ICAR AIEEA PG 2023 Agronomy Question Paper with Solutions

ZOLLEGE

General Instructions

(i) This booklet contains 120 questions, each provided with a complete, step-by-step solution.

(ii) It comprises 120 single-correct multiple-choice questions.

(iii) Attempt each question on your own before reviewing the given solution.

1. The term used for the growth of terrestrial plants without soil in mineral nutrient solutions is

(A) Nutrient culture

(B) Aquaculture

(C) Soilless culture

(D) Solution culture

Correct Answer: (D) Solution culture

SOLUTION:

This question checks whether you can tell apart several related terms used for growing plants without soil.

1. **Nutrient culture**: this phrase is used informally in places but it is not the standard agronomy term for root growth suspended purely in a mineral solution.
2. **Aquaculture**: this word belongs to fisheries science, the farming of fish, prawns and other aquatic animals, and has nothing to do with growing terrestrial plants.

3. **Soilless culture**: this is the general category name for any soil-free growing method, which also includes solid but soil-free media like sand, gravel or rockwool, so it is broader than what the question describes.
4. **Solution culture**: this names the specific method where a terrestrial plant's roots hang directly in an aerated liquid mineral nutrient solution with no solid medium at all, matching the question's wording exactly.

Since the question stresses growth "in mineral nutrient solutions" with no soil, it points at the narrower, specific technique rather than the broad category, so the correct term is solution culture.

Let's summarize:

- Soilless culture is the umbrella term, it can include solid soil-free media.
- Solution culture is one type of soilless culture, where roots sit only in liquid nutrient solution.

So the final answer is solution culture.

Quick Tip: Think about which method uses ONLY a liquid nutrient solution with no solid medium at all.

2. Match List-I with List-II (choose the correct answer from the options given below):

List-I (Instrument)	List-II (Parameter)
(A) Wind vane	(I) Photosynthetically active radiation
(B) Quantum sensor	(II) Wind speed
(C) Anemometer	(III) Atmospheric pressure
(D) Barometer	(IV) Wind direction

Choose the **correct** answer from the options given below:

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

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

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

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

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

SOLUTION:

This question tests basic knowledge of common weather and plant-science instruments used in agricultural meteorology.

1. **Wind vane**: a light arrow-shaped device that swings freely and points into the wind, so it tells us the wind direction, item (IV).
2. **Quantum sensor**: a small photocell tuned to the light band that plants use for photosynthesis, so it reads photosynthetically active radiation, item (I).
3. **Anemometer**: usually built with three spinning cups, its rotation speed is converted into wind speed, item (II).
4. **Barometer**: a sealed instrument that senses the push of the atmosphere on it, giving atmospheric pressure, item (III).

Putting these four pairs together gives (A)-(IV), (B)-(I), (C)-(II), (D)-(III), which is exactly option 1.

Let's summarize:

- Wind vane gives direction, anemometer gives speed, these two are often confused with each other.
- Quantum sensor gives PAR, barometer gives pressure, these two are unrelated to wind at all.

So the matching in option 1 is correct.

Quick Tip: Ask what each device physically senses: direction, light, speed, or pressure.

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3. If it is said that wind is blowing from 360°, then what is its meaning?

(A) Wind is not blowing

(B) Wind is blowing from south direction

(C) Wind is blowing from true north direction

(D) Wind is blowing from magnetic south direction

Correct Answer: (C) Wind is blowing from true north direction

SOLUTION:

This question checks understanding of how meteorologists report wind direction using a compass bearing.

1. **Wind is not blowing**: a value of 360° is a valid direction reading, calm conditions get their own separate label, so this does not fit.

2. **Blowing from south direction**: south on the 0 to 360 degree compass scale is 180°, not 360°, so this is incorrect.
3. **Blowing from true north direction**: on the standard meteorological scale, 0° and 360° both represent true north, since the scale wraps around a full circle, so this fits exactly.
4. **Blowing from magnetic south direction**: the reported wind bearing is referenced to true, geographic north, not to magnetic compass readings, and it does not equal 360° at south anyway, so this is wrong.

Since the compass bearing scale runs from 0° at north clockwise around to 360°, which lands back on north, a report of 360° means the wind is coming from true north.

Let's summarize:

- Wind direction is reported as where the wind comes FROM, on a 0 to 360 degree clockwise scale from true north.
- 0° and 360° are the same point on this circular scale, both meaning north.

So the answer is that the wind is blowing from the true north direction.

Quick Tip: Remember the compass bearing scale runs from 0° to 360°, both marking north.

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4. The complex which is specifically inhibited by SHAM in the electron transport chain

(A) Complex I

(B) Complex II

(C) Complex III

(D) Complex IV

Correct Answer: (D) Complex IV

SOLUTION:

This question is about the plant mitochondrial electron transport chain and its two separate routes for sending electrons to oxygen.

1. **Complex I**: this is NADH dehydrogenase, and its known specific inhibitor is rotenone, not SHAM, so it does not fit.
2. **Complex II**: this is succinate dehydrogenase, blocked specifically by malonate, again unrelated to SHAM.
3. **Complex III**: this is the cytochrome bc1 complex, blocked by antimycin A, and SHAM leaves this complex working normally.
4. **Complex IV**: this is cytochrome c oxidase, the normal terminal step that reduces oxygen to water. Plants have a second, parallel terminal step for this same job, run by the enzyme alternative oxidase (AOX), which SHAM specifically switches off.

Because AOX carries out the same overall function as Complex IV, handing electrons to oxygen, and SHAM is the standard inhibitor used to shut down this AOX route while leaving Complex I through Complex IV of the main chain untouched, this SHAM-sensitive step is treated as corresponding to Complex IV.

Let's summarize:

- Rotenone stops Complex I, malonate stops Complex II, antimycin A stops Complex III, cyanide stops Complex IV.

- SHAM stops the separate alternative oxidase enzyme, which does the job of a terminal oxidase in place of Complex IV.

So among the four listed complexes, the intended answer is Complex IV, keeping in mind that SHAM technically targets the alternative oxidase enzyme rather than Complex IV itself.

Quick Tip: SHAM blocks the cyanide-resistant alternative oxidase, which takes over the job normally done by the terminal complex.

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5. The cystic fibrosis transmembrane conductance regulator (CFTR) is a transporter involved in

(A) Glucose transport

(B) Chloride ion transport

(C) Calcium homeostasis

(D) Amino acid uptake

Correct Answer: (B) Chloride ion transport

SOLUTION:

This question asks what CFTR actually moves across the cell membrane, based on what its name and its role in disease tell us.

1. **Glucose transport**: sugar uptake into cells is carried out by GLUT-family carrier proteins, a completely different set of transporters from CFTR.
2. **Chloride ion transport**: CFTR forms a channel in the cell membrane that, once switched on by ATP and phosphorylation,

lets chloride ions flow out of epithelial cells, exactly what its full name, chloride conductance regulator, describes.

3. **Calcium homeostasis**: calcium levels inside cells are controlled by dedicated calcium pumps and calcium channels, not by CFTR.
4. **Amino acid uptake**: this job belongs to specific amino acid transporter proteins, again unrelated to CFTR's function.

Because faulty chloride transport through CFTR is exactly what causes the thick mucus seen in cystic fibrosis patients, the protein's core job must be chloride ion transport.

Let's summarize:

- CFTR is a chloride channel found in epithelial cell membranes.
- Loss of its chloride transport activity, not any glucose, calcium, or amino acid role, is what causes cystic fibrosis.

So the correct answer is chloride ion transport.

Quick Tip: Think about which ion's movement across epithelial cells is disrupted in cystic fibrosis.

6. Given below are two statements:

Statement I: Minimum, optimum and maximum temperatures for germination of rice crop are $10\text{-}12^{\circ}C$, $30\text{-}32^{\circ}C$ and $36\text{-}38^{\circ}C$, respectively.

Statement II: Minimum, optimum and maximum temperatures for germination of wheat crop are $3\text{-}4.5^{\circ}C$, $20\text{-}25^{\circ}C$ and $30\text{-}40^{\circ}C$, respectively.

In the light of the above statements, choose the **correct** answer from the options given below

(A) Both Statement I and Statement II are correct

(B) Both Statement I and Statement II are not correct

(C) Statement I is correct but Statement II is not correct

(D) Statement I is not correct but Statement II is correct

Correct Answer: (C) Statement I is correct but Statement II is not correct

SOLUTION:

This question compares the cardinal, minimum, optimum, maximum, germination temperatures given for rice and wheat against the standard values used in agronomy.

1. **Statement I (rice)**: the figures given, about $10\text{-}12^{\circ}C$ minimum, $30\text{-}32^{\circ}C$ optimum and $36\text{-}38^{\circ}C$ maximum, match the commonly cited cardinal temperatures for rice seed germination, so this statement holds up.
2. **Statement II (wheat)**: the minimum, $3\text{-}4.5^{\circ}C$, and optimum, $20\text{-}25^{\circ}C$, figures for wheat are correct, since wheat is a temperate cereal that germinates well in cooler soil than rice. The maximum

figure of 30-40°C, though, overstates the usual maximum for wheat, which is closer to 30-32°C, so this statement is not fully correct.

Since one statement, rice, is fully accurate and the other, wheat, contains an inflated maximum value, the combined judgement has to separate the two rather than accept or reject them together.

Let's summarize:

- Rice cardinal germination temperatures as given in Statement I are the standard accepted figures.
- Wheat's maximum germination temperature is overstated in Statement II, even though its minimum and optimum values are right.

So the correct choice is that Statement I is correct while Statement II is not correct.

Quick Tip: Compare each crop's given maximum germination temperature against the standard textbook value, that is where the difference lies.

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7. The transcription factor SNAC1 (Stress-responsive NAC1) is involved in drought stress response in which of the following crop plants?

(A) *Sorghum bicolor* (sorghum)

(B) *Phaseolus vulgaris* (common bean)

(C) *Brassica napus* (rapeseed)

(D) *Musa spp* (banana)

Correct Answer: (A) *Sorghum bicolor* (sorghum)

SOLUTION:

This question is about the crop species in which the drought-responsive transcription factor SNAC1 has been studied.

1. ***Sorghum bicolor* (sorghum)**: sorghum is a cereal, grass-family, crop known for natural drought tolerance, and NAC-family stress transcription factors, the same family SNAC1 belongs to, have been characterized in cereal crops for their role in closing stomata and conserving water under drought.
2. ***Phaseolus vulgaris* (common bean)**: this is a legume crop with its own separate set of drought-responsive genes, not the SNAC1 gene under discussion here.
3. ***Brassica napus* (rapeseed)**: an oilseed mustard-family crop, again studied through its own distinct stress-response transcription factors, unrelated to SNAC1.
4. ***Musa spp* (banana)**: a fruit crop, and while it faces drought stress too, it is not the crop associated with SNAC1 research.

Since SNAC1-type genes and their drought tolerance function are grounded in cereal crop physiology, and sorghum is the only cereal among the four options, it is the best fitting answer, with the caveat that the original SNAC1 work is most closely tied to rice, which does not appear on this list.

Let's summarize:

- SNAC1 is a NAC-family transcription factor that helps a crop plant close its stomata and resist drought.
- Among the given four crops, only sorghum is a cereal grass, matching the crop group this gene family is best known in.

So the intended answer is *Sorghum bicolor*.

Quick Tip: SNAC1 is a NAC-family drought stress transcription factor best known from cereal, grass-family, crop research.

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8. The technique used to study the spatial distribution of nutrients in plant tissues at a cellular level is?

(A) Immunohistochemistry

(B) Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)

(C) Metabolomics

(D) RNA-sequencing (RNA-seq)

Correct Answer: (B) Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)

SOLUTION:

This question asks which technique can pinpoint exactly where mineral nutrients sit within plant tissue, at the resolution of single cells.

1. **Immunohistochemistry**: this method locates specific proteins in a tissue section using labeled antibodies, useful for protein localization but not for mapping mineral elements.
2. **Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS)**: a focused laser scans across a thin tissue slice, vaporizing tiny spots one at a time, and each spot's vapor is analyzed in a mass spectrometer for its elemental

content, building a fine-scale map of nutrient distribution across the tissue, down to cellular resolution.

3. **Metabolomics**: this profiles the overall mix of small metabolite molecules in a sample, giving a chemical fingerprint rather than a spatial map of elements.
4. **RNA-sequencing (RNA-seq)**: this reads out gene expression levels across the genome, telling us about active genes, not the physical location of nutrients.

Only LA-ICP-MS is built specifically to scan tissue spot by spot and report elemental content at each point, so it directly answers the need for cellular-level nutrient mapping.

Let's summarize:

- Immunohistochemistry maps proteins, metabolomics profiles metabolites, RNA-seq profiles gene expression, none of these map mineral elements spatially.
- LA-ICP-MS is purpose built for spatial, cell-level elemental (nutrient) mapping in tissue.

So the correct technique is LA-ICP-MS.

Quick Tip: Think about which technique physically scans a tissue section point by point to measure elemental content at each spot.

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9. Leaf relative growth rate (LRGR) can be calculated using which of the following expressions?

(A) $LRGR = \dfrac{\log LW_2 - \log LW_1}{t_2 - t_1}$

(B) $LRGR = \dfrac{LW_2 - LW_1}{t_2 - t_1}$

(C) $LRGR = \dfrac{\log LW_2 + \log LW_1}{t_2 - t_1}$

(D) $LRGR = \dfrac{LW_2 + LW_1}{t_2 - t_1}$

Correct Answer: (A) $LRGR = \dfrac{\log LW_2 - \log LW_1}{t_2 - t_1}$

SOLUTION:

This question checks whether you know the exact shape of the relative growth rate formula when it is applied to leaf weight. Let's check each option using logic instead of just recalling the formula.

1. **Option 1, LRGR = (log LW2 - log LW1)/(t2-t1)**: a relative rate always compares change to the starting size, and growth analysts do this by taking the log of each weight first, then finding the difference over time. This removes the effect of the leaf's actual size, which is exactly what relative growth rate means.
2. **Option 2, LRGR = (LW2 - LW1)/(t2-t1)**: a plain weight difference over time gives the Absolute Growth Rate, which depends on leaf size and is not relative at all.
3. **Option 3, LRGR = (log LW2 + log LW1)/(t2-t1)**: adding two logs together does not represent any change, it just gives a combined magnitude with no meaning as a rate.
4. **Option 4, LRGR = (LW2 + LW1)/(t2-t1)**: adding raw weights and dividing by time gives a meaningless quantity, since growth is about change, not a sum.

Only option 1 uses logs to remove the effect of starting size and a difference, not a sum, to capture change over time.

Let's summarize:

- Relative growth rate uses log-transformed weights because plant growth is close to exponential.
- The rate is a difference of logs over a time difference, never a sum.

So the correct formula for LRGR is option 1.

Quick Tip: Remember growth analysis formulas use log-transformed weights, not raw weights.

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10. The efficiency of PCR amplification in DNA barcoding can be enhanced by the presence of which mineral nutrient known for its stabilizing effect on DNA polymerase?

(A) Rhodium

(B) Ruthenium

(C) Osmium

(D) Iridium

Correct Answer: (B) Ruthenium

SOLUTION:

This question lists four metals, Rhodium, Ruthenium, Osmium and Iridium, and asks which one improves PCR efficiency by stabilizing DNA polymerase. Since none of these four is the standard PCR cofactor (that role belongs to Mg^{2+}, with Mn^{2+} as an occasional substitute), we judge which choice has the strongest reported connection to DNA and its enzymes.

1. **Rhodium**: used mostly in industrial catalysis and plating, with no known role in DNA enzyme chemistry.
2. **Ruthenium**: ruthenium complexes are widely studied for binding directly to the DNA helix and are used in DNA electrochemical biosensors and DNA damage research, putting this metal closer to DNA-related enzyme work than the other three.
3. **Osmium**: mainly used as a fixative and stain in electron microscopy, not connected to DNA polymerase function.
4. **Iridium**: used mainly in electrodes and some catalytic complexes, with no established link to DNA polymerase stability.

By elimination, Ruthenium stands out as the metal with the closest documented relationship to DNA chemistry among the four choices, so it is picked as the best-supported answer, even though this is not a standard, widely-taught PCR fact.

Let's summarize:

- The real, standard cofactor for DNA polymerase in PCR is Mg^{2+}, with Mn^{2+} sometimes used instead.
- Among the four unusual metals given, Ruthenium has the strongest documented association with DNA chemistry.

So the answer chosen is Ruthenium, while noting this is not a mainstream, widely taught PCR fact.

Quick Tip: Think about which of these four metals is actually studied in connection with DNA, even though none of them is the standard PCR cofactor.

11. The amino acid considered as a branched-chain amino acid (BCAA) is:

(A) Serine

(B) Leucine

(C) Asparagine

(D) Tyrosine

Correct Answer: (B) Leucine

SOLUTION:

The question asks us to spot the branched-chain amino acid (BCAA) from a list of four amino acids. BCAAs are a specific, small group, Leucine, Isoleucine and Valine, and their side chains all include a branch point instead of a single straight carbon chain.

1. **Serine**: has a hydroxymethyl side chain and belongs to the polar, uncharged amino acid group, not the BCAA group.
2. **Leucine**: its side chain is an isobutyl group with a clear branch, making it one of the three true BCAAs.
3. **Asparagine**: has an amide side chain and is classed as a polar amino acid, unrelated to branching.
4. **Tyrosine**: carries an aromatic phenol ring side chain, placing it with the aromatic amino acids.

Only Leucine fits the strict definition of a branched-chain amino acid, since its side chain actually branches, unlike the other three options.

Let's summarize:

- The only true BCAAs among all twenty amino acids are Leucine, Isoleucine and Valine.
- Serine, Asparagine and Tyrosine belong to other structural classes, polar, amide and aromatic.

So the correct answer is Leucine.

Quick Tip: Only three amino acids, Leucine, Isoleucine and Valine, count as branched-chain amino acids.

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12. A lack of micronutrients affects not only plant growth but also vital functions, such as photosynthetic and mitochondrial electron flow. Which of the following group of elements shall have the greatest impact on both photosynthetic and mitochondrial electron transport?

(A) Co, Ni and Mo

(B) Ca, K and Na

(C) Mn, Co and Ca

(D) Cu, Mn and Fe

Correct Answer: (D) Cu, Mn and Fe

SOLUTION:

This question is really about which micronutrients are physically built into the electron carriers of photosynthesis and respiration. Let's check each group against what these chains are actually made of.

1. **Co, Ni and Mo**: cobalt supports vitamin B12 related reactions and nitrogen fixation, nickel is a cofactor for urease, and molybdenum is needed for nitrate reductase and nitrogenase. None of these three sit inside the electron transport chains themselves.
2. **Ca, K and Na**: mainly involved in cell signaling, osmotic regulation and stomatal opening and closing, not in carrying

electrons through the chain.

3. **Mn, Co and Ca**: manganese is correct, since it is part of the water-splitting complex in Photosystem II, but cobalt and calcium here are not core electron transport components.
4. **Cu, Mn and Fe**: copper is the metal center of plastocyanin and cytochrome c oxidase, manganese runs the oxygen-evolving complex of Photosystem II, and iron is central to cytochromes and iron-sulfur clusters used in both chains.

Only the fourth group has all three metals directly built into the protein complexes that carry electrons in photosynthesis and in mitochondrial respiration.

Let's summarize:

- Fe and Cu are shared electron-carrier metals in both chloroplasts and mitochondria.
- Mn is essential specifically for splitting water in Photosystem II.

So the group with the greatest impact on both electron transport chains is Cu, Mn and Fe.

Quick Tip: Look for the metals that sit directly inside cytochromes, plastocyanin and the water-splitting complex.

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13. The deficiency symptoms of an essential element tend to appear first in young leaves, indicating that the element is relatively immobile. Such symptoms would be shown by which one of the following elemental deficiencies?

(A) Sulphur

(B) Iron

(C) Nitrogen

(D) Potassium

Correct Answer: (B) Iron

SOLUTION:

The question tests the idea of nutrient mobility inside a plant, and how it decides whether a deficiency shows up in old leaves or young leaves first. Mobile nutrients get shifted out of old leaves toward new growth, so old leaves show the symptom. Immobile nutrients cannot be moved this way, so young leaves suffer instead.

1. **Sulphur**: shows some resemblance to nitrogen deficiency and has limited mobility, but it is not the standard textbook case used for young-leaf symptom questions.
2. **Iron**: fixed once used inside mature leaf cells and cannot be pulled back out and resent to new leaves. Because of this, iron deficiency shows up as interveinal chlorosis in the youngest leaves first, the classic example of an immobile nutrient.
3. **Nitrogen**: highly mobile, withdrawn from older leaves and sent to new growth when scarce, so its deficiency appears in old leaves first.
4. **Potassium**: also highly mobile, moved from older tissue to younger tissue when scarce, so its deficiency again shows in old leaves first.

Since the question describes symptoms appearing first in young leaves due to immobility, the answer has to be the immobile element among the four, which is Iron.

Let's summarize:

- Mobile nutrients, N and K, show deficiency in old leaves first.
- Immobile nutrients, like Fe, show deficiency in young leaves first, since they cannot be recycled from mature tissue.

So the correct answer is Iron.

Quick Tip: Immobile nutrients cannot be withdrawn from old leaves, so their deficiency shows up in young leaves first.

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14. In which of the following organelles are the enzyme pyruvate dehydrogenase complex and the glycolytic pathway located?

(A) Cytosol and Mitochondria

(B) Cytosol and chloroplast

(C) Golgi bodies and ER

(D) Microsomes and ribosomes

Correct Answer: (A) Cytosol and Mitochondria

SOLUTION:

This question checks if you know exactly where, inside the cell, two connected steps of respiration take place, glycolysis and the pyruvate dehydrogenase reaction that follows it.

1. **Cytosol and Mitochondria**: glycolysis breaks glucose down to pyruvate in the cytosol without needing any organelle, and then the pyruvate dehydrogenase complex, sitting inside the

mitochondrial matrix, converts that pyruvate to acetyl-CoA. Both processes match this pair of locations exactly.

2. **Cytosol and chloroplast**: the cytosol part is right for glycolysis, but chloroplasts run photosynthesis, not the pyruvate dehydrogenase reaction, so this pairing is wrong.
3. **Golgi bodies and ER**: these handle protein modification, packaging and lipid synthesis, they play no part in glycolysis or pyruvate oxidation.
4. **Microsomes and ribosomes**: microsomes are lab-prepared membrane fragments and ribosomes make proteins, neither is where glycolysis or the pyruvate dehydrogenase complex functions.

Only the first option correctly places glycolysis in the cytosol and the pyruvate dehydrogenase complex in the mitochondria.

Let's summarize:

- Glycolysis happens in the cytosol and needs no oxygen or organelle.
- The pyruvate dehydrogenase complex works in the mitochondrial matrix, the link step before the Krebs cycle.

So the correct answer is Cytosol and Mitochondria.

Quick Tip: Glycolysis needs no organelle, while the pyruvate dehydrogenase step needs the mitochondrial matrix.

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15. During translocation of photosynthates in plants from source to sink:

(A) The loading of photosynthates at source is by active transport and unloading at the sink is by passive transport.

(B) The loading of photosynthates at source is by passive transport and unloading at the sink is by active transport.

(C) Both loading at the source and unloading at the sink are by active transport.

(D) Both loading at the source and unloading at the sink are by passive transport.

Correct Answer: (A) The loading of photosynthates at source is by active transport and unloading at the sink is by passive transport.

SOLUTION:

This question is about the pressure-flow mechanism of phloem transport, and specifically whether the two end steps, loading at the source and unloading at the sink, need energy or not.

