HL Paper 1

Which type of bond is formed when a Lewis acid reacts with a Lewis base?

A. Covalent

B. Dipole-dipole

C. Double

D. Hydrogen

Which compounds can be mixed together as solutions of equal volume and concentration to form a buffer solution?

A. Nitric acid and potassium hydroxide

B. Nitric acid and potassium nitrate

C. Propanoic acid and potassium hydroxide

D. Propanoic acid and potassium propanoate

Which salt solution has the highest pH?

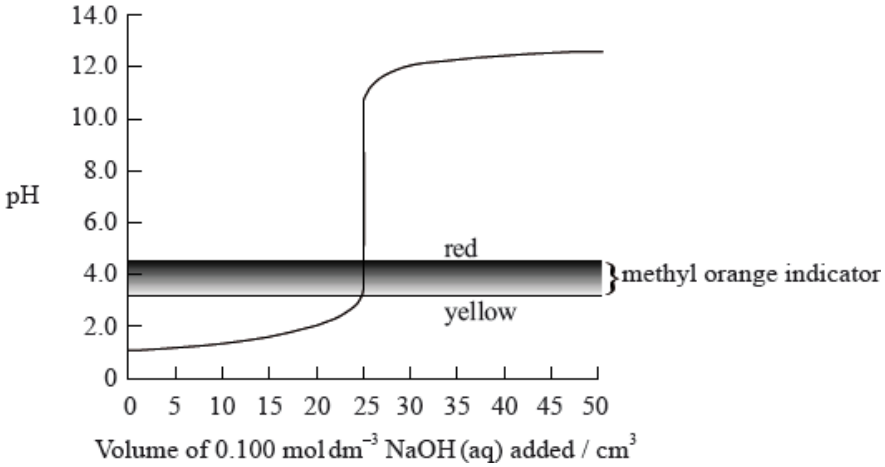
A. NH_4Cl

B. $Ca(NO_3)_2$

C. Na_2CO_3

D. K_2SO_4

The graph below shows the titration curve of $25\ \mathrm{cm}^3$ of $0.100\ \mathrm{mol\,dm}^{-3}$ of hydrochloric acid with sodium hydroxide, of $0.100\ \mathrm{mol\,dm}^{-3}$ concentration. The indicator methyl orange was used to determine the equivalence point. Methyl orange has a pH range of 3.2– 4.4.



If the hydrochloric acid was replaced by ethanoic acid of the same volume and concentration, which property of the titration would remain the same?

A. The initial pH

B. The pH at the equivalence point

C. The volume of strong base, NaOH, needed to reach the equivalence point

D. The colour of the titration mixture just before the equivalence point is reached

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For which equilibrium can an expression for a base dissociation constant, K_b, for the forward reaction be written?

A. $NH_3 + H_3O^+ \rightleftharpoons NH_4^+ + H_2O$

B. $F^- + H_2O \rightleftharpoons HF + OH^-$

C. $NH_4^+ + OH^- \rightleftharpoons NH_3 + H_2O$

D. $HF + OH^- \rightleftharpoons H_2O + F^-$

Which statements are correct?

I. Lewis bases can act as nucleophiles.

II. Electrophiles are Lewis acids.

III. Lewis acids are electron pair acceptors.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Which combination of acid and base is most likely to have a pH of 8.5 at the equivalence point in a titration?

A. Hydrochloric acid and sodium hydroxide

B. Hydrochloric acid and ammonia

C. Nitric acid and ammonia

D. Methanoic acid and sodium hydroxide

Which definition of a base is correct?

A. A Lewis base accepts a proton.

B. A Brønsted-Lowry base accepts an electron pair.

C. A Brønsted-Lowry base donates an electron pair.

D. A Lewis base donates an electron pair.

The K_b value for a base is $5.0 \times 10^{-2}\ \mathrm{mol\,dm^{-3}}$ at 298 K. What is the K_a value for its conjugate acid at this temperature?

A. 5.0×10^{-2}

B. 2.0×10^{-6}

C. 2.0×10^{-12}

D. 2.0×10^{-13}

The colours of three indicators are shown in the table below.

Indicator	Colour at low pH	Colour at high pH	pH range at which colour change takes place
methyl orange	red	yellow	3.2–4.4
bromothymol blue	yellow	blue	6.0–7.6
phenolphthalein	colourless	pink	8.2–10.0

Equal volumes of these three indicators were mixed and the mixture was added to a solution of $\mathrm{pH} = 5.0$. What colour would be seen?

