Problem 1

a. Avgjør hvilke av navnene nedenfor som er riktige og gale for ioniske forbindelser:

i. Cesium(I) fluorid **(0.5%)**

ii. Litium(I) fluorid **(0.5%)**

iii. Tinn fluorid **(0.5%)**

iv. Sølv(I) fluorid **(0.5%)**

v. Sink(II) fluorid **(0.5%)**

b. Bestem oksidasjonstallet for hvert atom i følgende forbindelser:

i. CaH_2 **(1%)**

ii. I_2O_5 **(1%)**

iii. BO_3^{3-} **(1%)**

iv. IO^- **(1%)**

v. N_2O_4 **(1%)**

c. Balanser følgende reaksjonslikninger:

i. $C_3H_6O + O_2 \rightarrow CO_2 + H_2O$ **(1%)**

ii. $Sn^{4+} + Sn \rightarrow Sn^{2+}$ **(1%)**

iii. $Hg^{2+} + Cr \rightarrow Hg_2^{2+} + Cr^{3+}$ **(1%)**

d. Hvor mange milliliter med H_2O og konsentrert NH_4OH (14.5 M) trengs til å lage en 1.50 L 4.50 M NH_4OH(aq)-løsning? **(2%)**

Problem 2

a. Hvor mange gram NaCl kreves til å lage en 0.50 L 3.00 M NaCl(aq)-løsning? **(2%)**

b. Beregn masseprosenten til NaCl i en 3.0 M NaCl(aq)-løsning med en tetthet lik 1.25 kg/L. **(4%)**

c. Tegn cellereaksjonen for den galvaniske cellen som er beskrevet i følgende celldiagram **(3.5%)**:

$$Al(s) \,|\, Al^{3+}(aq) \,||\, Fe^{2+}(aq) \,|\, Fe(s)$$

d. Bestem cellepotensialet (E_{cell}) til den galvaniske cellen som er beskrevet i **Problem 2c** når konsentrasjonene er 0.100 M for Fe^{2+} og 0.300 M for Al^{3+}. **(3%)**

Problem 3

a. Identifiser hvilke av de følgende figurene som beskriver en reaksjon ved kjemisk likevekt (begrunn svaret ditt) (hvor V er reaksjonsraten) **(3.5%)**:

(A) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_1 > V_2$

(B) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_2 > V_1$

(C) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_2 = V_1$

(D) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_1 > V_2$

(E) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_2 = V_1$

(F) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_2 > V_1$

(G) $Br_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HBr(g)$ $V_1 > V_2$

(H) $F_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HF(g)$ $V_2 = V_1$

(I) $Cl_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HCl(g)$ $V_2 > V_1$

(J) $Cl_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HCl(g)$ $V_2 = V_1$

b. Forklar hvordan reaksjon **1** kan tvinges bort fra kjemisk likevekt ved konstant temperatur **(3%)**.

$$I_2(g) + H_2(g) \rightleftharpoons 2HI(g) \; (\mathbf{1})$$

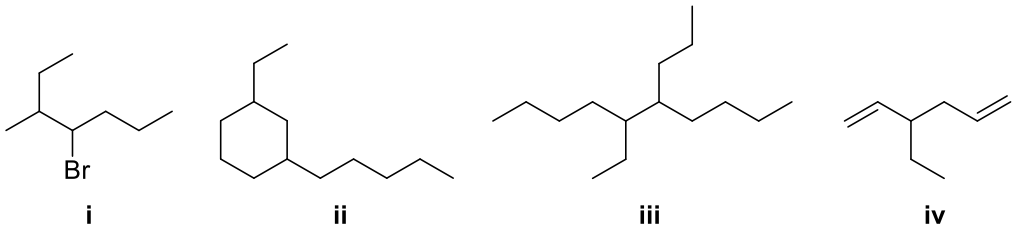
c. Når reaksjon **2** er ved kjemisk likevekt i en reaksjonsbeholder ved 25 ^{o}C, er de assosierte trykkene 1.00 atm for $N_2O_4(g)$ og 0.337 atm for $NO_2(g)$. Beregn likevektskonstanten (K_c) til reaksjon **2 (2%)**.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g) \ (\mathbf{2})$$

