Eksamenssæt 26027 Grundlæggende Kemi F20

1

Hvilken orbital kan indeholde en elektron med følgende kvantetal: n = 4, l = 2, m_s = -½ ?

Which orbital can contain an electron with these quantum numbers: n = 4, l = 2, m_s = -½ ?

$2d_{xy}$

$4d_{xy}$

$4p_x$

$4p_z$

Der findes ingen orbital svarende til disse kvantetal --- *There is no orbital with these quantum numbers*

2

Hvad er elektronkonfigurationen for ruthenium og oxygen i Ru_2O_3 (i stoffet, *ikke* i de frie atomer)?

What is the electron configuration of ruthenium and oxygen in Ru_2O_3 (in the compound, not as free atoms)?

Ruthenium: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1 4d^7$ Oxygen: $1s^2 2s^2 2p^4$

Ruthenium: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1 4d^4$ Oxygen: $1s^2 2s^2 2p^6$

Ruthenium: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^5$ Oxygen: $1s^2 2s^2 2p^6$

Ruthenium: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1 4d^4$ Oxygen: $1s^2 2s^2 2p^4$

Ruthenium: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 4d^5$ Oxygen: $1s^2 2s^2 2p^4$

3

En foton har netop energi nok til at spalte et HI molekyle. Hvad er bølgelængden af denne foton?

A photon has exactly enough energy to split a HI molecule. What is the wavelength of this photon?

5×10^{-19} m

Ca. 400 nm

Ca. 400 µm

Ca. 4 nm

Ca. 200 nm

4

Et givent molekyle har formlen ABC, hvor "A" er et grundstof fra gruppe 5A (dog ikke fra 2. periode), "B" er et grundstof fra gruppe 6A og "C" et grundstof fra gruppe 7A. Hvilken geometri forventer man for molekylet ABC?

A given molecule has the formula ABC, in which "A" is an element from group 5A (but not second period), "B" is an element from group 6A and "C" is an element from group 7A. Which geometry is expected for the molecule ABC?

Tetraederisk */ Tetrahedral*

Lineær */ Linear*

Trigonal plan / *Trigonal planar*

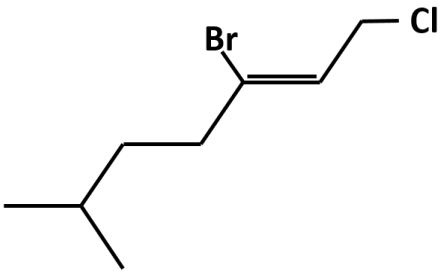
Bøjet / *Bent*

Trigonal pyramidal / *Trigonal pyramidal*

5

Angiv det korrekte navn for molekylet:

State the correct name for the molecule:



3-bromo-1-chloro-6-methyl-2-hepten(e)

1-chloro-3-bromo-6-methyl-3-hepten(e)

2-methyl-5-bromo-7-chloro-6-hepten(e)

3-bromo-1-chloro-6-methyl-3-hepten(e)

Chloro-methylheptyl-bromid(e)

6

En væske har en molær fordampningsentalpi ΔH_{vap} = 50 kJ/mol. Damptrykket ved 30 °C er 200 mmHg. Ved hvilken temperatur er damptrykket 400 mmHg?

A liquid has a molar vaporisation enthalpy ΔH_{vap} = 50 kJ/mol. *The partial pressure at 30 °C is 200 mmHg. Determine the temperature at which the partial pressure is 400 mmHg.*

41 °C

-9 °C

31 °C

314 °C

225 °C

7

En prøve består af en ukendt organisk forbindelse. Det vides dog, at prøven udelukkende indeholder carbon og hydrogen. 5,0 g af prøven opløses i 200 g cyclohexan (K_f = 20,0 °C/m), hvorved frysepunktet af opløsningen bliver 4,0 °C lavere end for ren cyclohexan. Hvad er molmassen af den ukendte forbindelse?

A sample consists of an unknown organic compound, which only contains carbon and hydrogen. 5,0 g of this sample is dissolved in 200 g cyclohexane (K_f = 20,0 °C/m). The freezing point of the solution is now 4,0 °C lower than for pure cyclohexane. What is the molar mass of the unknown compound?

17 g/mol

40 g/mol

125 g/mol

192 g/mol

200 g/mol

8

Koncentrationerne af en ukendt forbindelse ”A” over tid i et eksperiment udført ved 317 K er givet i nedenstående tabel. Hvad var koncentrationen af “A“ ved t = 0 s?

The concentration of the unknown molecule ”A” has been measured during an experiment conducted at 317 K as follows. What is the concentration of “A” at t = 0 s?

