

CBSE Class 10, 2026 Agriculture Question Paper with Solutions

Time Allowed :3 Hours

Maximum Marks :80

Total questions :38

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The paper is divided into Section A and Section B.
2. Section A includes objective-type, short answer, and long answer questions.
3. All questions in Section A are compulsory.
4. Section B contains elective questions based on the chosen topic.
5. Answers must be written legibly within the word limit.
6. Use of unfair means or electronic devices is prohibited.
7. Follow the correct format and instructions for each section.

1.i. Which of the following is NOT a type of motivation?

- (A) Internal
- (B) Intermediate
- (C) External
- (D) Extensive

Correct Answer: (B) Intermediate

Solution:

Step 1: Understand the concept of motivation types.

Motivation is typically classified into two main categories: Intrinsic (Internal) motivation and Extrinsic (External) motivation.

Step 2: Recall the standard types of motivation.

- **Internal Motivation (Intrinsic):** Comes from within an individual, such as personal satisfaction, interest, or enjoyment of a task.
- **External Motivation (Extrinsic):** Comes from outside factors, such as rewards, praise, recognition, or avoiding punishment.

Step 3: Analysis of each option.

- **(A) Internal: Correct type.** This is another term for intrinsic motivation.
- **(B) Intermediate: NOT a type of motivation.** This term is not recognized as a standard category of motivation in psychology or management studies.
- **(C) External: Correct type.** This is another term for extrinsic motivation.
- **(D) Extensive: NOT a type of motivation.** This term is also not a standard type of motivation. However, since the question asks for which is NOT a type, and both (B) and (D) are incorrect types, we need to determine the intended answer. In standard textbooks, "Extensive" is sometimes confused with "Extrinsic," but "Intermediate" is clearly not a motivation type. Most exam patterns consider "Intermediate" as the correct answer for this question.

Step 4: Conclusion.

Based on standard classification, motivation is primarily divided into Internal (Intrinsic) and External (Extrinsic). "Intermediate" is not a recognized type of motivation.

Final Answer: (B) Intermediate

Quick Tip

Remember the two main types of motivation: Intrinsic (Internal) and Extrinsic (External). Any option other than these is likely incorrect.

ii. Which of the following is not a form of written communication?

- (A) Circulars
- (B) Reports

(C) Discussion

(D) SMS

Correct Answer: (C) Discussion

Solution:

Step 1: Understand the concept of written communication.

Written communication involves transmitting messages, information, or ideas through written symbols, words, or characters. It includes any communication method that uses text as the medium.

Step 2: Recall the forms of written vs. oral communication.

- **Written Communication:** Circulars, reports, memos, letters, emails, SMS, notices, manuals, etc.
- **Oral/Verbal Communication:** Discussions, meetings, conversations, speeches, telephonic talks, etc.

Step 3: Analysis of each option.

- **(A) Circulars: Written communication.** Circulars are written documents distributed to a group of people for information or instruction.
- **(B) Reports: Written communication.** Reports are formal written documents that present information, findings, or analysis.
- **(C) Discussion: NOT written communication.** Discussion is an oral/verbal form of communication where participants exchange ideas through speaking and listening.
- **(D) SMS: Written communication.** Short Message Service (SMS) involves sending text messages through mobile phones.

Step 4: Conclusion.

Among the given options, only "Discussion" is a form of oral communication. Circulars, Reports, and SMS all involve written text and therefore fall under written communication.

Final Answer: (C) Discussion

Quick Tip

To identify written communication, ask: "Does this involve text on a surface (paper, screen, etc.)?" If yes, it's written. If it involves speaking and listening, it's oral communication.

iii. Enlist different problems related to Sustainable Development.

Correct Answer: The major problems related to Sustainable Development are:

Solution:

Step 1: Define Sustainable Development.

Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It balances economic growth, social inclusion, and environmental protection.

Step 2: Identify the major problems/challenges to Sustainable Development.

- **1. Population Growth:** Rapid increase in population puts pressure on natural resources and makes sustainable development difficult to achieve.
- **2. Poverty and Inequality:** Widespread poverty forces people to overexploit natural resources for survival, while inequality leads to social unrest.
- **3. Environmental Degradation:** Deforestation, pollution, loss of biodiversity, and climate change hinder sustainable progress.
- **4. Resource Depletion:** Overconsumption of non-renewable resources like fossil fuels, minerals, and water creates scarcity.
- **5. Climate Change:** Global warming, extreme weather events, and rising sea levels threaten ecosystems and human settlements.
- **6. Lack of Education and Awareness:** Many people are unaware of sustainable practices and their importance.
- **7. Political and Governance Issues:** Corruption, weak policies, lack of political will, and poor implementation of environmental laws.

- **8. Economic Constraints:** High costs of switching to sustainable technologies and practices, especially for developing countries.
- **9. Urbanization:** Rapid and unplanned urban growth leads to slums, pollution, and strain on infrastructure.
- **10. Technological Gaps:** Lack of access to clean and green technologies in developing nations.
- **11. Conflict and War:** Destroys infrastructure, displaces people, and diverts resources away from sustainable development.
- **12. Waste Management:** Improper disposal of industrial, electronic, and plastic waste pollutes land and water.

Step 3: Conclusion.

Sustainable Development faces multiple interconnected challenges that require coordinated global efforts, policy interventions, technological innovation, and behavioral changes to overcome.

Final Answer:

1. Population Growth
2. Poverty and Inequality
3. Environmental Degradation
4. Resource Depletion
5. Climate Change
6. Lack of Education and Awareness
7. Political and Governance Issues
8. Economic Constraints
9. Urbanization
10. Technological Gaps
11. Conflict and War
12. Waste Management

Quick Tip

Remember the three pillars of Sustainable Development: Environment, Economy, and Society. Problems can be categorized under these three heads for better understanding.

iv. Entrepreneurs can create jobs in the market (True or False).

Correct Answer: True

Solution:

Step 1: Understand the role of entrepreneurs.

Entrepreneurs are individuals who identify business opportunities, organize resources, and take risks to establish and run enterprises.

Step 2: Analyze the relationship between entrepreneurship and job creation.

- Entrepreneurs start new businesses and ventures.
- As businesses grow, they need employees to handle various operations.
- Each new business creates direct employment opportunities.
- Successful enterprises also create indirect jobs in the supply chain and support services.
- Small and Medium Enterprises (SMEs), which are often entrepreneur-led, are major contributors to employment in most economies.

Step 3: Examples of job creation by entrepreneurs.

- A startup founder hires software developers, marketers, and sales staff.
- A restaurant owner hires chefs, waiters, and cleaners.
- A manufacturer creates jobs in production, logistics, and administration.
- Entrepreneurs also create opportunities for suppliers, distributors, and service providers.

Step 4: Conclusion.

Entrepreneurs are indeed job creators. They not only employ themselves but also generate employment opportunities for others, contributing significantly to economic growth and reducing unemployment.

Final Answer: True

Quick Tip

Entrepreneurs are often called "job creators" because every new business venture generates employment opportunities directly and indirectly.

v. Which of the following functions is not performed with a mouse?

- (A) Turn on
- (B) Hover
- (C) Right click
- (D) Drag and drop

Correct Answer: (A) Turn on

Solution:

Step 1: Understand the functions of a computer mouse.

A computer mouse is an input device used to interact with the graphical user interface (GUI) of a computer. It performs various functions through its buttons and movement.

Step 2: Identify common mouse functions.

- **Click:** Pressing and releasing a mouse button (left click for selection, right click for context menu).
- **Double-click:** Two quick clicks to open files or programs.
- **Hover:** Placing the cursor over an item without clicking to see tooltips or highlights.
- **Drag and Drop:** Clicking and holding an item while moving the mouse to relocate it.
- **Scroll:** Using the scroll wheel to move up and down on a page.

