Progress test 3

Multiple choice tests

- In the periodic table, Oxygen belongs to the sixth group and to the second period, therefore:
  - it has a total of 6 electrons
  - it has 6 electrons in the last shell [*]
  - it has 2 electrons in the last shell
  - it has 6 electronic levels

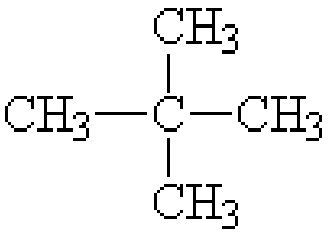
- Ethanol and dimethyl-ether are an example of which type of isomerism?
  - Optical isomerism
  - *cis-trans* isomerism
  - positional isomerism
  - functional group isomerism [*]

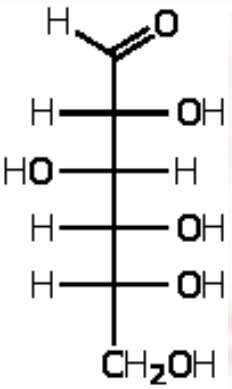
- Which of the following formulas would you use to calculate the equilibrium constant of the following homogeneous reactions?
  $2N_2O_5 \leftrightarrows 2N_2 + 5O_2$
  - $Kc= [N_2O_5]^2/[N_2]^2[O_2]^5$
  - $Kc= [N_2]^2[O_2]^5/[N_2O_5]^2$ [*]
  - $Kc= [N_2O_5]/[N_2][O_2]$
  - $Kc= [N_2]^5[O_2]^2/[N_2O_5]^2$

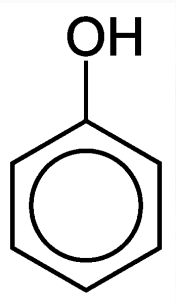
- Which of the following compounds has an acidic behaviour in water?
  - Sodium nitrate
  - ammonium chloride [*]
  - sodium hydrogen carbonate
  - potassium sulphate

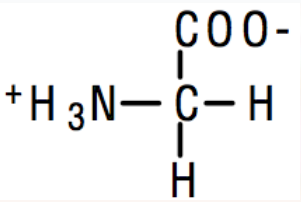
- What does a stick of metal submerged in an aqueous solution of its ion represent?
  - A difference in electric potential
  - The half of a buffer
  - A voltaic cell
  - The half of a galvanic cell [*]

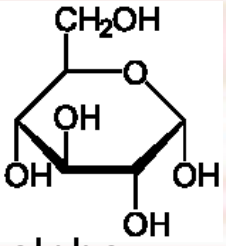
- 2,2-dimethylpropane; glucose; phenol; glycine



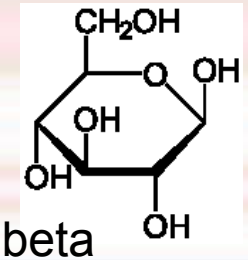








alpha



beta

Exercise 7

- Calculate the osmotic pressure of an aqueous slution containing 0.7 g of glucose and 1 g of potassium sulphate in 500 ml of water at 25°C. [Answer: ...1.032 atm....]

$n_{glucose} = 0.7 / 180 = 3.89 \cdot 10^{-3}$ mol

$n_{(K2SO4)} = 1 / 174.26 = 5.74 \cdot 10^{-3} \cdot [1+\alpha(v-1)] = 5.74 \cdot 10^{-3} \cdot 3 =$
$= 1.72 \cdot 10^{-2}$ mol

$\pi = (n_{tot} / V) \cdot R \cdot T = (0.0211 / 0.5) \cdot 0.082 \cdot 298 = 1.032$ atm

Exercise 8

- The following homogeneous gaseous reaction takes place at 900K:

$$3H_2 + N_2 \leftrightarrows 2NH_3$$

Determine the numerical value of the equilibrium constant and its units of measurement, knowing that after having mixed 2.7 mol of molecular Hydrogen and 0.9 mol of molecular nitrogen in a volume of 5 L, at equilibrium there are 2.1 mol of molecular Hydrogen. [Answer: .0.615 M^{-2}]

	H_2	N_2	NH_3
start	2.7	0.9	0
	-3x	-x	+2x
eq.	2.1		

2.7-3x = 2.1
3x = 0.6
x = 0.2

[H2] = 2.1 / 5 = 0.42 M
[N2] = 0.7 / 5 = 0.14 M
[NH3] = 0.4 / 5 = 0.08 M

$$Kc = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{0.08^2}{0.14 \cdot 0.42^3} = \frac{6.4 \cdot 10^{-3}}{0.0104} = 0.615\, M^{-2}$$

Exercise 9

- 1 g of sodium methanoate is added to 500 ml of methanoic acid 0.05 M. Which is the final pH? (Ka = $2 \cdot 10^{-4}$ M).

[Answer: .....3.45....]

HCOONa + HCOOH → buffer solution

Cs = g / (FW ·V) = 1 / (68·0.5) = 0.029 M

$$pH = pKa + \log \frac{Cs}{Ca} = 3.69 + \log \frac{0.029}{0.05} = 3.69 - 0.24 = 3.45$$

Exercise 10

- Calculate the pH of a solution of ammonia prepared by diluting 5 ml of the commercial solution (30%w, d=0.9 g/ml) in 500 ml of water. (Ignore the variation of volume; Kb= $1.8 \cdot 10^{-5}$ M).
  [Answer: ...11.23...]

To convert 30%w into Molar concentration I need to calculate the volume corresponding to 100 g of solution:

$V = g / d = 100 / 0.9 = 0.111$ L

$C1 = g / (FW \cdot V) = 30 / (17 \cdot 0.111) = 15.9$ M

Then I can dilute and calculate the final pH:

$C1 \cdot V1 = C2 \cdot V2 \rightarrow C2 = 15.9 \cdot 5 / 500 = 0.159$ M

$[OH^-] = \sqrt{Kb \cdot Cb} = \sqrt{1.8 \cdot 10^{-5} \cdot 0.159} = 1.7 \cdot 10^{-3}$ M

$pOH = 2.77 \rightarrow pH = 14 - 2.77 = 11.23$