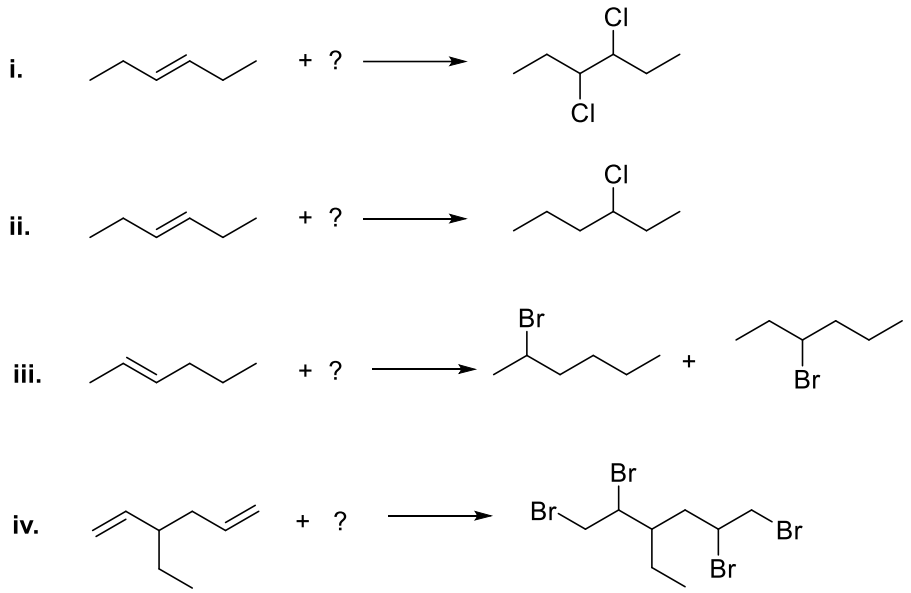
d. Reaksjon **2** blir tvunget bort fra den første kjemiske likevekten som er beskrevet i **Problem 3c** ved å doble volumet til reaksjonsbeholderen. Beregn de molare konsentrasjonene til $N_2O_4(g)$ og $NO_2(g)$ ved den nye kjemiske likevekten ved 25 ^{o}C **(4%)**.

Problem 4

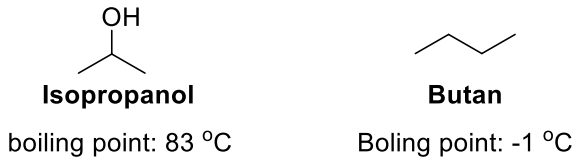
a. Navngi følgende molekyler **(4%)**:



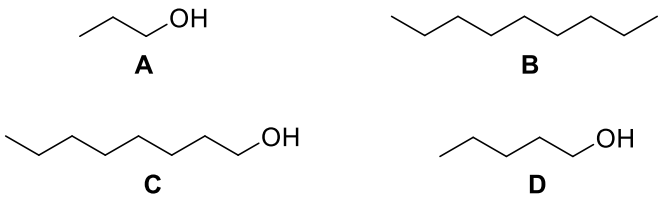
b. Foreslå et reagens (?) for hver av de følgende reaksjonene **(2.5%)**:



c. Forklar hvorfor kokepunktet er mye høyere for isopropanol (83 °C) enn det er for butan (-1 °C) **(3%)**.



d. Arranger følgende forbindelser etter økt vannløselighet fra venstre til høyre **(3%)**:



Problem 5

a. Vis hvordan ozon blir dannet i Chapman-syklusen og spesifiser kilden til O_2 i samme syklus. **(4%)**
b. Forklar hvorfor mesteparten av ozonet blir dannet i stratosfæren over tropene. **(4%)**
c. Bruk reaksjonslikninger til å vise hvordan klorfluorkarboner (CFCs) er involvert i nedbrytningen av ozonlaget. **(5%)**
d. Gi et eksempel på en gruppe drivhusgasser som bare inkluderer menneskeskapte gasser. **(3%)**

