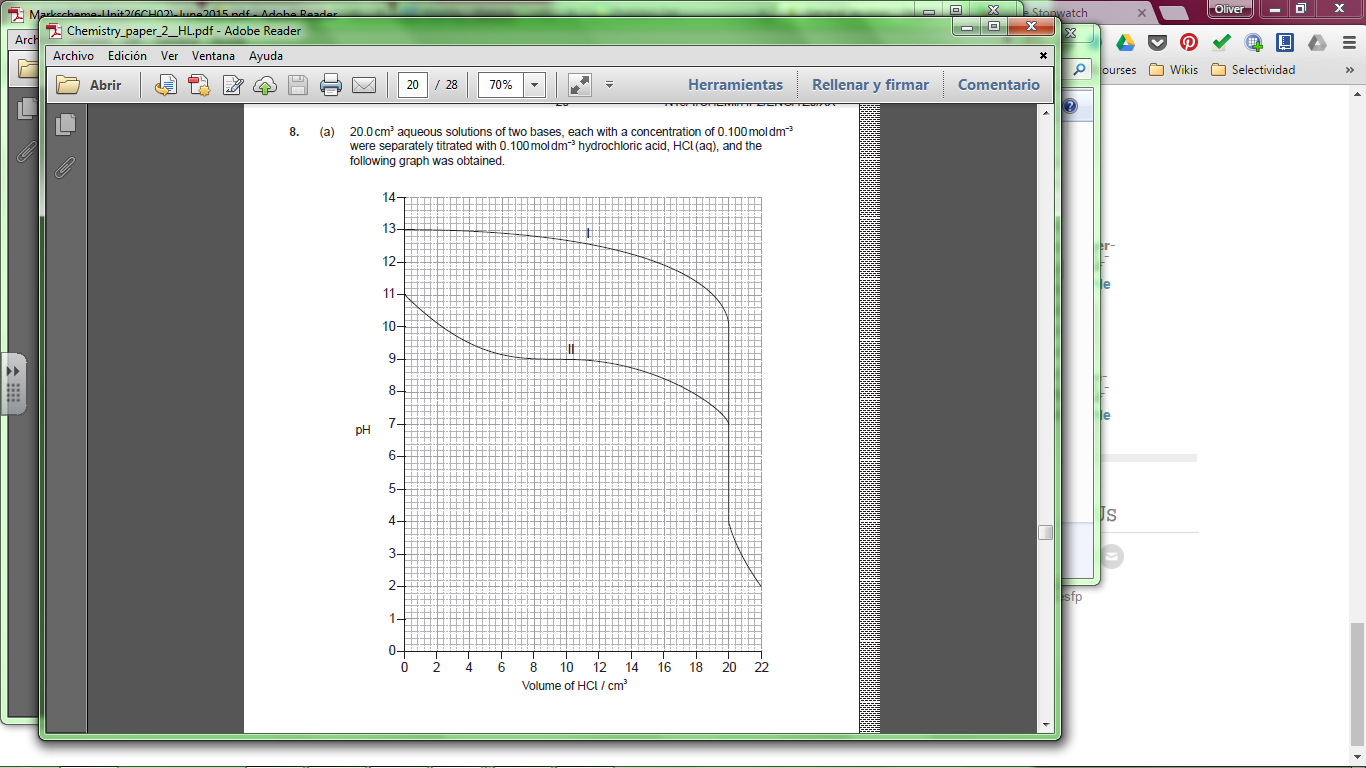
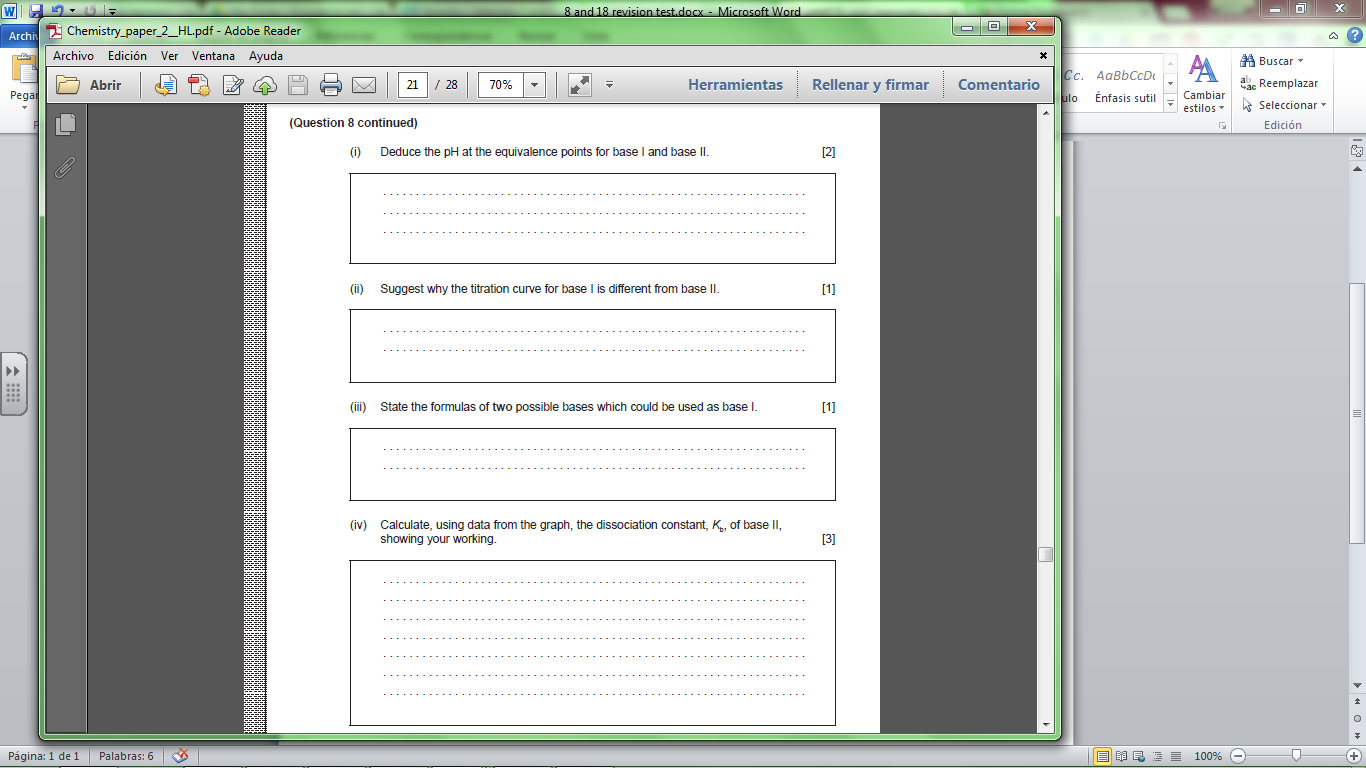
