- Phenylketonuria is an inherited disorder in which phenylacetic acid, $C_6H_5CH_2COOH$, (simplified here to HPAc) accumulates in the blood. A study of the acid shows that the pH of a 0.12 M HPAc solution is 2.60. What is the pK_a of phenylacetic acid? **3**

Answer:

Marks 7

- A sample of hydrofluoric acid (0.10 M, 25.0 mL) is titrated with 0.10 M NaOH. The pK_a of hydrofluoric acid, HF, is 3.17. Calculate the pH at the following four points.

before any NaOH is added

pH =

when half of the HF has been neutralised

pH =

at the equivalence point

pH =

after the addition of 37.5 mL of NaOH

pH =

THIS QUESTION CONTINUES ON THE NEXT PAGE.

Sketch the titration curve.	**Marks 2**

THE REMAINDER OF THIS PAGE IS FOR ROUGH WORKING ONLY.

• Explain the following terms or concept.	**Marks**
Lewis base	**1**

• What amount of NaOH (in mol) needs to be added to 250 mL of 0.10 M acetic acid to give a solution with a pH of 5.00? The pK_a of acetic acid is 4.76.	**Marks 3**
Answer:	

• Explain the following term or concept.	**Marks**
Isoelectric point	**1**

	Marks
• Phenylketonuria is an inherited disorder in which phenylacetic acid, $C_6H_5CH_2COOH$, (simplified here to HPAc) accumulates in the blood. If untreated, it can cause mental retardation and death. A study of the acid shows that the pH of a 0.12 M HPAc solution is 2.60. What is the pK_a of phenylacetic acid?	**3**
Answer:	

Marks 4

- Buffer 1 is a solution containing 0.08 M NH_4Cl and 0.12 M NH_3. Buffer 2 is a solution containing 0.15 M NH_4Cl and 0.05 M NH_3. The acid dissociation constant of the ammonium ion is 5.50×10^{-10}. What are the pH values of each of the buffer solutions?

Buffer 1 pH =	Buffer 2 pH =

Which buffer is better able to maintain a steady pH on the addition of small amounts of both a strong acid and strong base? Explain.

• Explain the role played by the lungs and the kidneys in maintaining blood pH at a constant value of 7.4.	**Marks 4**

Page Total:

Marks
8

- Sketch the titration curve (pH against mL of added base) when 25.0 mL of 0.010 M hydrofluoric acid (HF) with a pK_a of 3.17 is titrated with 0.010 M NaOH.
  Calculate the pH at the following four points:
  (i) before any NaOH is added;
  (ii) when half of the HF has been neutralised;
  (iii) at the equivalence point; and
  (iv) 50% beyond the equivalence point, *i.e.* when 1.5 times the equivalence volume has been added.

Page Total:

	Marks
• Tris(hydroxymethyl)aminomethane is commonly used to make buffer solutions. It has a base ionisation constant of 1.26×10^{-6}. What is the pH of a 0.05 M aqueous solution of this compound?	**3**
Answer:	
• The ionisation constant of water, K_w, at 37 °C is 2.42×10^{-14}. What is the pH for a neutral solution at 37 °C?	**1**
Answer:	

- Calculate the pH of a 0.10 mol L^{-1} solution of HF. (The pK_a of HF is 3.17.)

Marks 6

Answer:

What mass of NaF needs to be added to 100.0 mL of the above solution to make a buffer with a pH of 3.00?

Answer:

Explain why HCl is a much stronger acid than HF.

- A 300.0 mL solution of HCl has a pH of 1.22. Given that the pK_a of iodic acid, HIO_3, is 0.79, how many moles of sodium iodate, $NaIO_3$, would need to be added to this solution to raise its pH to 2.00? **3**

Answer:

- Explain why the acidity of hydrogen halides *increases* with increasing halogen size (*i.e.*, K_a (HCl) < K_a (HBr) < K_a (HI)), while the acidity of hypohalous acids *decreases* with increasing halogen size (*i.e.*, K_a (HOCl) > K_a (HOBr) > K_a (HOI)).

3

Marks 5

- The K_a of benzoic acid is 6.3×10^{-5} M at 25 °C.

  Calculate the pH of a 0.0100 M aqueous solution of sodium benzoate (C_6H_5COONa).

Answer:

A buffer solution is prepared by adding 375 mL of this 0.0100 M aqueous solution of sodium benzoate to 225 mL of 0.0200 M aqueous benzoic acid. Calculate the pH of the buffer solution.

Answer:

	Marks
• The active ingredient in aspirin is the monoprotic acid, acetylsalicylic acid ($HC_9H_7O_4$) that has a K_a of 3.3×10^{-4} M at 25 °C. What is the pH of a solution obtained when a tablet containing 200 mg of acetylsalicylic acid is dissolved in 125 mL of water?	**3**
Answer:	
• A standard test for the presence of chloride ion in water involves the appearance of a precipitate of AgCl upon addition of 1 mL of $AgNO_3$ (0.03 M) to 100 mL of the water sample. What is the minimum concentration of Cl^- detectable by this method? K_{sp} (AgCl) = 1.8×10^{-10} M^2.	**2**
Answer:	

Marks 7

- Uric acid, $C_5H_5N_4O_3$, is a weak diprotic acid with a low solubility of 70 mg L^{-1}. The extremely painful inflammation known as gout occurs when crystals of uric acid are deposited in the joints. Given that the pH of a saturated solution of uric acid is 4.58, calculate the pK_{a1} of uric acid at 25 °C?

Answer:

The monosodium salt of uric acid is slightly more soluble, 8×10^{-4} g mL^{-1}. Calculate the solubility product constant, K_{sp}, of sodium urate at 25 °C. Assume no hydrolysis of the urate ion occurs.

Answer:

Suggest a possible reason why the pH of blood plasma remains near 7.4 even when saturated with uric acid.

- The formulation of a pharmaceutical to be delivered by injection includes sodium chloride to make it isotonic with blood plasma. Why is this necessary?

Marks
2

- A solution of volume 2.00 L was prepared by mixing equal volumes of nitric acid (0.10 M) and sulfuric acid (0.10 M). To this, sodium hydroxide (10.0 g) was added. Assuming no volume change, what is the pH of the final solution?

3

pH =

- Acetic acid (100 mL, 0.20 M) is mixed with solid sodium hydroxide (0.010 mol). Calculate the final pH of the solution. pK_a of acetic acid = 4.76

3

pH =