CHEMISTRY.
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SwissChO 2023 - Central Exam

Instructions

- Write your name on each page and number these.
- You have three hours to solve the problems. Wait for the **START** signal before you begin.
- Use a new page for each problem.
- Write all necessary calculations legibly.
- Put your pages into the provided envelope at the end of the exam. Do not seal the envelope.
- Finish your work immediately when the **STOP** signal is given.
- Leave your seat only when allowed to do so.
- Only **answers written on the answer sheets** can be considered.
- This exam has 20 pages.

Viel Erfolg!

Bonne chance!

Buona fortuna!

Good luck!

CONSTANTS AND FORMULAE

Avogadro constant	$N_A = 6.022 \cdot 10^{23}\ \mathrm{mol^{-1}}$	Ideal gas law	$pV = nRT$
Universal gas constant	$R = 8.314\ \mathrm{J\ mol^{-1}\ K^{-1}}$	Gibbs energy	$G = H - TS$
Faraday constant	$F = 96\,485\ \mathrm{C\ mol^{-1}}$	$\Delta_r G^0 = -RT \cdot \ln(K) = -nFE^0_{\text{Zelle}}$	
Planck constant	$h = 6.626 \cdot 10^{-34}\ \mathrm{J\ s}$	Nernst equation	$E = E^0 + \frac{R \cdot T}{z \cdot F} \cdot \ln\left(\frac{c_{\text{ox}}}{c_{\text{red}}}\right)$
Speed of light	$c = 2.998 \cdot 10^8\ \mathrm{m\ s^{-1}}$	Energy of a photon	$E = \frac{h \cdot c}{\lambda}$
Temperature	$0\,^\circ\mathrm{C} = 273.15\,\mathrm{K}$	Lambert-Beer law	$A = \log\left(\frac{I_0}{I}\right) = \epsilon \cdot c \cdot L$

For the calculation of equilibrium constants all concentrations, refer to the standard concentration $1\,\mathrm{mol\ dm^{-3}} = 1\,\mathrm{mol\ L^{-1}}$. If not stated otherwise in a task, consider all gases ideal throughout this test.

Periodic Table of Elements

1 H 1.008																	2 He 4.003
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.63	33 As 74.92	34 Se 78.97	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.95	43 Tc [98]	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29
55 Cs 132.91	56 Ba 137.33	57–71	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po [209]	85 At [210]	86 Rn [212]
87 Fr [223]	88 Ra [226]	89–103	104 Rf [267]	105 Db [268]	106 Sg [269]	107 Bh [270]	108 Hs [270]	109 Mt [278]	110 Ds [281]	111 Rg [282]	112 Cn [285]	113 Nh [286]	114 Fl [289]	115 Mc [290]	116 Lv [293]	117 Ts [294]	118 Og [294]

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 140.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.05	71 Lu 174.97
89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	94 Pu [244]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [251]	99 Es [252]	100 Fm [257]	101 Md [258]	102 No [259]	103 Lr [266]

SCORE SHEET **NOT TO BE FILLED IN BY PARTICIPANTS**

Name of participant: _____

Task	Title	Maximum Points	Achieved Points
1	Periodic trends	12.0	
2	Chemical Bonding	10.0	
3	Stoichiometry	10.0	
4	Gases	10.0	
5	Chemical equilibrium	10.0	
6	Thermochemistry	10.0	
7	Chemical kinetics	10.0	
8	Acid base	10.0	
9	Redox	10.0	
10	Electrochemistry	10.0	
11	Solubility	10.0	
12	Organic chemistry	10.0	
Total		122.0	

PROBLEM 1 - PERIODIC TRENDS — 12.0 POINTS

The periodic table is often considered to be the "best friend" of chemists and chemistry students alike. It includes information about atomic masses and element symbols, but it can also be used to make predictions about atomic size, electronegativity, ionisation energies, bonding, solubility and reactivity.

1.1 Consider the data in Model 1 on the next page:

a) Each element has three numbers listed under it. Which value out of the 1^{st} , 2^{nd} or 3^{rd} from the top represents the atomic radius?

b) What are the units for the atomic radius?

c) Write a complete sentence to convey your understanding of atomic radius. Note: you may not use the word "radius" in your definition.

1.2 In general, what is the trend in atomic radius as you go down a group in Model 1? Support your answer using an example from a group.