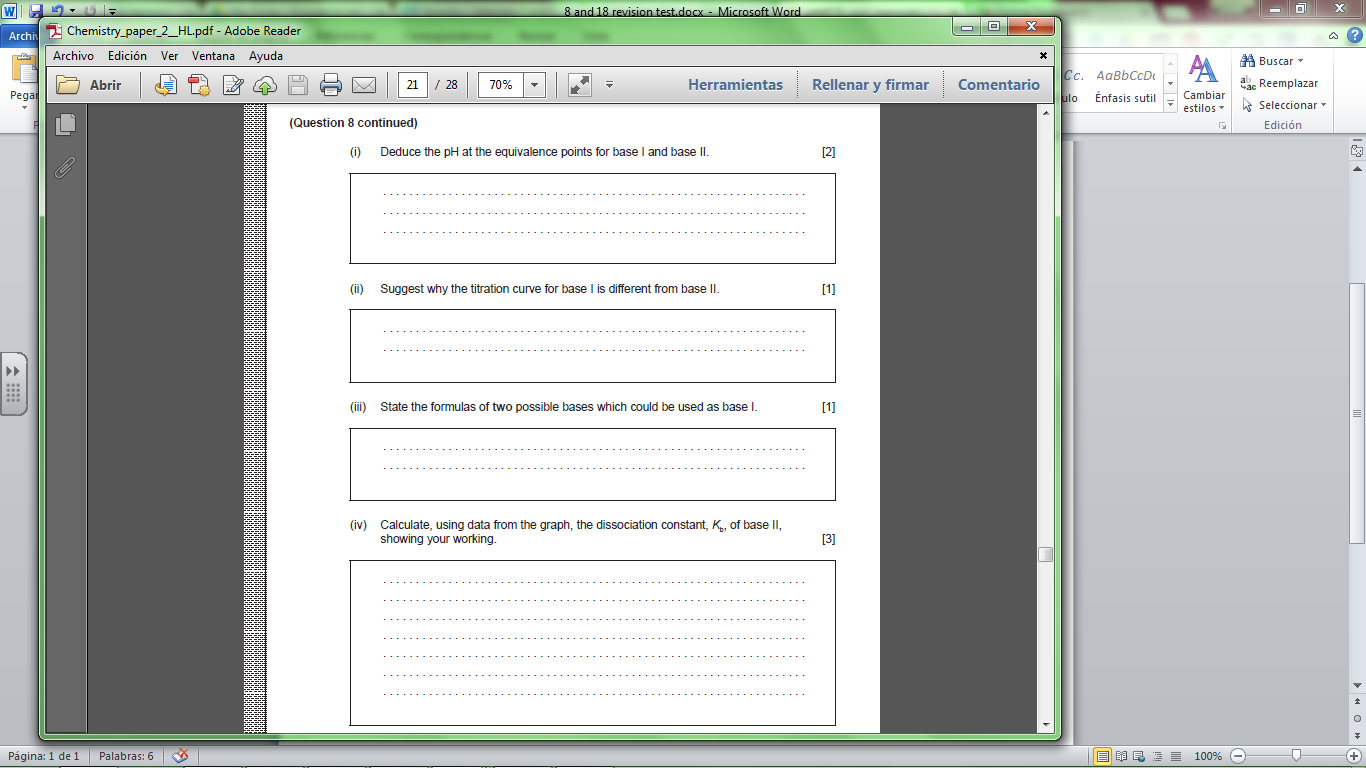
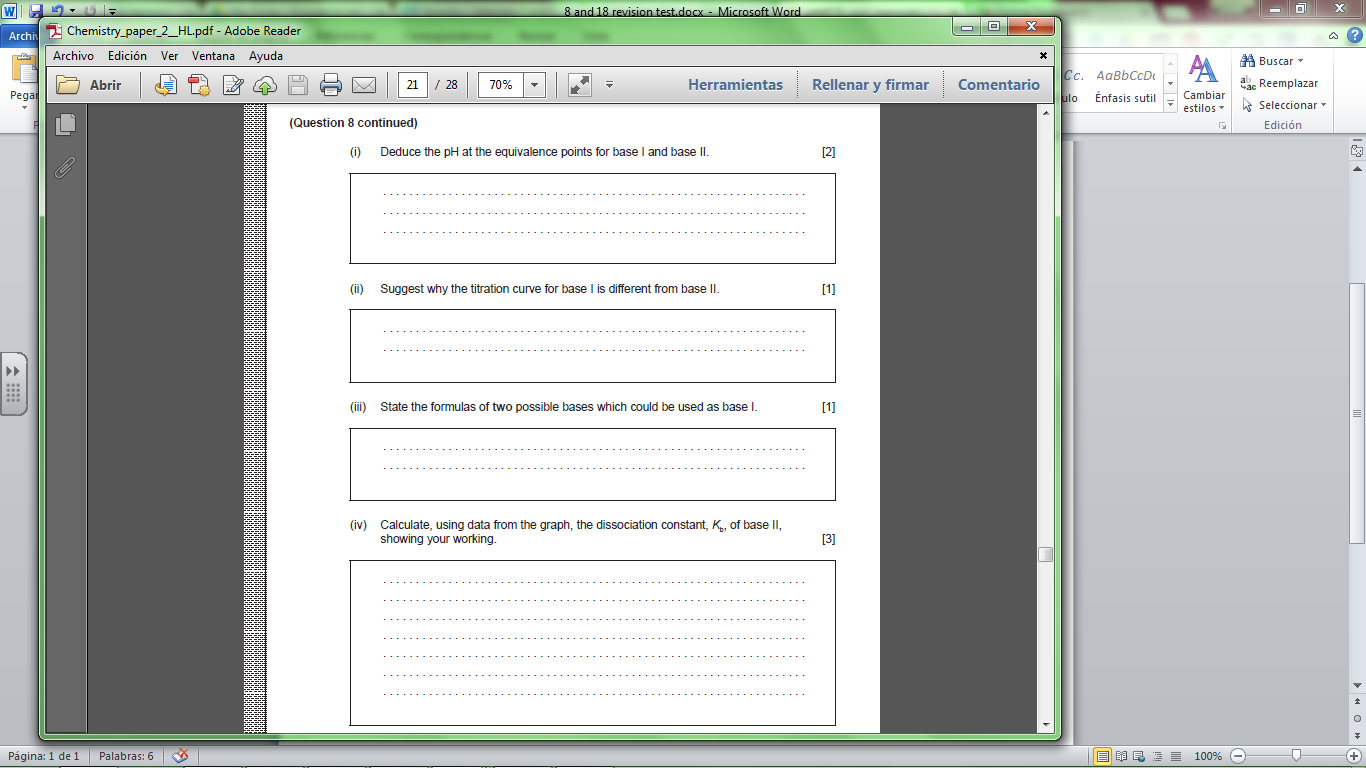
**8 and 18 practice test**

