Rajasthan JET Agriculture Sample Paper-7

Duration: 40 Minutes **Maximum Marks: 160**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**.
- Each incorrect answer carries: **−1 marks**.
- Use of mobile phones, smartwatches, calculators, or any electronic gadgets is strictly prohibited.

Q1. The base saturation of a soil refers to:

(A) The total negative charge present on soil colloids

(B) The proportion of CEC occupied by hydrogen and aluminium ions

(C) The percentage of CEC occupied by basic cations such as Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+}

(D) The amount of lime required to neutralize soil acidity

Q2. Which of the following best describes the role of *Streptomyces* spp. (Actinomycetes) in agricultural soils?

(A) They decompose resistant organic matter such as chitin and lignin and produce antibiotics in soil

(B) They fix atmospheric nitrogen through symbiotic association with legume roots

(C) They solubilize inorganic phosphates through the secretion of organic acids

(D) They produce indole acetic acid (IAA) to promote root elongation

Q3. Sulphur deficiency in mustard and groundnut is distinguished from nitrogen deficiency because:

(A) Symptoms appear first on older lower leaves in sulphur deficiency

(B) Yellowing appears first on young upper leaves in sulphur deficiency, whereas in nitrogen deficiency older leaves are affected first

(C) Sulphur deficiency causes stunted roots while nitrogen deficiency does not

(D) Both deficiencies show identical symptoms and can only be differentiated by soil testing

Q4. Among soil nutrients, which form is most susceptible to leaching losses in sandy soils?

(A) Potassium (K^+)

(B) Phosphate ($H_2PO_4^-$)

(C) Ammoniacal nitrogen (NH_4^+)

(D) Nitrate nitrogen (NO_3^-)

Q5. Check dams built across nallahs (seasonal streams) in arid Rajasthan primarily help by:

(A) Slowing runoff, trapping silt, and recharging groundwater through percolation

(B) Providing water for surface irrigation by gravity flow to distant fields

(C) Preventing soil compaction in fields adjacent to the nallah

(D) Eliminating the need for rainwater harvesting structures at the farm level

Q6. Furrow irrigation is most suitable for which of the following crop types, and why?

(A) Broadcasting crops like wheat, because the entire surface is wetted uniformly

(B) Orchard trees, because water is delivered at the tree base only

(C) Row crops like maize, cotton, and sugarcane, because water flows in furrows between rows reducing evaporation compared to basin irrigation

(D) Paddy, because standing water is maintained throughout the season

Q7. The "critical period of weed competition" in maize refers to:

(A) The entire crop season from sowing to harvest

(B) Approximately the first 4 weeks after emergence, during which weed competition causes the greatest yield loss

(C) The period between tasselling and silking only

(D) The last 3 weeks before harvest when weeds reduce grain filling

Q8. Post-emergence herbicide selectivity between a crop and a weed is most commonly due to:

(A) The herbicide molecule being physically repelled by the crop leaf surface

(B) Differences in leaf shape that affect droplet retention

(C) Selective translocation: the herbicide moves only in the phloem of weeds

(D) The crop rapidly metabolizing (detoxifying) the herbicide while the weed cannot

Q9. The Hagberg Falling Number test for wheat grain quality measures:

(A) Alpha-amylase activity: a low falling number indicates high enzyme activity and pre-harvest sprouting damage

(B) Wet gluten content as a percentage of flour weight

(C) Protein content by the Kjeldahl nitrogen method

(D) Test weight (hectolitre weight) in kg per 100 litres

Q10. Which of the following is the most important agronomic advantage of Direct Seeded Rice (DSR) over Transplanted Puddled Rice (TPR)?

(A) Higher grain yield under all soil conditions

(B) Greater resistance to brown planthopper infestation

(C) Saving of approximately 20–25% irrigation water and significant reduction in labour requirement

(D) Complete elimination of weed problems without herbicide use

Q11. The characteristic visual symptom of zinc deficiency in maize is:

(A) Purple/red coloration of older leaves due to anthocyanin accumulation

(B) Whitish or pale yellow stripes on young leaves ("white bud"), with the youngest leaves most severely affected

(C) Marginal scorch and browning of lower leaves

(D) Water-soaked lesions on the stem followed by dark rot

Q12. The correct botanical name and chromosome number of Bajra (Pearl millet) is:

(A) *Sorghum bicolor*, 2n = 20

(B) *Setaria italica*, 2n = 18

(C) *Eleusine coracana*, 2n = 36

(D) *Pennisetum glaucum* (syn. *Cenchrus americanus*), 2n = 14

Q13. In chickpea, the determinate growth habit is characterised by:

(A) Finite vegetative growth where the apical meristem terminates in a flower, concentrating pod set over a shorter, defined period

(B) Continued branching and indefinite stem elongation with pods setting over a prolonged period

(C) Production of both normal and cleistogamous flowers on the same plant

(D) Predominantly basal pod setting with no branching above the first node

Q14. Yellow sarson (*Brassica rapa* var. *yellow sarson*) differs from brown sarson primarily in that:

(A) It has a higher glucosinolate content making it unsuitable for oil extraction

(B) It requires a longer growing season of over 160 days

(C) It naturally contains low erucic acid, making its oil nutritionally superior without genetic modification

(D) It is exclusively a fodder crop with no oilseed value

Q15. Pigeon pea (*Cajanus cajan*) forms root nodules with:

(A) *Bradyrhizobium japonicum*

(B) *Rhizobium* spp. (slow-growing strains, genus *Bradyrhizobium* formerly classified under *Rhizobium*)

(C) *Azospirillum brasilense*

(D) *Frankia* spp.

Q16. Guar gum extracted from cluster bean (*Cyamopsis tetragonoloba*) seeds is chemically a:

(A) Cellulose derivative used in paper manufacture

(B) Fructooligosaccharide used as a prebiotic

(C) Pectin-based emulsifier derived from seed coat

(D) Galactomannan polymer (mannose backbone with galactose side chains) with high viscosity and industrial export value

Q17. Litchi (*Litchi chinensis*) requires specific environmental conditions for floral induction. The correct requirement is:

(A) Cool winter temperatures below 15°C for 4–6 weeks to break dormancy and induce flower bud differentiation

(B) A dry spell of at least 3 months followed by heavy irrigation to trigger flowering

(C) Long-day photoperiod conditions (more than 14 hours of daylight)

(D) High summer temperatures above 40°C for effective pollination

Q18. Indian gooseberry (Amla, *Phyllanthus emblica*) is known for exceptional Vitamin C content. The approximate Vitamin C content per 100 g of fresh amla is:

(A) 50–80 mg/100 g

(B) 200–300 mg/100 g

(C) 600–900 mg/100 g

(D) 1500–2000 mg/100 g

Q19. Phalsa (*Grewia asiatica*), a minor fruit grown in arid Rajasthan, is best described as:

(A) A large yellow berry harvested at full maturity, sensitive to heat stress

(B) A small purple drupe from a drought-tolerant shrub, consumed as sherbet in summer and highly heat-tolerant

(C) A citrus relative propagated exclusively by seed with no commercial grafting

(D) A nut crop belonging to the family Anacardiaceae

Q20. The bitter taste of karela (bitter gourd, *Momordica charantia*) is due to the compound:

(A) Cucurbitacin B

(B) Charantin (a steroidal compound)

(C) Vicine (a pyrimidine glycoside)

(D) Momordicin (a tetracyclic triterpenoid)

Q21. Among propagation by layering methods—simple layering, compound (serpentine) layering, ground layering, and air layering—the one that results in the fastest root formation at the target point is:

(A) Air layering (goatee layering), because the rooting medium (moist sphagnum moss) is applied directly around the girdled section, maintaining optimal moisture and aeration at the wound site

(B) Simple layering, because the entire stem rests in moist soil

(C) Compound layering, because multiple root zones form simultaneously

(D) Ground layering, because soil provides the richest nutrient environment

Q22. Fenugreek (Methi, *Trigonella foenum-graecum*) is an important dual-use crop in Rajasthan. The districts most renowned for its commercial production are:

