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High School Teacher TGT Science CBZ Previous Year Question

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10 Toughest Chemistry, Botany & Zoology Questions (2019 – 2025)
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CBZ – 10 TOUGHEST PYQ

Hand-picked from 5 TGT Science CBZ papers (DSE Odisha RHT 2019 & 2021, OSSC RHT Main 2023, OSSC LTR Mains 2024-25 and SSB 2024) – with the same step-by-step solutions you get in the full pack.

Q-1 Ethyl acetate reacts with excess CH_3MgBr to produce

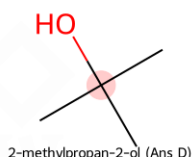
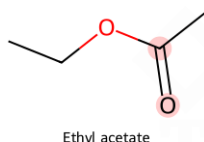
[DSE Odisha TGT SCI CBZ 2019]

- (A) propanal-1
- (B) propanol-1
- (C) isopropyl alcohol
- (D) 2-methylpropan-2-ol

ANS- (D) 2-methylpropan-2-ol

Given:

$\rightarrow \text{CH}_3\text{COOC}_2\text{H}_5$ (ethyl acetate) + excess CH_3MgBr , then H_3O^+

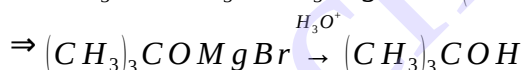
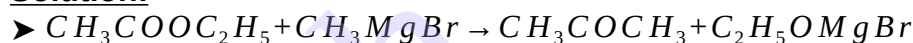


Excess CH_3MgBr , then H_3O^+ : 2 CH_3 groups added

Concept:

$\rightarrow$ An ester reacts with Grignard reagent twice: first the $-\text{OR}$ group is lost to give a ketone, then the ketone reacts again to give a tertiary alcohol

Solution:



$\rightarrow$ Ans: (D) 2-methylpropan-2-ol

Why not others:

$\rightarrow$ (A) propanal and (B) propan-1-ol are straight-chain; two CH_3 groups on one carbon cannot give them

$\rightarrow$ (C) isopropyl alcohol (2°) comes from an aldehyde (e.g. acetaldehyde) + 1 CH_3MgBr , not from an ester

Hint:

$\rightarrow$ Ester + excess RMgX gives a 3° alcohol with two identical R groups; formate ester gives a 2° alcohol.

Q-2 What is the condition in which a dicotyledonous plant bear flowers but do not produce fruits and seeds?

[DSE Odisha TGT SCI CBZ 2019]

- (A) Plant is monoecious
- (B) When the plant is dioecious but bears staminate flowers





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- (C) When climatic conditions are not favourable for survival
(D) When the plant is dioecious, but bears pistillate flowers

ANS- (B) When the plant is dioecious but bears staminate flowers

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Explanation:

A dioecious plant that bears only **staminate flowers** is a male plant, which has stamens and anthers but lacks a carpel, so it produces flowers but forms no fruits or seeds. In the figure, the Staminate flower with Anther and Stamen is on one papaya tree, while the Pistillate flower with Carpel, Ovary and Fruit is on the other tree.

