

**CAMBRIDGE**  
INTERNATIONAL EXAMINATIONS

**NOVEMBER 2002**

**GCE Advanced Level**

**MARK SCHEME**

**MAXIMUM MARK : 40**

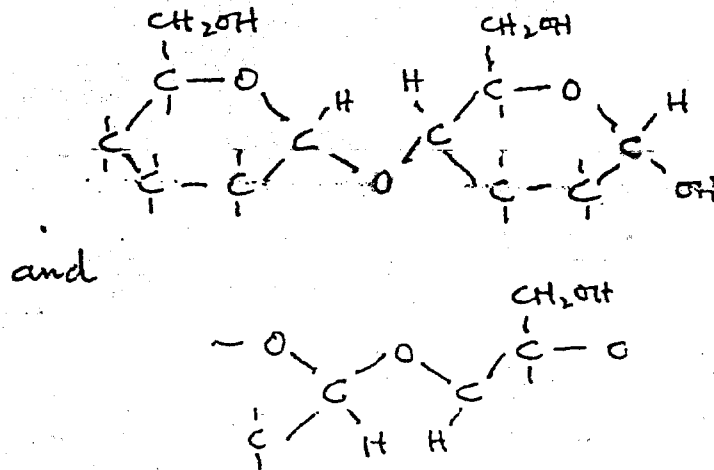
**SYLLABUS/COMPONENT :9701 /6**

**CHEMISTRY  
(OPTIONS (A2))**



**Biochemistry**

1. (a) (i)



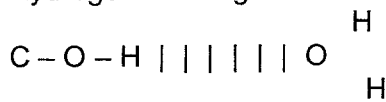
(2 x 1)

(ii) Chiral / anomeric / optically active centre is created since rotation is possible at C<sub>1</sub>

(1)  
[3]

(b) Hydrogen bonding

(1)



(1)  
[2]

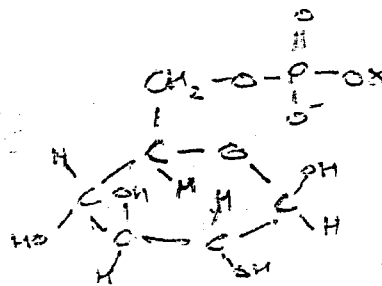
(c) (i) glucose + ATP => glucose-6-phosphate + ADP

(1)

an enzyme / hexokinase / glucokinase is needed

(1)

(ii)



(1)

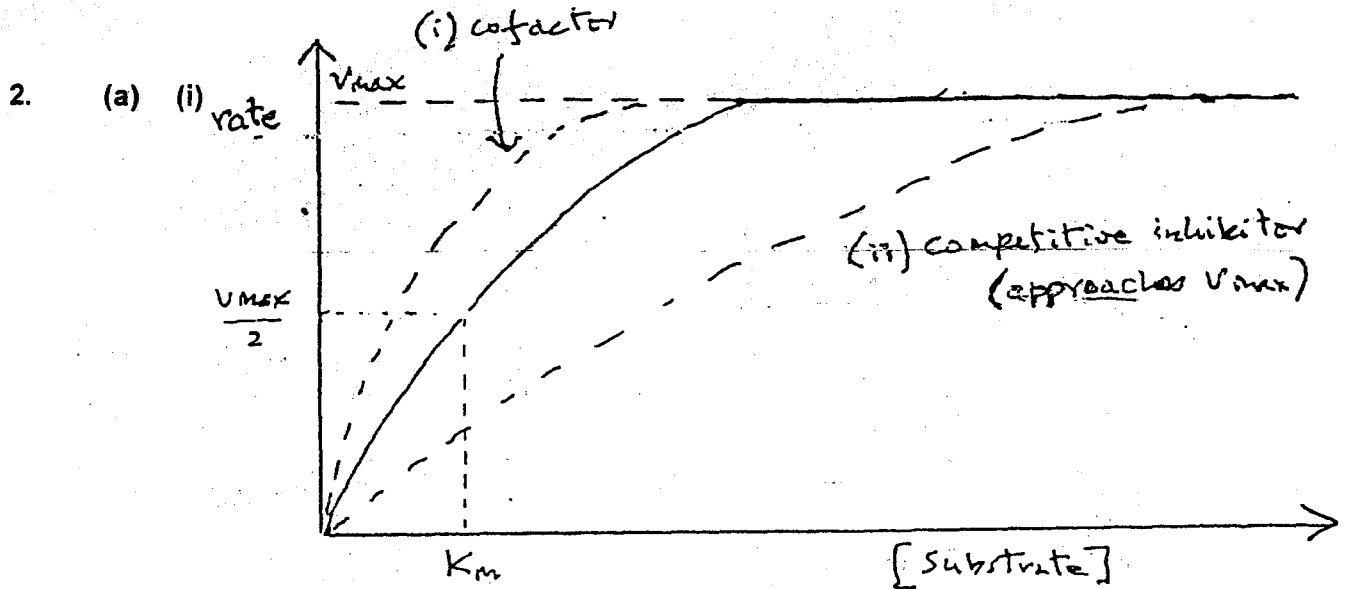
(iii) Glucose-6-phosphate is a competitive/reversible inhibitor

