Eksamenssæt 26027 Grundlæggende Kemi – F21 eksamen

Opg. 1

Hvor mange orbitaler er i alt (alle orbitaler af alle typer) knyttet til hovedkvantetallet n = 5? (medregn ikke skaller for lavere n-kvantetal, kun n = 5)

What is the total number of all orbitals of all types associated with the principal quantum number n= 5? (without including shells of lower n quantum number, only n = 5)

5

9

25*

50

54

Opg. 2

Kalium (K) har en ioniseringsenergi på 418.7 kJ/mol. Men hvis atomet findes i en bestemt exciteret tilstand er ioniseringsenergien kun 262.4 kJ/mol. Udregn bølgelængden af en foton, der opstår ved en overgang (ikke ionisering!) fra denne exciterede tilstand til grundtilstanden.

The ionization energy of potassium is 418.7 kJ/mol. However, if the atom is in a particular excited state, the ionization energy is only 262.4 kJ/mol. Calculate the wavelength of a photon emitted in a transition (not ionisation!) from this excited state to the ground state.

≈ 286 nm

≈ 456 nm

≈ 766 nm*

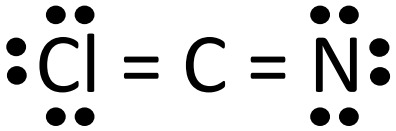
≈ 0.766 mm

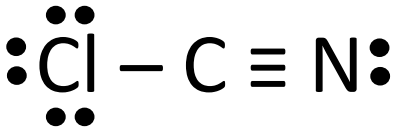
≈ 1.3×10^{-21} nm

Opg. 3

Hvad er den korrekte Lewis struktur for ClCN? (NB: formelle ladninger er ikke angivet)

What is the correct Lewis structure for ClCN? (NB: formal charges have not been indicated)





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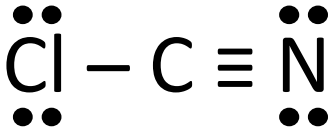
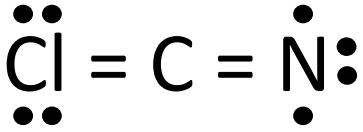
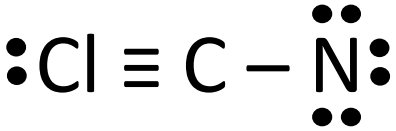






Opg. 4

Hvad er geometrien af $[BeCl_4]^{2-}$ ionen og hybridiseringstilstanden af Be atomet i denne ion?

What is the geometry of the $[BeCl_4]^{2-}$ ion and the hybridization state of the beryllium atom in this ion?

Square planar / sp^3 - Kvadratisk plan / sp^3

Octahedral / sp^3d^2 - Oktaederisk / sp^3d^2

Octahedral / sp^3 - Oktaederisk / sp^3

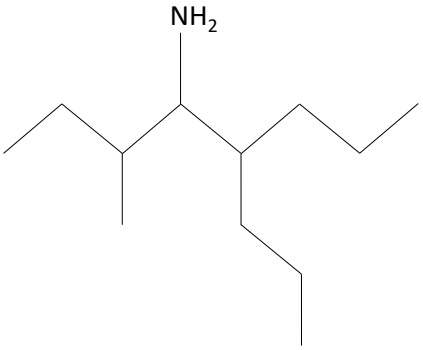
Square planar / sp^2 - Kvadratisk plan / sp^2

Tetrahedral / sp^3 - Tetraederisk / sp^3 *

Opg. 5

Hvad er det mest korrekte navn for følgende molekyle?

What is the most correct name of this molecule?