A. Yellow

B. Orange

C. Green

D. Blue

What is the expression for the ionic product constant of water, K_w?

A. $K_\mathrm{w} = K_\mathrm{a} \times K_\mathrm{b}$

B. $K_\mathrm{w} = K_\mathrm{a} + K_\mathrm{b}$

C. $K_\mathrm{w} = \frac{K_\mathrm{a}}{K_\mathrm{b}}$

D. $K_\mathrm{w} = K_\mathrm{a} - K_\mathrm{b}$

The indicator, HIn is used in a titration between an acid and base. Which statement about the dissociation of the indicator, HIn is correct?

$$\underset{\text{colour A}}{\mathrm{HIn(aq)}} \rightleftharpoons \mathrm{H^+(aq)} + \underset{\text{colour B}}{\mathrm{In^-(aq)}}$$

A. In a strongly alkaline solution, colour B would be observed.

B. In a strongly acidic solution, colour B would be observed.

C. $[\mathrm{In^-}]$ is greater than [HIn] at the equivalence point.

D. In a weakly acidic solution colour B would be observed.

The K_a values of four weak acids W, X, Y and Z are listed below.

W $K_\mathrm{a} = 1.35 \times 10^{-3}$

X $K_\mathrm{a} = 4.47 \times 10^{-2}$

Y $K_\mathrm{a} = 9.33 \times 10^{-6}$

Z $K_\mathrm{a} = 1.47 \times 10^{-5}$

The acid–base indicator phenol red, HIn, changes colour from yellow to red over a pH range of 6.6–8.2. Which statement is correct?

A. In a strongly acidic solution $[\mathrm{HIn}] < [\mathrm{In^-}]$.

B. The $\mathrm{p}K_\mathrm{a}$ of phenol red is between 6.6 and 8.2.

C. The $\mathrm{In^-}$ ions are yellow.

D. Phenol red would be a suitable indicator for the titration of a strong acid and a weak base.

Methylamine acts as a weak base when it reacts with water. For a diluted aqueous solution, what is the K_b expression for this reaction?

A. $K_\mathrm{b} = \dfrac{[\mathrm{CH_3NH_3^+}][\mathrm{OH^-}]}{[\mathrm{CH_3NH_2}]}$

B. $K_\mathrm{b} = \dfrac{[\mathrm{CH_3NH_2}][\mathrm{H_2O}]}{[\mathrm{CH_3NH_3^+}][\mathrm{OH^-}]}$

C. $K_\mathrm{b} = \dfrac{[\mathrm{CH_3NH_3^+}][\mathrm{OH^-}]}{[\mathrm{CH_3NH_2}][\mathrm{H_2O}]}$

D. $K_\mathrm{b} = \dfrac{[\mathrm{CH_3NH_2}]}{[\mathrm{CH_3NH_3^+}][\mathrm{OH^-}]}$

Four aqueous solutions are listed below.

W. $0.100\ \text{mol dm}^{-3}\ \text{HNO}_3(\text{aq})$

X. $0.001\ \text{mol dm}^{-3}\ \text{HNO}_3(\text{aq})$

Y. $0.100\ \text{mol dm}^{-3}\ \text{KOH}(\text{aq})$

Z. $0.001\ \text{mol dm}^{-3}\ \text{KOH}(\text{aq})$

What is the correct order of **increasing** pH of these solutions?

A. $\text{W} < \text{X} < \text{Y} < \text{Z}$

B. $\text{W} < \text{X} < \text{Z} < \text{Y}$

C. $\text{X} < \text{W} < \text{Y} < \text{Z}$

D. $\text{X} < \text{W} < \text{Z} < \text{Y}$

Which of the following is an example of a Lewis acid–base reaction, but not a Brønsted–Lowry acid–base reaction?

A. $2\text{CrO}_4^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Cr}_2\text{O}_7^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l})$

B. $\text{Co(H}_2\text{O)}_6^{2+}(\text{aq}) + 4\text{HCl}(\text{aq}) \rightarrow \text{CoCl}_4^{2-}(\text{aq}) + 4\text{H}^+(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$

C. $\text{NH}_3(\text{aq}) + \text{H}^+(\text{aq}) \rightarrow \text{NH}_4^+(\text{aq})$

D. $\text{CH}_3\text{COO}^-(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{CH}_3\text{COOH}(\text{aq}) + \text{OH}^-(\text{aq})$

Which equation represents a reaction for which a base dissociation constant expression, K_b, can be written?