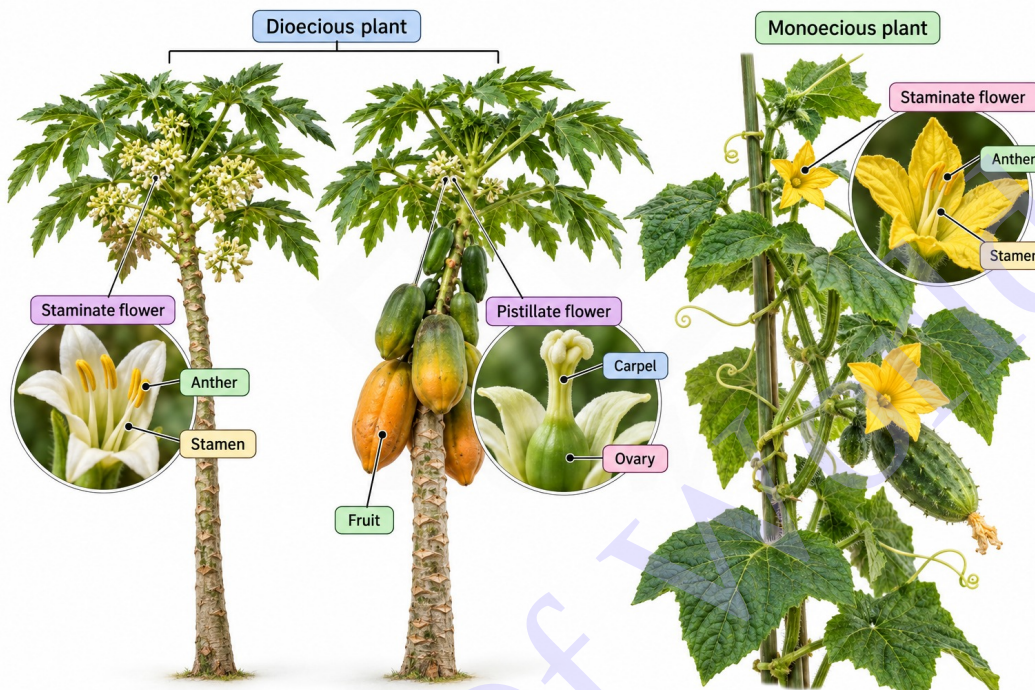


Fig. Dioecious papaya trees: one tree with Staminate flower (Anther, Stamen) and the other with Pistillate flower (Carpel, Ovary, Fruit) (asked part: Staminate flower).

Key Points:

- ♦ **Dioecious:** Male and female flowers are borne on separate plants, as in papaya and date palm.
- ♦ **Monoecious:** Both staminate and pistillate flowers occur on the same plant, as in maize and castor.
- ♦ **Fruit formation:** A fruit develops from the ovary and a seed from the ovule after fertilisation.
- ♦ **Pollination need:** A pistillate plant of a dioecious species receives pollen from a separate staminate plant, so cross-pollination is the route.

Other Options:

- (A) Plant is monoecious - it carries both staminate and pistillate flowers on one plant, so the pistillate flowers can form fruits and seeds.
- (C) Unfavourable climate - an environmental stress on survival of the whole plant, while fruit setting depends on a carpel and ovary in the flower.
- (D) Dioecious plant with pistillate flowers - a female plant whose carpel and ovary develop into fruit and seed after pollination and fertilisation.

Memory Hook:

Staminate has Stamens; Pistillate has the Pistil - the pistil bears the fruit.





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Q-3 Which of the following is TRUE about bacterial photosynthesis?

[DSE Odisha TGT SCI CBZ 2021]

- (A) Hydrogen donor is ammonia
- (B) Hydrogen donor is water
- (C) Hydrogen donor is hydrogen sulphide
- (D) Hydrogen donor is sulphur

ANS- (C) Hydrogen donor is hydrogen sulphide

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Explanation:

In purple and green sulphur bacteria, **hydrogen sulphide (H_2S)** is the hydrogen donor, as the picture shows with the H_2S arrow entering the bacterium. Sulphur granules are released instead of oxygen, and bacteriochlorophyll traps the light. In green plants, **water** is the donor and oxygen is released.