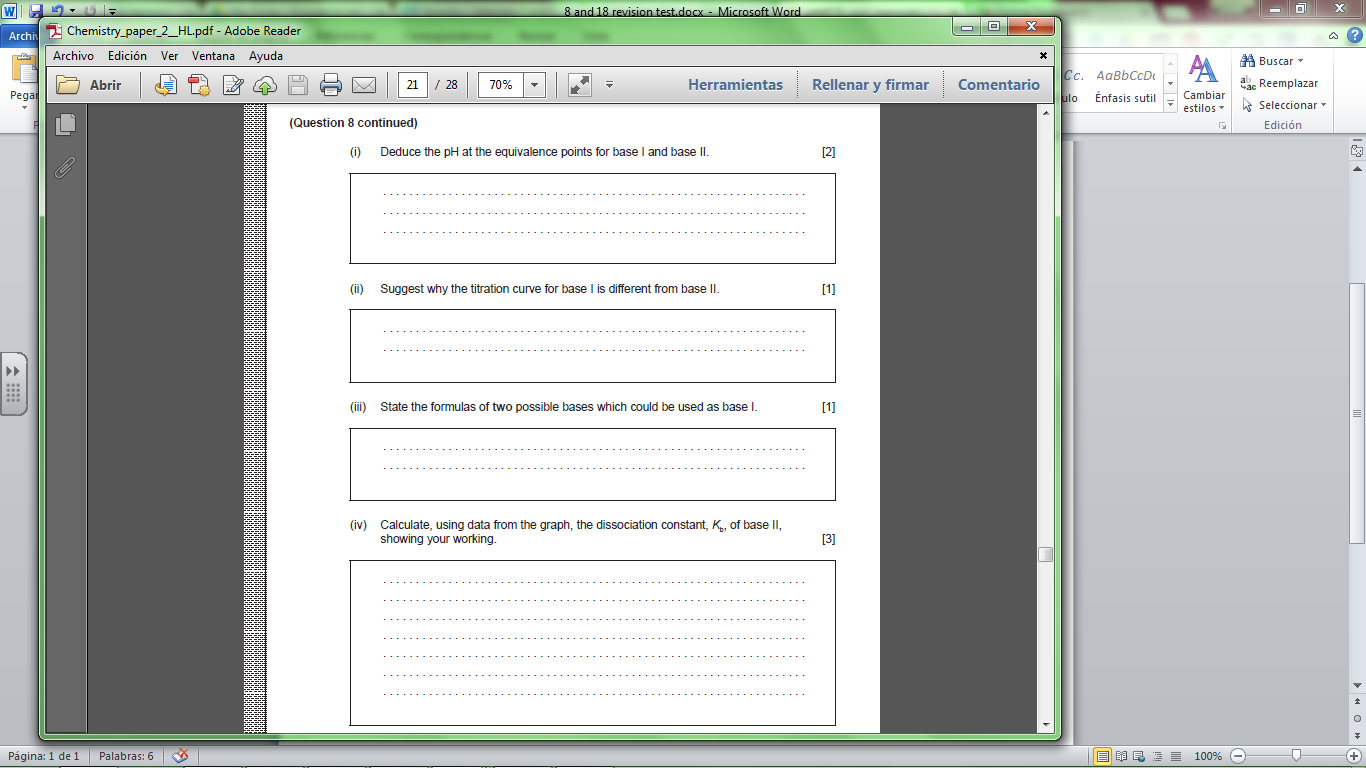
2015 PP.

