Question A1	
Page 1/2	**Marks**
a) A strong monoprotic acid **HX**, is a solid at 25 °C. It is the only acidic constituent of a descaler for cafetières. – AVKALKNING FÖR KAFFEMASKINER Assuming that the scale is composed of calcium carbonate, $CaCO_3(s)$, give the equation for the reaction observed when a cafetière is descaled using a solution of **HX**(aq). SCALE- KALK-AVLAGRING	2 marks
b) A commercial descaling product contains 91.0% by mass of this acid **HX**. In order to determine the molar mass of this acid, 3.00 g of the descaler were dissolved in distilled water and the total volume made up to 5.00×10^{-1} dm^3. A 20.0 cm^3 sample of this solution was titrated with sodium hydroxide solution, NaOH(aq). The pH of the solution was recorded as the volume of base, V_b, was added progressively. The titration graph obtained, pH =f(V_b), gave the following information: pH = 1.25 when V_b = 0.00 cm^3 ; pH = 7.00 when V_b = 11.2 cm^3.	
i. Sketch the titration graph obtained.	3 marks
ii. Show with the help of a calculation that the initial concentration of the acid solution was 5.62×10^{-2} mol dm^{-3}.	2 marks
iii. Calculate the molar mass of the acid **HX**.	2 marks
iv. Calculate the concentration of the solution of sodium hydroxide used.	2 marks
Further experiments were carried out to determine the percentage composition by mass of each of the elements in the acid **HX**. The following results were obtained : H: 3.10 %, N: 14.4 %, S: 33.0%, O: 49.5 %	
v. Determine the molecular formula of the acid **HX**.	3 marks
<u>Given:</u> The ionic product of water at 25 °C: $K_w = 1.00 \times 10^{-14}$ Molar atomic mass (in g mol^{-1}): H: 1.01 ; O: 16.0 ; N: 14.0 ; S: 32.1.	

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c) Another descaler is a pure monoprotic acid, **HY**, and was studied using a similar technique.
3.00 g of pure **HY** was dissolved in distilled water and the total volume made up to 5.00×10^{-1} dm^3. A 20.0 cm^3 sample of this solution was titrated with a solution of sodium hydroxide, NaOH(aq) and the pH measured as the volume of base, V_b, was progressively added. A graph of pH = f(V_b) was plotted.

The titration graph obtained, pH =f(V_b), showed that **HY** is a weak acid and gave the following information :

pH = 2.90 when V_b = 0.00 cm^3 ;
pH at the half-equivalence point = 4.80.

- **i.** Calculate the initial concentration of the solution of acid **HY**. — 2 marks
- **ii.** Show by calculation that the pH at the equivalence point is 8.75, knowing that the equivalence point was reached after the addition of 20.0 cm^3 of the sodium hydroxide solution. — 3 marks
- **iii.** State how the titration graph of a strong acid with a strong base differs to that of a weak acid with a strong base. — 2 marks

d) Each of the two acids, **HX** and **HY**, can be used to prepare a buffer solution by mixing them with another substance in aqueous solution.

- **i.** Show how this can be achieved in each case. — 2 marks
- **ii.** With the help of two relevant equations show how a buffer solution prepared using the acid **HY** can function as a buffer. — 2 marks

---med kommentarer…..

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b)	A commercial descaling product contains 91.0% by mass of this acid **HX**. In order to determine the molar mass of this acid, 3.00 g of the descaler were dissolved in distilled water and the total volume made up to 5.00×10^{-1} dm^3. A 20.0 cm^3 sample of this solution was titrated with sodium hydroxide solution, NaOH(aq). The pH of the solution was recorded as the volume of base, V_b, was added progressively. The titration graph obtained, pH =f(V_b), gave the following information: pH = 1.25 when V_b = 0.00 cm^3 ; pH = 7.00 when V_b = 11.2 cm^3.	
	vi. Sketch the titration graph obtained.	3 marks
	vii. Show with the help of a calculation that the initial concentration of the acid solution was 5.62×10^{-2} mol dm^{-3}. Använd pH =1.25 och att stark syra protolyseras fullständigt	2 marks
	viii. Calculate the molar mass of the acid **HX**.	2 marks
	ix. Calculate the concentration of the solution of sodium hydroxide used.	2 marks
	Further experiments were carried out to determine the percentage composition by mass of each of the elements in the acid **HX**. The following results were obtained : H: 3.10 %, N: 14.4 %, S: 33.0%, O: 49.5 %	
	x. Determine the molecular formula of the acid **HX**.	3 marks
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iv. Calculate the initial concentration of the solution of acid **HY**.	2 marks
v. Show by calculation that the pH at the equivalence point is 8.75, knowing that the equivalence point was reached after the addition of 20.0 cm^3 of the sodium hydroxide solution. Obs vi behöver inte basens concentration. Vi behöver volymen 20.0 för att räkna ut koncentrationen Y^- vid ekvivalenspunkten. Så vi kan beräkna pOH och sen pH. Vi behöver pkB också från pkA =4.80	3 marks
vi. State how the titration graph of a strong acid with a strong base differs to that of a weak acid with a strong base. Tänk buffert zoner	2 marks
d) Each of the two acids, **HX** and **HY**, can be used to prepare a buffer solution by mixing them with another substance in aqueous solution.	
ii. Show how this can be achieved in each case.	2 marks
iii. With the help of two relevant equations show how a buffer solution prepared using the acid **HY** can function as a buffer.	2 marks