Step 3: Analysis of each option.

- **(A) Turn on: NOT performed with a mouse.** Turning on a computer is done by pressing the power button on the CPU, laptop, or monitor. A mouse cannot power on a computer.

- **(B) Hover: Performed with a mouse.** Moving the cursor over an item and leaving it there is a standard mouse function.
- **(C) Right click: Performed with a mouse.** Clicking the right button on a mouse opens context menus.
- **(D) Drag and drop: Performed with a mouse.** Holding the left button while moving the mouse to relocate files or objects.

Step 4: Conclusion.

Among the given options, "Turn on" is the only function that cannot be performed using a mouse. It requires pressing the physical power button on the computer.

Final Answer: (A) Turn on

Quick Tip

Remember: A mouse is an input device for interaction after the computer is already powered on. Power functions (turn on/off, restart) are performed using buttons on the computer itself.

vi. Which of the following function is not a way to protect data?

- (A) Password
- (B) Antivirus and firewall
- (C) Secure sites
- (D) Trojan horse

Correct Answer: (D) Trojan horse

Solution:

Step 1: Understand data protection methods.

Data protection refers to the processes and mechanisms used to secure digital information from corruption, compromise, or loss. Common methods include access controls, security software, and safe browsing practices.

Step 2: Distinguish between protective measures and threats.

It is crucial to differentiate between tools that enhance security and those that are actually malicious programs designed to bypass security.

Step 3: Analysis of each option.

- **(A) Password: This is a protective measure.** Passwords restrict access to data, ensuring only authorized users can view or modify it.
- **(B) Antivirus and firewall: This is a protective measure.** Antivirus software detects and removes malicious programs, while a firewall monitors and controls incoming and outgoing network traffic based on security rules.
- **(C) Secure sites: This is a protective measure.** Secure websites (using HTTPS) encrypt data transmitted between the user and the site, protecting it from interception.
- **(D) Trojan horse: This is NOT a protective measure.** A Trojan horse is a type of malicious software (malware) that disguises itself as legitimate software to trick users into installing it. Once installed, it can steal, corrupt, or delete data. It is a threat to data, not a way to protect it.

Step 4: Conclusion.

Passwords, antivirus/firewall software, and secure sites are all methods used to safeguard data. In contrast, a Trojan horse is a harmful program designed to compromise data security.

Final Answer: (D) Trojan horse

Quick Tip

Always differentiate between security tools (passwords, firewalls) and security threats (viruses, trojans, malware). The question asks for something that is NOT a way to protect data, which points directly to a threat.

2.i. Which is a 'Kharif' crop?

(A) Maize

- (B) Wheat
- (C) Barley
- (D) Mustard

Correct Answer: (A) Maize

Solution:

Step 1: Understand the cropping seasons in India.

In India, crops are broadly classified into three seasons: Kharif, Rabi, and Zaid. The classification is based on the sowing and harvesting seasons, which are influenced by the monsoon.

Step 2: Recall the characteristics of Kharif crops.

- **Kharif Crops:** Sown with the onset of monsoon (June-July) and harvested in autumn (September-October). They require warm, wet conditions.
- **Examples:** Rice, maize, cotton, groundnut, jowar, bajra, tur (arhar), moong, urad, etc.

Step 3: Analysis of each option.

- **(A) Maize: Correct.** Maize is a major Kharif crop grown during the rainy season.
- **(B) Wheat:** Incorrect. Wheat is a Rabi crop, sown in winter (October-December) and harvested in spring (March-April).
- **(C) Barley:** Incorrect. Barley is also a Rabi crop, grown during the winter season.
- **(D) Mustard:** Incorrect. Mustard is a prominent Rabi oilseed crop.

Step 4: Conclusion.

Among the given options, only maize is a Kharif crop. The others (wheat, barley, mustard) are all Rabi crops.

Final Answer: (A) Maize

Quick Tip

To remember: Kharif = Monsoon crops (June-October) e.g., Rice, Maize, Cotton. Rabi = Winter crops (October-March) e.g., Wheat, Barley, Mustard, Gram.

ii. _____ is a rabi cereal crop.

- (A) Paddy
- (B) Maize
- (C) Wheat
- (D) Gram

Correct Answer: (C) Wheat

Solution:

Step 1: Recall the characteristics of Rabi crops.

- **Rabi Crops:** Sown in winter (October-December) and harvested in spring (March-April). They require cool growing conditions.
- **Examples:** Wheat, barley, gram, peas, mustard, linseed, etc.

Step 2: Understand the term "cereal crop."

Cereal crops are grasses cultivated for their edible grains or seeds. Examples include wheat, rice, maize, barley, oats, etc. Pulses like gram are not cereals; they are legumes.

Step 3: Analysis of each option.

- **(A) Paddy:** Incorrect. Paddy (rice) is a Kharif crop, not a Rabi crop.
- **(B) Maize:** Incorrect. Maize is a Kharif crop, though in some regions it can be grown in other seasons, it is primarily a Kharif cereal.
- **(C) Wheat:** **Correct.** Wheat is the primary Rabi cereal crop in India.
- **(D) Gram:** Incorrect. Gram (chickpea) is a Rabi crop, but it is a pulse (legume), not a cereal.

Step 4: Conclusion.

Wheat is the only option that is both a Rabi crop and a cereal. Gram is a Rabi crop but a pulse, while paddy and maize are Kharif crops.

Final Answer: (C) Wheat

Quick Tip

Cereals = Grains like wheat, rice, maize. Pulses = Legumes like gram, pea, arhar. Don't confuse the two categories.

iii. Marigold is propagated by

- (A) Tubers
- (B) Corms
- (C) Bulbs
- (D) Seeds

Correct Answer: (D) Seeds

Solution:

Step 1: Understand plant propagation methods.

Plant propagation can be done through sexual methods (seeds) or asexual/vegetative methods (tubers, corms, bulbs, cuttings, etc.).

Step 2: Recall the propagation method for Marigold.

Marigold (*Tagetes* species) is an annual flowering plant that is primarily propagated through seeds. It grows easily from seeds and flowers within a short period.

Step 3: Analysis of each option.

- **(A) Tubers:** Incorrect. Tubers (like potato) are swollen underground stems used for vegetative propagation. Marigold does not produce tubers.
- **(B) Corms:** Incorrect. Corms (like gladiolus) are swollen underground stems that store food. Marigold does not produce corms.
- **(C) Bulbs:** Incorrect. Bulbs (like onion, garlic) are underground storage organs with fleshy leaves. Marigold does not produce bulbs.
- **(D) Seeds: Correct.** Marigold is commonly and easily propagated through seeds. It produces abundant seeds that germinate readily.

Step 4: Conclusion.

Marigold is an annual plant that completes its life cycle in one season and reproduces primarily through seeds. While some varieties can be propagated through cuttings, the most common and primary method is by seeds.

Final Answer: (D) Seeds

Quick Tip

Annual flowers like marigold, zinnia, and sunflower are usually propagated by seeds. Perennials are often propagated by vegetative methods like bulbs, corms, or tubers.

iv. Powder mildew disease is caused by -----

- (A) Bacteria
- (B) Fungus
- (C) Virus
- (D) Nematodes

Correct Answer: (B) Fungus

Solution:

Step 1: Understand what Powdery Mildew is.

Powdery mildew is a common fungal disease that affects a wide range of plants. It appears as white or gray powdery spots on leaves, stems, flowers, and fruits.

Step 2: Identify the causal organism.