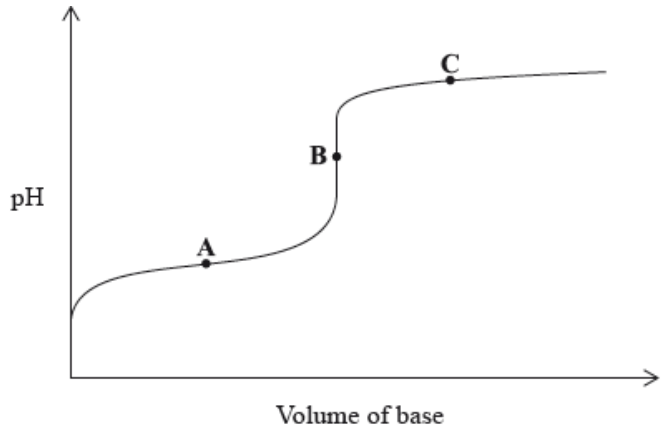
A. $\text{CH}_3\text{COOH}(\text{aq}) + \text{NH}_3(\text{aq}) \rightleftharpoons \text{CH}_3\text{COO}^-(\text{aq}) + \text{NH}_4^+(\text{aq})$

B. $\text{HF}(\text{aq}) \rightleftharpoons \text{H}^+(\text{aq}) + \text{F}^-(\text{aq})$

C. $\text{HCN}(\text{aq}) + \text{OH}^-(\text{aq}) \rightleftharpoons \text{CN}^-(\text{aq}) + \text{H}_2\text{O}(\text{l})$

D. $\text{NH}_3(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{NH}_4^+(\text{aq}) + \text{OH}^-(\text{aq})$

A weak acid is titrated with a strong base. Which statement is true for the titration curve?



A. **A** is the equivalence point.

B. The pH at **A** equals the $\mathrm{p}K_\mathrm{a}$ of the acid.

C. The pH at **B** equals 7.

D. **C** is in the buffer region.

Which mixture will form a buffer in aqueous solution?

A. $0.10\ \mathrm{mol\ NH_3} + 0.20\ \mathrm{mol\ HCl}$

B. $0.10\ \mathrm{mol\ NH_3} + 0.20\ \mathrm{mol\ NaOH}$

C. $0.10\ \mathrm{mol\ NaOH} + 0.20\ \mathrm{mol\ KCl}$

D. $0.20\ \mathrm{mol\ NH_3} + 0.10\ \mathrm{mol\ HCl}$

Ammonia acts as a weak base when it reacts with water. What is the K_b expression for this reaction?

A. $\dfrac{[\mathrm{NH_4^+}][\mathrm{OH^-}]}{[\mathrm{NH_3}][\mathrm{H_2O}]}$

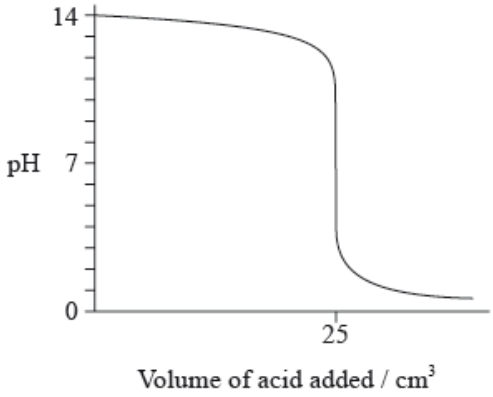
B. $\dfrac{[\mathrm{NH_3}][\mathrm{H_2O}]}{[\mathrm{NH_4^+}][\mathrm{OH^-}]}$

C. $\dfrac{[\mathrm{NH_3}]}{[\mathrm{NH_4^+}][\mathrm{OH^-}]}$

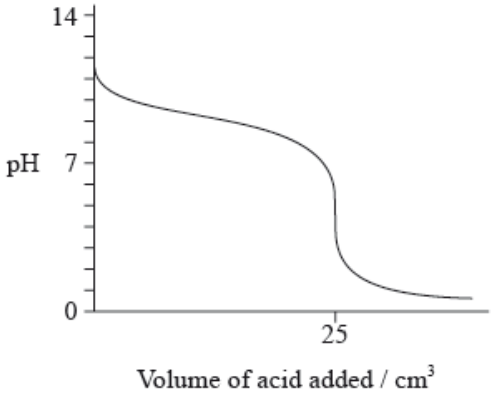
D. $\dfrac{[\mathrm{NH_4^+}][\mathrm{OH^-}]}{[\mathrm{NH_3}]}$

Which titration curve is produced by the titration of $25\ \mathrm{cm^3}$ of $1.00\ \mathrm{mol\,dm^{-3}}$ NaOH with $1.00\ \mathrm{mol\,dm^{-3}}$ $\mathrm{CH_3COOH}$?