Problem 6

a. Forklar forskjellen på en eksoterm og en endoterm reaksjon. **(4%)**
b. Forklar rollen endoterme og eksoterme reaksjoner har i en varmepumpe. **(6%)**
c. Forklar hvilken rolle solen har i vindkraft. **(3%)**
d. Forklar ved hjelp av figurer, ord, og reaksjonslikninger hvordan hydrogengass ($H_2(g)$) produseres fra vann. **(5%)**

Problem 7

a. Forklar forskjellen mellom primære og sekundære luftforurensende stoffer. **(4%)**
b. Gi eksempler på to primære luftforurensende stoffer, som er involvert i dannelsen av sur nedbør. **(4%)**
c. Hvor i atmosfæren er ozon skadelig for levende organismer på jorden? **(4%)**
d. Gi eksempler på primære luftforurensende stoffer som er involvert i dannelsen av ozon på bakkenivå. **(4%)**

Formulas

Avogadro's law:	$\frac{V_1}{n_1} = \frac{V_2}{n_2}$
°C to K:	$T_K = T_{°C} + 273.15$
Density:	$d = \frac{m}{V}$
Molar concentration:	$c = \frac{n}{V}$
Number of moles:	$n = \frac{m}{M}$
The ideal gas law:	$PV = nRT$
Expression for pH:	$pH = -\log[H_3O^+]$
Expression for pOH:	$pOH = -\log[OH^-]$
Relationship between K_a and K_b	$K_a \times K_b = K_w$
Expression for the autoprotolysis constant of H_2O:	$K_w = [H_3O^+][OH^-]$
Standard cell potential:	$E^\circ_{cell} = E^\circ_{ox} + E^\circ_{red}$
Nernst equation:	$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log Q$

Fundamental constants

Name	Symbol	Value
Atomic mass unit:	u	1.66054×10^{-24} g
Avogadro constant:	N_A	$6.02214086 \times 10^{23}$/mol
Boltzmann constant:	k	1.38066×10^{-23} J/K
Elementary charge:	e	1.60218×10^{-19} C
Faraday constant:	F	96485.3 C/mol
Gas constant:	R	8.31451 J/K mol
		8.31451 L kPa/K mol
		0.0820578 L atm/K mol
		62.3639 L Torr/K mol
		0.0831451 L bar/K mol
Autoprotolysis constant for water at 25 °C	K_w	1.00×10^{-14}

Problem 1

a. Identify which names below that are correct and incorrect for ionic compounds:

i. Cesium(I) fluoride **(0.5%)**

ii. Lithium(I) fluoride **(0.5%)**

iii. Tin fluoride **(0.5%)**

iv. Silver(I) fluoride **(0.5%)**

v. Zinc(II) fluoride **(0.5%)**

b. Identify the oxidation number for each atom in the following compounds:

i. CaH_2 **(1%)**

ii. I_2O_5 **(1%)**

iii. BO_3^{3-} **(1%)**

iv. IO^- **(1%)**

v. N_2O_4 **(1%)**

c. Balance the following reaction equations:

i. $C_3H_6O + O_2 \rightarrow CO_2 + H_2O$ **(1%)**

ii. $Sn^{4+} + Sn \rightarrow Sn^{2+}$ **(1%)**

iii. $Hg^{2+} + Cr \rightarrow Hg_2^{2+} + Cr^{3+}$ **(1%)**

d. How many milliliters of H_2O and concentrated NH_4OH (14.5 M) are needed to prepare a 1.50 L 4.50 M NH_4OH(aq) solution? **(2%)**