1. **Loading at source is active, unloading at sink is passive**: at the source, sucrose is pumped into the phloem sieve tubes against its concentration gradient using ATP-driven proton pumps paired with sucrose transporters, building up a high sugar concentration in the phloem. At the sink, that already-high concentration pushes sugar out into the sink cells, which keep using up sugar, so this step needs no extra energy of its own.
2. **Loading at source is passive, unloading at sink is active**: this reverses the real biology, since building a high sugar concentration in the phloem at the source cannot happen by passive diffusion alone, it needs the active pumping step.
3. **Both active**: this makes unloading harder than it needs to be, since the sink can rely on the gradient set up during loading and

does not always need its own active step.

4. **Both passive**: this ignores that sugar must be moved into the phloem against a gradient at the source, which cannot happen without active transport.

Only the first statement matches the pressure-flow model, active loading builds the pressure, and passive unloading releases it at the sink.

Let's summarize:

- Source: active loading, using ATP-powered proton pumps and sucrose co-transporters.
- Sink: passive unloading, driven by the concentration gradient already created at the source.

So the correct answer is that loading at the source is active transport and unloading at the sink is passive transport.

Quick Tip: Loading needs energy to build a sugar gradient in the phloem, unloading can simply use that gradient.

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16. Match List-I with List-II

List-I Specialized part of cell	**List-II** Specialized combinations of cell
(A) Centriole	(I) Infoldings in mitochondria
(B) Chlorophyll	(II) Thylakoids
(C) Cristae	(III) Nucleic acids
(D) Ribozymes	(IV) Basal body cilia or flagella

Choose the **correct** answer from the options given below:

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

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

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

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

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

SOLUTION:

This is a direct matching question, so the fastest way to solve it is to fix each item in List-I to its one correct partner in List-II based on basic cell biology facts, then check which option lists all four pairs correctly.

1. **(A) Centriole**: organizes the basal body, the structure that gives rise to cilia and flagella, so A matches (IV) Basal body cilia or flagella.
2. **(B) Chlorophyll**: sits inside the thylakoid membranes inside the chloroplast, so B matches (II) Thylakoids.
3. **(C) Cristae**: are simply the folded inner membrane of the mitochondrion, so C matches (I) Infoldings in mitochondria.
4. **(D) Ribozymes**: are RNA molecules that can catalyze reactions, placing them in the nucleic acids group, so D matches (III) Nucleic acids.

Putting these four pairs together gives A-IV, B-II, C-I, D-III, exactly the combination listed in option 1. None of the other three options keep all four pairs correct at the same time, each swaps at least one match, such as pairing Ribozymes with basal bodies or Cristae with nucleic acids, which does not fit the actual structures.

Let's summarize:

- Centriole links to the basal body of cilia and flagella, Chlorophyll to thylakoids, Cristae to mitochondrial infoldings, Ribozymes to nucleic acids.
- Only option 1 keeps every one of these four pairs correct together.

So the correct answer is option 1, (A)-(IV), (B)-(II), (C)-(I), (D)-(III).

Quick Tip: Match each structure to its one clear textbook function before checking the options.

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17. Select out of the following the correct statement regarding cell membrane.

(A) Na and K ions move across the cell membrane by passive transport.

(B) Proteins make up 60 to 70% of the cell membrane.

(C) Fluid mosaic model of the cell membrane was proposed by Singer and Nicolson.

(D) Lipids are arranged in a bilayer with polar heads towards the inner part.

Correct Answer: (C) Fluid mosaic model of the cell membrane was proposed by Singer and Nicolson.

SOLUTION:

This question checks basic facts about how the cell membrane is built and how it works, by testing four separate claims one at a time.

1. **Na and K ions move by passive transport**: Wrong. These ions are pumped against their concentration gradient by the

sodium potassium pump, which burns ATP. That makes it active transport, not passive movement.

2. **Proteins make up 60 to 70% of the membrane**: Wrong. Membrane protein content is not fixed at one number, it ranges widely across cell types, roughly from a fifth to four fifths of the membrane mass, so no single percentage band is a safe rule.
3. **Fluid mosaic model given by Singer and Nicolson**: Right. This 1972 model describes the membrane as a moving, fluid layer of lipids with proteins scattered through it like tiles in a mosaic, and it is the accepted model taught today.
4. **Lipids arranged with polar heads towards the inner part**: Wrong. The polar heads of the lipid bilayer point outward, towards water on both sides of the membrane. The tails, which avoid water, point inward and face each other.

Once each claim is checked against the real biology, only the statement about Singer and Nicolson survives, so option 3 is the correct answer.

Let's summarize:

- Sodium and potassium cross the membrane mainly through active transport by the sodium potassium pump.
- The fluid mosaic model, given by Singer and Nicolson in 1972, correctly describes the cell membrane.

So the correct statement regarding the cell membrane is option 3, the fluid mosaic model proposed by Singer and Nicolson.

Quick Tip: Think about which membrane model is taught as the standard, and which direction lipid heads actually face.

18. Vegetable crops like tomatoes and bell pepper, allowed growing in a carbon dioxide rich environment, showed higher yields because:

(A) C4 pathway for carbon fixation at high carbon dioxide is the limiting factor in such plants.

(B) These showed an increased rate of photosynthesis at higher carbon dioxide concentrations.

(C) These can respond to high carbon dioxide conditions even in low light conditions.

(D) Only carbon dioxide is the limiting factor in such plants.

Correct Answer: (B) These showed an increased rate of photosynthesis at higher carbon dioxide concentrations.

SOLUTION:

Tomato and bell pepper follow the ordinary C3 route of carbon fixation, and this question asks what actually happens to them when they are grown with extra carbon dioxide around their leaves.

1. **C4 pathway is the limiting factor**: Not applicable, since tomato and bell pepper never use a C4 pathway at all, they are C3 crops.
2. **Increased photosynthesis rate at higher CO2**: This fits the science. In C3 plants the RuBisCO enzyme also reacts with oxygen and wastes energy through photorespiration when CO2 is scarce near the enzyme. Extra CO2 shifts this balance towards carbon fixation, so the plant makes more sugar and yield rises.
3. **Respond to high CO2 even in low light**: Photosynthesis still needs light to run its light reactions and supply energy, so this claim goes too far.

4. **Only CO_2 is limiting**: Too absolute, since water, nutrients, temperature and light all limit yield as well.

The one option that matches real plant behaviour is the rise in photosynthesis rate, because more CO_2 lets RuBisCO fix carbon instead of wasting effort on photorespiration.

Let's summarize:

- Tomato and pepper are C_3 crops, so CO_2 enrichment reduces photorespiration and boosts carbon fixation.
- This higher photosynthesis rate is what drives the yield gain, not light independence or CO_2 being the sole factor.

So option 2, the increased rate of photosynthesis at higher CO_2, is the correct answer.

Quick Tip: Remember tomato and bell pepper are C_3 crops, and think about what extra CO_2 does to RuBisCO's two competing reactions.

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19. Photorespiration does not take place in C_4 plants because such plants:

(A) Do not contain the fixation enzyme RUBISCO.

(B) Have cells that are impermeable to oxygen.

(C) Have a mechanism that increases the concentration of CO_2 at the enzyme site.

(D) Cells do not allow oxygen to accumulate in them.

Correct Answer: (C) Have a mechanism that increases the concentration of CO_2 at the enzyme site.

SOLUTION:

C4 plants like maize and sugarcane rarely lose carbon to photorespiration, and this question checks whether you know the actual reason for that advantage.

1. **No RuBisCO enzyme**: False, RuBisCO is present and active inside the bundle sheath cells of C4 plants, where the Calvin cycle still runs.
2. **Cells impermeable to oxygen**: False, oxygen is made during the light reactions in these cells just like in any green cell, it is not blocked out.
3. **Mechanism that raises CO2 at the enzyme site**: True. PEP carboxylase in mesophyll cells grabs CO2 first, ships it inward as a four carbon acid, and releases it in the bundle sheath, right where RuBisCO sits, so RuBisCO is surrounded by a high CO2 pool and rarely binds oxygen instead.
4. **Cells do not allow oxygen to build up**: False, oxygen is still generated normally, this is not the mechanism at play.

The concentrating step carried out by PEP carboxylase and the bundle sheath is what starves RuBisCO of the chance to react with oxygen, so photorespiration barely happens in C4 plants.

Let's summarize:

- C4 plants keep RuBisCO but surround it with a high CO2 environment through the bundle sheath pathway.
- This CO2 pumping mechanism, not a lack of RuBisCO or oxygen exclusion, is why photorespiration is suppressed.

Hence option 3, the CO_2 concentrating mechanism at the enzyme site, is the correct answer.

Quick Tip: Think about the role of PEP carboxylase and the bundle sheath cells in building up CO_2 around RuBisCO.

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20. The product of the photorespiration process is:

(A) Phosphoglycerate

(B) Phosphoglycolate

(C) Both A and B

(D) Oxalo acetic acid

Correct Answer: (C) Both A and B

SOLUTION:

Photorespiration starts when RuBisCO, instead of grabbing CO_2, grabs oxygen and splits the RuBP molecule it is holding. This question asks what comes out of that split.

1. **Phosphoglycerate**: Correct in part, one of the two fragments formed when RuBP reacts with oxygen is the three carbon compound 3-phosphoglycerate, the same molecule also made in normal carbon fixation.
2. **Phosphoglycolate**: Also correct in part, the other fragment from the same reaction is the two carbon compound 2-phosphoglycolate, which is unique to the oxygenation route and has to be recycled through the photorespiratory pathway.

3. **Both A and B**: Since the oxygenase reaction of RuBisCO on one RuBP molecule always gives one phosphoglycerate and one phosphoglycolate together, listing both as the product is the complete and accurate answer.
4. **Oxaloacetic acid**: This compound belongs to the C4 carbon fixation cycle, made when PEP carboxylase fixes CO_2, it does not come from the photorespiratory oxygenation reaction at all.

Because RuBisCO's reaction with oxygen breaks RuBP into these two fragments in one step, neither fragment alone tells the full story, so the pair together is the right answer.

Let's summarize:

- RuBP plus oxygen gives one 3-phosphoglycerate and one 2-phosphoglycolate.
- Oxaloacetic acid belongs to C4 fixation, not to photorespiration.

So option 3, both A and B, is the correct answer for the products of photorespiration.

Quick Tip: Recall that RuBisCO's oxygenase reaction splits RuBP into two different fragments, not just one.

• • •

21. The country that has given the name of the tropical cyclone "Mocha" developed in the month of May, 2023 in the Bay of Bengal is:

(A) Bangladesh

(B) Pakistan

(C) India

(D) Yemen

Correct Answer: (D) Yemen

SOLUTION:

Cyclone names in the Bay of Bengal and Arabian Sea region come from a shared list, and each name is contributed in turn by one of the participating countries around the North Indian Ocean.

1. **Bangladesh**: Bangladesh contributes its own set of names to the rotating panel list, but "Mocha" is not one of them.
2. **Pakistan**: Pakistan has also suggested other names for this list over the years, not this particular one.
3. **India**: India too has proposed several cyclone names in past cycles, but "Mocha" did not come from India.
4. **Yemen**: Yemen proposed the name "Mocha", named after its own historic Red Sea port city Mocha, long known worldwide for exporting coffee, which is also why the coffee drink "mocha" carries this name.

Since the cyclone that struck the Bay of Bengal in May 2023 used this Yemen suggested name, Yemen is the country credited with naming it.

Let's summarize:

- Cyclone names in this ocean basin rotate through a list built from suggestions of all member countries.
- "Mocha" was Yemen's contribution, named after its own coffee trading port city.

So the correct answer is option 4, Yemen.

Quick Tip: Think about which country's port city, famous for coffee trade,

shares its name with this cyclone.

• • •

22. Which of the following clouds is a rain bearing cloud?

(A) Nimbostratus

(B) Altocumulus

(C) Cirrostratus

(D) Stratocumulus

Correct Answer: (A) Nimbostratus

SOLUTION:

Clouds are grouped by their height and shape, and only a couple of types are actually built to release steady rainfall, so this question is really asking you to spot the "rain cloud" among four look-alikes.

1. **Nimbostratus**: This is the thick, dark grey blanket cloud that covers the whole sky and drops slow, steady rain or snow for hours, exactly what the word "nimbo" (rain bearing) signals in cloud names.
2. **Altocumulus**: A mid level cloud of small white or grey clumps, it can hint that weather is changing but it does not itself pour down rain.
3. **Cirrostratus**: A thin, high, ice crystal sheet that often produces a ring or halo around the sun, linked with calm or slowly worsening weather, not rainfall.
4. **Stratocumulus**: A low, patchy, lumpy grey layer that mostly gives a dull overcast sky, with at most a light drizzle rather than real rain.

Among these four, only nimbostratus is built to drop continuous rain over a wide area, which matches exactly what the word "rain bearing cloud" describes.

Let's summarize:

- The "nimbo" or "nimbus" root in a cloud's name marks it as a true rain producer.
- Altocumulus, cirrostratus and stratocumulus do not fit that description.

So option 1, nimbostratus, is the correct rain bearing cloud.

Quick Tip: Look for the cloud name that carries the root word meaning rain.

• • •

23. Which of the following statements is correct?

(A) One cm of rainfall is the equivalent of one liter of water per square meter.

(B) One millimeter of rainfall is the equivalent of 10 liter of water per square meter.

(C) One millimeter of rainfall is the equivalent of one liter of water per square meter.

(D) One cm of rainfall is the equivalent of 10 liter of water per square meter.

Correct Answer: (C) One millimeter of rainfall is the equivalent of one liter of water per square meter.

SOLUTION:

Agronomists often need to turn a rainfall reading in millimeters into an actual volume of water so they can plan irrigation, and this question tests whether that conversion is done correctly.

1. **1 cm of rainfall = 1 liter per square meter**: Wrong, since 1 cm is a depth of 0.01 meter, and over 1 square meter that works out to 0.01 cubic meter, which is 10 liters, not 1 liter.
2. **1 mm of rainfall = 10 liters per square meter**: Wrong, since 1 mm is a depth of 0.001 meter, and over 1 square meter that gives 0.001 cubic meter, which is only 1 liter, not 10.
3. **1 mm of rainfall = 1 liter per square meter**: Right. This is the standard conversion used across agriculture and meteorology: a 1 millimeter rain event delivers 1 liter of water on every square meter of ground, or equivalently 10,000 liters on a hectare.
4. **1 cm of rainfall = 10 liters per square meter**: This is numerically consistent too, since 1 cm is simply 10 mm, so it scales to 10 liters, but it is the same underlying fact restated at a different unit rather than the standard way the relationship is quoted.

Since 1 mm depth of water over 1 square meter always works out to exactly 1 liter by direct volume calculation, and this is the form the relationship is conventionally taught in, the millimeter based statement is taken as the intended correct answer.

Let's summarize:

- Multiply rainfall depth in meters by area in square meters and by 1000 to get liters.
- 1 mm over 1 square meter gives 1 liter, and 1 cm over 1 square meter gives 10 liters.

So option 3, one millimeter of rainfall equals one liter of water per square meter, is the correct statement.

Quick Tip: Convert 1 mm of depth over 1 square meter into cubic meters, then into liters, before comparing the options.

• • •

24. Particles that are not used for cloud seeding in artificial rain making is:

(A) Silver iodide

(B) Dry ice

(C) Common salt

(D) Kaolinite

Correct Answer: (D) Kaolinite

SOLUTION:

Cloud seeding adds specific particles to clouds to trigger rain, either by giving ice crystals something to form around in cold clouds, or by pulling water together in warm clouds, and this question asks which of the four substances does not play that role.

1. **Silver iodide**: Used. Its crystal shape closely matches natural ice, so it acts as an efficient nucleus that ice can form on, making it the most common cloud seeding chemical worldwide.
2. **Dry ice**: Used. As solid carbon dioxide it is extremely cold, and when released into a cloud it chills the air sharply enough to freeze water vapor into ice crystals, seeding the cloud from the cold side.

3. **Common salt**: Used. Being hygroscopic, salt particles draw in surrounding water vapor and help droplets in warm clouds merge and grow large enough to fall, which is the basis of warm cloud seeding.
4. **Kaolinite**: Not used. This is a common clay mineral, valued in ceramics and paper making, but it does not have the ice forming or strong moisture drawing properties that make the other three substances effective seeding agents.

Three of the four options, silver iodide, dry ice and common salt, are established cloud seeding materials, leaving kaolinite as the one substance that is not actually used this way.

Let's summarize:

- Cold cloud seeding relies on silver iodide and dry ice to trigger ice formation.
- Warm cloud seeding relies on hygroscopic particles like common salt.

So kaolinite, option 4, is the particle not used for cloud seeding.

Quick Tip: Think about which of these four substances is just a clay mineral with no ice forming or water attracting role.

25. Given below are two statements:

Statement (I): In the atmosphere, 90% of the ozone is distributed in the troposphere, while only 10% is confined to the stratosphere.

Statement (II): According to IPCC (2007) estimated value of radiative forcing from the tropospheric ozone is to be 0.35 ± 0.15 W m^{-2}.

In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (D) Statement (I) is incorrect but Statement (II) is correct.

SOLUTION:

This question tests two separate facts: where ozone is concentrated in the atmosphere, and the radiative forcing value the IPCC assigned to tropospheric ozone in its 2007 report.

1. **Statement (I)**: This claims 90% of ozone sits in the troposphere and 10% in the stratosphere. That is backwards. Nearly 90% of the atmosphere's ozone is found in the stratosphere, where the ozone layer forms and blocks harmful ultraviolet rays. The troposphere holds only a small share, around 10%. So this statement is false.
2. **Statement (II)**: This gives the IPCC (2007) radiative forcing figure for tropospheric ozone as 0.35 ± 0.15 W/m^2. The IPCC Fourth Assessment Report listed the radiative forcing of

tropospheric ozone at about +0.35 W/m^2, with the uncertainty band close to this range. So this statement is true.

Since Statement (I) fails the basic fact check on ozone distribution while Statement (II) matches the IPCC (2007) figure, the correct choice is that Statement (I) is incorrect but Statement (II) is correct.

Let's summarize:

- About 90% of atmospheric ozone lies in the stratosphere, not the troposphere.
- The IPCC (2007) radiative forcing value for tropospheric ozone is close to 0.35 ± 0.15 W/m^2.

So option (4) is correct: Statement (I) is incorrect but Statement (II) is correct.

Quick Tip: Recall which layer, troposphere or stratosphere, actually holds most of the atmosphere's ozone.

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26. Full form of NISAR satellite is

(A) National Indian Satellite for Agricultural Research

(B) NASA ISRO Satellite for Agricultural Research

(C) NASA ISRO Synthetic Aperture Radar

(D) NASA ISRO Synchronised Agricultural Radar

Correct Answer: (C) NASA ISRO Synthetic Aperture Radar

SOLUTION:

NISAR is a real, upcoming satellite mission, so this question is really just checking if you know its correct expansion.

1. **National Indian Satellite for Agricultural Research**: This is not the actual name; NISAR is not a purely agriculture focused mission and this expansion does not match the real acronym letters.
2. **NASA ISRO Satellite for Agricultural Research**: This gets the two space agencies right but wrongly narrows the mission to agriculture, which is not what the acronym stands for.
3. **NASA ISRO Synthetic Aperture Radar**: This is the correct expansion. NISAR is a joint mission of NASA and ISRO built around synthetic aperture radar (SAR) imaging, used to track changes in land, ice and vegetation across the globe.
4. **NASA ISRO Synchronised Agricultural Radar**: This mixes real agency names with an invented mission purpose and does not match the actual name.

Matching each letter of NISAR to its word gives NASA ISRO Synthetic Aperture Radar, so option (3) is correct.

Let's summarize:

- NISAR is a joint NASA and ISRO Earth observation mission.
- Its name expands to NASA ISRO Synthetic Aperture Radar, based on SAR imaging technology.

So the correct full form of NISAR is NASA ISRO Synthetic Aperture Radar.

Quick Tip: NISAR is a joint NASA-ISRO radar mission; expand each letter

carefully.

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27. Match List-I with List-II

List-I (Fact/feature/event/phenomena)	**List-II** (Definition)
(A) Ecotype	(I) A uniform interbreeding population spread over time and space.
(B) Ecotone	(II) It is a group of individual organisms of the same species in a given area.
(C) Species	(III) It is a population of individuals of a species, which are genetically different.
(D) Population	(IV) A zone of transition, presenting a situation of special ecological interest between two different types of communities.

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

Each item in List-I is a standard ecology term, and the job here is to pair each with the one definition in List-II that describes it best.

1. **Ecotype**: A genetically distinct race of a species shaped by local environmental pressure, for example a drought tolerant ecotype of a plant. This fits "a population of individuals of a species, which are genetically different," definition (III).
2. **Ecotone**: The overlap strip where two different communities meet, like the edge between a wetland and a forest, carries a special mix of species from both sides. This fits definition (IV), the zone of transition.
3. **Species**: A group whose members can breed with one another wherever and whenever they occur, forming one uniform interbreeding unit across space and time. This fits definition (I).
4. **Population**: Simply the individuals of one species sharing a given area at a given time, without any requirement of genetic difference. This fits definition (II).

Putting these together gives (A)-(III), (B)-(IV), (C)-(I), (D)-(II).

Let's summarize:

- Ecotype centers on genetic difference within a species.
- Ecotone is about the transition boundary between two communities.
- Species is the broad interbreeding unit, and population is just the local group of one species.

So option (2) gives the correct match.

Quick Tip: Think about which term describes genetic variation within a

species, and which describes a transition zone between communities.

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28. Match List-I with List-II

List-I (Types of ecology)	**List-II** (Explanation)
(A) Ecosystem ecology	(I) The units of study are interactions between different communities of area.
(B) Community ecology	(II) The units of study are pure stands of individuals of a single species.
(C) Biome ecology	(III) The units of study are groups of individuals belonging to different species of plants as well as animals.
(D) Population ecology	(IV) The most complicated synecological approach to the ecology of an area.

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

The four branches of ecology in List-I sit at four different scales of study, and each pairs with the definition that describes its scope.

1. **Ecosystem ecology**: Covers living communities together with the non living environment, making it the widest and most tangled, or synecological, level of study. This fits definition (IV).
2. **Community ecology**: Looks at several species of plants and animals sharing one area and how they interact. This fits definition (III).
3. **Biome ecology**: Looks at how different communities across a large region interact with each other. This fits definition (I).
4. **Population ecology**: Focuses on just one species at a time, essentially a pure stand of individuals from that single species. This fits definition (II).

Combining these gives (A)-(IV), (B)-(III), (C)-(I), (D)-(II).

Let's summarize:

- Population ecology is the narrowest, single species scale.
- Community, then biome, ecology widen the scale to many species and many communities.
- Ecosystem ecology is the broadest, combining biotic and abiotic factors.

So option (4) is the correct match.

Quick Tip: Start from the narrowest scale, a single species population, and build up to the broadest, the whole ecosystem.

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29. The region of atmosphere having the constant temperature is

(A) Troposphere

(B) Mesopause

(C) Stratosphere

(D) Ionosphere

Correct Answer: (C) Stratosphere

SOLUTION:

This question is about how temperature changes with height in the four named parts of the atmosphere.

1. **Troposphere**: Temperature drops continuously as altitude increases, so it never stays constant.
2. **Mesopause**: This is a narrow transition point, not a thick layer, marking where the mesosphere ends; it is the coldest spot in the atmosphere rather than a zone of constant temperature.
3. **Stratosphere**: Its lower section holds a steady, near constant temperature before the ozone layer causes temperature to climb in the upper part. This steady lower band is the reason the stratosphere is linked with constant temperature.
4. **Ionosphere**: Temperature rises steeply here because charged particles absorb a lot of solar energy, so this layer is far from constant.

Since only the stratosphere carries a broad, near flat temperature stretch, it is the correct answer.

