

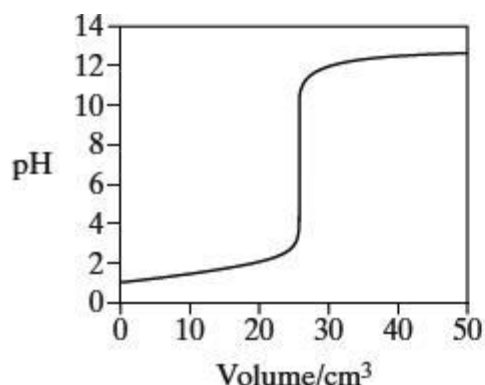
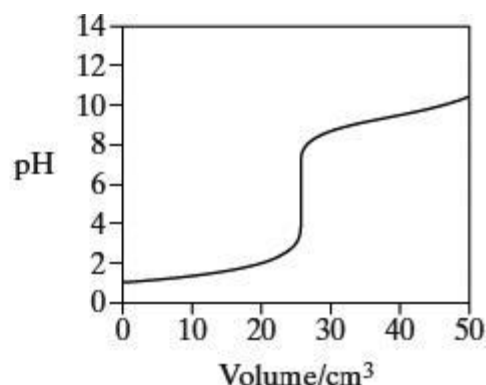
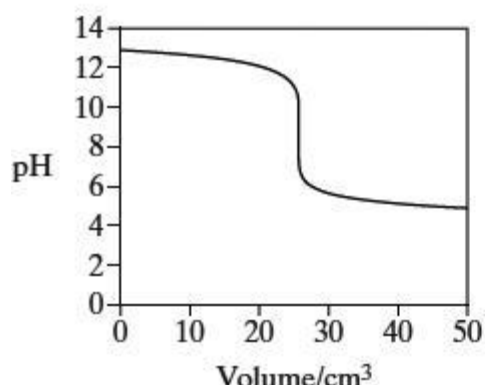
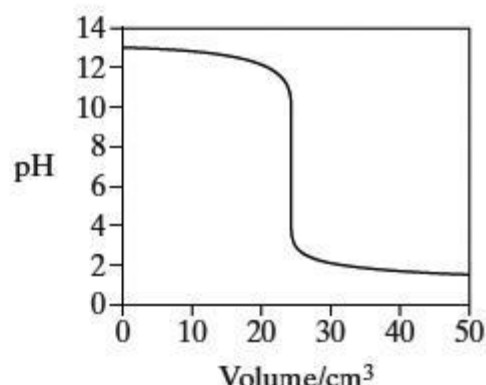
Name of the Student: _____

Max. Marks : 25 Marks

Time : 25 Minutes

Q1.

- (a) Titration curves labelled **A**, **B**, **C** and **D** for combinations of different acids and bases are shown below. All solutions have a concentration of 0.1 mol dm^{-3} .

**A****B****C****D**

- (i) Select from **A**, **B**, **C** and **D** the curve produced by the addition of
- ammonia to 25 cm^3 of hydrochloric acid _____
- ethanoic acid to 25 cm^3 of sodium hydroxide _____
- sodium hydroxide to 25 cm^3 of hydrochloric acid _____
- (ii) A table of acid–base indicators and the pH ranges over which they change colour is shown below.

Indicator	pH range
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Thymol blue	1.2 – 2.8
Bromophenol blue	3.0 – 4.6
Methyl red	4.2 – 6.3
Cresolphthalein	8.2 – 9.8
Thymolphthalein	9.3 – 10.5

Select from the table an indicator which could be used in the titration which produces curve **A** but not in the titration which produces curve **B**.

(4)

- (b) (i) Write an expression for the term *pH*.

- (ii) A solution of potassium hydroxide has a pH of 11.90 at 25°C. Calculate the concentration of potassium hydroxide in the solution.

(4)

- (c) The acid dissociation constant, K_a , for propanoic acid has the value of $1.35 \times 10^{-5} \text{ mol dm}^{-3}$ at 25 °C.

$$K_a = \frac{[\text{H}^+][\text{CH}_3\text{CH}_2\text{COO}^-]}{[\text{CH}_3\text{CH}_2\text{COOH}]}$$

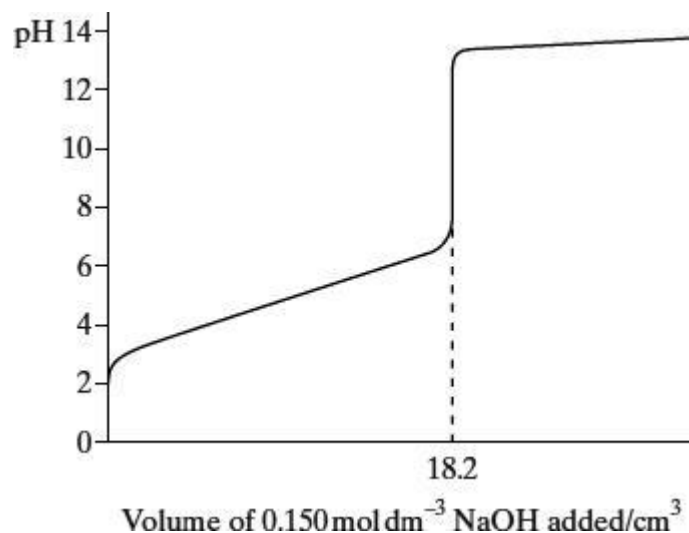
In each of the calculations below, give your answer to 2 decimal places.

- (i) Calculate the pH of a $0.117 \text{ mol dm}^{-3}$ aqueous solution of propanoic acid.

- (ii) Calculate the pH of a mixture formed by adding 25 cm^3 of a $0.117 \text{ mol dm}^{-3}$ aqueous solution of sodium propanoate to 25 cm^3 of a $0.117 \text{ mol dm}^{-3}$ aqueous solution of propanoic acid.

Q2.

The pH curve shown below was obtained when a $0.150 \text{ mol dm}^{-3}$ solution of sodium hydroxide was added to 25.0 cm^3 of an aqueous solution of a weak monoprotic acid, HA.



- (a) Use the information given to calculate the concentration of the acid.

(2)

- (b) (i) Write an expression for the acid dissociation constant, K_a , for HA.

- (ii) Write an expression for pK_a

- (iii) Using your answers to parts (b)(i) and (b)(ii), show that when sufficient sodium hydroxide has been added to neutralise half of the acid,

pH of the solution = pK_a for the acid HA

(4)

- (c) Explain why dilution with a small volume of water does not affect the pH of a buffer solution.

(2)

- (d) (i) Calculate the change in pH when $0.250 \text{ mol dm}^{-3}$ hydrochloric acid is diluted with water to produce $0.150 \text{ mol dm}^{-3}$ hydrochloric acid.

- (ii) Calculate the volume of water which must be added to 30.0 cm^3 of $0.250 \text{ mol dm}^{-3}$ hydrochloric acid in order to reduce its concentration to $0.150 \text{ mol dm}^{-3}$.

(4)

(Total 12 marks)