(1)

It fits into the active site on the enzyme/similar shape to glucose

(1)

[5]



Axes labelled (1)  
 Graph (1)  
 $V_{max}$  and  $V_{max}/2$  indicated (1)

(ii) Check lines on sketch above for  $V_{max}/2$  to give  $K_m$  as [S] (1)

(iii) The value of  $K_m$  shows the efficiency / effectiveness of the enzyme / affinity of the enzyme for the substrate / strength of the enzyme-substrate bond (1)

Small values for  $K_m$  indicate very efficient systems (1)  
 [6]

(b) (i) Correct line on sketch (1)  
 Competes for active sites on the enzyme (1)

(ii) Correct line on sketch (1)  
 Increase the efficiency of the enzyme (1)  
 [4]

### Environmental Chemistry

3. (a) Increased use of fertilisers (1)
- Leaching / runoff of soluble compounds such as nitrates (1)
- This increases the growth of algae (1)
- When these die and decay they use up dissolved oxygen / eutrophication (1)
- [4]
- (b) Water from the Baltic is less dense due to lower salinity **and** higher temperatures (**both** required) (1)
- (c) Nutrient levels are greatest in the North Sea water in which the algae grow (1)
- The 'jump' layer is not as mobile as the surface waters / little or no mixing (1)
- [2]
- (d) The algal decomposition mainly affects the deeper waters reducing the oxygen content (1)
- Oxygen loss is less significant at the surface (1)
- The smaller the cod populations, the fewer herrings are eaten (1)
- Cod are found at greater depths where the oxygen loss is greatest (1)
- [max 2]
- (e) This shows severely reducing conditions / a large oxygen loss. (1)

4. (a) Lack of flammability / inertness to combustion  
 Suitable volatility / easily liquefied  
 Lack of reactivity towards other chemicals present  
 Non-toxic [max 2]
- (b)  $\text{CFCl}_3 \Rightarrow \text{CFCl}_2\cdot + \text{Cl}\cdot$  (1)  
 $\text{Cl}\cdot + \text{O}_3 \Rightarrow \text{ClO}\cdot + \text{O}_2$  (1)  
 $\text{ClO}\cdot + \text{O} \Rightarrow \text{Cl}\cdot + \text{O}_2$  (1)  
 $\text{Cl}\cdot$  is recycled, and can thus destroy many ozone molecules (1)  
 [4]
- (c) (i) It breaks down more easily (1)  
 (ii) CFC-11 must have a shorter residence time than CFC-12 (1)  
 CFC-12 must have a very long residence time (> 100 years) (1)  
 [max 2]
- (d) HCFCs are more readily destroyed in the troposphere (1)  
 The C—H bond is more readily attacked, and this promotes the breakdown of the molecule (1)  
 Polarisation of the C-H bond (1)  
 [max 2]

### Phase Equilibria

5. (a) As the molecules gain energy (1)  
the forces between them become much weaker (1)  
The magnitude of the change is proportional to  $\Delta H_{\text{vap}}$  (1)  
[max 2]
- (b) (i)  $\text{H}_2\text{O}$  has a high b.p. due to hydrogen bonding (1)  
Diagram of water showing 2 H-bonds per molecule (1)  
 $\text{H}_2\text{S}$  to  $\text{H}_2\text{Te}$  have similar intermolecular dipole-dipole forces / van der Waals' (1)
- (ii)  $\text{H}_2\text{O} : \frac{40.7}{373} = 0.109$        $\text{H}_2\text{S} : \frac{18.7}{213} = 0.088$   
 $\text{H}_2\text{Se} : \frac{19.3}{243} = 0.079$        $\text{H}_2\text{Te} : \frac{23.2}{268} = 0.087$   
Four values (1)  
For similar bonding, b.p. and  $\Delta H_{\text{vap}}$  are proportional (1)  
Water has a higher ratio due to different / stronger hydrogen bonding (1)  
[max 5]
- (c) (i)  $P = P_A \times X_A$   
The vapour pressure exerted by a gas is proportional to its mole fraction (1)
- (ii) Law holds only for similar intermolecular forces /  $\text{H}_2\text{S}$  and  $\text{H}_2\text{Se}$  both have van der Waals' forces (1)  
 $\text{H}_2\text{O}$  and  $\text{H}_2\text{S}$  have different forces (1)  
[3]