Let's summarize:

- Troposphere: temperature falls with height.
- Stratosphere: nearly constant temperature in its lower part.
- Ionosphere: temperature rises sharply.

So the stratosphere, option (3), is the region best known for constant temperature.

Quick Tip: Think about which atmospheric layer has a nearly flat temperature profile before the ozone driven rise begins.

• • •

30. The concentration of nitrogen in atmosphere upto 50 km from the ground surface is

(A) About 48% nitrogen

(B) About 58% nitrogen

(C) About 68% nitrogen

(D) About 78% nitrogen

Correct Answer: (D) About 78% nitrogen

SOLUTION:

This question checks the basic composition of air in the part of the atmosphere where gases stay evenly mixed.

1. **About 48% nitrogen**: Far too low; this is not close to nitrogen's real share.
2. **About 58% nitrogen**: Still well under the true figure.
3. **About 68% nitrogen**: Closer, but still short of the accepted value.
4. **About 78% nitrogen**: This matches the standard textbook figure. In the well mixed part of the atmosphere, up to roughly 50 to 100 km, nitrogen holds close to 78% by volume, with oxygen at

about 21% and the remainder split between argon, carbon dioxide and trace gases.

Since air stays well mixed up to 50 km, the nitrogen share there matches the overall atmospheric figure of about 78%.

Let's summarize:

- The atmosphere below about 50 to 100 km is called the homosphere, where major gases stay in a fixed ratio.
- Nitrogen: about 78%, oxygen: about 21%, with small shares of argon and carbon dioxide.

So option (4), about 78% nitrogen, is correct.

Quick Tip: Recall the standard composition figures for nitrogen and oxygen in the well mixed lower atmosphere.

31. Match List-I with List-II

List-I (CGIAR centers)	**List-II** (Headquarter)
(A) International Institute of Tropical Agriculture (IITA)	(I) Nairobi, Kenya
(B) International Livestock Research Institute (ILRI)	(II) Battaramulla, Sri Lanka
(C) International Water Management Institute (IWMI)	(III) Beirut, Lebanon
(D) International Center for Agricultural Research in the Dry Areas (ICARDA)	(IV) Ibadan, Nigeria

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

Each of these four organizations belongs to the CGIAR network of international agricultural research centers, and each has a fixed home city.

1. **IITA**: Based in Ibadan, Nigeria, this center works on tropical crops important to Africa, such as cassava and cowpea. This matches (IV).

2. **ILRI**: Based in Nairobi, Kenya, this center researches livestock systems to help farmers in developing regions. This matches (I).
3. **IWMI**: Based in Battaramulla, Sri Lanka, this center studies water use and management for farming. This matches (II).
4. **ICARDA**: Based in Beirut, Lebanon, this center focuses on farming systems suited to dry, non tropical zones. This matches (III).

Putting these together gives (A)-(IV), (B)-(I), (C)-(II), (D)-(III).

Let's summarize:

- IITA sits in Nigeria, working on tropical crops.
- ILRI sits in Kenya, working on livestock.
- IWMI sits in Sri Lanka, working on water management.
- ICARDA sits in Lebanon, working on dry area agriculture.

So option (3) is the correct match.

Quick Tip: Recall each CGIAR center's home region: Nigeria for tropical crops, Kenya for livestock, Sri Lanka for water, Lebanon for dry area farming.

32. Which of the following statements are correct for "Tillage"?

(A) The most important objectives of tillage are seedbed preparation, increasing soil fertility, and soil moisture conservation.
(B) Tillage increases the bulk density of soil in the long run.
(C) Tillage improve soil tilth, soil aeration and root penetration.
(D) Tillage removes hard pans thus increase the soil depth for water absorption.

Choose the *correct* answer from the options given below:

(A) (A) and (B) only.

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

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

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

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

SOLUTION:

Tillage changes the physical condition of soil, and this question checks whether you know which claimed effects are actually true.

1. **Statement (A)**: Claims tillage's main goals include seedbed preparation, raising soil fertility, and moisture conservation. Seedbed preparation and moisture conservation are genuine tillage goals, but raising soil fertility is not something tillage itself does directly, and repeated tillage can even reduce organic matter over years. So this statement is not accepted as fully correct.
2. **Statement (B)**: Claims tillage raises soil bulk density over the long run. Year after year of ploughing at the same depth presses down the layer just under the tilled zone, building up a

compacted plough pan with higher bulk density there. So this long term compaction effect is correct.

3. **Statement (C)**: Claims tillage improves tilth, aeration and root penetration. Breaking up compact soil into a looser structure is exactly what tillage does in the short term, so this statement is correct.
4. **Statement (D)**: Claims tillage removes hard pans and increases usable soil depth for water. Deep tillage and subsoiling are used for exactly this purpose, breaking hard pans so water and roots can reach further down. This statement is correct.

Only statement (A) overreaches by crediting tillage with raising soil fertility, so the correct set is (B), (C) and (D) only.

Let's summarize:

- Tillage loosens soil and helps tilth, aeration and root growth in the short term.
- Repeated tillage at one depth builds a compacted pan below it, raising bulk density there over time.
- Deep tillage breaks hard pans, adding usable depth for water.

So option (3), (B), (C) and (D) only, is correct.

Quick Tip: Separate tillage's short term benefits, like better tilth and aeration, from its long term compaction effects.

33. Given below are two statements:

Statement (I): Precision agriculture is generally defined as information and technology based farm management system to identify, analyze and manage variability within fields for optimum profitability, sustainability and protection of the land resources.

Statement (II): Precision agriculture is the application of drone technologies in agricultural production.

In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (C) Statement (I) is correct but Statement (II) is incorrect.

SOLUTION:

This question checks whether the student can tell a full, accurate definition of precision agriculture from a description that mixes it up with just one of its tools.

1. **Statement (I)**: This describes precision agriculture as a data and technology driven way to manage a farm, built around finding and handling variability inside a field to raise profit, keep the system sustainable, and protect the soil and land. This is the accepted textbook definition, so it holds up as true.

2. **Statement (II)**: This reduces precision agriculture to only drone use. Drones give aerial images and crop stress maps, but precision agriculture also leans on GPS based auto steering, geographic information systems, yield monitors, soil sensors and variable rate applicators. Calling it just drone application misses most of the field, so this statement is false.

Since the first statement gives the real definition and the second one wrongly narrows the concept to a single technology, the correct choice is that Statement (I) is correct and Statement (II) is incorrect.

Let's summarize:

- Precision agriculture covers a whole toolbox of technologies, not just drones.
- Its goal is managing within-field variability for profit, sustainability and land protection together.

So the final answer is option 3.

Quick Tip: Think about whether drone use alone can capture the full scope of precision agriculture.

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34. Calculate the cumulative pan evaporation (CPE) required for scheduling irrigation at an IW/CPE ratio of **0.5**, given **5** cm of irrigation water (IW).

(A) 5 cm

(B) 10 cm

(C) 15 cm

(D) 20 cm

Correct Answer: (B) 10 cm

SOLUTION:

Concept:

The IW/CPE ratio approach schedules irrigation by comparing how much water is applied against how much water the pan has lost through evaporation. A ratio of 0.5 means for every 1 cm of pan evaporation, only 0.5 cm of irrigation water gets applied over the same period, or equivalently the irrigation depth is half the cumulative evaporation depth.

Step 1: Set up the relation.

$$IW = 0.5 \times CPE$$

Step 2: Substitute the known irrigation depth.

We are told $IW = 5$ cm, so:

$$5 = 0.5 \times CPE$$

Step 3: Solve for CPE.

$$CPE = \frac{5}{0.5} = 10 \text{ cm}$$

Checking it back: half of 10 cm is 5 cm, which matches the given

irrigation depth, so the number is consistent.

Step 4: Final answer.

$$\boxed{CPE = 10 \text{ cm}}$$

Quick Tip: Use $CPE = IW/\text{ratio}$ to find the pan evaporation depth.

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35. Which of the following statements are correct for "Dryland agriculture"?

(A) Growing season in dryland agriculture is < 300 days.
(B) Rainfall should be < 1800 mm.
(C) Main constraints are wind and water erosion.
(D) Growing regions are mainly humid and tropical as well as uplands.

Choose the *correct* answer from the options given below:

(A) (A) and (B) only.

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

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

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

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

SOLUTION:

This question tests the basic climatic and constraint profile that defines dryland agriculture as a farming system.

1. **(A) Growing season < 300 days**: The real growing season in dryland tracts is short, usually under 200 days because rain runs out early. Since that true figure is still less than 300, the statement as worded stays correct.
2. **(B) Rainfall < 1800 mm**: Dryland regions are marked by scanty rain, generally under about 1150 mm a year. An 1800 mm ceiling is far too generous and does not describe dryland conditions, so this is wrong.
3. **(C) Wind and water erosion as main constraints**: Bare, loose soil combined with strong winds in arid tracts and sudden intense showers in semi-arid tracts make both forms of erosion the chief soil loss problems here, so this is correct.
4. **(D) Humid and tropical uplands**: Dryland agriculture is practiced in arid and semi-arid areas, the reverse of humid tropical conditions, so this statement is false.

Only statements (A) and (C) hold up, so the correct combination is (A) and (C) only.

Let's summarize:

- Dryland agriculture means short growing seasons and low, erratic rainfall, not humid tropical uplands.
- Wind and water erosion are the defining soil hazards of these regions.

The final answer is option 2.

Quick Tip: Recall the rainfall and growing season limits used to define dryland regions.

36. Match List-I with List-II.

List-I (Plant hormones)	**List-II** (Major function)
(A) Auxins	(I) Induces leaf and fruit abscission
(B) Cytokinin	(II) Elongation of cells
(C) Abscisic acid	(III) Stimulates the swelling of stems and roots
(D) Ethylene	(IV) Stimulate cell division

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

This question asks us to link four plant hormones to the one function each is most associated with in plant physiology.

1. **Auxins**: Known chiefly for making cells stretch and elongate, especially in the shoot tip and coleoptile, so this pairs with "Elongation of cells" (II).
2. **Cytokinin**: Works with auxin to push cells through division and multiplication, particularly in roots and shoots, so it pairs with "Stimulate cell division" (IV).
3. **Abscisic acid**: Builds up when the plant is under water or salt stress and it promotes the dropping of leaves and fruit along with

seed dormancy, so it pairs with "Induces leaf and fruit abscission" (I).

4. **Ethylene**: A gaseous hormone that, besides ripening fruit, is responsible for thickening and swelling of stems and roots as part of its growth response, so it pairs with "Stimulates the swelling of stems and roots" (III).

Putting these together gives (A)-(II), (B)-(IV), (C)-(I), (D)-(III).

Let's summarize:

- Auxin: elongation. Cytokinin: division. Abscisic acid: abscission and stress. Ethylene: swelling and ripening.

So the correct option is option 1.

Quick Tip: Match each hormone to the one growth process it is most famous for.

• • •

37. Given below are two statements, one labelled as **Assertion (A)** and other one labelled as **Reason (R)**.

Assertion (A): Zero-tillage practice in rice-wheat cropping system is a climate change adaptation strategy.

Reason (R): It helps to avoid terminal heat stress of wheat.

In light of the above statements, choose the *correct* answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (A) Both (A) and (R) are true and (R) is the correct explanation of (A).

SOLUTION:

This question checks whether we understand the real reason zero-tillage in the rice-wheat system is treated as a climate adaptation practice.

1. **Assertion**: Zero-tillage in rice-wheat systems is indeed promoted as a climate adaptation strategy because it changes how and when wheat is established after rice.
2. **Reason**: Avoiding terminal heat stress of wheat is true and is also the actual mechanism behind the benefit named in the assertion.

Under conventional tillage, wheat sowing after rice harvest is delayed by the time needed to plough, level and prepare the field. Zero-tillage drills wheat seed directly into the rice stubble without this delay, so sowing happens earlier. Earlier sowing means the grain filling period of wheat finishes before the hot, dry weather of late season sets in, so the crop avoids terminal heat stress, which otherwise cuts short grain filling and lowers yield. Because rising temperatures under climate change make this heat stress risk worse, timely sowing through zero-tillage becomes a direct adaptation tool.

Let's summarize:

- Zero-tillage speeds up wheat sowing after rice.
- Earlier sowing lets wheat escape terminal heat stress during grain filling.
- This escape from heat stress is the reason zero-tillage counts as climate adaptation.

So both statements are true and the reason correctly explains the assertion, matching option 1.

Quick Tip: Think about how skipping tillage changes the wheat sowing date after rice harvest.

• • •

38. What is the optimum range of soil moisture for effective ploughing?

(A) 5 to 10 per cent depletion of available soil moisture

(B) 15 to 20 per cent depletion of available soil moisture

(C) 25 to 50 per cent depletion of available soil moisture

(D) 50 to 60 per cent depletion of available soil moisture

Correct Answer: (D) 50 to 60 per cent depletion of available soil moisture

SOLUTION:

This question is about the soil moisture window that gives the best tilth when ploughing, sometimes called the friable range.

1. **5 to 10 per cent depletion**: At this level, very little of the available water has left the soil, so the soil is still close to field capacity, too wet for clean tillage, and this option is ruled out.

2. **15 to 20 per cent depletion**: The soil is still wet enough here that ploughing will smear and compact it rather than break it into fine crumbs, so this is also too early.
3. **25 to 50 per cent depletion**: This range still sits on the wetter side of the friable window for most soils and is not the accepted optimum band.
4. **50 to 60 per cent depletion**: By this point, the soil has dried enough to crumble easily under the plough without smearing, yet not so much that it has turned into hard clods, so this is the recognized optimum window for tillage.

Ploughing at 50 to 60 per cent depletion of available soil moisture gives the best soil tilth with the least power and clod formation.

Let's summarize:

- Too wet a soil smears and compacts under the plough.
- Too dry a soil breaks into hard clods and needs more force.
- The 50 to 60 per cent depletion window balances both, giving the friable, workable tilth.

So the correct option is option 4.

Quick Tip: Recall the friable moisture range where soil crumbles instead of smearing or clodding.

39. Given below are two statements, one labelled as **Assertion (A)** and other one labelled as **Reason (R)**.

Assertion (A): Ridging increases albedo, thereby increasing the effective incoming radiation compared to a flat surface.

Reason (R): Tillage causes unequal distribution of energy at the soil surface.

In light of the above statements, choose the *correct* answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (D) (A) is false but (R) is true.

SOLUTION:

This question tests whether we can connect ridging, albedo and radiation absorption correctly, since the assertion mixes these ideas up.

1. **Assertion**: It says ridging raises the albedo and that this raised albedo is what raises effective incoming radiation. This is backwards physics, since a higher albedo means more reflection and less absorption, not more. In reality, the ridge and furrow shape traps reflected light between the slopes, which lowers albedo rather than raising it, so the assertion is false.

2. **Reason**: It says tillage causes an uneven spread of energy at the surface. Since ridges expose sunlit and shaded faces at different angles to the sun, the surface really does receive and absorb energy unevenly, so this statement is true on its own.

Because the assertion itself does not hold up, the true reason cannot be explaining it, even though the reason is a correct fact by itself.

Let's summarize:

- Higher albedo means less absorption, so the assertion's logic is reversed.
- Ridged surfaces usually show lower albedo because of radiation trapping between ridges and furrows.
- The reason about uneven energy distribution is true but stands apart from the false assertion.

So the assertion is false while the reason is true, which is option 4.

Quick Tip: Remember that a rise in albedo means more reflection, not more absorption.

40. Given below are two statements, one labelled as **Assertion (A)** and other one labelled as **Reason (R)**.

Assertion (A): The Net Assimilation Rate (NAR) is a measure of the average photosynthetic efficiency of leaves in a crop community.

Reason (R): It is highest when the plants are small and most of the leaves are exposed to sunlight.

In light of the above statements, choose the *correct* answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (A) Both (A) and (R) are true and (R) is the correct explanation of (A).

SOLUTION:

This question checks whether we understand what Net Assimilation Rate (NAR) measures and why it changes as a crop grows.

1. **Assertion**: NAR is dry matter gain per unit leaf area per unit time, which is exactly a measure of the average photosynthetic efficiency of the leaves in the crop stand, so this statement is true.
2. **Reason**: In young, small plants, leaf area index is low and self shading between leaves is minimal, so nearly every leaf gets strong, direct sunlight and photosynthesizes efficiently, giving a

high NAR. As the canopy fills in with growth, lower leaves fall into shade cast by upper leaves, their photosynthesis slows, and the average NAR across the whole plant drops. So this statement is also true.

Since the drop in self shading in small plants is precisely what keeps every leaf efficient and pushes NAR to its peak, the reason directly explains the assertion.

Let's summarize:

- NAR measures dry matter built per unit leaf area, an index of average leaf efficiency.
- Small plants have little mutual shading, so NAR is highest early in growth.
- Canopy closure later on lowers NAR through increased shading.

Both statements are true and the reason correctly explains the assertion, so the answer is option 1.

Quick Tip: Think about how much shading occurs between leaves when a crop is still small.

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41. The practice of controlling water erosion by cultivation of alternate erosion permitting and erosion resistant crops is called as

(A) Mixed cropping

(B) Intercropping

(C) Strip cropping

(D) Relay cropping

Correct Answer: (C) Strip cropping

SOLUTION:

This question checks whether you can tell apart the common cropping systems used in agronomy, and asks which one is built around alternating erosion permitting and erosion resisting crops in strips.

1. **Mixed cropping**: seeds of two or more crops are sown together with no fixed row layout, mainly as insurance against the failure of one crop, not laid out as conservation strips.
2. **Intercropping**: two or more crops share the field in fixed row proportions to raise the total output per unit area, without any requirement to alternate erosion permitting and erosion resisting bands.
3. **Strip cropping**: the field is split into long strips running across the slope, and strips of erosion permitting crops (like maize) alternate with strips of erosion resisting crops (like grasses or legumes), so each resistant strip checks the runoff before it can build up speed.
4. **Relay cropping**: a second crop is planted into the first crop before it is harvested, so the two overlap in time. This is about timing, not about erosion control.

Only strip cropping matches the exact description in the question, so option (3) is correct.

Let's summarize:

- Strip cropping shortens the effective slope length by alternating resistant and permitting crop bands.
- Mixed cropping, intercropping and relay cropping are defined by crop combination or timing, not by erosion control layout.

The correct answer is strip cropping, option (3).

Quick Tip: Think of a field divided into long bands where row crops and close growing crops alternate across the slope.

• • •

42. The Dapog method of raising rice nursery was introduced in India from

(A) Myanmar

(B) Japan

(C) China

(D) Philippines

Correct Answer: (D) Philippines

SOLUTION:

The question is testing a simple fact about the origin of one named nursery raising method used in rice cultivation, the Dapog method.

1. **Myanmar**: a major rice growing country, but it is not the source credited for the Dapog technique in Indian agronomy textbooks.
2. **Japan**: known for its own mat type nursery used with mechanical transplanters, but this is a separate tradition from the Dapog method.
3. **China**: also a leading rice grower, yet not the origin point named for this particular soil-less mat nursery.
4. **Philippines**: home to the International Rice Research Institute (IRRI), which developed the Dapog technique of raising a thin,

rollable seedling mat on a raised bed lined with leaves or polythene, later adopted in India.

Because IRRI is located in the Philippines and developed this exact nursery raising package, the correct source country is the Philippines, option (4).

Let's summarize:

- Dapog nursery uses pre-germinated seed on a thin bed, ready to transplant in about 12 to 14 days.
- Its origin traces to IRRI, based in the Philippines.

So the answer is the Philippines, option (4).

Quick Tip: This soil-less mat nursery method is linked to IRRI, which is based in the Philippines.

• • •

43. Area of the micro-watershed is

(A) 10-100 ha

(B) 100-1000 ha

(C) 1000-10000 ha

(D) 10000-50000 ha

Correct Answer: (B) 100-1000 ha

SOLUTION:

Watershed management divides one large drainage area into smaller planning units, and this question checks whether you know where the micro-watershed sits on that size ladder.

1. **10-100 ha**: this is the size given to the smallest unit on the ladder, the mini-watershed, so it is too small to be the micro-watershed.
2. **100-1000 ha**: this is the range that soil and water conservation planning assigns to the micro-watershed, the unit one step above the mini-watershed.
3. **1000-10000 ha**: this range belongs to the milli-watershed, a bigger grouping formed by joining several micro-watersheds.
4. **10000-50000 ha**: this range belongs to the sub-watershed, formed by joining several milli-watersheds, and is much larger than a micro-watershed.

Reading the ladder from smallest to largest as mini, micro, milli, sub, macro, the micro-watershed lands on 100-1000 ha, so option (2) is correct.

Let's summarize:

- Mini-watershed is the smallest unit, around 10-100 ha.
- Micro-watershed comes next, around 100-1000 ha, which is the answer here.

The area of the micro-watershed is 100-1000 ha, option (2).

Quick Tip: Place mini, micro, milli and sub-watershed in increasing order of size and match the range.

• • •

44. Type of soil water available for normal crop growth

(A) Hygroscopic

(B) Gravitational

(C) Capillary

(D) Hygroscopic and Gravitational

Correct Answer: (C) Capillary

SOLUTION:

Step 1: Understanding the Concept:
Soil water is grouped into three forms by how strongly the soil holds onto it: hygroscopic, gravitational and capillary. The question asks which one is the source a crop actually draws upon for its daily growth.

Step 2: Key Formula or Approach:
A rough working scale of soil moisture tension helps here. Hygroscopic water is held at very high tension, far beyond what a root can pull against. Gravitational water is held at almost no tension and drains out under its own weight. Capillary water sits at a moderate tension, low enough for roots to pull it out, but high enough that it stays in the root zone instead of draining away.

Step 3: Detailed Explanation:
Right after rain or irrigation, the gravitational water in the large pores drains downward within one to two days and moves below the root zone, so a crop gets only limited benefit from it.
The hygroscopic water forms a very thin film stuck to the particle surface, and even at wilting point this water is still present in the soil, unused, because roots cannot generate enough suction to remove it.
Once the gravitational water has drained away, what remains in the

smaller pores is capillary water, held by surface tension against gravity but still weak enough that plant roots can pull it in day after day. This is why capillary water is treated as the usable, plant-available water in soil.

Step 4: Final Answer:
Capillary water is the type of soil water available for normal crop growth, so option (3) is correct.

Quick Tip: Ask which form of soil water is neither drained away by gravity nor held too tightly for roots to pull.

• • •

45. Using the following types of water erosion, find which order is the correct one.
(A) Splash erosion
(B) Sheet erosion
(C) Rill erosion
(D) Gully erosion
Choose the **correct** answer from the options given below:

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

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

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

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

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

SOLUTION:

Water erosion does not appear as one single event, it develops in stages that get more severe over time, and this question checks whether you know that order.

1. **Splash erosion**: caused directly by the beating action of individual raindrops on unprotected soil, breaking soil clumps apart and flinging particles a short distance. This is always the first stage since it needs nothing more than bare soil and rainfall.
2. **Sheet erosion**: once loosened particles begin moving with a thin, even film of runoff water, a uniform layer of topsoil is stripped off the whole surface. This can only happen after splash has already loosened the soil, so it is the second stage.
3. **Rill erosion**: as sheet flow keeps moving, it naturally gathers into many small, narrow channels wherever the land has slight low spots, cutting shallow rills that a farmer can still erase by normal tillage. This stage needs sheet flow to already be underway, so it comes third.
4. **Gully erosion**: if the rills are left alone, repeated flow cuts them deeper and wider until they become gullies, too large to plough out. Since gullies grow out of neglected rills, this is the last and most damaging stage.

Because each stage is the direct outcome of the one before it, the sequence must run splash, sheet, rill, gully, which is (A), (B), (C), (D), option (1).

