HTKK, TTKK, LTKK, OY, ÅA / Insinööriosastot

Valintakuulustelujen kemian koe 30.5.2002

1. Kun 0,225 g metallia M (moolimassa 27,0 g/mol) reagoi vetykloridin kanssa, muodostui metallikloridia ja vapautui 0,303 dm^3 vetykaasua 17 ^oC lämpötilassa ja 98,8 kPa paineessa.

   a) Mikä on muodostuneen metallikloridin kaava?
   b) Kirjoita näiden tietojen perusteella reaktioyhtälö.
   c) Anna myös kaava kyseessä olevan metallin M oksidille.

2. Veden pysyvä kovuus aiheutuu pääasiassa kalsium- ja magnesiumsulfaateista tai –klorideista. Kovuutta voidaan poistaa ioninvaihtomenetelmällä. Ioninvaihtomassat ovat liukenemattomia orgaanisia hartseja, joilla on kyky vaihtaa joko kationeja tai anioneja.

   Eräässä vesinäytteessä kovuuden aiheuttaja oli kalsiumsulfaatti $CaSO_4$. Kun tätä vettä valutettiin kationinvaihtohartsin ($R\text{-}SO_3H$, missä R on hiilivetyketju) läpi, veden kalsiumionit vaihtuivat hartsin vetyioneihin. 25 cm^3 ioninvaihdettua vettä titrattiin 0,0133 mol/dm^3 NaOH-liuoksella, jota kului 7,59 cm^3.

   a) Kirjoita ioninvaihdon reaktioyhtälö.
   b) Mikä oli vesinäytteen kovuus laskettuna mmol/dm^3 Ca^{2+}- ioneja?

3. 100 cm^3 neutraalia liuosta, joka sisälsi 1,572 g $CuSO_4 \cdot 5\ H_2O$, elektrolysoitiin, kunnes kaikki kupari oli saostunut katodilla. Anodilla syntyi samanaikaisesti vedestä happea. Kuparin saostumisen jälkeen elektrolyysiä jatkettiin vielä 7 min, jonka aikana katodilla tapahtui vetyionien pelkistyminen vedyksi ja anodilla jatkui hapen kehittyminen. Käytetty virta oli 1,2 A ja virtahyötysuhde 100 %.

   a) Kirjoita kaikki edellä mainitut elektrodireaktiot.
   b) Kuinka paljon aikaa kului kuparin saostamiseen?
   c) Kuinka monta cm^3 kaasuja (NTP) vapautui koko elektrolyysin aikana?
   d) Mikä oli liuoksen pH silloin, kun kupari oli saostunut?

4. a) Täydennä ja tasapainota seuraavat reaktioyhtälöt:

   1) $WO_3\ (s) + H_2\ (g) \rightarrow$

   2) $KNO_3\ (s) \xrightarrow{\text{kuum.}}$

   3) $Na_2CO_3\ (s) + HCl\ (aq) \rightarrow$

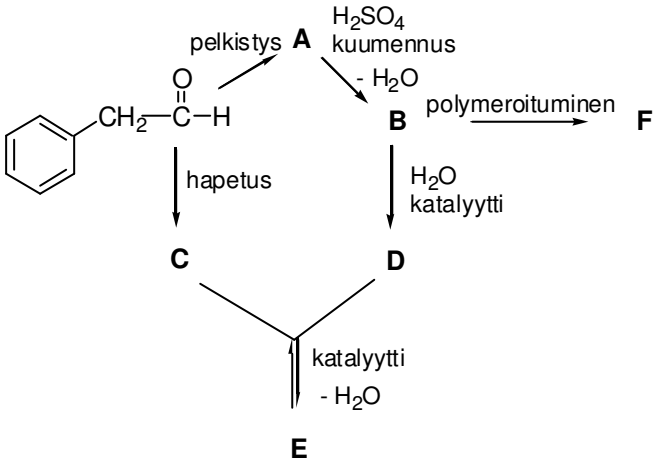
b) Yhdistä alkuaine tai yhdiste ja sen sovellus:

AgBr	mikropiirit
S	pronssi
Cr	sementti
H_2O_2	pigmentit
MnO_2	valokuvaus
Na_2CO_3	ruostumaton teräs
NH_4NO_3	valkaisu
Si	teflon
TiO_2	räjähdysaineet
Sn	lasin valmistus
$CaCO_3$	kumin vulkanointi
F	paristot