1.3 Using your knowledge of Coulombic attraction and the structure of the atom, explain the trend in atomic radius that you identified in question 1.2. Hint: you should discuss either a change in distance between the nucleus and outer shell of electrons or a change in the number of protons in the nucleus.

1.4 In general, what is the trend in atomic radius as you go across a period (left to right) in Model 1? Support your answer using an example.

1.5 Using your knowledge of Coulombic attraction and the structure of the atom, explain the trend in atomic radius that you identified in question 1.4.

Model 1 – Main Group Elements

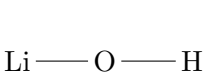
1 H 							2 He
37							31
1312							2372
2.1							N/A
3 Li 	4 Be 	5 B 	6 C 	7 N 	8 O 	9 F 	10 Ne 
152	112	83	77	71	66	71	70
520	900	801	1086	1402	1314	1681	2081
1.0	1.5	2.0	2.5	3.0	3.5	4.0	N/A
11 Na 	12 Mg 	13 Al 	14 Si 	15 P 	16 S 	17 Cl 	18 Ar 
186	160	143	117	115	104	99	98
496	738	578	786	1011	1000	1251	1521
0.9	1.2	1.5	1.8	2.1	2.5	3.0	N/A
19 K 	20 Ca 	31 Ga 	32 Ge 	33 As 	34 Se 	35 Br 	36 Kr 
227	197	122	123	125	117	114	112
404	550	558	709	834	869	1008	1170
0.8	1.0	1.7	1.8	1.9	2.1	2.5	N/A

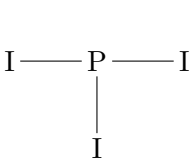
Atomic Number
Element Symbol
Electron Shell Diagram
Atomic Radius (pm)
1st Ionization Energy (kJ/mol)
Electronegativity

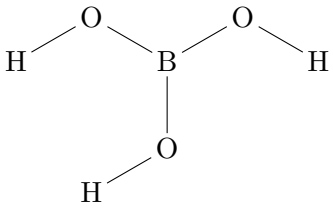
Note: The transition elements and f-block elements have been removed from the periodic table here to ease the analysis of the trends.

PROBLEM 2 - CHEMICAL BONDING **10 POINTS**

2.1 Here is a series of developed formulas:







a) Correct the false bonds representations on the molecules or salts above (you do not have to take into account steric mistakes).

b) If applicable, draw the missing electron pairs.

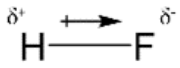
c) Name all the bond types and justify your answer

d) Indicate all the charges and if necessary, modify the formalism of the bonds

2.2 Fill in the table below appropriately.

Formula	Lewis structure	VSEPR (3D molecule)	Dipolar moment vectors	Main intermolecular force
CH_3Cl				
H_2O				
SO_3				

Example for Dipolar moment vectors:



PROBLEM 3 - STOICHIOMETRY **10 POINTS**

Calcium chloride can be produced by calcic attack using hydrochloric acid with a mass percentage of 36.0% and a density of 1.18 g/mL.
Consider a limestone sample in which the mass percentage of calcium carbonate ($CaCO_3$) is equal to 98.0%.

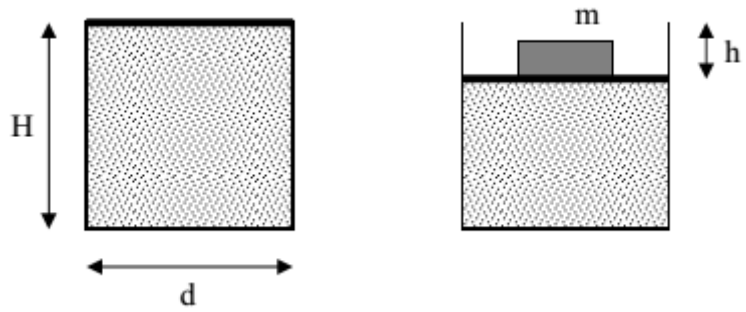
3.1 Calculate, in kilograms, the mass of limestone and, in litres, the volume of hydrochloric acid required to produce 400.0 L of calcium chloride solution of mass percent 35.0% (ρ= 1.338 g/mL at 20°C) assuming the reaction is complete under stoichiometric conditions.

3.2 What volume of carbon dioxide will be released at a temperature of 20°C and a pressure of 1.00 bar?

PROBLEM 4 - GASES **10 POINTS**

A **cylinder** of diameter d = 25 cm and height H = 35 cm is closed, at its upper end, by a piston of negligible mass and thickness. Inside the cylinder, is an ideal gas.

