts the activity of enzymes that produce these desirable volatile compounds, resulting in a bland, mealy product. While room temperature is best for flavor, short-term storage at a cool temperature may be used to slow down over-ripening. Among the available choices, **(IV) 4.4 - 10°C** is a plausible, though not ideal, range for this specific purpose of short-term holding.

Final Answer

Based on the physiological requirements of each food, the best pairings are: A-I (Banana), B-III (Lemon), C-II (Nuts), and D-IV (Tomato). This corresponds to option (B).

Quick Tip

Remember the general rule for produce storage: Tropical/subtropical fruits (like bananas, tomatoes, mangoes) are prone to chilling injury and should be stored cool, not cold. Low-moisture, high-fat foods (like nuts) benefit from cold storage to prevent rancidity.

---

30. What does the term "JECFA" stands for:

(A) Joint Expert Committee on Food Additives
(B) Joint Excellence Committee on Food Allergens
(C) Joint Expert Committee on Food Analysis
(D) Joint Export Committee on Food Additives

Correct Answer: (A) Joint Expert Committee on Food Additives

Solution:

Conceptual Understanding

JECFA is a highly respected international scientific body responsible for providing independent expert advice on the safety of chemicals in food. It operates under the joint stewardship of two major United Nations organizations, which is reflected in its full name.

Expanded Explanation

- **Correct Expansion:** The acronym **JECFA** stands for the **Joint FAO/WHO Expert Committee on Food Additives**.
- **Joint Administration:**
  - **FAO:** The Food and Agriculture Organization of the United Nations.
  - **WHO:** The World Health Organization.
  - The "Joint" nature of the committee is a critical part of its identity, signifying its role in serving both organizations and their member countries.
- **Primary Mandate:** JECFA is not a regulatory body but an international *scientific advisory* committee. Its primary role is to conduct rigorous, independent scientific risk assessments and provide advice to the FAO, WHO, and international standard-setting bodies like the Codex Alimentarius Commission. Its scope includes:
  - **Food Additives:** Evaluating their safety and establishing Acceptable Daily Intakes (ADIs).
  - **Contaminants and Natural Toxins:** Assessing the risks from substances like heavy metals, mycotoxins, and processing contaminants.
  - **Residues of Veterinary Drugs:** Evaluating the safety of residues of drugs used in food-producing animals and recommending Maximum Residue Limits (MRLs).
- **Analysis of Incorrect Options:** The other options are incorrect because they insert words like "Excellence," "Analysis," or "Export" that are not part of the official title. The name specifically highlights its status as a "Joint" endeavor of the FAO and WHO, its composition of "Experts," and its function as a "Committee."

Final Answer

The correct and full expansion of the acronym JECFA is the **Joint FAO/WHO Expert Committee on Food Additives**.

> Quick Tip
>
> For exams, it is crucial to memorize the full names of key international food safety organizations. Remember that JECFA provides the scientific advice, and the Codex Alimentarius Commission (CAC) uses this advice to set international food standards.

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31. Which of the following criteria that are used for screening of the New Food Product ideas?
(A). Marketability
(B). Technical feasibility
(C). Manufacturing capability
(D). Financial capability
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (D) only.
(B) (A), (B) and (C) only.
(C) (A), (B), (C) and (D).
(D) (B), (C) and (D) only.

Correct Answer: (C) (A), (B), (C) and (D).

Solution:

Conceptual Understanding

New Product Development (NPD) is a structured, multi-stage process that guides a product from concept to market launch. A critical early stage in this process is **Idea Screening**. This functions as a "stage gate" or a crucial go/no-go decision point. Its purpose is to filter out unpromising ideas before committing significant time, money, and resources to their development. This screening is performed against a comprehensive set of business and technical criteria.

Expanded Explanation: The Four Pillars of Idea Screening

For a new food product idea to be considered viable, it must successfully pass scrutiny against four fundamental and interconnected criteria. All four are essential for a holistic assessment.

- **(A) Marketability (Commercial Viability):** This criterion assesses the business potential and asks the fundamental question: "Will anyone buy this?"
  - **Consumer Need:** Does the product solve a problem or fulfill a desire for consumers?

  - **Target Market:** Who are the intended customers? How large is this segment?
  - **Competitive Landscape:** Who are the existing competitors? What is our competitive advantage?
  - *A product that is technically brilliant but has no market is a commercial failure.*
- **(B) Technical Feasibility (Product Viability):** This criterion assesses the scientific and technological challenges. The key question is: "Can we actually make this product?"
  - **Formulation:** Can we create a recipe that delivers the desired taste, texture, and appearance?
  - **Stability:** Can we ensure the product has an acceptable and safe shelf life?
  - **Technology:** Do the technologies required to produce this product exist and are they accessible?
  - *An idea for a great-selling product that is impossible to create is not a viable concept.*
- **(C) Manufacturing Capability (Operational Viability):** This criterion assesses the practical aspects of production. The central question is: "Can we produce this product at scale?"
  - **Equipment and Facilities:** Do we have the necessary production lines and factory infrastructure?
  - **Expertise:** Do our staff have the skills and knowledge to produce the product consistently?
  - **Scalability:** Can we move from a lab-scale prototype to efficient, large-scale manufacturing?
  - *A product that can be made in a lab but not in a factory cannot be a commercial success.*
- **(D) Financial Capability (Economic Viability):** This criterion assesses the profitability and resource requirements. The main question is: "Does this product make financial sense?"
  - **Profitability:** Can the product be produced and sold at a price that generates a profit?
  - **Costs:** What are the estimated costs for R&D, raw materials, production, and marketing?
  - **Funding:** Do we have the necessary capital to fund the entire project from development to launch?
  - *A marketable and manufacturable product that loses money is not a sustainable business proposition.*

Final Answer

Marketability, technical feasibility, manufacturing capability, and financial capability are all critical and interdependent criteria used in the idea screening phase of new product development. A viable idea must satisfy all four.

Quick Tip

Think of the NPD screening process as a checklist for success. A good idea must be **desirable** (marketable), **feasible** (technically possible), **viable** (financially sound), and **producible** (manufacturing capability). All aspects must be considered.

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32. In chiffon cakes, leavening occurs mainly by whipping of the _____

(A) egg yolk
(B) citric acid
(C) egg white
(D) ascorbic acid

Correct Answer: (C) egg white

Solution:

Conceptual Understanding

Leavening is the process of introducing a gas into a batter or dough to create a light, porous, and voluminous structure in the final baked product. This can be achieved through three mechanisms:

- **Chemical Leavening:** Using chemical reactions that produce carbon dioxide gas (e.g., baking soda, baking powder).
- **Biological Leavening:** Using microorganisms, typically yeast, that produce carbon dioxide gas through fermentation.
- **Mechanical Leavening:** Physically incorporating air into a mixture (e.g., by whipping, creaming, or sieving).

Chiffon cakes are a type of foam cake, meaning their primary leavening comes from a mechanically created foam.

Expanded Explanation

- **The Primary Leavening Agent: Whipped Egg Whites** A chiffon cake's signature light, airy, and spongy texture is achieved primarily through the air trapped in a stable **egg white foam**. This is a classic example of mechanical leavening.
  - **Foam Creation:** When egg whites are whipped, the mechanical shear forces cause the proteins (primarily ovalbumin) to denature and unfold.
  - **Air Entrapment:** These unfolded proteins then link together to form a cohesive, elastic network around the air bubbles being incorporated, trapping them and creating a voluminous foam.

- **Expansion during Baking:** When the cake is baked, the heat causes the trapped air bubbles to expand according to the gas laws. This expansion provides the lift, or "rise," for the cake. The heat also coagulates the protein network, setting the light, airy structure permanently.

- **Roles of Other Ingredients:**
  - **Egg Yolk:** Used in the batter portion of the chiffon cake, egg yolks provide richness, flavor, color, and emulsification (due to lecithin), but they cannot form the large, stable foam required for leavening. In fact, fat from the yolk inhibits egg white foaming.
  - **Citric Acid (or Cream of Tartar):** An acid is a crucial *stabilizer*, but not the leavening agent itself. When added to egg whites before whipping, the acid lowers the pH. This helps the proteins denature more easily and prevents them from bonding too tightly, resulting in a more stable, stronger, and more voluminous foam that is less likely to collapse.
  - **Ascorbic Acid (Vitamin C):** While an acid, it is not typically used for stabilizing egg white foams in baking.

Final Answer

The primary leavening in a chiffon cake is **mechanical**. It is achieved by the expansion of air that is trapped within the stable protein foam created by **whipping egg whites**.

Quick Tip

Remember the three main types of foam cakes and their leavening:

- **Angel food cake:** Uses only whipped egg whites.
- **Sponge cake:** Uses both whipped egg whites and whipped egg yolks.
- **Chiffon cake:** Uses whipped egg whites and contains oil/fat for moistness.

In all three, whipped egg whites are a key leavening component.

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33. Hypobaric storage represents storage at _____
(A). Low pressure
(B). High pressure
(C). Low pressure and high humidity
(D). Low pressure and low humidity
Choose the most appropriate answer from the options given below:

(A) (A) and (B) only.
(B) (C) only.
(C) (A), (B), (C) and (D).
(D) (B), (C) and (D) only.

Correct Answer: (B) (C) only.

Solution:

Conceptual Understanding

Hypobaric storage is an advanced form of modified atmosphere storage used to dramatically extend the shelf life of highly perishable produce like fruits, vegetables, and flowers. The term itself provides the key to its mechanism: *hypo-* means "low" and *-baric* relates to "pressure." Thus, it is a low-pressure storage system.

Expanded Explanation: The Dual-Action System

Hypobaric storage relies on the synergistic effect of two critical environmental parameters: low pressure and high humidity. Both are essential for the system to work.

1. **(A) Low Pressure (Sub-Atmospheric):** The core of the technology involves placing the produce in a sealed, refrigerated chamber and using a vacuum pump to maintain a pressure significantly below normal atmospheric pressure. This low pressure has several benefits:
    - **Reduced Oxygen:** The low total pressure reduces the partial pressure of oxygen. This drastically slows down the rate of aerobic respiration in the produce, which is the primary process that consumes stored energy (sugars) and leads to senescence (aging).
    - **Inhibition of Aerobic Microbes:** The low-oxygen environment also suppresses the growth of aerobic spoilage microorganisms like bacteria and molds.
    - **Ethylene Removal:** The constant evacuation of air from the chamber effectively removes ethylene, a volatile plant hormone produced by the fruits themselves that accelerates ripening and aging.
2. **The Need for High Humidity:** Storing produce under low pressure alone would be disastrous. The low-pressure environment creates a very large water vapor pressure deficit between the moist produce and the surrounding air. This would act like a vacuum dryer, causing the produce to rapidly lose water, shrivel, and dehydrate.
    - **Counteracting Dehydration:** To prevent this moisture loss, the atmosphere within the hypobaric chamber must be maintained at a very high relative humidity, typically 90-95% or higher.

Therefore, the complete and accurate description of the technology is **(C) Low pressure and high humidity**. Low pressure with low humidity would be a dehydration process, and high pressure is a completely different technology (e.g., High-Pressure Processing for microbial inactivation).

Final Answer

Hypobaric storage is a preservation technology that combines storage at **low pressure** (to slow respiration and remove ethylene) with **high humidity** (to prevent dehydration), thereby extending the shelf life of fresh produce.

Quick Tip

Break down the word: **Hypo** = Low, **Baric** = Pressure. So, it's low-pressure storage. Then, ask yourself: what would happen to a fruit at low pressure? It would dry out. So, you must add humidity to prevent that. This logic leads you to "Low pressure and high humidity."

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34. Which of the following is commonly used as oxygen scavenger in food packaging?

(A) Powdered iron
(B) Calcium
(C) Potassium permanganate
(D) Chlorine

Correct Answer: (A) Powdered iron

Solution:

Conceptual Understanding

An **oxygen scavenger** (or oxygen absorber) is a key component of **active packaging**. Unlike passive packaging which simply provides a barrier, active packaging systems interact with the internal environment of the package to extend shelf life or improve quality. Oxygen scavengers are placed inside a sealed package in a sachet or as part of the packaging film to actively remove residual oxygen.

Expanded Explanation

- **Purpose:** Removing oxygen from the package headspace protects the food from oxygen-related deterioration, such as:
  - Growth of aerobic spoilage microbes (molds, yeasts, bacteria).
  - Oxidative rancidity of fats and oils.
  - Loss of vitamins and color degradation.
- **The Standard Chemical: Powdered Iron** The most common and commercially widespread chemical used in oxygen scavenging sachets is **powdered iron (Fe)**.
  - **Mechanism of Action:** The scavenger works through the simple and irreversible chemical process of iron oxidation, more commonly known as **rusting**. In the presence of water, iron reacts with oxygen to form hydrated iron oxide (rust). The simplified chemical reaction is: $4Fe + 3O_2 + 6H_2O \rightarrow 4Fe(OH)_3$ (hydrated iron(III) oxide)
  - **Effectiveness:** This reaction is highly efficient and can reduce the oxygen level inside a package to below 0.01%, effectively creating an anaerobic environment. The sachet

also contains activators like salt and a moisture-retaining substance (like activated carbon) to facilitate the reaction.

- **Analysis of Other Chemicals:**
  - **Calcium (e.g., Calcium Oxide, CaO):** Primarily used as a **desiccant** to absorb moisture, not oxygen. It reacts with water to form calcium hydroxide.
  - **Potassium Permanganate ($KMnO_4$):** A strong oxidizing agent, but it is used as an **ethylene scavenger**. It oxidizes the ethylene gas produced by fruits and vegetables, thereby slowing the ripening process.
  - **Chlorine (Cl_2):** A powerful disinfectant and sanitizing agent. It is not used for scavenging oxygen within a sealed food package due to its high reactivity and potential to form harmful compounds with food components.

Final Answer

The standard and most common chemical used in oxygen scavenging sachets for food packaging applications is **powdered iron**.

Quick Tip

Think of the small "Do Not Eat" packets found in jerky, nuts, or cured meats. These are oxygen scavengers, and they almost always contain iron powder that "rusts" to remove oxygen and extend shelf life.

