1 (a) (i) Haemoglobin binds carbon monoxide irreversibly; [1]

reducing the oxygen carrying capacity of haemoglobin [1]

(ii) bind to O_2 and transport to cells; [1]

haemoglobin has a higher affinity for oxygen in areas of high concentrations of oxygen (vice versa) ~~$Fe^{2+} \rightleftharpoons Fe^{3+} + e^-$~~; [1]

Quarternary; large surface area [1]

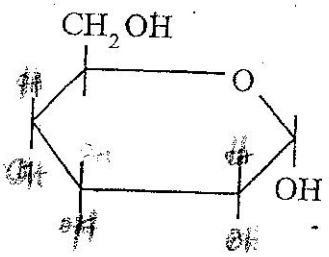
Haem chelates ~~Fe^{2+}/Fe^{3+}~~ enhances binding of O_2; [1]

(b)(c) Primary, secondary, tertiary quartenary [2]

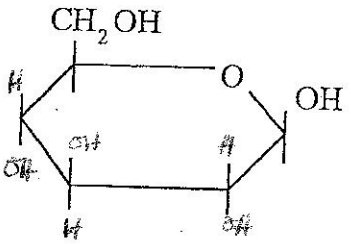
(c)(d) Fibrous – spiralling length for structural purposes; [1]

globular – folded to expose polar groups; [1]

2 (a) (i)



α glucose monomer of starch ; [1]



β glucose monomer of cellulose ; [1]

(ii) Glycosidic linkage; [1]

(iii) starch – storage; [1]

highly branched; [1]

cellulose – structural; [1]

rigid; [1]

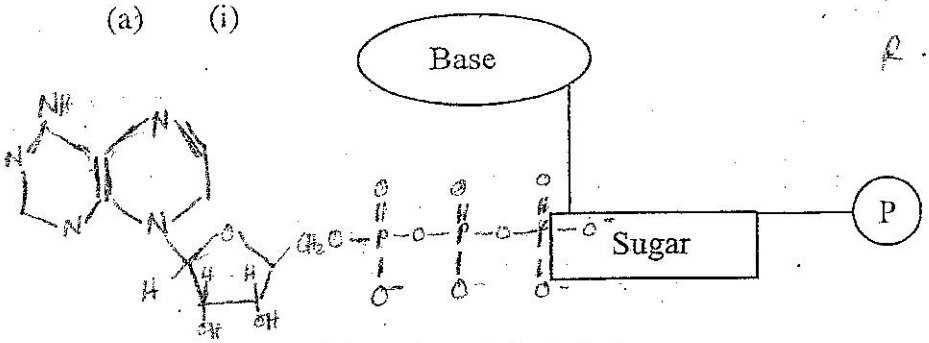
(b) sucrose soluble; [1]

starch and cellulose } insoluble ; [1]

solubilities differ as a result of degree of hydrogen bonding with water; [1]

[Total:10 marks]

(a) (i)



[1]

(ii) Adenosine triphosphate; [1]

Release of energy in reactions / hydrolysis; [1]

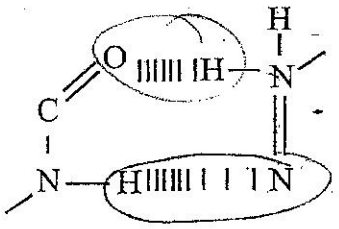
Ease of hydrolysis derived from repulsion between negatively charged phosphate groups; [1]

(b) (i) Transcribing genetic sequence of DNA; [1]

(ii) Store of genetic information in form of code / sequence of three bases; [1]

(c) GGA TCA ATC; [2]
(deduct [1] if one base is wrong)

(d) (i)



[1]

(ii) Hydrogen bond; [1]

[Total: 10 marks]

---

4 (a) - A gap exist between layers; [1]

- no hydrogen bonding between the layers; [1]

- removal of water causes lamellae to fall apart during drying; [1]

(b) - In acidic soils the silicate structure is destroyed; [1]

- Aluminium associated with clay become soluble in form of Al^{3+}; [1]

$$Al_2Si_2O_5(OH)_{4(aq)} + H^+_{aq} \rightarrow 2Al^{3+}_{(aq)} + 2[Si(OH)_4]_{(s)} + H_2O_{(l)};$$

