Essential Pre-Uni Chemistry J5.1

A Level

Sodium dihydrogenphosphate has a $\mathrm{p}K_\mathrm{a}$ value of 7.2. Give the pH of a buffer formed by mixing equal amounts of sodium dihydrogenphosphate and disodium hydrogenphosphate in aqueous solution.

Essential Pre-Uni Chemistry J5.2

A Level

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

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.3

A Level

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.

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.4

A Level

Part A (a)

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

Part B (b)

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

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.5

A Level

P P P

Part A (a)

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

Part B (b)

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

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.6

A Level

Calculate the volume of $2.00\,\text{mol}\,\text{dm}^{-3}$ KOH that should be added to $60.0\,\text{cm}^3$ of $1.00\,\text{mol}\,\text{dm}^{-3}$ H_3PO_4 to make a buffer solution of $\text{pH}\ 2.00$, given the $\text{p}K_\text{a}$ 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.)

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.8

A Level

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

Calculate the $\mathrm{p}K_\mathrm{a}$ of CHES.

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.9

A Level

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.

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.10

A Level

A buffer of $\mathrm{pH}\ 7.8$ 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".

Gameboard:

STEM SMART Chemistry Week 33

Essential Pre-Uni Chemistry J5.7

A Level

N.B. This question is significantly harder

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

Assume: (1) That no $\mathrm{CO_2}$ 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,

$$\mathrm{HNO_3 + Na_2CO_3 \longrightarrow NaHCO_3 + NaNO_3}$$