An object is delicately placed on the piston which then sinks down by h = 5 cm.



4.1 Assuming that the temperature of the system (T = 27°C) remains unchanged and that the atmospheric pressure is the normal pressure, calculate the mass m of the object.

4.2 Without removing the object, we want to return the piston to its initial position. To do this, the gas in the cylinder is heated. To what temperature (in °C) must it be brought?

PROBLEM 5 - CHEMICAL EQUILIBRIUM **10 POINTS**

NO_2 gas is an atmospheric pollutant. Depending on the conditions, it can exist in the air in equilibrium with its dimer N_2O_4 according to the equation below:

$$2\,NO_2\,(g) \rightleftharpoons N_2O_4\,(g)$$

At the beginning under normal temperature and pressure conditions, 3.35 mol of N_2O_4 are introduced into a 50.00 L container. Once the equilibrium is reached (with NO_2), a N_2O_4 concentration of 0.0643 M is measured.

5.1 What is the K_c for the above equilibrium (direct reaction)?

5.2 What are all the possible ways to shift this equilibrium towards N_2O_4?
Each proposal must be justified to be validated.

5.3 What is the K_c for the equilibrium below (indirect reaction)?

$$2\,NO_2\,(g) \rightleftharpoons N_2O_4\,(g)$$

PROBLEM 6 - THERMOCHEMISTRY 10 POINTS

When aluminium is added to iron (III) oxide, metallic iron and aluminium oxide are formed.

6.1 Write the reaction equation and balance it.

6.2 Is this reaction exo- or endothermic? Sketch its reaction profile.

6.3 Is this reaction spontaneous at 25°C? Justify your answer with a calculation.

6.4 At what temperature does this reaction become spontaneous?

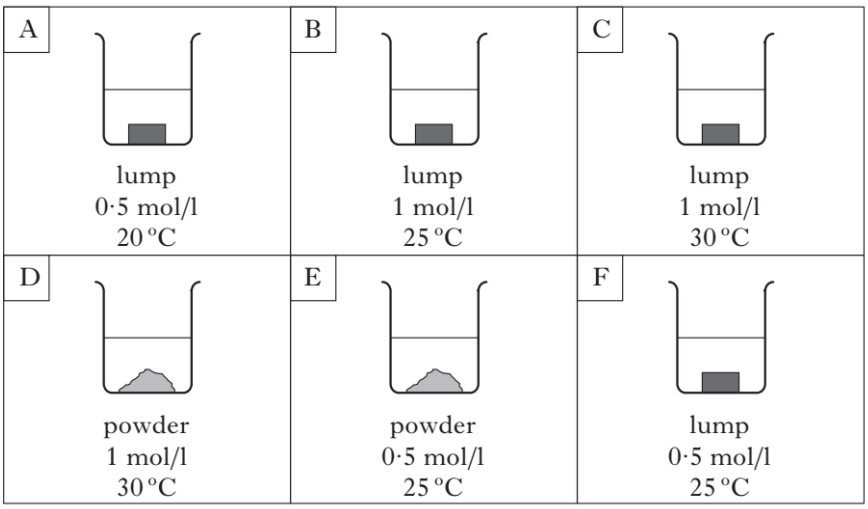
6.5 What is the name of this mixture of aluminium and iron oxide seen in the series "Breaking Bad"?

6.6 For which "everyday life" operation do we use this reaction?

Thermochemical tables			
Substance	**ΔHf° (kJ/mol)**	**ΔGf° (kJ/mol)**	**S° (J/mol K)**
Al(s)	0.0	0.0	28.3
Al(g)	330.0	289.4	164.6
$AlCl_3$(s)	-704.2	-628.8	109.3
Al_2O_3(s)	-1675.7	-1582.3	50.9
Fe(s)	0.0	0.0	27.3
Fe(g)	416.3	370.7	180.5
Fe^{2+}(aq)	-89.1	-78.9	-137.7
Fe^{3+}(aq)	-48.5	-4.7	-315.9
$FeCl_2$(s)	-341.8	-302.3	118.0
$FeCl_3$(s)	-399.5	-334.0	142.3
FeO(s)	-272.0	-251.4	60.7
Fe_2O_3(s)	-824.2	-742.2	87.4
Fe_3O_4(s)	-1118.4	-1015.4	146.4
FeS_2(s)	-178.2	-166.9	52.9
$FeCO_3$(s)	-740.6	-666.7	92.9
NO_2(g)	33.05	51.84	239.74
N_2O_4(g)	9.67	98.28	304.30

PROBLEM 7 - CHEMICAL KINETICS 10 POINTS

7.1 A student is analysing the reaction rate of dissolving chalk in hydrochloric acid.



a) Identify three experiments, among the 6 above, that can be compared to show the effect of concentration on the reaction rate. Justify.

b) Identify the experiment that will have the greatest reaction rate and explain why.