(A) Kota and Baran

(B) Bikaner and Jaisalmer

(C) Nagaur and Ajmer

(D) Alwar and Bharatpur

Q23. Recurrent selection as a plant breeding method is primarily used to:

(A) Fix desirable traits rapidly in self-pollinated crop varieties through repeated inbreeding

(B) Gradually improve the population mean for quantitative traits in cross-pollinated crops over successive cycles

(C) Create doubled haploids for instant homozygosity

(D) Introduce a single dominant gene from a donor parent into an elite background

Q24. In the pedigree breeding method for self-pollinated crops, individual plant selection with progeny row maintenance begins from:

(A) F_1 generation, taking advantage of maximum heterozygosity

(B) P (parental) generation as a base for establishing pedigree records

(C) F_3 generation onward, after initial single-seed descent from F_2

(D) F_2 generation onwards, where genetic segregation first becomes visible

Q25. Simple Sequence Repeat (SSR) markers are preferred in Marker-Assisted Selection (MAS) because they are:

(A) Codominant and highly polymorphic, allowing discrimination between homozygous and heterozygous loci

(B) Dominant and technically simple, requiring no gel electrophoresis

(C) Based on hybridization to known DNA sequences (RFLP technique)

(D) Applicable only to polyploid species

Q26. The minimum isolation distance recommended for certified seed production of maize (a cross-pollinated crop) from other maize plots of different variety is approximately:

(A) 3 metres

(B) 50 metres

(C) 200 metres

(D) 500 metres

Q27. For monitoring and mass-trapping of the cucurbit fruit fly (*Bactrocera cucurbitae*), the chemical lure used in traps is:

(A) Trichlorfon bait spray

(B) Methyl eugenol, a male attractant pheromone analogue

(C) Spinosad mixed with protein bait

(D) Malathion emulsifiable concentrate

Q28. Red spider mite (*Tetranychus urticae*) populations build up most rapidly under:

(A) Cool, wet, and overcast weather with frequent rainfall

(B) Moderate temperature and high relative humidity above 80%

(C) Waterlogged soil conditions with poor aeration

(D) Hot, dry weather with low relative humidity, favouring rapid reproduction and dispersal

Q29. The causal organism of Alternaria blight of mustard, which produces dark concentric ring-patterned spots on leaves and pods, is:

(A) *Alternaria brassicae*

(B) *Sclerotinia sclerotiorum*

(C) *Peronospora parasitica*

(D) *Albugo candida*

Q30. Powdery mildew of cucurbits, caused by *Podosphaera xanthii*, is favoured by:

(A) High rainfall and saturated soil conditions

(B) Very high temperatures above 40°C with full sun exposure

(C) Moderate temperatures (20–28°C) with low to moderate relative humidity and absence of free water on leaves

(D) Cool foggy nights followed by hot days with high soil moisture

Q31. *Trichoderma viride* acts as a biocontrol agent against soil-borne plant pathogens primarily through secretion of:

(A) Aflatoxins that suppress competitor fungi

(B) Cell-wall-degrading enzymes including chitinase and β-1,3-glucanase that lyse fungal cell walls of pathogens

(C) Systemic insecticides toxic to nematodes in the rhizosphere

(D) Ethylene gas that inhibits spore germination of competitor organisms

Q32. *Bacillus thuringiensis* var. *kurstaki* (Btk) produces Cry1A proteins that are active specifically against:

(A) Dipteran larvae (mosquitoes and black flies)

(B) Coleopteran larvae (beetles and weevils)

(C) Homopteran insects (aphids and whiteflies)

(D) Lepidopteran larvae (caterpillars, borers, and moths)

Q33. Nagori cattle, recognised by NBAGR as a distinct breed, are a:

(A) Draught breed originating from Nagaur district of Rajasthan, historically valued for heavy load-pulling capacity

(B) High-milk-yield breed from Gujarat, producing A2 beta-casein milk

(C) Dual-purpose breed developed by NDRI Karnal for the semi-arid tropics

(D) Sacred temple breed maintained only for religious purposes in Pushkar

Q34. The National Research Centre on Camel (NRC Camel) in India is located at:

(A) Jodhpur, Rajasthan

(B) Jaisalmer, Rajasthan

(C) Bikaner, Rajasthan

(D) Barmer, Rajasthan

Q35. The Barbari breed of goat, known as a compact meat breed, is believed to have originated from:

(A) The Thar Desert of western Rajasthan

(B) Berbera port in Somalia (East Africa), later established in the Mathura–Agra region of Uttar Pradesh

(C) The Himalayan foothills of Uttarakhand

(D) Indigenous selection from the Banni grasslands of Gujarat

Q36. Foot and Mouth Disease (FMD) is caused by a virus belonging to the family:

(A) Reoviridae (double-stranded RNA)

(B) Poxviridae (double-stranded DNA)

(C) Herpesviridae (enveloped DNA virus)

(D) Picornaviridae (small non-enveloped single-stranded RNA), with 7 recognised serotypes

Q37. Engel's Law in agricultural economics states that as household income rises:

(A) The income elasticity of demand for food is less than one, meaning food expenditure grows proportionally less than income, so the share of food in total expenditure declines

(B) The income elasticity of demand for food is greater than one, so food becomes a luxury good

(C) Total food expenditure remains absolutely constant regardless of income change

(D) Farmers diversify entirely into cash crops and abandon subsistence food production

Q38. The "Farmer's Share in Consumer Rupee" is calculated as:

(A) (Retail price $-$ Farm price) $\div$ Retail price $\times$ 100

(B) (Farm price $-$ Cost of production) $\div$ Farm price $\times$ 100

(C) Farm gate price $\div$ Retail consumer price $\times$ 100

(D) (Total marketing margin) $\div$ Farm price $\times$ 100

Q39. CWC in the context of agricultural warehousing and storage stands for:

(A) Commodity Welfare Committee

(B) Central Warehousing Corporation

(C) Co-operative Warehousing Council

(D) Crop Warehouse Certification authority

Q40. ATMA (Agricultural Technology Management Agency) operates primarily at which administrative level and what is its main function?

(A) State level, to formulate agricultural research priorities

(B) Block level, to implement individual farm extension visits only

(C) Village level, to manage self-help groups of women farmers

(D) District level, as an autonomous body to plan, implement, and coordinate agricultural extension activities, with farmer advisory committees and Block Farm Information & Advisory Centres (BFIACs)

Detailed Solutions

Q1.

Solution

Key Concepts:

- **Cation Exchange Capacity (CEC)**: The total negative charge on soil colloids (clay minerals and humus), measured in cmol_c/kg or meq/100g. It represents the soil's total capacity to hold cations against leaching.
- **Base Saturation**: The percentage of the CEC occupied by **basic cations** — Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+}. The formula is:

$$\text{Base Saturation (\%)} = \frac{\text{Sum of basic cations (cmol}_c\text{/kg)}}{\text{CEC (cmol}_c\text{/kg)}} \times 100$$

- **Significance**: A higher base saturation (above 80%) indicates a more fertile, less acidic soil. Acid soils have lower base saturation because H^{+} and Al^{3+} occupy a large fraction of exchange sites.
- **Relationship with pH**: Soils with pH $>$ 6.5 typically have base saturation $>$ 80%; as pH falls below 5.5, base saturation drops sharply.

Options A describes CEC itself. Option B describes acid saturation (the complement). Option D defines lime requirement.

Final Answer: Base saturation (%) is the fraction of CEC occupied by basic cations (Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}), indicating soil fertility and pH status.

Answer: (C) Go Back to Q1

Q2.

Solution

Key Concepts:

- **Actinomycetes** are filamentous, Gram-positive bacteria in soil. The genus *Streptomyces* accounts for the majority of soil actinomycetes (60–70% of isolates).
- **Organic matter decomposition**: They specialise in breaking down **resistant substrates** — chitin (from insect exoskeletons and fungal cell walls), lignin, keratin, and cellulose that other bacteria cannot easily degrade.
- **Geosmin production**: *Streptomyces* produces geosmin, a sesquiterpene

compound responsible for the characteristic earthy smell of freshly turned soil.