Tid / *Time* (s)	Koncentration / *concentration* 10^3 [A] (mol/L)
10.0	12.46
20.0	6.24
30.0	4.16
40.0	3.12
50.0	2.50
60.0	2.08

Ca. 25 M

Ca. 5.8 M

Ca. 0.025 M

Ca. 5800 M

Ca. 0.25 M

9

Ligevægtskonstanten K_c for reaktionen $2AB_3$ (g) ⇌ A_2 (g) + $3B_2$ (g) er 0,92 ved 250 °C. 16 g af AB_3 (molmasse = 21 g/mol) introduceres ved stuetemperatur i en 2 L flaske. Temperaturen hæves hurtigt til 250 °C og holdes derefter konstant. Beregn ligevægtskoncentrationerne af alle gasserne.

The equilibrium constant K_c for the reaction $2AB_3$ (g) ⇋ A_2 (g) + $3B_2$ (g) is 0.92 at 250 °C. 16 g of AB_3 (molar mass = 21 g/mol) are introduced at room temperature in a 2 L flask. The temperature is rapidly increased to 250 °C and then kept constant at this temperature. Calculate the equilibrium concentrations of all gases.

$[AB_3]$ = 0.092 M $[A_2]$ = 0.289 M $[B_2]$ = 0.289 M

$[AB_3]$ = 0.127 M $[A_2]$ = 0.064 M $[B_2]$ = 0.191 M

$[AB_3]$ = 0.089 M $[A_2]$ = 0.292 M $[B_2]$ = 0.292 M

$[AB_3]$ = 0.076 M $[A_2]$ = 0.153 M $[B_2]$ = 0.458 M

$[AB_3]$ = 0.104 M $[A_2]$ = 0.138 M $[B_2]$ = 0.415 M

10

Syntetisk kryolit bruges i forbindelse med aluminiumsfremstilling og fremstilles i overensstemmelse med nedenstående reaktionsligning. Hvor mange kilo kryolit dannes, hvis man fra start har 100 kg NaOH, 100 kg HF og 100 kg $Al(OH)_3$?

Synthetic cryolite is used in aluminum fabrication, and the manufacture of cryolite follows the reaction scheme stated below. How many kilos of cryolite are made, when starting out with 100 kg NaOH, 100 kg HF and 100 kg $Al(OH)_3$?→

$$3\ NaOH + 6\ HF + Al(OH)_3 \rightarrow Na_3AlF_6 + 6\ H_2O$$

175 kg

269 kg

524 kg

833 kg

1049 kg

11

En 2,5 liters dunk helt fyldt med vandig tomatgødning indeholder 1,5 M ammoniumnitrat (NH_4NO_3). Hvad er vægtprocenten af nitrogen i gødningen? Densiteten af den vandige gødning antages at være lig vands.

A 2.5 L bottle completely filled with aqueous tomato fertilizer contains 1.5 M ammonium nitrate (NH_4NO_3). What is the weight percentage of nitrogen in the fertilizer? The density of the aqueous fertilizer is assumed to equal the density of water.

≈ 2 %

≈ 4 %

≈ 8%

≈11%

≈24%

12

Afstem nedenstående reaktionsligning i sur opløsning. Brug de mindst mulige heltallige koefficienter og angiv svaret som <u>summen</u> af alle koefficienterne, inklusive H^+.

Balance the reaction scheme below under acidic conditions. Use the smallest possible whole numbers as coefficients, and state the answer as <u>the sum</u> of all the coefficients, including H^+.

$$Cu\ (s) + HNO_3(aq) \rightarrow Cu^{2+}(aq) + NO\ (g) + H_2O\ (l)$$

12

14

16

18

20

13

Hævemidlet potaske har det kemiske navn kaliumcarbonat. Hvor stort et volumen CO_2 dannes, hvis hele indholdet af en pose potaske (25 g) opvarmes til 200 °C i ovnen? Antag, at trykket er 1 atm og at al carbon omdannes til CO_2.

The raising agent potash has the chemical name potassium carbonate. How large a volume of CO_2 is formed, if the entire content of a bag of potash (25 g) is heated to 200 °C in the oven? Assume that the pressure is 1 atm and that all carbon is converted to CO_2.