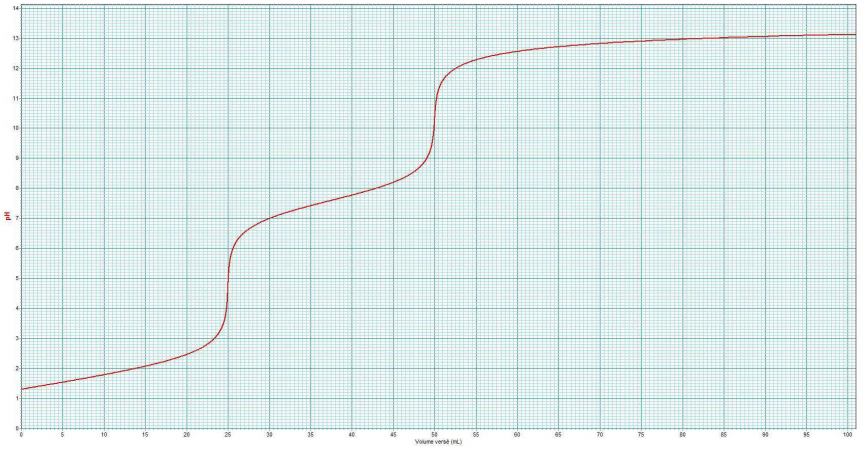
7.2 The kinetics of the reaction CCl_3COOH (aq) $\longrightarrow$ CO_2 + $CHCl_3$ at 70°C is followed. We then measure the following concentrations of the reagent as a function of time:

t/h	$[CCl_3COOH]$ / mol L^{-1}
0.00	0.1000
1.00	0.09403
2.00	0.08842
3.00	0.08314
4.00	0.07817
5.00	0.07351

What is the order of the reaction and the value of the rate constant k?

PROBLEM 8 - ACID BASE — 10 POINTS

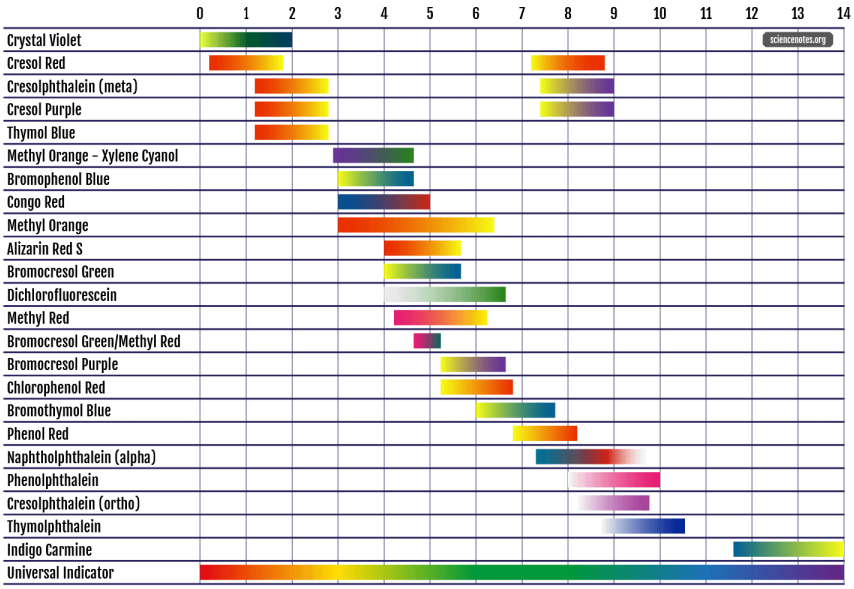
You find an unlabelled vial in the acid cabinet of your laboratory. You decide to determine what type of acid it is by performing a titration. You take 0.82 g of the unknown acid and dissolve it in 50 mL of deionized water. You then titrate your solution with 0.4 M NaOH and you obtain the following curve:



a) Determine which acid it is.

b) Write down the first two hydrolysis reaction equations.

c) If you did not have access to a pH-meter, what mixture of coloured indicators could you use to determine the two equivalence points? What colours will the solution be during all of the titration when using this mixture?