- Powdery mildew is caused by **ascomycete fungi** belonging to the order Erysiphales.
- Common genera include *Erysiphe*, *Podosphaera*, *Oidium*, *Uncinula*, etc.

Step 3: Analysis of each option.

- **(A) Bacteria:** Incorrect. Bacterial diseases show different symptoms like wilting, spots with yellow halos, or oozing. They do not cause powdery growth.

- **(B) Fungus: Correct.** Powdery mildew is specifically a fungal disease.
- **(C) Virus:** Incorrect. Viral diseases cause symptoms like mosaic patterns, leaf curling, stunting, or yellowing, not powdery growth.
- **(D) Nematodes:** Incorrect. Nematodes are microscopic roundworms that affect roots, causing galls or root knots, not powdery growth on leaves.

Step 4: Conclusion.

Powdery mildew is a well-known fungal disease characterized by white powdery growth on plant surfaces. It is caused by various species of fungi.

Final Answer: (B) Fungus

Quick Tip

Remember: "Powdery" growth on plants = Fungal disease. Bacteria cause spots with water-soaked appearance, viruses cause mosaic patterns, and nematodes affect roots.

v. Highest lactose is found in

- (A) Human milk
- (B) Cow milk
- (C) Buffalo milk
- (D) Camel milk

Correct Answer: (A) Human milk

Solution:

Step 1: Understand what lactose is.

Lactose is a disaccharide sugar (glucose + galactose) found primarily in milk and dairy products. It is often referred to as "milk sugar."

Step 2: Compare lactose content in different types of milk.

The approximate lactose content in various milk sources:

- **Human milk:** 6.5% - 7.0% (highest among mammals)

- **Cow milk:** 4.5% - 5.0%
- **Buffalo milk:** 4.5% - 5.0%
- **Camel milk:** 4.0% - 4.5%
- **Goat milk:** 4.0% - 4.5%
- **Sheep milk:** 4.5% - 5.0%

Step 3: Analysis of each option.

- **(A) Human milk: Correct.** Human milk contains the highest lactose content (around 7%) compared to other mammals. This provides energy for rapid brain development in infants.
- **(B) Cow milk:** Incorrect. Cow milk contains about 4.8% lactose, which is lower than human milk.
- **(C) Buffalo milk:** Incorrect. Buffalo milk contains about 4.8% lactose, similar to cow milk.
- **(D) Camel milk:** Incorrect. Camel milk contains about 4.4% lactose, which is lower than cow and buffalo milk.

Step 4: Conclusion.

Human milk has the highest lactose content among all mammals, typically ranging from 6.5% to 7.0%. This high lactose content is essential for infant nutrition and development.

Final Answer: (A) Human milk

Quick Tip

Remember: Lactose content varies by species. Human milk has the highest lactose, while marine mammals like seals have very low or no lactose.

vi. Protein content in soybean is -----

(A) 30%

- (B) 40-45%
- (C) 60%
- (D) 55%

Correct Answer: (B) 40-45%

Solution:

Step 1: Understand the nutritional composition of soybean.

Soybean (*Glycine max*) is a legume that is exceptionally rich in protein. It is considered a complete protein source as it contains all essential amino acids.

Step 2: Recall the protein content of soybean.

- Soybean contains approximately **40-45% protein** on a dry weight basis.
- This is the highest protein content among all legumes and most plant-based foods.
- Other nutrients in soybean include:
 - Oil: 18-22%
 - Carbohydrates: 20-30%
 - Fiber: 5-8%
 - Moisture: 8-10%

Step 3: Analysis of each option.

- **(A) 30%:** Incorrect. This is too low for soybean. Some other legumes like chickpea or lentil may have around 20-25% protein, but soybean is higher.
- **(B) 40-45%: Correct.** This is the accurate protein content range for soybean.
- **(C) 60%:** Incorrect. This is too high. No common food crop has 60% protein content. Soy protein isolates can reach this level after processing, but not whole soybean.
- **(D) 55%:** Incorrect. This is higher than the actual protein content of whole soybean.

Step 4: Conclusion.

Soybean is renowned for its high protein content, typically ranging from 40% to 45%, making it an excellent source of plant-based protein for human consumption and animal feed.

Final Answer: (B) 40-45%

Quick Tip

Soybean = King of plant proteins (40-45%). Compare with other legumes: Gram (20-25%), Pea (20-25%), Lentil (25-28%).

3. List different methods of communication.

Solution:

Step 1: Definition of communication.

Communication is the process of exchanging information, ideas, thoughts, and feelings between people through various methods.

Step 2: Different methods of communication.

The main methods of communication are:

1. **Verbal Communication:** Exchange of information through spoken words. Examples: face-to-face conversations, telephone calls, video calls, speeches, presentations.
2. **Non-Verbal Communication:** Communication without words, using body language, gestures, facial expressions, eye contact, and posture.
3. **Written Communication:** Exchange of information through written symbols. Examples: letters, emails, reports, memos, notices, articles, text messages.
4. **Visual Communication:** Use of visual aids to convey information. Examples: charts, graphs, diagrams, maps, posters, photographs, videos, presentations.
5. **Formal Communication:** Official communication following established channels in organizations. Examples: official meetings, memos, circulars, reports.
6. **Informal Communication:** Unofficial communication that occurs naturally among people. Examples: casual conversations, gossip, grapevine communication.
7. **Digital/Virtual Communication:** Communication through electronic means. Examples: emails, social media, instant messaging, video conferencing, blogs.

Quick Tip

Remember: Communication methods can be categorized as verbal/non-verbal, formal/informal, written/oral, and digital/traditional. Each method has its own advantages and appropriate contexts.

4. What is stress? Enlist few simple stress management techniques.

Solution:

Step 1: Definition of stress.

Stress is a state of mental or emotional strain or tension resulting from adverse or demanding circumstances. It is the body's natural response to challenges, pressure, or threats. When faced with stress, the body releases hormones like adrenaline and cortisol that prepare it for a "fight or flight" response.

Step 2: Types of stress.

- **Acute stress:** Short-term stress from immediate pressures
- **Chronic stress:** Long-term stress from ongoing situations
- **Eustress:** Positive stress that motivates and enhances performance

Step 3: Simple stress management techniques.

1. **Deep Breathing Exercises:** Practice slow, deep breaths to calm the nervous system and reduce tension.
2. **Regular Physical Exercise:** Engage in activities like walking, jogging, yoga, or swimming to release endorphins (feel-good hormones).
3. **Meditation and Mindfulness:** Spend a few minutes daily in quiet reflection to clear the mind and focus on the present moment.
4. **Adequate Sleep:** Ensure 7-8 hours of quality sleep to allow the body and mind to rejuvenate.

5. **Healthy Diet:** Eat balanced meals with fruits, vegetables, and avoid excessive caffeine or sugar.
6. **Time Management:** Prioritize tasks, set realistic goals, and avoid overcommitment.
7. **Talking to Someone:** Share feelings with trusted friends, family, or a counselor.
8. **Pursuing Hobbies:** Engage in activities you enjoy like reading, music, gardening, or painting.
9. **Taking Breaks:** Step away from work periodically to relax and recharge.
10. **Positive Thinking:** Practice gratitude and focus on solutions rather than problems.

Quick Tip

Remember: Stress is inevitable but manageable. Simple techniques like deep breathing, exercise, meditation, and proper time management can significantly reduce stress levels and improve overall well-being.

5. Enlist plan for monthly maintenance of computer.

Solution:

Step 1: Importance of computer maintenance.

Regular maintenance of computers ensures optimal performance, extends hardware life, prevents data loss, and protects against security threats.

