JUNE 2004

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 40

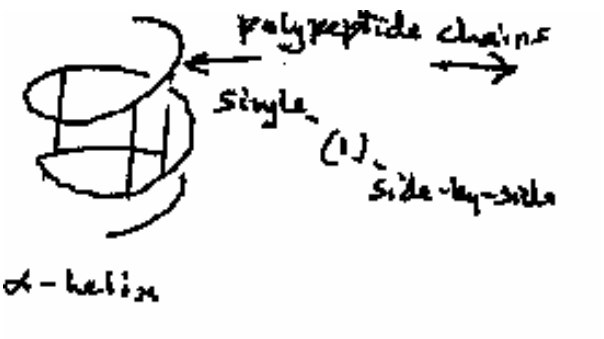
SYLLABUS/COMPONENT: 9701/06

CHEMISTRY
Options

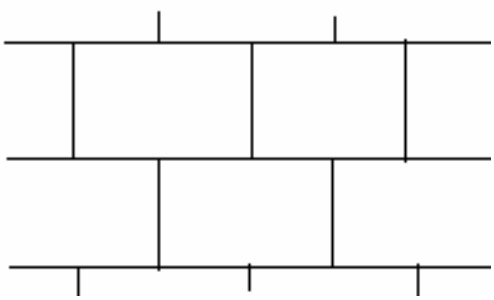
UNIVERSITY of CAMBRIDGE
International Examinations

Biochemistry

1. (a)



(1)



β – pleated sheet (1)

Stabilising bonds are C==O ||||||H—N (1)

[4]

(b) (i) pH changes affect R groups

High pH $-CO_2H + OH^- \rightarrow -CO_2^-$

or $-NH_3^+ + OH^- \rightarrow -NH_2$ (1)

Low pH $-NH_2. + H^+ \rightarrow -NH_3^+$

or $-CO_2^- + H^+ \rightarrow -CO_2H$ (1)

Change in pH breaks hydrogen bonds between groups (1)

Heavy metals form salts

$--CO_2H + Ag^+ \rightarrow --CO_2^- Ag^+ + H^+$ (1)

and break disulphide links

$--CH_2—S—S—CH_2-- + Cu^{2+} \rightarrow 2\ -CH_2—S^- Cu^{2+}$ (1)

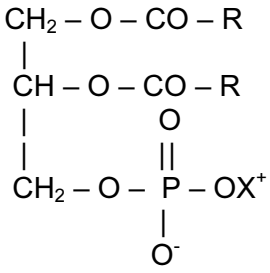
[5]

(c) The cooking of an egg - bonds are broken by heat

Or The solidifying of milk by bacteria in cheese/yoghurt - pH is changed

[1]

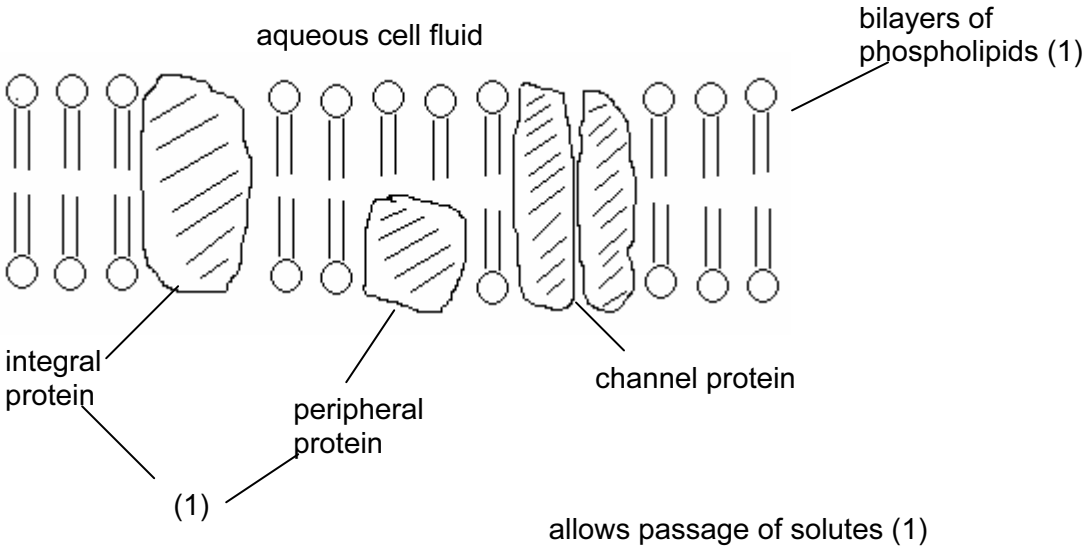
2. **(a)** **(i)**



glycerol (1)
ester displayed (1)
phosphate (1)