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35. Match List-I with List-II

List-I **Method**	**List-II** **Process**
(A) Rigor mortis	(I) Papain
(B) Tenderization of meat	(II) Muscle stiffness
(C) Evisceration	(III) Removal of feathers
(D) Scalding	(IV) Inspection of viscera

Choose the most appropriate answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (C) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

This question requires matching key physiological processes and operational steps that occur during and after animal slaughter with their correct definitions or associated items.

Expanded Explanation: Analysis of Pairings

- **(A) Rigor mortis → (II) Muscle stiffness** *Rigor mortis* is a Latin term literally meaning "stiffness of death." It is the well-understood post-mortem physiological process where, due to the cessation of blood flow and oxygen supply, the muscle cells run out of ATP (energy). Without ATP, the contractile proteins (actin and myosin) form permanent cross-bridges, causing the muscles to become stiff, rigid, and inextensible. This is a direct match.
- **(B) Tenderization of meat → (I) Papain** Tenderization is the process of making meat less tough. This can be done mechanically (pounding), by aging (endogenous enzymes), or by adding exogenous enzymes. **Papain** is a potent proteolytic enzyme (protease) extracted from the latex of the papaya fruit. It is the active ingredient in many commercial meat tenderizer powders. When applied to meat, it breaks down tough muscle fiber proteins and connective tissue (collagen), resulting in a more tender product. This is a correct pairing of a process with its agent.
- **(C) Evisceration → (IV) Inspection of viscera** In the slaughter process, **evisceration** is the step where the internal organs (the viscera, including the heart, lungs, liver, and digestive tract) are removed from the carcass. By law in regulated facilities, this step is immediately followed by a post-mortem **inspection of the viscera** by a qualified veterinarian or inspector. They check for signs of disease, parasites, or contamination to ensure the meat is safe and wholesome for consumption. The process and its subsequent mandatory check are directly linked.
- **(D) Scalding → (III) Removal of feathers Scalding** is a critical step in poultry processing. After slaughter and bleeding, the bird carcasses are immersed in a tank of precisely temperature-controlled hot water (typically 50-65°C). The heat denatures the proteins within the feather follicles, which causes them to relax their grip on the feathers. This makes the subsequent mechanical **removal of feathers** (defeathering or picking) much faster, easier, and more complete. The two steps are sequential and functionally linked.

Final Answer

The correct pairings are: (A) Rigor mortis - (II) Muscle stiffness, (B) Tenderization of meat - (I) Papain, (C) Evisceration - (IV) Inspection of viscera, and (D) Scalding - (III) Removal of feathers.

Quick Tip

Visualize the poultry processing line: Scalding (hot water) happens before feather removal. Evisceration (organ removal) is done before inspection. For meat science, remember Rigor Mortis is the stiffening, and enzymes like Papain are used for tenderizing.

---

36. The penetration of fat within the muscle fibre when an animal is well fed, is called as _____

(A) stabilization
(B) marbling
(C) ageing
(D) rigor mortis

Correct Answer: (B) marbling

Solution:

Conceptual Understanding

The distribution and amount of fat are critical determinants of meat quality, influencing its flavor, juiciness, and tenderness. The specific term for fat deposited within the muscle tissue itself is a key concept in meat science and grading.

Expanded Explanation

- **Marbling:** The correct term is **marbling**. It refers to the streaks and flecks of **intramuscular fat** (fat within the muscle) that are visible in a cut of meat. It is called marbling because the fine lines of white fat resemble the patterns in a marble stone.
  - **Impact on Quality:** Marbling is one of the most important factors in grading meat quality (e.g., USDA Prime, Choice, Select; or Japanese A5). Higher levels of marbling are highly desirable because the fat melts during cooking, leading to a more juicy, flavorful, and tender eating experience.
- **Analysis of Other Terms:**
  - **Stabilization:** This is a general term meaning to make a system stable (e.g., an emulsion). It is not specific to meat science or fat deposition.
  - **Ageing (or Aging):** This is the post-mortem process of holding meat at controlled, refrigerated temperatures for a period of time. During aging, natural enzymes in the meat break down muscle proteins, which increases tenderness. It is a tenderization process, not a term for fat deposition.
  - **Rigor Mortis:** This is the post-mortem stiffening of muscles due to the depletion of ATP. It is a temporary phase in the conversion of muscle to meat.

Final Answer

The specific term for the deposition of intramuscular fat within the lean tissue of meat, a key indicator of quality, is **marbling**.

> Quick Tip
>
> When you see a high-quality cut of steak with fine white lines of fat running through the red meat, you are looking at marbling. It's a visual indicator of a tender and flavorful piece of meat.

---

37. The molten mixture of sand, soda, limestone for the development of glass is called as _____

(A) mold
(B) gob
(C) curing
(D) annealing

Correct Answer: (B) gob

Solution:

Conceptual Understanding

The manufacture of glass containers (bottles, jars) is a high-temperature process that involves melting raw materials and then precisely forming the molten glass. The terminology used in this process is specific to the industry.

Expanded Explanation

- **The Process Flow:** Raw materials (sand, soda ash, limestone, etc.) are heated in a furnace to over 1500°C until they become a homogenous molten liquid, often called the glass melt. To form individual containers, a precise amount of this melt is needed for each one.
- **The Gob:** A specific, measured quantity of molten glass, sheared off from the main flow of glass from the furnace, is called a **gob**. The gob is the exact amount of glass required to form one single container. Its temperature and viscosity are critical. This gob is then delivered to a forming machine.
- **Analysis of Other Terms:**
  - **Mold:** This is the tool used to shape the glass, not the portion of glass itself. The hot gob is dropped into a mold, where it is either pressed or blown into the final shape of the bottle or jar.

– **Curing:** This term is not typically used in glass manufacturing. It refers to a process of hardening or setting, commonly associated with polymers (plastics), concrete, or adhesives.
– **Annealing:** This is a crucial step that occurs *after* the glass container has been formed. The newly formed bottle is passed through a temperature-controlled oven called a lehr, where it is slowly and uniformly cooled. This process relieves internal stresses that are created during rapid cooling, preventing the glass from becoming brittle and shattering easily.

Final Answer

In glass manufacturing, a measured portion of the molten glass mixture that is used to form a single glass container is known as a **gob**.

Quick Tip

Visualize a glass bottle factory. A stream of glowing, molten glass comes out of the furnace. Shears cut off a precise "gob" of this glass, which then drops into a mold to be shaped. The gob is the raw material unit for one bottle.

---

38. Application of silicone on the glass bottle surface during their manufacturing helps in
(A). Maintaining glossy appearance
(B). Prevents breakage
(C). Decreases the noise on contact
(D). Prevents spoilage
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (D) only.
(B) (A), (B) and (C) only.
(C) (A), (B), (C) and (D).
(D) (B), (C) and (D) only.

Correct Answer: (B) (A), (B) and (C) only.

Solution:

Conceptual Understanding

During glass bottle manufacturing, protective surface coatings are applied in two stages. A "hot-end" coating is applied before annealing, and a "cold-end" coating is applied after. The cold-end coating, often silicone-based, is crucial for protecting the bottle and facilitating its handling on high-speed filling lines.

Expanded Explanation: The Benefits of Lubricity

The primary function of the silicone coating is to provide **lubricity**—it makes the bottle surface very slippery. This property yields several key benefits:

- **(A) Maintaining Glossy Appearance:** On a high-speed filling line, uncoated bottles would rub and bump against each other and against guide rails. This abrasion would cause scuffing and scratches, dulling the surface and ruining the bottle's glossy, pristine appearance. The silicone coating acts as a lubricant, allowing bottles to slide past each other without damage, thus preserving their gloss.
- **(B) Prevents Breakage:** The strength of a glass bottle is determined by the integrity of its surface. Scratches and abrasions create microscopic surface flaws (known as Griffith flaws) which act as points of stress concentration. When the bottle is subjected to impact or internal pressure (e.g., from a carbonated beverage), the stress at these flaw points can exceed the strength of the glass, causing it to break. By preventing scratches, the lubricant coating preserves the bottle's original strength and significantly reduces the risk of breakage.
- **(C) Decreases Noise on Contact:** The high friction between uncoated glass bottles moving at speed on a conveyor belt generates a significant amount of clatter and noise. The lubricity provided by the silicone coating allows the bottles to glide smoothly and quietly, dramatically reducing the noise level on the production line.
- **(D) Prevents Spoilage (Incorrect):** This statement is false. The silicone coating is a thin, external layer with no antimicrobial or barrier properties. The prevention of spoilage is the function of the food preservation method used (e.g., pasteurization, preservatives) and the hermetic integrity of the bottle's cap or closure, which prevents microbial recontamination.

Final Answer

The application of a silicone coating to glass bottles helps maintain a glossy appearance, prevent breakage by reducing scratches, and decrease noise on filling lines.

Quick Tip

The primary function of a silicone coating on glass is to make it slippery. This slipperiness prevents scratches (which maintains gloss and strength) and reduces noise on the production line. It's a physical protection, not a chemical or microbial one.

---

39. Sugarcane gur (jaggery) contains _____ % sucrose.

(A) 65 to 85
(B) 20 to 30
(C) 35 to 40
(D) 50 to 60

Correct Answer: (A) 65 to 85

Solution:

Conceptual Understanding

Gur, also known as jaggery, is a traditional **non-centrifugal sugar**. This means it is produced by concentrating sugarcane juice through boiling, but without the step of centrifugation that separates the sugar crystals from the molasses. This retention of molasses gives jaggery its characteristic color, flavor, and nutritional profile, which is distinct from refined sugar.

Expanded Explanation: Typical Composition

Because jaggery is a less-refined product, its composition is more complex than that of white sugar. While sucrose is still the main component, other constituents are present in significant amounts. A typical composition for good quality sugarcane jaggery is:

- **Sucrose: 65-85%** This is the primary sugar component, but its concentration is significantly lower than that of refined sugar.
- **Invert Sugars (Glucose and Fructose): 10-15%** These simple sugars are formed by the partial inversion (breakdown) of sucrose during the acidic boiling process. They contribute to jaggery's sweetness and hygroscopic (moisture-attracting) properties.
- **Moisture: 5-10%** Jaggery retains a higher moisture content than crystalline sugar, contributing to its softer texture.
- **Ash (Minerals): 2-5%** This represents the mineral content retained from the sugarcane molasses, including iron, magnesium, and potassium, which are almost entirely removed from refined sugar.

In contrast, refined white table sugar is purified to be ¿99.7% sucrose. Therefore, the range of **65 to 85%** accurately reflects the typical sucrose content of traditional sugarcane gur.

Final Answer

Sugarcane jaggery typically contains **65 to 85 percent** sucrose.

> Quick Tip
>
> Remember that jaggery is basically solidified, concentrated sugarcane juice. It's mostly sugar, so the percentage of sucrose must be high. However, it's not pure sugar, so it won't be close to 100%. The 65-85% range is the most logical choice.

---

40. During processing, the characteristic flavor is developed in cocoa:

(A) Cooking
(B) Roasting

(C) Boiling
(D) Frying

Correct Answer: (B) Roasting

Solution:

Conceptual Understanding

The characteristic and complex flavor of chocolate is not present in the raw cocoa bean. It is developed through a series of carefully controlled processing steps. While the foundation is laid during fermentation, the primary flavor profile is created during a critical high-temperature step.

Expanded Explanation: A Two-Stage Flavor Development Process

1. **Stage 1: Precursor Development (Fermentation)** Immediately after harvest, raw cocoa beans undergo fermentation. This process kills the bean and breaks down internal cell walls, allowing enzymes to create the essential building blocks for chocolate flavor:

   - **Amino acids** (from protein breakdown)
   - **Reducing sugars** (from sucrose breakdown)

   At the end of fermentation, the beans have a harsh, acidic, and astringent taste; they do not taste like chocolate. They only contain the *potential* for chocolate flavor.

2. **Stage 2: Flavor Creation (Roasting)** The main flavor profile is created during the **roasting** step. The dried, fermented cocoa nibs are heated to high temperatures (typically 120-160°C). This heat triggers a cascade of chemical reactions between the precursors formed during fermentation:

   - **Maillard Reaction:** This is a complex reaction between amino acids and reducing sugars. It is responsible for creating hundreds of different flavor compounds that give chocolate its nutty, caramel-like, roasted, and malty notes. It also develops the characteristic brown color.
   - **Strecker Degradation:** A related reaction that specifically produces aromatic aldehydes. These volatile compounds are crucial contributors to the distinct "chocolatey" aroma.

The other terms (cooking, boiling, frying) are either too general or are not the correct technical terms for this specific and critical flavor development stage in cocoa processing.

Final Answer

While flavor precursors are formed during fermentation, the characteristic flavor and aroma of cocoa are primarily developed during the **roasting** process through the Maillard reaction and Strecker degradation.

Quick Tip

Just like coffee beans, cocoa beans must be roasted to unlock their flavor. Associate the process of "roasting" with the development of the rich, complex flavors in both coffee and chocolate.

---

41. Increase in volume of bread during baking is known as _____

(A) sheen
(B) oven spring
(C) bloom
(D) rising

Correct Answer: (B) oven spring

Solution:

Conceptual Understanding

When bread dough is introduced to the intense heat of an oven, it undergoes a final, dramatic burst of expansion before the crust solidifies. This phenomenon is a critical factor in achieving a light, airy crumb and a good overall volume in the finished loaf. It has a specific technical name in baking.

Expanded Explanation

The correct term for this rapid increase in volume during the initial phase of baking is **Oven Spring** (or oven kick). This occurs in the first 10-12 minutes of baking, before the internal temperature of the dough becomes high enough to kill the yeast and set the crust. Oven spring is driven by two primary physical and biological processes:

1. **Accelerated Fermentation:** The initial heat of the oven rapidly warms the dough. This raises the temperature of the yeast into its optimal activity range (around 35-40°C or 95-105°F), causing it to ferment vigorously and produce a large, final burst of carbon dioxide (CO_2) gas.
2. **Thermal Expansion of Gases:** According to the gas laws, gases expand when heated.
    - The existing CO_2 bubbles trapped within the gluten network, along with the newly produced CO_2, expand significantly as their temperature rises.
    - The water within the dough turns to steam, which occupies a much larger volume than liquid water. This expansion of steam also contributes powerfully to the leavening effect.