Step 2: Monthly maintenance plan for computer.

1. Clean Hardware Components:

- Dust the CPU, monitor, keyboard, and mouse using a soft cloth or compressed air
- Clean the screen with a microfiber cloth
- Ensure proper ventilation around the computer

2. Disk Cleanup:

- Remove temporary files, cache, and browser history
- Empty the recycle bin
- Use built-in Disk Cleanup tool (Windows) or similar utilities

3. Defragment Hard Drive:

- Run disk defragmentation to optimize file storage (for HDDs, not needed for SSDs)
- This improves system speed and performance

4. Update Software:

- Install latest operating system updates and security patches
- Update all installed applications and drivers
- Update antivirus definitions

5. Scan for Malware and Viruses:

- Run a full system scan using reliable antivirus software
- Use anti-malware tools for additional protection

6. Backup Important Data:

- Create backups of important files to external drives or cloud storage
- Verify that backups are working properly

7. Organize Files and Folders:

- Delete unnecessary files and organize documents into proper folders
- Remove duplicate files

8. Check Startup Programs:

- Disable unnecessary programs that auto-start with Windows
- This improves boot time and system performance

9. Check Hardware Health:

- Monitor hard drive health using diagnostic tools

- Check for unusual noises from fans or hard drives
- Ensure all cables are securely connected

10. Password and Security Review:

- Update passwords if needed
- Review account security settings
- Check for any unauthorized access attempts

Quick Tip

Remember: Regular monthly maintenance prevents major computer problems. A systematic approach to cleaning, updating, scanning, and backing up ensures your computer runs smoothly and securely.

6. What are the qualities a successful entrepreneur should have?

Solution:

Step 1: Definition of entrepreneur.

An entrepreneur is an individual who creates, organizes, and operates a business or venture, taking on financial risks to do so. Successful entrepreneurs possess specific qualities that help them overcome challenges and achieve success.

Step 2: Essential qualities of a successful entrepreneur.

1. **Passion and Motivation:** Deep interest in their work that drives them to persist despite obstacles and setbacks.
2. **Risk-Taking Ability:** Willingness to take calculated risks and step out of comfort zones for potential rewards.
3. **Self-Confidence:** Belief in their own abilities and decisions, even when others doubt them.
4. **Innovation and Creativity:** Ability to think differently, generate new ideas, and find unique solutions to problems.

5. **Leadership Skills:** Capacity to inspire, guide, and manage teams effectively towards common goals.
6. **Resilience and Perseverance:** Ability to bounce back from failures and keep going despite difficulties.
7. **Adaptability and Flexibility:** Willingness to adapt to changing market conditions and customer needs.
8. **Strong Work Ethic:** Dedication to working hard and putting in the necessary time and effort.
9. **Decision-Making Ability:** Capacity to make timely and effective decisions, even under pressure.
10. **Financial Management Skills:** Understanding of budgeting, cash flow, and financial planning.
11. **Communication Skills:** Ability to clearly convey ideas to customers, investors, employees, and partners.
12. **Networking Ability:** Skill in building and maintaining relationships that can benefit the business.
13. **Customer Focus:** Deep understanding of customer needs and commitment to delivering value.
14. **Time Management:** Efficient use of time to prioritize tasks and meet deadlines.
15. **Continuous Learning:** Desire to constantly learn, improve, and stay updated with industry trends.

Quick Tip

Remember: Successful entrepreneurs combine passion with practical skills. While some qualities like risk-taking and innovation are innate, others like financial management and communication can be developed through learning and experience.

7. Enlist different problems related to Sustainable Development.

Solution:

Step 1: Definition of sustainable development.

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It balances economic growth, social inclusion, and environmental protection.

Step 2: Major problems related to sustainable development.

1. Environmental Problems:

- Climate change and global warming due to greenhouse gas emissions
- Depletion of natural resources (fossil fuels, minerals, water)
- Deforestation and loss of biodiversity
- Air, water, and soil pollution
- Waste management issues, especially plastic and electronic waste
- Ozone layer depletion
- Ocean acidification and marine pollution

2. Economic Problems:

- Poverty and income inequality
- Unemployment and underemployment
- Unsustainable consumption and production patterns
- Economic instability and financial crises
- Lack of access to affordable and clean energy
- Unsustainable agricultural practices
- Debt burdens on developing countries

3. Social Problems:

- Rapid population growth

- Food insecurity and malnutrition
- Lack of access to quality education and healthcare
- Gender inequality and discrimination
- Urbanization and slum development
- Child labor and human rights violations
- Social conflicts and displacement

4. Political and Institutional Problems:

- Lack of political will and commitment
- Weak governance and corruption
- Inadequate policies and regulations
- Poor implementation of sustainable development goals
- Conflicts between developed and developing nations
- Lack of international cooperation

5. Technological Problems:

- Digital divide and lack of access to technology
- Insufficient clean and green technologies
- Dependence on non-renewable energy sources
- Lack of sustainable infrastructure
- E-waste management challenges

6. Intergenerational Equity Problems:

- Overconsumption by current generations
- Depletion of resources for future generations
- Irreversible environmental damage
- Loss of cultural heritage and traditional knowledge

Quick Tip

Remember: Sustainable development faces interconnected environmental, economic, social, political, and technological challenges. Solving these requires integrated approaches, global cooperation, and commitment from all stakeholders.

8. List the major pests and diseases of rice and discuss shoot borer's damage and management.

Solution:

Step 1: Major pests of rice.

The major insect pests that attack rice crops include:

- **Stem borers:** Yellow stem borer, Striped stem borer, Pink stem borer
- **Leaf feeders:** Rice leaf folder, Rice hispa, Rice horned caterpillar
- **Sucking pests:** Brown planthopper, Green leafhopper, Rice earhead bug
- **Root feeders:** Rice root weevil, Rice root aphid
- **Grain feeders:** Rice weevil (in storage), Rice bug
- **Others:** Gall midge, Rice caseworm, Whorl maggot

Step 2: Major diseases of rice.

The common diseases affecting rice cultivation are:

- **Fungal diseases:** Blast, Sheath blight, Brown spot, False smut, Sheath rot
- **Bacterial diseases:** Bacterial leaf blight, Bacterial leaf streak
- **Viral diseases:** Rice tungro virus, Rice grassy stunt virus
- **Nematode diseases:** Root knot nematode, White tip nematode

Step 3: Introduction to rice shoot borer (Stem borer).

Rice shoot borer, commonly known as rice stem borer, is one of the most destructive pests of rice. The major species include **Yellow stem borer (*Scirpophaga incertulas*)** and **Striped**

stem borer (*Chilo suppressalis*). It is widely distributed across all rice-growing regions and causes significant yield losses.

Step 4: Nature of damage caused by shoot borer.

The damage caused by rice shoot borer occurs at different growth stages:

- **Vegetative stage damage:**

- Larvae bore into the stem and feed internally
- Damage to the central shoot causes **deadheart** - the central leaf whorl dries up and does not unfold
- Deadhearts are easily pulled out from the stem
- Tillering is reduced, affecting plant growth

- **Reproductive stage damage:**

- Larvae feed inside the stem near the panicle base
- This results in **whiteheads** - panicles become empty, chaffy, and white in color
- Affected panicles stand upright and do not produce grain
- Severe infestation can cause 20-60% yield loss

- **Other damage symptoms:**

- Presence of **egg masses** covered with buff-colored hairs on leaf tips
- **Exit holes** on stems where larvae have emerged
- Frass (insect excrement) visible inside the stem
- Reduced tillering and stunted plant growth

Step 5: Integrated management of rice shoot borer.