(c) Al3+ has a high charge density which polarises the water molecule; [1]

$$\left[Al(H_2O)_6\right]^{3+}_{aq} \rightarrow \left[Al(H_2O)_5OH\right]^{2+}_{aq} + H^+_{aq}$$ [1]

(d) - increase in humus content; [1]
- respiration; [1]
- acid rain; [1]

ion uptake oxidation of NH4+ [Total:10 marks]

5 (a) **Decomposition zone**
- oxidation of organic material by bacteria; [1]
- oxygen concentration is reduced; [1]

Septic zone
- less organic material and oxidation process low oxygen remains constant; [1]

Recovery zone
- more oxygen is dissolved; [1]
- oxygen concentration restored; [1]

Clean zone
- clean water restored; [1]
- oxygen concentration high; [max 4]

(b) (i) Biological oxygen demand; / Biochemical Oxygen [1]

(ii) - oxygen quantity in fresh water determined; [1]
- sealed sample allowed to stand for a period of time oxygen quantity determined again; [1]
- Difference in two values is the B.O.D; [1]

(c) - sedimentation and flocculation; [1]
- filtration; [1]
- chlorination; [1] [max 2]

[Total:10 marks]

6 (a) - Eutrophication
Proliferation of plants; Clogging of water ways
- Penetration of light is reduced to submerged plants reducing photosynthesis;
- Reduced oxygen leading to anaerobic reactions causing foul smelling substances e.g NH_3, H_2S;
- Dying of aquatic animals;
- Wastes from industries may contain heavy metals which poison aquatic animals; [max 4]

(b) (i) - Production of dioxins; [2]
which are carcinogenic; / toxic

(ii) - Recreational beaches are ruined by oil washed ashore;
- Seabirds covered with oil cannot fly – drown; [max 2]
- Oxygen dissolved in water is reduced;
- Toxic to aquatic / marine life.

leachate

(iii) - Production of greenhouse gases; landfill gas
- Production of organic acids;

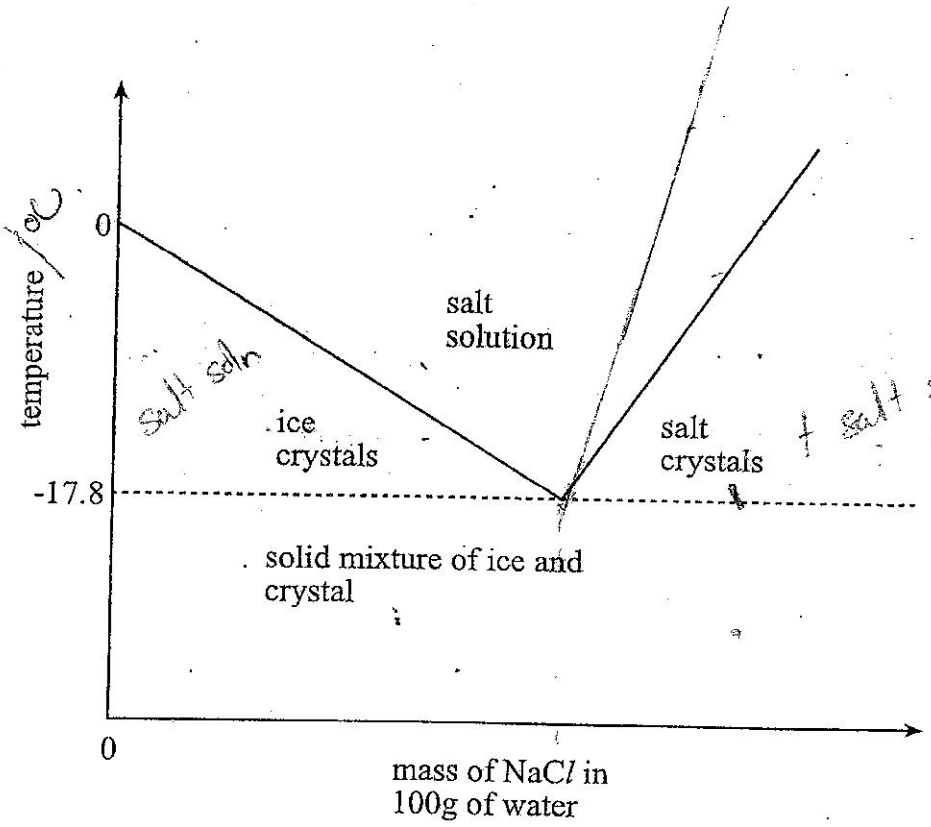
[2]
[Total: 10 marks]