0.0.12 Comparison with Other Terms

- **Rising:** This is a general term that describes the increase in dough volume during the bulk fermentation and final proofing stages, which occur *before* the dough enters the oven. Oven spring specifically refers to the rising that happens *inside* the oven.
- **Bloom:** This describes the desirable way the crust of the bread opens up or "blooms" along the score lines (cuts made on the dough surface). A good bloom is a result of a good oven spring, but it is not the term for the volume increase itself.
- **Sheen:** This refers to the glossy, shiny appearance of the crust. It is a visual attribute, often enhanced by applying an egg wash or using steam injection during baking, and is unrelated to the increase in volume.

Final Answer

The final, rapid burst of leavening that bread dough undergoes in the first few minutes of baking is correctly known as **oven spring**.

> Quick Tip
>
> Think of the dough "springing" into action one last time when it feels the intense heat of the oven. This final expansion before the crust sets is the "oven spring."

---

42. _____ are responsible for the flavor and aroma of bread.

(A) Propanol and maltol
(B) Flavanol and isomaltol
(C) Maltol and Isomaltol
(D) Maltose and galactose

Correct Answer: (C) Maltol and Isomaltol

Solution:

Conceptual Understanding

The complex and appealing flavor and aroma of baked bread are not inherent in its raw ingredients (flour, water, salt, yeast). Instead, these characteristics are developed through a series of chemical reactions during fermentation and, most significantly, during the high-heat baking process.

Expanded Explanation: The Chemistry of Crust Flavor

The desirable roasted, nutty, and caramel-like notes in bread crust are primarily generated by two types of non-enzymatic browning reactions:

1. **Maillard Reaction:** A complex reaction between amino acids (from the flour's protein) and reducing sugars (like maltose, glucose). This reaction produces a vast array of compounds, including melanoidins (which give the brown color) and numerous aromatic compounds.
2. **Caramelization:** The thermal decomposition of sugars at high temperatures, which produces sweet, nutty, and slightly bitter flavor compounds.

Among the hundreds of compounds formed, **Maltol** and **Isomaltol** are particularly important contributors to the characteristic "baked" aroma.

- **Maltol:** This compound is formed during the thermal processing of carbohydrates. It has a characteristic sweet, caramel, or cotton candy-like aroma and enhances the perception of sweetness in the crust.
- **Isomaltol:** Also produced during high-heat reactions, Isomaltol contributes to the caramel and roasted notes of the bread crust.

0.0.13 Analysis of Other Options

- **Propanol:** This is an alcohol that can be a minor byproduct of yeast fermentation. It is highly volatile and does not define the primary character of baked bread aroma.
- **Flavanol:** This is a class of polyphenolic compounds (flavonoids) found in plants like tea and cocoa. It is not associated with the primary aroma of bread.
- **Maltose and Galactose:** These are sugars. They are crucial *precursors* or *reactants* in the Maillard and caramelization reactions, but they are not the final aromatic compounds themselves.

Final Answer

Maltol and **Isomaltol** are key flavor compounds, formed during baking via Maillard and caramelization reactions, that are responsible for the desirable sweet, caramel, and roasted aroma of bread.

> Quick Tip
>
> For questions about the flavor of baked goods (bread, cookies) or roasted products (coffee, cocoa), the answer often involves compounds formed by the Maillard reaction and caramelization. Maltol is a classic example of such a compound.

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43. Match List-I with List-II

List-I Food	**List-II Toxicant**
(A) Peas	(I) Hemagglutinins
(B) Soyabean	(II) Saponins
(C) Spinach	(III) Prussic acid
(D) Almond	(IV) Oxalic acid

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(B) (A) - (I), (B) - (III), (C) - (II), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

Many raw plant foods contain naturally occurring compounds known as anti-nutritional factors or toxicants. These substances can interfere with nutrient absorption or be toxic if consumed in sufficient quantities without deactivation, which is often achieved through processing like cooking, soaking, or sprouting.

Expanded Explanation: Matching Foods to Their Toxicants

- **(A) Peas → (I) Hemagglutinins:** Peas, like most legumes, contain proteins called **lectins**, a major group of which are the hemagglutinins. These proteins have the ability to bind to carbohydrate molecules on the surface of cells, particularly red blood cells, causing them to clump together (agglutination). If consumed raw in large amounts, they can disrupt the lining of the digestive tract and interfere with nutrient absorption. Fortunately, lectins are heat-labile, meaning they are denatured and inactivated by thorough cooking.
- **(B) Soyabean → (II) Saponins:** Soybeans contain a variety of anti-nutritional factors, including trypsin inhibitors and lectins. They are also known to contain **saponins**, which are a class of bitter-tasting glycosides that have soap-like foaming properties when agitated in water. While they have some negative effects, they are also being researched for potential health benefits.
- **(C) Spinach → (IV) Oxalic acid:** Spinach is famously high in **oxalic acid**. This organic acid is a potent chelating agent, meaning it can bind tightly with divalent metal ions. In the digestive tract, it binds with minerals like calcium and iron from the spinach and other foods, forming insoluble salts (calcium oxalate, iron oxalate). This process makes these essential minerals unavailable for absorption by the body. This is why the calcium in spinach is not considered bioavailable.
- **(D) Almond → (III) Prussic acid:** This refers specifically to bitter almonds, not the sweet almonds commonly eaten. Bitter almonds contain high levels of a cyanogenic glycoside called **amygdalin**. When the almond seed is crushed, chewed, or damaged, an enzyme (emulsin) comes into contact with amygdalin, hydrolyzing it to release benzaldehyde (which gives the characteristic "almond" aroma), glucose, and highly toxic **hydrogen cyanide (HCN)**. Prussic acid is an older, common name for hydrogen cyanide. Ingesting even a small number of raw bitter almonds can be lethal.

Final Answer

The correct pairings are: (A) Peas - (I) Hemagglutinins, (B) Soyabean - (II) Saponins, (C) Spinach - (IV) Oxalic acid, and (D) Almond - (III) Prussic acid.

> Quick Tip
>
> Memorize these common food-toxicant pairs for exams: Legumes (beans, peas) → Lectins/Hemagglutinins; Spinach/Rhubarb → Oxalic Acid; Bitter Almonds/Cassava → Cyanide/Prussic Acid; Soybeans → Trypsin inhibitors/Saponins.

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44. A flexible pouch capable of withstanding temperatures of about 120 °C is known as _____

(A) High barrier plastic
(B) Microwave-ovenable package
(C) Retortable pouch
(D) Aseptic pouch

Correct Answer: (C) Retortable pouch

Solution:

Conceptual Understanding

"In-package" thermal sterilization, also known as retorting or autoclaving, is a preservation method where food is sealed in a container and then heated to high temperatures (typically 121°C or 250°F) under pressure to achieve commercial sterility. This process requires packaging that can withstand these harsh conditions.

Expanded Explanation

- **Retortable Pouch:** This is the correct term for a flexible, laminated pouch specifically engineered to be a lightweight, modern alternative to a metal can.
  - **Construction:** It is a multi-layer composite material, typically consisting of an outer layer for strength and printability (e.g., polyester), a middle barrier layer (e.g., aluminum foil or a specialty polymer) to block oxygen, light, and moisture, and an inner layer for food contact and heat-sealing (e.g., polypropylene).
  - **Function:** This construction allows the pouch to withstand the high temperatures and external pressures of the retorting process without delaminating, losing its barrier properties, or compromising its seal integrity.
- **Analysis of Other Options:**

- **High barrier plastic:** This describes a *property* of a material, not a final package type. While retort pouches are made from high-barrier plastics, "high barrier plastic" is not the name of the pouch itself.
- **Microwave-ovenable package:** This packaging is designed to be used by the consumer for reheating in a microwave. It does not necessarily have the structural integrity or material stability to withstand the intense conditions of industrial retorting.
- **Aseptic pouch:** This describes a completely different sterilization process. In aseptic packaging, the food product and the packaging material are sterilized *separately* in different systems. The sterile food is then filled into the sterile package within a commercially sterile environment. The filled and sealed package is **not** subjected to a final high-heat retorting step.

Final Answer

A flexible pouch specifically designed to withstand in-package sterilization at temperatures around 121°C in a retort is called a **retortable pouch**.

Quick Tip

Associate the word "retort" with high-temperature sterilization (like a pressure cooker). A "retortable pouch" is essentially a flexible can, designed to go through this process.

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45. Match List-I with List-II

List-I (Can Name)	**List-II (Dimension)**
(A) 62	(I) 307 x 409
(B) No.2	(II) 203 x 308
(C) No.10	(III) 303 x 406
(D) 303	(IV) 603 x 700

Choose the most appropriate answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Correct Answer: (B) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

To ensure consistency and interchangeability in the food processing and packaging industries, metal cans are manufactured to standardized dimensions. These dimensions are designated by a three-digit code for the diameter and a three-digit code for the height (e.g., Diameter x Height).

Expanded Explanation: Decoding the System

The three-digit code is a shorthand for inches and sixteenths of an inch.

- The **first digit** represents the number of whole inches.
- The **next two digits** represent the number of sixteenths of an inch.

Example: A dimension of **307** is decoded as **3 and 7/16 inches**.

0.0.14 Matching Cans to Dimensions

- **(C) No. 10 Can → (IV) 603 x 700:** This is a large, institutional or food-service size can.
  - Diameter (603) = **6 and 3/16 inches**
  - Height (700) = **7 and 0/16 inches (or 7 inches)**

  This is the standard dimension for a No. 10 can.
- **(B) No. 2 Can → (I) 307 x 409:** This is a common retail can size.
  - Diameter (307) = **3 and 7/16 inches**
  - Height (409) = **4 and 9/16 inches**

  This is the standard dimension for a No. 2 can.
- **(D) 303 Can → (III) 303 x 406:** Another very common retail can, slightly smaller than a No. 2 can.
  - Diameter (303) = **3 and 3/16 inches**
  - Height (406) = **4 and 6/16 inches (or 4 3/8 inches)**
- **(A) 6Z → (II) 203 x 308:** By elimination, this can name matches the remaining dimension.
  - Diameter (203) = **2 and 3/16 inches**
  - Height (308) = **3 and 8/16 inches (or 3 1/2 inches)**

Final Answer

The correct pairings based on the standard can dimension coding system are: (A)-(II), (B)-(I), (C)-(IV), and (D)-(III).

Quick Tip

For can sizes, remember the largest and most common: the No. 10 can is the huge one used in restaurants (603 x 700). The 303 can is a very standard supermarket size. Knowing these two can often help you solve the matching question by elimination.

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46. Which of the following is NOT a type of "Difference test"?

(A) Duo-trio test
(B) Triangle test
(C) Paired-comparison test
(D) Hedonic test

Correct Answer: (D) Hedonic test

Solution:

Conceptual Understanding

Sensory evaluation is a scientific discipline used to evoke, measure, analyze, and interpret reactions to the characteristics of food as they are perceived by the senses. The tests are broadly divided into two main categories based on their objective.

Expanded Explanation

- **Analytical Tests:** These tests are objective and focus on the properties of the product itself. The goal is to obtain factual information about the food. They often use trained or expert panelists. Analytical tests can be further subdivided:
  - **Difference Tests (or Discrimination Tests):** These are used to determine if a sensory difference exists between two or more products. They answer the question, "Are the products different?" They do not ask about preference. Examples include:
    - **Triangle Test:** Three samples are presented (two are identical, one is different). The panelist must identify the odd sample.
    - **Duo-Trio Test:** A reference sample is presented, followed by two other samples. The panelist must identify which of the two samples matches the reference.
    - **Paired-Comparison Test:** Two samples are presented. Panelists are asked to identify which sample has more of a specific attribute (e.g., "Which is sweeter?"). This is a directional difference test.
  - **Descriptive Tests:** These are used to identify and quantify the specific sensory attributes of a product (e.g., Quantitative Descriptive Analysis).
- **Affective Tests (or Consumer Tests):** These tests are subjective and focus on the consumer's response to a product. The goal is to measure personal feelings like preference, liking, or acceptance. These tests use untrained consumers from the target population.

– **Hedonic Test:** This is the most common affective test. It directly measures how much a consumer likes or dislikes a product. Panelists rate their liking on a scale, most famously the **9-point hedonic scale**, which ranges from "Dislike Extremely" (1) to "Like Extremely" (9).

Final Answer

The Duo-trio, Triangle, and Paired-comparison tests are all types of analytical difference tests. The **Hedonic test** is fundamentally different because its purpose is to measure liking, making it an affective test, not a difference test.

Quick Tip

Remember the core question each sensory test answers:

- Difference Tests (Triangle, Duo-Trio): "Are they different?"
- Affective/Hedonic Tests: "How much do you like it?"

This distinction is key to classifying them correctly.

---

47. QRAC stands for:

(A) Qualitative Risk Analyzing Committee
(B) Qualitative Risk Assessment Committee
(C) Quantitative Risk Assessment Committee
(D) Quantitative Risk Analysing Committee

Correct Answer: (C) Quantitative Risk Assessment Committee

Solution:

Conceptual Understanding

Risk assessment in fields like food safety is a structured, scientific discipline with specific terminology. An acronym like QRAC would refer to a formal body or committee involved in this process.

Expanded Explanation

0.0.15 Understanding Risk Assessment

Risk Assessment is a formal, scientifically-based process comprising four steps, as defined by international bodies like the Codex Alimentarius Commission:

1. Hazard Identification
2. Hazard Characterization

3. Exposure Assessment
4. Risk Characterization

"Risk Analyzing" is a less formal, more general term. Therefore, options with "Risk Assessment" are more likely to be correct in a formal context.

0.0.16 Qualitative vs. Quantitative Risk Assessment

Risk assessments can be categorized by their approach:

- **Qualitative Risk Assessment:** This approach describes the risk in non-numerical terms, using categories like "high," "medium," "low," or "negligible." It is often used for screening or when data is limited.
- **Quantitative Risk Assessment (QRA):** This approach uses mathematical and statistical models to provide a numerical estimate of the risk. For example, it might estimate the probability of illness per serving of a food product. QRA is data-intensive and provides a more detailed and precise characterization of the risk.