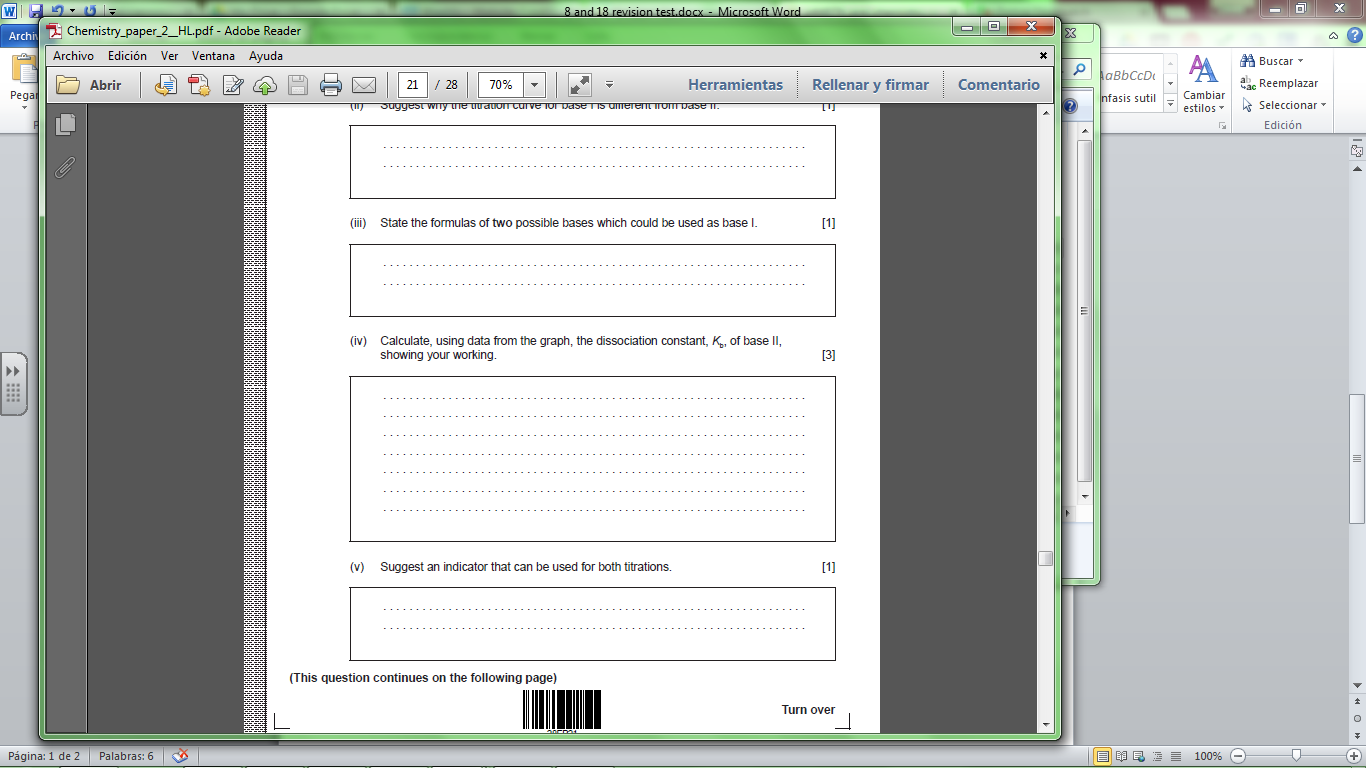


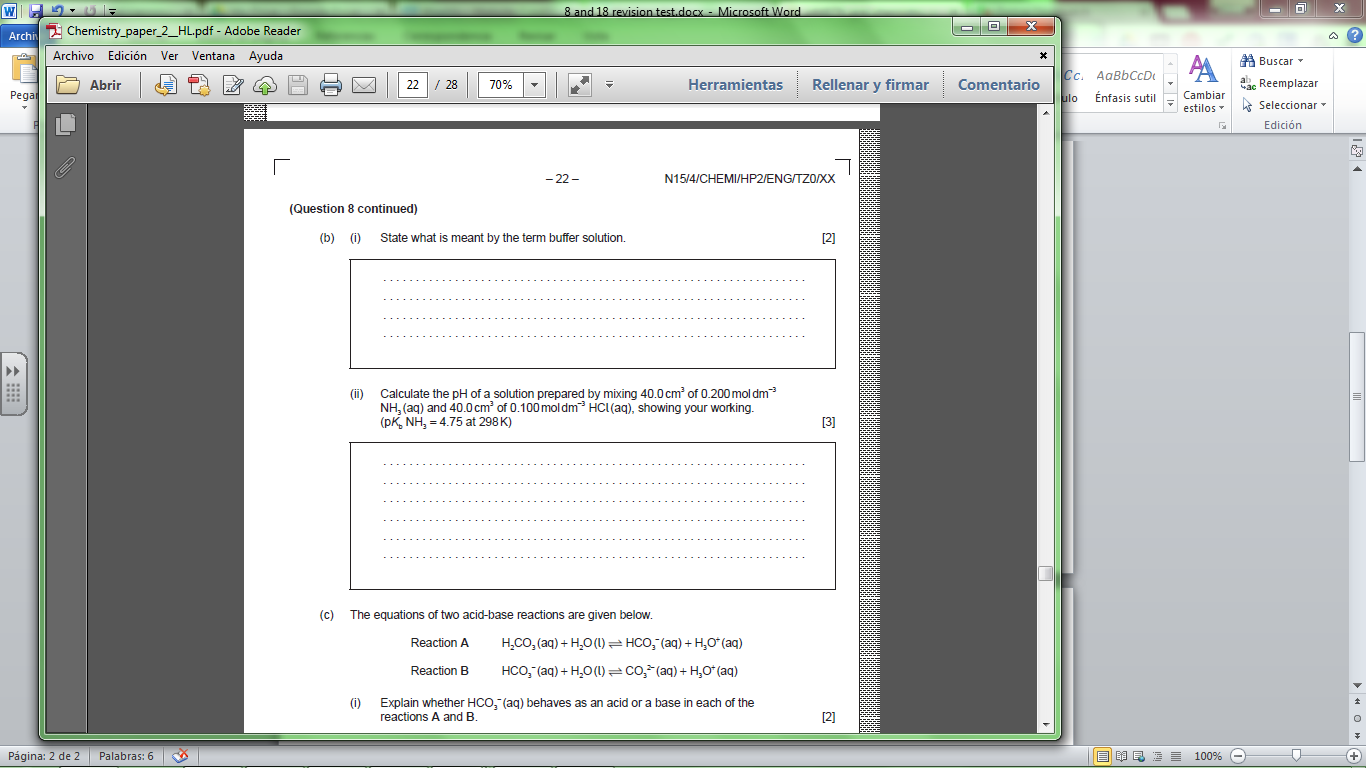


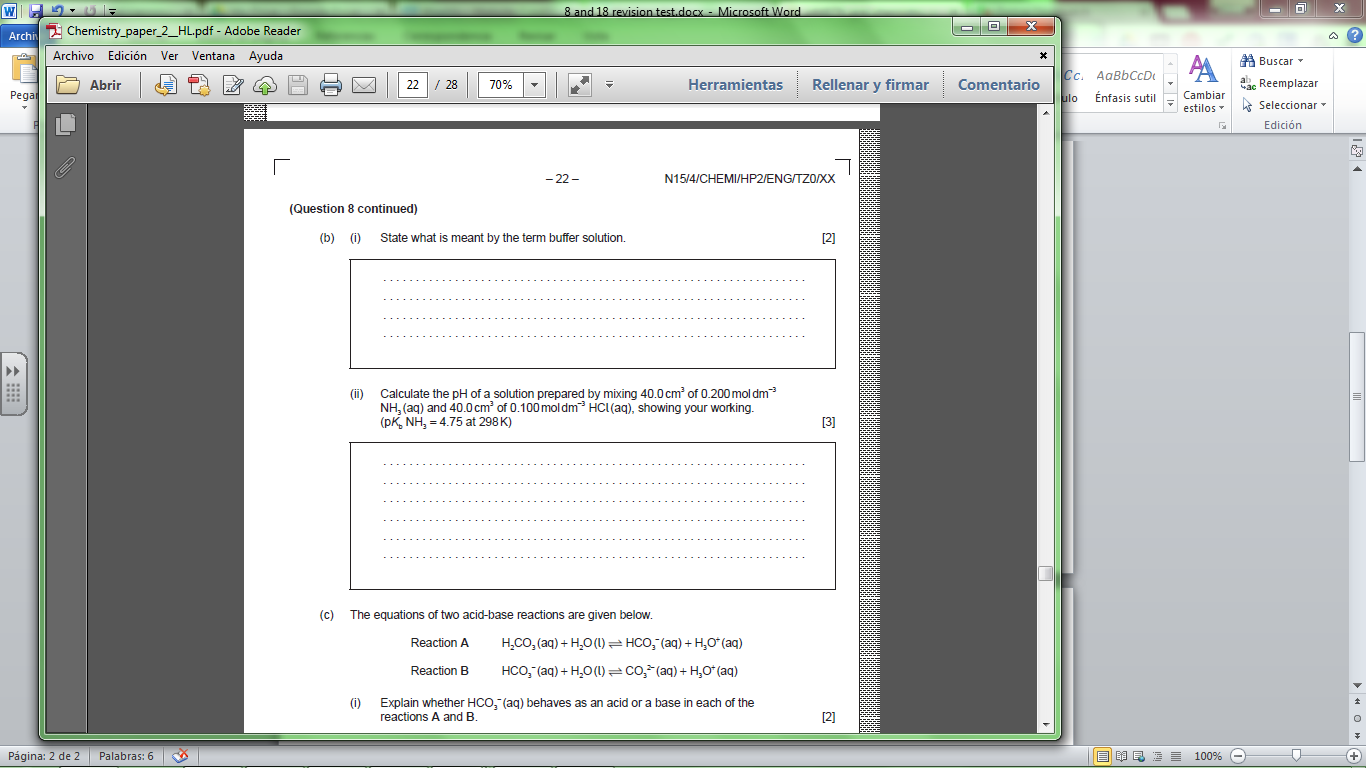


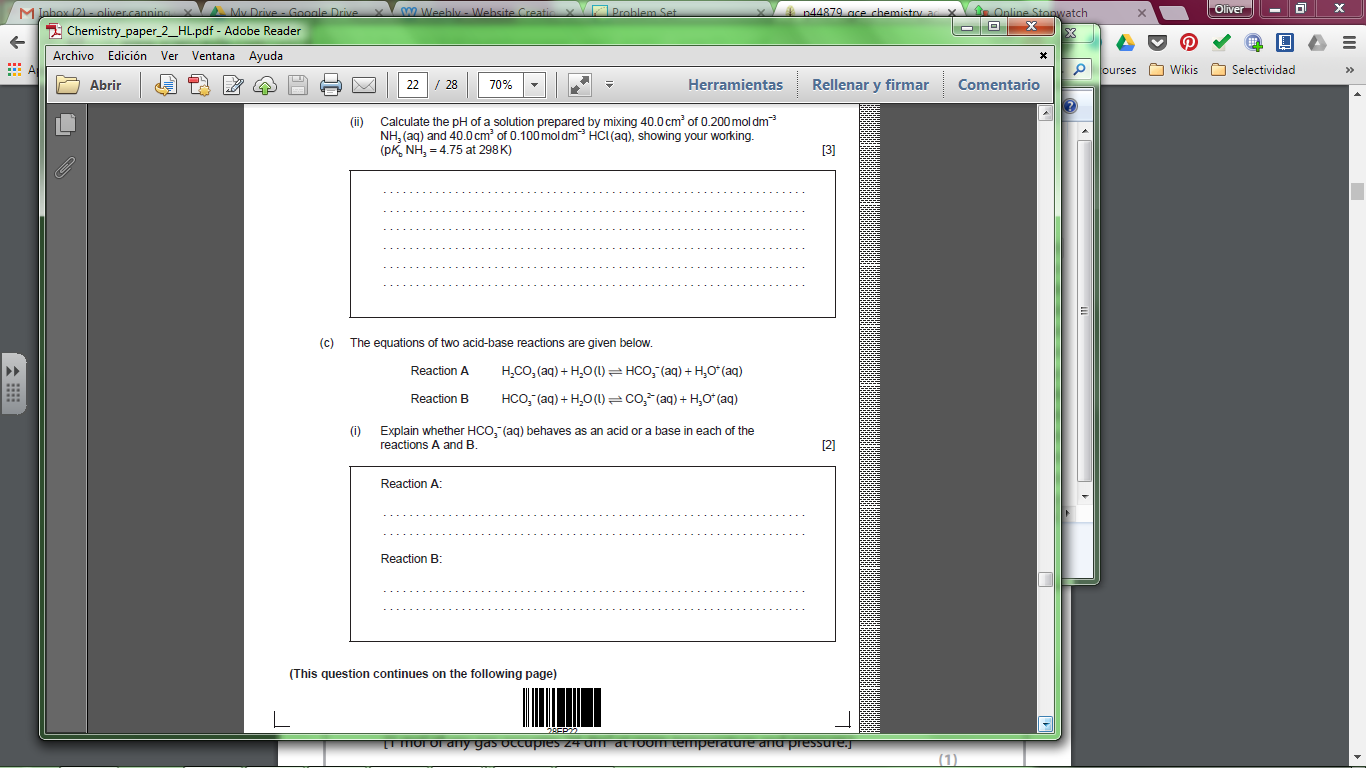