1-methyl-2-amino-3-propyloctane / 1-methyl-2-amino-3-propyloctan

5-amino-6-methyl-4-propyloctane / 5-amino-6-methyl-4-propyloctan

3-methyl-4-amino-5-propyloctane / 3-methyl-4-amino-5-propyloctan

4-amino-3-methyl-5-propyloctane / 4-amino-3-methyl-5-propyloctan*

4-propyl-5-amino-6-methyloctane/ 4-propyl-5-amino-6-methyloctan

Opg. 6

En væske har en damptryk på 20.3 mmHg ved 30 °C og en fordampningsvarme på 23.7 kJ/mol. Hvad er damptrykket ved 100 °C?

If the vapor pressure of a liquid at 30 °C is 20.3 mmHg and its heat of vaporization is 23.7 kJ/mol. What is the vapor pressure of this liquid at 100 °C?

≈ 22 mmHg

≈ 36 mmHg

≈ 119 mmHg *

≈ 1190 mmHg

≈ 1420 mmHg

Opg. 7

En 760 mL vandig opløsning af 0.372 g af en stærk monoprotisk syre har et osmotisk tryk på 76 mmHg ved 38 °C. Hvad er molarmassen af syren? (Antag fuld dissociation af syren).

A 760 mL aqueous solution of 0.38 g of a strong monoprotic acid has an osmotic pressure of 76 mmHg at 38°C. What is the molar mass of the acid? (Assume full dissociation of the acid).

≈ 125 g/mol

≈ 250 g/mol *

≈ 500 g/mol

≈ 12500 g/mol

≈ 25000 g/mol

Opg. 8

Hastighedskonstanten (k) for en reaktion blev målt ved forskelige temperaturer. Data er vist i tabellen. Find aktiveringsenergien (E_a) samt frekvens-faktoren (A).

The rate constant (k) for a reaction was measured at five different temperatures. The data are shown in the table. Determine the activation energy (E_a) and the frequency factor (A).

k [1/$M^{1/2}$·s]	T [°C]
0.11781	0
0.30309	100
0.52292	200
0.74581	300
0.95718	400

E_a = 8 kJ/mol A = 4 $M^{-1/2}s^{-1}$ *

E_a = 8 kJ/mol A = 1.4 $M^{-1/2}s^{-1}$

E_a = 960 J/mol A = 4 $M^{-1/2}s^{-1}$

E_a = 960 J/mol A = 1.4 $M^{-1/2}s^{-1}$

E_a = 80 J/mol A = 4 $M^{-1/2}s^{-1}$

Opg. 9

0.8 mol A_2 og 0.8 mol B_2 molekyler blandes i en 2 L beholder. Ligevægtskonstanten for reaktionen $A_2(g) + B_2(g) \leftrightharpoons 2AB(g)$ er 16.0. Beregn ligevægtskoncentrationerne for A_2, B_2 and AB.

0.8 mol A_2 and 0.8 mol B_2 molecules are mixed in a 2 L vessel. The equilibrium constant (K_c) for the reaction $A_2(g) + B_2(g) \leftrightharpoons 2AB(g)$ is 16.0. Calculate the equilibrium concentrations of A_2, B_2 and AB.

$[A_2] = 0.267$ M $[B_2] = 0.267$ M $[AB] = 0.533$ M

$[A_2] = 0.133$ M $[B_2] = 0.133$ M $[AB] = 0.533$ M *

$[A_2] = 0.267$ M $[B_2] = 0.267$ M $[AB] = 0.267$ M

$[A_2] = 0.100$ M $[B_2] = 0.100$ M $[AB] = 0.200$ M

$[A_2] = 0.267$ M $[B_2] = 0.267$ M $[AB] = 1.067$ M

Opg. 10

Afstem nedenstående reaktionsligning i sur opløsning med de mindst mulige heltallige koefficienter. Angiv facit som summen af koefficienterne for Mn^{2+}, PbO_2, MnO_4^-, Pb^{2+} og H_2O.

Balance the reaction scheme below under acidic conditions. Use the smallest possible whole numbers as coefficients, and state the answer as the sum of the coefficients for Mn^{2+}, PbO_2, MnO_4^-, $Pb^{2+}$and H_2O.