- **Antibiotic production**: Over 60% of all clinically used antibiotics (streptomycin, erythromycin, tetracycline, chloramphenicol) are derived from *Streptomyces* spp. They produce these in soil to suppress competing microorganisms.

Options B (N-fixation) describes *Rhizobium/Bradyrhizobium*. Option C (P-solubilisation) describes *Bacillus/Pseudomonas*. Option D (IAA production) describes PGPR like *Azospirillum*.

Final Answer: *Streptomyces* spp. (Actinomycetes) decompose resistant organic matter such as chitin and lignin in soil and also produce antibiotics that suppress competing microorganisms.

Answer: (A) Go Back to Q2

Q3.

Solution

Key Concepts:

- **Sulphur (S) mobility in plant**: Sulphur is **immobile** in the phloem. It cannot be remobilised from older leaves to young growing tissues.
- Therefore, **S-deficiency symptoms appear first on young/upper leaves** (pale yellow to light green), while older leaves remain green initially.
- **Nitrogen (N) mobility**: Nitrogen is **mobile** in the phloem. Under N-deficiency, N is remobilised from older (lower) leaves to supply young growing tissues.
- Therefore, **N-deficiency symptoms appear first on older/lower leaves** (yellowing starts from leaf tip moving upward on lower leaves).
- **Importance of S in oilseeds**: Sulphur is essential for synthesis of sulphur-containing amino acids (methionine, cysteine) needed for protein and for glucosinolate synthesis in mustard. It is also critical for oil quality improvement in groundnut.
- **Correction**: Application of gypsum ($CaSO_4 \cdot 2H_2O$) at 250–400 kg/ha in S-deficient soils of Rajasthan.

Final Answer: Sulphur deficiency causes yellowing of young upper leaves first (immobile nutrient), whereas nitrogen deficiency affects older lower leaves first

because nitrogen is phloem-mobile and remobilised from old tissue.

Answer: (B) Go Back to Q3

Q4.

Solution

Key Concepts:

- **Nitrate (NO_3^-)** is an **anion**. Soil colloids carry net negative charges, which **repel anions**. Therefore, nitrate is not adsorbed and moves freely with soil water.
- In sandy soils (low CEC, high permeability), water moves rapidly through large pores, carrying dissolved nitrate into groundwater — a process called **nitrate leaching**.
- **K^+**: Cation, adsorbed on exchange sites; moderate leaching.
- **Phosphate ($H_2PO_4^-$)**: Although an anion, it is strongly fixed by Al^{3+} and Fe^{3+} in acidic soils and by Ca^{2+} in calcareous soils, resulting in very low leaching.
- **NH_4^+**: Cation, held on CEC; nitrified to NO_3^- in well-aerated soils, after which it becomes susceptible to leaching.
- **Management**: Split N application, use of nitrification inhibitors (e.g., neem-coated urea), and slow-release fertilizers reduce nitrate leaching.

Final Answer: Nitrate nitrogen (NO_3^-) is most susceptible to leaching in sandy soils because, as an anion, it is repelled by negatively charged soil colloids and moves freely with percolating water.

Answer: (D) Go Back to Q4

Q5.

Solution

Key Concepts:

- **Check dams** are small barriers (earthen, rubble, or concrete) constructed across seasonal streams (nallahs) in the direction perpendicular to water flow.
- **Primary function**: They slow the velocity of runoff, trap eroded silt, and create a temporary pool that allows water to percolate into the ground, thereby **recharging groundwater aquifers**.

- **Importance in Rajasthan**: In the arid and semi-arid zones of Rajasthan, rainfall is erratic and surface runoff is rapid. Check dams are critical water conservation structures under schemes like Mukhyamantri Jal Swavlamban Abhiyan (MJSA).
- **Percolation pond**: A larger version of the check-dam concept — a shallow embankment designed primarily for groundwater recharge rather than surface storage.
- **Complementary benefits**: Reduced soil erosion, improved soil moisture in adjacent fields, and enhanced availability of groundwater for irrigation through wells.

Final Answer: Check dams across nallahs primarily slow runoff, trap silt, and recharge groundwater through percolation, making them vital water-harvesting structures in arid Rajasthan.

Answer: (A) Go Back to Q5

Q6.

Solution

Key Concepts:

- **Furrow irrigation**: Water is conveyed in small, narrow channels (furrows) cut between crop rows. It is a form of surface irrigation.
- **Suitable crops**: Row crops with wide spacing — maize (corn), cotton, sugarcane, potato, and sorghum.
- **Advantages over basin irrigation**:
  - Only the furrow bottom and sides are wetted; the ridge (where the crop rows are planted) remains relatively dry, reducing direct evaporation.
  - Soil structure on the ridge is not destroyed by water impact.
  - Reduces weed germination between rows.
- **Application efficiency**: 50–70% under traditional management; can be improved with surge irrigation or polypipe.
- **Wheat** uses border strip or check basin irrigation because it is a broadcast crop.
- **Paddy** uses continuous flooding (basin method).

Final Answer: Furrow irrigation is most suitable for row crops like maize, cotton, and sugarcane, as water flows in furrows between rows reducing evaporation compared to basin irrigation.

Answer: (C) Go Back to Q6

Q7.

Solution

Key Concepts:

- **Critical Period of Weed Competition (CPWC)**: The specific growth period of a crop during which weed competition must be controlled to prevent unacceptable yield losses. It is determined by two components:
  (a) The maximum duration of weed-free conditions needed at the start of the crop season (critical weed-free period).
  (b) The maximum duration of weed infestation tolerable before yield loss becomes significant.
- **In maize**: The CPWC is approximately **the first 4 weeks (21–35 days after emergence)**. Weed competition during this period — when maize plants are small and canopy closure has not occurred — causes the most severe yield reduction.
- **Practical implication**: One timely inter-cultivation (mechanical weeding) or pre/post-emergence herbicide application within the first 4 weeks is critical for maize yield protection.
- **Other crops**: Wheat 30–45 days, soybean 20–40 days, cotton 45–60 days from emergence.

Final Answer: The critical period of weed competition in maize is approximately the first 4 weeks after emergence, when uncontrolled weeds cause the greatest yield loss before canopy closure.

Answer: (B) Go Back to Q7

Q8.

Solution

Key Concepts:

- **Differential metabolism (metabolic selectivity)**: The most common basis for post-emergence herbicide selectivity. The crop plant possesses specific enzymes (e.g., cytochrome P450 monooxygenases, glutathione S-transferases) that rapidly convert the herbicide into a non-toxic metabolite. The weed lacks these enzymes and accumulates the toxic herbicide.
- **Examples**:
  - **Isoproturon** in wheat: Wheat metabolizes isoproturon faster than annual grasses, giving selectivity.
  - **2,4-D** in wheat: Broadleaf weeds (Bathua, Hirankhuri) accumulate 2,4-D and are killed; wheat metabolizes it rapidly.
  - **Atrazine** in maize: Maize detoxifies atrazine via glutathione conjugation; broad-leaf weeds do not.
- Other selectivity mechanisms include differential absorption (leaf morphology), translocation differences, and target-site insensitivity — but metabolic detoxification is the primary mechanism for most post-emergence herbicides.

Final Answer: Post-emergence herbicide selectivity is most commonly due to differential metabolism: the crop rapidly detoxifies the herbicide via specific enzymes (P450, GST), while the weed accumulates the toxic compound and is killed.

Answer: (D) Go Back to Q8

Q9.

Solution

Key Concepts:

- **Hagberg Falling Number (HFN)**: A measure of **alpha-amylase enzyme activity** in wheat flour/meal. It is expressed in seconds — the time taken for a plunger to fall through a gelatinised flour paste.
- **Interpretation**:
  - **High falling number** (>300 sec): Low alpha-amylase activity — good quality wheat with no pre-harvest sprouting.
  - **Low falling number** (<150 sec): High alpha-amylase activity — indicates pre-harvest sprouting or rain damage; starch is being degraded.

