2025 Ch H2 Q5

Section: Nature's Chemistry
Topic: Soaps, Detergents, Emulsions, Proteins, Fats and Oils

Question Summary:
This question involves solubility of sucrose, peptide hydrolysis, amino acids, fatty acids, terpenoids, functional groups, and a caffeine intake calculation.

Worked Solution

(a) Why sucrose is water soluble
Sucrose contains many hydroxyl (OH) groups. These form strong hydrogen bonds with water molecules. As a result, sucrose dissolves readily in water because extensive hydrogen bonding occurs between the sucrose molecules and the surrounding water.

(b)(i) Amino acid sequence of the original peptide
From the fragments:
Tyr–Pro–Phe
Gly–Pro–Phe
Iso–Pro–Gly–Pro

The full sequence is:
Tyr–Pro–Phe–Pro–Gly–Pro–Iso

(b)(ii) Term for amino acids the body cannot make
Essential amino acids.

(c)(i) Class of compounds to which edible oils belong
Edible oils are esters (specifically triglycerides).

(c)(ii)(A) Name of the other compound produced on hydrolysis
Glycerol (propane-1,2,3-triol).

(c)(ii)(B) Saturated fatty acid obtained from palm oil
Palmitic acid ($C_{15}H_{31}COOH$).

(c)(iii) Another name for hydrogenation of oils
Addition (reaction).

(d)(i) Systematic name for acetaldehyde
Ethanal.

(d)(ii) Functional group circled in furaneol

Alcohol (OH group).

(d)(iii)(A) Class of terpenoids to which cafestol belongs
Cafestol has 20 carbons → 4 isoprene units → a diterpenoid.

(d)(iii)(B) Isoprene unit circled for linalool
A correct circled isoprene unit must show a 5■carbon branched structure matching 2■methylbuta■1,3■diene.

(e) Maximum number of cups for a 66 kg adult
Recommended safe intake = 5.7 mg per kg
Total safe intake = 66 × 5.7 = 376.2 mg
Each cup contains 125 mg caffeine
Number of cups = 376.2 ÷ 125 = 3.0096 → 3 cups

Revision Tips

- Sucrose solubility comes from many OH groups forming hydrogen bonds.
- Peptide fragments can be reassembled by finding overlaps.
- Oils are triglycerides; hydrolysis produces glycerol + fatty acids.
- Terpenoids are classified by the number of isoprene units.
- Always round down when calculating a maximum safe number of consumable items.