Let's summarize:

- Erosion severity grows from raindrop splash to sheet to rill to gully.
- Catching erosion at the sheet or rill stage is far cheaper to fix than after gullies have formed.

The correct order is (A), (B), (C), (D), option (1).

Quick Tip: Think about erosion growing from a single raindrop splash to a small sheet, then rills, then deep gullies.

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46. The physical basis of precision farming is

(A) Input quality

(B) Variable rate technology

(C) Field variability

(D) Site-specific output

Correct Answer: (C) Field variability

SOLUTION:

Precision farming is often confused with the machines used to carry it out, but this question is asking for the underlying physical fact that makes it needed at all.

1. **Input quality**: relates to how good a seed or fertilizer product is, a general concern for any farm, and not something that varies within the boundary of one single field.
2. **Variable rate technology**: this is the machinery and software that changes the application rate of seed, water or fertilizer as the machine moves across the field. It is the response tool built to act on variability, but it does not itself explain why that variability exists.
3. **Field variability**: soil texture, nutrient content, moisture holding capacity, slope and pest load all differ from one small

zone of a field to another. It is this on-ground spatial difference that means applying one uniform input rate over the whole field is inefficient, and that is exactly what makes precision management worthwhile.

4. **Site-specific output**: this describes the customized recommendation or yield map produced for each zone, which is a result that precision farming delivers, not the reason precision farming is used in the first place.

Since precision farming exists specifically to handle the real spatial differences within a field, field variability is the correct physical basis, option (3).

Let's summarize:

- Variable rate technology and site-specific output are tools and outcomes of precision farming.
- Field variability is the underlying condition that makes precision farming worth doing.

The physical basis of precision farming is field variability, option (3).

Quick Tip: Ask why a single blanket application rate across a field would fail; the reason is the true basis.

• • •

47. An intercropping system can be said beneficial, if it has LER:

(A) Equal to 1.0

(B) < 1.0

(C) >1.0

(D) Zero

Correct Answer: (C) >1.0

SOLUTION:

Land Equivalent Ratio (LER) is the standard way agronomists check whether growing two crops together on one field actually beats growing them separately, and this question asks what LER value counts as a genuine benefit.

1. **Equal to 1.0**: this means the combined yield from intercropping needs exactly as much land as separate sole crops would need for the same output, so there is no saving and no advantage.
2. **Less than 1.0**: this means intercropping actually needs more total land than sole cropping to reach the same yield, so the system performed worse, not better.
3. **Greater than 1.0**: this means intercropping produces the same combined yield using less land than two sole crops would need, which is exactly the land saving that makes intercropping worth doing.
4. **Zero**: this would mean no usable yield came from the system at all, which is clearly not a beneficial result.

Since a value above 1.0 is the only case where intercropping outperforms sole cropping in land use terms, that is the condition for calling the system beneficial.

Let's summarize:

- LER equal to 1.0 means no advantage over sole cropping.
- LER greater than 1.0 means intercropping saves land and is beneficial.

So the correct answer is LER greater than 1.0, option (3).

Quick Tip: Recall that LER above 1.0 means the intercrop saves land compared with growing both crops as sole crops.

• • •

48. Drought avoidance mechanism is found in which of the following crops?

(A) Barley

(B) Maize

(C) Sorghum

(D) Sunflower

Correct Answer: (C) Sorghum

SOLUTION:

Step 1: Understanding the Concept:
Crops resist water shortage through three broad strategies. Drought escape means completing the life cycle quickly before the dry period peaks. Drought avoidance means the plant actively limits water loss or increases water uptake so its internal tissues stay hydrated even while the soil is drying. Drought tolerance means the plant can keep functioning even after its own tissues have lost a lot of water.

Step 2: Key Formula or Approach:
To pick the drought avoiding crop among the options, look for physical traits that reduce transpiration loss or improve access to soil water, such as a deep root system, thick waxy cuticle, leaf rolling and quick stomatal closure.

Step 3: Detailed Explanation:

Barley is usually grown under cooler and comparatively moisture assured conditions and is not marked out for these avoidance traits.
Maize has a relatively shallow root system compared with sorghum and shows early leaf rolling and yield loss once soil moisture drops, which points more toward sensitivity than avoidance.
Sunflower carries large leaves with high transpiration demand and is generally described as sensitive at flowering and seed filling under moisture stress, not as a drought avoider.
Sorghum sends roots deep into the soil profile to keep reaching moisture that shallow rooted crops cannot access, carries a waxy bloom on its leaf surface that cuts direct water loss, and can roll its leaves and shut its stomata quickly when the atmosphere turns dry, all of which keep its internal water status close to normal even as the surrounding soil dries out.

Step 4: Final Answer:
Sorghum is the crop showing a drought avoidance mechanism among the given options, so option (3) is correct.

Quick Tip: Look for the crop with a deep root system, waxy leaves and leaf rolling that keeps it hydrated in dry soil.

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49. Planting geometry that ensures a uniform incidence of solar radiation is:

(A) Square planting

(B) Rectangular planting

(C) Mixed planting

(D) Random planting

Correct Answer: (A) Square planting

SOLUTION:

This question checks whether the student knows how row geometry affects light distribution over a crop stand.

1. **Square planting**: Row spacing and plant spacing are equal, so each plant sits at the centre of an identical square of ground. Sunlight falls on the canopy from every direction the same way, giving uniform incidence across the field.
2. **Rectangular planting**: Row spacing is larger than plant spacing, so shading is heavier along the row than across it. Light interception becomes direction dependent, not uniform.
3. **Mixed planting**: Two crops of different heights share the field, and the taller one always casts shade on the shorter one from a fixed side, breaking uniformity.
4. **Random planting**: There is no set spacing pattern, so the amount of shading each plant receives varies from plant to plant with no consistency at all.

Because square planting keeps equal distance between plants in all directions, it is the geometry that spreads solar radiation most evenly over the crop.

Let's summarize:

- Equal row and plant spacing (square planting) gives symmetric canopy development.
- Any geometry with unequal spacing or mixed crop heights creates direction based shading.

So the correct answer is square planting.

Quick Tip: Think about which spacing pattern keeps row distance and plant distance equal in every direction.

• • •

50. The Kufri Bahar is a prominent variety of:

(A) Sunflower

(B) Cotton

(C) Potato

(D) Tobacco

Correct Answer: (C) Potato

SOLUTION:

This question tests knowledge of Indian varietal naming conventions used by national crop research institutes.

1. **Sunflower**: Sunflower varieties released in India do not use the "Kufri" prefix, so this option does not match the naming pattern.
2. **Cotton**: Cotton varieties are usually named after the breeding centre or given alphanumeric codes, again without the "Kufri" prefix.
3. **Potato**: Every "Kufri" named variety, including Kufri Bahar, Kufri Jyoti and Kufri Chandramukhi, comes from the ICAR-Central Potato Research Institute at Shimla, which uses "Kufri" as its standard variety prefix for potato.
4. **Tobacco**: Tobacco varieties in India carry separate names such as Kanchan, and do not use the "Kufri" prefix either.

Since the "Kufri" prefix is reserved for potato varieties bred by CPRI, Kufri Bahar has to be a potato variety.

Let's summarize:

- "Kufri" is the standard prefix used only for potato varieties from CPRI, Shimla.
- Other crops mentioned in the options use entirely different naming systems.

So Kufri Bahar is a variety of potato.

Quick Tip: Recall which crop's varieties are traditionally named after the town of Kufri in Himachal Pradesh.

• • •

51. Hybrid rice for commercial production was first evolved in:

(A) India

(B) China

(C) Japan

(D) USA

Correct Answer: (B) China

SOLUTION:

This question is about the country of origin of commercial hybrid rice technology.

1. **India**: India developed and released its own hybrid rice varieties, but only starting in the early 1990s, after the technology already existed elsewhere.
2. **China**: China is where Yuan Longping developed the cytoplasmic male sterility based three line hybrid system in the early 1970s,

and China released the world's first commercial hybrid rice varieties in 1976.

3. **Japan**: Japanese researchers had earlier worked on male sterility in rice in the 1950s and 1960s, but they did not carry this through to commercial scale hybrid rice production.
4. **USA**: The USA developed hybrid rice for its own market much later and is not the country of origin of the technology.

Since commercial scale hybrid rice cultivation started in China in the 1970s, before any other country, China is the correct answer.

Let's summarize:

- Yuan Longping's three line CMS system made hybrid rice practical to produce.
- China commercialised it first, in 1976, ahead of India, Japan and the USA.

So hybrid rice for commercial production was first evolved in China.

Quick Tip: Think of the scientist Yuan Longping and the country that first commercialised the three line hybrid system.

• • •

52. Mentha crop is commercially raised through:

(A) Seed

(B) Root cutting

(C) Stolons

(D) Leaflets

Correct Answer: (C) Stolons

SOLUTION:

This question is about how mint (Mentha) is multiplied for commercial oil production.

1. **Seed**: Mentha is highly heterozygous, so seed grown plants segregate and do not keep the parent's menthol content and yield, which makes seed propagation unreliable for commercial fields.
2. **Root cutting**: Mentha does not naturally regenerate from cut root pieces, so this is not the standard commercial method.
3. **Stolons**: Mentha produces creeping stem like stolons (locally called suckers) that root at every node. Farmers lift these from an old field, cut them into node bearing segments, and plant them directly, which reliably reproduces the same clone.
4. **Leaflets**: A single leaflet cannot regenerate a complete new mentha plant on its own under field conditions, so this is not a commercial propagation method.

Because stolons carry nodes that root and shoot readily and keep the clone genetically identical to the parent, they are used as the standard commercial planting material for mentha.

Let's summarize:

- Mentha is propagated vegetatively, not through true seed, to preserve oil quality.
- Stolons (creeping stem cuttings with nodes) are the practical, field level propagating unit.

So mentha crop is commercially raised through stolons.

Quick Tip: Think about which part of the plant is heterozygous by seed and hence must be multiplied vegetatively.

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53. The oil content in sunflower is:

(A) 10-20%

(B) 20-35%

(C) 35-45%

(D) 45-60%

Correct Answer: (C) 35-45%

SOLUTION:

This question checks the known oil percentage range for sunflower seed, one of India's major oilseed crops.

1. **10-20%**: This range is closer to a low oil crop like soybean, which has about 18 to 20 percent oil, and understates sunflower's true oil content by a wide margin.
2. **20-35%**: This range is still lower than what is reported for sunflower seed in standard agronomy references.
3. **35-45%**: This matches the oil content generally reported for whole sunflower seed (achene) in Indian agronomy texts, making it the crop's typical oil richness.
4. **45-60%**: This higher range describes the oil content of the dehulled kernel rather than the whole seed, so it overstates the seed level figure asked for here.

Sunflower is prized as an oilseed crop precisely because its whole seed oil content of 35 to 45 percent is much higher than that of common

pulses and several other oilseeds. A little variation exists between sources, but 35-45% is the range accepted for this question.

Let's summarize:

- Whole sunflower seed contains about 35 to 45 percent oil.
- The dehulled kernel alone has a higher oil percentage than the whole seed figure asked for here.

So the oil content in sunflower is 35-45%.

Quick Tip: Recall that this figure is for the whole seed, not the dehulled kernel, which runs higher.

• • •

54. Which among the following is the temperate grass?

(A) White and red clover

(B) Napier grass

(C) Setaria grass

(D) Guinea grass

Correct Answer: (A) White and red clover

SOLUTION:

This question tests the classification of common fodder crops as temperate or tropical.

1. **White and red clover**: These are cool season legume forages that grow best in temperate climates, such as hill regions, and are the standard example of temperate fodder legumes in Indian agronomy.

2. **Napier grass**: A tall, warm season grass adapted to tropical and subtropical climates, grown widely as green fodder in the plains.
3. **Setaria grass**: Also a warm season, tropical forage grass, not suited to cool temperate conditions in the same way as clover.
4. **Guinea grass**: Another tropical perennial fodder grass that thrives in warm, humid regions.

Since clovers are cool season legumes while Napier, Setaria and Guinea grasses are all warm season tropical grasses, white and red clover is the only temperate forage in the list.

Let's summarize:

- Clovers (white and red) are classic temperate legume forages.
- Napier, Setaria and Guinea grasses are tropical, warm season fodder grasses.

So white and red clover is the temperate forage among the given options.

Quick Tip: Think about which option is a cool season legume rather than a warm season tropical grass.

• • •

55. Aeroponic technology is commercially used in quality seed/planting material production in:

(A) Tomato

(B) Capsicum

(C) Potato

(D) Brinjal

Correct Answer: (C) Potato

SOLUTION:

This question is about where aeroponic (air root, mist fed) technology is used at commercial scale for planting material production.

1. **Tomato**: Tomato is propagated through true seed or seedlings, not through an underground vegetative structure, so aeroponics is not the standard commercial method for its seed production.
2. **Capsicum**: Capsicum is also raised from seed and transplanted seedlings, without any tuber like structure that aeroponics would specially benefit.
3. **Potato**: Potato seed programs use aeroponics to grow tissue culture derived plantlets with roots suspended in a misted, dark air chamber, letting mini tubers form on the stem base and be harvested several times from the same plant over the season, sharply increasing the number of disease free mini tubers produced.
4. **Brinjal**: Like tomato and capsicum, brinjal is a fruit and seed propagated crop with no tuber forming stage, so aeroponics is not its standard commercial seed technology.

Because potato's planting material is a tuber that forms on an underground stem, aeroponics fits naturally as a way to multiply disease free mini tubers, which is why it is used commercially for potato and not for the other three crops listed.

Let's summarize:

- Aeroponics suspends roots in air and mists them with nutrient solution.

- It is used commercially in potato to produce large numbers of disease free mini tubers from tissue culture plants.

So the crop is potato.

Quick Tip: Think about which crop's planting material is a tuber that forms on an underground stem.

• • •

56. Weed seed dispersal by ants is called as:

(A) Exozoochory

(B) Autochory

(C) Myrmecochory

(D) Herpochory

Correct Answer: (C) Myrmecochory

SOLUTION:

This question is about the correct technical term for seed dispersal that is carried out specifically by ants.

1. **Exozoochory**: This term covers seeds that stick externally to an animal's body, such as fur or feathers, and get carried away that way. It is a broader animal dispersal category, not specific to ants.
2. **Autochory**: This describes a plant dispersing its own seed without help from any outside agent, for example through pods that burst open on their own. It does not involve ants at all.
3. **Myrmecochory**: Built from "myrmex" (ant in Greek) and "-chory" (dispersal), this is the specific term for seeds being

collected and moved by ants, usually because the seed carries a nutrient rich elaiosome that attracts the ants.

4. **Herpochory**: This term refers to dispersal by seeds creeping or crawling slowly across the ground surface, unrelated to an ant carrying the seed away.

Because the word is built directly from the Greek root for ant plus the general dispersal suffix "-chory", myrmecochory is the precise term for ant mediated seed dispersal.

Let's summarize:

- "-chory" is the general suffix for seed dispersal, and the prefix names the agent involved.
- "Myrmec-" specifically means ant, so myrmecochory means dispersal by ants.

So weed seed dispersal by ants is called myrmecochory.

Quick Tip: Break the word down: the Greek root for ant is myrmex, combined with the dispersal suffix -chory.

• • •

57. *Commelina benghalensis* bearing blue coloured short-lived flowers is a _____.

(A) Pteridophyta

(B) Spermatophyta

(C) Dicot

(D) Monocot

Correct Answer: (D) Monocot

SOLUTION:

This question checks whether we can place a common weed, Commelina benghalensis, into its correct botanical group based on its flower and leaf features.

1. **Pteridophyta**: These are ferns and fern allies that reproduce by spores and never form true flowers, so a plant with blue flowers cannot belong here.
2. **Spermatophyta**: This is the umbrella group of all seed producing plants, covering both monocots and dicots, so it is correct in a very general sense but not the specific answer the question wants.
3. **Dicot**: Dicot plants usually show net like leaf veins and flower parts in fours or fives, along with a tap root system, none of which match Commelina benghalensis.
4. **Monocot**: Commelina benghalensis has parallel veined leaves, a fibrous root system, and flowers built on a three part plan, which are the defining marks of a monocot.

Since the plant's leaf and flower structure line up with monocot features, the correct choice is option 4, Monocot.

Let's summarize:

- Commelina benghalensis belongs to family Commelinaceae, a monocot family.
- Parallel venation and floral parts in threes are the giveaway monocot traits here.

So the final answer is Monocot.

Quick Tip: Check the leaf venation and floral parts to place this plant among monocots or dicots.

• • •

58. Given below are two statements:
Statement (I): The combined effect of competition and allelopathy where growth of weeds or crop or both is reduced is called allelomediation.
Statement (II): Allelopathy depends on addition of chemical compounds while competition involves removal of an essential factor from the environment.
In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are true.

(B) Both Statement (I) and Statement (II) are false.

(C) Statement (I) is true but Statement (II) is false.

(D) Statement (I) is false but Statement (II) is true.

Correct Answer: (A) Both Statement (I) and Statement (II) are true.

SOLUTION:

This question tests whether we know the exact definitions used to separate competition, allelopathy, and their combined effect called allelomediation.

1. **Statement I**: It defines allelomediation as the joint effect of competition and allelopathy causing reduced growth in weeds, crop, or both. This is the standard textbook definition, so this statement is true.

2. **Statement II**: It separates the two mechanisms by their mode of action, allelopathy adds chemical compounds to the surroundings while competition removes a needed factor like water, light, or nutrients from the surroundings. This distinction is also the standard one used in weed science, so this statement is true as well.

Since both statements match the accepted definitions used for these terms, the correct choice is option 1, both Statement I and Statement II are true.

Let's summarize:

- Allelomediation combines competition and allelopathy into one net effect on growth.
- Allelopathy adds chemicals, competition removes resources, and both statements state this correctly.

So the final answer is that both statements are true.

Quick Tip: Recall that allelopathy adds chemicals to the surroundings while competition removes resources from it.

• • •

59. Which among the following is an ephemeral weed?

(A) *Stellaria media*

(B) *Phalaris minor*

(C) *Medicago denticulata*

(D) *Phyllanthus niruri*

Correct Answer: (A) *Stellaria media*

SOLUTION:

The question wants us to spot the weed that behaves as an ephemeral, meaning it completes several short life cycles in one growing season rather than one long cycle.

1. **Stellaria media**: This weed finishes germination to seed shedding in about five to six weeks and can throw up multiple generations in a single season, which is the hallmark of an ephemeral weed.
2. **Phalaris minor**: This grassy weed of wheat fields follows one normal season long life cycle, so it is a simple annual, not an ephemeral.
3. **Medicago denticulata**: This is a winter season annual with a single full cycle each year, again not ephemeral in habit.
4. **Phyllanthus niruri**: This broadleaf weed also completes just one season length cycle rather than repeating quickly.

Only Stellaria media shows the rapid, repeated life cycle that defines an ephemeral weed, so option 1 is correct.

Let's summarize:

- Ephemeral weeds complete germination to seed set in a few weeks and repeat several times a season.
- Stellaria media is the textbook example of this habit among the given choices.

So the final answer is Stellaria media.

Quick Tip: Look for the weed known for completing several life cycles within one growing season.

• • •

60. Given below are two statements:

Statement (I): Management means to maintain weed population below a threshold level, however, control remains implicit in management.

Statement (II): Integrated weed management (IWM) necessarily embraces that a combination of the methods of weed control rather than a single method be exercised for management of weeds below a threshold population.

In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (A) Both Statement (I) and Statement (II) are correct.

SOLUTION:

This question checks the difference between weed control and weed management, and how integrated weed management, or IWM, fits into that picture.

1. **Statement I**: Management is described as keeping the weed population under a threshold, with control being just one implicit tool inside that broader goal. This is the accepted distinction in weed science, so it is true.
2. **Statement II**: IWM is described as always needing a mix of control methods rather than a single method, to keep weeds below the threshold. IWM is defined exactly this way, combining

cultural, mechanical, biological, and chemical tools together, so this is also true.

Both statements line up with how management, control, and IWM are defined in weed science, so option 1 is the right choice.

Let's summarize:

- Management is the broad goal of keeping weeds below a damaging threshold, control is one tool used within it.
- IWM by definition blends more than one control method to reach that goal.

So the final answer is that both statements are correct.

Quick Tip: Remember that control is one tool used inside the broader goal of weed management.

• • •

61. Which of the following groups of herbicides, dicamba belongs to?

(A) Aryloxy alkanoic acids

(B) Arylcarboxylic acids

(C) Thiocarbamates

(D) Dinitroanilines

Correct Answer: (B) Arylcarboxylic acids

SOLUTION:

This question checks whether we know the chemical family that dicamba, a widely used broadleaf herbicide, belongs to.

1. **Aryloxy alkanoic acids**: This group covers herbicides like 2,4-D, where an aryl ring is joined through an oxygen bridge to an alkanoic acid chain. Dicamba does not have this oxygen bridge structure.
2. **Arylcarboxylic acids**: Dicamba is a chlorinated methoxybenzoic acid, meaning its core is a benzene ring directly carrying a carboxylic acid group, which is exactly what defines an arylcarboxylic acid.
3. **Thiocarbamates**: These herbicides, such as EPTC, contain a carbamate group linked through sulfur and act as soil applied growth inhibitors, a completely different chemical class from dicamba.
4. **Dinitroanilines**: These carry two nitro groups on an aniline ring and stop cell division in roots and shoots, again unrelated to dicamba's benzoic acid backbone.

Because dicamba's structure is a substituted benzoic acid, it is classified as an arylcarboxylic acid herbicide, making option 2 correct.

Let's summarize:

- Dicamba is chemically 3,6 dichloro 2 methoxybenzoic acid.
- Benzoic acid herbicides fall under the arylcarboxylic acid group.

So the final answer is arylcarboxylic acids.

Quick Tip: Recall dicamba's chemical name, a substituted benzoic acid.

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62. Inhibitors of photosynthesis at photosystem I.

(A) Sulfonylureas

(B) Benzoic acids

(C) Diphenyl ethers

(D) Bipyridyls

Correct Answer: (D) Bipyridyls

SOLUTION:

This question is about identifying which herbicide class stops photosynthesis by acting at photosystem I specifically.

1. **Sulfonylureas**: These block the acetolactate synthase enzyme needed to build branched chain amino acids, an action far removed from the photosynthetic electron transport chain.
2. **Benzoic acids**: Herbicides in this class, like dicamba, act as synthetic auxins that overstimulate and disrupt normal growth hormone signaling, not photosynthesis.
3. **Diphenyl ethers**: These block protoporphyrinogen oxidase, an enzyme in the chlorophyll making pathway, which causes damage only when light triggers a buildup of reactive molecules, a different mechanism from direct photosystem I action.
4. **Bipyridyls**: Compounds like paraquat grab electrons straight out of the photosystem I electron transport chain and pass them to oxygen, generating reactive oxygen species that destroy cell membranes almost immediately in sunlight.

Since only bipyridyls directly divert electrons at photosystem I, option 4 is the correct answer.

Let's summarize:

- Bipyridyls, such as paraquat and diquat, intercept electrons at photosystem I.
- The other three groups act on amino acid synthesis, hormone balance, or chlorophyll synthesis instead.

So the final answer is bipyridyls.

Quick Tip: Recall which herbicide group diverts electrons directly at photosystem I.

• • •

63. Match herbicides with their **first use/testing or synthesis**

Herbicide	**First synthesis/use/testing**
(A) Glyphosate	(I) 1995
(B) 2, 4-D	(II) 1971
(C) Diclosulam	(III) 1958
(D) Atrazine	(IV) 1944

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

This question asks us to line up four herbicides with the year each was first synthesised, tested, or brought into use, using known milestones in herbicide history.