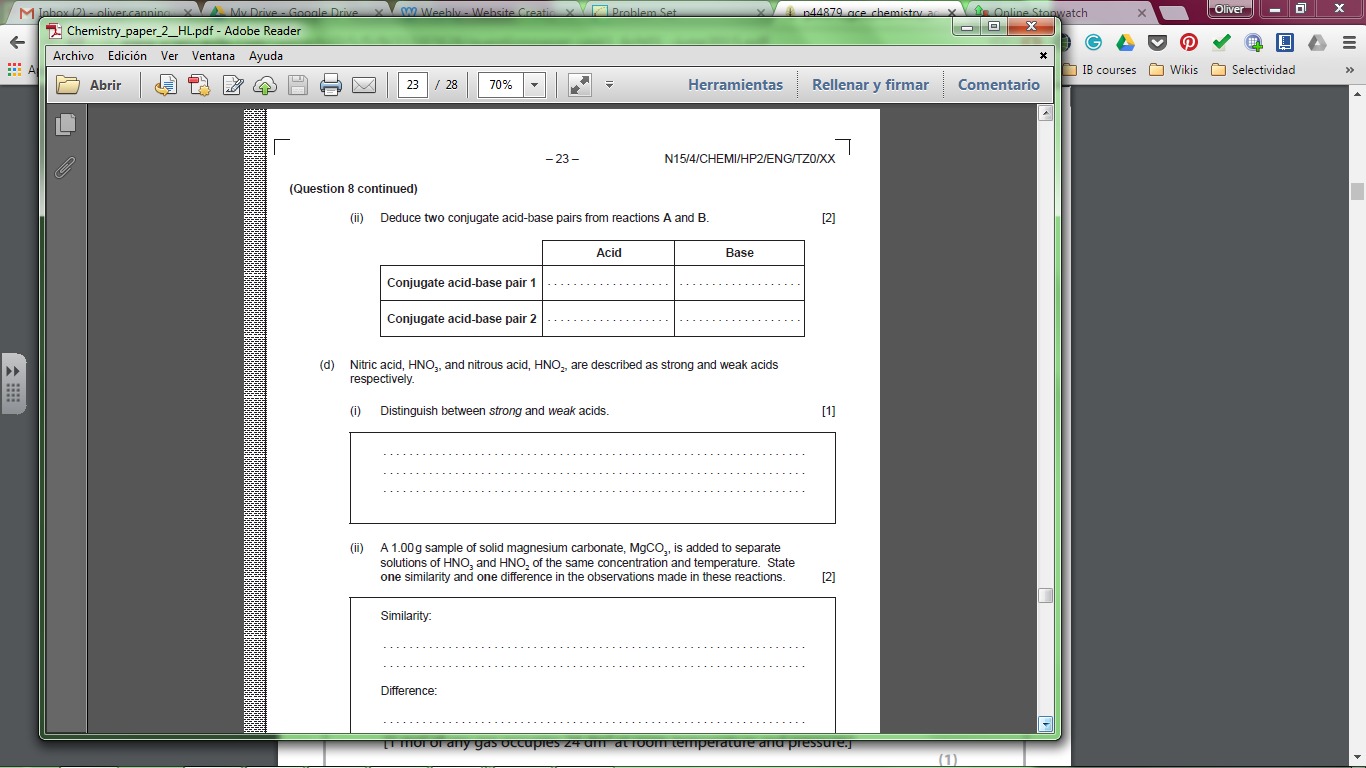


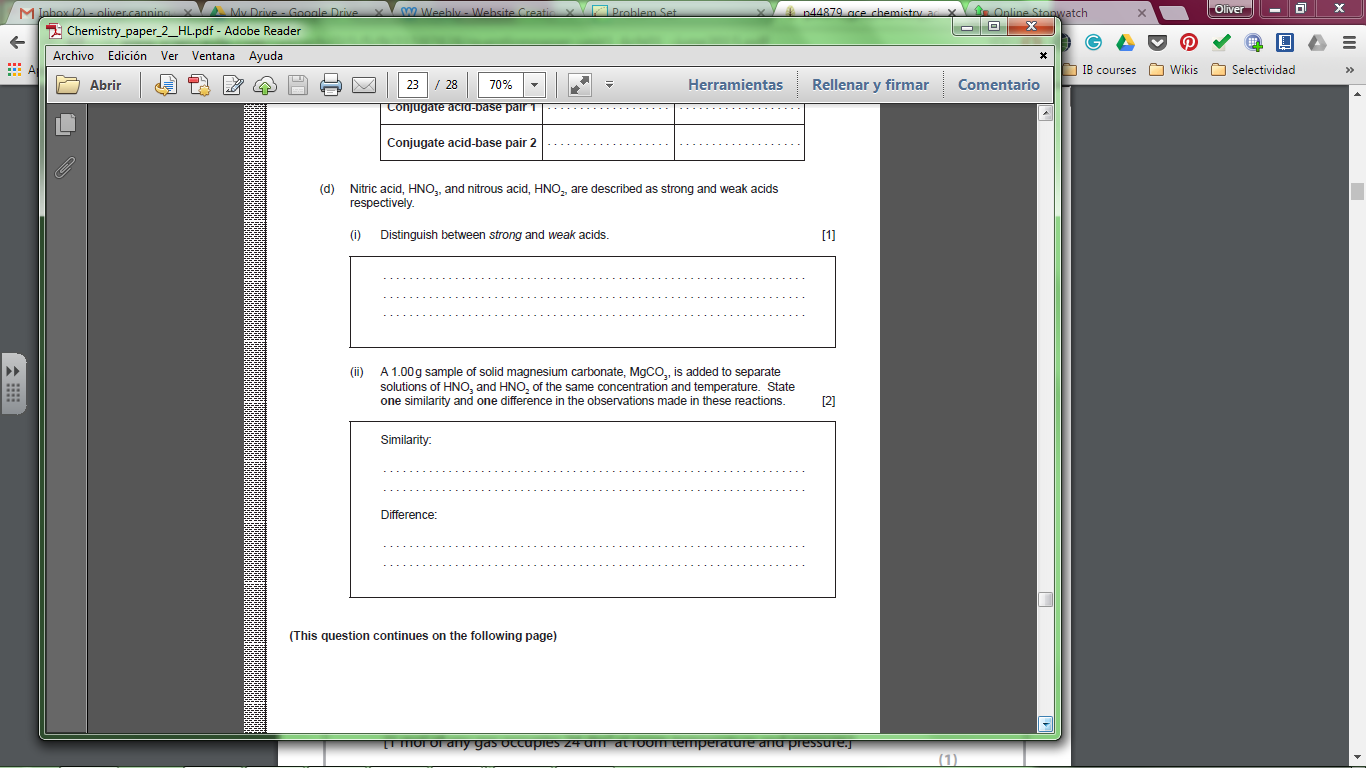


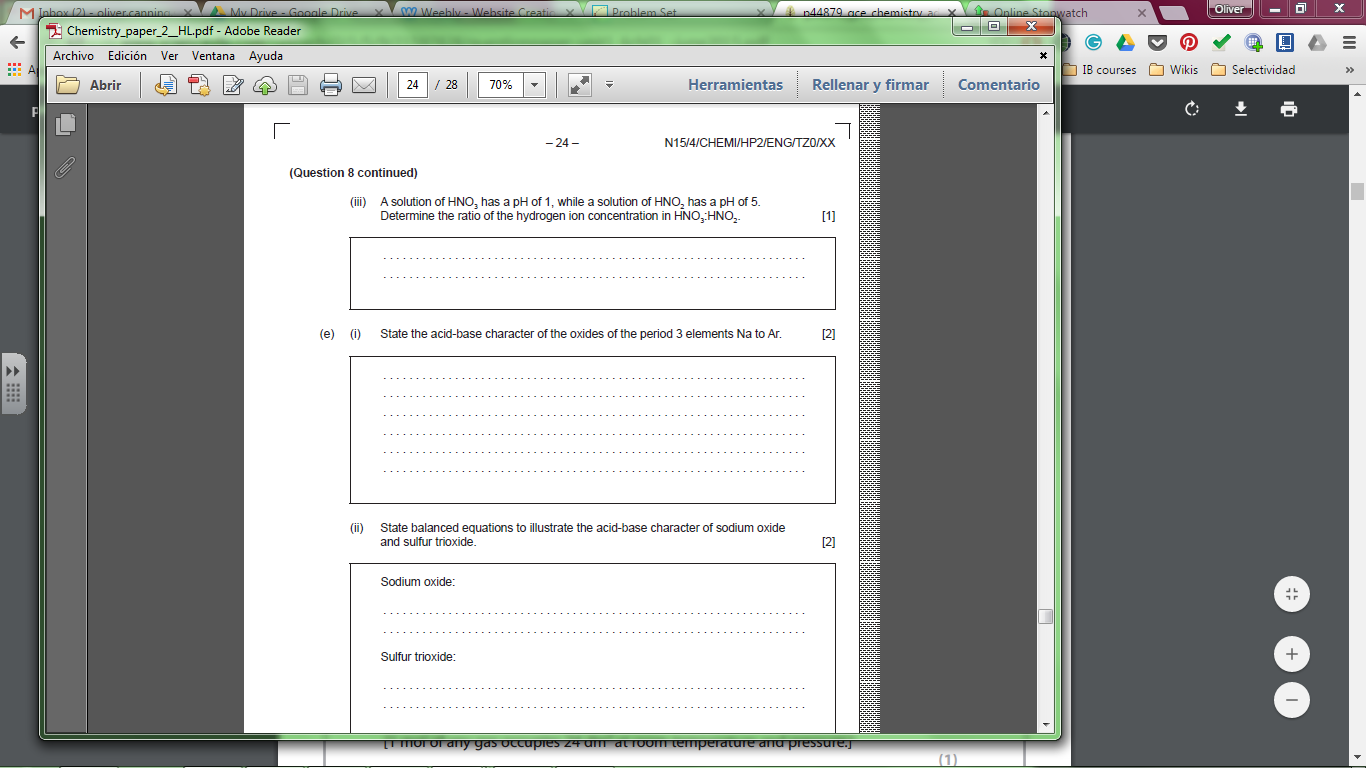


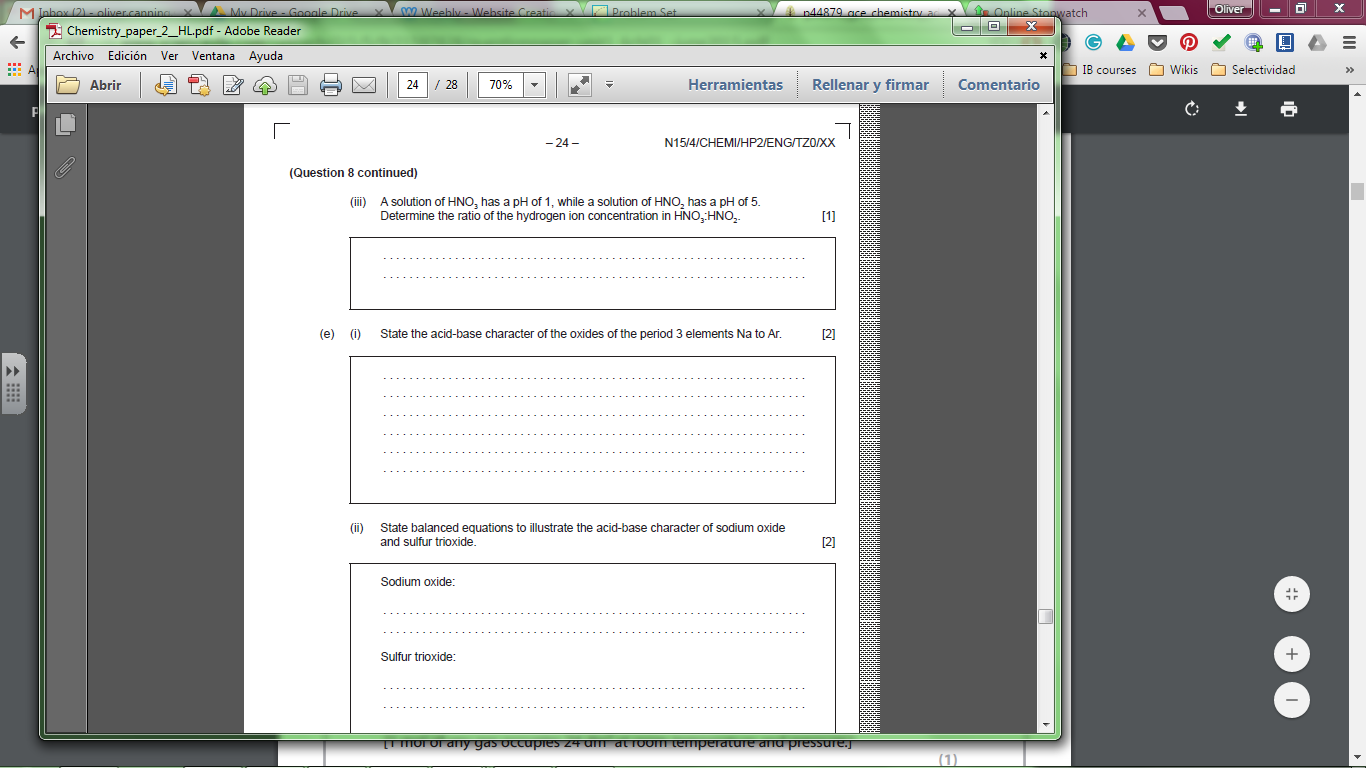