Acid	**HA**	**A^-**	**Ka**	**pKa**
Iodic	HIO_3	IO_3^-	1.6×10^{-1}	0.80
Oxalic (1)	$H_2C_2O_4$	$HC_2O_4^-$	5.9×10^{-2}	1.23
Sulfurous (1)	H_2SO_3	HSO_3^-	1.54×10^{-2}	1.81
Sulfuric (2)	HSO_4^-	SO_4^{2-}	1.2×10^{-2}	1.92
Chlorous	$HClO_2$	ClO_2^-	1.1×10^{-2}	1.96
Phosphoric (1)	H_3PO_4	$H_2PO_4^-$	7.52×10^{-3}	2.12
Arsenic (1)	H_3AsO_4	$H_2AsO_4^-$	5.0×10^{-3}	2.30
Chloroacetic	$CH_2ClCOOH$	CH_2ClCOO^-	1.4×10^{-3}	2.85
Citric (1)	$H_3C_6H_5O_7$	$H_2C_6H_5O_7^-$	8.4×10^{-4}	3.08
Hydrofluoric	HF	F^-	7.2×10^{-4}	3.14
Nitrous	HNO_2	NO_2^-	4.0×10^{-4}	3.39
Formic	HCOOH	$HCOO^-$	1.77×10^{-4}	3.75
Lactic	$HCH_3H_5O_3$	$CH_3H_5O_3^-$	1.38×10^{-4}	3.86
Ascorbic (1)	$H_2C_6H_6O_6$	$HC_6H_6O_6^-$	7.9×10^{-5}	4.10
Benzoic	C_6H_5COOH	$C_6H_5COO^-$	6.46×10^{-5}	4.19
Oxalic (2)	$HC_2O_4^-$	$C_2O_4^{2-}$	6.4×10^{-5}	4.19
Hydrazoic	HN_3	N_3^-	1.9×10^{-5}	4.72
Citric (2)	$H_2C_6H_5O_7^-$	$HC_6H_5O_7^{2-}$	1.8×10^{-5}	4.74
Acetic	CH_3COOH	CH_3COO^-	1.76×10^{-5}	4.75
Propionic	CH_3CH_2COOH	$CH_3CH_2COO^-$	1.34×10^{-5}	4.87
Pyridinium ion	$C_5H_4NH^+$	C_5H_4N	5.6×10^{-6}	5.25
Citric (3)	$HC_6H_5O_7^{2-}$	$C_6H_5O_7^{3-}$	4.0×10^{-6}	5.40
Carbonic (1)	H_2CO_3	HCO_3^-	4.3×10^{-7}	6.37
Sulfurous (2)	HSO_4^-	SO_4^{2-}	1.02×10^{-7}	6.91
Arsenic (2)	$H_2AsO_4^-$	$HAsO_4^{2-}$	$8/9.3 \times 10^{-8}$	7.10/7.03
Hydrosulfuric	H_2S	HS^-	1.0×10^{-7} / 9.1×10^{-8}	7/7.04
Phosphoric (2)	$H_2PO_4^-$	HPO_4^{2-}	6.23×10^{-8}	7.21
Hypochlorous	HClO	ClO^-	$3.5/3.0 \times 10^{-8}$	7.46/7.53
Hypobromous	HBrO	BrO^-	2.0×10^{-9}	8.70
Hydrocyanic	HCN	CN^-	6.17×10^{-10}	9.21
Boric (1)	H_3BO_3	$H_2BO_3^-$	5.8×10^{-10}	9.23
Ammonium ion	NH_4^+	NH_3	5.6×10^{-10}	9.25
Phenol	C_6H_5OH	$C_6H_5O^-$	1.6×10^{-10}	9.80
Carbonic (2)	HCO_3^-	CO_3^{2-}	4.8×10^{-11}	10.32
Hypoiodous	HIO	IO^-	2.0×10^{-11}	10.70
Arsenic (3)	$HAsO_4^{2-}$	AsO_4^{3-}	6.0×10^{-10} / 3.0×10^{-12}	9.22/11.53
Hydrogen peroxide	H_2O_2	HO_2^-	2.4×10^{-12}	11.62
Ascorbic (2)	$HC_6H_6O_6^-$	$C_6H_6O_6^{2-}$	1.6×10^{-12}	11.80
Phosphoric (3)	HPO_4^{2-}	PO_4^{3-}	$4.8/2.2 \times 10^{-13}$	12.32/12.66

PROBLEM 9 - REDOX **10 POINTS**

To determine the iron in solution in the form of ferrous ions (Fe^{2+} (aq)), it is possible to titrate them in acid medium (containing H^+) by reacting them with an acidic permanganate solution (MnO_4^- (aq)) of known concentration.