- **Why it matters**: High alpha-amylase activity degrades starch in the grain, making flour sticky, unsuitable for bread-making (poor crumb structure, gummy bread).
- **Test weight** (Hectolitre weight): Measures physical grain quality (bulk density), in kg/hL. It is a different test from HFN.
- **Grain protein %**: Measured by Kjeldahl nitrogen $\times$ 5.7; relates to gluten strength (chapati and bread quality).

Final Answer: The Hagberg Falling Number measures alpha-amylase activity in wheat; a low value indicates high enzyme activity from pre-harvest sprouting, signalling poor flour quality.

Answer: (A) Go Back to Q9

Q10.

Solution

Key Concepts:

- **Direct Seeded Rice (DSR)**: Seed is sown directly in the main field (wet DSR into puddled soil, or dry DSR into unpuddled soil). No nursery raising or manual transplanting.
- **Water saving**: DSR saves approximately **20–25% of irrigation water** compared to TPR (Transplanted Puddled Rice), as no standing water is maintained continuously and no puddling water is required.
- **Labour saving**: Eliminates nursery raising, uprooting, carrying, and transplanting operations — saving up to 20 man-days/ha.
- **Other advantages**: Earlier crop maturity (5–7 days), lower methane (CH_4) emissions from non-flooded aerobic soil, better soil structure preservation (no puddling).
- **Key disadvantage**: Significantly higher weed pressure (especially *Echinochloa* spp. and Eclipta), requiring herbicide use (pendimethalin + bispyribac-sodium programme).

Final Answer: The key agronomic advantage of DSR over TPR is saving approximately 20–25% of irrigation water and significantly reducing the labour requirement by eliminating nursery and transplanting operations.

Answer: (C) Go Back to Q10

Q11.

Solution

Key Concepts:

- **Zinc (Zn) deficiency in maize**: Zinc is **immobile** in the phloem, so symptoms appear first on young/new leaves.
- **Characteristic symptom — "White Bud"**: Broad, white or pale yellow stripes running parallel to the midrib on young leaf blades. In severe cases, the entire young leaf (bud) turns white.
- **Mechanism**: Zn is a cofactor for tryptophan synthetase (needed for auxin/IAA biosynthesis) and carbonic anhydrase. Deficiency impairs chloroplast development and chlorophyll synthesis in expanding tissues.
- **Correction**: Soil application of $ZnSO_4 \cdot 7H_2O$ at **25 kg/ha** before sowing, or foliar spray of 0.5% $ZnSO_4$ at tasselling stage.
- **Purple/red colour** (Option A): Phosphorus deficiency or cold stress (anthocyanin), not Zn.
- **Marginal scorch** (Option C): Potassium or manganese toxicity, not Zn.

Final Answer: Zinc deficiency in maize produces the characteristic "white bud" symptom — whitish or pale-yellow stripes on young leaves — because zinc is immobile and cannot be remobilised from older tissue.

Answer: (B) Go Back to Q11

Q12.

Solution

Key Concepts:

- **Bajra (Pearl millet)**: Family Poaceae (Gramineae), Tribe Paniceae.
- **Botanical name**: *Pennisetum glaucum* (L.) R. Br. — now reclassified as ***Cenchrus americanus*** (L.) Morrone following phylogenetic studies. Both names appear in literature.
- **Chromosome number**: **2n = 14** (diploid, x = 7). This distinguishes it from sorghum (2n = 20, x = 10) and finger millet/ragi (2n = 36, hexaploid, x = 9).
- **Importance**: Bajra is the most important kharif cereal of arid Rajasthan (Barmer, Jaisalmer, Jodhpur districts). India accounts for over 50% of global

bajra production.

- **Other options**:
  - *Sorghum bicolor*: Jowar, 2n = 20.
  - *Setaria italica*: Foxtail millet, 2n = 18.
  - *Eleusine coracana*: Finger millet (Ragi), 2n = 36.

Final Answer: Bajra (Pearl millet) is correctly identified as *Pennisetum glaucum* (syn. *Cenchrus americanus*) with a chromosome number of 2n = 14.

Answer: (D) Go Back to Q12

Q13.

Solution

Key Concepts:

- **Determinate growth habit**: The main stem and branches terminate in a reproductive structure (flower/pod). Vegetative growth is **finite** and stops once flowering begins. This concentrates pod setting into a shorter, more defined window, which is advantageous for uniform maturity and mechanical harvesting.
- **Indeterminate growth habit**: The apical meristem continues to produce vegetative nodes even after flowering begins. Vegetative growth continues alongside reproductive development. Pods are set over a prolonged, overlapping period.
- **Chickpea varieties**:
  - **Determinate types** (Kabuli chickpea, many desi types): compact plant, relatively uniform maturity.
  - **Indeterminate types**: more branching, longer season.
- **Significance in Rajasthan**: Chickpea is the leading rabi pulse. Determinate varieties suit irrigation-limited conditions as they mature uniformly with less water.

Final Answer: In chickpea, the determinate growth habit is characterised by the apical meristem terminating in a flower, giving finite vegetative growth and concentrating pod set over a shorter, well-defined period.

Answer: (A) Go Back to Q13

Q14.

Solution

Key Concepts:

- **Yellow sarson** (*Brassica rapa* var. *yellow sarson*): A naturally occurring variant that is **low in erucic acid** (the 22-carbon fatty acid that is harmful at high dietary concentrations). This makes its oil nutritionally superior **without any genetic modification** — unlike canola, which required traditional breeding selection from high-erucic rapeseed.
- **Erucic acid**: At high levels, associated with myocardial lipidosis in animal studies. Canola oil = $<$2% erucic acid (bred down from $>$40% in rapeseed). Yellow sarson naturally has $<$5% erucic acid.
- **Brown sarson** (*Brassica rapa*): Higher erucic acid; pungent flavour preferred in traditional cooking in Bengal/Bihar.
- **Lahi**: Another name for small-seeded brown sarson types.
- **Option A** is incorrect: yellow sarson is a valued oilseed crop with good oil quality.
- **Option B** is incorrect: it is an early-maturing rabi crop in most conditions.

Final Answer: Yellow sarson differs from brown sarson by naturally containing low erucic acid, making its oil nutritionally superior without requiring any genetic modification.

Answer: (C) Go Back to Q14

Q15.

Solution

Key Concepts:

- **Pigeon pea** (*Cajanus cajan*) forms root nodules with slow-growing strains of rhizobia. These are now classified in the genus ***Bradyrhizobium*** (previously grouped under *Rhizobium* in older literature).
- The specific species involved include *Bradyrhizobium cajani*, *B. yuanmingense*, and related slow-growing strains.
- Option B reflects the historical and still widely used examination terminology (*Rhizobium* spp.) while also acknowledging the current classification (*Bradyrhizobium*).

- **Distinction**:
  - **Fast-growing rhizobia** (genus *Rhizobium/Sinorhizobium*): nodulate legumes like chickpea, clover, alfalfa, beans.
  - **Slow-growing rhizobia** (genus *Bradyrhizobium*): nodulate soybean, pigeon pea, peanut.
- ***Azospirillum***: Free-living PGPR, does not nodulate.
- ***Frankia***: Nodulates non-legume trees (Casuarina, Alnus).

Final Answer: Pigeon pea forms root nodules with slow-growing *Rhizobium* spp. (currently classified as *Bradyrhizobium*), which fix atmospheric nitrogen symbiotically.

Answer: (B) Go Back to Q15

Q16.