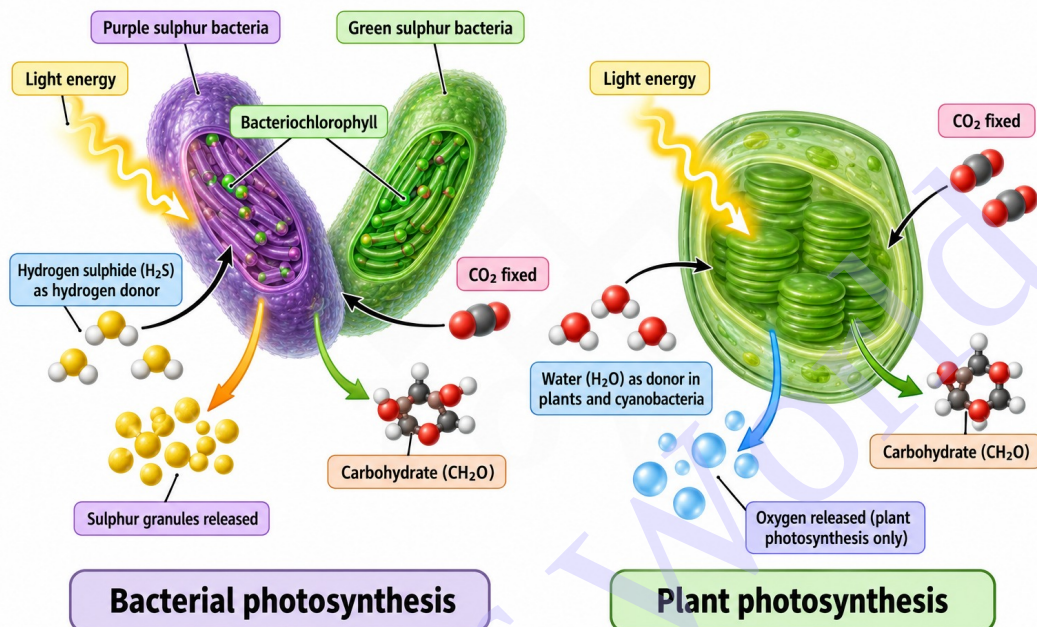


Fig. Bacterial photosynthesis (hydrogen sulphide as hydrogen donor, sulphur granules released) compared with plant photosynthesis (asked part: Hydrogen sulphide as hydrogen donor).

Key Points:

- ✦ **Anoxygenic:** Photosynthesis that releases sulphur and no oxygen is called **anoxygenic photosynthesis**.
- ✦ **Examples:** *Chromatium* is a purple sulphur bacterium and *Chlorobium* is a green sulphur bacterium.
- ✦ **Hydrogen donor rule:** In every type, hydrogen from a donor (H_2A) reduces CO_2 to carbohydrate.
- ✦ **Scientist:** C. B. van Niel, studying purple and green bacteria, inferred that the oxygen of plants comes from water.

Other Options:

- (A) Ammonia (NH_3) - A nitrifying bacteria oxidise for energy in chemosynthesis, a separate process from photosynthesis.
- (B) Water (H_2O) - The hydrogen donor of green plants and cyanobacteria, which release oxygen in oxygenic photosynthesis.
- (D) Sulphur - The element released as granules by sulphur bacteria after H_2S gives up its hydrogen.

Memory Hook:

H_2S for bacteria, H_2O for plants.





Q-4 Read the following statements regarding genetic drift and choose the CORRECT option:

- (i) Genetic drift describes random fluctuations in the numbers of gene variants in a population**
- (ii) Genetic drift takes place when the occurrence of variant forms of a gene, called alleles, increases and decreases by chance over time**

[DSE Odisha TGT SCI CBZ 2021]

- (A) (i) and (ii) are TRUE
- (B) (i) and (ii) are FALSE
- (C) (i) is TRUE and (ii) is FALSE
- (D) (i) is FALSE and (ii) is TRUE

ANS- (A) (i) and (ii) are TRUE

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Explanation:

Both statements are **true**, so option A fits: statement (i) and statement (ii) describe the same idea, that **genetic drift** is a chance change in allele numbers. In the figure, a random bottleneck or founder event moves the allele frequency from A 50%, a 50% to A 80%, a 20%, and by Generation 3 one allele is lost (fixation).