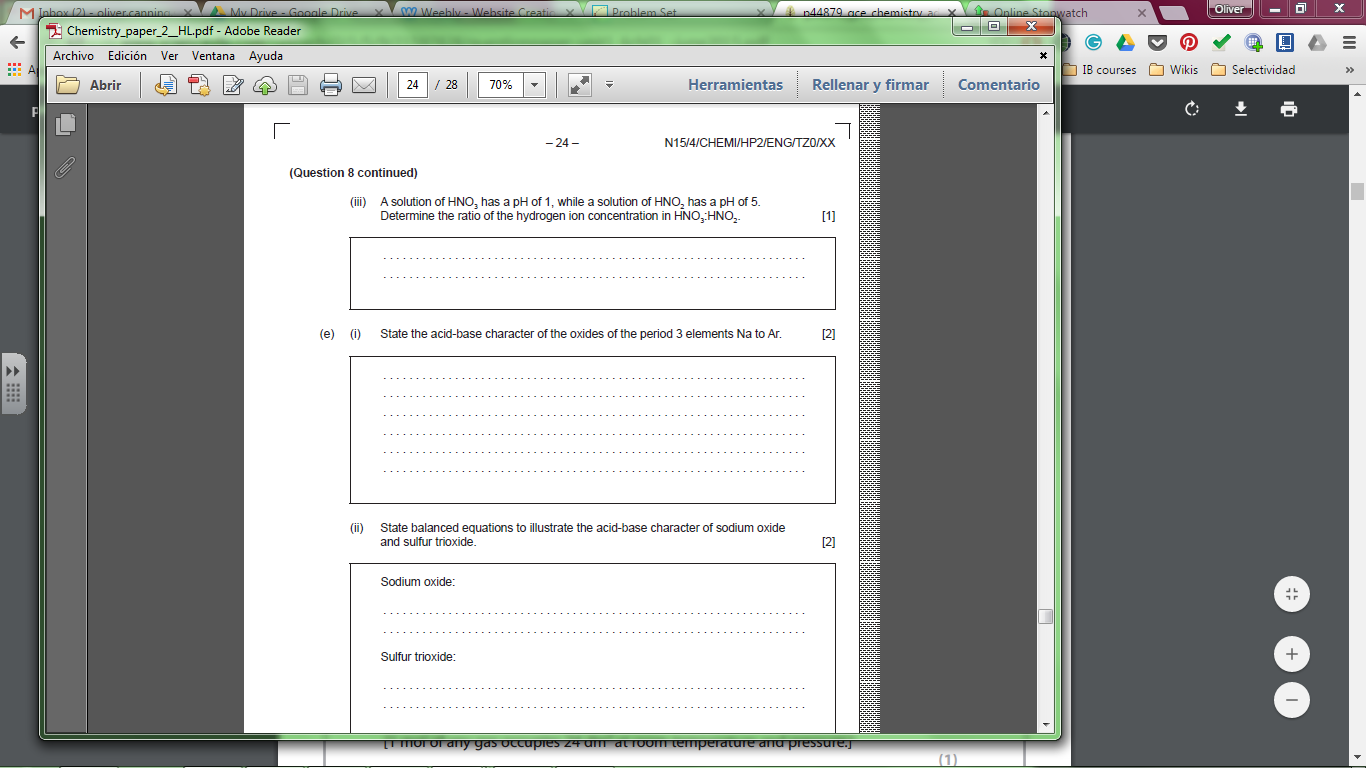












**1.** (a) The nitrite ion is present in nitrous acid, HNO2, which is a weak acid. The nitrate ion is present in nitric acid, HNO3, which is a strong acid. Distinguish between the terms *strong* and *weak acid* and state the equations used to show the dissociation of each acid in aqueous solution.