Effective management combines cultural, mechanical, biological, and chemical methods:

- **Cultural methods:**

- Use resistant varieties like IR-36, IR-64, TN-1
- Early planting to escape peak pest incidence
- Synchronized planting in a community to reduce pest buildup

- Avoid close planting; maintain optimum spacing
 - Balanced fertilization - avoid excess nitrogen
 - Field sanitation - destroy stubbles and crop residues after harvest
 - Summer plowing to expose pupae to sunlight and predators
- **Mechanical methods:**
 - Collection and destruction of egg masses
 - Removal and destruction of deadhearts and whiteheads
 - Use of light traps to attract and kill adult moths
 - Installation of pheromone traps (4-5 traps per acre) for monitoring and mass trapping
- **Biological methods:**
 - Conservation of natural enemies like egg parasitoids (*Trichogramma* spp.), larval parasitoids, predators like spiders, ladybird beetles
 - Release of *Trichogramma japonicum* @ 50,000 per acre at 10-day intervals
 - Use of microbial pesticides like *Bacillus thuringiensis*
- **Chemical methods:**
 - Apply insecticides only when economic threshold level is reached (2 egg masses/m² or 5% deadhearts)
 - Recommended insecticides: Carbofuran 3G, Cartap hydrochloride, Chlorantraniliprole, Fipronil
 - Apply granules in standing water or spray during evening hours
 - Rotate insecticides to avoid resistance development

Quick Tip

Remember: Rice shoot borer causes deadhearts in vegetative stage and whiteheads in reproductive stage. Integrated management combining resistant varieties, cultural practices, biological control, and need-based chemical application is most effective.

9. Discuss in detail life cycle of Lac insect.

Solution:

Step 1: Introduction to Lac insect.

Lac insect (**Kerria lacca**) is a tiny scale insect that produces lac, a natural resin of commercial importance. It is cultivated mainly in India, Thailand, and Myanmar on host trees like palas, ber, and kusum. Lac is used in making jewellery, sealing wax, polishing materials, and in food and cosmetic industries.

Step 2: Host plants of Lac insect.

The major host plants include:

- **Kusum (Schleichera oleosa)** - Best for rangeeni strain
- **Palas (Butea monosperma)** - For kusmi strain
- **Ber (Ziziphus mauritiana)** - For both strains
- Other hosts: Ficus, Acacia, Shisham

Step 3: Life cycle stages of Lac insect.

The life cycle of lac insect consists of the following stages:

1. Egg stage:

- Female lac insect lays eggs inside its own body (viviparous/ovoviviparous)
- A single female can lay 200-500 eggs
- Incubation period: Few hours to 2-3 days
- Eggs hatch inside the female's body and young ones emerge

2. Crawler stage (Nymph - Stage I):

- Newly emerged nymphs are called crawlers
- They are tiny, reddish, and have six legs and antennae
- Crawlers emerge through the anal opening of the mother
- They remain active for 1-3 days and crawl to find suitable settling sites on tender shoots

- This is the only mobile stage in the life cycle
- They insert their proboscis into the bark and start sucking sap
- Duration: 2-4 days

3. **Settled nymph stage (Stage II):**

- After settling, nymphs lose their legs and antennae
- They start secreting lac resin from their body
- The resin forms a protective cell around them
- They continue feeding on plant sap
- Sex differentiation begins at this stage
- Duration: 15-20 days

4. **Stage III nymph (Pre-adult):**

- Further development with increased lac secretion
- Male and female nymphs show distinct development paths
- Female nymphs remain in the cell and continue growing
- Male nymphs undergo complete metamorphosis
- Duration: 20-25 days

5. **Adult stage:**

- **Female adult:**

- Females are wingless, legless, and remain inside the cell
- They have a sac-like body without distinct segmentation
- Continue feeding and secreting lac throughout life
- Attract males through pheromones
- After mating, they lay eggs and die
- Life span: 3-4 months

- **Male adult:**

- Males undergo complete metamorphosis (pupal stage)

- They emerge as tiny, winged insects with legs
- Reddish in color with two long anal filaments
- Do not feed after emergence (mouthparts absent)
- Come out of the cell, search for females, mate and die within 1-2 days
- Life span: 1-2 days only

Step 4: Mating and reproduction.

- Males emerge from their cells and locate females through pheromones
- Mating occurs through the female's cell opening
- After mating, females continue feeding and developing eggs
- Females are ovoviviparous - eggs hatch inside the body and crawlers emerge
- Each female produces 200-500 crawlers

Step 5: Duration of life cycle.

The complete life cycle duration depends on the strain and season:

- **Rangeeni strain:** Two crops per year
 - **Baisakhi crop:** June-July emergence (Rainy season)
 - **Katki crop:** October-November emergence (Winter season)
 - Total life cycle: 4-5 months
- **Kusmi strain:** Two crops per year
 - **Jethwi crop:** May-June emergence (Summer season)
 - **Aghani crop:** December-January emergence (Winter season)
 - Total life cycle: 5-6 months

Step 6: Economic importance and harvesting.

- Lac is harvested just before crawler emergence
- Twigs with lac encrustation are cut (called sticklac)

- Sticklac is processed to remove resin, dye, and other impurities
- Yield depends on host plant, strain, and management practices

Quick Tip

Remember: Lac insect life cycle includes egg, crawler (mobile stage), settled nymph, and adult stages. Only crawlers are mobile; males are winged but short-lived. The insect completes 2 generations per year depending on the strain (rangeeni or kusmi).

10. Discuss cultivation of apple under the following heads: Soil and climate, major varieties, propagation and rootstock and major diseases and their management.

Solution:

Step 1: Soil and climate requirements for apple cultivation.

Climate requirements:

- **Temperature:**
 - Apples require temperate climate with distinct winter and summer seasons
 - Optimum temperature range: 21-24°C during growing season
 - Winter chilling requirement: 1000-1600 hours below 7°C for proper bud break and flowering
 - Can tolerate temperatures as low as -30°C in dormant stage
 - Summer temperatures above 35°C can affect fruit quality
- **Rainfall:**
 - Annual rainfall requirement: 1000-1250 mm
 - Rainfall should be well-distributed throughout the year
 - Excessive rainfall during flowering affects pollination
 - Hailstorms can damage fruits and trees
- **Altitude:**

- Grown at altitudes of 1500-2700 meters above sea level
- In India, major apple-growing regions are in Himalayan states (Jammu Kashmir, Himachal Pradesh, Uttarakhand)

- **Sunlight:**

- Require full sunlight for at least 6-8 hours daily
- Adequate sunlight ensures proper fruit color development

Soil requirements:

- **Soil type:** Well-drained deep loamy soils with good organic matter
- **Soil depth:** At least 1-1.5 meters depth for proper root development
- **Soil pH:** Slightly acidic to neutral (pH 5.5-6.5)
- **Soil drainage:** Excellent drainage essential - waterlogging causes root rot
- **Soil fertility:** Rich in organic matter with good nutrient-holding capacity
- Avoid heavy clay soils, shallow soils, and saline/alkaline soils

Step 2: Major varieties of apple.

Popular varieties grown in India:

- **Royal Delicious:** Most popular commercial variety, red color, excellent quality
- **Red Delicious:** Sweet flavor, conical shape, deep red color
- **Golden Delicious:** Yellow-green color, sweet, excellent for eating fresh
- **Rich-a-Red:** Early maturing, deep red color, good shelf life
- **Vance Delicious:** High yielding, attractive red color
- **Starking Delicious:** Striped red color, good quality
- **Ambri:** Traditional Kashmiri variety, long storage life
- **Chaubattia Princess:** Developed in India, good for mid-hills
- **Chaubattia Anupam:** Early maturing, disease resistant

- **Oregon Spur:** Spur-type variety, compact growth, high yield

Other international varieties:

- Fuji, Gala, Granny Smith, Pink Lady, Braeburn, Honeycrisp

Step 3: Propagation and rootstock.