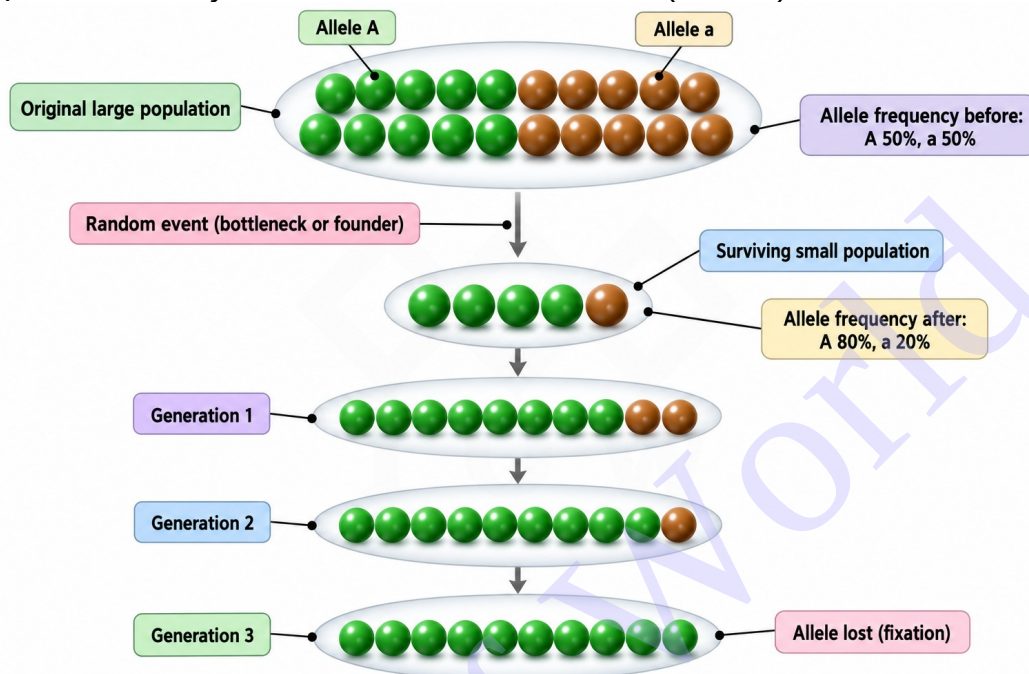


Fig. Genetic drift shown with beads: random event, allele frequency before (A 50%, a 50%) and after (A 80%, a 20%), then Generations 1 to 3 ending in fixation (asked part: random change in allele numbers).

Key Points:

- ✦ **Cause:** Drift comes from chance events, and natural selection plays no part in it.
- ✦ **Population size:** Drift acts more strongly in a small population than in a large one.
- ✦ **Hardy-Weinberg:** Drift is one of the five factors that change allele frequency, along with gene flow, mutation, recombination and natural selection.
- ✦ **Other name:** Genetic drift is also called the Sewall Wright effect.

Statements:

- ✓ True - drift means random fluctuations in the numbers of gene variants, as the bead counts in the figure change by chance from one generation to the next.
- ✓ True - alleles are the variant forms of a gene, and their numbers rise and fall by chance over time, as allele A (green) goes from 8 of 10 beads in Generation 1 to 10 of 10 in Generation 3.

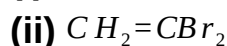
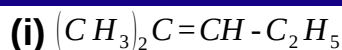
Both statements TRUE gives option A.

Memory Hook:

Drift = dice-roll of alleles: chance decides which ones stay.

Q-5 Which of the following compounds will show cis-trans isomerism?





[OSSC RHT SCI CBZ Main 2023 By TCS]

(A) only (ii)

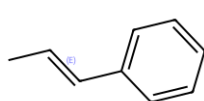
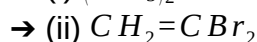
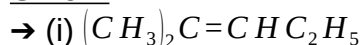
(B) (iii) and (iv) only

(C) (i), (ii), and (iii) only

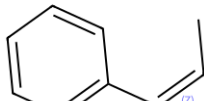
(D) only (i) and (ii)

ANS- (B) (iii) and (iv) only

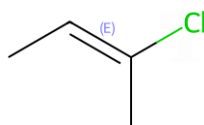
Given:



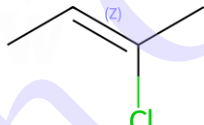
(iii) trans



(iii) cis



(iv) CH₃ groups cis (E)



(iv) CH₃ groups trans (Z)

Each C of C=C holds two different groups

Concept:

→ Cis-trans isomerism needs restricted rotation about C=C, and each doubly bonded carbon must carry two different groups

→ If any one C=C carbon has two identical groups, there is no cis-trans isomerism

Solution:

➤ (i) one carbon has two CH_3 groups, so no isomerism

⇒ (ii) one carbon has two H, the other has two Br, so no isomerism

⇒ (iii) C_6H_5 and H on one carbon, CH_3 and H on the other, so cis and trans exist

⇒ (iv) CH_3 and H on one carbon, Cl and CH_3 on the other, so cis and trans exist

➤ Ans: (B) (iii) and (iv) only

Why not others:

→ (A), (C), (D) each include (i) or (ii), and both have two identical groups on one C=C carbon

Hint:

→ Quick test: draw the double bond and look at both ends. Both ends must have two different groups.