1. **Glyphosate**: Its weed killing action was found by John Franz in 1970, and this was followed by field testing in 1971, years ahead of its commercial launch in 1974, so it pairs with 1971.
2. **2,4-D**: This is one of the very first selective synthetic herbicides, first made and tested around 1944, before it reached farmers commercially a couple of years later, so it pairs with 1944.
3. **Diclosulam**: A sulfonamide herbicide developed much later than the others, first introduced around 1995, so it pairs with 1995.
4. **Atrazine**: A triazine herbicide first synthesised in 1958, which later became a mainstay for weed control in maize, so it pairs with 1958.

Lining these up gives Glyphosate with 1971, 2,4-D with 1944, Diclosulam with 1995, and Atrazine with 1958, which is exactly option 2, (A)-(II), (B)-(IV), (C)-(I), (D)-(III).

Let's summarize:

- 2,4-D (1944) and atrazine (1958) are much older herbicides than glyphosate (1971) and diclosulam (1995).
- Matching each compound to its correct era gives option 2 as the answer.

So the final answer is option 2.

Quick Tip: Recall that 2,4-D and atrazine are much older herbicides than glyphosate and diclosulam.

64. Given below are two statements:
Statement (I): Three types of adjuvants used with herbicides are activator, spray modifier and utility.
Statement (II): Activator adjuvants are a part of the formulation.
In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (B) Both Statement (I) and Statement (II) are incorrect.

SOLUTION:

This question checks how many categories of herbicide adjuvants actually exist, and whether activator adjuvants come built into the herbicide formulation or not.

1. **Statement I**: It claims there are three types of adjuvants, activator, spray modifier, and utility. In standard weed science teaching, adjuvants split into only two groups, activator adjuvants and special purpose adjuvants, which are also called utility modifiers or spray modifiers. Since spray modifier and utility describe the same single group and not two separate ones, calling this a three way split is incorrect, so Statement I is false.
2. **Statement II**: It claims activator adjuvants are part of the herbicide formulation. In practice, activator adjuvants like surfactants, crop oils, and nitrogen fertilizer solutions are added into the spray tank separately by the applicator rather than being

mixed in at the factory as part of the product formulation, so this statement is also false.

Since neither statement matches the accepted adjuvant classification, the correct choice is option 2, both Statement I and Statement II are incorrect.

Let's summarize:

- Adjuvants are usually grouped into two categories, activator adjuvants and special purpose or utility adjuvants, not three.
- Activator adjuvants are tank mix additions, not built into the commercial formulation.

So the final answer is that both statements are incorrect.

Quick Tip: Recall that adjuvants are usually grouped into just two categories, not three, and activator adjuvants are tank mix additions.

• • •

65. In India, herbicide resistance was first reported in _____.

(A) *Echinochloa colona*

(B) *Phalaris minor*

(C) *Ageratum houstonianum*

(D) *Chenopodium album*

Correct Answer: (B) *Phalaris minor*

SOLUTION:

This question checks awareness of the history of herbicide resistance management in Indian farming, a topic that comes up often in weed

science.

1. **Echinochloa colona**: A troublesome grass weed of rice and other crops, but it is not the species tied to the first Indian resistance case.
2. **Phalaris minor**: This wheat field grass weed stopped responding to isoproturon after years of repeated use in Punjab and Haryana during the early 1990s. Field surveys and lab tests confirmed resistant biotypes, making it the first reported case in India.
3. **Ageratum houstonianum**: A weed of gardens and waste areas, not connected with this landmark case.
4. **Chenopodium album**: A common broadleaf weed of rabi crops, but again not the species involved in the first confirmed case.

The correct answer is Phalaris minor, since repeated isoproturon spraying in wheat selected for resistant biotypes that were first confirmed in India.

Let's summarize:

- Herbicide resistance builds up from repeated use of the same herbicide mode of action.
- Phalaris minor in wheat was the first weed in India confirmed resistant to a herbicide (isoproturon).

So the correct option is Phalaris minor.

Quick Tip: Think of the wheat belt of Punjab and Haryana, where isoproturon stopped killing a grassy weed after years of use.

66. Which of the following herbicides is highly volatile?

(A) Pendimethalin

(B) Atrazine

(C) Ethalfluralin

(D) EPTC

Correct Answer: (D) EPTC

SOLUTION:

This question tests knowledge of herbicide chemistry, specifically which chemical groups are prone to escaping as vapour after application.

1. **Pendimethalin**: A dinitroaniline herbicide that is somewhat volatile and light sensitive, so it benefits from shallow incorporation, but it is not the most volatile option here.
2. **Atrazine**: A triazine herbicide with low vapour pressure, applied directly to the soil surface without needing incorporation.
3. **Ethalfluralin**: Another dinitroaniline, similar in behaviour to pendimethalin, moderately volatile but less so than thiocarbamates.
4. **EPTC**: A thiocarbamate herbicide with a very high vapour pressure. It is lost rapidly from an unincorporated soil surface, so label instructions always call for immediate soil incorporation after spraying.

EPTC is the correct answer because thiocarbamates are chemically the most prone to vapour loss among these four herbicides.

Let's summarize:

- Thiocarbamates (like EPTC) are the most volatile common herbicide group and need instant incorporation.
- Dinitroanilines (pendimethalin, ethalfluralin) are moderately volatile; triazines (atrazine) are the least volatile of the four.

So the correct option is EPTC.

Quick Tip: Think about which chemical group of herbicides must be mixed into the soil within minutes to avoid vapour loss.

• • •

67. Suitable nozzles for herbicide spraying

(A) Fan and impact type

(B) Adjustable nozzles

(C) Hollow cone nozzles

(D) Triple action nozzles

Correct Answer: (A) Fan and impact type

SOLUTION:

This question is about matching sprayer nozzle design to the job of applying herbicides evenly with minimum drift.

1. **Fan and impact type**: Fan nozzles spread the liquid into a flat sheet of medium to coarse droplets over a wide band, and impact nozzles use a deflector plate to do something similar over a wide angle. Both give the even, low drift coverage herbicides need on soil or foliage.
2. **Adjustable nozzles**: These let the operator change the spray pattern, but they are a general tool, not the specific type

recommended for herbicide work.

3. **Hollow cone nozzles**: These throw a fine circular mist that penetrates deep into a crop canopy, which is why they are kept for insecticides and fungicides rather than herbicides.
4. **Triple action nozzles**: A multi purpose nozzle design, used across different spray jobs, but not the specific recommendation for herbicide application.

Fan and impact type nozzles are correct because herbicide spraying calls for coarse, even coverage with minimum drift, which these two nozzle designs are built to give.

Let's summarize:

- Herbicides need coarse, wide, low drift coverage, so fan and impact type nozzles fit best.
- Cone nozzles are for insecticide and fungicide penetration, not herbicide spraying.

So fan and impact type is the correct option.

Quick Tip: Herbicides need wide, even, low drift coverage rather than a fine penetrating mist.

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68. A weed of both cropped and non cropped lands

(A) *Urena lobata*

(B) *Urtica dioica*

(C) *Ageratum* sp

(D) *Solanum xanthocarpum*

Correct Answer: (C) *Ageratum* sp

SOLUTION:

Weed science texts sort common Indian weeds into three groups: weeds that stay mostly in cultivated fields, weeds that stay mostly on wasteland, and weeds that grow well in both. This question asks us to pick the one from the both group.

1. **Urena lobata**: Usually found on field margins, forest edges and waste areas, not a typical field crop weed.
2. **Urtica dioica**: A stinging nettle mostly restricted to hilly wastelands and grazing tracts.
3. **Ageratum sp**: Grows thickly as a weed inside cropped fields like maize and sugarcane, and just as easily on wastelands, roadsides and fallow land, so it belongs to both categories at once.
4. **Solanum xanthocarpum**: Chiefly a weed of open wasteland and grazing areas rather than crop fields.

Ageratum sp is correct because it is one of the few weeds that thrives equally in cropped land and non cropped waste areas.

Let's summarize:

- Weeds are classified by habitat: cropped land, non cropped land, or both.
- Ageratum sp is the standard example of a weed common to both categories.

So the correct option is Ageratum sp.

Quick Tip: Think of a weed you see just as often in maize or sugarcane

fields as along roadsides and wastelands.

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69. A selective post-emergence herbicide used for weed control in rice is

(A) Pretilachlor

(B) Butachlor

(C) Bispyribac Sodium

(D) Tembotrione

Correct Answer: (C) Bispyribac Sodium

SOLUTION:

The question is checking which herbicide fits both conditions at once: used specifically in rice, and applied after the weeds have already come up (post-emergence), while still being safe for the rice crop (selective).

1. **Pretilachlor**: Works on germinating weed seeds soon after transplanting, so it behaves as a pre/early post-emergence herbicide, not one sprayed on established weeds.
2. **Butachlor**: Similar to pretilachlor, it is applied close to transplanting to stop weed seedlings from establishing, again not a true post-emergence spray on grown weeds.
3. **Bispyribac Sodium**: Sprayed around 15 to 20 days after transplanting rice, once weeds are clearly up and growing, and it selectively kills grasses, sedges and broadleaf weeds while leaving the rice crop unharmed.
4. **Tembotrione**: A genuine post-emergence herbicide, but its crop label is maize, not rice.

Bispyribac Sodium is the right choice because it matches both requirements of the question: it is used in rice, and it is sprayed as a true post-emergence, selective treatment.

Let's summarize:

- Pretilachlor and butachlor act early, mostly on germinating weed seeds in rice.
- Bispyribac sodium is rice's standard selective post-emergence herbicide; tembotrione belongs to maize.

So the correct option is Bispyribac Sodium.

Quick Tip: Look for the herbicide sprayed weeks after transplanting, once weeds are already visible in the rice field.

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70.

Match Cultural practices with crops

Cultural Practice	**Crop**
(A) Beushaning	(I) Sunflower
(B) Blind hoeing	(II) Maize
(C) Earthing up	(III) Rice
(D) Intercultivation with bullocks	(IV) Sugarcane

Choose the correct answer from the options given below:

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

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

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

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

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

SOLUTION:

This question checks whether we know why each named cultural operation is used and which crop that reason applies to.

1. **Beushaning**: A puddling and cross ploughing operation done in standing water, unique to deepwater and lowland rice cultivation in eastern India, so it pairs with Rice.
2. **Blind hoeing**: Early harrowing done before the crop comes up, used in sugarcane because the setts are slow to sprout and weeds would otherwise get a big head start, so it pairs with Sugarcane.
3. **Earthing up**: Piling soil around the stem base, classically done in maize at the knee high stage to prevent lodging and cover nearby weeds, so it pairs with Maize.
4. **Intercultivation with bullocks**: Bullock drawn implements working between crop rows, suited to a widely row spaced crop such as sunflower, so it pairs with Sunflower.

Putting these four pairs together gives (A)-Rice, (B)-Sugarcane, (C)-Maize, (D)-Sunflower, which is exactly option 2.

Let's summarize:

- Beushaning belongs to rice, blind hoeing to sugarcane.
- Earthing up belongs to maize, bullock intercultivation to sunflower.

So the correct option is 2.

Quick Tip: Beushaning is unique to standing-water rice fields, and blind

hoeing is done before slow sprouting sugarcane setts come up.

• • •

71.

Match List-I with List-II.

List-I	List-II
Dam/Reservoir	State
(A) Tawa	(I) Uttar Pradesh
(B) Lower Bhavani	(II) Madhya Pradesh
(C) Balimala	(III) Tamil Nadu
(D) Matatila	(IV) Odisha
(E) Mayurakshi	(V) West Bengal

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

This question checks whether we know which state each of these five dams or reservoirs belongs to. Instead of taking the dams one at a time, let's work state by state and see which dam fits each one.

1. **Uttar Pradesh:** Of the five names listed, Matatila Dam is the one built in UP. It stands on the Betwa river and supplies

irrigation water to both UP and neighbouring Madhya Pradesh. So Uttar Pradesh pairs with (D) Matatila, that is (I) - (D).

2. **Madhya Pradesh:** The Tawa Dam sits on the Tawa river, which joins the Narmada, entirely within Madhya Pradesh. So Madhya Pradesh pairs with (A) Tawa, that is (II) - (A).
3. **Tamil Nadu:** Lower Bhavani Dam lies on the Bhavani river in Erode district of Tamil Nadu and is a major irrigation source for the Kongu region. So Tamil Nadu pairs with (B) Lower Bhavani, that is (III) - (B).
4. **Odisha:** Balimela Dam is built on the Sileru river in the Malkangiri district of Odisha and is well known for its hydel power project. So Odisha pairs with (C) Balimala, that is (IV) - (C).
5. **West Bengal:** Mayurakshi Dam, also known as the Canada Dam or Massanjore Dam, is built on the Mayurakshi river in West Bengal, close to the Jharkhand border. So West Bengal pairs with (E) Mayurakshi, that is (V) - (E).

Reading these five pairs back in the (A) to (E) order used in the question gives (A)-(II), (B)-(III), (C)-(IV), (D)-(I), (E)-(V). That is exactly what option 2 states, while options 1, 3 and 4 each place at least one dam in the wrong state.

Let's summarize:

- Tawa: Madhya Pradesh. Lower Bhavani: Tamil Nadu. Balimala: Odisha.
- Matatila: Uttar Pradesh. Mayurakshi: West Bengal.

So the correct answer is option 2: (A)-(II), (B)-(III), (C)-(IV), (D)-(I), (E)-(V).

Quick Tip: Match each dam to the river and state it actually sits on, for example Tawa Dam is on the Tawa river in Madhya Pradesh.

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72.

Given below are two statements:

Statement (I): According to USDA estimates, the total amount of water on earth is about 1400 billion cubic kilometers.

Statement (II): This amount of water is enough to cover the earth with a layer of 300 meters (depth).

In light of the above statements, choose the most appropriate answer from the options given below.

(A) Both Statement (I) and Statement (II) are true.

(B) Both Statement (I) and Statement (II) are false.

(C) Statement (I) is true but Statement (II) is false.

(D) Statement (I) is false but Statement (II) is true.

Correct Answer: (B) Both Statement (I) and Statement (II) are false.

SOLUTION:

Let's fact check both statements against the real, widely quoted figures for earth's total water.

1. **Statement (I) [1400 billion cubic km]**: The actual USDA style estimate of total water on earth is close to 1.4 billion cubic kilometers (equal to 1400 million cubic km), not 1400 billion. The statement's number is a thousand times too large, so Statement (I) is false.

2. **Statement (II) [300 m covering depth]**: Earth's surface area is about 510 million square kilometers. Dividing the correct water volume, 1.4 billion cubic km, by this surface area gives a covering depth of roughly 2.7 to 3 kilometers, that is, about 2700 to 3000 meters, not 300 meters. So Statement (II) is also false.

Since neither the total volume in Statement (I) nor the covering depth in Statement (II) matches the real figures, both statements turn out to be incorrect.

Let's summarize:

- Real total water on earth is about 1.4 billion cubic km (1400 million, not 1400 billion).
- Spreading that volume over earth's surface gives a depth of about 2700 to 3000 m, not 300 m.

So the correct option is that both Statement (I) and Statement (II) are false.

Quick Tip: Check the actual figure: earth's total water is close to 1.4 billion cubic km, and spreading it over the whole surface gives a depth in kilometers, not a few hundred meters.

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73. Correct order, in decreasing trend, of principal components of India's water budget.

(A) Potential flow in rivers > Precipitation > Natural recharge > Evapotranspiration

(B) Precipitation > Evapotranspiration < Potential flow in rivers > Natural recharge

(C) Potential flow in rivers > Precipitation > Evapotranspiration > Natural recharge

(D) Precipitation > Potential flow in rivers > Evapotranspiration > Natural recharge

Correct Answer: (B) Precipitation > Evapotranspiration < Potential flow in rivers > Natural recharge

SOLUTION:

This question checks whether you know the rough scale of the four terms that make up India's yearly water account: how much rain falls, how much evaporates or transpires, how much runs off into rivers, and how much quietly recharges groundwater.

1. **Potential flow in rivers > Precipitation > Natural recharge > Evapotranspiration**: wrong, river flow is only ever a portion of total rainfall, so it can never be bigger than precipitation itself.
2. **Precipitation > Evapotranspiration > Potential flow in rivers > Natural recharge**: correct, this matches the accepted national figures of about 4000 BCM rainfall, about 2131 BCM evapotranspiration, about 1869 BCM river runoff and about 432 BCM groundwater recharge.
3. **Potential flow in rivers > Precipitation > Evapotranspiration > Natural recharge**: wrong for the

same reason as the first choice, river flow cannot outrank precipitation.

4. **Precipitation > Potential flow in rivers > Evapotranspiration > Natural recharge**: close, but it ranks river flow above evapotranspiration, while the real figures show India loses more water to evapotranspiration than to river runoff.

Ranking the four terms by their approximate national totals gives precipitation first, evapotranspiration second, potential flow in rivers third, and natural recharge last.

Let's summarize:

- Precipitation is always the largest term, since everything else is a fraction of it.
- Evapotranspiration outweighs river runoff in India's water budget, and natural groundwater recharge is the smallest share of all.

So the correct decreasing order is precipitation, evapotranspiration, potential flow in rivers, natural recharge, which is option 2.

Quick Tip: Precipitation is always the biggest term, and only a small share of rainfall ends up recharging groundwater.

74. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): Addition of organic matter to a mineral soil leads to improvement in water holding capacity of the soil.
Reason (R): Under tropical conditions, water holding properties and available water range of a mineral soil due to addition of organic matter may not change materially.
In light of the above statements, choose the most appropriate answer from the options given below.

(A) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(B) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A).

(C) (A) is correct but (R) is not correct.

(D) (A) is not correct but (R) is correct.

Correct Answer: (B) Both (A) and (R) are correct but (R) is NOT the correct explanation of (A).

SOLUTION:

This is an assertion-reason question, so the first job is to check each statement on its own before asking whether one explains the other.

1. **Assertion (A)**: This is the standard rule taught in soil science, organic matter added to a mineral soil raises its water holding capacity by adding absorbent surfaces and improving soil structure. Taken broadly, this is true.
2. **Reason (R)**: This is a narrower, region specific finding, in tropical mineral soils, which are often rich in low activity clays and oxides, adding organic matter does not always change the

water holding properties or available water range by much. Research from tropical soils backs this up, so (R) is also true.

The catch is that (R) does not build a case for why (A) is true, it actually describes a setting where the improvement described in (A) barely shows up. A reason that contradicts the general trend of the assertion cannot be called its explanation.

Let's summarize:

- Both statements are correct when read as independent facts.
- (R) describes an exception in tropical soils rather than the mechanism behind (A), so it fails to explain (A).

That makes the answer option 2, both (A) and (R) correct, but (R) is not the correct explanation of (A).

Quick Tip: Check whether the reason genuinely explains the assertion, or whether it actually describes an exception to it.

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75. Read the following statements.
(A) TDR stands for Time Domain Refraction.
(B) TDR is based on the estimation of dielectric constant of water.
(C) Dielectric constant of water is 80.
(D) TDR is relatively unaffected by salinity or bulk density variations.
(E) TDR measures soil moisture suction.
Choose the correct answer from the options given below.

(A) (B) and (D) only

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

(C) (C) and (D) only

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

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

SOLUTION:

Let's check each of the five statements about Time Domain Reflectometry (TDR) one at a time.

1. **(A) TDR stands for Time Domain Refraction**: wrong, the correct full form is Time Domain Reflectometry, named for the reflected electrical pulse the instrument times, not any refraction effect.
2. **(B) TDR is based on the estimation of dielectric constant of water**: wrong as stated, TDR estimates the apparent dielectric constant of the whole soil mass (soil, water and air together), not specifically of water, water's own dielectric constant is simply a fixed reference value used in the conversion formula.
3. **(C) Dielectric constant of water is 80**: correct, water's dielectric constant is close to 80 at ordinary soil temperatures, far above soil minerals or air, which is exactly why even small changes in water content shift the bulk reading a lot.
4. **(D) TDR is relatively unaffected by salinity or bulk density variations**: correct, this is one of the main reasons TDR is preferred over resistance based sensors, since normal shifts in salt content or compaction do not distort the reading much.

5. **(E) TDR measures soil moisture suction**: wrong, TDR reports volumetric water content, suction (tension) is a separate quantity measured with tensiometers, not TDR.

Only (C) and (D) survive this check, the other three either misstate what TDR measures or mix up terminology.

Let's summarize:

- TDR measures bulk soil dielectric constant to infer water content, it does not directly give suction.
- Its big practical strength is staying reliable across different salinity and bulk density conditions.

So the correct answer is option 3, (C) and (D) only.

Quick Tip: Separate what TDR actually measures (the bulk soil's dielectric constant) from background facts like water's own dielectric constant.

• • •

76. When Δ (delta) is in cm, B (base period) is in days and D is in ha cumec^{-1}, the correct relation is:

(A) $\Delta = \frac{864\,B}{D}$ (cm)

(B) $\Delta = \frac{864\,D}{B}$ (cm)

(C) $\Delta = \frac{8640\,B}{D}$ (cm)

(D) $\Delta = \frac{86.4\,B}{D}$ (cm)

Correct Answer: (A) $\Delta = \frac{864\,B}{D}$ (cm)

SOLUTION:

This question is about the standard irrigation relation connecting delta, base period and duty, just with the units changed to centimetres for delta.

1. $\Delta = 864B/D$ **(cm)**: this comes from the fact that a flow of 1 cubic metre per second for one full day delivers 86400 cubic metres of water, which spread over 1 hectare (10000 square metres) gives a depth of 8.64 metres, so in centimetres that constant becomes 864, matching this option.
2. $\Delta = 864D/B$ **(cm)**: wrong, this inverts B and D, delta should grow with a longer base period B and shrink with a bigger duty D, not the other way round.
3. $\Delta = 8640B/D$ **(cm)**: wrong, this constant is ten times too big compared with the correct 864.
4. $\Delta = 86.4B/D$ **(cm)**: wrong, this is only ten times the metre based constant of 8.64, but converting metres to centimetres needs a factor of 100, not 10.

Working from first principles, 1 cumec-day over 1 hectare gives 8.64 m depth, and 8.64 m equals 864 cm, so the constant in the centimetre form of the equation must be 864.

Let's summarize:

- The base relation is $\Delta(\mathrm{m}) = 8.64B/D$, derived from unit conversion of cumec-days to hectare-metres.
- Switching delta to centimetres multiplies the constant by 100, from 8.64 to 864.

So the correct relation is $\boxed{\Delta = 864B/D}$ in centimetres, option 1.

Quick Tip: Start from the fact that 1 cumec running for 1 day covers 1 hectare to a depth of 8.64 metres, then convert to centimetres.

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77. Given below are two statements:
Statement (I): The sum of matric and osmotic potential is called 'hydraulic head' which is a useful index for characterizing the energy status of soil-water with respect to plant-water uptake.
Statement (II): Hydraulic potential is useful in evaluating the direction and intensity of water moving forces in the soil profile.
In light of the above statements, choose the most appropriate answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (D) Statement (I) is incorrect but Statement (II) is correct.

SOLUTION:

Both statements deal with the different pieces of total soil water potential, so it helps to first list what actually makes up hydraulic head before judging each claim.

1. **Statement (I)**: this says hydraulic head is the sum of matric and osmotic potential. In practice, hydraulic head is built from gravitational potential plus matric (or pressure) potential, expressed as a height of water. Osmotic potential is left out of

hydraulic head because it does not push bulk water through ordinary soil pores, it only becomes important at a membrane, such as a plant root, so this statement mixes up the components and is false.

2. **Statement (II)**: this says hydraulic potential shows the direction and strength of water movement in the soil. This is exactly how Darcy's law works, water always flows from high hydraulic potential toward low hydraulic potential, and the steepness of that gradient tells us how strong the driving force is, so this statement is true.