(ii) Phosphate has a negative charge on –P—O , positive on X (1)
[4]

(b)



allows passage of solutes (1)

Protein increases the flexibility of the bilayer (1)

van der Waals' forces between the alkyl groups of phospholipids (1)

ionic and H-bonds between phosphate residues / protein and the aqueous cell fluid (1)
[6]

Environmental Chemistry

3. **(a)** (i) At night plant respiration occurs, but negligible photosynthesis (1)

(ii) In winter lower temperatures and less sunlight reduce photosynthesis (1)

[2]

(b) (i) Two of : CH_4 N_2O, O_3, CFCs or H_2O (2 x 1)

(ii) Gases absorb infrared energy by increased bond vibration (1)
Some of this i.e. re-emitted back to Earth (1)

[4]

(c) CO_2 dissolves in water and can react to form HCO_3 and CO_3^- ions

$CO_2(g) \leftrightarrow CO_2(aq)$ (1)

$CO_2(aq) + H_2O \leftrightarrow H^+ + HCO_3^-$ (1)

$HCO_3 \leftrightarrow H^+ + CO_3^{2-}$ (1)

Some dissolved CO_2 is used by plankton in photosynthesis (1)

CO_2 is more soluble under pressure. (1)

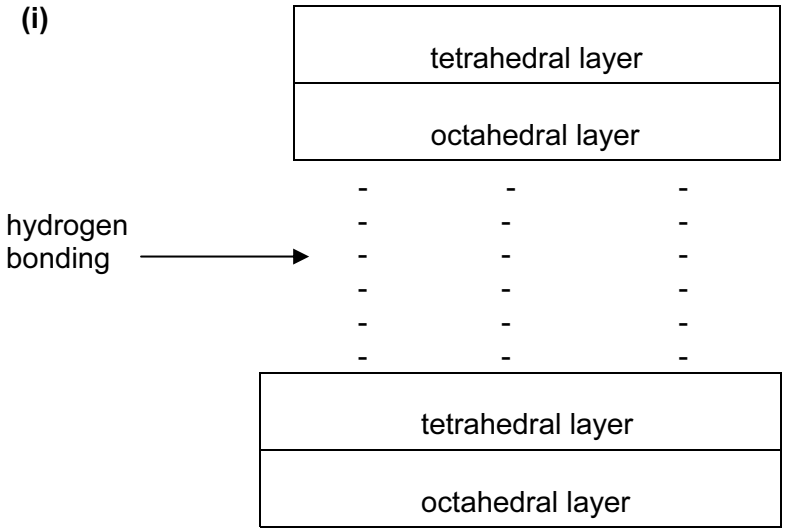
CO_3^{2-} ions can react with Ca^{2+} ions and $CaCO_3$ is precipitated (1)
[max 4]

4. **(a)** Gaps between small particles produce capillary action
or Water binds to minerals (1)

(b) In sandy soils, the decay of organic materials increases CO_2 levels in large pores (1)

In clay soils waterlogging produces reducing conditions promoting Anaerobic decomposition (1)

(c) **(i)**



(2)

(ii) Water cannot enter the gap between the layers due to hydrogen bonding between them (1)

Thus the soil does not expand on wetting or contract on drying out (1)
[4]

(d) Reduced by increased amount of humus (1)
Reduced by increased amount of Al^{3+} (1)

Increased by increased amount of Ca^{2+} (1)
[3]