0.0.17 Expanding the Acronym

Given this context, the acronym **QRAC** most plausibly and directly expands to **Quantitative Risk Assessment Committee**. This would describe a specialized expert committee convened to conduct, review, or provide guidance on complex quantitative risk assessments. This is a recognized concept within scientific and regulatory fields dealing with risk. While a "Qualitative" committee could exist, the "Q" in the acronym most commonly and directly stands for "Quantitative."

Final Answer

In the context of scientific risk evaluation, the most accurate and standard expansion of the acronym QRAC is **Quantitative Risk Assessment Committee**.

> Quick Tip
>
> In technical acronyms, always choose the most formal and precise terminology. "Assessment" is the standard term for the formal process, more so than "Analyzing". Both "Qualitative" and "Quantitative" are valid types, but "Quantitative" fits the "Q" in the acronym.

---

48. The instrument used to measure plasticity of bread dough is known as

(A) Penetrometer
(B) Fibrograph meter
(C) Tenderometer
(D) Brabender Farinograph

Correct Answer: (D) Brabender Farinograph

Solution:

Conceptual Understanding

Dough rheology is the scientific study of the flow and deformation of dough under applied force. Properties like plasticity (the ability to be shaped and hold that shape) and elasticity (the ability to spring back after deformation) are critical for predicting how dough will behave during processing (mixing, sheeting, moulding) and for determining the final quality of the baked product. Specialized instruments are used to measure these properties.

Expanded Explanation

- **Brabender Farinograph:** This is the correct instrument. It is a standard piece of equipment in the cereal and baking industries specifically designed to measure the rheological properties of dough during mixing.
  - **Principle of Operation:** It functions as a recording dough mixer. It measures the torque, or resistance, that a dough exerts against two rotating mixer blades as it is being mixed. This resistance is plotted against time on a chart called a **Farinogram**.
  - **Information Gained:** The Farinogram provides crucial data related to the dough's physical properties, including:
    - **Water Absorption:** The amount of water required to achieve a standard dough consistency.
    - **Dough Development Time:** The time it takes for the dough to reach its maximum consistency (optimal gluten development).
    - **Stability and Mixing Tolerance:** How long the dough maintains its maximum consistency before the gluten network begins to break down from overmixing. These measurements are directly related to the dough's strength, plasticity, and elasticity.
- **Analysis of Other Instruments:**
  - **Penetrometer:** Measures hardness or consistency by measuring how deep a standard cone or needle penetrates a sample under a fixed weight. It is used for fats, gels, and some fruits, not for mixing dough.
  - **Fibrograph meter:** This is an instrument used in the **textile industry** to measure the length, uniformity, and strength of cotton fibers. It has no application in baking.
  - **Tenderometer:** This instrument measures the tenderness of foods, most famously peas, by measuring the force required to crush or shear a sample. It is not used for dough.

Final Answer

The **Brabender Farinograph** is the instrument specifically designed to measure the physical and rheological properties, including plasticity and elasticity, of bread dough during the mixing process.

Quick Tip

Associate key instruments with their function in cereal science:

- **Farinograph:** Dough behavior during mixing.
- **Extensograph:** Dough resistance to stretching and elasticity.
- **Alveograph:** Dough tenacity, extensibility, and baking strength by inflating a dough bubble.

---

49. The 'AGMARK' standard was set up by

(A) Ministry of Health and Family Welfare
(B) Ministry of Agriculture
(C) Directorate of Marketing and Inspection
(D) Directorate of Quality and Inspection

Correct Answer: (C) Directorate of Marketing and Inspection

Solution:

Conceptual Understanding

AGMARK is a certification mark used on agricultural products in India, signifying that they conform to a set of grade standards established by the Government of India. The question asks to identify the specific governmental body that sets up and administers this certification scheme.

Expanded Explanation

- **Acronym and Legislation:** The term **AGMARK** stands for **AG**ricultural **MARK**. The legal framework for this certification was established by the Agricultural Produce (Grading and Marking) Act of 1937.
- **The Responsible Body: DMI** The legally constituted body responsible for formulating the grade standards, promoting them, and implementing the certification and inspection scheme for AGMARK is the **Directorate of Marketing and Inspection (DMI)**.
- **Governmental Hierarchy:** It is important to understand the organizational structure to see why DMI is the most precise answer.
  - The **Ministry of Agriculture and Farmers Welfare** is the parent ministry responsible for agriculture in India.
  - Within this ministry is the Department of Agriculture and Farmers Welfare.
  - The **Directorate of Marketing and Inspection (DMI)** is an attached office of this department.

Therefore, while the Ministry of Agriculture is ultimately in charge, the DMI is the specific agency directly tasked with the day-to-day administration, standard setting, and implementation of the AGMARK scheme.

- **Other Ministries:** The Ministry of Health and Family Welfare is responsible for general food safety and oversees the Food Safety and Standards Authority of India (FSSAI), which has a different mandate from AGMARK's focus on agricultural grade standards.

Final Answer

The AGMARK standard is set up and implemented by the **Directorate of Marketing and Inspection (DMI)**.

Quick Tip

The name itself is a clue: **AGMARK** = **AG**ricultural **MARK**eting. This directly links the standard to the Directorate of **Marketing** and Inspection.

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50. The Codex Alimentarius Commission was established under the authority of
(A). World Health Organization
(B). World Trade Organization
(C). Food and Agriculture Organization
(D). International Organization for Standardization
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (C) only
(B) (A) and (D) only
(C) (A) and (C) only
(D) (B), (C) and (D) only

Correct Answer: (C) (A) and (C) only

Solution:

Conceptual Understanding

The **Codex Alimentarius Commission (CAC)**, the preeminent international food standards-setting body, was created to address global concerns about food safety, quality, and trade. Its establishment was a collaborative effort between two specialized agencies of the United Nations.

Expanded Explanation

- **Establishment and Purpose:** The Codex Alimentarius Commission was established in 1963 as the central body of the Joint FAO/WHO Food Standards Programme. Its dual mandate is:

1. To protect the health of consumers.
2. To ensure fair practices in the international food trade.

- **The Two Founding Organizations:** The CAC was jointly created and is jointly administered by two key UN organizations:
  - **(A) World Health Organization (WHO):** As the UN's authority on international public health, the WHO's involvement ensures that Codex standards are based on sound science and are protective of human health.
  - **(C) Food and Agriculture Organization (FAO):** As the UN's agency for leading international efforts to defeat hunger and improve nutrition and food security, the FAO's involvement ensures that standards are practical for the global food supply chain and promote food quality.

  The collaboration between these two bodies ensures a comprehensive approach that balances public health with food production and trade considerations.
- **Roles of Other Organizations:**
  - **World Trade Organization (WTO):** The WTO did not establish Codex. However, under its Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), the WTO recognizes Codex standards as the international benchmark for food safety. Countries that base their national regulations on Codex standards are presumed to be in compliance with WTO rules.
  - **International Organization for Standardization (ISO):** The ISO is a separate, independent, non-governmental organization that develops a wide range of voluntary international standards. While it has developed important food safety management system standards like ISO 22000, it is not the intergovernmental body responsible for creating the food standards found in the Codex Alimentarius.

Final Answer

The Codex Alimentarius Commission was jointly established by the **World Health Organization (WHO)** and the **Food and Agriculture Organization (FAO)**.

Quick Tip

Remember the partnership that created Codex: The FAO brings expertise in **food and agriculture**, while the WHO brings expertise in public **health**. Together, they create standards for safe food.

---

51. Bananas usually get spoiled due to chilling injury when stored at temperature

(A) <12 °C
(B) <18 °C
(C) <15 °C
(D) <21 °C

Correct Answer: (A) <12 °C

Solution:

Conceptual Understanding

Chilling injury is a physiological disorder, a type of cellular damage that affects many plants and produce of tropical or subtropical origin when they are exposed to low temperatures that are above their freezing point. It is not frost damage. The injury manifests as a variety of external and internal symptoms that are often mistaken for spoilage but are rooted in a metabolic disruption. Bananas are a classic and highly sensitive example.

Expanded Explanation

The susceptibility of bananas to chilling injury is due to the composition of their cellular membranes, which are adapted for warm climates.

- **Mechanism of Injury:** At low temperatures, the lipids in the cell membranes undergo a phase transition, changing from a flexible, fluid state to a rigid, gel-like state. This loss of membrane fluidity disrupts normal cellular functions, leading to:
  - Increased membrane permeability, causing leakage of ions and metabolites between cell compartments.
  - Impaired function of membrane-bound enzymes, disrupting key metabolic pathways like respiration and ripening.
  - Production of toxic compounds and reactive oxygen species that further damage tissues.
- **Critical Temperature Threshold:** For bananas, the critical temperature below which these changes and subsequent damage begin to occur is widely recognized to be approximately **12-13°C (about 54-55°F)**.
- **Symptoms of Chilling Injury in Bananas:** Storing bananas below this threshold leads to a cascade of visible defects:
  - **Peel Discoloration:** The most obvious symptom is the enzymatic browning of the peel, which turns dull, smoky-gray, and eventually black. This is caused by the breakdown of cellular compartmentalization, allowing phenolic compounds to mix with polyphenol oxidase enzymes.
  - **Failure to Ripen:** The ripening process is halted, so the pulp remains hard, fails to soften, and does not develop its characteristic sweet flavor.
  - **Development of Off-Flavors:** Disrupted metabolism can lead to the production of undesirable flavor compounds.

Final Answer

The critical temperature threshold below which chilling injury is induced in bananas is approximately **12°C**. Storing them at temperatures lower than this will cause physiological damage and spoilage.

Quick Tip

A simple practical tip is "Never put unripe bananas in the refrigerator." A typical refrigerator is set at around 4 °C, which is well below the 12 °C threshold and will cause the peel to turn black while the fruit inside fails to ripen properly.

---

52. The chemical agents most suitable for deflocculation process are
(A). Sodium metasilicate
(B). Sodium tripolyphosphate
(C). Sodium decaphosphate
(D). Sodium sesquisilicate
Choose the most appropriate answer from the options given below:

(A) (A) and (D) only
(B) (A), (B) and (D) only
(C) (A), (C) and (D) only
(D) (C) and (D) only

Correct Answer: (B) (A), (B) and (D) only

Solution:

Conceptual Understanding

Deflocculation (or dispersion) is the process of preventing fine colloidal particles suspended in a liquid from aggregating into larger clumps called "flocs," or the process of breaking up existing flocs. Chemical agents that achieve this are called deflocculants or dispersing agents. They work by altering the surface properties of the particles to promote mutual repulsion. In industry, particularly in detergents, ceramics, and water treatment, inorganic condensed phosphates and silicates are major classes of deflocculants.

Expanded Explanation

Deflocculants primarily work by increasing the electrostatic repulsion between particles.

- **Sodium Silicates:**
  - **(A) Sodium Metasilicate (Na_2SiO_3)** and **(D) Sodium Sesquisilicate ($Na_3HSiO_4 \cdot 2H_2O$):** These are alkaline metal silicates. In solution, they adsorb onto the surface of particles, imparting a strong negative charge. This high surface charge causes the particles to repel each other, keeping them suspended and dispersed. They are highly effective and widely used in cleaning and detergent formulations for their dispersing and buffering capabilities.
- **Condensed Phosphates (Polyphosphates):**

- **(B) Sodium Tripolyphosphate (STPP, $Na_5P_3O_{10}$):** STPP is arguably one of the most powerful, effective, and historically significant deflocculants and sequestrants. As a polyphosphate, it is a highly charged anion that adsorbs onto particle surfaces, creating strong electrostatic repulsion. Additionally, its ability to sequester (bind) hardness ions like Ca^{2+} and Mg^{2+} prevents these ions from bridging and flocculating the particles. It has been a cornerstone of detergent formulations for decades.
- **(C) Sodium Decaphosphate:** This is a less common term, likely referring to a longer-chain polyphosphate. While functional, STPP is the most representative and widely used member of this class for this purpose.

All four listed compounds are effective deflocculants. However, a question asking for the best combination typically seeks the most common and representative examples from the key chemical classes. Sodium metasilicate, sodium sesquisilicate, and especially STPP are all prime examples of widely used industrial deflocculants.

Final Answer

Sodium metasilicate, sodium tripolyphosphate (STPP), and sodium sesquisilicate are all highly suitable and commonly used deflocculating agents in various industries. The combination that includes these prominent examples is a strong choice.

Quick Tip

Remember that two major classes of inorganic chemicals used as deflocculants (dispersing agents) are polyphosphates (like STPP) and silicates (like sodium metasilicate). They are key ingredients in many detergent and cleaning formulations.

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53. NOEL stands for

(A) Non-Observable Effluent Limit
(B) No Observable Effluent Limit
(C) Non-Observable Effect Level
(D) No Observable Effect Level

Correct Answer: (D) No Observable Effect Level

Solution:

Conceptual Understanding

In the fields of toxicology and risk assessment, a central goal is to determine a safe level of exposure to a chemical substance (like a food additive, pesticide residue, or environmental contaminant). This is typically done by conducting controlled studies in laboratory animals. The **NOEL** is a fundamental data point derived from these studies.

Expanded Explanation

- **Correct Expansion:** The acronym **NOEL** stands for **No Observable Effect Level**.
- **Definition:** The NOEL is defined as the **highest dose** or concentration of a substance, administered to a group of test animals in a study, at which there are no statistically or biologically significant detectable effects (either adverse or non-adverse) observed in the exposed animals when compared to a control group (which receives no substance).
- **Role in Risk Assessment:** The NOEL is a critical starting point for calculating a safe intake level for humans. The most common application is in establishing the **Acceptable Daily Intake (ADI)**.
  - **ADI Calculation:** The ADI is an estimate of the amount of a substance that a person can ingest daily over a lifetime without an appreciable health risk. It is typically calculated as:
$$\text{ADI} = \frac{\text{NOEL}}{\text{Safety Factor}}$$
  - **Safety Factor:** A safety factor (often 100) is applied to the NOEL to account for uncertainties. This factor typically consists of a 10-fold factor for interspecies differences (animal to human) and a 10-fold factor for intraspecies variability (differences among humans).
- **Related Terms:** A closely related term is **NOAEL**, which stands for No Observable *Adverse* Effect Level. The NOAEL is now more commonly used as it focuses specifically on adverse effects, ignoring benign or adaptive changes.
- **Incorrect Terms:** "Non-Observable" is grammatically incorrect in this context. "Effluent Limit" is an environmental term referring to the maximum allowable concentration of a pollutant in wastewater discharge.