5. Esitä esimerkkirakennekaavat seuraaville orgaanisille yhdistetyypeille ja nimeä yhdisteet:

a) aromaattinen amiini
b) viisihiilinen *cis*-alkeeni
c) halogeenialkaani, jossa on asymmetrinen hiiliatomi
d) tertiäärinen alkoholi
e) aromaattinen alkoholi
f) heterosyklinen yhdiste

6. Esitä seuraavassa reaktiosarjassa muodostuvien yhdisteiden **A** – **F** rakennekaavat.



R = 8,314 J mol^{-1} K^{-1}, F = 96500 As mol^{-1}, V_m = 22,4 dm^3 mol^{-1}

Alkuaineiden moolimassoja:

Alkuaine:	H	O	S	Cu
M / g mol^{-1}:	1,01	16,00	32,06	63,55

HTH, TTH, VTH, UU, ÅA / Ingenjörsavdelningarna

Inträdesförhör i kemi 30.5.2002

1. Då 0,225 g av metallen M (molmassa 27,0 g/mol) reagerade med väteklorid bildades metallklorid och samtidigt utvecklades 0,303 dm^3 vätgas vid temperaturen 17 ^oC och trycket 98,8 kPa.

   a) Vilken är formeln för den metallklorid som bildades?
   b) Skriv reaktionslikhet med hjälp av ovanstående uppgifter.
   c) Ange också formeln för oxiden för ifrågavarande metall M.

2. Permanent hårdhet hos vatten orsakas främst av kalcium- och magnesiumsulfater eller –klorider. Vatten kan avhärdas med hjälp av jonbytarmetoden. Jonbytarmassorna består av olösliga organiska hartser, som kan byta antingen katjoner eller anjoner.

   I ett vattenprov orsakades hårdheten av kalciumsulfat $CaSO_4$. Då detta vatten fick passera genom katjonbytarharts (R-SO_3H, där R är en kolvätekedja) byttes vattnets kalciumjoner mot hartsens vätejoner. 25 cm^3 jonbytt vatten titrerades med 0,0133 mol/dm^3 NaOH-lösning, av vilken det gick åt 7,59 cm^3.

   a) Skriv reaktionslikhet för jonbytet.
   b) Beräkna vattenprovets hårdhet i mmol/dm^3 Ca^{2+}- joner.

3. 100 cm^3 neutral lösning, som innehöll 1,572 g $CuSO_4 \cdot 5\ H_2O$, elektrolyserades tills all koppar hade fällts ut på katoden. Vid anoden utvecklades samtidigt syre ur vattnet. Efter kopparutfällningen fortsattes elektrolysen ännu 7 min. Under denna tid reducerades vätejoner till väte vid katoden och syreutvecklingen fortsatte vid anoden. Strömmen var konstant 1,2 A och strömutbytet 100 %.

   a) Skriv alla ovannämnda elektrodreaktioner.
   b) Hur lång tid tog det att fälla ut all koppar?
   c) Hur många cm^3 gaser (NTP) utvecklades under hela elektrolysen?
   d) Vad var lösningens pH då all koppar fällts ut?

4. a) Komplettera och balansera följande reaktionslikheter:

   1) $WO_3\ (s) + H_2\ (g) \rightarrow$

   2) $KNO_3\ (s) \xrightarrow{\text{upphettn.}}$

   3) $Na_2CO_3\ (s) + HCl\ (aq) \rightarrow$

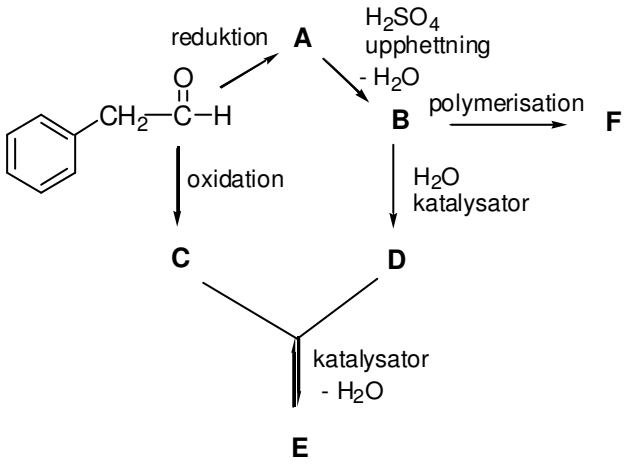
b) Kombinera följande grundämnen och föreningar med rätt tillämpningar:

AgBr	mikrokretsar
S	brons
Cr	cement
H_2O_2	pigment
MnO_2	fotografering
Na_2CO_3	rostfritt stål
NH_4NO_3	blekning
Si	teflon
TiO_2	sprängämnen
Sn	framställning av glas
$CaCO_3$	vulkanisering av gummi
F	batterier

5. Ge exempel på nedanstående typer av organiska föreningar. Skriv strukturformel för varje förening och namnge den.

a) en aromatisk amin
b) en *cis*-alken med fem kolatomer
c) en halogenalkan med en asymmetrisk kolatom
d) en tertiär alkohol
e) en aromatisk alkohol
f) en heterocyklisk förening

6. Skriv strukturformler för föreningarna **A** – **F** , som bildas i nedanstående reaktionsserie.



R = 8,314 J mol^{-1} K^{-1}, F = 96500 As mol^{-1}, V_m = 22,4 dm^3 mol^{-1}

Grundämnenas molmassor:

Grundämne:	H	O	S	Cu
M / g mol^{-1}:	1,01	16,00	32,06	63,55

ENTRANCE EXAMINATION AT THE UNIVERSITIES OF TECHNOLOGY IN FINLAND (HELSINKI, TAMPERE, LAPPEENRANTA, OULU, ÅBO)

Chemistry Exam 30 May 2002

1. When 0.225 g of metal M (molar mass 27.0 g/mol) reacted with hydrogen chloride, metal chloride was formed and 0.303 dm^3 hydrogen gas was released at the temperature of 17 ^oC and at the pressure of 98.8 kPa.

   a) What is the formula of the metal chloride formed?
   b) Write the reaction equation based on these facts.
   c) Give also the chemical formula for the oxide of metal M.

2. Permanent hardness of water is mainly caused by calcium and magnesium sulfates or chlorides. Hardness can be removed by ion exchange method. Ion exchange masses are insoluble organic resins which can exchange either cations or anions.

   In a water sample the hardness was caused by calcium sulfate $CaSO_4$. When this water was passed through a cation exchange resin (R-SO_3H where R is a hydrocarbon chain), the calcium ions of water were replaced by the hydrogen ions of the resin. 25 cm^3 of the ion exchanged water was titrated with 0.0133 mol/dm^3 NaOH solution. The consumption of NaOH was 7.59 cm^3.

   a) Write the reaction equation of the ion exchange.
   b) What was the hardness of the water sample calculated as mmol/dm^3 Ca^{2+} -ions?

3. 100 cm^3 of neutral solution containing 1.572 g $CuSO_4 \cdot 5\ H_2O$ was electrolyzed until all copper was precipitated at the cathode. At the same time oxygen originating from water was evolved at the anode. After all copper had precipitated the electrolysis was still continued for 7 minutes during which time the hydrogen ions were reduced to hydrogen at the cathode while at the anode the evolution of oxygen was continued. The current used was 1.2 A and the current efficiency was 100 %.

   a) Write all the above mentioned electrode reactions.
   b) How long did it take to precipitate copper?
   c) What was the volume of gases (cm^3, NTP) released during the whole electrolysis?
   d) What was the pH of the solution when copper had precipitated?

4. a) Complete and balance the following reaction equations:

   1) $WO_3\ (s) + H_2\ (g) \rightarrow$

   2) $KNO_3\ (s) \xrightarrow{\text{heat}}$

   3) $Na_2CO_3\ (s) + HCl\ (aq) \rightarrow$

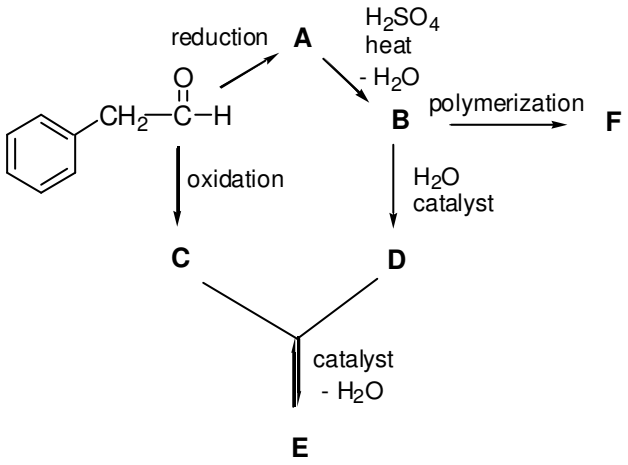
b) Combine an element or a compound with its application:

AgBr	micro circuits
S	bronze
Cr	cement
H_2O_2	pigments
MnO_2	photography
Na_2CO_3	stainless steel
NH_4NO_3	bleaching
Si	Teflon
TiO_2	explosives
Sn	manufacture of glass
$CaCO_3$	vulcanization of rubber
F	batteries

5. Give the examples of structural formulas for the following types of organic compounds and name the compounds:

a) an aromatic amine
b) a *cis*-alkene with five carbon atoms
c) a halogenated alkane which has an asymmetric carbon atom
d) a tertiary alcohol
e) an aromatic alcohol
f) a heterocyclic compound

6. Give the structural formulas for compounds **A – F** formed in the following reaction series.



R = 8.314 J mol^{-1} K^{-1}, F = 96500 As mol^{-1}, V_m = 22.4 dm^3 mol^{-1}

Molar masses of the elements:

Element:	H	O	S	Cu
M / g mol^{-1}	1.01	16.00	32.06	63.55

HTKK, TTK, LTKK, OY, ÅA/Insinööriosastot
Kemian pääsykoetehtävien 2002 malliratkaisut

1. a) $M + x\,HCl \rightarrow x/2\,H_2 + MCl_x$

$n_M = 0{,}225\ g / 27\ g\ mol^{-1} = 0{,}00833\ mol$

$PV = nRT \Rightarrow n = PV/RT$

$n(H_2) = 98{,}8 \cdot 10^3\ Nm^{-2} \cdot 0{,}303 \cdot 10^{-3}\ m^3 / (8{,}314\ J\ mol^{-1}\ K^{-1} \cdot 290\ K) = 0{,}01242\ mol$

$n(HCl) = n(Cl) = 2 \cdot n(H_2) = 2 \cdot 0{,}01242\ mol = 0{,}02484\ mol$

$n(M) = 0{,}00833\ mol / 0{,}00833\ mol = 1$
$n(Cl) = 0{,}02484\ mol / 0{,}00833\ mol = 2{,}98 \cong 3$

$\Rightarrow n(M) / n(Cl) = 1:3 \Rightarrow$ <u>Kloridin kaava = MCl_3</u>

b) $M + 3\,HCl \rightarrow 3/2\,H_2 + MCl_3 \quad / x2$

<u>$2\,M + 6\,HCl \rightarrow 3\,H_2 + 2\,MCl_3$</u>

c) oksidi: <u>M_2O_3</u>

2. a) $2\,R\text{-}SO_3H + Ca^{2+} \rightarrow (R\text{-}SO_3)_2Ca + 2H^+$

b) Titraus: $H^+ + OH^- \rightarrow H_2O$

$c(NaOH) = 0{,}0133\ mol/dm^3, \quad V(NaOH) = 7{,}59\ cm^3$

$n(NaOH) = c \cdot V = 0{,}0133\ mol/dm^3 \cdot 7{,}59 \cdot 10^{-3}\ dm^3 = 0{,}100947\ mmol$

$n(H^+) = n(OH^-) = 0{,}100947\ mmol$

$n(Ca^{2+}) = ½\ n(H^+) = 0{,}05047\ mmol$

Näytteen tilavuus oli $25\ cm^3$. $c\,(Ca^{2+}) = n/V = 0{,}05047 \cdot 10^{-3}\ mol / 25 \cdot 10^{-3}\ dm^3$
$= 2{,}02 \cdot 10^{-3}\ mol/dm^3$

$\Rightarrow$ Vesinäytteen kovuus : <u>$2{,}02\ mmol/dm^3$</u>

3. a) 1. Kuparin saostus: $Cu^{2+} + 2e^- \rightarrow Cu$ (katodi)

2. Hapen kehittyminen: $2\,H_2O \rightarrow O_2\,(g) + 4\,H^+ + 4e^-$ (anodi)

3. Vedyn kehittyminen: $2\,H^+ + 2e^- \rightarrow H_2\,(g)$ (katodi)

b) $m(CuSO_4 \cdot 5\,H_2O) = 1{,}572\ g;\ M(CuSO_4 \cdot 5\,H_2O) = 249{,}71\ g/mol$