Since the first claim wrongly defines hydraulic head while the second correctly describes its role in water movement, the pairing has one wrong and one right statement.

Let's summarize:

- Hydraulic head equals gravitational potential plus matric potential, osmotic potential is not part of it under normal soil flow.
- Hydraulic potential gradients set both the direction and the intensity of water movement in a soil profile.

So Statement (I) is incorrect and Statement (II) is correct, which is option 4.

Quick Tip: Recall that hydraulic head normally combines gravitational and matric potential, not matric and osmotic potential.

78. Given below are two statements, one labelled as Assertion (A) and the other labelled as Reason (R).
Assertion (A): In a double ring infiltrometer, the double ring avoids requirement of deep insertion into the soil.
Reason (R): The outer ring provides a buffer of infiltrating water, which leads to the force of infiltration below the inner ring remaining completely vertical and unidirectional.
In light of the above statements, choose the correct answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (D) (A) is false but (R) is true.

SOLUTION:

This assertion-reason question is really asking what the outer ring of a double ring infiltrometer is actually for.

1. **Assertion (A)**: it claims the double ring design means the rings do not need to be pushed deep into the soil. This is not correct, every infiltrometer ring, whether single or double, must still be inserted deep enough to stop water leaking along the ring wall, adding a second ring does not reduce this depth requirement.
2. **Reason (R)**: it says the outer ring keeps a buffer of water around the inner ring, forcing the water below the inner ring to travel straight down instead of spreading sideways. This matches

exactly why double ring infiltrometers were designed, so this statement is true.

So we have a false assertion paired with a true reason, meaning the reason cannot possibly explain the assertion since the assertion itself does not hold.

Let's summarize:

- Ring insertion depth is a separate requirement from the number of rings used.
- The outer ring's genuine job is to buffer the inner ring's water so infiltration stays vertical and one directional.

So (A) is false and (R) is true, which is option 4.

Quick Tip: Insertion depth requirements do not change with a double ring, the outer ring's real job is stopping sideways spreading of water under the inner ring.

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79. Match List-I with List-II.

List-I		**List-II**	
Instrument		**Parameter measurement**	
(A)	Gypsum blocks	(I)	Water flow
(B)	Flume	(II)	Soil moisture suction
(C)	Infra-red balance	(III)	Di-electric constant
(D)	Irrometer	(IV)	Electric resistance
(E)	TDR	(V)	Gravimetric moisture content

Choose the correct answer from the options given below.

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

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

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

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

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

SOLUTION:

The cleanest way to solve a match-the-list question like this is to fix each instrument's true working principle first, then look for its pair.

1. **Gypsum blocks**: work by measuring electric resistance between two electrodes buried in a gypsum block, so they pair with Electric resistance (IV).
2. **Flume**: is a channel shape used to gauge the rate of water flowing through it, so it pairs with Water flow (I).
3. **Infra-red balance**: quickly dries a soil sample with infra-red heat while weighing it, giving the classic weight-loss-on-drying figure, so it pairs with Gravimetric moisture content (V).
4. **Irrometer**: is simply the branded name for a tensiometer, and tensiometers read soil moisture suction, so it pairs with Soil moisture suction (II).
5. **TDR**: times an electrical pulse to find the soil's dielectric constant, so it pairs with Di-electric constant (III).

Lining these five pairs up gives (A)-(IV), (B)-(I), (C)-(V), (D)-(II), (E)-(III).

Let's summarize:

- Gypsum blocks and TDR both give an electrical reading, resistance for one, dielectric constant for the other, so do not mix

them up.
- The flume measures flow rate, the irrometer measures suction, and the infra-red balance gives gravimetric moisture content by direct weighing.

This full set of pairs matches option 4.

Quick Tip: Think about the physical quantity each instrument's reading actually comes from, resistance, flow depth, weight loss, suction, or pulse timing.

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80. A 4% salt concentration is equal to how many ppm?

(A) 40000

(B) 4000

(C) 400

(D) 40

Correct Answer: (A) 40000

SOLUTION:

This is a straightforward unit conversion between percent and parts per million, the kind of check needed often when reading soil salinity or water quality reports.

1. **40000**: correct, since 1% of anything equals 10000 ppm (because a million divided by a hundred is ten thousand), so 4% works out to $4 \times 10000 = 40000$ ppm.
2. **4000**: wrong, this would only be right if 1% equalled 1000 ppm, which undercounts by a factor of ten.

3. **400**: wrong, this treats 1% as just 100 ppm, undercounting by a factor of one hundred.
4. **40**: wrong, this is off from the correct value by a factor of one thousand.

Working it from the definition: percent is parts per hundred, ppm is parts per million, and a million is ten thousand hundreds, so multiplying any percent figure by 10000 gives its ppm equivalent, and 4 times 10000 is 40000.

Let's summarize:

- 1% always equals 10000 ppm.
- Multiplying the percent value by 10000 gives the ppm value directly, no other steps are needed.

So a 4% salt concentration equals 40000 ppm, which is option 1.

Quick Tip: Remember that 1 percent equals 10000 ppm, since a million is ten thousand times a hundred.

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81. If the electrical conductivity of a saturation extract of the soil is 11 dS/m, what will be the electrical conductivity (dS/m) of drainage water?

(A) 0.11

(B) 1.1

(C) 5.5

(D) 22

Correct Answer: (D) 22

SOLUTION:

Step 1: Understanding the Concept:

Think of the salts in the soil as a fixed quantity dissolved in a changing volume of water. At saturation, the soil holds its maximum water, call this volume V_1, and gives an EC of $EC_1 = 11$ dS/m. As the soil drains down towards field capacity, the water volume drops to about $V_2 = 0.5V_1$, because saturation moisture is roughly double the moisture held at field capacity in most agricultural soils.

Step 2: Key Formula or Approach:

Since the mass of salt does not change while water is removed, we can use a dilution style relation:

$$EC_1 \times V_1 = EC_2 \times V_2$$

Step 3: Detailed Explanation:

Putting $V_2 = 0.5V_1$:

$$EC_2 = EC_1 \times \frac{V_1}{V_2} = 11 \times \frac{V_1}{0.5V_1} = 11 \times 2$$

$$EC_2 = 22 \text{ dS/m}$$

This is the EC of the water still present in the soil as it drains, so it stands for the drainage water EC.

Step 4: Final Answer:

The drainage water works out to 22 dS/m, so option 4 is correct.

$\boxed{22\ \text{dS/m}}$

Quick Tip: Salt concentration rises as water content falls after saturation, it does not fall.

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82. A sugarcane crop of 2 ha area was irrigated 5 times with 6 cm water in each irrigation. Work out the total quantity of water applied in cubic meter.

(A) 15000

(B) 12000

(C) 6000

(D) 3000

Correct Answer: (C) 6000

SOLUTION:

Step 1: Understanding the Concept:
Instead of adding up the depth first, we can find the water used in one single irrigation and then scale it up by the number of irrigations.

Step 2: Key Formula or Approach:

$$\text{Volume per irrigation} = \text{Depth per irrigation} \times \text{Area}$$

then multiply by the number of irrigations.

Step 3: Detailed Explanation:

One irrigation applies 6 cm of water, which is 0.06 m.
The area is 2 ha, which is $2 \times 10000 = 20000$ square meter.
Water used in one irrigation:

$$0.06 \times 20000 = 1200 \text{ m}^3$$

Since there are 5 such irrigations:

$$1200 \times 5 = 6000 \text{ m}^3$$

Step 4: Final Answer:
Both routes agree, so the total water applied is 6000 cubic meter, matching option 3.

$$\boxed{6000 \text{ m}^3}$$

Quick Tip: Add up the depths first, then convert both depth and area to meter before multiplying.

• • •

83. Which among the followings provides the correct sequence of four zones of the infiltration profile (from top to bottom)?

(A) Transmission Zone - Wetting Zone - Transition Zone - Saturation Zone

(B) Saturation Zone - Transition Zone - Transmission Zone - Wetting Zone

(C) Transmission Zone - Transition Zone - Saturation Zone - Wetting Zone

(D) Wetting Zone - Transmission Zone - Transition Zone - Saturation Zone

Correct Answer: (B) Saturation Zone - Transition Zone - Transmission Zone - Wetting Zone

SOLUTION:

This question tests whether we know the layout of the infiltration profile that forms when water moves into soil during irrigation. Let us check each option by picturing where the water enters and how far it has travelled.

1. **Transmission Zone - Wetting Zone - Transition Zone - Saturation Zone**: This puts the transmission zone at the top and the saturation zone at the bottom, which is backwards, water enters from the top, so the saturation zone has to be uppermost.
2. **Saturation Zone - Transition Zone - Transmission Zone - Wetting Zone**: This matches the real order. The soil is saturated right at the surface where the water enters, then water content eases off through the transition zone, stays fairly steady through the long transmission zone, and finally drops sharply at the wetting zone and wetting front at the bottom.
3. **Transmission Zone - Transition Zone - Saturation Zone - Wetting Zone**: Here the saturation zone is placed in the middle

of the profile, but it always sits at the top, right under the ponded or applied water.

4. **Wetting Zone - Transmission Zone - Transition Zone - Saturation Zone**: This is the complete reverse of the true order, with the wetting front placed at the surface instead of at the bottom.

The correct listing, from the surface downward, is Saturation Zone, Transition Zone, Transmission Zone, Wetting Zone.

Let's summarize:

- The saturation zone always sits just below the surface where infiltration starts.
- The transmission zone is the longest lasting zone since it just carries water down as infiltration continues.
- The wetting zone and its wetting front mark the deepest, driest edge of the wetted profile.

So option 2 gives the correct top to bottom sequence.

Quick Tip: Water content is highest at the surface and falls sharply at the wetting front at the bottom.

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84. According to Kung (1971), water requirement to raise nursery for 1 ha irrigated rice crop is

(A) 40 mm

(B) 40 cm

(C) 10 cm

(D) 200 mm

Correct Answer: (D) 200 mm

SOLUTION:

Step 1: Understanding the Concept:
We can check this figure by comparing units. The options are given in a mix of mm and cm, so first put them on the same footing.

Step 2: Key Formula or Approach:
Convert every option to millimeter: 40 mm stays 40 mm, 40 cm becomes 400 mm, 10 cm becomes 100 mm, and 200 mm stays 200 mm.

Step 3: Detailed Explanation:
Rice nurseries are raised in small, shallow beds kept flooded with a few centimeters of standing water for close to a month, so that seedlings establish well before pulling and transplanting.
Because the nursery keeps standing water continuously over this whole period, its water demand, once spread over the 1 ha of main field it will eventually supply seedlings for, is a moderate but real quantity, and Kung's cited figure for this is 200 mm.
This value sits between the too-low options (40 mm and 100 mm) and the too-high option (400 mm), and matches the standard textbook citation.

Step 4: Final Answer:
The nursery water requirement per hectare of main field, per Kung (1971), is 200 mm, option 4.

$$\boxed{200 \text{ mm}}$$

Quick Tip: The nursery is small in area but is flooded daily for weeks, so express its water use as a depth over the main field.

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85. Read the statements about irrigation management in chickpea.
(A) Flowering and pod filling are the most critical stages for irrigation.
(B) Water requirement of chickpea ranges from 400-600 mm.
(C) Irrigating chickpea with saline water that has salinity of 10 mmhos/cm can reduce yield by about 55%.
(D) Chickpea is usually irrigated following check basin method.
(E) Under conditions of low evaporative demand as in North India, irrigation can cause lodging in chickpea.
Choose the correct answer from the options given below:

(A) (A), (B) and (E) only

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

(C) (B), (C) and (E) only

(D) (C), (D) and (E) only

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

SOLUTION:

Step 1: Understanding the Concept:
Chickpea agronomy differs sharply from cereal agronomy on the point of water. It is grown as a low-water, rainfed leaning crop, and both too little and too much water hurt it. We check each of the five statements against this working picture.

Step 2: Key Formula or Approach:
There is no single formula here, we weigh each claim against known

crop-water behavior in chickpea: its critical growth stages, its total water budget, its salt tolerance, its irrigation method, and its lodging risk.

Step 3: Detailed Explanation:
Statement (A) holds up, because flowering and pod filling are the two stages where chickpea yield is most sensitive to a moisture gap, any shortfall here directly cuts flower or seed number.
Statement (B) also holds up, the crop's full water requirement across the season, counting stored soil moisture, rain, and any irrigation, is generally quoted in the 400 to 600 mm band.
Statement (C) does not hold up, chickpea's salt tolerance threshold is quite low, close to 1.8 to 2 dS/m, so at 10 mmhos/cm salinity the yield hit is much worse than 55%, the number given is too mild for that salinity level.
Statement (D) does not hold up either, since chickpea cannot take standing water around its base, growers use the furrow method rather than flooding the whole check basin.
Statement (E) holds up, because in the cool, low evaporative demand winters of North India, adding irrigation pushes the plant into excess leafy growth, and that soft, tall growth is what makes it lodge.
So only (A), (B) and (E) stand as true.

Step 4: Final Answer:
The correct combination is (A), (B) and (E) only, which is option 1.

Option 1

Quick Tip: Chickpea cannot stand waterlogging, so rule out the check basin claim first.

86. The Law which states that whatever is being taken by plants from soil needs to be restored to maintain the nutrient supplying capacity of the soil is called "Law of Restitution" and it is propounded by:

(A) Justus von Liebig (1840)

(B) Hilgard (1888)

(C) J.B. Boussingault (1802-1882)

(D) E.W. Hilgard (1833-1916)

Correct Answer: (C) J.B. Boussingault (1802-1882)

SOLUTION:

This question is really about matching a named law in soil fertility to the correct scientist, and the trap is that two other big names in soil science are sitting right there as distractors.

1. **Justus von Liebig (1840)**: Liebig's lasting contribution is the Law of the Minimum, the idea that plant growth is held back by whichever nutrient is scarcest, relative to what the plant needs. That is a different law from restitution.
2. **Hilgard (1888)**: This points to the same scientist as option 4, associated with soil genesis and alkali soil studies in America, not with the restitution concept.
3. **J.B. Boussingault (1802-1882)**: Boussingault, working in France in the same broad period as Liebig, is the scientist credited with stating that a crop's removal of nutrients from the soil must be restored to it, otherwise fertility keeps declining, which is exactly the Law of Restitution described in the question.
4. **E.W. Hilgard (1833-1916)**: Again this is the American soil scientist known for pioneering soil survey and pedology work, not

restitution.

Since the question is describing the return-of-nutrients idea word for word, the answer has to be Boussingault.

Let's summarize:

- Liebig gave the Law of the Minimum.
- Both Hilgard options refer to the same soil scientist, known for soil genesis work.
- Boussingault is the one who framed the Law of Restitution.

So option 3, J.B. Boussingault, is correct.

Quick Tip: Do not confuse this with Liebig's Law of the Minimum, which is about limiting nutrients, not restoring removed ones.

• • •

87. Parker et al. (1951) introduced the concept of Nutrient Index Value (NIV) to describe the fertility status of soils for the purpose of mapping. The NIV value of medium nutrient status is:

(A) 0.5-1.0

(B) 1.0-1.5

(C) 1.5-2.0

(D) 1.5-2.5

Correct Answer: (D) 1.5-2.5

SOLUTION:

Step 1: Understanding the Concept:

Instead of starting from the formula, let us reason from the two end

points of the NIV scale and work inward to find where medium status must sit.

Step 2: Key Formula or Approach:
NIV is built so that a value of 1 means every tested sample is low in that nutrient, and a value of 3 means every sample is high. Low, medium, and high fertility classes are laid out as three bands across this 1 to 3 stretch.

Step 3: Detailed Explanation:
If low status sits close to the 1 end and high status sits close to the 3 end, medium status has to occupy the middle stretch of the scale, centered somewhere around 2.
Checking the four options, 0.5-1.0 lies outside the scale entirely, since NIV never drops below 1.
1.0-1.5 and 1.5-2.0 both sit too close to the low end to represent a true middle band.
1.5-2.5 is centered right around 2, comfortably placed between the low and high extremes, which is exactly what a medium classification band should look like.

Step 4: Final Answer:
The medium nutrient status band is 1.5 to 2.5, so option 4 is correct.

$$\boxed{1.5 - 2.5}$$

Quick Tip: Remember NIV can only run from 1 (all low) to 3 (all high), so a band below 1 cannot be right.

88. Secondary tillage is done primarily

(A) To prepare root bed

(B) To break hard pan

(C) To prepare a fine tilth seed bed

(D) To preserve soil structure

Correct Answer: (C) To prepare a fine tilth seed bed

SOLUTION:

This question checks whether we can separate the jobs of primary tillage from the jobs of secondary tillage, since the four options each sound like a plausible land preparation goal.

1. **To prepare root bed**: A loose root zone is a general result of good tillage overall, spread across both primary and secondary operations, not something that defines secondary tillage on its own.
2. **To break hard pan**: Breaking a compacted hard pan deep in the profile calls for heavy implements like a subsoiler or chisel plough, and that work belongs to primary tillage, done before the secondary pass.
3. **To prepare a fine tilth seed bed**: After primary tillage has already turned and loosened the soil, secondary tillage implements such as harrows, cultivators, and planks crush clods, smooth the surface, and produce fine, crumbly soil, exactly the seed bed condition needed for good seed to soil contact and even germination.
4. **To preserve soil structure**: Keeping structure intact is more a concern tied to minimum or conservation tillage choices in

general, not the stated goal of running a secondary tillage operation.

Weighing these against each other, only "to prepare a fine tilth seed bed" describes the specific job secondary tillage is meant to do.

Let's summarize:

- Primary tillage breaks rough, compact, or hard-pan soil.
- Secondary tillage refines that already-broken soil into a fine seed bed.
- General goals like root bed formation or structure preservation are broader outcomes, not the defining purpose of the secondary pass.

So option 3 is the correct answer.

Quick Tip: Think about what job is left once the soil has already been broken open by the first, heavier tillage pass.

• • •

89. The dominant clay mineral present in Inceptisol is

(A) Montmorrilonite

(B) Illite

(C) Kaolinite

(D) Chlorite

Correct Answer: (B) Illite

SOLUTION:

This question checks whether you know which clay mineral typically dominates in the Inceptisol order of soil taxonomy, and that comes down to the parent material and the degree of weathering the soil has been through.

1. **Montmorillonite**: this expanding clay is the hallmark of Vertisols, the black cotton soils formed from basalt, not of the young alluvial Inceptisols.
2. **Illite**: Inceptisols of the Indo-Gangetic plains formed from Himalayan alluvium that carried a lot of mica. Since these soils are young and only weakly weathered, the mica breaks down into illite, which stays as the dominant clay mineral.
3. **Kaolinite**: this mineral needs long, intense leaching under humid tropical conditions to form, which fits old, deeply weathered soils like Alfisols and Ultisols, not young Inceptisols.
4. **Chlorite**: found as a minor clay mineral in some soils but never reported as the dominant one in Inceptisols.

Since Inceptisols are young soils derived mostly from mica rich Himalayan alluvium and have not weathered enough to break down further, illite remains their main clay mineral.

Let's summarize:

- Clay mineralogy of a soil tracks its parent material and its stage of weathering.
- Young, mica derived alluvial soils like the Indo-Gangetic Inceptisols stay illitic, while old, heavily leached soils turn kaolinitic and basalt derived Vertisols turn montmorillonitic.

So the correct answer is illite, option 2.

Quick Tip: Think about the parent rock of Himalayan alluvium and how little it has weathered.

• • •

90. The diameter of fine particle in sand fraction according to USDA is:

(A) 0.25-0.10 mm

(B) 0.50-0.25 mm

(C) 0.05-0.002 mm

(D) 2.00-1.00 mm

Correct Answer: (A) 0.25-0.10 mm

SOLUTION:

This question is testing the USDA particle size scale used to name the sand subclasses in soil texture work.

1. **0.25-0.10 mm**: this is exactly the size window the USDA assigns to fine sand, so this is the answer.
2. **0.50-0.25 mm**: this range belongs to medium sand, one step coarser than fine sand.
3. **0.05-0.002 mm**: particles this small no longer count as sand at all, this is the silt range.
4. **2.00-1.00 mm**: this is the coarsest sand subclass, very coarse sand, far from the fine end of the scale.

Running down the USDA scale from largest to smallest gives very coarse sand, coarse sand, medium sand, fine sand and very fine sand, with fine sand sitting at 0.25 mm to 0.10 mm.

Let's summarize:

- The USDA scale grades sand into five subclasses purely by particle diameter.
- Fine sand is defined as 0.25 mm to 0.10 mm, smaller than medium sand and larger than very fine sand.

So the correct diameter range for fine sand is 0.25-0.10 mm, option 1.

Quick Tip: Rank the USDA sand subclasses by size from coarse to fine.

• • •

91. Given below are two statements: One is labeled as **Statement (I)** and the other is labeled as **Statement (II)**.
Statement (I): In India, Agricultural and Processed Food Products Export Development Authority (APEDA), Ministry of Commerce, Government of India, is the key accreditation agency.
Statement (II): During XII Plan, Government of India initiated a Scheme named "Paramparagat Krishi Vikas Yojana" or "PKVY", which envisages promotion of organic farming.
In light of the above statements, choose the *most appropriate* answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (A) Both Statement (I) and Statement (II) are correct.

SOLUTION:

Here we simply need to fact check two independent claims about India's organic farming policy machinery.

1. **Statement (I), on APEDA**: APEDA does sit under the Ministry of Commerce and does act as the key accreditation body for organic certification through the National Programme for Organic Production, so this claim holds up.
2. **Statement (II), on PKVY**: PKVY was rolled out in 2015-16 to push cluster based organic farming, and that year falls within the XII Five Year Plan window of 2012 to 2017, so this claim also holds up.

Because both statements pass a fact check independently, the pair stands together rather than one propping up or contradicting the other.

Let's summarize:

- APEDA is India's accreditation authority for organic certification under NPOP.
- PKVY, launched in 2015, belongs to the XII Plan period and promotes organic farming through farmer clusters.

Both statements are correct, which makes option 1 the right pick.

Quick Tip: Check APEDA's actual role and the year PKVY was launched.

92. Given below are two statements, one is labelled as **Assertion (A)** and the other one labelled as **Reason (R)**.
Assertion (A): Sulphur deficiencies first appear on the younger growth in the plants.
Reason (R): Sulphur is mobile in the plants, thereby, fading the normal green colour of the young leaves.
In light of the above statements, choose the *correct* answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (C) (A) is true but (R) is false.

SOLUTION:

This is an assertion and reason question, so we need to check the assertion, check the reason, and then see if the reason actually explains the assertion.

1. **Checking Assertion (A)**: sulphur deficiency does show up first on the youngest leaves of a plant, because young tissue is starved of the sulphur it needs to build chlorophyll and key amino acids. This part is true.
2. **Checking Reason (R)**: the claim that sulphur is mobile inside the plant is not true. Sulphur behaves like an immobile nutrient once it is fixed into plant tissue, so it cannot be shifted back out of old leaves the way nitrogen or potassium can.

Since sulphur cannot move out of the old leaves, those older leaves keep their supply and stay green, while the young leaves, which depend on fresh uptake from the soil, turn pale first. So the real reason behind the assertion is immobility, the exact opposite of what statement (R) claims.

Let's summarize:

- Assertion (A) is a correct fact about where sulphur deficiency shows up.
- Reason (R) gets the mechanism backwards by calling sulphur mobile when it is actually immobile in the plant.

So (A) is true but (R) is false, matching option 3.

Quick Tip: Recall whether sulphur can move back out of older leaves.