Final Answer

The correct and standard expansion of the toxicology acronym NOEL is **No Observable Effect Level**.

Quick Tip

Distinguish between NOEL and its close relative, NOAEL (**No Observable Adverse Effect Level**). NOAEL is the highest dose with no *adverse* effects, and is more commonly used today. However, NOEL is still a key term to know. Focus on the "No" and "Effect Level" parts.

---

54. The instrument used to measure the salt percentage of pickles is_____

(A) Polarimeter
(B) Brinograph
(C) Saltmeter

(D) Ionograph

Correct Answer: (C) Saltmeter

Solution:

Conceptual Understanding

Pickling is a food preservation method that uses a brine, a solution of salt (sodium chloride) in water. The concentration of salt in the brine is a critical control point, as it determines the safety (inhibition of spoilage microbes), quality (texture and flavor), and consistency of the final product. A specific instrument is used to measure this concentration.

Expanded Explanation

- **Saltmeter:** This is the correct and most specific term for an instrument designed to measure the salt content (salinity) of a solution. Other names for the same device include salinometer or salometer. These instruments work on one of two common principles:
  1. **Conductivity:** Salt (NaCl) dissolved in water dissociates into ions (Na^+ and Cl^-). These ions allow the solution to conduct electricity. A conductivity-based saltmeter measures how well the brine conducts electricity, which is directly proportional to the salt concentration.
  2. **Specific Gravity (Hydrometry):** Dissolving salt in water increases the density or specific gravity of the solution. A saltmeter can be a specialized hydrometer, a calibrated float that sinks to a certain depth depending on the brine's density. The scale is calibrated to read directly in salt percentage or degrees Salometer.
- **Analysis of Other Instruments:**
  - **Polarimeter:** This instrument measures the degree to which a substance rotates the plane of polarized light. It is used to determine the concentration of optically active substances, most notably sugars (sucrose), not salt.
  - **Brinograph:** This is not a standard scientific term for an instrument. It may be confused with the Brinell hardness tester, which is used in metallurgy to measure the hardness of metals.
  - **Ionograph:** This is a more general and highly specialized instrument, typically used in the electronics industry to measure the concentration of ionic contaminants on printed circuit boards. While salt is an ionic compound, "Saltmeter" is the correct, specific term for the food application of measuring salt in brine.

Final Answer

The instrument specifically designed and commonly used to measure the percentage of salt in pickles or brine is a **Saltmeter**.

Quick Tip

For instrumentation questions, the most direct and specific name is usually the correct answer. To measure salt, you use a saltmeter. To measure pH, you use a pH meter.

---

55. A type of freezing where resistance to heat transfer is minimized due to intimate contact between food or package and refrigerant

(A) Indirect contact freezing
(B) Air freezing
(C) Immersion freezing
(D) Fluidized-bed freezing

Correct Answer: (C) Immersion freezing

Solution:

Conceptual Understanding

The speed and efficiency of a freezing process are dictated by the rate of heat transfer from the food product to the cooling medium (refrigerant). Heat transfer is fastest when the thermal resistance between the food and the medium is minimized. This is achieved by ensuring the most direct and intimate contact possible over the entire surface of the food.

Expanded Explanation

- **Immersion Freezing:** This method provides the most intimate contact. It involves directly submerging the food product (packaged or unpackaged) into a bath of liquid refrigerant. The liquid refrigerant, which could be chilled brine (salt water), glycerol, or a cryogenic fluid like liquid nitrogen, is in complete, direct contact with every part of the food's surface. Because liquids are excellent conductors of heat compared to gases, and because the contact is total, heat is removed from the food extremely rapidly. This leads to very fast freezing rates, which is desirable for forming small ice crystals and preserving food quality.
- **Indirect Contact Freezing (e.g., Plate Freezing):** In this method, the food is placed on or between hollow metal plates through which a refrigerant is circulated. The heat is transferred from the food, through the metal plate, to the refrigerant. While the contact between the food and the plate is good, it is indirect (heat must pass through the plate) and can be imperfect if the food product is irregularly shaped.
- **Air Freezing (e.g., Blast Freezing):** This method uses high-velocity cold air as the cooling medium. Air is a very poor conductor of heat (it's an insulator). Therefore, even with high velocities, the rate of heat transfer from the food to the air is much slower than to a liquid.

- **Fluidized-Bed Freezing:** This is an advanced form of air freezing used for small, particulate foods (like peas or berries). High-velocity cold air is blown up through a bed of the food, causing the particles to be suspended or "fluidized" in the air stream. This ensures that each particle is surrounded by cold air, which is more efficient than standard air freezing, but the contact is still with air (a gas), which is inherently less efficient for heat transfer than direct contact with a liquid.

Final Answer

Immersion freezing provides the most intimate contact between the food and the refrigerant, minimizing heat transfer resistance and resulting in the most rapid freezing rates.

Quick Tip

Think about cooling a hot object. Plunging it into cold water (immersion) cools it much faster than leaving it in a cold room (air) or placing it on a cold block (indirect contact). The same principle applies to freezing.

---

56. The process of 'Hot-break' is commonly used in the manufacturing of products like
(A). Orange squash
(B). Tomato paste
(C). Orange juice
(D). Tomato juice
Choose the most appropriate answer from the options given below:

(A) (B) and (D) only
(B) (A), (B) and (C) only
(C) (A), (B), (C) and (D)
(D) (C) and (D) only

Correct Answer: (A) (B) and (D) only

Solution:

Conceptual Understanding

The viscosity (thickness) of processed tomato products is largely determined by their pectin content. Pectin is a natural structural carbohydrate in the tomato's cell walls. However, raw tomatoes also contain pectic enzymes, specifically pectin methylesterase (PME) and polygalacturonase (PG), which rapidly break down pectin once the tomato tissue is ruptured (e.g., by crushing or chopping). The **'hot-break'** process is a specific thermal step designed to control the activity of these enzymes.

Expanded Explanation

- **The 'Hot-Break' Process:** This process involves heating freshly crushed tomatoes very rapidly to a high temperature, typically around 90-95°C (195-205°F), immediately after crushing.
  - **Purpose:** The sole purpose of this immediate, high-heat treatment is to **completely and instantaneously inactivate** the native pectic enzymes before they have a chance to degrade the pectin.
  - **Result:** By preserving the natural pectin in its long-chain form, the hot-break process results in a final product with a very high and stable viscosity.
- **Product Applications:** This high viscosity is a highly desirable quality in certain tomato products:
  - **(B) Tomato Paste and Ketchup:** These products require a thick, rich consistency. The high viscosity from the hot-break process is essential for their quality and prevents issues like water separation.
  - **(D) Tomato Juice (thick style):** Some styles of tomato juice are valued for their thick, rich mouthfeel, which is achieved using the hot-break method.
- **The 'Cold-Break' Alternative:** An alternative process involves heating the crushed tomatoes to a lower temperature (e.g., 65-75°C). This 'cold-break' allows the pectic enzymes to remain active for a period, breaking down some of the pectin. The result is a product with a much lower viscosity, which is suitable for thin, concentrated tomato juices.
- **Non-Tomato Products:** The hot-break process is a technology specifically developed for controlling pectin-based viscosity in **tomato processing**. It is not used for **(A) Orange squash** or **(C) Orange juice**, as their processing and viscosity characteristics are governed by different factors.

Final Answer

The 'hot-break' process is used in the manufacturing of high-viscosity tomato products, including both **Tomato paste** and certain styles of **Tomato juice**.

> Quick Tip
>
> Associate 'Hot-break' and 'Cold-break' exclusively with tomato products. Remember: **Hot-break = High Heat = No Enzymes = High Viscosity** (for paste/ketchup).

---

57. During the process of ripening of fruits, the transition of pectic substance occurs in the following order:
(A). Protopectin
(B). Pectin
(C). Pectinic acid
(D). Pectic acid

Choose the most appropriate answer from the options given below:

(A) (A), (C), (B), (D)
(B) (B), (A), (C), (D)
(C) (B), (C), (D), (A)
(D) (C), (B), (D), (A)

Correct Answer: (No correct option provided, the actual sequence is (A)→(B)→(C)→(D))

Solution:

Conceptual Understanding

Pectic substances are complex polysaccharides that act as the primary "cementing" agent in the middle lamella and primary cell walls of plants, contributing to the firmness and texture of fruits. As a fruit ripens, a series of enzymatic reactions progressively breaks down these pectic substances, leading to the characteristic softening of the tissue. This degradation follows a specific and predictable biochemical sequence.

Expanded Explanation: The Ripening Sequence

The transformation of pectic substances from the unripe to the over-ripe stage occurs in the following scientifically correct order:

1. **(A) Protopectin:** This is the parent pectic substance found in unripe, hard fruits. It is a very large, water-insoluble polymer that is bound to other cell wall components like cellulose. Its presence is responsible for the hard, rigid texture of unripe fruit.
2. **(B) Pectin:** As ripening begins, the enzyme **protopectinase** acts on protopectin, breaking it down into smaller, water-soluble molecules. These molecules are **pectin**. Pectin has a high degree of methylation (its carboxylic acid groups are esterified with methanol) and is responsible for the ability of some fruit juices to form gels. This initial breakdown causes the fruit to begin to soften.
3. **(C) Pectinic Acid:** With continued ripening, the enzyme **pectin methylesterase (PME)** becomes active. PME systematically removes some of the methyl groups from the pectin molecules, converting them into **pectinic acids**. Pectinic acids are less methylated than pectin and have a lower gelling capacity.
4. **(D) Pectic Acid:** In the final stages of ripening and into over-ripening, the enzyme **polygalacturonase (PG)** acts to break the main polymer chains of pectin and pectinic acid into much smaller units. Any remaining methyl groups are also removed. The final product is **pectic acid** (or polygalacturonic acid), which is a short-chain polymer with no methyl groups. This extensive breakdown of the pectic structure leads to the very soft, mushy texture of an over-ripe fruit.

The correct and irreversible biochemical sequence is therefore: **Protopectin** → **Pectin** → **Pectinic acid** → **Pectic acid**.

Final Answer

The correct sequential order for the enzymatic transformation of pectic substances during fruit ripening is Protopectin → Pectin → Pectinic acid → Pectic acid. As noted in the source material, if none of the provided multiple-choice options match this scientifically correct sequence, the question itself is flawed.

> Quick Tip
>
> Remember the progression from hard to mushy: Starts with the large, insoluble **Protopectin** (unripe). This breaks down into soluble **Pectin** (ripe), which is then further degraded into **Pectinic acid** and finally **Pectic acid** (overripe/mushy).

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58. The soft and fragile food products, having delicate flavors and colors, are best dried by which of the following method:

(A) Drum drying
(B) Vacuum drying
(C) Tray drying
(D) Freeze drying

Correct Answer: (D) Freeze drying

Solution:

Conceptual Understanding

Drying preserves food by removing water, thereby inhibiting microbial growth and enzymatic activity. However, the method of water removal, particularly the amount of heat used, can significantly impact the final quality of the product. For delicate, heat-sensitive products, the goal is to remove water while causing minimal damage to the physical structure, color, and volatile flavor compounds.

Expanded Explanation

- **Freeze Drying (Lyophilization):** This is universally recognized as the gentlest drying method, preserving the quality of sensitive products better than any other technique. The process occurs in three stages:
    1. **Freezing:** The food product is first frozen solid. This locks the food's structure in place.
    2. **Primary Drying (Sublimation):** The frozen product is placed in a strong vacuum chamber. Under this vacuum, the ice is converted directly into water vapor without passing through the liquid phase. This process is called **sublimation**. Because the water is never liquid, there is no movement of solutes and minimal shrinkage, so the original shape and porous structure of the food are maintained.

3. **Secondary Drying (Desorption):** A small amount of bound water remains. A slight increase in temperature under vacuum removes this final bit of moisture.

The entire process occurs at low temperatures, which perfectly preserves heat-sensitive flavors, colors, and nutrients. It is the ideal method for fragile products like berries, coffee, herbs, and pharmaceuticals.

- **Comparison with Other Methods:**
  - **Drum Drying and Tray Drying:** Both are atmospheric drying methods that rely on high heat to evaporate water. This high heat causes significant damage: it destroys delicate flavors, causes browning reactions (caramelization and Maillard), denatures proteins, and leads to severe shrinkage and structural collapse.
  - **Vacuum Drying:** This method is gentler than atmospheric drying because the vacuum lowers the boiling point of water, allowing evaporation to occur at a lower temperature. However, the water is still in a liquid phase during removal, which can lead to some solute migration and structural collapse (shrinkage). It is not as gentle as freeze drying, where the rigid, frozen structure is maintained throughout.

Final Answer

Freeze drying (Lyophilization) is the superior method for drying soft, fragile foods with delicate flavors because the process of sublimation at low temperatures best preserves the product's original structure, color, and aroma.

Quick Tip

For questions about preserving the highest quality in a dried product (especially structure, flavor, color), the answer is almost always **Freeze Drying**. It is the premium, albeit most expensive, drying method.

---

59. Which of the following is used as an antioxidant in fats and oils?

(A) BHA
(B) BHF
(C) HBT
(D) HBA

Correct Answer: (A) BHA

Solution:

Conceptual Understanding

Antioxidants are food additives that prevent or delay the oxidative deterioration of foods. In products containing fats and oils, their primary role is to inhibit **oxidative rancidity**.

This process involves a free-radical chain reaction that degrades fats, producing undesirable off-flavors and odors. Synthetic phenolic antioxidants are commonly used for this purpose.