Propagation methods:

- **Budding:** Most common method for commercial propagation
 - T-budding or shield budding done in spring (March-April)
 - Chip budding also successful
 - Budwood collected from disease-free mother plants
- **Grafting:**
 - Tongue grafting or whip grafting in winter
 - Used for top-working or changing varieties
- **Layering:** Not common for commercial propagation
- **Tissue culture:** Modern method for disease-free plants

Rootstocks used in apple cultivation:

- **Vigorous rootstocks:**
 - **Seedling rootstock:** Grown from seeds of crab apple or commercial varieties
 - **Malling-Merton (MM) series:** MM.111, MM.106 - semi-vigorous, widely used
- **Semi-dwarfing rootstocks:**
 - **M.7:** Adaptable to various soils, resistant to collar rot
 - **MM.106:** Most popular in India, semi-vigorous, early bearing
 - **M.26:** Semi-dwarf, precocious, requires support
- **Dwarfing rootstocks:**
 - **M.9:** Most popular dwarfing rootstock worldwide, early bearing, requires support

- **M.27:** Very dwarfing, for high-density planting
- **Characteristics of good rootstock:**
 - Good anchorage and adaptability to soil conditions
 - Resistance to diseases (woolly aphid, collar rot)
 - Compatibility with scion varieties
 - Influence on tree size, precocity, and yield

Step 4: Major diseases of apple and their management.

- **Apple Scab (*Venturia inaequalis*):**
 - **Symptoms:** Olive-green to black velvety spots on leaves and fruits; fruit cracking
 - **Management:**
 - * Grow resistant varieties
 - * Remove and destroy fallen leaves
 - * Spray fungicides like Captan, Mancozeb, or Carbendazim at green tip, pink bud, and petal fall stages
- **Powdery Mildew (*Podosphaera leucotricha*):**
 - **Symptoms:** White powdery coating on leaves, shoots, and flowers; stunted growth
 - **Management:**
 - * Prune and destroy infected shoots
 - * Avoid excess nitrogen fertilization
 - * Spray Sulfur, Karathane, or Triadimefon at 10-15 day intervals
- **Fire Blight (*Erwinia amylovora*):**
 - **Symptoms:** Bacterial disease; blossoms and shoots look burnt, cankers on branches
 - **Management:**
 - * Remove and destroy infected parts
 - * Disinfect pruning tools
 - * Spray Streptomycin or Bordeaux mixture during bloom

- **Collar Rot (*Phytophthora cactorum*):**

- **Symptoms:** Rot at the base of trunk (collar region), leaf yellowing, tree decline

- **Management:**

- * Use resistant rootstocks (MM.111, MM.106)

- * Ensure proper drainage

- * Avoid planting too deep

- * Drench with Metalaxyl or Fosetyl-Al

- **Alternaria Leaf Spot:**

- **Symptoms:** Small brown spots with concentric rings on leaves

- **Management:**

- * Collect and destroy fallen leaves

- * Spray Mancozeb or Iprodione

Integrated disease management approach:

- Use certified disease-free planting material
- Select resistant varieties and rootstocks
- Follow proper orchard sanitation
- Ensure proper pruning for air circulation
- Balanced nutrition to avoid susceptibility
- Need-based fungicide application following warning systems

Quick Tip

Remember: Apple cultivation requires temperate climate with adequate winter chilling, well-drained loamy soils (pH 5.5-6.5), and careful selection of varieties and rootstocks. Major diseases like apple scab and powdery mildew require integrated management through resistant varieties, cultural practices, and timely fungicide applications.

11. Discuss any four characteristics of a good quality seed.

Solution:

Step 1: Introduction to seed quality.

Good quality seed is the foundation of successful agriculture. It determines the potential yield, crop health, and overall productivity. Quality seeds ensure uniform germination, vigorous growth, and resistance to pests and diseases.

Step 2: Four important characteristics of good quality seed.

1. High Genetic Purity:

- The seed should be true to its variety type with minimum contamination from other varieties or crops
- Genetic purity ensures desired traits like yield potential, disease resistance, and quality parameters
- Certified seeds should have genetic purity above 98%
- Maintained through proper isolation during production and careful processing
- Adulteration with other varieties reduces crop uniformity and market value

2. High Physical Purity:

- Seeds should be clean and free from inert matter like dust, stones, straw, and weed seeds
- Free from seeds of other crops and varieties
- Minimum physical purity standards (usually 98% or higher for certified seeds)
- Achieved through proper cleaning, grading, and processing
- Presence of weed seeds can introduce competitive weeds in the field

3. High Germination Percentage:

- Good quality seeds should have high germination capacity (usually above 80-90% depending on crop)
- Seeds should produce healthy, vigorous seedlings under favorable conditions

- Uniform and rapid germination ensures even crop stand
- Tested through germination tests under controlled conditions
- Low germination leads to poor crop establishment and yield loss

4. **High Vigor and Viability:**

- Seeds should have strong vigor to emerge quickly even under less-than-ideal conditions
- Vigorous seeds produce healthy seedlings that can compete with weeds
- Viability refers to the seed's ability to remain alive and germinate after storage
- High vigor ensures better field establishment and stress tolerance
- Factors affecting vigor include seed maturity, storage conditions, and seed health

Step 3: Additional characteristics (for reference).

While the question asks for four, other important characteristics include:

- **Health status:** Free from seed-borne diseases and pests
- **Optimum moisture content:** Proper moisture level for safe storage (usually 8-12% depending on crop)
- **Uniform size and appearance:** Uniform seeds ensure uniform planting and crop growth
- **Good storage life:** Ability to maintain viability during storage
- **Properly dried and treated:** Seeds should be properly dried and treated with recommended fungicides/insecticides

Quick Tip

Remember: Good quality seed must have genetic purity, physical purity, high germination percentage, and high vigor. These characteristics ensure uniform crop establishment, optimal yield, and resistance to stresses. Always purchase certified seeds from reliable sources.

12. What is pollination? Discuss mechanism favoring self and cross-pollination in crop plants.

Solution:

Step 1: Definition of pollination.

Pollination is the process of transfer of pollen grains from the anther (male part) to the stigma (female part) of a flower. It is the first step in the reproductive process that leads to fertilization and seed formation. Pollination is essential for fruit and seed production in flowering plants.

Step 2: Types of pollination.

There are two main types of pollination:

- **Self-pollination (Autogamy):** Transfer of pollen from anther to stigma of the same flower or another flower on the same plant
- **Cross-pollination (Allogamy):** Transfer of pollen from anther of one flower to stigma of another flower on a different plant of the same species

Step 3: Mechanisms favoring self-pollination.

Plants have developed various adaptations that promote self-pollination:

1. Bisexuality:

- Flowers contain both male and female reproductive organs (stamens and pistil) in the same flower
- Examples: Wheat, rice, tomato, chickpea, beans

2. Cleistogamy:

- Flowers never open and pollination occurs inside the closed flower
- Ensures complete self-pollination
- Examples: Groundnut, pansy, some grass species

3. Homogamy:

- Anthers and stigma mature at the same time

- Ensures pollen is available when stigma is receptive
- Examples: Wheat, rice, tomato

4. **Position of floral parts:**

- Anthers are positioned above or around the stigma so pollen naturally falls on stigma
- Stigma and anthers are in close proximity
- Examples: Tomato, brinjal

5. **Bud pollination:**

- Pollination occurs in the bud stage before the flower opens
- Common in some legumes
- Examples: Pea, bean

Step 4: Mechanisms favoring cross-pollination.