Solution

Key Concepts:

- **Guar gum** is extracted from the **endosperm** of guar (cluster bean) seeds. It is a **galactomannan** — a polysaccharide with a mannose backbone (beta-1,4-linkages) with single galactose side chains (alpha-1,6-linkages) at approximately every other mannose unit.
- **Properties**: Extremely high water-binding capacity; forms viscous gels; non-ionic; stable over a wide pH and temperature range.
- **Industrial applications**: Oil-well drilling (hydraulic fracturing/fracking fluid viscosifier — this is Rajasthan's major export earner from guar); paper and textile sizing; food industry (ice cream stabiliser, bread improver); pharmaceutical tablet binding.
- **Rajasthan's dominance**: India produces >80% of world guar; within India, Rajasthan (Jodhpur, Barmer, Nagaur, Churu, Bikaner) accounts for the majority. Guar is a critical drought-tolerant kharif crop for arid zone farmers.
- **Variety**: HG-365 (High Gum content, disease tolerant).

Final Answer: Guar gum is chemically a galactomannan polymer (mannose backbone with galactose side chains) extracted from cluster bean seed endosperm, valued for its high viscosity and industrial applications.

Answer: (D) Go Back to Q16

Q17.

Solution

Key Concepts:

- **Litchi** (*Litchi chinensis*): A subtropical fruit requiring **cool winter temperatures** for floral induction.
- **Chilling requirement**: Litchi requires **temperatures below 15°C for 4–6 weeks** during winter (November–January) to induce floral differentiation. This cool spell is essential; without it, trees produce only vegetative flush.
- **Why Rajasthan plains are unsuitable**: The hot arid plains of Rajasthan (Jodhpur, Bikaner, Jaisalmer) do not receive adequate winter chilling hours, so litchi cannot be cultivated commercially there. It thrives in sub-Himalayan areas (Bihar's Muzaffarpur, West Bengal, Uttar Pradesh's Saharanpur, Uttarakhand).
- **Other requirements**: Well-distributed rainfall during fruit development; no strong hot winds (loo) during fruit set; slightly acidic to neutral, well-drained deep soils.
- **Dry spell** (Option B): This is the induction method for *mango*, not litchi.

Final Answer: Litchi requires cool winter temperatures below 15°C for 4–6 weeks to break dormancy and induce flower bud differentiation, making chilling the essential trigger for its flowering.

Answer: (A) Go Back to Q17

Q18.

Solution

Key Concepts:

- **Amla (Indian Gooseberry, *Phyllanthus emblica* syn. *Emblica officinalis*)**: Contains one of the highest Vitamin C (ascorbic acid) concentrations of any naturally occurring fruit.
- **Vitamin C content**: **600–900 mg per 100 g** of fresh fruit. Compare: orange = 50 mg/100g; guava = 200 mg/100g; synthetic Vitamin C supplements = 500 mg per tablet.
- **Unique feature**: The Vitamin C in amla is bound to tannins (**emblicanin A and B**), which protect it from oxidation during cooking and processing — unlike most fruits where Vitamin C is destroyed by heat.

- **Medicinal uses**: Key ingredient in **Triphala** (Amla + Harad + Baheda), Chyawanprash. Used in Ayurveda for hair care, immunity, and diabetes management.
- **Propagation**: Budding (patch budding) and grafting (epicotyl grafting); seed propagation gives poor results.
- Rajasthan's main production area: Pratapgarh district (Chittorgarh division) produces a significant portion of India's amla.

Final Answer: Amla contains approximately 600–900 mg of Vitamin C per 100 g of fresh fruit, one of the highest among natural sources, with the ascorbic acid protected from oxidation by tannin complexes.

Answer: (C) Go Back to Q18

Q19.

Solution

Key Concepts:

- **Phalsa (*Grewia asiatica*)**: Family Tiliaceae (Malvaceae sensu lato).
- **Plant form**: A large shrub or small tree, deciduous, highly **drought-tolerant** and **heat-tolerant** — perfectly adapted to the hot, dry plains of Rajasthan and other arid regions of India.
- **Fruit**: Small (**1–1.5 cm diameter**), round to ovoid **drupe**; dark purple to bluish-black when ripe; thin, papery skin; sweet-acid pulp with 1–2 hard seeds.
- **Season**: Fruits in May–June, the hottest part of the Indian summer.
- **Culinary use**: Extremely popular as **sherbet** (a summer cooling drink) in Rajasthan, Punjab, and UP. Also eaten fresh or processed into squash/candy.
- **Nutritional value**: Rich in Vitamin C, anthocyanins (antioxidants), and iron.
- **Cultivation areas in Rajasthan**: Jodhpur, Jaipur, Bharatpur, Sikar.

Final Answer: Phalsa (*Grewia asiatica*) is a small purple drupe borne on a drought- and heat-tolerant shrub, widely consumed as a summer sherbet in arid Rajasthan.

Answer: (B) Go Back to Q19

Q20.

Solution

Key Concepts:

- **Momordicin**: A group of **tetracyclic triterpenoid** (cucurbitane-type) compounds found in bitter gourd (*Momordica charantia*), primarily responsible for the characteristic bitter taste.
- **Other bitter compounds**: Charantin (a steroidal glycoside with hypoglycaemic activity) and momordicosides are also present; however, momordicin is the principal compound associated with bitterness in the context of post-harvest and breeding studies.
- **Medicinal significance**: Bitter gourd is used as an anti-diabetic vegetable. Charantin and polypeptide-p have insulin-like activity.
- **Cucurbitacin** (Option A): A different class of bitter cucurbitane triterpenoids found in cucumber, pumpkin, and other cucurbits as defence against insects — not the primary bitter principle in karela specifically.
- **Harvest stage**: Bitter gourd should be harvested at the **immature stage (dark green to light green colour, before seeds mature)**. Overripe fruit turns orange/red and splits open.
- **Variety Pusa Do Mausami**: IARI variety, two-season bearing; popular in north India.

Final Answer: The bitter taste of karela (bitter gourd) is primarily due to momordicin, a tetracyclic triterpenoid compound belonging to the cucurbitane class.

Answer: (D) Go Back to Q20

Q21.

Solution

Key Concepts:

- **Air layering (goatee/marcotting)**: A section of a suitable branch (pencil-thick) is **girdled** (a ring of bark 2–3 cm wide is removed, or a tongue-cut is made), and the wounded section is wrapped with **moist sphagnum moss** (or coir fibre + soil), then covered with a black polythene sheet tied at both ends.
- **Why fastest root formation**: The sphagnum moss maintains **optimal and consistent moisture and aeration** directly at the wound site 24/7.

Girdling interrupts downward phloem transport, concentrating auxins, carbohydrates, and rooting cofactors at the cut. Darkness (black polythene) promotes root elongation.

- **Simple/Ground/Compound layering**: The stem must be bent and buried in soil, which limits moisture control and aeration at the root initiation zone, and the stem position may stress the plant.
- **Rooting time**: Air layering on litchi, mango, guava — 4–8 weeks; ground layering on Ber — 8–12 weeks.
- **Used for**: Litchi (most common), guava, pomegranate, fig, mango, Ber.

Final Answer: Air layering results in the fastest root formation because moist sphagnum moss applied directly to the girdled section maintains optimal moisture and aeration at the wound site around the clock.

Answer: (A) Go Back to Q21

Q22.

Solution

Key Concepts:

- **Fenugreek (Methi, *Trigonella foenum-graecum*)**: Family Fabaceae.
- **Rajasthan's dominance**: India is the world's largest producer and exporter of fenugreek seeds. Rajasthan accounts for approximately **80% of India's fenugreek production**.
- **Major production districts**: **Nagaur** and **Ajmer** districts of Rajasthan are the most important centres. Other districts: Sikar, Jhunjhunu, Tonk, Sirohi.
- **Nagaur district**: Known as the "Fenugreek Bowl of India". The Nagaur Agricultural Produce Market Committee (APMC) is one of the largest fenugreek trading hubs in Asia.
- **Dual use**: (1) **Leaf vegetable (Kasuri methi)** — young leaves harvested 20–25 days after sowing; (2) **Spice seed** — ripe seeds harvested at maturity (90–110 days).
- **Medicinal**: Seeds contain trigonelline, diosgenin, and fibre — used in management of type-2 diabetes and cholesterol.
- **Varieties**: Rajendra Kanti, Lam Selection-1, HM-103, RMT-305.

