18.1 Further Aspects of Acids & Bases
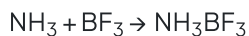
Question Paper

Course	DP IB Chemistry
Section	18. Acids & Bases (HL only)
Topic	18.1 Further Aspects of Acids & Bases
Difficulty	Hard

Time allowed: 50

Score: /35

Percentage: /100

Question 1a

a)

Ammonia reacts with boron trifluoride to form an adduct, a molecule made from the combination of two others.
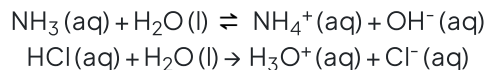
$$NH_3 + BF_3 \rightarrow NH_3BF_3$$

Identify the Lewis acid and base and the type of bond formed between a Lewis acid and base.

[2]

[2 marks]

Question 1b

b)

Explain the role of water, in terms of Lewis acid-base theory, in the following equations:

$$NH_3\,(aq) + H_2O\,(l) \rightleftharpoons NH_4^+\,(aq) + OH^-\,(aq)$$
$$HCl\,(aq) + H_2O\,(l) \rightarrow H_3O^+\,(aq) + Cl^-\,(aq)$$

[2]

[2 marks]

Question 1c

c)

'All Brønsted–Lowry acids are Lewis acids but not all Lewis acids are Brønsted Lowry acids.'
Evaluate whether this statement is true, giving an appropriate example.
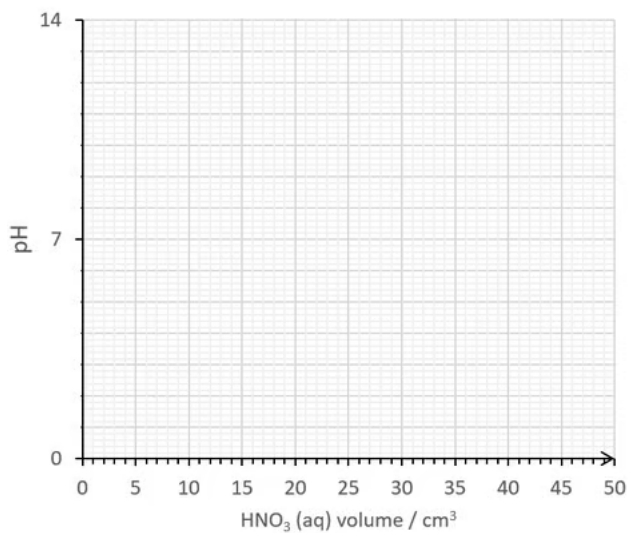
[4]

[4 marks]

Question 1d

d)
In the nitration of benzene, identify a species which acts as a Lewis base.

[1]

[1 mark]

Question 2a

a)
Sketch the titration curve when 50 cm^3 of 0.1 mol dm^{-3} HNO$_3$ (aq) is titrated against 25 cm^3 of 0.1 mol dm^{-3} NH$_3$ (aq).

[4]

[4 marks]

Question 2b

b)

Select a suitable indicator for the titration from table 22 of the Data booklet.

[1]

[1 mark]

Question 2c

c)

Calculate the pH of 0.1 mol dm^{-3} ammonia using section 21 of the Data booklet.

[5]

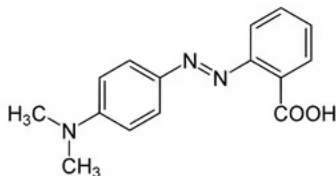**[5 marks]**

Question 2d

d)

Deduce, using section 21 of the Data booklet whether the pH of 0.1 mol dm^{-3} ethylamine would be higher or lower than 0.1 mol dm^{-3} ammonia solution.

[1]

[1 mark]

Question 3a

a)

Indicators are solutions of weak acids or bases. Methyl red has the molecular formula $C_{15}H_{15}N_2O_2$.

Draw the structure of the conjugate base of methyl red.

[1]

[1 mark]

Question 3b

b)

What will be seen if a few drops of methyl red are added during a titration of 50 cm^3 of 0.1 mol dm^{-3} HCl (aq) against 25 cm^3 of 0.1 mol dm^{-3} NaOH (aq).

[1]

[1 mark]

Question 3c

c)

The pKa of methyl red is 5.1. Explain how this relates to the acid–base character of methyl red when added to water.

[3]

[3 marks]

Question 4a

a)
Using section 21 of the Data booklet, discuss the relationship between the chemical structures and acidity of chloroethanoic acid, dichloroethanoic acid and trichloroethanoic acid.

[3]

[3 marks]

Question 4b

b)
This question is about acid buffers.

i)
Explain how you could make a buffer given a supply of the following:

20 cm^3 of 0.10 mol dm^{-3} chloroethanoic acid
20 cm^3 of 0.10 mol dm^{-3} potassium hydroxide

[3]

ii)
Determine the new concentration of each reactant in the buffer.

[1]

[4 marks]

Question 4c

c)

20 cm^3 of 0.05 mol dm^{-3} dichloroethanoic acid was reacted with 10 cm^3 of 0.10 mol dm^{-3} sodium hydroxide. Suggest, with a reason, a pH value for the resulting solution.

[3 marks]