Problem 2

a. How many grams NaCl is required to generate a 0.50 L 3.00 M NaCl(aq) solution? **(2%)**

b. Calculate the mass-percent NaCl in a 3.0 M NaCl(aq) solution with the density of 1.25 kg/L. **(4%)**

c. Draw the cell reaction for the galvanic cell that is described by the following cell-diagram **(3.5%)**:

$$Al(s) \,|\, Al^{3+}(aq) \,||\, Fe^{2+}(aq) \,|\, Fe(s)$$

d. Decide the cell potential (E_{cell}) of the galvanic cell described in the cell-diagram in **Problem 2c** when the concentrations are 0.100 M for Fe^{2+} and 0.300 M for Al^{3+}. **(3%)**

Problem 3

a. Identify which of the following figures that describe a reaction at chemical equilibrium (motivate your answer) (V signifies rate of reaction) **(3.5%)**:

(A) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_1 > V_2$

(B) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_2 > V_1$

(C) $N_2(g) + 2O_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} N_2O_4(g)$ $V_2 = V_1$

(D) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_1 > V_2$

(E) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_2 = V_1$

(F) $N_2(g) + 3H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2NH_3(g)$ $V_2 > V_1$

(G) $Br_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HBr(g)$ $V_1 > V_2$

(H) $F_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HF(g)$ $V_2 = V_1$

(I) $Cl_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HCl(g)$ $V_2 > V_1$

(J) $Cl_2(g) + H_2(g) \underset{V_2}{\overset{V_1}{\rightleftharpoons}} 2HCl(g)$ $V_2 = V_1$

b. Explain how reaction **1** can be forced away from its chemical equilibrium at constant temperature **(3%)**.

$$I_2(g) + H_2(g) \rightleftharpoons 2HI(g)\ (\mathbf{1})$$

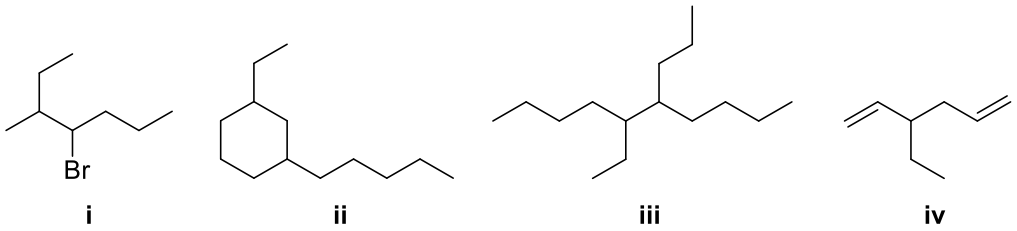
c. When reaction **2** is at chemical equilibrium in a reaction vessel at 25 ^{o}C, the pressures are 1.00 atm for $N_2O_4(g)$ and 0.337 atm $NO_2(g)$. Calculate the chemical equilibrium constant (K_c) for reaction **2 (2%)**.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)\ (\mathbf{2})$$

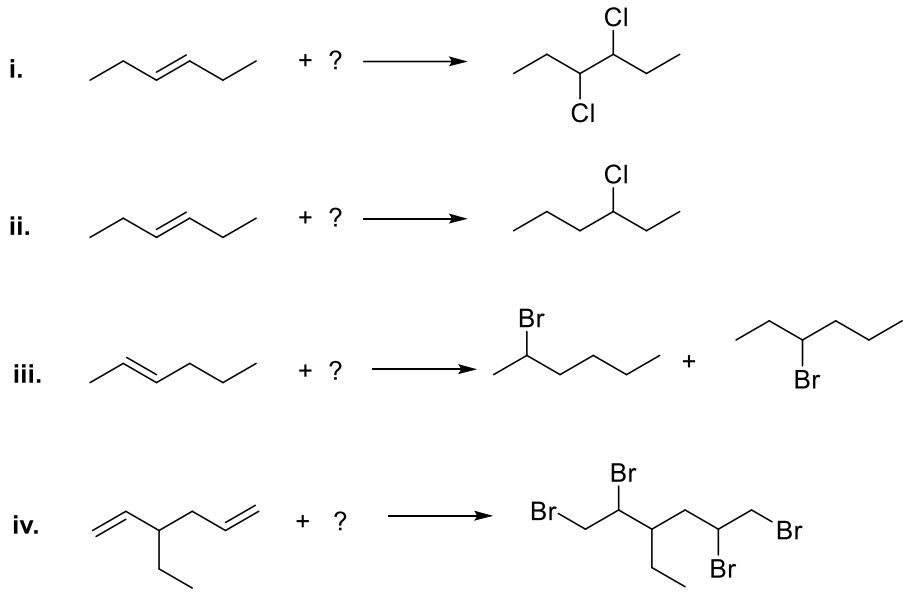
d. Reaction **2** is forced away from its first chemical equilibrium described in **Problem 3c** by doubling the volume of the reaction vessel. Calculate the molar concentrations of $N_2O_4(g)$ and $NO_2(g)$ when the new chemical equilibrium is established at 25 ^{o}C **(4%)**.