Final Answer: The districts of Nagaur and Ajmer in Rajasthan are most renowned

for commercial fenugreek production, with Nagaur known as the "Fenugreek Bowl of India" and a major global trading hub.

Answer: (C) Go Back to Q22

Q23.

Solution

Key Concepts:

- **Recurrent selection**: A cyclic breeding scheme designed to **gradually increase the frequency of desirable alleles** in a population while maintaining genetic diversity.
- **Target crops**: Primarily used in **cross-pollinated (outbreeding) crops** — maize, sorghum, pearl millet, rye — where maintaining a heterogeneous, open-pollinating population is desired.
- **Cycle**: (1) Evaluate individuals, (2) Select the superior ones, (3) Intermating among selected plants, (4) Advance to next cycle. Each cycle improves the population mean.
- **Types**:
  - **Half-sib recurrent selection**: Select based on half-sib progeny performance; maintains more genetic diversity.
  - **Full-sib recurrent selection**: Uses full-sib families; more intense selection.
  - **S_1 / S_2 recurrent selection**: Individuals are self-pollinated one or two generations before selection; higher selection accuracy.
- **Purpose**: Unlike backcrossing (introduces single gene), recurrent selection improves **quantitative traits** (yield, adaptation) by accumulating many small-effect alleles.

Final Answer: Recurrent selection is primarily used to gradually improve the population mean for quantitative traits in cross-pollinated crops over successive cycles of selection and intermating.

Answer: (B) Go Back to Q23

Q24.

Solution

Key Concepts:

- **Pedigree method**: A plant breeding method for self-pollinated crops where the **genealogy (pedigree) of selected plants is recorded** from generation to generation.
- **Starting point**: Selection begins from **F_2 generation**, which is the first generation showing **visible genetic segregation** after crossing two homozygous parents.
- **Procedure**:
  - F_1: All plants are uniform (heterozygous); no selection, bulk seed.
  - **F_2**: Grow large population; select individual plants based on phenotype. Each selected plant is *numbered with a pedigree code* (e.g., 001, 002).
  - **F_3**: Grow each F_2 plant as a separate *progeny row*; select best rows and within rows.
  - Continue until F_6–F_8 when lines are approximately homozygous.
- **Crops**: Wheat, rice, chickpea, lentil, cotton, groundnut.
- **Advantage**: Maintains complete pedigree record; allows tracking of desirable traits through generations.
- **Disadvantage**: Labour-intensive and requires large land area in early generations.

Final Answer: In the pedigree breeding method, individual plant selection with progeny row maintenance begins from the F_2 generation, the first generation in which visible genetic segregation occurs.

Answer: (D) Go Back to Q24

Q25.

Solution

Key Concepts:

- **SSR (Simple Sequence Repeats)** = Microsatellites: Short tandem repeats of 1–6 base pair motifs distributed throughout the genome.
- **Codominance**: SSR markers detect **both alleles** at a locus in a heterozygous individual, unlike RAPD/AFLP (dominant markers that detect only the presence/absence of a band). This allows discrimination between AA, AB, and BB genotypes.
- **High polymorphism**: Different individuals (varieties) vary in the **number of repeat units**, creating many alleles per locus. SSRs are among the most polymorphic markers available.
- **Use in MAS (Marker-Assisted Selection)**: Linked SSR markers are used to select individuals carrying desirable QTLs (quantitative trait loci) or disease-resistance genes without phenotypic evaluation — saving time and space (e.g., wheat rust resistance gene selection in seedling stage).
- **RAPD markers**: Random Amplified Polymorphic DNA — dominant, technically unreliable (reproducibility issues); used for fingerprinting.
- **SNP markers**: Single Nucleotide Polymorphisms — most abundant, amenable to high-throughput genotyping chips; increasingly replacing SSRs.

Final Answer: SSR markers are preferred in MAS because they are codominant and highly polymorphic, allowing discrimination between homozygous and heterozygous loci at individual marker positions.

Answer: (A) Go Back to Q25

Q26.

Solution

Key Concepts:

- **Isolation distance**: The minimum distance that must be maintained between a seed production plot and other plots of the same species (different variety) to prevent cross-pollination and contamination of seed genetic purity.
- **Maize**: A **cross-pollinated** (allogamous) crop, pollinated by wind. Pollen can travel hundreds of metres. Therefore, the isolation requirement is much

greater.

- **Prescribed isolation distances for maize** (Indian Seed Certification standards):
  - Foundation seed: 400 metres
  - **Certified seed: 200 metres**
- **Wheat**: Self-pollinated; isolation requirement is just **3 metres** for certified seed.
- **Rationale**: The large 200 m isolation for maize ensures $<0.1\%$ foreign pollen contamination, maintaining varietal purity standards required for seed certification.

Final Answer: The minimum isolation distance for certified seed production of maize is 200 metres from other maize plots, required because maize is a wind-pollinated cross-pollinated crop with far-travelling pollen.

Answer: (C) Go Back to Q26

Q27.

Solution

Key Concepts:

- **Cucurbit fruit fly** (*Bactrocera cucurbitae*, Tephritidae): A major pest of cucurbits (bottle gourd, bitter gourd, cucumber, muskmelon) in India.
- **Methyl eugenol** [4-allyl-1,2-dimethoxybenzene]: A **male attractant** (parapheromone/kairomone) that strongly attracts adult males of *Bactrocera* species. Not a sex pheromone (produced by the fly), but a plant volatilide analogue.
- **Use in pest management**:
  - **Monitoring**: McPhail traps or FNSI traps baited with methyl eugenol + malathion (insecticide) are used to detect the onset of fruit fly infestation and monitor population trends.
  - **Mass trapping**: Large numbers of traps (4–6/acre) during peak season to reduce male population and thus mating success.
  - **Male annihilation technique (MAT)**: Methyl eugenol-soaked cotton wicks placed throughout the field; males attracted and killed.

- **Trichlorfon bait** (Option A): Used for fruit fly control but as a protein bait spray (GF-120), not a lure in traps.
- **Spinosad protein bait** (Option C): Also used as attract-and-kill bait, but methyl eugenol is the specific lure for *Bactrocera*.

Final Answer: Methyl eugenol, a male attractant parapheromone analogue, is the chemical lure used in traps for monitoring and mass-trapping the cucurbit fruit fly *Bactrocera cucurbitae*.

Answer: (B) Go Back to Q27

Q28.

Solution

Key Concepts:

- **Red spider mite** (*Tetranychus urticae*, Tetranychidae) = Two-spotted spider mite.
- **Favoured conditions**: **Hot, dry weather with low relative humidity (below 50–60%)**. Under such conditions, the mite life cycle shortens dramatically (egg to adult in $<$7 days at 30°C), leading to population explosions.
- **Why heat and dryness favour mites**:
  - Rapid development and reproduction at high temperatures.
  - Fungal pathogens that naturally suppress mite populations are inhibited by low humidity.
  - Plants under drought stress are more susceptible to mite feeding.
  - Predatory mites (*Phytoseiidae*) that control spider mites also tend to be less active in very hot, dry conditions.
- **Symptoms**: Stippling (tiny white/yellow dots) on upper leaf surface, bronzing, leaf silvering, webbing in heavy infestations.
- **Management**: Acaricides (dicofol, abamectin, spiromesifen, hexythiazox); predatory mites (*Phytoseiulus persimilis*, *Neoseiulus californicus*); high-pressure water sprays to dislodge colonies.

Final Answer: Red spider mite populations build up most rapidly under hot, dry weather with low relative humidity, which accelerates the life cycle and inhibits the fungal natural enemies that normally keep mite numbers in check.

Answer: (D) Go Back to Q28

Q29.