$n(CuSO_4 \cdot 5\ H_2O) = m/M = 0{,}0063\ mol = n(Cu)$

$n = I\ t / Z\ F \ \Longrightarrow\ t = n\ Z\ F / I$

$t = 0{,}0063\ mol \cdot 2 \cdot 96500\ As\ mol^{-1} / 1{,}2\ A\ =\ 1013{,}25\ s\ =\ \underline{16{,}9\ min}$

c) Happea kehittyy sekä 1. että 2. vaiheessa.

$t_{kok} = 16{,}9\ min + 7\ min = 23{,}9\ min$

$n\ (O_2) = I\ t / Z\ F\ =\ 1{,}2\ A \cdot 23{,}9 \cdot 60\ s / 4 \cdot 96500\ As\ mol^{-1}\ =\ 0{,}00446\ mol$

Vetyä kehittyy 2. vaiheessa ; t = 7 min

$n\ (H_2) = I\ t / Z\ F\ =\ 1{,}2\ A \cdot 7 \cdot 60\ s / 2 \cdot 96500\ As\ mol^{-1}\ =\ 0{,}00261\ mol$

Kaasuja yhteensä: 0,00446 mol + 0,00261 mol = 0,00707 mol

$V_m = 22{,}4\ dm^3/mol \ \Longrightarrow\ V = 22{,}4\ dm^3/mol \cdot 0{,}00707\ mol\ =\ 0{,}1584\ dm^3\ =\ \underline{158{,}4\ cm^3}$

d) Kun kupari on saostunut, liuokseen on syntynyt ylimäärin H^+- ioneja.

$\Longrightarrow\ 2\ H_2O\ \rightarrow\ O_2 + 4\ H^+ + 4\ e^-$

$n\ (O_2) = 1{,}2\ A \cdot 16{,}9 \cdot 60\ s / 4 \cdot 96500\ As\ mol^{-1}\ =\ 0{,}00315\ mol$

$n\ (H^+) = 4 \cdot n\ (O_2) = 4 \cdot 0{,}00315\ mol = 0{,}01261\ mol$

$pH = -lg\ [H^+]\ ;\ V_{liuos} = 0{,}1\ dm^3 \ \Longrightarrow\ [H^+] = n/V = 0{,}01261\ mol / 0{,}1\ dm^3 =$

$0{,}1261\ mol / dm^3 \ \Longrightarrow\ \underline{pH =}\ -lg\ 0{,}1261 = \underline{0{,}9}$

4. a) 1. $WO_3\ (s) + 3\ H_2\ (g)\ \rightarrow\ W\ (s) + 3\ H_2O$

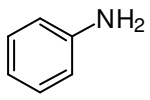
2. $2\ KNO_3\ (s)\ \rightarrow\ 2\ KNO_2\ (s) + O_2\ (g)$

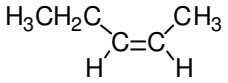
3. $Na_2CO_3\ (s) + 2\ HCl\ (aq)\ \rightarrow\ 2\ NaCl\ (aq) + CO_2\ (g) + H_2O\ (l)$

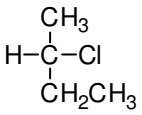
b)

$AgBr$	↔	valokuvaus
S	↔	kumin vulkanointi
Cr	↔	ruostumaton teräs
H_2O_2	↔	valkaisu
MnO_2	↔	paristot
Na_2CO_3	↔	lasin valmistus
NH_4NO_3	↔	räjähdysaineet
Si	↔	mikropiirit
TiO_2	↔	pigmentit
Sn	↔	pronssi
$CaCO_3$	↔	sementin valmistus
F	↔	teflon

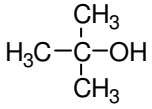
5.

a)  aniliini (hyväksyttäviä muita nimiä: fenyyliamiini, aminobentseeni)
[rakennekaavan tulee sisältää vähintään tämä rakenneosa]

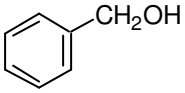
b)  *cis*-2-penteeni (*Z*-2-penteeni)

c)  2-klooributaani

myös muita mahdollisia rakenteita

d)  *tert*-butanoli (*t*-butanoli) tai 2-metyyli-2-propanoli

myös muita mahdollisia rakenteita

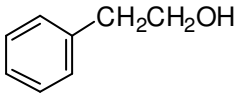
e)  bentsyylialkoholi tai fenyylimetanoli

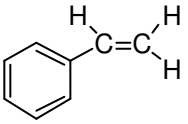
myös muita mahdollisia rakenteita, huom. ei fenoli!