Expanded Explanation

- **Correct Expansion:** The acronym **BHA** stands for **Butylated Hydroxyanisole**.
- **Mechanism of Action:** BHA is a synthetic phenolic antioxidant. Its chemical structure allows it to function as a free-radical scavenger. It donates a hydrogen atom to highly reactive lipid free radicals, thereby neutralizing them and terminating the chain reaction of oxidation. This significantly extends the shelf life of fat-containing foods.
- **Applications:** BHA is a widely used, effective, and government-approved antioxidant for preserving fats, oils, and foods containing them. Common applications include breakfast cereals, potato chips, chewing gum, and packaging materials.
- **Other Common Synthetic Antioxidants:** BHA is part of a group of similar synthetic antioxidants used in the food industry. The other major ones are:
  - **BHT:** Butylated Hydroxytoluene
  - **PG:** Propyl Gallate
  - **TBHQ:** Tertiary Butylhydroquinone

  Often, these are used in synergistic blends to enhance their effectiveness.
- **Incorrect Acronyms:** The other options listed (BHF, HBT, HBA) are not standard or recognized acronyms for approved food antioxidants.

Final Answer

The acronym BHA, representing a common synthetic antioxidant used in fats and oils, correctly expands to **Butylated Hydroxyanisole**.

Quick Tip

Memorize the "big four" synthetic antioxidants used in food: BHA, BHT, PG, and TBHQ. If you see one of these in an exam question about antioxidants, it is very likely the correct answer.

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60. The correct order of unit operations carried out in the Canning of vegetables is:

(A) Sorting—-Retorting—-Exhausting—-Filling—-Sealing
(B) Retorting—Filling—-Exhausting—-Processing—-Sealing
(C) Retorting—-Filling—-Processing—-Exhausting—-Sealing
(D) Sorting—-Filling—-Exhausting—-Sealing——Retorting

Correct Answer: (D) Sorting—-Filling—-Exhausting—-Sealing——Retorting

Solution:

Conceptual Understanding

Canning is a food preservation method that involves processing food, sealing it in an airtight container, and then subjecting it to a thermal process to achieve commercial sterility. This ensures a long, shelf-stable life at ambient temperatures. The process consists of a series of unit operations that must be performed in a specific, logical sequence.

Expanded Explanation: The Canning Line Sequence

The correct and logical sequence for a typical vegetable canning operation is as follows:

1. **Sorting (and Grading):** The process starts with the raw vegetables. They are sorted to remove any defective, damaged, or unsuitable items. They are also often graded based on size, color, or maturity to ensure a uniform final product. This step is often preceded or followed by washing.
2. **Filling:** The prepared vegetables (which may have undergone preliminary steps like peeling, cutting, or blanching) are filled into clean cans. A liquid, such as brine (salt water) or a sauce, is typically added to fill the spaces, aid in heat transfer, and contribute to flavor.
3. **Exhausting:** This is a critical step before sealing. Its purpose is to remove air (especially oxygen) from the headspace (the gap between the food and the top of the can). This is important because:
    - It creates a vacuum in the can after it cools, which prevents the can ends from bulging and indicates a proper seal.
    - It minimizes oxidative reactions that can degrade the food's quality (color, flavor, vitamins).
    - It prevents internal corrosion of the metal can.
4. **Sealing:** Immediately after exhausting, the can is hermetically (airtightly) sealed. This is done using a double seamer that interlocks the can lid and body to create a permanent, leak-proof seal.
5. **Retorting:** This is the final and most critical preservation step. The sealed cans are loaded into a large pressure vessel called a **retort** (or autoclave). They are heated with high-pressure steam to a temperature sufficient to destroy all spoilage microorganisms and their heat-resistant spores, most notably *Clostridium botulinum*. For low-acid vegetables, this is typically a minimum of 121°C (250°F). This step renders the food commercially sterile.

Any sequence that places the final sterilization step (Retorting) at or near the beginning is fundamentally incorrect, as the product would be re-contaminated during subsequent filling and sealing steps.

Final Answer

The correct logical sequence of unit operations in vegetable canning is: **Sorting** → **Filling** → **Exhausting** → **Sealing** → **Retorting**.

Quick Tip

For any preservation process, always think logically. Raw material preparation (Sorting) comes first. The final "kill step" or sterilization (Retorting) must happen after the container is sealed to prevent recontamination.

---

61. An example of hard and ripened cheese is:

(A) Roquefort cheese
(B) Cottage cheese
(C) Cheddar cheese
(D) Camembert cheese

Correct Answer: (C) Cheddar cheese

Solution:

Conceptual Understanding

Cheeses are classified based on a variety of characteristics, but two of the most fundamental are **moisture content** and the **ripening** (or aging) process.

- **Moisture Content:** This determines the cheese's texture. Categories include soft (¿40% moisture), semi-soft/semi-hard, and hard (¡39% moisture).
- **Ripening:** This distinguishes fresh, unripened cheeses (like Cottage cheese or cream cheese) from ripened cheeses, which are aged for a period (weeks to years) to allow enzymes and microorganisms to develop complex flavors and textures.

A hard, ripened cheese is therefore a cheese with a low moisture content that has undergone a significant aging period.

Expanded Explanation: Analysis of Cheese Types

- **Cheddar Cheese:** This is the quintessential example of a hard, ripened cheese.
  - **Hard Texture:** It has a low moisture content (typically 36-39%), achieved in part by the unique "cheddaring" process where slabs of curd are stacked and turned to expel whey.
  - **Ripened:** Cheddar is aged for several months to well over a year. During this time, enzymes from the starter culture and rennet break down proteins (proteolysis) and fats (lipolysis), developing its characteristic sharp, complex flavor and firm, dense texture.

- **Roquefort Cheese:** This is a **semi-soft**, ripened cheese. While it is ripened with the blue mold *Penicillium roqueforti*, its higher moisture content classifies it as semi-soft, not hard.
- **Cottage Cheese:** This is a **soft, unripened** (fresh) cheese. It has a very high moisture content, a soft, curdy texture, and is consumed fresh without any aging.
- **Camembert Cheese:** This is a **soft-ripened** cheese. It has a high moisture content and is characterized by a "bloomy rind" from the mold *Penicillium camemberti*, which ripens the cheese from the outside in, creating a soft, creamy, and sometimes runny interior.

Final Answer

Among the given options, **Cheddar cheese** is the best and most accurate example of a cheese that is both hard (low moisture) and ripened (aged).

Quick Tip

To classify cheese, ask two questions: 1. Is it soft or hard? (Think about how easily it slices or crumbles). 2. Is it eaten fresh or aged? (Fresh cheeses like cottage cheese and mozzarella are mild; aged cheeses like Cheddar and Parmesan are sharp). A hard, ripened cheese will be firm and flavorful.

---

62. The alkali treatment of cocoa to enhance its color and flavor is known as

(A) French process
(B) Dutch process
(C) Enrobing
(D) Tempering

Correct Answer: (B) Dutch process

Solution:

Conceptual Understanding

Natural cocoa powder, produced by pressing most of the cocoa butter from chocolate liquor, is naturally acidic (pH around 5.5) with a sharp, fruity flavor and a light reddish-brown color. A specific alkalization process was developed to modify these properties, creating a different type of cocoa powder.

Expanded Explanation

This alkali treatment is known as the **Dutch process** or "Dutching." It was invented in the 19th century by Coenraad Johannes van Houten of the Netherlands.

- **The Process:** Dutching involves treating the cocoa nibs or chocolate liquor with a mild alkaline solution, such as potassium carbonate or sodium carbonate.
- **Chemical and Sensory Effects:**
    1. **Neutralization:** The primary effect is the neutralization of the cocoa's natural acidity, raising its pH to 7 (neutral) or higher (alkaline).
    2. **Flavor Modification:** This neutralization mellows the flavor, reducing the harshness, astringency, and acidic notes of natural cocoa. The resulting flavor is smoother, milder, and often described as more "chocolatey" or fudgy.
    3. **Color Enhancement:** The change in pH darkens the natural flavonoid pigments in the cocoa. Dutch-processed cocoa powder has a color ranging from a deep, dark reddish-brown to nearly black.
    4. **Increased Solubility:** The treated cocoa particles disperse more easily in liquids, making Dutch-processed cocoa a preferred choice for beverages like hot chocolate.

0.0.18 Comparison with Other Terms

- **Enrobing:** A process in confectionery where a center (e.g., a biscuit, caramel, or truffle) is coated with a layer of molten chocolate.
- **Tempering:** A critical process of carefully heating and cooling molten chocolate to encourage the cocoa butter to crystallize in its most stable form. Proper tempering gives chocolate a glossy finish, a firm texture, and a satisfying "snap" when broken.

Final Answer

The process of treating cocoa with an alkali solution to neutralize its acidity and alter its flavor and color is known as the **Dutch process**.

> Quick Tip
>
> Remember the association: **Dutch** process = **D**ark cocoa. This alkali treatment is what gives Oreo cookies their characteristic dark color and smooth flavor.

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63. The enzyme used in isomerization of corn starch during the making of High Fructose Corn Syrup is/are:
(A). Alpha-amylase
(B). Glucoamylase
(C). Glucose isomerase
Choose the most appropriate answer from the options given below:

(A) (A) and (B) only
(B) (B) and (C) only
(C) (B) only
(D) (A), (B) and (C)

Correct Answer: (D) (A), (B) and (C)

Solution:

Conceptual Understanding

The manufacturing of High Fructose Corn Syrup (HFCS) from corn starch is a sophisticated biochemical process that relies on a sequence of three distinct enzymatic reactions to first break down the starch into its fundamental building block (glucose) and then convert some of that glucose into a sweeter sugar (fructose).

Expanded Explanation: The Three-Step Enzymatic Process

The entire process from starch to HFCS involves three key enzymes acting in succession:

1. **Step 1: Liquefaction**
   - **Enzyme: (A) Alpha-amylase**
   - **Action:** A slurry of corn starch is treated with alpha-amylase, which randomly hydrolyzes the long, complex starch molecules (amylose and amylopectin) into shorter, more soluble polysaccharide chains called dextrins. This step is called liquefaction because it dramatically reduces the viscosity of the starch slurry, making it easier to handle.
2. **Step 2: Saccharification**
   - **Enzyme: (B) Glucoamylase**
   - **Action:** The dextrins from the first step are treated with glucoamylase. This enzyme works from the ends of the dextrin chains, breaking off individual glucose molecules. The result of this step is a syrup that is very high in glucose (typically ¿90%), commonly known as corn syrup.
3. **Step 3: Isomerization**
   - **Enzyme: (C) Glucose isomerase** (also known as xylose isomerase)
   - **Action:** This is the crucial step that creates the "high fructose" product. The high-glucose syrup is passed over immobilized glucose isomerase, which converts a portion of the glucose molecules into fructose molecules. Since fructose is significantly sweeter than glucose, this step increases the overall sweetness of the syrup. The process is typically controlled to produce HFCS 42 (42% fructose) or HFCS 55 (55% fructose).

As the question asks about the enzymes used "during the making" of HFCS, it implies the entire manufacturing chain from the starting material (starch). Therefore, all three enzymes are involved.

Final Answer

The entire process of making HFCS from corn starch requires the sequential use of three enzymes: **alpha-amylase**, **glucoamylase**, and **glucose isomerase**.

Quick Tip

Remember the HFCS enzyme chain: 1. **Alpha-amylase** cuts the big starch chains (liquefaction). 2. **Glucoamylase** cuts the small chains into glucose (saccharification). 3. **Glucose Isomerase** converts glucose to fructose (isomerization).

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64. Match List-I with List-II

List-I **Type of sugar**	**List-II** **Application**
(A) Icing	(I) Common sweetening ingredient
(B) HFCS	(II) Cake preparation
(C) Sugar cubes	(III) Candies
(D) Granulated	(IV) Tea service

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)
(B) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(C) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (A) (A) - (II), (B) - (III), (C) - (IV), (D) - (I)

Solution:

Conceptual Understanding

Sugar (sucrose) is processed into various forms, each with unique physical properties that make it suitable for specific culinary or industrial applications. Matching the form of sugar to its primary use is a matter of understanding these properties.

Expanded Explanation: Matching Form to Function

- **(A) Icing Sugar → (II) Cake preparation:** Icing sugar, also known as powdered or confectioner's sugar, is granulated sugar that has been milled into a very fine powder.
  - **Property:** Its extremely small particle size.
  - **Function:** It dissolves almost instantly in liquid, which is essential for creating smooth, non-gritty icings, frostings, and glazes. It is a key component in "cake preparation," specifically for the finishing touches.
- **(B) HFCS (High Fructose Corn Syrup) → (III) Candies:** HFCS is a liquid sweetener derived from corn starch.
  - **Properties:** It is a liquid, hygroscopic (retains moisture), and, importantly, inhibits crystallization.

- **Function:** Its resistance to crystallization is highly desirable in the manufacturing of **candies**, where a smooth texture is needed and the formation of large sugar crystals (graining) is a common defect. It is also widely used in soft drinks.

- **(C) Sugar cubes → (IV) Tea service:** Sugar cubes are simply granulated sugar that has been moistened and compressed into blocks.
  - **Property:** They are a pre-portioned, solid unit.
  - **Function:** Their primary purpose is convenience and portion control for sweetening hot beverages like tea and coffee, making them a staple of **tea service**.

- **(D) Granulated sugar → (I) Common sweetening ingredient:** This is the standard, all-purpose "table sugar."
  - **Property:** It is the most versatile and widely available form of sugar.
  - **Function:** It is the universal or **common sweetening ingredient** used in countless applications in both households and industrial food production, from baking and cooking to preserving.

Final Answer

The correct pairings based on the primary function of each sugar type are: (A)-(II), (B)-(III), (C)-(IV), and (D)-(I).

Quick Tip

Associate the form of the sugar with its function: Powdered (Icing) for smooth things like frosting. Liquid (HFCS) for processed foods/candies. Blocks (Cubes) for drinks. Standard crystals (Granulated) for everything else.

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65. Match List-I with List-II

List-I **Fat type**	**List-II** **Manufacturing**
(A) Lard	(I) Ripening
(B) Butter	(II) Rendering
(C) Margarine	(III) Emulsion
(D) Mayonnaise	(IV) Partial hydrogenation

Choose the most appropriate answer from the options given below:

(A) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)
(B) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(C) (A) - (IV), (B) - (II), (C) - (I), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (A) (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

Solution:

Conceptual Understanding

The manufacturing of various fat-based foods involves distinct key processes that define the final product's origin, texture, and stability.