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Q-6 The supplementary factor is represented by phenotypic ratio

[OSSC RHT SCI CBZ Main 2023 By TCS]

- (A) 9:7
- (B) 9:3:4
- (C) 9:3:3:1
- (D) 12:3:1

ANS- (B) 9:3:4

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Explanation:

The **supplementary factor** gives the phenotypic ratio **9:3:4**. Gene A alone produces colour, while gene B acts only when A is present and deepens that colour. The picture's Punnett square of $AaBb \times AaBb$ shows 9 coloured, 3 intermediate and 4 colourless out of 16.

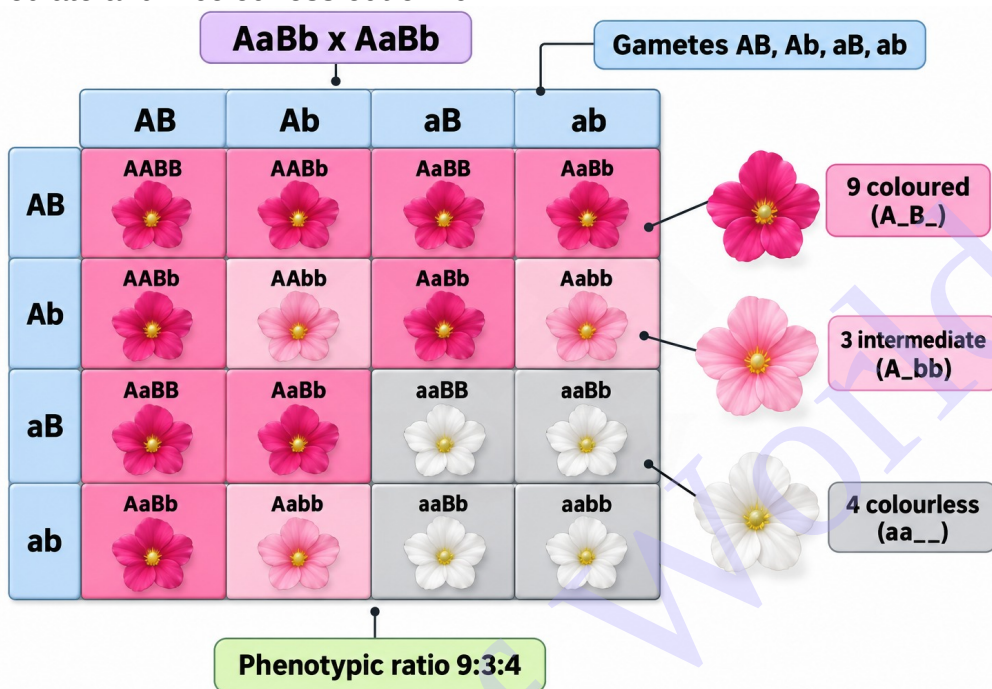


Fig. Punnett square of $AaBb \times AaBb$ showing 9 coloured : 3 intermediate : 4 colourless, the phenotypic ratio 9:3:4 (asked part: ratio 9:3:4).

Key Points:

- ✦ Type of epistasis: **Supplementary genes** show recessive epistasis, as the **aa** pair masks the effect of gene B.
- ✦ Modified ratio: **9:3:4** comes from Mendel's 9:3:3:1 by joining the last two classes ($3 + 1 = 4$).
- ✦ Gametes: Each $AaBb$ parent forms AB, Ab, aB and ab gametes in equal numbers.
- ✦ Example: Coat colour in mice gives 9 agouti, 3 black and 4 albino.

Other Options:

- (A) 9:7 - complementary genes, where both dominant alleles together are needed to show the trait.
- (C) 9:3:3:1 - Mendel's dihybrid ratio, where two genes act independently on two different traits.
- (D) 12:3:1 - dominant epistasis, where one dominant allele masks the other gene and gives three classes.

