Buffers 1

Essential Pre-Uni Chemistry J5.1

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P2

Sodium dihydrogenphosphate has a pK_a value of 7.2. Give the pH of a buffer formed by mixing equal amounts of sodium dihydrogenphosphate and disodium hydrogenphosphate in aqueous solution.

Buffers 2

Essential Pre-Uni Chemistry J5.2

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P2

Propanoic acid has a pK_a value of 4.9 and is highly soluble in water. If $200\,cm^3$ of propanoic acid solution at $2.0\,mol\,dm^{-3}$ is treated with $800\,cm^3$ of potassium propanoate solution at $1.0\,mol\,dm^{-3}$, give the pH of the resulting buffer.

Question deck:

STEM SMART Chemistry Week 33

Buffers 3

Essential Pre-Uni Chemistry J5.3

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P2

Given that benzoic acid has a K_a of $6.3 \times 10^{-5} \, \mathrm{mol \, dm^{-3}}$, calculate the pH of a buffer containing equal amounts of benzoic acid and sodium benzoate.

Question deck:

STEM SMART Chemistry Week 33

Buffers 4

Essential Pre-Uni Chemistry J5.4

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P2

Part A

(a)

Given that methanoic acid has a K_a of $1.6 \times 10^{-4} \, \text{mol} \, \text{dm}^{-3}$, calculate the pH of a solution containing $25 \, \text{mmol}$ of methanoic acid and $40 \, \text{mmol}$ of potassium methanoate.

Part B

(b)

Given that methanoic acid has a K_a of $1.6 \times 10^{-4} \, \text{mol} \, \text{dm}^{-3}$, calculate the pH of a solution containing $0.40 \, \text{mol}$ of methanoic acid and $0.32 \, \text{mol}$ of magnesium methanoate.

Question deck:

STEM SMART Chemistry Week 33

Buffers 5

Essential Pre-Uni Chemistry J5.5

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P3

Part A

(a)

Given that methanoic acid has a K_a of $1.6 \times 10^{-4} \, \text{mol} \, \text{dm}^{-3}$, calculate the pH obtained when $100 \, \text{cm}^3$ of $0.25 \, \text{mol} \, \text{dm}^{-3}$ methanoic acid is treated with $10 \, \text{cm}^3$ of $0.50 \, \text{mol} \, \text{dm}^{-3}$ sodium hydroxide.

Part B

(b)

Given that methanoic acid has a K_a of $1.6 \times 10^{-4} \, \text{mol} \, \text{dm}^{-3}$, calculate the pH of the solution obtained when $1.7 \, \text{g}$ of sodium methanoate is dissolved in $40 \, \text{cm}^3$ of $0.10 \, \text{mol} \, \text{dm}^{-3}$ hydrochloric acid.

Question deck:

STEM SMART Chemistry Week 33

Buffers 6

Essential Pre-Uni Chemistry J5.6

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P3

Calculate the volume of $2.00\,\mathrm{mol\,dm^{-3}}$ KOH that should be added to $60.0\,\mathrm{cm^3}$ of $1.00\,\mathrm{mol\,dm^{-3}}$ H_3PO_4 to make a buffer solution of $pH\ 2.00$, given the pK_a of phosphoric(V) acid is 2.10.

(Hint: work out the quantity in moles of acid used and then alkali required, rather than trying to use concentrations throughout.)

Question deck:
STEM SMART Chemistry Week 33

Buffers 8

Essential Pre-Uni Chemistry J5.8

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P2

A buffer solution made from "CHES" has a pH of 8.8 and contains $300\ \mu mol$ of "CHES" and $95\ \mu mol$ of its conjugate base.

Calculate the pK_a of CHES.

Question deck:

STEM SMART Chemistry Week 33

Buffers 9

Essential Pre-Uni Chemistry J5.9

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P3

A buffer made from "hexamine" containing $0.00250 \, \mathrm{mol \, dm^{-3}}$ of hexamine and $0.00180 \, \mathrm{mol \, dm^{-3}}$ of its conjugate acid has a pH of 5.03. Calculate the $\mathrm{p}K_\mathrm{b}$ of hexamine.

Question deck:

STEM SMART Chemistry Week 33

Buffers 10

Essential Pre-Uni Chemistry J5.10

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P3

A buffer of pH 7.8 is prepared by taking $200\,\mathrm{cm^3}$ of $0.020\,\mathrm{mol\,dm^{-3}}$ "tris" solution and adding dilute hydrochloric acid from a burette until the pH is correct. If this requires $1.35\,\mathrm{cm^3}$ of $2.0\,\mathrm{mol\,dm^{-3}}\,\mathrm{HCl\,(aq)}$, calculate the $\mathrm{p}K_\mathrm{a}$ of the conjugate acid of "tris".

Question deck:

STEM SMART Chemistry Week 33

Buffers 7

Essential Pre-Uni Chemistry J5.7

Subject & topics: Chemistry | Physical | Acids & Bases   **Stage & difficulty:** A Level P3

N.B. This question is significantly harder

Calculate the mass of sodium carbonate decahydrate, $Na_2CO_3 \cdot 10\,H_2O$, that should be added to $2.5\,dm^3$ of $0.40\,mol\,dm^{-3}$ nitric acid to make a buffer of pH 10.5, given that the pK_a of hydrogencarbonate is 10.3.

Assume: (1) That no CO_2 is given off in the reaction. (2) That the nitric acid just determines the hydrogencarbonate concentration and does not participate in the buffer, so that the hydrogencarbonate concentration is obtained from the reaction,

$$HNO_3 + Na_2CO_3 \longrightarrow NaHCO_3 + NaNO_3$$