A.



B.



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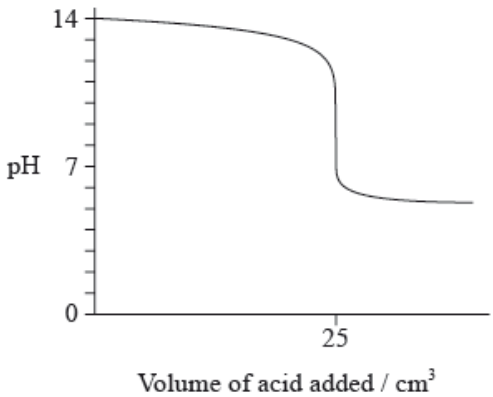
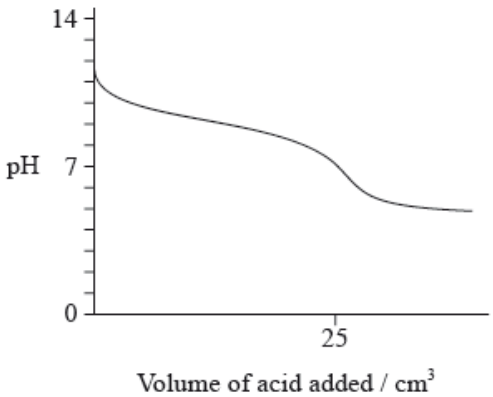


D.



Which reaction represents an acid–base reaction according to the Lewis theory but not according to the Brønsted–Lowry theory?

A. $\mathrm{CO_3^{2-}(aq) + H_3O^+(aq) \rightleftharpoons H_2O(l) + HCO_3^-(aq)}$

B. $\mathrm{CH_3COOH(aq) + NH_3(aq) \rightleftharpoons NH_4^+(aq) + CH_3COO^-(aq)}$

C. $\mathrm{NH_3(aq) + HF(aq) \rightleftharpoons NH_4^+(aq) + F^-(aq)}$

D. $\mathrm{CuSO_4(s) + 5H_2O(l) \rightleftharpoons CuSO_4 \bullet 5H_2O(s)}$

Which is an example of a Lewis base?

A. an electrophile

B. BF_3

C. CH_4

D. a nucleophile

Which mixtures could act as buffers?

I. NaOH(aq) and HCl(aq)

II. NaOH(aq) and $\mathrm{CH_3COOH(aq)}$

III. HCl(aq) and $\mathrm{CH_3COONa(aq)}$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

At the same concentration, which acid would have the lowest pH?

A.	$\mathrm{HNO_2}$	$K_\mathrm{a} = 5.6 \times 10^{-4}\ \mathrm{mol\,dm^{-3}}$
B.	HF	$K_\mathrm{a} = 6.8 \times 10^{-4}\ \mathrm{mol\,dm^{-3}}$
C.	$\mathrm{C_6H_5COOH}$	$K_\mathrm{a} = 6.3 \times 10^{-5}\ \mathrm{mol\,dm^{-3}}$
D.	HCN	$K_\mathrm{a} = 4.9 \times 10^{-10}\ \mathrm{mol\,dm^{-3}}$

Consider the equation for the dissociation of water:

$$\mathrm{H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)} \quad \Delta H = +57.3\ \mathrm{kJ\,mol^{-1}}$$

Which statement is correct?

A. The pH of pure water is always 7.

B. At temperatures above 298 K the pH of pure water is below 7.

C. At temperatures above 298 K the pH of pure water is above 7.

D. K_w decreases with increasing temperature.

Which pair of compounds could be used to make a buffer solution (assuming appropriate molar ratios)?