Expanded Explanation: Matching Product to Process

- **(A) Lard → (II) Rendering:** Lard is the fat derived from pigs. **Rendering** is the process of clarifying fat by melting fatty animal tissue (in this case, from a pig) to separate the pure liquid fat from the connective tissue, proteins, and water. The pure fat is then cooled and solidified to produce lard.
- **(B) Butter → (I) Ripening:** Butter is a dairy product made by churning cream. While churning is the mechanical step, a key flavor development step is often **ripening**. This involves inoculating the cream with a bacterial culture (similar to making yogurt) and allowing it to ferment. This process produces flavorful compounds, like diacetyl, that give cultured butter its characteristic tangy, "buttery" flavor.
- **(C) Margarine → (IV) Partial hydrogenation:** Margarine is a butter substitute made from vegetable oils. To convert these naturally liquid oils into a solid, spreadable fat, they traditionally underwent **partial hydrogenation**. This chemical process adds hydrogen atoms to the unsaturated fatty acids in the oil, making them more saturated and increasing their melting point. (Note: Due to concerns about trans fats created by this process, modern margarines often use other methods like interesterification).
- **(D) Mayonnaise → (III) Emulsion:** Mayonnaise is a classic example of an **emulsion**—specifically, an oil-in-water emulsion. It is a stable mixture of two liquids that do not normally mix: oil and the water from vinegar or lemon juice. This stability is achieved by a third component, an emulsifier. In mayonnaise, the lecithin found in the egg yolk acts as the powerful emulsifier that keeps the oil droplets permanently dispersed in the water phase.

Final Answer

The correct pairings are: (A) Lard - (II) Rendering, (B) Butter - (I) Ripening, (C) Margarine - (IV) Partial hydrogenation, and (D) Mayonnaise - (III) Emulsion.

Quick Tip

Remember the core process for each fat product: **Lard** = Rendering animal fat. **Margarine** = Hydrogenating vegetable oil. **Mayonnaise** = Emulsifying oil and vinegar. **Butter** = Churning cream (which can be ripened).

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66. Identify the correct sequence of product/by-product formation during cocoa and chocolate processing/manufacturing:

(A). Cocoa powder
(B). Chocolate liquor
(C). Cocoa butter
(D). Nibs
Choose the most appropriate answer from the options given below:

(A) (A), (B), (C), (D)
(B) (A), (B), (D), (C)
(C) (D), (B), (C), (A)
(D) (C), (B), (D), (A)

Correct Answer: (C) (D), (B), (C), (A)

Solution:

Conceptual Understanding

The journey from a raw cocoa bean to finished products like chocolate and cocoa powder is a sequential manufacturing process. Each major step transforms the material into a new, distinct intermediate product.

Expanded Explanation: The Process Flow

The manufacturing process proceeds in the following logical order:

1. **From Bean to (D) Nibs:** Raw cocoa beans are first fermented, dried, and roasted to develop flavor precursors. The roasted beans are then passed through a "cracker and fanner" (a process called winnowing) which breaks the bean and separates the light outer shell from the heavier inner kernel. This kernel is the **cocoa nib**.
2. **From Nibs to (B) Chocolate Liquor:** The cocoa nibs are then ground in a series of mills. The intense friction and pressure of milling generates heat, which melts the fat (cocoa butter, which makes up about 55% of the nib) and transforms the solid nibs into a thick, dark, liquid paste. This unsweetened paste is known as **chocolate liquor** or cocoa mass. It is the fundamental base for all chocolate products.
3. **From Chocolate Liquor to (C) Cocoa Butter and Press Cake:** To produce cocoa powder, the chocolate liquor is pumped into a powerful hydraulic press. The press squeezes the liquor with immense force, separating it into two components:
   - The liquid fat that is squeezed out is **cocoa butter**.
   - The solid, compressed block that remains is called the "press cake."
4. **From Press Cake to (A) Cocoa Powder:** The solid press cake, which still contains some cocoa butter (10-22%), is then broken up, cooled, and pulverized or milled into a fine powder. This is **cocoa powder**.

Final Answer

The correct sequence of product formation is: **Nibs** → **Chocolate liquor** → **Cocoa butter** → **Cocoa powder**. This corresponds to the order (D), (B), (C), (A).

Quick Tip

Think of the process as starting with the solid bean piece (**Nibs**), grinding it to a liquid (**Chocolate Liquor**), and then separating that liquid into its fat part (**Cocoa Butter**) and its solid part (**Cocoa Powder**).

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67. The drier that can be used for carrying out the instantizing or agglomeration process is:

(A) Drum drier
(B) Spray drier
(C) Tunnel drier
(D) Kiln drier

Correct Answer: (B) Spray drier

Solution:

Conceptual Understanding

Instantizing is an industrial process designed to improve the wettability, dispersibility, and solubility of a powder in a liquid. The underlying mechanism is **agglomeration**, where very fine, individual powder particles are clustered together to form larger, porous granules. These granules sink and wet more easily than a fine powder, which tends to float and clump.

Expanded Explanation

The equipment uniquely suited to perform both drying and agglomeration in a continuous process is a modern, multi-stage **Spray Drier**.

- **The Process:** In an instantizing spray drier system:
  1. **Initial Drying:** A liquid feed (e.g., liquid milk or coffee extract) is atomized into fine droplets and mixed with hot air, drying them into a fine powder.
  2. **Re-wetting/Agglomeration Zone:** As the fine particles fall to the bottom of the drying chamber, they pass through a zone where they are slightly re-wetted with steam or a fine water mist. This makes the surface of the particles sticky.
  3. **Fluid Bed Agglomeration and Final Drying:** The sticky particles then enter an integrated fluid bed drier. In the turbulent fluid bed, the sticky particles collide and bind together, forming the desired larger, porous agglomerates. The fluid bed then gently dries these granules to their final, stable moisture content.

This integrated, two-step process within a single system is the standard industrial method for producing "instant" powders like instant milk and instant coffee.

- **Unsuitable Equipment:**
  - **Drum Driers, Tunnel Driers, and Kiln Driers:** These are all different types of driers designed for other purposes. Drum driers produce flakes, while tunnel and kiln driers are typically used for bulk materials or large pieces (e.g., drying fruit slices or grains). They lack the specific mechanism for atomization and controlled re-wetting needed to produce fine agglomerated particles.

Final Answer

The **Spray drier**, particularly a multi-stage system featuring an integrated fluid bed, is the specific equipment used for the industrial agglomeration and instantizing process.

Quick Tip

Associate "instant" powders with agglomeration. The best way to create these porous, easy-to-dissolve granules from a liquid feed is by using a sophisticated spray drying process.

---

68. The major microorganism that the food handler's may harbour as part of the body's flora is:

(A) Staphylococcus aureus
(B) Bacillus thermophilus
(C) Clostridium botulinum
(D) Bacillus cereus

Correct Answer: (A) Staphylococcus aureus

Solution:

Conceptual Understanding

Food handlers can be a major vehicle for foodborne illness. While they may be perfectly healthy, they can carry microorganisms as part of their body's **normal flora** (the community of microbes living on and in the body). If transferred to food through poor hygiene, these organisms can cause illness.

Expanded Explanation

The major microorganism of concern that is part of the normal human flora is ***Staphylococcus aureus***.

- **Habitat and Carriage:** *S. aureus* is a common bacterium that lives harmlessly on the skin and, most notably, in the nasal passages of about 30-50% of healthy people. It can also be found in small cuts or infected pimples.
- **Mode of Transmission:** It is easily transferred from a food handler's hands, or via respiratory droplets from a cough or sneeze, onto ready-to-eat foods that are not subsequently cooked (e.g., salads, sandwiches, sliced meats, cream-filled pastries).
- **The Illness - Staphylococcal Food Poisoning:** The illness it causes is a food **intoxication**, not an infection.
  1. After contaminating the food, if the food is left at an improper temperature (in the "danger zone"), the bacteria will multiply.
  2. As they multiply, they produce a potent **heat-stable enterotoxin**.
  3. The illness is caused by ingesting the pre-formed toxin in the food. The "heat-stable" nature of the toxin is critical: reheating the food might kill the *S. aureus* bacteria, but it will **not** destroy the toxin, so the food will still cause illness.
- **Other Organisms:**
  - *Bacillus thermophilus:* A thermophilic (heat-loving) bacterium, not typically part of human flora.
  - *Clostridium botulinum* and *Bacillus cereus:* These are important foodborne pathogens, but they are spore-forming bacteria typically found in the environment (soil, dust) and are not considered a primary part of the normal human body flora.

Final Answer

Staphylococcus aureus is the major microorganism associated with the normal flora of a food handler that is a significant concern in food safety.

> Quick Tip
>
> In food safety questions, when you see "food handler," immediately think of *Staphylococcus aureus*. It's the classic example of a bacterium transferred from a person's skin or nose to food.

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69. The basic functions of a food package are:
(A). Containment
(B). Fortification
(C). Adulteration
(D). Communication
Choose the most appropriate answer from the options given below:

(A) (A) and (D) only
(B) (A), (B) and (D) only
(C) (A), (B), (C) and (D)

(D) (B), (C) and (D) only

Correct Answer: (A) (A) and (D) only

Solution:

Conceptual Understanding

Food packaging is an integral part of the food system, serving several fundamental functions beyond simply holding the product. These functions can be summarized as containment, protection, convenience, and communication. The question asks to identify the correct basic functions from a given list.

Expanded Explanation: Analysis of Functions

- **(A) Containment:** This is the most basic and essential function. The package must successfully hold the food, preventing it from leaking, spilling, or being lost during handling, transport, and storage. Without containment, all other functions are irrelevant.
- **(D) Communication:** The package is a critical vehicle for communication between the producer and the consumer. The surface of the package is used to convey vital information, including:
  - Product identity and brand name
  - Legally required information (e.g., ingredient list, nutritional facts, allergen warnings, net weight)
  - Instructions for use, opening, and storage
  - Marketing and promotional messages
- **Incorrect Options:**
  - **(B) Fortification:** This is the process of adding micronutrients (vitamins and minerals) *to the food itself* during formulation to improve its nutritional value (e.g., adding Vitamin D to milk). This is a function of food processing, not packaging.
  - **(C) Adulteration:** This is the illegal act of debasing a food's quality, often by adding inferior or harmful substances. A primary role of modern food packaging is to **protect against** adulteration and tampering through the use of tamper-evident seals and robust construction. It is the opposite of a packaging function.

Final Answer

From the given list, the two correct basic functions of a food package are **Containment** and **Communication**.

Quick Tip

Remember the four primary functions of packaging: Protection, Containment, Communication, and Convenience. Any option that falls outside these categories is likely incorrect.

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70. Examples of active packaging includes;
(A). MAP
(B). Ethylene scavenger
(C). Antioxidant release film
(D). Moisture absorbents
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (D) only
(B) (A), (B) and (C) only
(C) (A), (B), (C) and (D)
(D) (B), (C) and (D) only

Correct Answer: (D) (B), (C) and (D) only

Solution:

Conceptual Understanding

Traditional packaging acts as a **passive barrier**, protecting the food from external influences like moisture, oxygen, and light. **Active packaging**, in contrast, goes beyond this passive role. It refers to systems where the package, a component within it, or the headspace actively and continuously interacts with the food or its environment to extend shelf life or improve quality.

Expanded Explanation

Active packaging systems work by scavenging, absorbing, or releasing substances.

- **(B) Ethylene scavenger:** This is a classic example of active packaging. Fruits and vegetables naturally produce ethylene gas, a hormone that accelerates ripening and senescence. An ethylene scavenger, often a sachet containing potassium permanganate, is placed in the package to **actively absorb** this ethylene, thereby slowing down the ripening process and extending shelf life.
- **(C) Antioxidant release film:** This is an active system where the packaging film itself is impregnated with an antioxidant, such as Butylated Hydroxytoluene (BHT) or Vitamin E. Over time, the antioxidant **actively migrates** from the package into the food (especially onto the surface of high-fat foods) to inhibit oxidative rancidity.
- **(D) Moisture absorbents:** Also known as desiccants, these are pads or sachets (e.g., silica gel, or pads in fresh meat trays) that **actively absorb** excess moisture from within the package. This lowers the water activity, inhibiting the growth of mold and bacteria.

0.0.19 Distinction from Modified Atmosphere Packaging (MAP)

- **(A) MAP (Modified Atmosphere Packaging):** This is a closely related but distinct technology. In MAP, the air inside a package is flushed out and replaced with a specific gas mixture (e.g., a mix of nitrogen, carbon dioxide, and oxygen) *at the moment of sealing*. The package then acts as a **passive high-barrier** to maintain this modified atmosphere. It does not contain a component that is continuously and actively changing the atmosphere over time. Because of this lack of a continuous, active component, MAP is generally classified separately from active packaging systems.

Final Answer

Ethylene scavengers, antioxidant release films, and moisture absorbents are all clear examples of **active packaging** systems.

Quick Tip

The key to identifying active packaging is to look for an ongoing "action" word: scavenging, absorbing, releasing, or emitting. MAP is a one-time "modification" of the atmosphere, making it distinct.

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71. Match List-I with List-II

List-I **Irradiation dose range, kGy**	**List-II** **Objectives**
(A) 0.05-0.15	(I) Elimination of specific pathogens
(B) 35-60	(II) Insect disinfestation
(C) 3.0-13	(III) Inhibition of sprouting
(D) 0.1-0.5	(IV) Sterilization of foods

Choose the most appropriate answer from the options given below:

(A) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(B) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (I), (B) - (IV), (C) - (III), (D) - (II)

Correct Answer: (B) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:

Conceptual Understanding

Food irradiation is a preservation technology that exposes food to a controlled dose of ionizing radiation. The specific effect achieved is directly dependent on the applied dose, which is

measured in kiloGrays (kGy). Different dose levels are designated for specific purposes, from inhibiting physiological processes to achieving commercial sterilization.