7 (a)

; gel [1]

Separation based on mass to charge ratio; diagram [1]
DNA is negative and migrate to anode; + ve ions + cathode [1]
Electrophoresis pattern unique for an individual; [1]
~~Disease-causing genes also analysed;~~ ~~[1]~~

(b)



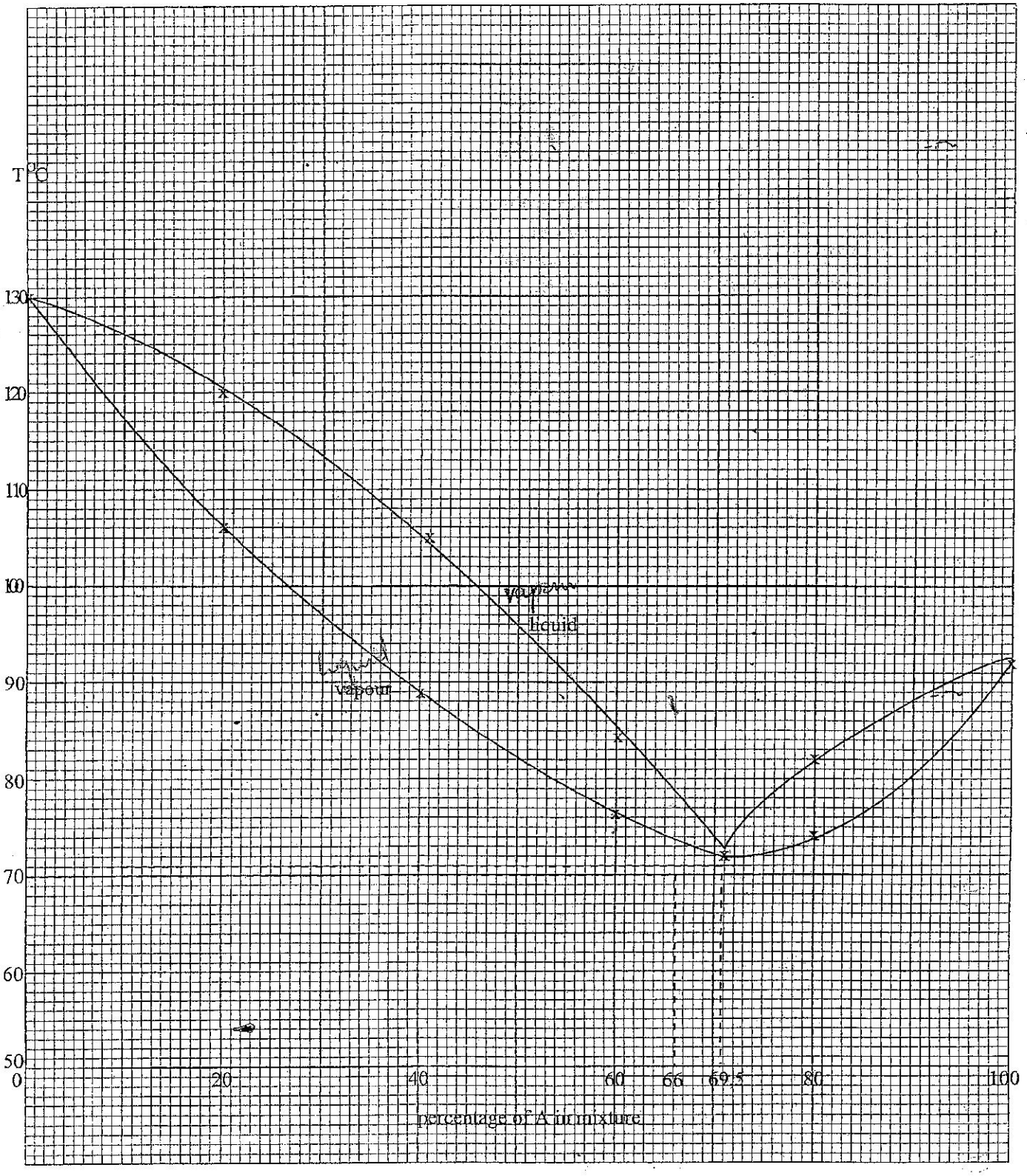
Correctly labelled axis; [1]
Labelled sections; 1 mark for 2; [2]
Correct temperatures shown 0°C and – 17°C; [1]