Problem 4

a. Name the following molecules **(4%)**:

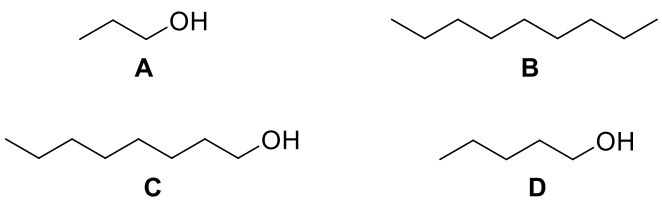


b. Suggest a reagent (?) for each of the following reactions **(2.5%)**:



c. Explain why the boiling point is much higher for isopropanol (83 ℃) than for butane (-1 ℃) **(3%)**.

d. Arrange the compounds below after increasing solubility in water from left to right **(3%)**:



Problem 5

a. Show how ozone is formed in the Chapman cycle and specify the source of O_2 in the Chapman cycle. **(4%)**
b. Explain why most of the ozone is formed in the stratosphere above the tropics. **(4%)**
c. Use reaction equations to show how chlorofluorocarbons (CFCs) are involved in the thinning of the ozone layer. **(5%)**
d. Give an example of a group of greenhouse gases that only includes man-made gases. **(3%)**

Problem 6

a. Explain the difference between an exothermic and endothermic reaction. **(4%)**
b. Explain the role of endothermic and exothermic reactions in a heating pump. **(6%)**
c. Explain the role of the sun in wind power. **(3%)**
d. Explain by figures, words, and reaction equations how hydrogen gas ($H_2(g)$) can be produced from water. **(5%)**

Problem 7

a. Explain the difference between primary and secondary air pollutants. **(4%)**
b. Give examples of two primary air pollutants, which are involved in the formation of acid rain. **(4%)**
c. Where in the atmosphere is ozone harmful for living organism on Earth? **(4%)**
d. Give examples of primary air pollutants that are involved in the formation of ground level ozone. **(4%)**

Formulas

Avogadro's law:	$\frac{V_1}{n_1} = \frac{V_2}{n_2}$
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Density:	$d = \frac{m}{V}$
Molar concentration:	$c = \frac{n}{V}$
Number of moles:	$n = \frac{m}{M}$
The ideal gas law:	$PV = nRT$
Expression for pH:	$pH = -\log[H_3O^+]$
Expression for pOH:	$pOH = -\log[OH^-]$
Relationship between K_a and K_b	$K_a \times K_b = K_w$
Expression for the autoprotolysis constant of H_2O:	$K_w = [H_3O^+][OH^-]$
Standard cell potential:	$E^\circ_{cell} = E^\circ_{ox} + E^\circ_{red}$
Nernst equation:	$E_{cell} = E^\circ_{cell} - \frac{0.059}{n}\log Q$

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Elementary charge:	e	1.60218×10^{-19} C
Faraday constant:	F	96485.3 C/mol
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		8.31451 L kPa/K mol
		0.0820578 L atm/K mol
		62.3639 L Torr/K mol
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Autoprotolysis constant for water at 25 °C	K_w	1.00×10^{-14}