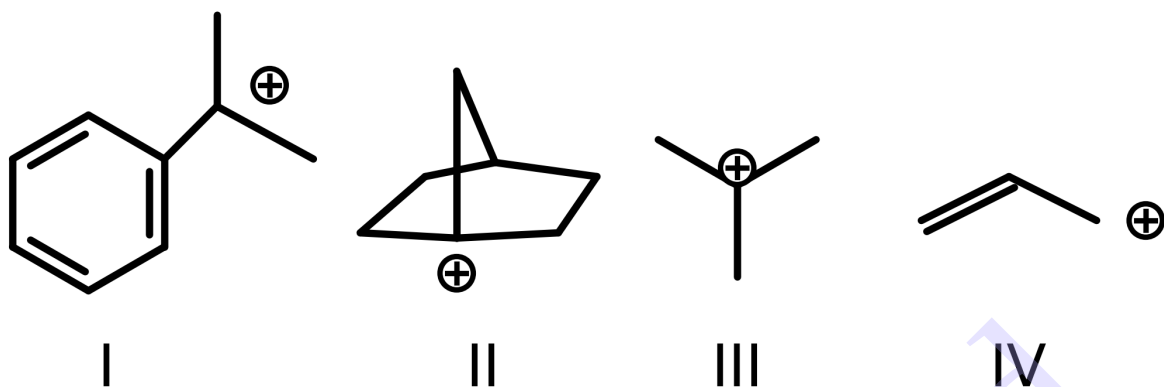
Memory Hook:

Supplementary = 9-3-4: three groups, four colourless.

Q-7 The correct order of stability for the following carbocation is:

[OSSC LTR TGT CBZ Mains 2024-2025]





(A) I < III < IV < II

(B) III < II < IV < I

(C) II < IV < III < I

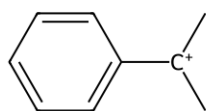
(D) IV < III < I < II

ANS- (C) II < IV < III < I

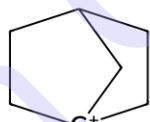
Given:

→ I = $C_6H_5 - C^+(CH_3)_2$ (tertiary benzylic), II = bridgehead carbocation of bicyclo[2.2.1]heptane

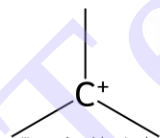
→ III = $(CH_3)_3C^+$ (tertiary), IV = $CH_2=CH - CH_2^+$ (allyl)



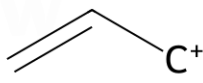
I tertiary benzylic (cumyl)



II bridgehead (non-planar)



III tert-butyl (tertiary)



IV allyl (primary, resonance)

Stability: II < IV < III < I

Concept:

→ A carbocation is stabilised by resonance, hyperconjugation and +I of alkyl groups; it needs a planar sp^2 carbon with an empty p orbital.

→ A bridgehead C^+ in a small bicyclic ring cannot become planar (Bredt's rule), so it is the least stable.

Solution:

► II: bridgehead, cannot flatten, no help from resonance or hyperconjugation → least stable

⇒ IV: $CH_2=CH - CH_2^+ \leftrightarrow \square^+CH_2 - CH=CH_2$ (resonance, but only a primary cation)



⇒ III: $(CH_3)_3C^+$ has 9 hyperconjugating C–H bonds and three +I methyl groups → more stable than allyl

⇒ I: tertiary like III, and the charge also spreads into the benzene ring (ortho and para positions) by resonance → most stable

⇒ Order: $II < IV < III < I$

► Ans: (C) $II < IV < III < I$

Hint:

→ Tertiary benzylic > tertiary > allyl > secondary > primary; a non-planar bridgehead cation is the worst.

Q-8 Based on the amount and pattern of distribution of yolk, the two types of cleavages seen are:

[OSSC LTR TGT CBZ Mains 2024-2025]

- (A) Holoblastic and Triploblastic
- (B) Holoblastic and Meroblastic
- (C) Determinant and Indeterminant
- (D) Meroblastic and Triploblastic

ANS- (B) Holoblastic and Meroblastic



Explanation:

Based on the amount and distribution of yolk, cleavage is of two types: **holoblastic** (the whole egg divides) and **meroblastic** (only the yolk-free cap divides). Yolk slows the cleavage furrows, so an egg with little or moderate yolk divides completely, while a yolk-rich egg divides only in part. In the figure, the **Holoblastic cleavage** panel shows blastomeres, and the **Meroblastic cleavage** panel shows a blastodisc sitting on a large yolk.