(c) Low melting point; [1]
sharp melting point / solidification /AW; [1]
conducts electricity; [1]
max 2

8 (a) (i) separation of components of a liquid mixture of different boiling points; [1]

(ii) length of fractionating column; [1]
size of packing material; [1]
bigger

(b) (i)



Labelled axis; units [1]

Correct points plotted; ~~Points correctly joined~~ [1]

Points correctly joined and ~~curves labelled~~; curves labelled [1]

curves - labelled

~~[3]~~

(ii) 1. 71°C correctly read from graph; [1]

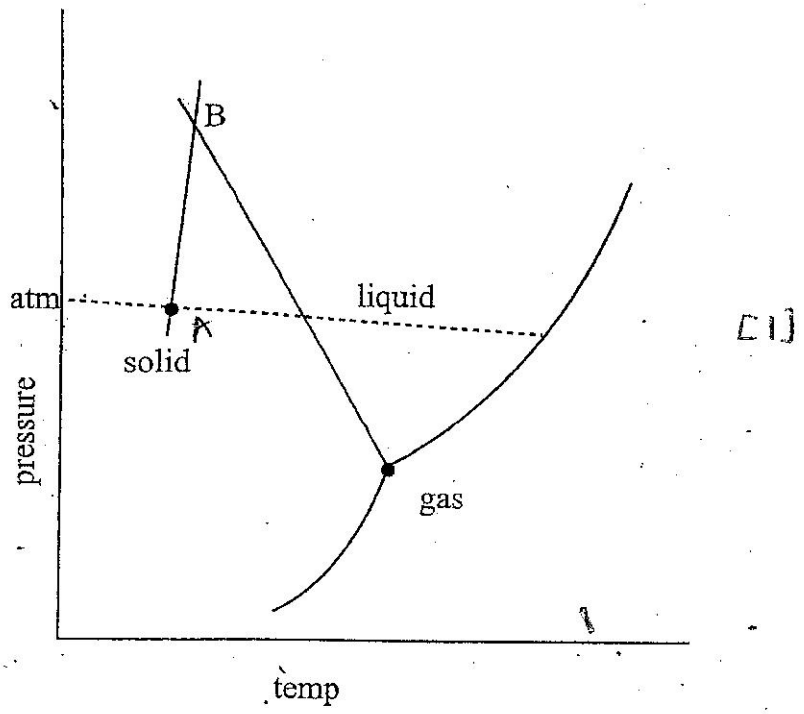
2. 69.5% A / 30.5% B; [1]

3. 70°C / correctly read from graph [1]

(iii) Illustration of plates on diagram / correctly identified on graph; [1]

[Total:10 marks]

9 (a)



At point A the phase is solid; [1]

Weights increase pressure below the wire; [1]

Phase changes to liquid and wire cuts through; [1]

Liquid above wire is at low pressure so changes to solid state; [1]

Phase diagram; [1]

Max 4

(b) $P = x_{solv} P^0_{solvent} + x_{solute} P^0_{solute}$; [1]

vapour pressure lowered in solution than in pure solvent; [1]

less solvent molecules on the surface; [1]

non volatile solute has negligible vapour pressure; [1]

boiling point elevated; [1]

freezing point lowered; [1]

[Total:10 marks]

10 (a) (i) NH_4^+; [1]

