

**Option A — Modern analytical chemistry**

- A1.** (a) *Monochromator:*  
allows only a narrow band/one frequency/wavelength/wavenumber (of IR radiation) to pass through;
- Splitter:*  
splits the (infrared) light into two beams (with the same wavelength);
- Reference:*  
absorbance/transmittance (of the reference) compared with/subtracted from absorbance/transmittance of sample / (the reference is) used to set the baseline / compare with sample/current / compensation for solvent / *OWTTE*; [3]
- (b) detector/sensor/photodiode/photomultiplier; [1]
- A2.** (a) *Qualitative:*  
identification of an unknown substance / identify presence/verify purity of an individual substance / determination of the qualitative composition of a mixture / *OWTTE*;
- Quantitative:*  
measurement of the concentration/amount/level of a substance in a solution/mixture/biological material / determination of the ratio of components/percentage composition of a mixture / *OWTTE*; [2]  
*Accept other general or specific uses.*
- (b) components dissolve in solvent/mobile phase;  
components adsorb onto stationary phase/SiO<sub>2</sub>;  
components have different affinities for stationary phase / different solubility in mobile phase;
- distribution/partition between a stationary phase and a mobile phase;  
components move only when they are in the mobile phase / components don't move when they are in/on the stationary phase / *OWTTE*;  
better soluble/less adsorbed components elute earlier / less soluble/better adsorbed component elute later / *OWTTE*; [4 max]  
*Accept silica/alumina etc. instead of stationary phase.*

A3. (a)

Chemical shift / ppm	Number of hydrogen atoms
1.0–1.1	3
2.15	3;
2.4–2.5	2;

[2]

(b)

Chemical shift / ppm	Splitting pattern	Number of adjacent hydrogen atoms
1.0–1.1	triplet	2
2.15	singlet	0
2.4–2.5	quartet	3

[2]

Award [1] for both splitting patterns correct.

Award [1] for both number of adjacent hydrogen atoms correct.

(c)  $\text{CH}_3\text{COCH}_2\text{CH}_3$  ;

[1]

Accept more detailed formula.

A4. (a) uses no ionizing radiation / uses low-energy radio waves / radio waves safer than x-rays / *OWTTE*;

[1]

Accept "does not damage body tissue".

(b) MRI is (usually) a proton NMR/ $^1\text{H}$ NMR;  
 (the states of) protons/hydrogen atoms in water/lipids/carbohydrates/proteins/  
 different (chemical) environments are detected;  
 different organs have different water concentration;  
 (strong) magnetic field **and** radio waves/frequency are used;  
 (by focusing the scanner on different parts of the body) three-dimensional/3-D  
 images of (organs in) the body are produced / *OWTTE*;

[3 max]

- A5. (a) increase in oxidation state causes greater splitting;  
change from H<sub>2</sub>O to NH<sub>3</sub> causes greater splitting;  
the greater the splitting, the higher the frequency (of absorbed light);  
(complexes of) Cr(III) absorb higher-frequency light than (complexes of) Cr(II) /  
(complexes with) NH<sub>3</sub> absorb higher-frequency light than (complexes with)  
H<sub>2</sub>O; [3 max]  
*Allow converse statements and OWTTE throughout.*
- (b) *Analysed solution:*  
 $1.43 \times 10^{-2} \text{ (mol dm}^{-3}\text{)}$ ;  
*Accept any value from  $1.40 \times 10^{-2}$  to  $1.46 \times 10^{-2}$ .*
- Sample:*  
 $0.286 \text{ mol dm}^{-3}$ ; [2]  
*Accept any value from 0.280 to 0.292.*
- (c) tetracene **and** greater number of conjugated (double) bonds/larger delocalized system / *OWTTE*; [1]

**Option B — Human biochemistry**

**B1.** (a) (plant) material/cellulose which is (mainly) indigestible/not hydrolysed (by human enzymes) / *OWTTE*; [1]

(b) provides bulk to the diet;  
 reduces appetite/intake of excessive food / prevents obesity;  
 prevents constipation / facilitates regular elimination / accelerates passage of food through digestive system;  
 regulates blood sugar / reduces the risk of diabetes;  
 reduces risk of hemorrhoids/bleeding of rectum wall/Crohn's disease/bowel cancer/disorders/IBS; [3 max]  
*Accept other examples.*