Plants have developed various adaptations to promote cross-pollination and avoid self-pollination:

1. **Dichogamy:**

- Anthers and stigma mature at different times
- **Protandry:** Anthers mature before stigma (Sunflower, cotton, carrot)
- **Protogyny:** Stigma matures before anthers (Pear, cabbage, fig)

2. **Self-incompatibility:**

- Pollen from the same flower or plant fails to germinate or grow on the stigma
- Genetic mechanism prevents self-fertilization
- Examples: Cabbage, radish, pear, apple, many grasses

3. **Unisexuality (Diclity):**

- Flowers are either male or female
- **Monoecious:** Male and female flowers on same plant (Maize, castor, cucumber)

- **Dioecious:** Male and female flowers on different plants (Papaya, date palm, spinach)

4. **Herkogamy:**

- Physical barrier between anthers and stigma
- Stigma is positioned away from anthers preventing contact
- Examples: Many orchids, some Brassicaceae members

5. **Heterostyly:**

- Different flower types with different lengths of style and stamens
- Pollination occurs only between different types
- Examples: Primrose, buckwheat

6. **Wind pollination (Anemophily):**

- Flowers are adapted for pollen dispersal by wind
- Large feathery stigmas, abundant light pollen
- Examples: Maize, wheat, grasses, pines

7. **Insect pollination (Entomophily):**

- Flowers attract insects with color, scent, nectar
- Insects carry pollen from flower to flower
- Examples: Sunflower, mustard, apple

Step 5: Advantages and disadvantages.

Self-pollination advantages:

- Maintains pure lines and genetic uniformity
- No need for external agents
- Ensures reproduction even in absence of pollinators
- Desirable traits are preserved

Self-pollination disadvantages:

- No genetic variation, leading to inbreeding depression
- Less adaptable to changing environments
- Vigor may decrease over generations

Cross-pollination advantages:

- Creates genetic diversity and variation
- Produces more vigorous offspring (hybrid vigor)
- Better adaptability to environmental changes
- Evolution of new traits

Cross-pollination disadvantages:

- Dependent on external agents (wind, insects)
- Risk of pollination failure
- Wastage of pollen grains
- Undesirable traits may be introduced

Quick Tip

Remember: Self-pollination mechanisms include bisexuality, cleistogamy, homogamy while cross-pollination mechanisms include dichogamy, self-incompatibility, unisexuality, and herkogamy. Plants evolve these adaptations based on their reproductive strategy and environmental conditions.

13. Write two major diseases of pulses.

Solution:

Step 1: Introduction to pulse crops.

Pulses are important food crops rich in protein. They include crops like chickpea (gram), pigeonpea (arhar), mungbean (green gram), urdbean (black gram), lentil (masur), and pea. These crops are susceptible to various diseases that cause significant yield losses.

Step 2: Two major diseases of pulses.

1. Wilt (**Fusarium wilt**):

- **Causal organism:** *Fusarium oxysporum* f. sp. *ciceri* (in chickpea), *Fusarium udum* (in pigeonpea)
- **Symptoms:**
 - Yellowing and drooping of leaves
 - Wilting of entire plant
 - Browning of vascular tissues
 - Sudden death of plants in patches
- **Affected pulses:** Chickpea, pigeonpea, lentil, pea
- **Management:** Use resistant varieties, seed treatment with fungicides, crop rotation

2. Powdery Mildew:

- **Causal organism:** *Erysiphe polygoni*
- **Symptoms:**
 - White or gray powdery growth on leaves, stems, and pods
 - Yellowing and drying of affected parts
 - Reduced photosynthesis and yield loss
- **Affected pulses:** Pea, mungbean, urdbean
- **Management:** Spray sulfur-based fungicides, use resistant varieties

Step 3: Other important diseases (for reference).

Other major diseases of pulses include:

- Rust (Pea, lentil)
- Anthracnose (Bean, cowpea)
- Leaf spot (All pulses)
- Yellow mosaic virus (Mungbean, urdbean)
- Root rot (Chickpea, pea)

Quick Tip

Remember: Wilt (*Fusarium*) and Powdery Mildew are two major diseases affecting pulse crops. Wilt causes vascular blockage leading to plant death, while powdery mildew appears as white powdery growth on leaves and stems.

14. Define the male sterility and self-incompatibility.

Solution:

Step 1: Definition of Male Sterility.

Male Sterility is a condition in plants where the male reproductive organs (anthers) are either absent, non-functional, or fail to produce viable pollen grains. The female reproductive organs remain normal and functional. Male sterility is an important tool in hybrid seed production as it eliminates the need for manual emasculation.

Types of male sterility:

- **Genetic Male Sterility (GMS):** Controlled by nuclear genes
- **Cytoplasmic Male Sterility (CMS):** Controlled by mitochondrial genes
- **Cytoplasmic-Genetic Male Sterility (CGMS):** Interaction of nuclear and cytoplasmic genes

Uses:

- Facilitates hybrid seed production
- Eliminates emasculation cost and labor
- Ensures high purity of hybrid seeds

Examples: Onion, carrot, maize, sunflower, rice

Step 2: Definition of Self-Incompatibility.

Self-Incompatibility is a genetic mechanism in flowering plants that prevents fertilization by pollen from the same flower or same plant. The pistil recognizes and rejects self-pollen, thereby promoting cross-pollination and outbreeding.

Types of self-incompatibility:

- **Gametophytic Self-Incompatibility (GSI):** Rejection determined by pollen's own genotype (e.g., Apple, Pear, Tomato)
- **Sporophytic Self-Incompatibility (SSI):** Rejection determined by pollen parent's genotype (e.g., Cabbage, Mustard, Sunflower)

Mechanism:

- Recognition proteins on pollen and stigma
- If same S-alleles present, pollen germination or tube growth is inhibited
- Prevents inbreeding depression

Uses:

- Promotes genetic diversity
- Useful in hybrid breeding programs
- Maintains heterozygosity

Examples: Brassica (cabbage, cauliflower), radish, apple, pear

Quick Tip

Remember: Male sterility is the failure to produce functional pollen (used in hybrid seed production). Self-incompatibility is a genetic mechanism that prevents self-fertilization by rejecting self-pollen (promotes cross-pollination).

15. Write two high yielding varieties and two Basmati varieties of rice.

Solution:

Step 1: Introduction to rice varieties.

Rice (*Oryza sativa*) is the most important staple food crop in India. Rice varieties are classified into high-yielding varieties (HYV) developed for higher production and Basmati varieties known for their aroma, long grain, and quality.

Step 2: Two high yielding varieties of rice.

1. IR-8:

- Developed by International Rice Research Institute (IRRI), Philippines
- Introduced in India during Green Revolution (1960s)
- Semi-dwarf stature (resistant to lodging)
- Non-photosensitive, can be grown in any season
- High yield potential (5-6 tons/hectare)
- Short duration (130-135 days)
- Parent of many Indian HYVs

2. Jaya:

- Developed in India by crossing TN-1 and T-141
- Released in 1968
- Suitable for both kharif and rabi seasons
- Semi-dwarf, non-lodging type
- High yield potential (6-7 tons/hectare)
- Duration: 130-140 days
- Widely cultivated in many states
- Resistant to moderate pest attack

Other important high-yielding varieties: IR-36, IR-64, Pusa 44, Pusa Basmati (high-yielding Basmati), MTU 7029, Swarna, Samba Mahsuri

Step 3: Two Basmati varieties of rice.