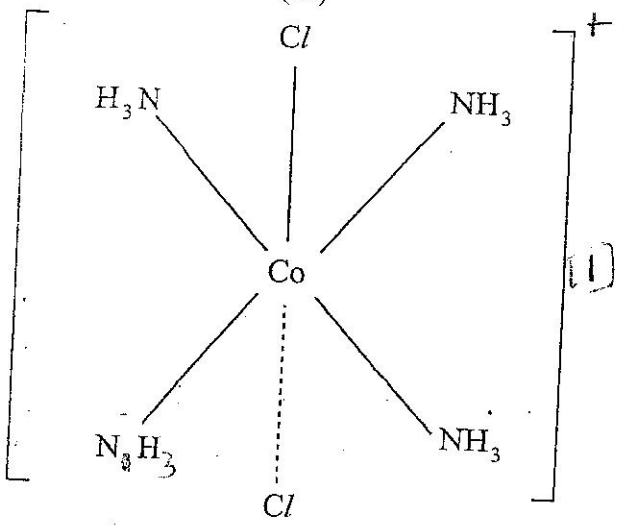
(ii) has no lone pairs / cannot form coordinate covalent bonds; [1]

(b) (i) +3; [1]

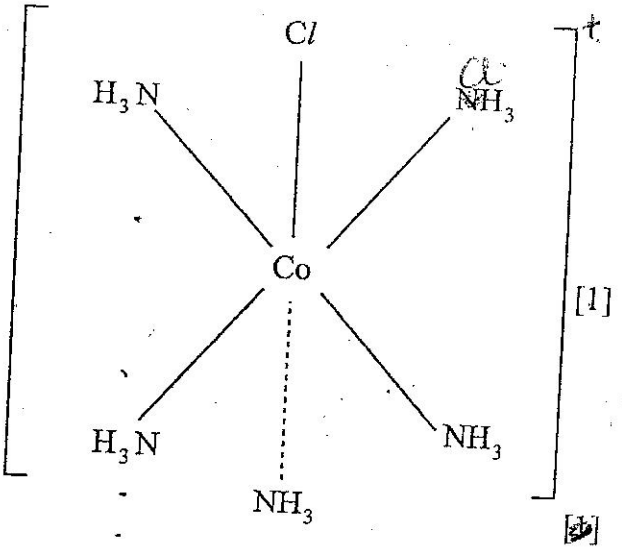
6; [1]

(ii) octahedral; [1]

(iii)



[1]



[1]

geometrical isomers; [1]

(c) $2Fe^{3+} + 2I^-_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + I_{2(aq)}$; [1]

$S_2O_8^{2-}{}_{(aq)} + 2Fe^{2+} \rightarrow 2SO_4^{2-}{}_{(aq)} + 2Fe^{3+}_{(aq)}$; [1]

~~Fe^{3+} ions effectively interacts with the negative species;~~ ~~[1]~~

[Total:10 marks]

11 (a) (i) x = 1; [1]

y = 2; [1]

(ii) +1; [1]

(iii) $2Fe^{3+} + 3Sal^- \rightleftharpoons [Fe_2(Sal)_3]^{3+}$ [2]

(iv) $K_{stab} = \dfrac{[Fe_2(Sal)_3]^{3+}}{[Fe^{3+}]^2[Sal^-]^3}$ [1]

(b) ~~Fe^{3+} is complex ion;~~

splitting of 'd' orbitals; [1]

movement of electrons from lower to upper; [1]

absorption of light / complementary colour is seen. [1]

(a) (i) Bidentate ligand – molecule offering two sets of bonding pairs of electrons for dative bonding; eg ethylene diamine / ethane dioic acid; [2]

Polydentate – three or more; eg EDTA; [2]

(ii) $\left[M\left(H_2O\right)_6\right]^{n+}_{(aq)} + 6L(aq) \rightleftharpoons \left[ML_6\right]^{n+}_{(aq)} + 6H_2O_{(l)}$; [1]

($[H_2O]$ being constant;)

$K_{stab} = \dfrac{\left[ML_6\right]^{n+}}{\left[M\left(H_2O\right)_6\right]^{n+}[L]^6}$; [1]

(b) $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$; [1]

OH^- displaces Cl^- forming $\left[Cu(OH)_2\right]_{(s)}$ ~~white~~ blue ppt; [1]

~~existence of green colour as a mixture of blue and yellow because of~~ ligand strength OH^- is displaced by NH_3 in excess; [1]

~~$\left[Cu(OH)_2\right] + 4NH_3 \rightleftharpoons \left[Cu(NH_3)_4\right]^{2+}$, deep blue~~ [1]

$K_{stab}\ \left[Cu(NH_3)_4\right]^{2+} > \left[CuCl_4\right]^{2-}$; so favoured [1] [5 max 4]

[Total: 10 marks]