9.1 Determine the oxidation half-equation.

9.2 Determine the reduction half-equation.

9.3 Write and balance the global redox equation.

Workaround: If you have not found the global equilibrium equation, you can use the equation of the titration in neutral medium for the rest of the exercise:

$$10\,FeSO_4 + 2\,KMnO_4 + 8\,H_2O \longrightarrow 2\,MnSO_4 + 5\,Fe_2(SO_4)_3 + 16\,KOH$$

The iron II sulphate content of a sample must be determined. For this purpose, 1.00 g of FeSO4 is dissolved in water and the solution is acidified.

The obtained solution is titrated by adding drop by drop a permanganate solution. Dropwise a 0.025 M until a persistent purple colour appears after addition of 24.5 mL (because of the excess of MnO_4^- (aq)).

9.4 Calculate in grams the mass of $FeSO_4$ contained in this sample.

9.5 Calculate the mass content of $FeSO_4$ (in %) in this sample.

PROBLEM 10 - ELECTROCHEMISTRY 10 POINTS

Jetsetter that you are, you leave for a weekend on your private yacht to make a small cruise in the Mediterranean. Unfortunately, your boat hits some rocks during a storm and you run aground on an unknown and empty beach. When you wake up, you look around to see if you have anything that could help you get out of this situation. You find your cell phone and its power cable, but unfortunately, its battery is empty. You look around on the beach and realize that you have access to the following materials:

- Aluminium cans
- Charcoal
- Oxygen from the air and water
- Sea water
- Material from your clothes

Assuming you need approximately 12 V to turn on your phone and make a call for help, explain how you will do this. Make diagrams to help you. To make life easier, consider that we are working under standard, non-acidic conditions!

10.1 Draw a labelled diagram of a device allowing the production of the 12 V according to the electrochemistry standards.

In your diagram, the following information must appear:

- The negative and positive poles
- The anode and the cathode
- The direction of the half reactions
- The directions of the ions in the salt bridge
- The direction of the electron movement and of the electrical current