$Mn^{2+} + PbO_2 \rightarrow MnO_4^- + Pb^{2+}$

8

10

12

14

16*

Opg. 11

Rengøringsmidlet klorin indeholder den kemiske forbindelse natriumhypoklorit (NaClO). Hvad er den molære koncentration af NaClO i en vandig klorin opløsning, som indeholder 3 wt% NaClO? (Antag densiteten af klorin-opløsningen er 1 g/mL).

The cleaning agent klorin contains the chemical compound sodium hypochlorite (NaClO). What is the molar concentration of NaClO in an aqueous klorin solution containing 3 wt% NaClO? (Assume the density of the klorin solution is 1 g/mL).

0.4 M*

4 M

0.04 M

0.004 M

0.0004 M

Opg. 12

Methanol kan bruges som brændstof i køretøjer, og omdannes ved fuldstændig forbrænding til carbondioxid og vand ifølge reaktionsskemaet herunder.

Hvor mange liter O_2 skal bruges for at afbrænde 1 kg methanol? (Antag, at trykket er 1 atm og temperaturen er 25 °C).

Methanol may be used as a fuel in vehicles. Upon complete combustion it is converted to carbon dioxide and water according to the reaction scheme below.

How many liters of O_2 are needed in order to combust 1 kg of methanol? (Assume that the pressure is 1 atm and the temperature is 25 °C).

$2\ CH_3OH\ (l) + 3\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + 4\ H_2O\ (g)$

1146 L *

769 L

96 L

64 L

513 L

Opg. 13

En tæt lukket metalbeholder indeholder kun Ar gas. Beholderen har et volumen på 5 L, temperaturen er 25 °C og trykket i den er 2 atm. Hvilket af følgende udsagn er falskt?

A tightly sealed metal container contains only Ar gas. The volume of the container is 5 L, the temperature is 25 °C, and the pressure is 2 atm. Which of the following statements is wrong?

Hvis temperaturen stiger til 50 °C fordobles trykket / If the temperature increases to 50 °C the pressure is doubled*

Hvis der tilføres 0.41 mol Ar, fordobles trykket / If 0.41 mol Ar is added, the pressure is doubled

Hvis der tilføres 0.41 mol Ne, fordobles trykket / If 0.41 mol Ne is added, the pressure is doubled

Hvis beholderen trykkes sammen til et volumen på 2.5 L fordobles trykket (temperaturen antages konstant) / If the container is compressed to a volume of 2.5 L, the pressure is doubled (temperature is assumed to be constant)

Trykket i beholderen er ≈ 2.0×10^5 Pa / The pressure in the container is ≈ 2.0×10^5 Pa

Opg. 14

Hvad er ligevægtskonstanten for nedenstående reaktion ved 25 °C, 1 atm?

What is the equilibrium constant for the reaction written below at 25 °C, 1 atm?

$2\ CO\ (g) + O_2\ (g) \rightarrow 2\ CO_2\ (g)$

≈ 1.2×10^{90} *

≈ 1.6×10^{87}

≈ 1.1×10^{45}

≈ 5.1×10^{2}

≈ 1.2

Opg. 15

Smelteenthalpien for H_2O er 6.01 kJ/mol. En isterning puttes i et vandglas med 200 mL 20 °C varmt vand. Da isen lige netop er smeltet, er vandet 16 °C varmt. Hvad vejede den oprindelige isterning? Du må antage, at hele isterningen var 0°C i det øjeblik, den kom i vandet, og at vandglasset ikke udveksler varme med omgivelserne.

The heat of fusion for H_2O is 6.01 kJ/mol. An ice cube is put into a glass of water containing 200 mL 20 °C warm water. Right after the ice cube has melted, the water is 16 °C. What was the weight of the original ice cube? You may assume that the entire ice cube was 0 °C at the moment it was put into the water, and no heat is exchanged between the glass of water and the surroundings.