(3)

(b) A small piece of magnesium ribbon is added to solutions of nitric and nitrous acid of the same concentration at the same temperature. Describe **two** observations that would allow you to distinguish between the two acids.

(2)

(c) A student decided to investigate the reactions of the two acids with separate samples of 0.20 mol dm–3 sodium hydroxide solution.

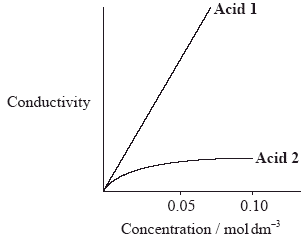
(i) Calculate the volume of the sodium hydroxide solution required to react exactly with a 15.0 cm3 solution of 0.10 mol dm–3 nitric acid.

(1)

(ii) The following hypothesis was suggested by the student: “Since nitrous acid is a weak acid it will react with a smaller volume of the 0.20 mol dm–3 sodium hydroxide solution.” Comment on whether or not this is a valid hypothesis.

(1)

(d) The graph below shows how the conductivity of the two acids changes with concentration.



Identify **Acid 1** and explain your choice.

(2)

(Total 9 marks)

**2.** (a) Ammonia can be converted into nitric acid, HNO3(aq), and hydrocyanic acid, HCN(aq). The p*K*a of hydrocyanic acid is 9.21.

(i) Distinguish between the terms *strong* and *weak acid* and state the equations used to show the dissociation of each acid in aqueous solution.

(3)

(ii) Deduce the expression for the ionization constant, *K*a, of hydrocyanic acid and calculate its value from the p*K*a value given.

(2)

(iii) Use your answer from part (a) (ii) to calculate the [H+] and the pH of an aqueous solution of hydrocyanic acid of concentration 0.108 mol dm–3. State **one** assumption made in arriving at your answer.

(4)

(b) A small piece of magnesium ribbon is added to solutions of nitric and hydrocyanic acid of the same concentration at the same temperature. Describe **two** observations that would allow you to distinguish between the two acids.

(2)

(c) A student decided to investigate the reactions of the two acids with separate samples of 0.20 mol dm–3 sodium hydroxide solution.

(i) Calculate the volume of the sodium hydroxide solution required to react exactly with a 15.0 cm3 solution of 0.10 mol dm–3 nitric acid.

(1)

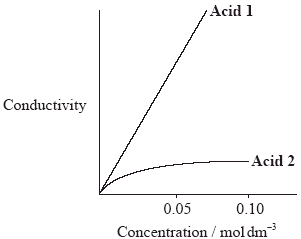
(ii) The following hypothesis was suggested by the student: “Since hydrocyanic acid is a weak acid it will react with a smaller volume of the 0.20 mol dm–3 sodium hydroxide solution.” Comment on whether or not this is a valid hypothesis.

(1)

(iii) Use Table 16 of the Data Booklet to identify a suitable indicator for the titration of sodium hydroxide and hydrocyanic acid.

(1)

(d) The graph below shows how the conductivity of the two acids changes with concentration.



Identify **Acid 1** and explain your choice.

(2)

(Total 16 marks)

**3.** (i) Describe how an indicator works.

(3)

(ii) Using Table 16 of the Data Booklet, identify the most appropriate indicator for the titration of ethanoic acid with potassium hydroxide. Explain your choice.

(2)

(Total 5 marks)

**4.** Determine the pH of the solution resulting when 100 cm3 of 0.50 mol dm–3 HCl(aq) is mixed with 200 cm3 of 0.10 mol dm–3 NaOH(aq).

(Total 5 marks)

**5.** (i) 25.0 cm3 of 1.00 × 10–2 mol dm–3 hydrochloric acid solution is added to 50.0 cm3 of  
1.00 × 10–2 mol dm–3 aqueous ammonia solution. Calculate the concentrations of both ammonia and ammonium ions in the resulting solution and hence determine the pH of the solution.

(5)

(ii) State what is meant by a buffer solution and explain how the solution in (i), which contains ammonium chloride dissolved in aqueous ammonia, can function as a buffer solution.

(3)

(Total 8 marks)

**6.** A 0.10 mol dm–3 ammonia solution is placed in a flask and titrated with a 0.10 mol dm–3 hydrochloric acid solution.

(i) Explain why the pH of the ammonia solution is less than 13.

(2)

(ii) Estimate the pH at the equivalence point for the titration of hydrochloric acid with ammonia and explain your reasoning.

(2)

(iii) State the equation for the reaction of ammonia with water and write the *K*b expression for NH3(aq).

(2)

(iv) When half the ammonia has been neutralized (the half-equivalence point), the pH of the solution is 9.25. Deduce the relationship between [NH3] and [NH4+] at the half-equivalence point.

(1)

(v) Determine p*K*b and *K*b for ammonia based on the pH at the half-equivalence point.

(3)

(vi) Describe the significance of the half-equivalence point in terms of its effectiveness as a buffer.

(1)

(Total 11 marks)

**7.** An experiment was carried out to determine the concentration of aqueous ammonia by titrating it with a 0.150 mol dm–3 sulfuric acid solution. It was found that 25.0 cm3 of the aqueous ammonia required 20.1 cm3 of the sulfuric acid solution for neutralization.

(a) Write the equation for the reaction and calculate the concentration, in mol dm–3, of the aqueous ammonia.

(4)

(b) Several acid-base indicators are listed in Table 16 of the Data Booklet. Identify **one** indicator that could be used for this experiment. Explain your answer.

(3)

(c) (i) Determine the pOH of 0.121 mol dm–3 aqueous ammonia (p*K*b= 4.75).

(4)

(ii) State what is meant by the term *buffer solution*, and describe the composition of an acid buffer solution in general terms.

(3)

(iii) Calculate the pH of a mixture of 50.0 cm3 of 0.100 mol dm–3 aqueous ammonia and 50.0 cm3 of 0.0500 mol dm–3 hydrochloric acid solution.

(4)

(Total 18 marks)