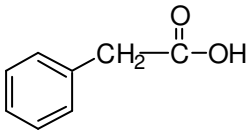
f)  pyridiini

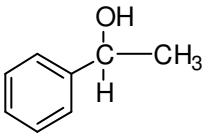
myös muut heterosykliset yhdisteet (aromaattiset ja alifaattiset) hyväksytään

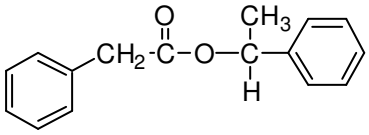
6.

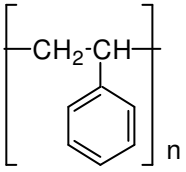
A 

B 

C 

D  (Markovnikov)

E 

F 

ENTRANCE EXAMINATION AT THE UNIVERSITIES OF TECHNOLOGY IN FINLAND (HELSINKI, TAMPERE, LAPPEENRANTA, OULU, ÅBO)

Model Solutions (Chemistry Exam 30.5.2002)

1. a) $M + x\,HCl \rightarrow x/2\,H_2 + MCl_x$

$n_M = 0.225\ g / 27\ g\ mol^{-1} = 0.00833\ mol$

$PV = nRT \Rightarrow n = PV/RT$

$n(H_2) = 98.8 \cdot 10^3\ Nm^{-2} \cdot 0.303 \cdot 10^{-3}\ m^3 / (8.314\ J\ mol^{-1}\ K^{-1} \cdot 290\ K) = 0.01242\ mol$

$n(HCl) = n(Cl) = 2 \cdot n(H_2) = 2 \cdot 0.01242\ mol = 0.02484\ mol$

$n(M) = 0.00833\ mol / 0.00833\ mol = 1$
$n(Cl) = 0.02484\ mol / 0.00833\ mol = 2.98 \cong 3$

$\Rightarrow n(M) / n(Cl) = 1:3 \Rightarrow$ <u>The formula of the chloride = MCl_3</u>

b) $M + 3\,HCl \rightarrow 3/2\,H_2 + 2MCl_3 \quad / x2$

<u>$2\,M + 6\,HCl \rightarrow 3\,H_2 + 2\,MCl_3$</u>

c) oxide: <u>M_2O_3</u>

2. a) $2\,R\text{-}SO_3H + Ca^{2+} \rightarrow (R\text{-}SO_3)_2Ca + 2H^+$

b) Titration: $H^+ + OH^- \rightarrow H_2O$

$c(NaOH) = 0.0133\ mol/dm^3$, $V(NaOH) = 7.59\ cm^3$

$n(NaOH) = c \cdot V = 0.0133\ mol/dm^3 \cdot 7.59 \cdot 10^{-3}\ dm^3 = 0.100947\ mmol$

$n(H^+) = n(OH^-) = 0.100947\ mmol$

$n(Ca^{2+}) = ½\ n(H^+) = 0.05047\ mmol$

The volume of the sample was $25\ cm^3$. $c(Ca^{2+}) = n/V = 0.05047 \cdot 10^{-3}\ mol / 25 \cdot 10^{-3}\ dm^3 = 2.02 \cdot 10^{-3}\ mol/dm^3$

$\Rightarrow$ The hardness of the water sample is: <u>$2.02\ mmol/dm^3$</u>

3. a) 1. Presipitation of copper: $Cu^{2+} + 2e^- \rightarrow Cu$ (cathode)

2. Evolution of oxygen: $2\,H_2O \rightarrow O_2 + 4\,H^+ + 4e^-$ (anode)

3. Evolution of hydrogen: $2\,H^+ + 2e^- \rightarrow H_2$ (cathode)

b) $m(CuSO_4 \cdot 5\,H_2O) = 1.572\ g$; $M(CuSO_4 \cdot 5\,H_2O) = 249.71\ g/mol$

$n(CuSO_4 \cdot 5\ H_2O) = m/M = 0.0063$ mol = n(Cu)

$n = I\ t / Z\ F \implies t = n\ Z\ F / I$

$t = 0.0063$ mol $\cdot 2 \cdot 96500$ As mol^{-1} / 1.2 A = 1013.25 s = <u>16.9 min</u>

c) Oxygen is evolved both in stage 1 and stage 2.