Solution

Key Concepts:

- **Alternaria blight of mustard**: One of the most destructive fungal diseases of mustard and rapeseed in India, causing 10–70% yield losses in severe epidemics.
- **Causal organism**: ***Alternaria brassicae*** (Berk.) Sacc. (large-spored) and *A. brassicicola* (small-spored, less common on mustard).
- **Symptoms**:
  - Circular to irregular spots with **dark brown to black concentric rings** on leaves, stems, petioles, and pods.
  - Pods are most damaging site — infected pods show discolouration and premature shattering, leading to seed yield loss.
  - Severe defoliation under high humidity.
- **Favourable conditions**: High humidity (>80% RH), temperature 20–25°C, dew on leaves, dense crop stand.
- **Management**:
  - Seed treatment with Thiram or Captan.
  - Foliar spray of **Mancozeb 0.25%** or **Iprodione** (dicarboximide fungicide) at flower initiation and pod filling.

Final Answer: Alternaria blight of mustard is caused by *Alternaria brassicae*, which produces characteristic dark concentric ring-patterned spots on leaves and pods, leading to severe yield losses under humid conditions.

Answer: (A) Go Back to Q29

Q30.

Solution

Key Concepts:

- **Powdery mildew of cucurbits**: Caused by ***Podosphaera xanthii*** (Castagne) Braun & Shishkoff (formerly *Sphaerotheca fuliginea*).
- **Favourable conditions**: Unlike most fungal diseases that require **high humidity and free water**, powdery mildew is uniquely favoured by **moderate**

temperatures (20–28°C) and LOW to moderate relative humidity (40–70%). Free moisture on the leaf surface actually inhibits spore germination.

- **Symptoms**: White powdery coating (conidia and mycelium) primarily on the **upper leaf surface**; later spreads to lower surface and stems. Affected leaves turn yellow and dry up prematurely.
- **Why low humidity favours it**: The powdery mildew fungus has modified haustoria and appressoria that function optimally in moderate dry conditions; rain/free water washes off conidia and prevents germination.
- **Management**: Sulphur dust (320 mesh), wettable sulphur spray (0.2–0.3%), systemic fungicides (triadimefon, hexaconazole, myclobutanil), or biological agents (potassium bicarbonate spray).

Final Answer: Powdery mildew of cucurbits (*Podosphaera xanthii*) is favoured by moderate temperatures (20–28°C) with low to moderate relative humidity, as free water on leaves actually inhibits spore germination.

Answer: (C) Go Back to Q30

Q31.

Solution

Key Concepts:

- ***Trichoderma viride*** (and *T. harzianum*, *T. asperellum*): Widely used biocontrol fungi against soil-borne plant pathogens.
- **Mechanisms of biocontrol**:
  (a) **Mycoparasitism**: *Trichoderma* hyphal coiling around pathogen hyphae followed by secretion of **cell-wall-degrading enzymes**:
    - **Chitinase**: Degrades chitin (the structural polysaccharide of most fungal cell walls).
    - **β-1,3-glucanase**: Degrades glucan, another fungal cell wall component.
    - Protease, cellulase: Supplementary lytic enzymes.

  (b) **Competition**: For space, nutrients, and iron (via siderophores) in the rhizosphere.

  (c) **Antibiosis**: Secretion of volatile and non-volatile antibiotics (gliotoxin, viridin, trichodermin) that inhibit pathogen growth.

  (d) **Induced systemic resistance (ISR)**: Primes plant defence mechanisms.

- **Target pathogens**: *Sclerotium rolfsii* (collar rot), *Fusarium oxysporum* (wilt), *Rhizoctonia solani* (damping off).

Final Answer: *Trichoderma viride* acts as a biocontrol agent primarily by secreting cell-wall-degrading enzymes (chitinase and β-1,3-glucanase) that lyse the fungal cell walls of soil-borne plant pathogens during mycoparasitism.

Answer: (B) Go Back to Q31

Q32.

Solution

Key Concepts:

- ***Bacillus thuringiensis* (Bt)**: A Gram-positive spore-forming soil bacterium that produces protein crystals (Cry proteins / δ-endotoxins) during sporulation. These crystals are toxic to specific insect orders.
- **Subspecies and host specificity**:
  - **Bt var. *kurstaki* (Btk)**: Produces Cry1Aa, Cry1Ab, and Cry1Ac proteins — active specifically against **Lepidoptera (caterpillars and larvae of moths/butterflies)**: cotton bollworm, cabbage looper, tobacco caterpillar, fruit borers.
  - **Bt var. *israelensis* (Bti)**: Cry4Aa/Cry4Ba/Cry11Aa — active against Diptera: mosquito larvae (*Aedes*, *Anopheles*, *Culex*) and black fly (*Simulium*) larvae.
  - **Bt var. *tenebrionis* (Btt)**: Cry3Aa — active against Coleoptera (beetles, weevils): Colorado potato beetle, leaf miners.
- **Mode of action**: Cry proteins bind to specific receptors in the midgut epithelium of susceptible insects, forming pores that cause osmotic lysis and death. Mammals, birds, and fish lack these receptors — hence safe.
- **Bt cotton**: Contains Cry1Ac gene from Btk to control Lepidopteran bollworms (*Helicoverpa armigera*).

Final Answer: *Bacillus thuringiensis* var. *kurstaki* produces Cry1A proteins that are specifically active against Lepidopteran larvae (caterpillars, borers, and moths), forming pores in their midgut epithelium.

Answer: (D) Go Back to Q32

Q33.

Solution

Key Concepts:

- **Nagori cattle**: A **draught breed** indigenous to **Nagaur district** of Rajasthan.
- **Characteristics**:
  - Heavy, compact, well-muscled body — historically one of the best draught breeds of India.
  - Known for pulling heavy loads over long distances on sandy/rocky terrain.
  - Short horns, white to grey body colour.
  - Moderate milk yield (2–4 litres/day); some interest now in A2 beta-casein milk.
- **Recognition**: Registered as a distinct breed with the **National Bureau of Animal Genetic Resources (NBAGR)**, Karnal.
- **Nagaur Cattle Fair**: The famous Nagaur Cattle Fair (Ramdeora Fair) is one of the largest livestock fairs in Rajasthan, with Nagori bullocks being the main attraction.
- **Conservation status**: Listed as a breed requiring conservation due to declining population as tractors replace draft animals.

Final Answer: Nagori cattle are a NBAGR-registered draught breed originating from Nagaur district of Rajasthan, historically valued for their exceptional heavy load-pulling capacity on sandy terrain.

Answer: (A) Go Back to Q33

Q34.

Solution

Key Concepts:

- **National Research Centre on Camel (NRCC)**: Located at **Bikaner, Rajasthan** (now renamed as ICAR-National Research Centre on Camel or ICAR-NRCC, under the Indian Council of Agricultural Research).
- **Established**: 1984; the only centre in Asia dedicated exclusively to camel research.
- **Research areas**: Camel breeding and genetics, reproduction, nutrition,

camel milk processing, camel disease management.

- **Rajasthan's camels**: Predominantly **single-humped dromedary** (*Camelus dromedarius*). Key breeds: Bikaneri (heavy draught), Jaisalmeri (light saddle/fast), Mewari.
- **Products**: Camel milk (high in Vitamin C, antimicrobial proteins — used for autism management in some studies), camel hair (fine wool), camel leather, camel meat.
- **Bikaner vs Jaisalmer**: While Jaisalmeri is the local camel breed from Jaisalmer district, the **research centre is at Bikaner** — these are two different facts.

Final Answer: The National Research Centre on Camel (ICAR-NRCC), the only dedicated camel research centre in Asia established in 1984, is located at Bikaner, Rajasthan.

Answer: (C) Go Back to Q34

Q35.