≈ 10 g *

≈ 8 g *

≈ 6 g

≈ 4 g

≈ 12 g

(Obs. Denne opgave var uskarpt formuleret i forhold til, om de 16 °C skal forstås som en fælles temperatur for både smeltet isterning og vand, eller kun for de oprindelige 200 mL vand. Derfor blev både besvarelsen 10 g og besvarelsen 8 g godkendt ved karaktergivningen)

Opg. 16

En vandig opløsning indeholder 11 mmol af en ukendt svag base og 9 mmol af den korresponderende svage syre. pH værdien for opløsningen bestemmes til 4.88. Angiv den svage syres styrkekonstant K_a.

An aqueous solution contains 11 mmol of an unknown weak base and 9 mmol of the corresponding weak acid. pH of the solution is determined to be 4.88. State the value of the acid ionization constant K_a for the weak acid.

1.6×10^{-5} *

4.8

0.31

7.3×10^{-3}

5.2×10^{-7}

Opg. 17

En vandig, basisk opløsning med volumen 0.5 L har en pH-værdi på 12. Til opløsningen tilsættes nu 0.5 L 0.005 M HCl. Hvad bliver pH i slutopløsningen?

An aqueous, alkaline solution of volume 0.5 L has a pH-value of 12. To this solution is added 0.5 L of 0.005 M HCl. What is pH in the final solution?

11.4 *

11.9

10

10.8

9.7

Opg. 18

Opløselighedsproduktet for $Cu(OH)_2$ er 2.2×10^{-20}. Hvad er koncentrationen af henholdsvis Cu^{2+} og OH^- i en mættet $Cu(OH)_2$ opløsning?

The solubility product for $Cu(OH)_2$ is 2.2×10^{-20}. What are the concentrations of Cu^{2+} and OH^- in a saturated $Cu(OH)_2$ solution?

$[Cu^{2+}] = 1.77 \times 10^{-7}$ M, $[OH^-] = 3.53 \times 10^{-7}$ M *

$[Cu^{2+}] = 1.77 \times 10^{-7}$ M, $[OH^-] = 1.77 \times 10^{-7}$ M

$[Cu^{2+}] = 2.22 \times 10^{-7}$ M, $[OH^-] = 4.45 \times 10^{-7}$ M

$[Cu^{2+}] = 1.48 \times 10^{-10}$ M, $[OH^-] = 2.97 \times 10^{-10}$ M

$[Cu^{2+}] = 1.48 \times 10^{-10}$ M, $[OH^-] = 1.48 \times 10^{-10}$ M

Opg. 19

En redox-reaktion mellem redox-parrene A/A^{2+}og B/B^{2+} er beskrevet ved nedenstående reaktionsligning

$A\ (aq) + B^{2+}\ (aq) \rightarrow A^{2+}\ (aq) + B\ (aq)$

Standard-reduktionspotentialerne for de to redox-par er $E^\circ_{A2+/A}$=-0.35 V og $E^\circ_{B2+/B}$=1.68 V. Hvad er ligevægtskonstanten for redox-reaktionen ved 25 °C? (Brug F = 96485 C/mol)

A redox reaction between the redox-couples A/A^{2+} and B/B^{2+} is described by the equation

$A\ (aq) + B^{2+}\ (aq) \rightarrow A^{2+}\ (aq) + B\ (aq)$

The standard reduction potentials for the two redox-couples are $E^\circ_{A2+/A}$=-0.35 V are $E^\circ_{B2+/B}$=1.68 V. State the value of the equilibrium constant for the redox-reaction at 25 °C (Use F = 96485 C/mol).

4.3×10^{68} *

2.0×10^{34}

8.9×10^{44}

6.1×10^{29}

2.5×10^{-69}

Opg. 20

Markér det korrekte d-orbitaldiagram for det tetraederiske kompleks $[CoCl_4]^{2-}$.

Mark the correct d-orbital diagram for the tetrahedral complex $[CoCl_4]^{2-}$.

*