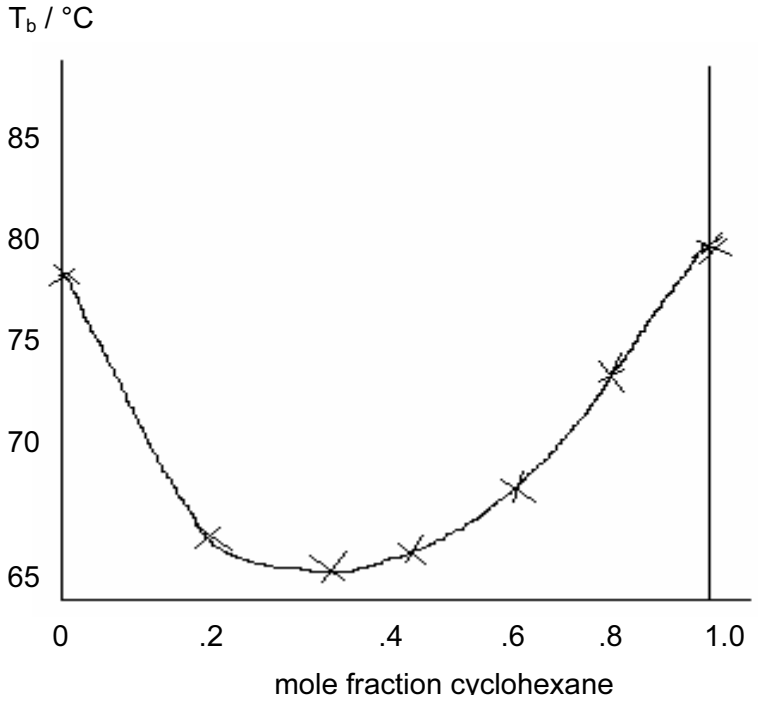
Phase Equilibria

5. **(a)** Enthalpy/energy required to convert one mole of the liquid into the gaseous phase (1)
[1]

(b) One correct observation about the difference in ΔH_{vap} with such different Values of M_r (1)

Cyclohexane — van der Waals' forces only, ethanol — H-bonding (1)

H-bonding stronger than van der Waals' (1)
[max 2]



axes (1)

points and plot (1)

(ii) 66.7°C at 0.3 mole fraction cyclohexane (1)
[3]

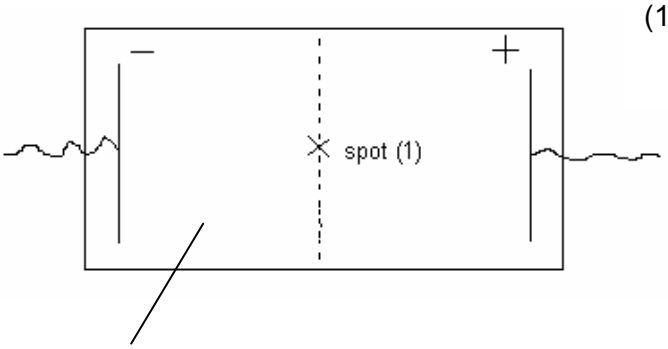
(d) **(i)** cyclohexane 0.3 x 35.7 = 10.7)
ethanol 0.7 x 83.9 = 58.7) (1)

ΔH_{vap} of mixture = 69.4 kJ mol^{-1} (1)

(ii) Mixing the two liquids will break the H-bonds in ethanol (1)
This reduces the ΔH_{vap} (1)
[4]

6. **(a)** **(i)** Reflux for a long period (6+ hours) with 6M HCl (1)
Use specified enzymes e.g. trypsin (1)

(ii)



(1)

kept wet in buffer (1)

(iii) From the positions to which they move (1)

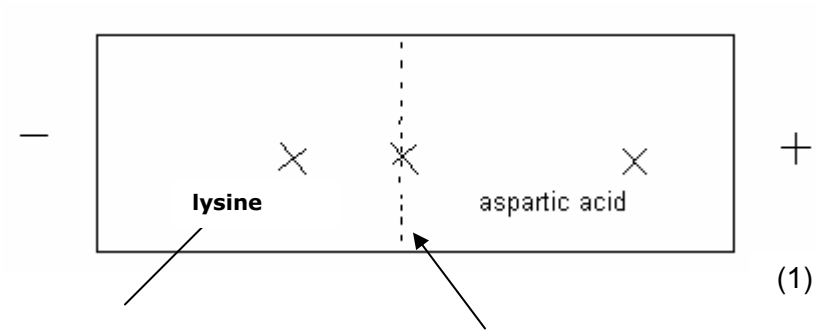
Under standard conditions (and times) (1)

Compare with reference samples (1)

Use of locating agent / ninhydrin / iodine (1)

[max 7]

(b)



(1)

moves to negative (1)
less movement than asp. (1)

glycine (1)

[max 3]

Spectroscopy

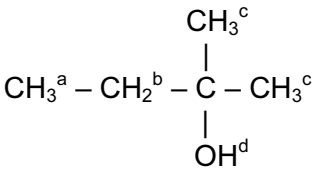
7. **(a)** Yellow colour of a sunflower is due to the other colours being absorbed OR only yellow being reflected (1)

Electrons move from low to higher energy orbitals (1)