6. (a) (i) Partition coefficient =  $\frac{[X]_{\text{solvent 1}}}{[X]_{\text{solvent 2}}}$  (1)

(ii)  $K = \frac{1.0 \times 10^{-2}}{4.0 \times 10^{-3}} = 2.5$  (1)

(iii) Let x mol of iodine be dissolved by the solvent

Then  $(4.0 \times 10^{-4} - x)$  mol  $I_2$  remain in  $100 \text{ cm}^3$  water (1)

And x mol  $I_2$  are present in  $50 \text{ cm}^3$  of solvent (1)

$$2.5 = \frac{[\text{Concn in solvent}]}{[\text{Concn in water}]} = \frac{20x}{10(4.0 \times 10^{-4} - x)}$$
 (1)

This gives  $20x = 25(4.0 \times 10^{-4} - x)$

$$45x = 10^{-2}$$

$$x = 2.2 \times 10^{-4} \text{ mol}$$
 (1)

Hence the concn of  $I_2$  in the solvent is  $20 \times 2.2 \times 10^{-4} \text{ mol dm}^{-3}$

or  $4.4 \times 10^{-3} \text{ mol dm}^{-3}$  (1)  
[max 6]

(b) (i) The solubility of a gas in a liquid is proportional to the (partial) pressure of the gas (1)

(ii) Solubility of  $N_2 = 0.79 \times 23.6 = 18.6 \text{ cm}^3 \text{ dm}^{-3}$  (1)

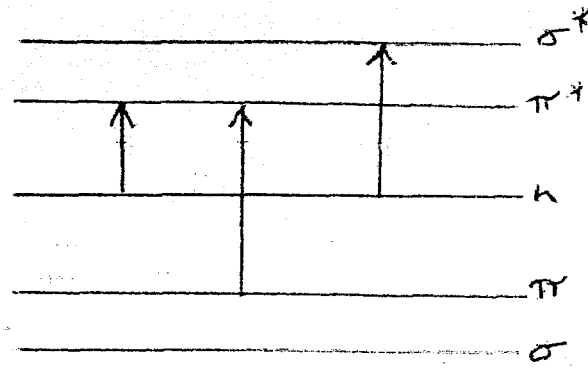
Solubility of  $O_2 = 0.20 \times 48.9 = 9.8 \text{ cm}^3 \text{ dm}^{-3}$  (1)

(iii) %  $N_2$  is  $\frac{18.6}{18.6 + 9.8} = \frac{18.6}{28.4} = 65.5\%$

And hence %  $O_2 = 34.5\%$  (1)  
[4]

Spectroscopy

7. (a)



-1 for every line over 3

(3 x 1)  
[3]



(2 x 1)  
[2]

-1 for every incorrect over 2

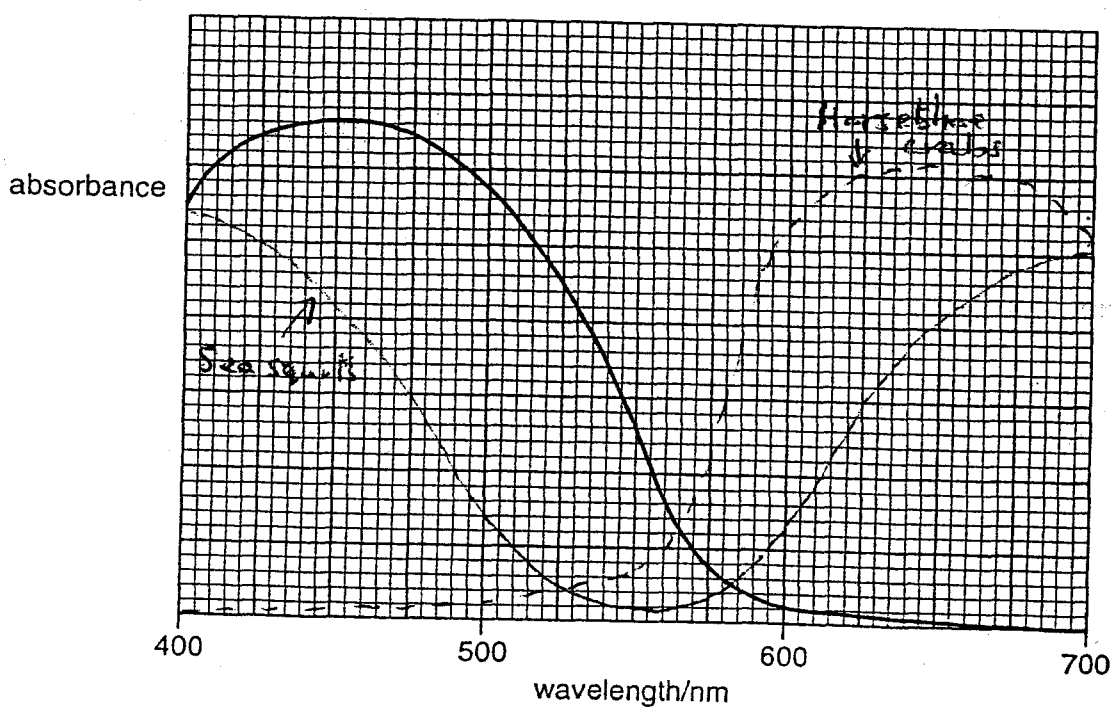
(c) (i) Diphenylmethanone will absorb at lower energy (longer wavelength) (1)