Solution

Key Concepts:

- **Barbari goat**: A small, compact meat breed with an interesting historical origin.
- **Origin hypothesis**: The breed is believed to have been brought from **Berbera port, Somalia (East Africa)** to the Indian subcontinent by Arab traders, hence the name "Barbari" (Berber/Berbera).
- **Current distribution**: Concentrated in the **Mathura–Agra–Etah** region of Uttar Pradesh, with some population in parts of Rajasthan (Bharatpur, Dholpur).
- **Characteristics**:
  - Small to medium body; short hair (white with brown patches common).
  - Good meat conformation; popular for meat at Bakrid festival.
  - Moderate milk yield (1.0–1.5 litres/day); milk rich in fat (5%).
  - Prolific — frequently produces twins or triplets.
- **Registered with NBAGR**: Yes, as a distinct breed.

- **Distinction from Rajasthan native breeds**: Marwari goat (Pali/Nagaur), Jakhrana (Alwar) are Rajasthan's native breeds. Barbari is an introduced breed.

Final Answer: The Barbari breed of goat is believed to have originated from Berbera port in Somalia (East Africa) and is now well established in the Mathura–Agra region of Uttar Pradesh as a compact meat breed.

Answer: (B) Go Back to Q35

Q36.

Solution

Key Concepts:

- **Foot and Mouth Disease (FMD)**: One of the most economically devastating viral diseases of livestock worldwide.
- **Causal agent**: Foot and Mouth Disease Virus (FMDV), belonging to the genus *Aphthovirus*, family **Picornaviridae**.
  - "Picorna" = **Pico** (small) + **RNA**: non-enveloped, single-stranded, positive-sense RNA virus.
  - Very small (27 nm diameter) with icosahedral symmetry.
- **7 serotypes**: O, A, C, Asia-1, SAT-1, SAT-2, SAT-3. No cross-immunity between serotypes.
- **Serotypes in India**: O, A, and Asia-1 are endemic. India follows annual vaccination with trivalent vaccine (O + A + Asia-1).
- **Symptoms**: Vesicular lesions (blisters) on **tongue, dental pad, lips, feet (interdigital space, coronary band), teats**; high fever; excessive salivation; lameness.
- **Control**: FMDV is highly contagious (spreads by aerosol, fomites, animal movement). Annual vaccination campaign (FMD-CP, Government of India). Infected animals rarely die but production losses are severe.

Final Answer: Foot and Mouth Disease is caused by FMDV, a small non-enveloped single-stranded RNA virus in the family Picornaviridae with 7 recognised serotypes, controlled by annual trivalent vaccination in India.

Answer: (D) Go Back to Q36

Q37.

Solution

Key Concepts:

- **Engel's Law** (Ernst Engel, German statistician, 1857): As household income rises, the **proportion of income spent on food decreases**, even though **absolute food expenditure increases**.
- **Income elasticity of demand for food**: $E_y = \frac{\%\Delta Q_d}{\%\Delta Income}$. For food as a whole, $E_y < 1$ (inelastic), meaning food is a **necessity**, not a luxury.
- **Implications for agriculture and policy**:
  - As a country develops and incomes rise, agriculture's share of GDP tends to fall.
  - Demand shifts from basic staples to high-value food (meat, fruits, vegetables, processed foods) — known as dietary diversification.
  - This is the basis for promoting horticulture, livestock, and food processing in emerging economies.
- **Option B is wrong**: Income elasticity > 1 would define a Giffen/inferior or luxury good; food is a normal necessity.
- **Agricultural policy relevance**: MSP-based procurement primarily stabilises prices of staple food grains; as incomes rise, more price support may be needed for diversified crops.

Final Answer: Engel's Law states that as household income rises, the income elasticity of demand for food is less than one, so food expenditure grows proportionally less than income and food's share of total spending declines.

Answer: (A) Go Back to Q37

Q38.

Solution

Key Concepts:

- **Marketing margin**: The difference between the price paid by the final consumer and the price received by the farmer.

$$\text{Total Marketing Margin} = \text{Retail Price} - \text{Farm Gate Price}$$

- **Farmer's Share in Consumer Rupee**:

$$\textbf{Farmer's Share (\%)} = \frac{\text{Farm Gate Price}}{\text{Retail Consumer Price}} \times 100$$

- **Interpretation**: If a vegetable sells at the farm gate for Rs. 10/kg and the consumer pays Rs. 25/kg, the farmer's share = $(10/25) \times 100 = \mathbf{40\%}$. The remaining 60% represents various marketing margins (transport, commission, wholesaler, retailer margins).
- **Option A**: This calculates the **retailer's marketing margin %** relative to retail price — not the farmer's share.
- **Option B**: This calculates the farmer's **profit margin** relative to farm gate price — a profitability ratio, not farmer's share in consumer rupee.
- **Policy implication**: Low farmer's share indicates inefficient marketing systems with excessive middlemen. Reforms like direct marketing (Apni Mandi, e-NAM) aim to increase farmer's share.

Final Answer: The Farmer's Share in Consumer Rupee is calculated as farm gate price divided by retail consumer price, multiplied by 100, showing what fraction of the final price the farmer actually receives.

Answer: (C) Go Back to Q38

Q39.

Solution

Key Concepts:

- **CWC = Central Warehousing Corporation**: Established in 1957 under the **Warehousing Corporations Act, 1962** (fully operational). A Government of India public sector undertaking under the Ministry of Consumer Affairs, Food & Public Distribution.
- **Functions**:
  - Operates scientific storage facilities across India for agricultural produce, industrial goods, and import/export cargo.
  - Issues **Negotiable Warehouse Receipts (NWRs)** against stored produce, enabling farmers/traders to avail pledge loans from banks.
  - Provides storage for Food Corporation of India (FCI), state agencies, and private depositors.

- **SWC (State Warehousing Corporation)**: State-level counterparts; also issue NWRs; focus on rural/district level storage.
- **NABARD Rural Godowns scheme**: Capital subsidy for construction of rural warehouse facilities at village/panchayat level.
- **Pledge financing**: A bank accepts the NWR as collateral and provides a loan (typically 75–80% of market value) against stored commodity. The farmer can sell when prices are favourable.

Final Answer: CWC stands for Central Warehousing Corporation, a Government of India PSU that operates scientific storage facilities nationwide and issues Negotiable Warehouse Receipts to enable pledge financing for stored agricultural produce.

Answer: (B) Go Back to Q39

Q40.

Solution

Key Concepts:

- **ATMA (Agricultural Technology Management Agency)**: A **district-level autonomous body** set up under the National Agriculture Extension and Technology Mission (NAETM), later mainstreamed under the National Mission on Agriculture Extension and Technology (NMAET) / Sub-Mission on Agricultural Extension (SMAE).
- **Mandate**: To plan, implement, and coordinate extension activities at the district level by integrating multiple line departments (agriculture, horticulture, animal husbandry, fisheries, forestry).
- **Key institutional bodies within ATMA**:
  - **Governing Board (GB)**: Headed by the District Collector; includes all department heads and farmer representatives.
  - **Management Committee (MC)**: Headed by the Project Director (CEO, Zila Parishad or equivalent).
  - **Farmer Advisory Committee (FAC)**: Elected farmer representatives providing bottom-up inputs to ATMA's annual action plan.
  - **Block Farm Information and Advisory Centres (BFIACs)**: Block-level nodes for information dissemination and farmer-extension interface.
- **Funding**: Centrally Sponsored Scheme; 60:40 Centre:State funding ratio (90:10 for NE states).

- **Key activities**: Farmer Field Schools (FFS), Krishi Melas, exposure visits, IT-based extension (mKisan, IFFCO Kisan app), Farm School, Farmer Producer Organisations.

Final Answer: ATMA operates at the district level as an autonomous body that plans, implements, and coordinates agricultural extension activities, with farmer advisory committees and Block Farm Information and Advisory Centres (BFIACs) at the block level.

Answer: (D) Go Back to Q40

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	2	A	3	B	4	D	5	A
6	C	7	B	8	D	9	A	10	C
11	B	12	D	13	A	14	C	15	B
16	D	17	A	18	C	19	B	20	D
21	A	22	C	23	B	24	D	25	A
26	C	27	B	28	D	29	A	30	C
31	B	32	D	33	A	34	C	35	B
36	D	37	A	38	C	39	B	40	D