Expanded Explanation: Dose-Effect Relationships

- **Low Dose (¡ 1 kGy) - Radurization:** Used for inhibiting physiological processes.
  - **(A) 0.05–0.15 kGy:** A very low dose specifically used for **(III) Inhibition of sprouting** in bulbs and tubers like potatoes, onions, and garlic.
  - **(D) 0.1–0.5 kGy:** A slightly higher low dose used for **(II) Insect disinfestation** in stored products like cereals, pulses, and dried fruits, and to control quarantine pests in fresh fruits.
- **Medium Dose (1–10 kGy) - Radicidation:** Used for reducing microbial load.
  - **(C) 3.0–13 kGy:** This dose range is effective at extending shelf life by reducing spoilage microorganisms and for the **(I) Elimination of specific pathogens**. Doses of 3–10 kGy are used to eliminate non-spore-forming pathogenic bacteria like *Salmonella*, *E. coli*, and *Campylobacter* in raw meat, poultry, and seafood.
- **High Dose (¿ 10 kGy) - Radappertization:** Used for commercial sterilization.
  - **(B) 35–60 kGy:** A very high dose required for the **(IV) Sterilization of foods**. This dose is sufficient to reduce the microbial population to the point of commercial sterility, creating shelf-stable products (similar to canned goods) that do not require refrigeration. It is often used for meals for astronauts or immunocompromised hospital patients.

Final Answer

The correct pairings based on established irradiation dose applications are: (A)-(III), (B)-(IV), (C)-(I), and (D)-(II).

Quick Tip

Remember the general rule for irradiation dosage: The smaller the target, the lower the dose needed. It takes a very low dose to stop a plant from sprouting. It takes a bit more to kill an insect. It takes a medium dose to kill bacteria. It takes a very high dose to kill the most resistant bacterial spores for complete sterilization.

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72. The industrial High Pressure Processing setup consists of the following components;
(A). Pressure pump
(B). Pressure agitator
(C). Pressure chamber
(D). Pulse chamber
Choose the most appropriate answer from the options given below:

(A) (A), (B) and (D) only
(B) (A) and (D) only
(C) (A) and (C) only
(D) (B), (C) and (D) only

Correct Answer: (C) (A) and (C) only

Solution:

Conceptual Understanding

High Pressure Processing (HPP) is a non-thermal (or "cold pasteurization") food preservation method that uses extremely high hydrostatic pressure to inactivate spoilage and pathogenic microorganisms. An industrial HPP system has two fundamental components required to generate and contain this pressure.

Expanded Explanation: The Core System

- **The Essential Components:**
  1. **(A) Pressure Pump:** This is the "engine" of the HPP system. It is a high-pressure intensifier pump capable of generating the immense pressures required for the process, typically ranging from 400 to 600 MPa (60,000 to 87,000 psi). The pump pressurizes the pressure-transmitting fluid (usually water).
  2. **(C) Pressure Chamber (or Vessel):** This is a thick-walled, robust cylinder made of high-strength steel alloy. It is designed to safely contain the extreme hydrostatic pressure during the processing cycle. The packaged food, submerged in the water, is loaded into this chamber.
- **Analysis of Incorrect Components:**
  - **(B) Pressure Agitator:** This term is incorrect and the component is unnecessary. HPP relies on **Pascal's Principle**, which states that pressure applied to an enclosed, incompressible fluid is transmitted instantly and uniformly throughout the fluid and to the walls of its container. This means the pressure is applied evenly from all directions at once, making any form of agitation both impossible and completely unnecessary.
  - **(D) Pulse Chamber:** This component belongs to a different non-thermal technology called **Pulsed Electric Field (PEF) processing**. In a PEF system, a liquid food is passed through a treatment chamber containing electrodes, where it is subjected to short, high-voltage electrical pulses. It is not part of an HPP system.

Final Answer

The essential and fundamental components of a High Pressure Processing (HPP) system from the list are the **pressure pump** and the **pressure chamber**.

Quick Tip

Think of an HPP machine as a very simple but powerful system: you need something to make the pressure (**pump**) and something to hold the pressure (**chamber**). Other terms like "agitator" or "pulse chamber" are likely distractors from other technologies.

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73. Match List-I with List-II

List-I **Foods**	**List-II** **a_w values**
(A) Flour	(I) 0.96
(B) Dry Fruits	(II) 0.75-0.80
(C) Jam	(III) 0.55-0.80
(D) Bread	(IV) 0.67-0.87

Choose the most appropriate answer from the options given below:

(A) (A) - (IV), (B) - (III), (C) - (II), (D) - (I)
(B) (A) - (I), (B) - (II), (C) - (III), (D) - (IV)
(C) (A) - (I), (B) - (II), (C) - (IV), (D) - (III)
(D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct Answer: (D) (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Solution:

Step 1: Understanding the Concept:
Water activity (a_w) is a measure of the free water available in a food for microbial growth and chemical reactions. It ranges from 0 (completely dry) to 1.0 (pure water). Different food types have characteristic a_w ranges.

Step 2: Detailed Explanation:
Let's match the foods with their typical a_w values:
- **(D) Bread:** This is a high-moisture baked good. Its a_w is quite high, typically around 0.94-0.98. Out of the given options, the range is not perfect. However, bread is the wettest product on this list aside from jam. Let's re-evaluate.
- **(C) Jam:** Jams have a very high sugar content. Sugar binds water, significantly lowering the water activity to prevent microbial spoilage, despite their high moisture content. A typical a_w for jam is 0.75-0.80. Let's match (C) to (II).
- **(B) Dry Fruits:** These are intermediate moisture foods. Their a_w is lower than bread but higher than flour. A range of 0.60-0.65 is common, but the provided options are higher. Let's examine the ranges again.
- **(A) Flour:** This is a low-moisture food, stable against most microbial growth. Its a_w is typically between 0.67-0.87. Let's match (A) to (IV).

Let's re-examine based on the provided options which seem unusual. Let's work backwards from the given answer key's logic: (A) - (III), (B) - (IV), (C) - (I), (D) - (II). - (C) Jam is matched with (I) 0.96. This is incorrect. Jam's a_w is low due to sugar. - (D) Bread is matched with (II) 0.75-0.80. This is also incorrect. Bread's a_w is very high. - (A) Flour is matched with (III) 0.55-0.80. This range is plausible for flour. - (B) Dry Fruits is matched with (IV) 0.67-0.87. This range is also plausible for some dried fruits.
There appears to be a significant error in the question's provided ranges or the options. Let's attempt a logical matching based on relative water activity. - Highest a_w: Bread (˜0.96) - High a_w but lowered by solutes: Jam (˜0.80) - Intermediate a_w: Dry Fruits (˜0.65) - Low a_w: Flour (˜0.60)
Matching to the closest given values: - (D) Bread → (I) 0.96 - (C) Jam → (II) 0.75-0.80 - (B) Dry Fruits → (IV) 0.67-0.87 (plausible range) - (A) Flour → (III) 0.55-0.80 (plausible range)
This logical matching (D-I, C-II, B-IV, A-III) does not correspond to any of the answer choices. The question or options are flawed. However, if forced to choose the "best fit" from the flawed options, it requires accepting some incorrect pairings. Let's analyze option (D) again: (A)-(III), (B)-(IV), (C)-(I), (D)-(II). This option incorrectly matches Jam to 0.96 and Bread to 0.75-0.80. Due to these fundamental errors, a correct solution cannot be derived.

Step 3: Final Answer:
The question contains incorrect data in the options, making a correct match impossible based on standard food science values. Both the water activity values for bread and jam are mismatched in all options. The question is fundamentally flawed.

Quick Tip

When faced with a flawed matching question, try to find the "best" or most logical pairings first. High-moisture products like fresh bread have a very high a_w (close to 1.0). High-sugar products like jam have a much lower a_w than their moisture content suggests. Dry products like flour have the lowest a_w. If no option fits this logic, recognize the question may be faulty.

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74. Which of the following statements is/are correct with reference to composition of fats and oils;
(A). The chain length and degree of saturation control the properties that are found within the fatty acids and lipids
(B). Fatty acids typically contain an even number of carbon atoms.
(C). The saturated acids have higher melting points than unsaturated acids of corresponding size.
Choose the most appropriate answer from the options given below:

(A) (A) and (C) only
(B) (B) and (C) only
(C) (A) only (B) only
(D) (A), (B) and (C)

Correct Answer: (D) (A), (B) and (C)

Solution:

Conceptual Understanding

This question evaluates three core statements about the structure and properties of fatty acids, which are the primary components of fats and oils (lipids).

Expanded Explanation: Analysis of Statements

- **(A) The chain length and degree of saturation control the properties that are found within the fatty acids and lipids: CORRECT.** This is the most fundamental principle of lipid chemistry.
  - **Chain Length:** The number of carbon atoms. Longer chains have stronger van der Waals forces between them, resulting in higher melting points.
  - **Degree of Saturation:** The number of carbon-carbon double bonds. Saturated fatty acids have no double bonds. Unsaturated fatty acids have one (mono-) or more (poly-) double bonds. Double bonds introduce "kinks" in the chain, lowering the melting point. These two factors dictate whether a lipid is a solid fat or a liquid oil at room temperature, as well as its solubility and susceptibility to oxidation.
- **(B) Fatty acids typically contain an even number of carbon atoms: CORRECT.** This is a direct consequence of their biochemical synthesis pathway in most living organisms. Fatty acids are built by the sequential addition of two-carbon units derived from acetyl-CoA. This results in the vast majority of naturally occurring fatty acids having an even number of carbons, such as palmitic acid (C16), stearic acid (C18), and oleic acid (C18). Odd-chain fatty acids exist but are much less common.
- **(C) The saturated acids have higher melting points than unsaturated acids of corresponding size: CORRECT.** This is explained by molecular geometry and intermolecular forces.
  - **Saturated Fatty Acids:** Have straight, linear chains that can pack together very tightly and orderly, maximizing the surface area for contact. This allows for strong intermolecular van der Waals forces, which require a large amount of thermal energy (a high temperature) to overcome.
  - **Unsaturated Fatty Acids:** The *cis* double bonds common in nature create rigid kinks or bends in the carbon chain. These kinks prevent the molecules from packing closely together. The resulting disordered arrangement leads to weaker intermolecular forces and, consequently, a much lower melting point.

Final Answer

All three statements—(A) regarding the control of properties, (B) regarding the even number of carbons, and (C) regarding the higher melting point of saturated acids—are fundamental and correct principles of fatty acid chemistry.

Quick Tip

Remember these key fatty acid rules: 1. **Saturation affects shape and state**: Saturated = Straight = Solid fat. Unsaturated = Kinked = Liquid oil. 2. **Melting Point**: Longer chain = Higher MP. More saturation = Higher MP. 3. **Natural structure**: Most are even-numbered chains.

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75. Identify the factors that decrease the stability of egg foams;
(A). Acidity
(B). Fat content
(C). Salt content
(D). Sugar
Choose the most appropriate answer from the options given below:

(A) (B) and (C) only
(B) (A), (B) and (D) only
(C) (A), (B), (C) and (D)
(D) (B), (C) and (D) only

Correct Answer: (A) (B) and (C) only

Solution:

Conceptual Understanding

Egg foam (meringue) stability refers to the ability of the whipped foam to maintain its volume and structure over time without collapsing or weeping (leaking liquid). The stability is determined by the strength of the protein network formed around the trapped air bubbles. Certain ingredients can either strengthen or weaken this network.

Expanded Explanation: Analysis of Factors

- **(A) Acidity: INCREASES Stability.** The addition of a small amount of acid, such as cream of tartar or lemon juice, is beneficial. The acid lowers the pH, which helps the egg white proteins to unfold and bond together more effectively, creating a stronger, more elastic network. It also helps protect the foam from over-beating.
- **(B) Fat Content: DECREASES Stability.** Fat is highly detrimental to both the formation and stability of egg foams. Fat molecules are surface-active and will compete with the egg proteins for a position at the air-water interface. By interfering with the protein-protein bonds, even a trace of fat (like a speck of egg yolk) will disrupt the formation of a cohesive protein film, resulting in a weak foam that has poor volume and collapses easily.
- **(C) Salt Content: DECREASES Stability.** While adding salt can decrease the time it takes to whip egg whites, it ultimately has a negative impact on stability. The salt ions interfere with the electrostatic interactions between the protein molecules, weakening the

overall structure of the foam. A foam made with salt is less stable and more likely to weep liquid over time.

- **(D) Sugar: INCREASES Stability.** Sugar is the most important stabilizer for egg foams. It should be added gradually after the foam has begun to form (soft peak stage). Sugar stabilizes the foam in two ways:
  1. It dissolves in the liquid phase of the foam, greatly increasing its viscosity. This thickened liquid drains much more slowly, preventing the foam from collapsing.
  2. It protects the protein structure from over-coagulation during whipping and baking, resulting in a fine-textured, glossy, and very stable meringue.

Final Answer

The two factors from the list that are known to decrease the stability of egg foams are **Fat content** and **Salt content**.

Quick Tip

To remember egg foam chemistry:

- **Stabilizers (Friends):** Acid (cream of tartar), Sugar. They make the foam stronger.
- **Destabilizers (Foes):** Fat (yolk), Salt. They make the foam weaker.

Biscuit Type	Defining Property	Detailed Explanation
(D) Soft dough biscuit	**(IV) Flowy**	These doughs are characterized by high levels of fat and sugar relative to flour. The fat coats the flour particles, and the sugar competes for water, both of which significantly inhibit the development of a gluten network. The resulting dough is weak, soft, and lacks elasticity. It is often described as "short" and has a flowable, batter-like consistency, making it suitable for being deposited or extruded into shapes. *Examples: Cookies, shortbread.*
(C) Hard dough biscuit	**(III) Partially developed gluten**	These doughs have lower fat and sugar content and a higher water content compared to soft doughs. This formulation allows for some gluten development when the dough is mixed. The resulting dough is not as strong or elastic as bread dough but is tough, extensible, and cohesive. It is not flowy and must be formed by being sheeted into a thin layer and then cut. *Examples: Marie biscuits, Rich Tea biscuits.*
(B) Cracker	**(I) Low sugar and fat**	Crackers are typically savory products, so their doughs are lean, meaning they have very little or no sugar and a low fat content. The gluten is often well-developed to allow the dough to be laminated (layered with fat) or sheeted very thin to produce the characteristic crisp, flaky texture. *Examples: Saltine crackers, water biscuits.*
(A) Biscuit (General)	**(II) Flat crisp baked product**	This is a broad, overarching description that fits the general category. While textures vary from tender to hard, a com-