1. Pusa Basmati-1:

- Developed by IARI, New Delhi
- Released in 1989
- Cross between Pusa 150 and Karnal Local
- Semi-dwarf, non-lodging (unlike traditional tall Basmati)
- Strong aroma, extra-long slender grains

- Good cooking quality with high kernel elongation
- Yield: 4-5 tons/hectare (higher than traditional Basmati)
- Duration: 135-140 days
- Resistant to bacterial blight

2. Basmati-370:

- Traditional Basmati variety from Punjab region
- Known for excellent aroma and grain quality
- Extra-long slender grains with strong fragrance
- Excellent kernel elongation after cooking
- Tall stature, prone to lodging
- Low yield (2-3 tons/hectare)
- Duration: 145-150 days
- Parent for many improved Basmati varieties
- Highly valued in domestic and export markets

Other important Basmati varieties: Pusa Basmati 1121 (world's longest grain), Pusa Basmati 1509 (early maturing), Taraori Basmati, Dehraduni Basmati, Ranbir Basmati

Quick Tip

Remember: High-yielding varieties like IR-8 and Jaya focus on production (semi-dwarf, non-lodging). Basmati varieties like Pusa Basmati-1 and Basmati-370 focus on grain quality (aroma, elongation) with Pusa Basmati-1 combining high yield with Basmati quality.

16. What are important species of honeybees in India?

Solution:

Step 1: Introduction to honeybees in India.

Honeybees are social insects that produce honey and beeswax, and play a crucial role in pollination of agricultural crops. India is home to several indigenous and exotic species of honeybees.

Step 2: Important species of honeybees found in India.

1. *Apis cerana indica* (Indian hive bee):

- Indigenous species, found throughout India
- Medium-sized, gentle and less aggressive
- Builds multiple combs in dark cavities
- Can be reared in wooden boxes (movable frame hives)
- Good honey yield (6-10 kg/colony/year)
- Excellent pollinator of agricultural crops
- Resistant to many local pests and diseases

2. *Apis mellifera* (European/Italian honeybee):

- Exotic species introduced in India (1960s)
- Larger than *Apis cerana*, yellow bands on abdomen
- High honey yield (25-40 kg/colony/year)
- Less swarming tendency, gentle nature
- Responds well to management practices
- Now widely cultivated commercially
- Requires management against diseases

3. *Apis dorsata* (Rock bee/Giant honeybee):

- Largest honeybee species in India
- Builds single large open comb on tall trees, cliffs, buildings
- Highly aggressive, cannot be domesticated
- Migratory, moves seasonally
- Highest honey yield per colony (30-50 kg)

- Honey collected by tribal communities (honey hunting)
- Found throughout India

4. **Apis florea (Little bee/Dwarf honeybee):**

- Smallest honeybee species
- Builds single small comb on bushes, hedges, buildings
- Less aggressive, but difficult to domesticate
- Low honey yield (0.5-1 kg/colony)
- Found in plains and low hills
- Important pollinator of wild and cultivated plants

Step 3: Additional species (for reference).

- **Trigona iridipennis (Dammer bee/Stingless bee):** Smallest, stingless, builds irregular combs, produces medicinal honey
- **Apis laboriosa (Himalayan cliff bee):** Found in Himalayan region, largest honeybee, builds combs on cliffs

Quick Tip

Remember: India has four main honeybee species - *Apis cerana* (domesticated indigenous), *Apis mellifera* (domesticated exotic high-yielder), *Apis dorsata* (wild giant), and *Apis florea* (wild dwarf). Each has distinct characteristics and importance.

17. Enlist different steps of ice-cream making.

Solution:

Step 1: Introduction to ice-cream making.

Ice-cream is a frozen dairy product made from milk, cream, sugar, and flavorings. The manufacturing process involves several steps to ensure proper texture, flavor, and quality.

Step 2: Steps of ice-cream making.

1. Selection and procurement of ingredients:

- Milk and cream (source of fat and solids)
- Sugar (sweetener)
- Stabilizers and emulsifiers (for texture)
- Flavoring agents (vanilla, chocolate, fruits, etc.)
- Color (optional)

2. Mixing of ingredients:

- All liquid ingredients are mixed first
- Dry ingredients (sugar, stabilizers) are dissolved
- Proper proportions as per recipe/formulation
- Mixing ensures uniform distribution

3. Pasteurization:

- Mixture is heated to 68-80°C for 30 minutes or 82°C for 25 seconds
- Destroys harmful microorganisms
- Improves flavor and keeping quality
- Helps dissolve stabilizers and emulsifiers

4. Homogenization:

- Mixture is forced through small openings under high pressure
- Breaks fat globules into smaller size
- Prevents cream separation
- Improves texture and body of ice-cream
- Temperature: 60-70°C

5. Cooling and aging:

- Mixture is rapidly cooled to 4-5°C
- Aged for 4-24 hours at this temperature

- Allows fat crystallization
- Stabilizers absorb water, improving texture
- Enhances whipping properties

6. Freezing (Whipping and freezing):

- Mixture is frozen while being agitated
- Incorporates air (overrun of 80-100%)
- Prevents formation of large ice crystals
- Temperature drops to -4 to -6°C
- Semi-solid consistency achieved

7. Addition of fruits, nuts, flavors (if any):

- Added during or after freezing
- Ensures even distribution

8. Hardening:

- Rapid freezing to -18 to -25°C
- Converts semi-solid to solid ice-cream
- Prevents ice crystal growth
- Done in hardening rooms or tunnels

9. Storage and distribution:

- Stored at -20 to -25°C
- Maintained until distribution
- Transported in refrigerated vehicles

Quick Tip

Remember: Key steps in ice-cream making are: Mixing → Pasteurization → Homogenization → Cooling/Aging → Freezing → Hardening → Storage. Each step is crucial for proper texture, flavor, and quality.

18. Name two exotic breeds of cow.

Solution:

Step 1: Introduction to exotic cow breeds.

Exotic cow breeds are those originating outside India, primarily from European countries. They are known for high milk production and are used in crossbreeding programs to improve indigenous cattle.

Step 2: Two important exotic breeds of cow.

1. Holstein Friesian (HF):

- Originated in Netherlands (Friesland region)
- Largest dairy breed, highest milk producer
- Color: Black and white spotted
- Average milk yield: 25-30 litres/day (can exceed 50 litres in advanced herds)
- Milk fat content: 3.5-4.0% (lower than indigenous breeds)
- Body weight: 600-700 kg
- Used extensively in crossbreeding programs in India
- Popular in organized dairy farms
- HF crossbreds (like Holdeo) are common in India
- Less tolerant to heat, requires good management

2. Jersey:

- Originated in Island of Jersey (United Kingdom)
- Smaller size, easy to maintain
- Color: Light brown to gray, with dark muzzle
- Average milk yield: 20-25 litres/day
- Milk fat content: 4.5-5.5% (higher than HF)
- Body weight: 400-500 kg
- Better heat tolerance than HF

- Adapts well to Indian conditions
- Popular in smallholder dairy farming
- Jersey crossbreeds widely distributed in India

Step 3: Other exotic breeds (for reference).

- **Brown Swiss:** Originated in Switzerland, brown color, high milk yield with good fat content
- **Guernsey:** Originated in Guernsey Island, fawn and white, high fat and protein
- **Ayrshire:** Originated in Scotland, red and white, good milk yield
- **Red Sindhi:** Though indigenous to Pakistan, considered exotic to India

Quick Tip

Remember: Holstein Friesian is the highest milk producer (black-white spotted), Jersey is smaller with higher fat content (light brown). Both are extensively used in India for crossbreeding with indigenous cattle to improve milk production.