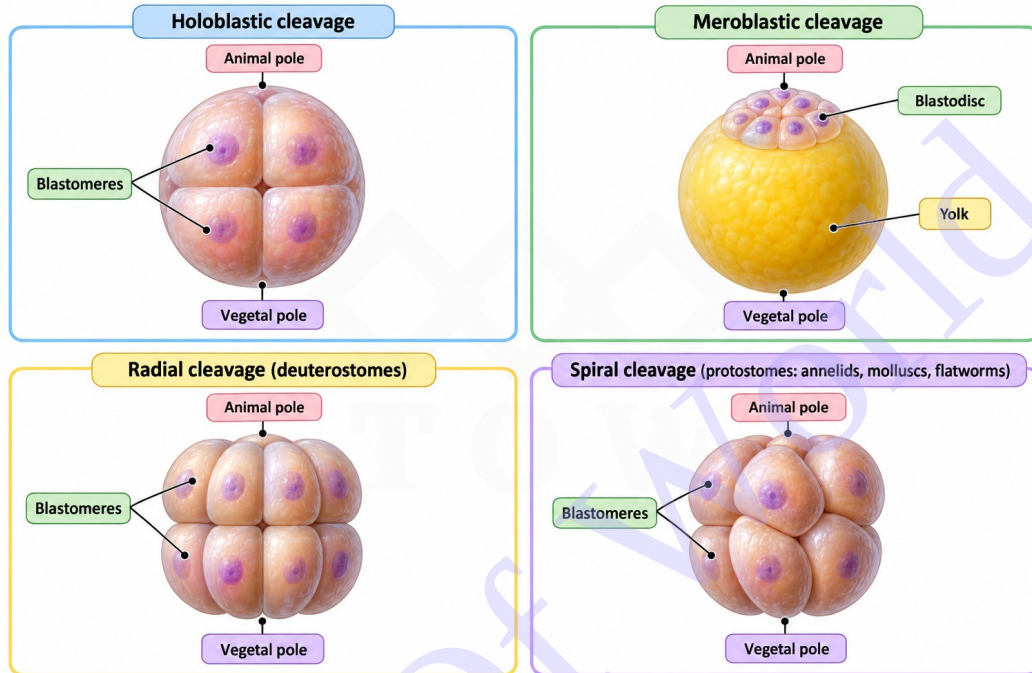


Fig. Types of cleavage: Holoblastic, Meroblastic, Radial and Spiral cleavage panels with animal pole, vegetal pole, blastomeres, blastodisc and yolk (asked parts: Holoblastic cleavage and Meroblastic cleavage).

Key Points:

- ✦ **Holoblastic:** Complete division of the egg, equal in *Amphioxus* and unequal in frog
- ✦ **Meroblastic:** Incomplete division in yolk-rich eggs, discoidal type in birds
- ✦ **Triploblastic:** Describes an embryo with three germ layers, ectoderm, mesoderm and endoderm
- ✦ **Determinate cleavage:** Cell fate gets fixed early, which is a fate-based idea and not a yolk-based one

Other Options:

- (A) Holoblastic and Triploblastic - the first term is a yolk-based cleavage type and the second names an embryo with three germ layers.
- (C) Determinant and Indeterminant - these terms describe whether the fate of blastomeres is fixed early or kept flexible.
- (D) Meroblastic and Triploblastic - the first term is cleavage in yolk-rich eggs and the second names an embryo with three germ layers.

Memory Hook:

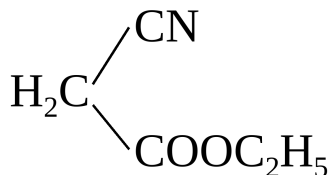
Holo = whole egg divides, Mero = only a part divides.



Q-9 Which of the following compounds does not form carbanion with sodium ethoxide?

[SSB TGT CBZ 2024]

- (A) $CH_3COCH_2COOC_2H_5$
(B) $(CH_3)_3C.COOC_2H_5$
(C) $H_2C(COOC_2H_5)_2$



(D)

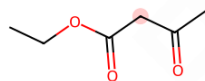
ANS- (B) $(CH_3)_3C.COOC_2H_5$

Given:

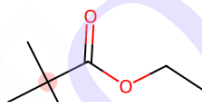
→ Base: sodium ethoxide (C_2H_5ONa).

→ (A) $CH_3COCH_2COOC_2H_5$, (B) $(CH_3)_3C-COOC_2H_5$, (C) $CH_2(COOC_2H_5)_2$,

(D) $NC-CH_2-COOC_2H_5$



Has alpha-H (CH₂): carbanion



No alpha-H: NO carbanion

Ans: carbon next to C=O needs an H

Concept:

→ A carbanion forms only if the carbon next to C=O (alpha carbon) carries an H (alpha-H).