A. KCl and HCl

B. NaCl and HCl

C. $\mathrm{KHSO_4}$ and $\mathrm{H_2SO_4}$

D. $\mathrm{CH_3COONa}$ and $\mathrm{CH_3COOH}$

During a titration, $0.1\ \mathrm{mol\,dm^{-3}}$ sodium hydroxide is added to $0.1\ \mathrm{mol\,dm^{-3}}$ ethanoic acid. Which indicator would be the **best** to use as an end point indicator in this titration?

	Indicator	pH range of indicator
A.	methyl orange	3.2–4.4
B.	bromophenol blue	3.0–4.6
C.	bromothymol blue	6.0–7.6
D.	phenolphthalein	8.2–10.0

Bromophenol blue changes from yellow to blue over the pH range of 3.0 to 4.6. Which statement is correct?

A. Molecules of bromophenol blue, HIn, are blue.

B. At $\mathrm{pH} < 3.0$, a solution of bromophenol blue contains more ions, $\mathrm{In^-}$, than molecules, HIn.

C. The $\mathrm{p}K_\mathrm{a}$ of bromophenol blue is between 3.0 and 4.6.

D. Bromophenol blue is a suitable indicator to titrate ethanoic acid with potassium hydroxide solution.

$100\ \mathrm{cm^3}$ of a NaOH solution of pH 12 is mixed with $900\ \mathrm{cm^3}$ of water. What is the pH of the resulting solution?

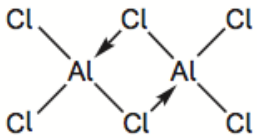
A. 1

B. 3

C. 11

D. 13

The diagram represents the bonding in aluminium chloride.



Which statement is correct?

A. The aluminium atoms behave as Lewis acids.
B. The aluminium atoms behave as Lewis bases.
C. One aluminium atom is a Lewis base and the other a Lewis acid.
D. One chlorine atom is a Lewis base and the other a Lewis acid.

Equal volumes and concentrations of hydrochloric acid and ethanoic acid are titrated with sodium hydroxide solutions of the same concentration.

Which statement is correct?

A. The initial pH values of both acids are equal.

B. At the equivalence points, the solutions of both titrations have pH values of 7.

C. The same volume of sodium hydroxide is needed to reach the equivalence point.

D. The pH values of both acids increase equally until the equivalence points are reached.

Which statements are correct about the complex $[\mathrm{Cu(NH_3)_2Cl_2}]$?

I. Oxidation state of copper is +2.

II. Ammonia is a ligand.

III. Chloride ions act as Lewis acids.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

In which reaction does $\mathrm{H_2O}$ act as a Lewis base but not as a Brønsted–Lowry base.

A. $\mathrm{H_2O + NH_4^+ \rightarrow H_3O^+ + NH_3}$

B. $\mathrm{H_2O + CaO \rightarrow Ca^{2+} + 2OH^-}$

C. $\mathrm{H_2O + [Fe(H_2O)_6]^{3+} \rightarrow Fe[(OH)(H_2O)_5]^{2+} + H_3O^+}$

D. $\mathrm{6H_2O + [Ni(NH_3)_6]^{2+} \rightarrow 6NH_3 + [Ni(H_2O)_6]^{2+}}$

The strengths of four acids are:

glycine $\quad \mathrm{p}K_\mathrm{a} = 9.87$

chloroethanoic acid $\quad K_\mathrm{a} = 1.38 \times 10^{-3}$

phenol $\quad K_\mathrm{a} = 1.00 \times 10^{-10}$

butanoic acid $\quad \mathrm{p}K_\mathrm{a} = 4.82$

What is the order of **increasing** acid strength?

A. $\mathrm{chloroethanoic\ acid < butanoic\ acid < phenol < glycine}$

B. $\mathrm{glycine < phenol < chloroethanoic\ acid < butanoic\ acid}$

C. $\mathrm{phenol < chloroethanoic\ acid < butanoic\ acid < glycine}$

D. $\mathrm{phenol < glycine < butanoic\ acid < chloroethanoic\ acid}$

Based on information in the table below, which acid is the strongest?

	Acid	pK_a	K_a
A.	HA	2.0	–
B.	HB	–	1×10^{-3}
C.	HC	4.0	–
D.	HD	–	1×10^{-5}

Methyl orange is an indicator which changes its colour from red to yellow in a pH range of 3.2 – 4.4.

For which titration would methyl orange be a suitable indicator?