3 L

4 L

7 L

10 L

712 L

14

Reaktionsligningen for processen "steam-reforming" er givet herunder sammen med værdier for $\Delta G_f°$, $\Delta H_f°$ and $\Delta S_f°$. Hvilket af nedenstående udsagn er <u>forkert?</u> →

The reaction scheme for the process "steam-reforming" is given below together with the values for $\Delta G_f°$, $\Delta H_f°$ and $\Delta S_f°$. Which of the statements below is <u>false</u>?

$$CH_4(g) + H_2O(g) \rightarrow 3H_2(g) + CO(g)$$

	CH_4	H_2O	H_2	CO
$\Delta G_f°$ (kJ/mol)	-50.8	-228.6	0	-137.7
$\Delta H_f°$ (kJ/mol)	-74.85	-241.8	0	-110.5
$\Delta S_f°$ (J/(K mol)	186.2	188.7	131	197.9

Entropien vokser, når reaktionen forløber */The entropi increases, when the reaction proceeds*

Ved reaktionen udvikles varme under standardbetingelser / *Heat is evolved when the reaction proceeds at standard conditions*

Processen er ikke spontan ved 300 °C / *The process is not spontaneous at 300 °C*

ΔG for reaktionen er nul ved ligevægt / *ΔG for the reaction is zero at equilibrium*

Enthalpien H er en tilstandsfunktion / The enthalpy *H is a state function*

15

Svovldioxid oxideres til svovltrioxid som beskrevet af reaktionsligningen herunder. Ligevægtskonstanten for den opskrevne reaktion er K_p = 4,79 ved 650 °C, og partialtrykkene er p(SO_2) = 0,1 atm og p(O_2) = 0,1 atm. Hvad er partialtrykket af SO_3 ved 650 °C?

Sulfur dioxide is oxidized to sulfur trioxide according to the reaction scheme below. The equilibrium constant for the reaction as written is K_p = 4.79 at 650 °C *and the partial pressures are p(SO_2) = 0.1 atm and p(O_2) = 0.1 atm. What is the partial pressure of SO_3 in the reaction mixture at 650 °C?*

$$SO_2(g) + ½\ O_2\ (g) \leftrightharpoons SO_3(g)$$

0.05 atm

0.10 atm

0.15 atm

0.20 atm

0.25 atm

16

Til husholdningsbrug anvendes ofte en 32 vægtprocent vandig opløsning af eddikesyre. Hvad er pH i denne opløsning? (Opløsningen antages at have samme densitet som vand).

In the household a 32 weight percent aqueous solution of acetic acid is often used. What is the pH in this solution? (Assume the solution has the same density as water).

pH=1

pH=2

pH=3

pH=4

pH=5

17

Hvilket af følgende udsagn er forkert?

Which of the following statements is wrong?

En basisk opløsning har pH > 7

En svag base har en høj K_b-værdi / *A weak base has a high K_b-value*

Et salt kan ændre pH-værdien i en vandig opløsning / *A salt may change the pH value of an aqueous solution*

En svag syre har en stærk konjugerende base / *A weak acid has a strong conjugate base*

En buffer-opløsning har størst buffer-kapacitet, når koncentrationen af det konjugerende syre-base par er høj / *a buffer solution has the largest buffer capacity, when the concentration of the conjugate acid-base couple is high*

18

Hvilken af følgende redoxreaktioner vil ikke forløbe spontant mod højre ved standardbetingelser (antag at reaktionerne er under termodynamisk kontrol, og reaktionskinetikkern er uden betydning).

Which of the following redox reactions will not proceed spontaneous to the right at standard conditions? (assume that the reactions are controlled by thermodynamics, not by reaction kinetics)

$2\ Na(s) + Cl_2(g) \rightarrow 2\ NaCl(aq)$

$2\ Zn(s) + O_2(g) + 2H_2O(l) \rightarrow 2\ Zn(OH)_2(aq)$

$2\ Ag(s) + MnO_2(s) + 2Cl^-(aq) + 4H^+(aq) \rightarrow 2\ AgCl(aq) + Mn^{2+}(aq) + 2H_2O(l)$

$Cd(s) + Pb^{2+}(aq) \rightarrow Cd^{2+}(aq) + Pb(s)$

$3\ Fe^{2+}(aq) \rightarrow Fe + 2\ Fe^{3+}$

19

Hvad er cellespændingen i en galvanisk celle indeholdende en sølvelektrode (sølvtråd) i 2,00 M $AgNO_3$ (aq) og en Ni elektrode i 0.300 M $Ni(NO_3)_2$ (aq) ved temperaturen 298.15 K?

What is the cell potential of a galvanic cell containing a silver electrode (Silver wire) in 2.00 M $AgNO_3$ and a Ni electrode in 0.300 M $Ni(NO_3)_2$ at the temperature 298.15 K?

-1.02 V

1.02 V

1.08 V

1.21 V

-1.13 V

20

Angiv, hvor mange uparrede elektroner, der er i et oktaedrisk Fe(II) højspinskompleks, og i et oktaedrisk Cr(III) lavspinskompleks.

Determine the number of unpaired electrons in an octahedral Fe(II) high spin coordination complex and a octahedral Cr(III) low-spin coordination complex.

Fe(II) højspin / *high-spin* , Cr(III) lavspin / *low-spin*

1, 3

4, 3

1, 2

4, 2

6, 2