(ii) Energy levels are closer together (1)

hence less energy is required for transitions  
(allow longer chromophore / greater delocalisation / conjugation) (1)

[3]

(d)



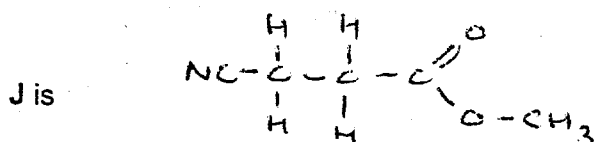
[2]



8. (a) (i) A suspension of an organic solid (1)  
in a hydrocarbon oil / Nujol (1)
- (ii) Ethanol shows a strong IR absorption due to –OH (1)  
It absorbs water which would attack the NaCl plates (1)  
[max 3]

(b) Q -C≡N                      R C=O                      S -C-O-

(3 correct 2 marks  
2 correct 1 mark)



Or ester isomers of the above, NOT –OH / –NH<sub>2</sub> containing isomers(1)  
[3]

- (c) (i) Peak is at M – 15, hence CH<sub>3</sub> has been lost (1)
- (ii) T to U is a loss of 30, suggests loss of CH<sub>2</sub>O or –CH<sub>2</sub>NH<sub>2</sub> (1)
- (iii) Ratio of M : M+1 gives  $n = \frac{0.11 \times 100}{2.5 \times 1.1}$  or 4 carbons (1)

If K is saturated, it will contain 8 hydrogens (C<sub>4</sub>H<sub>8</sub>O<sub>x</sub>) (1)

This leaves a mass of 32 for the oxygen

Hence K is C<sub>4</sub>H<sub>8</sub>O<sub>2</sub> (1)  
[max 4]

### Transition Elements

9. (a) Labelled diagram is acceptable (1)
- Impure copper anode, pure copper cathode (1)
- Copper is transferred to the cathode (or equations) (1)
- $\text{CuSO}_4(\text{aq})$  is the electrolyte (1)
- Silver settles as the metal in the anode sludge (1)
- Because  $E^\circ$  is more +ve than  $\text{Cu}^{2+}$  (1)
- Ni / Zn goes into solution as  $\text{M}^{2+}$  (1)
- Because their  $E^\circ$  is more negative than  $\text{Cu}^{2+}$  (1)
- [max6]
- (b) (i) Brass, with zinc; bronze, with tin etc (1)
- (ii) moles of  $\text{S}_2\text{O}_3^{2-} = 0.1 \times 20/1000 = 2 \times 10^{-3}$  mol (1)
- moles of  $\text{I}_2 = 1 \times 10^{-3}$  (1)
- moles of  $\text{Cu}^{2+} = 2 \times 10^{-3}$  (1)
- Mass of copper =  $63.5 \times 2 \times 10^{-3}$  g  
= 0.127 g
- Hence % copper = 50.8% (1)
- [4]

10. (a)  $[\text{Ar}]3d^4$  [1]

(b) Mn(II) colourless OR pale pink

Mn(III) red

Mn(VI) green

Mn(VII) purple

4 correct, 3 marks  
3 correct, 2 marks etc

[3]

(c) (i) From Data Book :  $4\text{MnO}_4^{2-} - 4e^- \Rightarrow 4\text{MnO}_4^-$   $E^\circ = 0.56\text{V}$  (1)

$5\text{MnO}_4^{2-} + 8\text{H}^+ \Rightarrow \text{Mn}^{2+} + 4\text{MnO}_4^- + 4\text{H}_2\text{O}$  (1)

$E^\circ_{\text{cell}} = +1.74 - 0.56 = +1.18\text{V}$  (1)

(ii) Oxidation no = +5 (1)

$8\text{H}^+ + 3\text{MnO}_4^{3-} \Rightarrow 2\text{MnO}_2 + \text{MnO}_4^- + 4\text{H}_2\text{O}$   
(1 for correct formulae, 1 for balancing)(2)

[6]