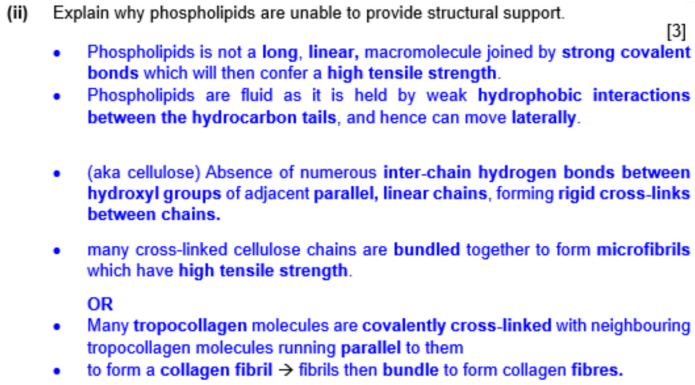
Lipids



(ii) Explain why phospholipids are unable to provide structural support. [3]

- Phospholipids is not a **long**, **linear,** macromolecule joined by **strong covalent bonds** which will then confer a **high tensile strength**.
- Phospholipids are fluid as it is held by weak **hydrophobic interactions between the hydrocarbon tails**, and hence can move **laterally**.
- (aka cellulose) Absence of numerous **inter-chain hydrogen bonds between hydroxyl groups** of adjacent **parallel, linear chains**, forming **rigid cross-links between chains.**
- many cross-linked cellulose chains are **bundled** together to form **microfibrils** which have **high tensile strength**.

OR

- Many **tropocollagen** molecules are **covalently cross-linked** with neighbouring tropocollagen molecules running **parallel** to them
- to form a **collagen fibril** → fibrils then **bundle** to form collagen **fibres.**

▼ Tips

- **Cross-refer to structures that provide strong structural support**
  - For example, tropocollagen molecules in proteins
  - Cellulose in carbohydrates
- Talk about the lack of strong bonds to form rigid cross-links between chains
  - Absence of inter chain hydrogen bonding between hydroxyl groups of adjacent parallel linear chains

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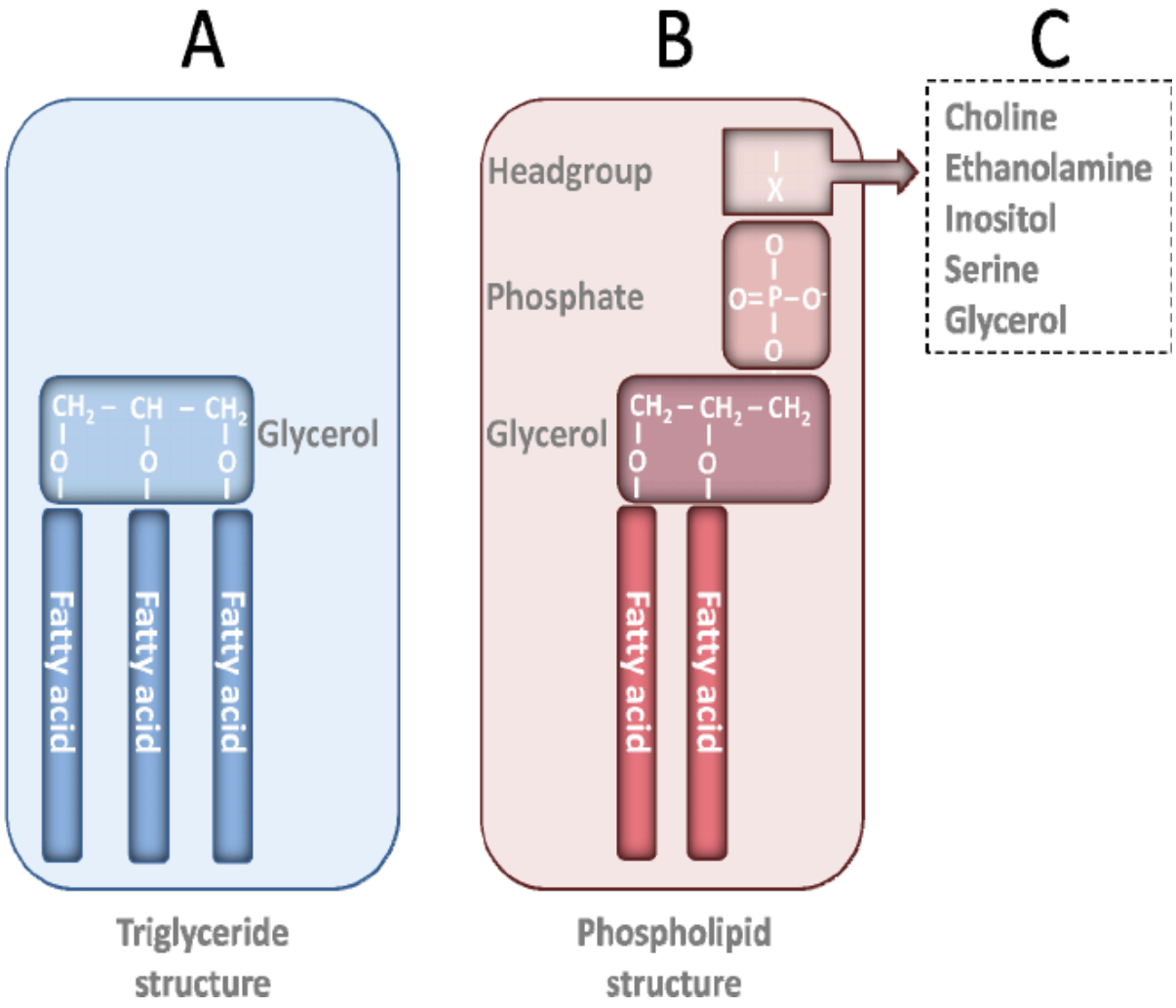
Compare triglycerides and phospholipids