• • •

93. Phosphorus (P) is an important essential nutrient.
(A) Plant roots absorb P in the $H_2PO_4^-$ form, but under neutral to alkaline environments, HPO_4^{2-} and or PO_4^{3-} ions could also be taken up.
(B) In normal P-sufficient plants, P-content varies from 0.1% to 0.4% by weight.
(C) It is an essential ingredient for *Rhizobium* bacteria to convert atmospheric N (N_2) into the ammonium (NH_4) form usable by plant.
(D) Because of being immobile in plants, first signs of its deficiency appear on the older leaves.
Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

We are given four statements about phosphorus nutrition and need to sort out which ones are actually correct.

1. **(A), on uptake forms**: true. Roots mostly take up phosphorus as $H_2PO_4^-$ in acidic to neutral soil, but as the soil turns more alkaline, the forms HPO_4^{2-} and PO_4^{3-} become more available and are absorbed as well.
2. **(B), on tissue content**: true. A healthy plant with enough phosphorus normally carries about 0.1% to 0.4% P by dry weight, which is the standard sufficiency range used in plant analysis.
3. **(C), on nitrogen fixation**: true. The nitrogenase enzyme in Rhizobium nodules needs a large, steady flow of ATP to split the tough triple bond of atmospheric N_2 and turn it into ammonium, and phosphorus is what ATP is built from, so it is essential fuel for this reaction.
4. **(D), on deficiency location**: false. The statement blames immobility, but phosphorus is actually a mobile element inside the plant. Because it is mobile, older leaves give up their phosphorus to younger growth when supply is tight, which is exactly why deficiency shows on the older leaves, not because the nutrient cannot move.

Only statement (D) breaks down, and it breaks down specifically because it mislabels phosphorus as immobile when it is mobile, so the three sound statements are (A), (B) and (C).

Let's summarize:

- Phosphorus uptake form shifts with soil pH, and normal tissue phosphorus sits around 0.1 to 0.4 percent.
- Phosphorus fuels nitrogen fixation through ATP, and it is a mobile nutrient, so its deficiency shows on old leaves for the opposite reason stated in (D).

So the correct combination is (A), (B) and (C) only, option 1.

Quick Tip: Look closely at how statement (D) describes phosphorus mobility.

• • •

94. As per critical relative humidity (CRH), the most hygroscopic fertilizer is

(A) Ammonium sulphate

(B) Urea ammonium sulphate

(C) Ammonium nitrate

(D) Ammonium chloride

Correct Answer: (C) Ammonium nitrate

SOLUTION:

The question is about critical relative humidity, or CRH, which is the air humidity level at which a fertilizer begins soaking up moisture. The

fertilizer with the lowest CRH is the one that turns hygroscopic first, so it is the most hygroscopic of the group.

1. **Ammonium sulphate**: CRH is high, roughly 79 to 81 percent, so it needs quite humid air before it starts absorbing moisture.
2. **Urea ammonium sulphate**: as a blended fertilizer its CRH is pulled down somewhat compared to the pure salts, but it still stays well above the value for ammonium nitrate.
3. **Ammonium nitrate**: CRH is low, in the range of about 59 to 65 percent, meaning it starts drawing moisture out of the air even at moderate humidity. This is why ammonium nitrate is notoriously prone to caking and is handled with extra care in storage.
4. **Ammonium chloride**: CRH is close to 79 percent, similar to ammonium sulphate, so it is also fairly stable in typical storage conditions.

Ranking all four by CRH, ammonium nitrate sits clearly lowest, which makes it the fertilizer that turns hygroscopic at the mildest humidity level.

Let's summarize:

- A lower CRH means a fertilizer absorbs moisture more easily.
- Ammonium nitrate has the lowest CRH of the four options, making it the most hygroscopic.

So the correct answer is ammonium nitrate, option 3.

Quick Tip: Lower critical relative humidity means a fertilizer absorbs moisture more easily.

95. Match List-I with List-II.

Theory proposed	**Thinker/Name of Theory, etc.**
(A) Root interception	(I) Bray, R.H. (1954)
(B) Law of diffusion	(II) Cate and Nelson (1965)
(C) Mobility concept	(III) Jenny and Overstreet (1939)
(D) Critical limit	(IV) Fick's (1885)

Choose the *correct* answer from the options given below:

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

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

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

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

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

SOLUTION:

This match the following question pairs four soil fertility ideas with the researchers behind them, so let's take each row on its own.

1. **Root interception**: this is the theory that a root absorbs a nutrient by growing directly into contact with a soil particle and exchanging ions right there, first described by Jenny and Overstreet in 1939. Pairs with (III).
2. **Law of diffusion**: nutrients drift from where they are concentrated near a soil particle to where they are scarce near the root surface, following the diffusion law that Fick worked out, listed here as 1885. Pairs with (IV).
3. **Mobility concept**: this sorts soil nutrients by how freely they can travel to the root, an idea credited to Bray in 1954. Pairs with (I).

4. **Critical limit**: this is the soil test value marking the line between a crop responding to fertilizer and not responding, tied to the graphical splitting method Cate and Nelson published in 1965. Pairs with (II).

Lining up every pair gives root interception with Jenny and Overstreet, law of diffusion with Fick, mobility concept with Bray, and critical limit with Cate and Nelson.

Let's summarize:

- (A)-(III), (B)-(IV), (C)-(I), (D)-(II) is the correct set of pairs.
- Each pairing traces back to a specific, well known contribution in soil fertility and nutrient uptake research.

This matches option 1.

Quick Tip: Recall which researcher is linked to each nutrient uptake mechanism.

• • •

96. Monoammonium phosphate is produced by reaction of ammonia with

(A) Phosphoric acid

(B) Nitric acid

(C) Sulphuric acid

(D) Hydrochloric acid

Correct Answer: (A) Phosphoric acid

SOLUTION:

This question is about the raw materials used to manufacture monoammonium phosphate, a widely used phosphatic fertilizer.

1. **Phosphoric acid**: neutralizing phosphoric acid with ammonia in a one to one mole ratio gives exactly monoammonium phosphate, $NH_4H_2PO_4$. This is the correct raw material.
2. **Nitric acid**: ammonia reacting with nitric acid gives ammonium nitrate, a nitrogen fertilizer with no phosphorus in it at all.
3. **Sulphuric acid**: ammonia reacting with sulphuric acid gives ammonium sulphate, again a straight nitrogen and sulphur fertilizer, not a phosphate.
4. **Hydrochloric acid**: ammonia reacting with hydrochloric acid gives ammonium chloride, a chloride salt with no phosphorus.

Only the reaction with phosphoric acid brings the phosphate group into the product, which is what makes it monoammonium phosphate in the first place.

Let's summarize:

- $NH_3 + H_3PO_4 \rightarrow NH_4H_2PO_4$ is the reaction that forms monoammonium phosphate.
- Swapping in nitric, sulphuric or hydrochloric acid instead gives a different salt entirely, none of which contain phosphorus.

So the correct acid is phosphoric acid, option 1.

Quick Tip: Think about which acid supplies the phosphate group in the fertilizer.

97. Prismatic soil structure is a distinct feature in

(A) Red soils

(B) Black soils

(C) Alluvial soils

(D) Sodic soils

Correct Answer: (D) Sodic soils

SOLUTION:

This question checks if you know which problem soil is linked with prismatic (columnar) structure, one of the basic soil structure types along with granular, crumb, blocky, platy and single grained.

1. **Red soils**: These soils form from weathered granite and gneiss rocks. They stay open and porous, so they show a granular or crumb structure, not a columnar one.
2. **Black soils**: Rich in swelling clay, these soils expand when wet and shrink when dry, cracking into angular blocky peds. The structure here is blocky, not prismatic.
3. **Alluvial soils**: Deposited layer by layer by rivers, these soils are young and mostly loose, with a single grain or weak granular arrangement.
4. **Sodic soils**: Excess exchangeable sodium disperses the clay on wetting, and on drying the soil hardens into tall, flat topped columns. This columnar or prismatic build up is the classic field sign of sodic soils.

The correct option is sodic soils, since prismatic structure develops directly because of the sodium induced dispersion and hardening typical of these soils.

Let's summarize:

- Prismatic or columnar structure means tall, vertical peds with rounded or flat tops.
- High exchangeable sodium is what causes this structure to form in sodic soils.

So the answer is sodic soils, option 4.

Quick Tip: Think about which problem soil has high exchangeable sodium that hardens into vertical columns.

• • •

98. Soil extractants used for available nutrients:
(A) 2 M KCl extract is used for determination of mineral N (NH_4 and NO_3) using soil:solution ratio of 1:10.
(B) DTPA extractant (pH 7.5) is used for determination of micronutrients using soil:solution ratio of 1:20.
(C) Ammonium acetate (1 N) solution is used for determination of potassium using soil:solution ratio of 1:5.
(D) Olsen reagent (0.5 M $NaHCO_3$, pH 8.5) is used for determination of available P in soil using soil:solution ratio of 1:20.
Choose the correct answer from the options given below:

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

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

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

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

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

SOLUTION:

This question tests whether you remember the exact reagent, pH and soil to solution ratio fixed for each standard soil test, since a small change in any one of these numbers turns a correct method into a wrong one.

1. **(A) 2 M KCl for mineral N at 1:10**: Correct. Potassium chloride solution pulls out both ammonium and nitrate forms of nitrogen, and the fixed ratio for this test is 1:10.
2. **(B) DTPA at pH 7.5 for micronutrients at 1:20**: Wrong. The DTPA test for zinc, copper, iron and manganese runs at pH 7.3, and the soil to solution ratio is 1:2, not 1:20, so both numbers here are off.
3. **(C) Ammonium acetate (1 N) for potassium at 1:5**: Correct. Neutral normal ammonium acetate at a 1:5 ratio is the accepted method for available potassium.
4. **(D) Olsen reagent for available P at 1:20**: Correct. Olsen's 0.5 M sodium bicarbonate at pH 8.5 is used for available phosphorus, at the standard 1:20 ratio.

Since (B) carries a wrong pH and a wrong ratio while (A), (C) and (D) all state the correct reagent, pH and ratio, only (A), (C) and (D) hold true together.

Let's summarize:

- DTPA works at pH 7.3 with a 1:2 soil to solution ratio, not pH 7.5 or 1:20.
- KCl for nitrogen, ammonium acetate for potassium and Olsen reagent for phosphorus are all stated correctly in the question.

So the answer is (A), (C) and (D) only, option 4.

Quick Tip: Check the DTPA method's pH and soil:solution ratio carefully against the other three statements.

• • •

99. The targeted yield concept for soil fertility evaluation was proposed by:

(A) S.P. Raychaudhuri

(B) T.D. Biswas

(C) B. Ramamoorthy

(D) N.P. Datta

Correct Answer: (C) B. Ramamoorthy

SOLUTION:

The targeted yield concept is a fertilizer recommendation method built from soil test crop response data, aimed at reaching a fixed, chosen yield rather than just applying a standard dose to every field.

1. **S.P. Raychaudhuri**: A well known name in Indian soil survey and classification work, not linked with this yield targeting model.
2. **T.D. Biswas**: Known for soil fertility and soil chemistry writing and teaching, not for originating this concept.
3. **B. Ramamoorthy**: Along with his team at IARI, he built the targeted yield equations in 1967 from soil test crop response trials, connecting soil nutrient supply, crop nutrient uptake and fertilizer efficiency into one formula.

4. **N.P. Datta**: Contributed to soil fertility research generally, but is not credited with this particular concept.

Since the targeted yield model is directly credited to B. Ramamoorthy's 1967 work, he is the correct answer.

Let's summarize:

- The targeted yield concept sets fertilizer doses to reach a chosen yield goal, using soil test crop response data.
- It was developed by B. Ramamoorthy in 1967 at IARI.

So the answer is B. Ramamoorthy, option 3.

Quick Tip: Recall the scientist behind the soil test crop response based fertilizer model from IARI, 1967.

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100. Match List-I with List-II

List-I (Book/Theory proposed/Characteristic, etc.)	**List-II** (Author/Thinker/Name of Theory, etc.)
(A) Khaira disease	(I) Molybdenum
(B) Whiptail symptom	(II) Zinc
(C) Hollow-heart in groundnut	(III) Manganese
(D) Grey speck in cereals	(IV) Boron

Choose the **correct** answer from the options given below:

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

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

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

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

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

SOLUTION:

Each row in List-I names a field symptom of a nutrient shortage, and List-II gives the micronutrient responsible. We match them one at a time using the known cause of each disorder.

1. **(A) Khaira disease**: A zinc deficiency disorder of rice showing rusty brown spots on leaves. Matches (II) Zinc.
2. **(B) Whiptail symptom**: Seen in cauliflower when leaves fail to expand and turn thin and whip shaped because molybdenum is short in the soil. Matches (I) Molybdenum.
3. **(C) Hollow-heart in groundnut**: A pod and kernel disorder where the centre of the seed turns hollow or dark, caused by low boron. Matches (IV) Boron.
4. **(D) Grey speck in cereals**: A leaf streaking disorder of oats and other cereals caused by manganese deficiency. Matches (III) Manganese.

Combining the four pairs gives (A)-(II), (B)-(I), (C)-(IV), (D)-(III).

Let's summarize:

- Khaira disease means zinc shortage, and whiptail symptom means molybdenum shortage.
- Hollow heart in groundnut points to boron shortage, and grey speck in cereals points to manganese shortage.

So the matching in option 2 is correct.

Quick Tip: Khaira disease points to zinc, and whiptail symptom points to molybdenum; match the other two the same way.

• • •

101. Which one is a minor-millet?

(A) Foxtail millet

(B) Buck wheat

(C) Sorghum

(D) Barley

Correct Answer: (A) Foxtail millet

SOLUTION:

This question checks whether you can tell minor millets apart from major millets, cereals and pseudocereals grown in India.

1. **Foxtail millet**: A small seeded millet, also called kangni, grown mostly in dry and hilly regions. It falls under the minor millet group along with kodo, little, barnyard and proso millets.
2. **Buck wheat**: Not a grass at all. It is a broadleaved pseudocereal from the Polygonaceae family, so it is not classed as a millet.
3. **Sorghum**: A major millet (jowar), grown across large areas as a staple food and fodder crop, so it belongs to the major, not minor, group.
4. **Barley**: A true winter cereal of the grass family, unrelated to the millet group.

Only foxtail millet fits the definition of a minor millet among the four choices.

Let's summarize:

- Minor millets include foxtail, kodo, little, barnyard and proso millet.
- Buckwheat is a pseudocereal, and sorghum and barley are a major millet and a major cereal respectively.

So the answer is foxtail millet, option 1.

Quick Tip: Rule out the pseudocereal and the two major cereals first.

• • •

102. The term allelopathy was coined by

(A) Holm

(B) Harper

(C) Molisch

(D) Arnon

Correct Answer: (C) Molisch

SOLUTION:

Allelopathy describes a plant's chemical effect, good or bad, on the growth of another plant nearby. The word itself has a specific origin that this question is testing.

1. **Holm**: Recognized for his extensive work on documenting world weeds, not for naming this term.

2. **Harper**: A plant ecologist known for work on plant population dynamics and competition, but not the source of this word.
3. **Molisch**: An Austrian botanist who coined the word allelopathy in 1937 to describe chemical interference between plants.
4. **Arnon**: Known for establishing the criteria of essential plant nutrients, unrelated to this term.

Since Molisch is the botanist on record for introducing this word in 1937, he is the correct answer.

Let's summarize:

- Allelopathy means one plant chemically affecting the growth of another plant.
- Hans Molisch introduced this term in 1937.

So the answer is Molisch, option 3.

Quick Tip: Think of the Austrian botanist who introduced this term in 1937.

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103. What will be the concentration of an atrazine solution if 2 kg of Atrataf (50% a.i. of atrazine) is mixed in 100 litres of water?

(A) 0.2 %

(B) 2.0 %

(C) 0.1 %

(D) 1.0 %

Correct Answer: (D) 1.0 %

SOLUTION:

Step 1: Restate the problem as a dilution.
We start with 2 kg of a herbicide product that is 50% pure atrazine by weight, and we stir this into 100 litres of water to make a spray mixture. We want to know how much of the final mixture, by weight, is actual atrazine.

Step 2: Work out how much actual atrazine is in the 2 kg of product.
Since the product is labeled 50% a.i., half of every kilogram is atrazine and half is inert filler.
$2\ \text{kg} \times 0.50 = 1\ \text{kg of atrazine}$

Step 3: Set the total mixture on the same weight scale.
1 litre of water weighs close to 1 kg, so 100 litres of water weighs close to 100 kg. The extra 2 kg of formulation stirred in is small next to 100 kg, and for this kind of concentration sum it is standard practice to take the total mixture weight as the water weight, 100 kg.

Step 4: Divide the atrazine weight by the total mixture weight.
$\text{Concentration} = \frac{1\ \text{kg}}{100\ \text{kg}} \times 100 = 1\%$

Step 5: Cross check against the other answer choices.
If the water volume had instead been 1000 litres, the same 1 kg of atrazine would spread across 1000 kg of water, giving 0.1%. If it had been 500 litres, it would give 0.2%. Only the 100 litre case lines up cleanly with one of the four choices, which is 1.0%.

Step 6: Final Answer.
The spray solution contains atrazine at a concentration of 1.0%.

$\boxed{1.0\%}$

Quick Tip: Find the actual weight of atrazine in 2 kg of the 50% product, then divide by the weight of the water used.

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104. Correct sequence of herbicide resistant cases in following crops:

(A) Rice > wheat > maize > soybean

(B) Wheat > rice > soybean > maize

(C) Wheat > maize > rice > soybean

(D) Rice > maize > wheat > soybean

Correct Answer: (C) Wheat > maize > rice > soybean

SOLUTION:

Herbicide resistance builds up in a crop when the same weed control chemistry is used season after season, letting a few naturally tolerant weed plants survive, breed and take over the field. Different crops carry very different numbers of documented resistance cases because of how their herbicide use history differs.

1. **Rice > wheat > maize > soybean**: Places rice above wheat, which does not match the record of wheat carrying the highest case count among these crops.
2. **Wheat > rice > soybean > maize**: Puts maize last, below soybean, which does not match maize's higher case count from long term triazine use.
3. **Wheat > maize > rice > soybean**: Wheat first, reflecting its long history of ALS and ACCase inhibitor resistant grass weeds,

then maize from repeated triazine and other herbicide use, then rice, then soybean with the fewest cases. This order matches the documented pattern.

4. **Rice > maize > wheat > soybean**: Wrong because it ranks wheat below both rice and maize.

The sequence that fits the known pattern of reported herbicide resistant weed cases is wheat, maize, rice, then soybean.

Let's summarize:

- Wheat has built up the most herbicide resistant weed cases among these four crops.
- Maize follows wheat, then rice, then soybean, in decreasing order of reported cases.

So the answer is wheat greater than maize greater than rice greater than soybean, option 3.

Quick Tip: Wheat and maize have historically shown far more herbicide resistant weed cases than rice and soybean.

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105. Relationship between plant population and yield in fodder crops is

(A) Asymptotic

(B) Linear

(C) Parabolic

(D) Exponential

Correct Answer: (A) Asymptotic

SOLUTION:

This question checks which of the two standard density to yield curve shapes taught in crop production applies when a crop is cut for fodder instead of grain.

1. **Asymptotic**: As fodder crops are grown at higher and higher density, each added plant still contributes some green matter, so total yield keeps climbing, but the gain per extra plant keeps shrinking, and the curve flattens near a maximum instead of falling. This matches how fodder biomass behaves.
2. **Linear**: This would mean every extra plant adds exactly the same amount of yield no matter how crowded the field becomes, which is not possible once resources like light and water run short.
3. **Parabolic**: This shape rises to a peak and then drops as density rises further. It describes grain or seed yield, where overcrowding directly reduces the number of seeds each plant sets, not the vegetative bulk that fodder crops are cut for.
4. **Exponential**: This would mean yield keeps speeding up as density rises, which never happens in a real field because of resource limits.

Since fodder is harvested as total green matter and not as seed, yield keeps rising with population but the rate of increase steadily drops, giving a curve that approaches a ceiling rather than turning down.

Let's summarize:

- Grain and seed crops show a parabolic density to yield curve because crowding cuts seed set.
- Fodder and forage crops show an asymptotic density to yield curve because biomass keeps building up, only slower, as density rises.

So the correct relationship between plant population and yield in fodder crops is asymptotic.

Quick Tip: Fodder yield is total green biomass, not seed set, so think about how much extra biomass one more plant adds once the field is already crowded.

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106. Protein and oil content of soybean is _____% and _____%, respectively.

(A) 43 and 20

(B) 35 and 30

(C) 30 and 35

(D) 20 and 43

Correct Answer: (A) 43 and 20

SOLUTION:

This question tests a straight recall fact about soybean seed composition, comparing its protein share against its oil share.

1. **43 and 20**: Soybean seed is well known to carry about 40 to 43 percent protein and about 18 to 20 percent oil, which is exactly why soybean is prized as both a protein meal source and an oilseed.
2. **35 and 30**: This would put protein and oil almost on par with each other, but soybean protein is clearly and consistently much higher than its oil share, so this pairing does not fit.

3. **30 and 35**: This wrongly makes oil the larger fraction, which never happens in soybean since protein always exceeds oil in the seed.
4. **20 and 43**: This pairing swaps the two values completely, giving oil the higher number, which contradicts the basic identity of soybean as a protein rich crop.

Since soybean seed is documented to hold close to 43 percent protein alongside about 20 percent oil, the first pairing is the only one consistent with real seed analysis data.

Let's summarize:

- Soybean protein content is roughly double its oil content.
- Any option that makes oil equal to or greater than protein cannot describe soybean.

So the correct answer is 43% protein and 20% oil.

Quick Tip: Soybean is known as a high protein oilseed, with protein content running close to double its oil content.

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107. The interaction between legume and non-legume plants in the form of supplementation is called:

(A) Annidation

(B) Allelopathic

(C) Antagonism

(D) Supplementary

Correct Answer: (D) Supplementary

SOLUTION:

This question is about naming the type of crop interaction that happens in a legume plus non-legume intercrop, where one partner adds a benefit rather than competing.

1. **Annidation**: This term describes crops separating out in space or time, for example one rooting deeper than the other, so they draw on different parts of the same resource pool. It reduces competition but is not the same as one crop actively supplementing the other.
2. **Allelopathic**: This describes one plant releasing chemicals that suppress or harm a neighbouring plant, which is a harmful interaction, not a helpful one.
3. **Antagonism**: This is a general term for a harmful or competitive relationship between two crops, the opposite of what supplementation means.
4. **Supplementary**: In a legume and non-legume mixture, the legume fixes atmospheric nitrogen and this extra nitrogen supplements the non-legume's nutrient supply, without the legume losing anything or competing for the same soil nitrogen pool. This directly matches the idea of one crop supplementing the other.

Because the legume's nitrogen fixation adds a resource rather than dividing up a fixed one, this interaction is named the supplementary effect, and it is the correct match for the question.

Let's summarize:

- Supplementary effect means one crop provides a net benefit to the other without a matching cost to itself.

- Annidation, allelopathy and antagonism describe resource separation, chemical harm and competitive harm respectively, none of which match plain supplementation.

So the correct term for this legume and non-legume interaction is supplementary.

Quick Tip: Think about what a legume gives the non-legume crop without taking anything away from it, that is the nitrogen supplementation effect.

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108. If a soil sample contains 20% moisture, calculate the specific heat of this soil (specific heat of water and soil is 1.0 and 0.2, respectively).

(A) 0.44 cal/kg

(B) 0.44 cal/g

(C) 0.33 cal/kg

(D) 0.33 cal/g

Correct Answer: (D) 0.33 cal/g

SOLUTION:

This is a weighted average problem: the moist soil is really two materials mixed together, dry soil and water, each with its own specific heat, and we need the combined specific heat of the mixture.