10.2 Give both half reactions and the overall reaction.

10.3 Calculate the standard potential difference of the device drawn.

TABLE 18.1 Standard Reduction Potentials at 25°C

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	Reduction Half-Reaction		E° (V)	
Stronger oxidizing agent	$F_2(g) + 2\,e^-$	$\longrightarrow 2\,F^-(aq)$	2.87	Weaker reducing agent
	$H_2O_2(aq) + 2\,H^+(aq) + 2\,e^-$	$\longrightarrow 2\,H_2O(l)$	1.78	
	$MnO_4^-(aq) + 8\,H^+(aq) + 5\,e^-$	$\longrightarrow Mn^{2+}(aq) + 4\,H_2O(l)$	1.51	
	$Cl_2(g) + 2\,e^-$	$\longrightarrow 2\,Cl^-(aq)$	1.36	
	$Cr_2O_7^{2-}(aq) + 14\,H^+(aq) + 6\,e^-$	$\longrightarrow 2\,Cr^{3+}(aq) + 7\,H_2O(l)$	1.33	
	$O_2(g) + 4\,H^+(aq) + 4\,e^-$	$\longrightarrow 2\,H_2O(l)$	1.23	
	$Br_2(l) + 2\,e^-$	$\longrightarrow 2\,Br^-(aq)$	1.09	
	$Ag^+(aq) + e^-$	$\longrightarrow Ag(s)$	0.80	
	$Fe^{3+}(aq) + e^-$	$\longrightarrow Fe^{2+}(aq)$	0.77	
	$O_2(g) + 2\,H^+(aq) + 2\,e^-$	$\longrightarrow H_2O_2(aq)$	0.70	
	$I_2(s) + 2\,e^-$	$\longrightarrow 2\,I^-(aq)$	0.54	
	$O_2(g) + 2\,H_2O(l) + 4\,e^-$	$\longrightarrow 4\,OH^-(aq)$	0.40	
	$Cu^{2+}(aq) + 2\,e^-$	$\longrightarrow Cu(s)$	0.34	
	$Sn^{4+}(aq) + 2\,e^-$	$\longrightarrow Sn^{2+}(aq)$	0.15	
	$2\,H^+(aq) + 2\,e^-$	$\longrightarrow H_2(g)$	0	
	$Pb^{2+}(aq) + 2e^-$	$\longrightarrow Pb(s)$	−0.13	
	$Ni^{2+}(aq) + 2\,e^-$	$\longrightarrow Ni(s)$	−0.26	
	$Cd^{2+}(aq) + 2\,e^-$	$\longrightarrow Cd(s)$	−0.40	
	$Fe^{2+}(aq) + 2\,e^-$	$\longrightarrow Fe(s)$	−0.45	
	$Zn^{2+}(aq) + 2\,e^-$	$\longrightarrow Zn(s)$	−0.76	
	$2\,H_2O(l) + 2\,e^-$	$\longrightarrow H_2(g) + 2\,OH^-(aq)$	−0.83	
	$Al^{3+}(aq) + 3\,e^-$	$\longrightarrow Al(s)$	−1.66	
	$Mg^{2+}(aq) + 2\,e^-$	$\longrightarrow Mg(s)$	−2.37	
	$Na^+(aq) + e^-$	$\longrightarrow Na(s)$	−2.71	
Weaker oxidizing agent	$Li^+(aq) + e^-$	$\longrightarrow Li(s)$	−3.04	Stronger reducing agent

PROBLEM 11 - SOLUBILITY 10 POINTS

Urinary (or renal) lithiasis is a condition characterized by the formation of small crystalline accretions called "kidney stones".

These "stones" are made up mainly of calcium oxalate (CaC_2O_4) crystals.

Knowing that the K_s value of this salt is $2.3 \cdot 10^{-9} M^2$:

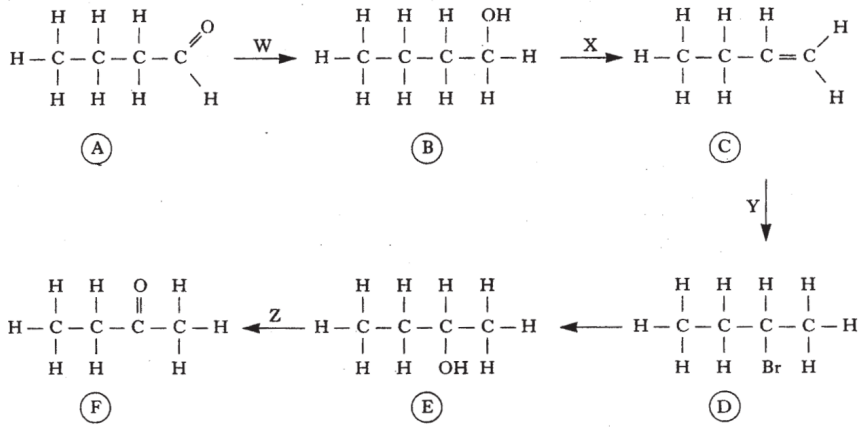
11.1 Write the expression of the ionic product of the species in solution.

11.2 Determine the minimum volume of aqueous solution required to solubilize a pure CaC_2O_4 kidney stone weighing 768 mg.

11.3 In the urine sample of a patient, a concentration of $2.5 \cdot 10^{-6} M$ oxalate ions ($C_2O_4{}^{2-}$) and $5.0 \cdot 10^{-4} M$ of calcium ions is measured in the urine sample of a patient. Is there a risk of precipitation of a kidney stone in this patient? The answer must be justified with all necessary calculations.

PROBLEM 12 - ORGANIC CHEMISTRY **10 POINTS**

A student designed the following reaction sequence:



12.1 Suggest a suitable reagent to carry out:

a) Step W

b) Step Y

12.2 What type of reaction occurs at:

a) Step X

b) Step Z

12.3 Name the other product which is likely to be formed in step Y.

12.4 Name a reagent which could be used to distinguish between A and F.

12.5 Why does C not have geometric isomers despite the presence of a carbon-carbon double bond?

12.6 Which of the compounds A-F have optical isomers?

12.7 Give the IUPAC name of compound B.