**B2.** (a) *Saturated:*  
 octanoic /  $C_7H_{15}COOH/CH_3(CH_2)_6COOH$  /  
 lauric /  $C_{11}H_{23}COOH/CH_3(CH_2)_{10}COOH$  /  
 palmitic /  $C_{15}H_{31}COOH/CH_3(CH_2)_{14}COOH$  /  
 stearic /  $C_{17}H_{35}COOH/CH_3(CH_2)_{16}COOH$  ;

*Mono-unsaturated:*

oleic /  $C_{17}H_{33}COOH/CH_3(CH_2)_7CH=CH(CH_2)_7COOH$  ;

*Poly-unsaturated:*

linoleic /  $C_{17}H_{31}COOH/CH_3(CH_2)_4(CH=CHCH_2)_2(CH_2)_6COOH$  /

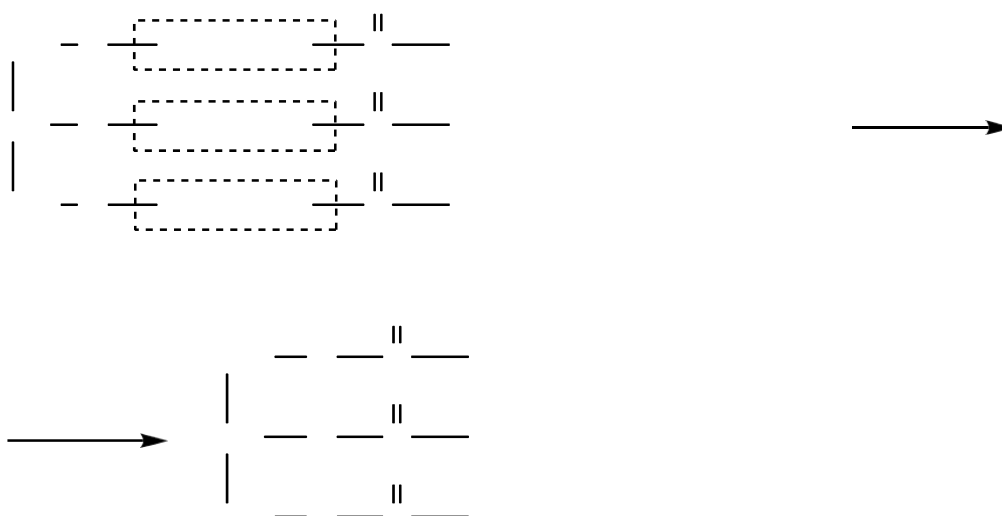
linolenic /  $C_{17}H_{29}COOH/CH_3CH_2(CH=CHCH_2)_3(CH_2)_6COOH$  ; [3]

*Accept name or formula.*

*Accept other correct examples of fatty acids.*

*Accept systematic names instead of trivial names.*

(b)



*This scheme is only one of many possible examples.*

the release of three molecules of water;

correct structure of all three ester groups;

[2]

*Accept more condensed structural formulas.*

*Ester group must be written correctly, glycerol-OOC-R (not glycerol-COO-R).*

*Do not penalize for minor mistakes in the hydrocarbon chains or the use of R.*

(c) (i) phospholipids **and** steroids;

[1]

*Do not accept cholesterol/other specific examples.*

(ii) all three types of lipids are (predominantly) hydrophobic/non-polar/consist mostly of hydrocarbon fragments;

triglycerides and (most) phospholipids contain (a fragment of) glycerol;

steroids are (poly)cyclic compounds/contain (several) rings;

phospholipids contain phosphate (group);

triglycerides and phospholipids are esters;

[2 max]

*Allow phosphoric acid/phosphorus instead of phosphate in phospholipids.*

*Allow cholesterol is (poly)cyclic compound/contains (several) rings as ECF from (i).*

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