	Phospholipids	Triglycerides
Solubility	Fatty acid tails are insoluble in aqueous medium as the long hydrocarbon chains that form the bulk of the molecule are hydrophobic Negatively charged phosphate	Insoluble in aqueous medium as they do not have any hydrophilic grouos

	Phospholipids	Triglycerides
	head soluble hence molecule is amphitatic	
Number of fatty acid residues	2	3
Intramolecular bonds	Phosphodiester bond and ester linkages	Only ester linkages
Function	Structural/biological membrane	Metabolic/energy reserve/respiratory substrate/insulation
Type of linkage	2 ester linkage	1 phosphoester linkage and 2 ester linkages

- both contain glycerol that is soluble in aqueous medium as it contains three hydroxyl groups which are hydrophilic
- Both contain fatty acids
- Fatty acid tails In both may differ in length/degree of saturation
- Both contains ester linkages



Why is the melting point of unsaturated fatty acids lower than saturated fatty acids

- kinks in unsaturated fatty acids tails prevent close packing of the molecules resulting in weaker hydrophobic interactions and intermolecular forces between adjacent fatty acid tails of unsaturated fatty acids and thus lower amount of energy needed to overcome these weak intermolecular forces

Function of triglycerides and phospholipids

- Phospholipid:

    - Form major components of cell membranes, where phospholipid molecules form bilayer in aqueous medium, where their polar heads point towards the aqueous medium and hydrocarbon tails from the hydrophobic core i.e forms cell surface membrane
    - Allows formation of organelles, facilitating compartmentalization of the cell, where specialized reactions can take place within the membrane-bound organelles
    - Hydrophilic/hydrophobic association with amphipathic proteins gives rise to lipoprotein
    - Hydrophobic core excludes large polar substances and charged particles from passing through the membrane, thus forming the basis for selective permeability of membranes and regulating the passage of substances in and out of the cell
    - Fluidity of unsaturated fatty acid chains allows lateral movement of membrane proteins
- Triglycerides
    - Serve as an excellent energy storage source, As it has a greater number of carbon and hydrogen atoms per gram, thus yielding a larger amount of energy when oxidized.
    - It serves as a good storage molecule also because it is insoluble in water and therefore does notcaffect the osmotic potential of the storage cell.
    - Produces metabolic water upon oxidation can be used by animals in dry habitats.
    - Serves as an insulator against heat loss (aquatic animals) and retains body heat (terrestrial animals).
    - Acts as an electrical insulator, speeding up the transmission of nerve impulses.
    - Provides aquatic animals with buoyancy.
    - Provides cushioning and protects delicate organs from damage / trauma.

Why are lipids better storage molecules than carbohydrates

- Lipids have a higher proportion of hydrogen and carbon per gram compared with carbohydrate
- When oxidized the same mass of lipids will be able to release more hydrogen ions during respiration Thus lipids are effective and efficient long term energy store, especially for hibernating animals;
- Also, when hydrogen part of triglyceride is oxidised, more metabolic water is produced as compared to same unit mass of carbohydrates.; Triglyceride is thus a better source of metabolic water than carbohydrate;
- Hydrogen has a lighter molecular weight than carbohydrates and thus lipids are less dense; This provides buoyancy especially for aquatic animals
- Lipids has about half the mass for the same amount of energy stored as compared to carbohydrates; Useful for animals in which locomotion requires body mass to be kept to a minimum;
- Lipids is a better thermal insulator than carbohydrates as they conduct heat slowly, thus reducing the loss of body heat; Important for mammals living in cold environment;
- Lipids aids in the absorption and storage of fat-soluble vitamins;
- Lipids also supplies essential fatty acids (such as linoleic acid) for proper growth and development.

Compare triglycerides and fatty acids

- A triglyceride is hydrophobic due to absence of carboxylic acid groups while a fatty acid is hydrophilic due to presence of carboxylic acid group
- A triglyceride has a glycerol joined to 3 fatty acids by 3 ester linkages while a fatty acid does not have any ester linkage and no glycerol

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Describe formation of bonds within glycerol and fatty acids

- An ester linkage is formed between a hydroxyl group of glycerol molecules and a carboxyl group of a fatty acid chain

- Via condensation reaction where a molecule of water is removed