→ A CH_2 between two electron-withdrawing groups (C=O, CN) is very acidic, so EtO^- removes its H easily.

Solution:

➤ $CH_3COCH_2COOC_2H_5 + C_2H_5O^- \rightarrow CH_3COCH^-COOC_2H_5 + C_2H_5OH$

⇒ (C) and (D) behave the same way through their active CH_2

⇒ (B): alpha carbon is $(CH_3)_3C$, which has no H → no carbanion

➤ Ans: (B) $(CH_3)_3C-COOC_2H_5$

Why not others:

→ (A) Active CH_2 between ketone and ester → carbanion forms.

→ (C) Active CH_2 between two esters (malonic ester) → carbanion forms.

→ (D) Active CH_2 between CN and ester → carbanion forms.

Hint:

→ Look for the alpha carbon: no alpha-H → no enolate/carbanion.

Q-10 Body cavity derived from blastocoel forms:





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[SSB TGT CBZ 2024]

- (A) Haemocoel
- (B) Schizocoel
- (C) Enterocoel
- (D) Pseudocoel

ANS- (D) Pseudocoel

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Explanation:

The body cavity that comes from the **blastocoel** is the **pseudocoel**, as seen in roundworms. In the figure, the green space labelled Pseudocoel (from blastocoel) lies between the outer mesoderm and the gut wall. Its lining is only partly made of mesoderm, so it is called a false coelom.

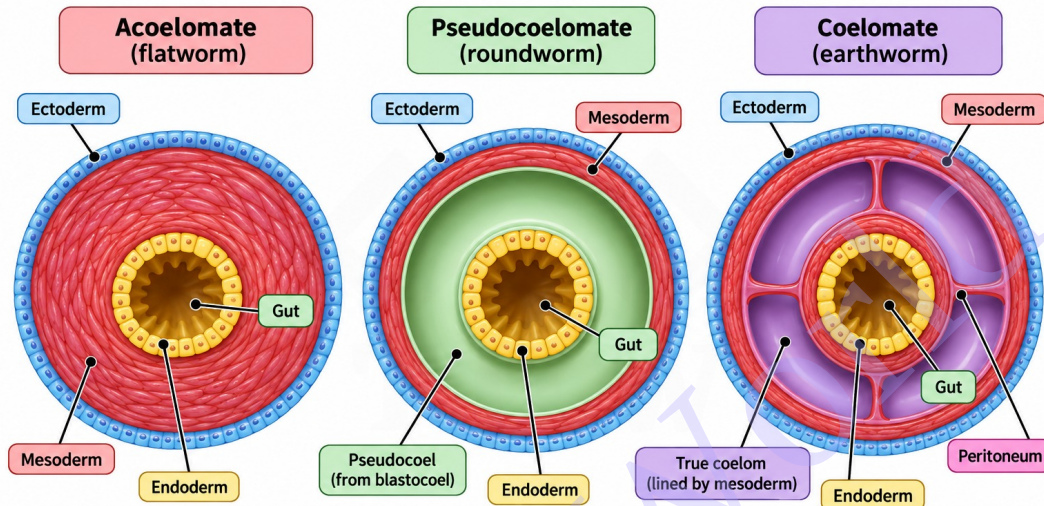


Fig. Acoelomate, pseudocoelomate and coelomate body plans, with the pseudocoel (from blastocoel) shown in the roundworm (asked part: pseudocoel).

Key Points:

- ♦ **Examples:** Roundworms (Aschelminthes) such as *Ascaris* are pseudocoelomates.
- ♦ **Blastocoel:** It is the fluid-filled cavity of the hollow ball-like blastula stage of the embryo, which stays on as the body cavity in roundworms.
- ♦ **Contrast:** A true coelom is lined by mesoderm and has a peritoneum, as in the earthworm.
- ♦ **Solid body:** Flatworms are acoelomates and have no body cavity between gut and body wall.

Other Options:

- (A) Haemocoel - a blood-filled body cavity of arthropods and molluscs, found in animals with an open circulatory system.
- (B) Schizocoel - a true coelom formed by splitting of the mesoderm, seen in annelids, molluscs and arthropods.
- (C) Enterocoel - a true coelom formed by pouches budding from the archenteron, seen in echinoderms and chordates.

Memory Hook:

Pseudo = from blastocoel; True = from mesoderm.





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