Yellow colour of streetlights is due to emission (1)

Excited electrons fall from high to lower energy orbitals (1)
[4]

(b) **(i)**



Peak of height 6 at 1.2 δ is produced by H_c (1)

Peak of height 3 at 0.9 δ is produced by H_a (1)

Peak of height 2 at 1.5 δ is produced by H_b (1)

Peak of height 1 at 3.2 δ is produced by H_d (1)

(ii) Peak at 3.2 δ disappears (1)

-OH proton exchanges with D_2O (1)

D does not absorb (in this part of the spectrum) (1)
[6]

8. **(a)** C-O is composed of different atoms, which produces a dipole (1)

When the bond vibrates, the dipole changes, absorbing in the ir (1)
[2]

(b) 1740 cm^{-1} ⟶ C=O (1)

1050 cm^{-1} **OR** 1240 cm^{-1} ⟶ C—O (1)

Functional group is ester (1)
[max 2]

(c) M + 1 ⟶ ^{13}C (1)

M + 2 ⟶ Halogen atom (C*l* or Br) (1)

M + 4 ⟶ Second halogen atom (1)

M + 2 peak approx equal in height to M + 4 ⟶ Br (1)
[4]

(d) m/e 29 ⟶ $C_2H_5^+$ (1)

m/e 43 ⟶ $C_3H_7^+$ or CH_3CO^+ (1)
[2]

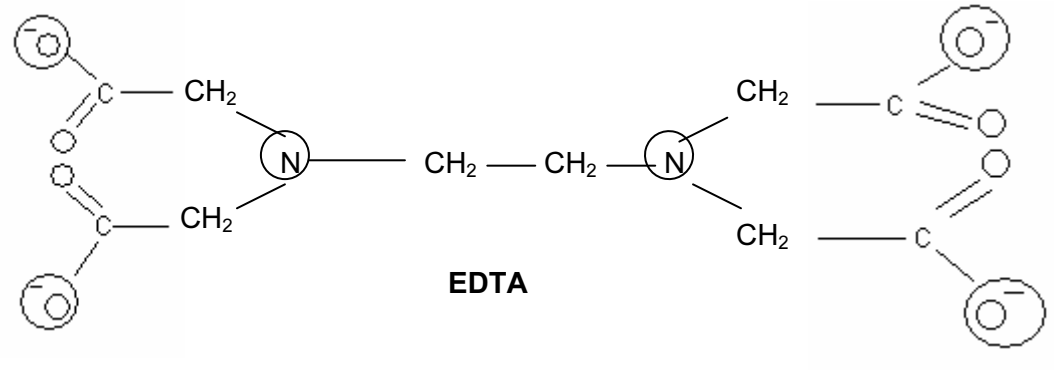
Transition Elements

9. **(a)** An atom, ion or molecule that has a lone pair of electrons (1)
that can form a dative bond to the metail ion (1)
[2]

(b) Examples – NH_3 or H_2O or Cl^- (1)

$H_3N: \longrightarrow Cr^{3+}$ or $H_2O: \longrightarrow Cr^{3+}$ or $^-Cl: \longrightarrow Cr^{3+}$ (1)

(c) **(i)**



EDTA

Oxygens circled (1), nitrogens circled (1)

(ii) K_c for the 2nd equilibrium is very large so well over to the RHS (1)

All Cd^{2+} ions will be complexed and flushed out via the kidneys (1)

Calcium is no problem since K_c is 10^6 smaller (1)

Zinc has a similar K_c to cadmium and will also be flushed out (1)

Solution is to give zinc as dietary supplement (1)
[max 6]

10. **(a)** **(i)** Green (1)

(ii) Purple (1)

(iii) $MnO_2 + ½\ O_2 + 2OH^- \rightarrow MnO_4^{2-} + H_2O$ (1)

(iv) $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ (1)
($H^+ + e^- \rightarrow ½\ H_2$ scores(1))

(v) $MnO_4^{2-} + H_2O \rightarrow MnO_4^- + ½\ H_2 + OH^-$ (1)

[5]

(b) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

(1) for correct species, (1) for balancing

[2]

(c) SO_3^{2-} requires 2 electrons change to SO_4^{2-}

Therefore Mn^{VII} has been reduced to Mn^{V} (1)

Suggest MnO_4^{3-} (1)

$SO_3^{2-} + MnO_4^- + 2OH^- \rightarrow MnO_4^{3-} + SO_4^{2-} + H_2O$ (1)

[3]