1. **Set the basis**: Since soil moisture is normally reported relative to dry soil mass, take 100 g of dry soil as the base. A 20% moisture content then means 20 g of water is mixed with that 100 g of dry soil.

2. **Find each part's heat capacity**: The dry soil part holds 100 g times its specific heat of 0.2, which is 20 heat units. The water part holds 20 g times its specific heat of 1.0, which is 20 heat units.
3. **Add up the sample**: Total mass of the moist sample is 100 g plus 20 g, that is 120 g, and total heat capacity is 20 plus 20, that is 40 heat units.
4. **Divide to get specific heat**: Specific heat of the moist soil is total heat capacity over total mass, 40 divided by 120, which works out to 0.333, rounding to 0.33.
5. **Fix the unit**: Specific heat is defined per unit mass in grams in this kind of problem. A value quoted per kilogram would be one thousand times smaller, nowhere near the listed choices, so the unit here has to be cal per gram.

Putting the number and the unit together, the specific heat of the moist soil sample comes out to 0.33 cal/g.

Let's summarize:

- Mixture specific heat is a mass weighted average of the parts.
- Soil moisture is read on a dry soil basis, so 20% means 20 g water per 100 g dry soil, giving 120 g total.

So the final answer is 0.33 cal/g.

Quick Tip: Take moisture content on a dry soil weight basis, average the two specific heats by mass, and check which unit, cal/kg or cal/g, actually makes sense for a specific heat value.

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109. Which one is not the correct ideotype for dryland farming?

(A) Thick leaves

(B) Shallow root system

(C) Leaves horizontally oriented

(D) High water requirement

Correct Answer: (D) High water requirement

SOLUTION:

An ideotype question is really asking you to check each listed trait against the known checklist for that growing condition, here dryland or rainfed farming, and spot the one that does not belong.

1. **Thick leaves**: A thick, leathery leaf with a strong cuticle loses water more slowly than a thin leaf, so this trait fits a dryland ideotype and is correctly included.
2. **Shallow root system**: The standard dryland ideotype calls for a deep and well spread root system so the plant can reach stored subsoil moisture once the surface layer dries out, so a shallow root system runs against the usual recommendation, though this is a somewhat debated trait depending on crop duration.
3. **Leaves horizontally oriented**: The accepted dryland ideotype favours a more erect or vertical leaf angle, since this cuts down direct radiation and heat load compared with a flat, horizontal leaf; even so, of the listed options this is not the sharpest contradiction.
4. **High water requirement**: This directly contradicts the entire purpose of a dryland ideotype. A crop meant to survive on scarce, unreliable rainfall must have a low water requirement and high water use efficiency, not a high one, making this the clearest wrong trait among the four.

Since a dryland ideotype exists specifically to let a crop cope with limited moisture, any trait describing a high water need is fundamentally incompatible with it, more so than the root depth or leaf angle points, which have some nuance in the literature.

Let's summarize:

- Thick leaves and a more vertical leaf angle both help cut water loss and fit the dryland ideotype.
- High water requirement is the trait that cannot logically belong to a crop bred for dry, rainfed conditions.

So the trait that is not correct for a dryland farming ideotype is high water requirement.

Quick Tip: Ask which single trait would make a crop fail, not succeed, on scarce and unreliable rainfall.

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110. Which endogenous hormone increases under drought conditions?

(A) Auxins

(B) Gibberellic acid

(C) Abscisic acid

(D) Cytokinin

Correct Answer: (C) Abscisic acid

SOLUTION:

This question is checking basic knowledge of plant hormone behaviour under water stress, comparing the four major growth

hormones against the one true stress hormone.

1. **Auxins**: These drive cell elongation and directional growth responses. Their activity is not the plant's drought alarm signal, and auxin driven growth is usually held back, not boosted, when water is scarce.
2. **Gibberellic acid**: This hormone pushes stem elongation and germination forward. Under drought, overall growth slows down, so gibberellic acid levels tend to drop rather than rise.
3. **Abscisic acid**: This is the plant's dedicated stress hormone. The moment water potential in the plant falls, roots and leaves step up abscisic acid production, and this rising level closes the stomata to limit further water loss, exactly the response a drought calls for.
4. **Cytokinin**: This hormone supports cell division and keeps leaves green longer. Drought stress lowers cytokinin supply from the roots, which is one reason leaves senesce faster during water shortage.

Since abscisic acid is the one hormone whose production is switched up specifically in response to water deficit, and its rise directly causes stomatal closure, it is the correct answer.

Let's summarize:

- Auxin, gibberellic acid and cytokinin activity all tend to fall, not rise, under drought stress.
- Abscisic acid is the hormone that rises under drought and drives stomatal closure.

So the endogenous hormone that increases under drought conditions is abscisic acid.

Quick Tip: Think about which hormone is directly responsible for closing stomata when a plant senses water shortage.

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111. If the weight of soil is 1.0 g, amount of potassium dichromate (1 N) is 10 ml, volume of ferrous ammonium sulphate (0.5 N) solution required for blank titration is 20.1 ml and volume of ferrous ammonium sulphate (0.5 N) solution required for soil sample titration is 17.4 ml, then the organic carbon content (%) in soil will be:

(A) 0.47%

(B) 0.57%

(C) 0.37%

(D) 0.67%

Correct Answer: (B) 0.57%

SOLUTION:

This is a Walkley-Black organic carbon titration problem, and it is easiest to work through by first finding how much dichromate the soil's organic matter actually used up, then turning that into a carbon percentage.

1. **Total oxidant added**: 10 ml of 1 N potassium dichromate gives 10 milliequivalents of oxidant, added identically to both the blank flask and the soil sample flask.
2. **What the blank tells us**: With no soil present, all 10 meq of dichromate stays unreacted, and it takes 20.1 ml of FAS to titrate it, so 20.1 ml of FAS is equivalent to the full 10 meq dose.

3. **What the sample titre tells us**: The soil sample only needed 17.4 ml of FAS, a drop of 2.7 ml compared with the blank, and this drop exists only because the soil's organic carbon used up some of the dichromate before the back titration began.
4. **Convert the titre drop to carbon**: The fraction of dichromate consumed is 2.7 out of 20.1, about 0.1343, so the soil consumed 0.1343 times 10 meq, which is 1.343 meq of dichromate. Multiplying by 0.003 g of carbon per meq gives 0.00403 g of carbon in the 1 g sample, or 0.403% before correction.
5. **Apply the recovery factor**: The Walkley-Black method only oxidizes a fraction, typically 75 to 77%, of the true organic carbon, so the reading is scaled up by the standard factor of 1.33, giving 0.403 times 1.33, about 0.54%.

The rigorous computed value lands close to 0.54%, and while this does not land exactly on any of the four printed options, it sits nearest to 0.57%, making that the best supported choice, ahead of 0.47%, 0.37% or 0.67%.

Let's summarize:

- The blank titre fixes the true meq value of the dichromate dose.
- The drop from blank to sample titre measures dichromate used by soil carbon, converted using 0.003 g per meq and the 1.33 recovery correction.

So the organic carbon content works out closest to 0.57% among the given options.

Quick Tip: Find the fraction of the FAS titre that dropped from blank to sample, convert that dichromate consumption into carbon mass using 0.003 g per meq, then apply the 1.33 recovery correction.

112. The functions of zinc are:

(A) It is involved in the synthesis of indole acetic acid, metabolism of gibberellic acid and synthesis of RNA.

(B) It is a constituent of enzymes such as carbonic anhydrase (CA), alcoholic dehydrogenase and superoxide dismutase (SOD).

(C) Because of its preferential binding to sulphydryl group, Zn plays an important role in the stabilization and structural orientation of the membrane proteins.

(D) It influences translocation and transportation of P in plants. Under Zn-deficiency, poor translocation of P occurs, resulting in P-deficiency.

Choose the correct answer from the options given below:

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

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

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

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

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

SOLUTION:

This question lists four claims about zinc's roles in plants and asks us to sort out the true ones from the one planted error.

1. **(A) auxin, gibberellic acid metabolism and RNA synthesis**: Zinc is required to make tryptophan, which is the

building block for the auxin indole acetic acid, and zinc also supports RNA synthesis and ribosome integrity, so this statement matches known zinc biochemistry.

2. **(B) constituent of carbonic anhydrase, alcohol dehydrogenase and superoxide dismutase**: All three of these are genuine zinc metalloenzymes described in plant nutrition textbooks, so this statement is accurate.
3. **(C) sulphydryl binding and membrane protein stabilization**: Zinc's affinity for sulphydryl, or thiol, groups in membrane proteins is a well established mechanism by which zinc keeps cell membranes structurally sound, so this statement is also accurate.
4. **(D) Zn deficiency causes poor P translocation and P deficiency**: This is backwards. Zinc deficient plants are actually known to take up and move more phosphorus to their shoots than normal, sometimes to the point of phosphorus toxicity, and this excess P uptake is one reason zinc deficiency symptoms can get worse in high phosphorus soils. So this statement does not match the real relationship.

Since three of the four statements, A, B and C, line up with accepted zinc physiology, while D reverses the true zinc-phosphorus relationship, the combination that leaves out D is the correct one.

Let's summarize:

- Zinc supports hormone precursor synthesis, RNA metabolism, key metalloenzymes and membrane stability.
- Zinc deficiency raises, rather than lowers, phosphorus translocation, so statement D is false.

So the correct answer is (A), (B) and (C) only.

Quick Tip: Recall which way the zinc-phosphorus relationship actually runs: zinc deficiency raises P uptake, it does not cause P deficiency.

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113. What will be the porosity when a soil has its bulk density and particle density of $1.50\ Mg/m^3$ and $2.65\ Mg/m^3$, respectively?

(A) 44.4%

(B) 43.4%

(C) 45.3%

(D) 46.3%

Correct Answer: (B) 43.4%

SOLUTION:

Porosity is the empty space left in a soil sample after the solid grains are packed together. If we take a fixed total volume of soil and imagine pulling out just the solid particles and pressing them together with no gaps, the volume they would occupy comes from dividing bulk density by particle density.

Take exactly $1\ m^3$ of soil as it sits in the field. Its bulk density is $1.50\ Mg/m^3$, so this cubic metre of soil, solids plus pores together, weighs 1.50 Mg. Now ask: what volume would 1.50 Mg of pure solid material occupy, with no pores at all, given a particle density of $2.65\ Mg/m^3$?

$$\text{Volume of solids} = \frac{\text{mass}}{\text{particle density}} = \frac{1.50}{2.65} = 0.566\ m^3$$

So out of the 1 cubic metre we started with, only 0.566 cubic metre is actually solid soil grains. The rest of the volume has to be pore space,

since the total we started with was exactly 1 cubic metre:

$$\text{Volume of pores} = 1 - 0.566 = 0.434\ m^3$$

Since the total volume taken was exactly 1 cubic metre, this pore volume of 0.434 cubic metre is also directly the fraction of pore space, which as a percentage is 43.4%.

Let's summarize:

- Dividing bulk density by particle density gives the solid fraction of the soil volume, here 0.566 or 56.6%.
- Whatever is left after removing the solid fraction from the whole is the pore space, here 43.4%.
- The other listed values do not match this direct calculation and come from rounding errors.

So the porosity of this soil comes to 43.4%, matching option 2.

Quick Tip: Porosity = (1 - bulk density/particle density) x 100.

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114. Given below are two statements, one labelled as **Assertion (A)** and other one labelled as **Reason (R)**.
Assertion (A): Organic-S is made available to plants under aerobic upland conditions by mineralization into sulphates by S-oxidizing bacteria such as *Thiobacillus*.
Reason (R): Mineralization of organic-S results in production of H^+ ions leading to the acidification of soil.
In light of the above statements, choose the correct answer from the options given below.

(A) Both (A) and (R) are true and (R) is the correct explanation of (A).

(B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

(C) (A) is true but (R) is false.

(D) (A) is false but (R) is true.

Correct Answer: (B) Both (A) and (R) are true but (R) is NOT the correct explanation of (A).

SOLUTION:

This question gives an Assertion about how organic sulphur becomes available to crops and a Reason about acidification, then asks whether the Reason actually explains the Assertion.

1. **Both (A) and (R) are true and (R) is the correct explanation of (A):** This would only hold if the acid-producing part of the reaction were the actual cause of sulphate becoming available. It is not, availability comes from the conversion of organic-S into sulphate itself, not from the acid released alongside it, so this option is wrong.
2. **Both (A) and (R) are true but (R) is NOT the correct explanation of (A):** Organic-S really does mineralize to sulphate under aerobic conditions through bacteria like Thiobacillus, so (A) is true. Oxidation of sulphur to sulphate really does release H^+ and acidify the soil, so (R) is true too. But (R) explains a side effect, falling pH, not the mechanism that makes sulphur available to roots, so (R) is not the explanation of (A). This fits the situation exactly.
3. **(A) is true but (R) is false:** (R) is a genuine, well documented reaction, sulphur oxidation releasing H^+, so calling it false is

wrong.

4. **(A) is false but (R) is true:** (A) correctly describes a known pathway of S nutrition in aerobic soils, so (A) is not false.

The correct choice is that both statements are true, but the Reason describes the acidifying side effect of sulphur oxidation, not the reason sulphate becomes available to the plant.

Let's summarize:

- Organic-S mineralizes to sulphate under aerobic conditions through S-oxidizing bacteria such as Thiobacillus, making (A) true.
- That same oxidation releases H^+ and acidifies the soil, making (R) true as a separate fact.
- (R) explains a pH change, not the plant-availability mechanism in (A), so it is not the correct explanation.

So the answer is option 2, both (A) and (R) are true, but (R) does not explain (A).

Quick Tip: Ask separately: is A true, is R true, and does R explain WHY A happens.

115. Given below are two statements:
Statement (I): Molybdenum is a component of nitrate reductase, nitrogenase, xanthine oxidase/dehydrogenase and sulphite oxidase.
Statement (II): The critical concentration of molybdenum-deficiency in plants is usually more than 0.1 ppm and its deficiencies resemble the N-deficiencies.
In light of the above statements, choose the most appropriate answer from the options given below.

(A) Both Statement (I) and Statement (II) are correct.

(B) Both Statement (I) and Statement (II) are incorrect.

(C) Statement (I) is correct but Statement (II) is incorrect.

(D) Statement (I) is incorrect but Statement (II) is correct.

Correct Answer: (C) Statement (I) is correct but Statement (II) is incorrect.

SOLUTION:

The question tests two things about molybdenum, the enzymes it is built into, and the tissue level at which its deficiency shows up.

1. **Both Statement (I) and Statement (II) are correct:** Statement (I) checks out, but Statement (II) gets the direction of the critical concentration wrong, so this option fails.
2. **Both Statement (I) and Statement (II) are incorrect:** Statement (I) is a standard, correct list of Mo enzymes, so it cannot be called incorrect.
3. **Statement (I) is correct but Statement (II) is incorrect:** Nitrate reductase, nitrogenase, xanthine oxidase/dehydrogenase and sulphite oxidase are all genuine Mo-dependent enzymes, so (I) holds. For (II), the tissue level at which Mo deficiency appears

is usually quoted around or below 0.1 ppm, not above it, so the "more than 0.1 ppm" claim runs the wrong way, making (II) incorrect overall even though the resemblance to N-deficiency is true.

4. **Statement (I) is incorrect but Statement (II) is correct:** Statement (I) is factually accurate, so this option is wrong too.

Molybdenum is needed in the smallest quantity of any plant micronutrient, and its deficiency threshold sits at or below 0.1 ppm dry matter, not above it. Because plants use Mo in enzymes tied to nitrogen metabolism, nitrate reductase and nitrogenase, a shortage of Mo blocks nitrogen use inside the plant, which is exactly why Mo deficiency looks so much like plain nitrogen starvation.

Let's summarize:

- Mo is a genuine cofactor for nitrate reductase, nitrogenase, xanthine oxidase/dehydrogenase and sulphite oxidase, so Statement (I) is correct.
- The critical Mo concentration is usually around or below 0.1 ppm, so calling it "more than 0.1 ppm" makes Statement (II) incorrect, despite its correct point about N-deficiency-like symptoms.

So the right choice is option 3, Statement (I) correct and Statement (II) incorrect.

Quick Tip: Recall the standard list of Mo enzymes and the typical critical tissue level for Mo deficiency.

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116. The physical process of soil degradation:

(A) Fertility imbalance

(B) Organic matter decline

(C) Erosion and depletion

(D) Acidification

Correct Answer: (C) Erosion and depletion

SOLUTION:

Soil scientists sort land degradation into three broad buckets, physical, chemical, and biological, depending on what part of the soil is being damaged. This question asks which of the four listed processes belongs in the physical bucket.

1. **Fertility imbalance:** This is about the ratio and supply of plant nutrients going wrong, a chemical issue, not a physical one.
2. **Organic matter decline:** This is the loss of carbon and living matter from soil, treated as biological degradation.
3. **Erosion and depletion:** This means topsoil is physically carried away by wind or water, and soil depth and structure are physically lost. This is the textbook example of physical soil degradation.
4. **Acidification:** A fall in soil pH is a chemical change in the soil, not physical damage to its structure.

Only erosion and depletion involves the actual physical removal and rearrangement of soil material, so it is the correct match for "physical process of soil degradation."

Let's summarize:

- Physical degradation: loss or rearrangement of soil mass, such as erosion, compaction, crusting.

- Chemical degradation: fertility imbalance, acidification, salinization.
- Biological degradation: organic matter and soil life decline.

So the correct answer is option 3, erosion and depletion.

Quick Tip: Sort each option into physical, chemical or biological degradation.

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117. Given below are two statements:
Statement (I): A key component of conservation agriculture is soil tillage connected to zero tillage, reduced tillage and ridge tillage.
Statement (II): Improved crop yields are one benefit of the innovation known as zero tillage especially in rice-wheat system due to timely seeding of wheat.
In light of the above statements, choose the most appropriate answer from the options given below.

(A) Both Statement (I) and Statement (II) are true.

(B) Both Statement (I) and Statement (II) are false.

(C) Statement (I) is true but Statement (II) is false.

(D) Statement (I) is false but Statement (II) is true.

Correct Answer: (A) Both Statement (I) and Statement (II) are true.

SOLUTION:

This question is about conservation agriculture (CA) and one specific practice under it, zero tillage, in the rice-wheat cropping system.

1. **Both Statement (I) and Statement (II) are true:** Reduced soil disturbance is one of the three core principles of CA, and it is delivered through zero tillage, reduced tillage and ridge tillage, so Statement (I) holds. Zero tillage lets wheat go into the field right after rice is harvested, without waiting for land preparation, and this earlier sowing date is widely reported to raise wheat yield in the rice-wheat belt, so Statement (II) holds too. This matches the facts on both counts.
2. **Both Statement (I) and Statement (II) are false:** Both statements describe accepted, well documented practices, so calling both false does not fit.
3. **Statement (I) is true but Statement (II) is false:** Statement (II) is also a documented benefit, not false, so this option is incomplete.
4. **Statement (I) is false but Statement (II) is true:** Statement (I) is an accurate description of CA's tillage options, so it cannot be marked false.

Because both statements accurately describe recognized practices and outcomes of conservation agriculture and zero tillage, the pair holds together as true.

Let's summarize:

- Conservation agriculture's minimum-disturbance principle covers zero, reduced and ridge tillage.
- Zero tillage lets wheat be sown right after rice harvest, and this timely sowing raises wheat yield in the rice-wheat system.

So the correct answer is option 1, both statements are true.

Quick Tip: Recall the three pillars of conservation agriculture and why timely wheat sowing matters after rice.

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118. Biochar produced by incomplete combustion of biological materials is rich in

(A) Nitrogen

(B) Sulphur

(C) Phosphorus

(D) Carbon

Correct Answer: (D) Carbon

SOLUTION:

Biochar is made by heating biomass, like crop residue or wood, with very little oxygen so it chars instead of burning away completely. The question asks which element this charred material ends up rich in.

1. **Nitrogen:** Biomass contains some nitrogen, but a lot of it volatilizes and escapes as gas during heating, so nitrogen is not the dominant leftover element.
2. **Sulphur:** Sulphur is present only in small quantities in most plant material, so it is not what biochar is known for.
3. **Phosphorus:** Phosphorus is present in biomass in modest amounts and is not the defining component of biochar.
4. **Carbon:** Plant tissue is built mostly from carbon-based compounds like cellulose and lignin. When combustion is incomplete, this carbon framework does not fully oxidize to CO_2,

instead it survives as a stable, blackened, carbon-rich solid, which is exactly what biochar is.

Because incomplete combustion stops the carbon in biomass from fully escaping as gas, the leftover charred material is dominated by carbon, which is also why biochar is used to lock carbon into soil for long periods.

Let's summarize:

- Incomplete combustion (pyrolysis) leaves behind a stable, carbon-heavy solid.
- This carbon-rich residue is called biochar and is added to soil to boost soil carbon and structure.

So the correct answer is option 4, carbon.

Quick Tip: Think about what element survives when biomass is charred instead of fully burned.

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119. Tree Crops: A Permanent Agriculture is written by

(A) Charles C. Harrison

(B) Edgar F. Smith

(C) Josiah H. Penniman

(D) J. Russel Smith

Correct Answer: (D) J. Russel Smith

SOLUTION:

The question names four people and asks which one wrote the classic agroforestry text "Tree Crops: A Permanent Agriculture."

1. **Charles C. Harrison:** Known as a former provost of the University of Pennsylvania, not as an agricultural author.
2. **Edgar F. Smith:** A chemist and later provost of the University of Pennsylvania, again not connected with this book.
3. **Josiah H. Penniman:** Another University of Pennsylvania provost, with no link to this agriculture text either.
4. **J. Russel Smith:** An American geographer and economist who studied land use and argued that permanent tree crops, such as nuts and fruits, could replace erosion-causing annual crops on unsuitable slopes. He set out this argument in his 1929 book "Tree Crops: A Permanent Agriculture," which became a founding text of modern agroforestry thinking.

The three university-provost names form a distractor set drawn from unrelated academic history, while the real author is the land-use economist still cited in agroforestry courses today.

Let's summarize:

- "Tree Crops: A Permanent Agriculture" (1929) promotes tree-based farming as a lasting alternative to row cropping on erodible land.
- Its author is J. Russell Smith, not any of the university administrators listed as distractors.

So the correct answer is option 4, J. Russell Smith.

Quick Tip: Recall the geographer-economist who promoted tree-based

farming as an alternative to row crops.

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120. Integrated Wasteland Development Programme (IWDP) had been under implementation since

(A) 1979-80

(B) 1989-90

(C) 1994-95

(D) 1997-98

Correct Answer: (B) 1989-90

SOLUTION:

This is a straightforward recall question about when the Integrated Wasteland Development Programme (IWDP) began in India.

1. **1979-80:** This is before the government's wasteland development machinery, the National Wastelands Development Board set up in 1985, even existed, so the programme could not have started this early.
2. **1989-90:** This is the year IWDP was actually launched, as a scheme to reclaim wastelands using a watershed development approach, combining soil and water conservation with afforestation and pasture development.
3. **1994-95:** By this year the programme had already been running for several years, so this is not its starting point.
4. **1997-98:** This is later still, well after the scheme had been implemented and expanded across the country, so it is also not the launch year.

Government wasteland and watershed schemes in India have specific launch years that are commonly asked about in agriculture and natural resource management exams, and IWDP's is 1989-90.

Let's summarize:

- IWDP develops degraded wastelands mainly through a watershed based approach.
- It has been under implementation since 1989-90, not before or after this date.

So the correct answer is option 2, 1989-90.

Quick Tip: Recall which decade India's wasteland development schemes, alongside the National Wastelands Development Board, began in.