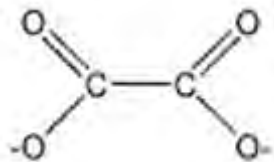


- M1.(a)** (i) absorbs (certain frequencies of) (white) light / photons
not absorbs white / u.v. light 1
- d* electrons excited / promoted
 or *d* electrons move between levels / orbitals
d electrons can be implied elsewhere in answer 1
- the colour observed is the light not absorbed / light reflected / light transmitted
allow blue light transmitted
penalise emission of light in M3 1
- (ii) ΔE is the energy gained by the (excited) electrons (of Cu^{2+})
allow:
- *energy difference between orbitals / sub-shells*
 - *energy of photon / light absorbed*
 - *change in energy of the electrons energy lost by excited electrons*
 - *energy of photon / light emitted*
- 1
- h (Planck's) constant 1
- ν frequency of light (absorbed by $\text{Cu}^{2+}(\text{aq})$)
do not allow wavelength
If energy lost / photon lost / light emitted in M1 do not penalised light emitted 1
- (iii) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+} + 4\text{Cl}^- \rightarrow [\text{CuCl}_4]^{2-} + 6\text{H}_2\text{O}$
note that $[\text{CuCl}_4]^{2-}$ is incorrect
penalise charges shown separately on the ligand and overall
penalise HCl 1
- tetrahedral 1
- Cl^- / Cl / chlorine too big (to fit more than 4 round Cu)
allow
water smaller than Cl^-

explanation that change in shape is due to change in co-ordination number

1

(b)



allow:

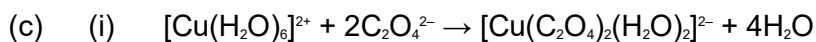
- ion drawn with any bond angles
- ion in square brackets with overall / 2- charge shown outside the brackets
- ion with delocalised O=C–O bonds in carboxylate group(s)

1

lone pair(s) on O / O

allow position of lone pair(s) shown on O in the diagram even if the diagram is incorrect.

1



product correct

1

equation balanced

1

6

note can only score M3 and M4 if M1 awarded or if complex in equation has 2 waters and 2 ethanedioates

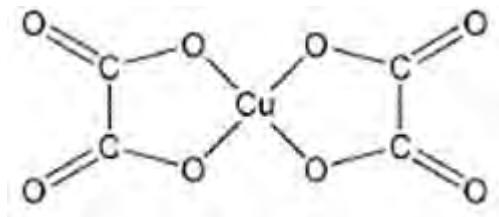
1

octahedral

If this condition is satisfied the complex can have the wrong charge(s) to allow access to M3 and M4 but not M1

1

(ii)



ignore charges

diagram must show both ethanedioates with correct bonding

ignore water

1

90°

allow 180°

mark bond angle independently but penalise if angle incorrectly labelled / indicated on diagram

1

[17]

M2.(a) (ligand) substitution

Allow 'ligand exchange'.

1

(b) To displace the equilibrium to the right

To ensure reaction goes to completion.

1

To improve the yield

Allow 'to replace all chlorines'.

1

(c) (i) $K_2PtCl_4 + 4KI \rightarrow K_2PtI_4 + 4KCl$

Allow correct ionic equations $PtCl_4^{2-} + 4I^- \rightarrow PtI_4^{2-} + 4Cl^-$

Allow multiples and fractions.

1

(ii) $= (780.9) \times 100 / (415.3 + 664)$

Working must be clearly shown.

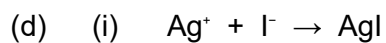
Allow one mark for correct relationship even if M_r values are incorrect eg using values from ionic equation.

1

= 72.4

Allow 72%

1



Ignore state symbols even if incorrect.

This equation only.

1

(ii) Stops the reverse reaction / equilibrium displaced to the right

1

(e) Number of steps in the process

Allow 'equilibrium may lie on the reactant side' / side reactions / isomer formation.

1

Losses at each stage of the synthesis

Equilibrium losses or practical losses or yield not 100% for each step.

1

(f) Minimum amount of hot solvent

Accept 'small' for minimum.

Accept water.

1

Cool / crystallise

1

Filter

1

(g) (i) Small amounts are more likely to kill cancer cells rather than the patient

1

(ii) Wear gloves / wash hands after use

Ignore masks.

Apply the list principle if more than one answer.

1

[15]

M3.(a) (i) $\text{EDTA}^{4-} + [\text{Cu}(\text{H}_2\text{O})_6]^{2+} \rightarrow [\text{Cu}(\text{EDTA})]^{2-} + 6\text{H}_2\text{O}$

1

(ii) (Mol EDTA = $(6.45/1000) \times 0.015 = 9.68 \times 10^{-5}$ mol Cu(II))

1

Conc. Cu(II) = $((9.68 \times 10^{-5}) / 0.025 =) 0.00387 \text{ mol dm}^{-3}$

Correct answer without working gains M2 only.

1

(b) Samples may not be consistent throughout the river

OR

Concentration may vary over time

Ignore comments on technique.

1

(c) $[\text{Ag}(\text{NH}_3)_2]^+$

Accept name eg diamminesilver(I) ion.

1

aldehyde

Allow CHO.

1

[6]