$t_{tot} = 16.9$ min + 7 min = 23.9 min

$n(O_2) = I\ t / Z\ F = 1.2$ A $\cdot 23.9 \cdot 60$ s / $4 \cdot 96500$ As $mol^{-1} = 0.00446$ mol

Hydrogen is evolved in stage 2 ; t = 7 min

$n(H_2) = I\ t / Z\ F = 1.2$ A $\cdot 7 \cdot 60$ s / 2 96500 As $mol^{-1} = 0.00261$ mol

Gases together: 0.00446 mol + 0.00261 mol = 0.00707 mol

$V_m = 22.4\ dm^3/mol \implies V = 22.4\ dm^3/mol \cdot 0.00707$ mol = 0.1584 dm^3 = <u>158.4 cm^3</u>

d) When copper has been precipitated exess of H^+- ions has evolved into the solution.

$\implies 2\ H_2O \rightarrow O_2 + 4\ H^+ + 4\ e^-$

$n(O_2) = 1.2$ A $\cdot 16.9 \cdot 60$ s / $4 \cdot 96500$ As $mol^{-1} = 0.00315$ mol

$n(H^+) = 4 \cdot n(O_2) = 4 \cdot 0.00315$ mol = 0.01261 mol

$pH = -\lg [H^+]$; $V_{solution} = 0.1\ dm^3 \implies [H^+] = n/V = 0.01261$ mol / 0.1 dm^3 =

0.1261 mol / dm^3 ==> <u>pH =</u> -lg 0.1261 = <u>0.9</u>

4. a) 1. $WO_3\ (s) + 3\ H_2\ (g) \rightarrow W\ (s) + 3\ H_2O$

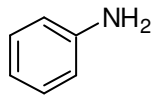
2. $2\ KNO_3\ (s) \rightarrow 2\ KNO_2\ (s) + O_2\ (g)$

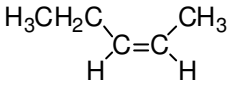
3. Na_2CO_3 (s9 + 2 HCl (aq) $\rightarrow$ 2 NaCl (aq) + CO_2 (g) + H_2O (l)

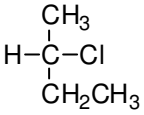
b)

AgBr	↔	photography
S	↔	vulcanization of rubber
Cr	↔	stainless steel
H_2O_2	↔	bleaching
MnO_2	↔	batteries
Na_2CO_3	↔	manufacture of glass
NH_4NO_3	↔	explosives
Si	↔	micro circuits
TiO_2	↔	pigments
Sn	↔	bronze
$CaCO_3$	↔	cement
F	↔	Teflon

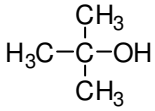
5.

a)  aniline (other acceptable names: phenylamine, aminobenzene)
the structural formula must contain this structural unit

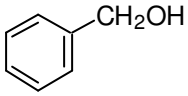
b)  *cis*-2-pentene (*Z*-2-pentene)

c)  2-chlorobutane

also other possible structures

d)  *tert*-butanol (*t*-butanol) or 2-methyl-2-propanol

also other possible structures

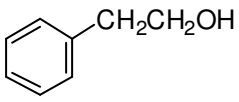
e)  benzylalcohol (or phenylmethanol)

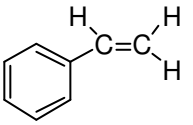
also other possible structures, notify: not phenol!

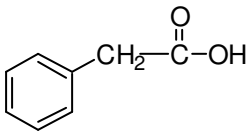
f)  pyridine

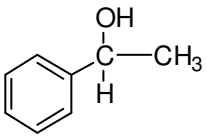
also other heterocyclic compounds (aromatic and aliphatic) will be accepted

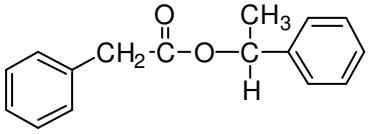
6.

A 

B 

C 

D  (Markovnikov)

E 

F