A. Iodine and sodium thiosulfate solution

B. Hydrochloric acid and ammonia solution

C. Ethanoic acid and sodium hydroxide solution

D. Ethanoic acid and ammonia solution

The $\mathrm{p}K_\mathrm{b}$ of $\mathrm{HS^-}$ is 7.08. What is its conjugate acid and what is the K_a value of the acid?

	Conjugate acid	K_a
A.	H_2S	$10^{-6.92}$
B.	H_2S	6.92
C.	S^{2-}	$10^{-6.92}$
D.	S^{2-}	6.92

Cobalt forms the complex $[\mathrm{Co(NH_3)_5Cl}]^{2+}$. Which statements are correct for this complex?

I. The cobalt ion acts as a Lewis acid.

II. The cobalt ion has an oxidation number of +II.

III. There are 90° bond angles between the cobalt ion and the ligands.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Which of the following will form a buffer solution if combined in appropriate molar ratios?

A. HCl and NaCl

B. NaOH and HCOONa

C. NH_4Cl and HCl

D. HCl and NH_3

Which mixtures are buffer solutions?

I. $\mathrm{KHSO_4(aq)}$ and $\mathrm{H_2SO_4(aq)}$

II. $\mathrm{CH_3COONa(aq)}$ and $\mathrm{CH_3COOH(aq)}$

III. $\mathrm{HCOOK(aq)}$ and $\mathrm{HCOOH(aq)}$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

For which titration can the end point **not** be determined accurately by using an acid-base indicator?

A. $\mathrm{NH_3(aq) + CH_3COOH(aq)}$

B. $\mathrm{NaOH(aq) + HNO_3(aq)}$

C. $\mathrm{NH_3(aq) + HNO_3(aq)}$

D. $\mathrm{NaOH(aq) + CH_3COOH(aq)}$

The table below shows data for the K_a and $\mathrm{p}K_\mathrm{b}$ values for some acids and bases at 298 K.

Acid	K_a	Base	pK_b
$HClO$	2.9×10^{-8}	NH_3	4.75
$C_6H_5CH_2COOH$	4.9×10^{-5}	$C_6H_5NH_2$	9.13

Which two formulas represent the weakest acid and the weakest base in the table?

A. HClO and $\mathrm{C_6H_5NH_2}$

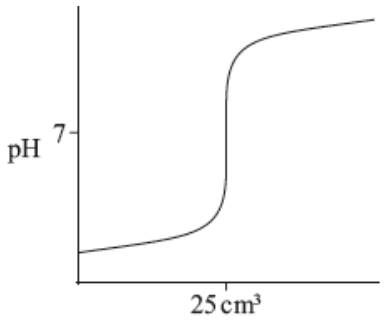
B. $\mathrm{C_6H_5CH_2COOH}$ and $\mathrm{NH_3}$

C. $\mathrm{C_6H_5CH_2COOH}$ and $\mathrm{C_6H_5NH_2}$

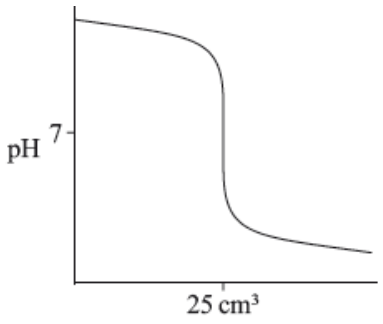
D. HClO and $\mathrm{NH_3}$

Which graph would be obtained by adding $0.10\ \text{mol dm}^{-3}\text{HCl(aq)}$ to $25\ \text{cm}^3$ of $0.10\ \text{mol dm}^{-3}\text{NaOH(aq)}$?

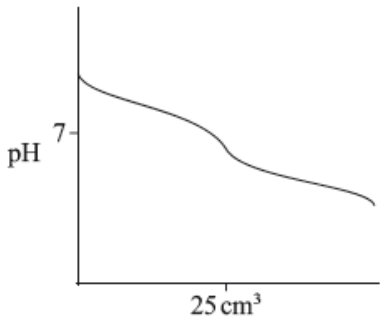
A.



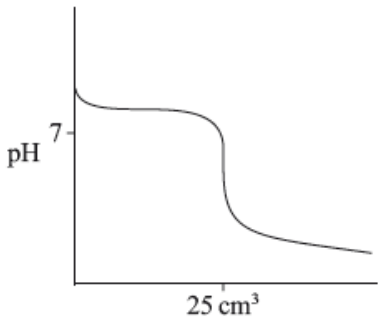
B.



C.



D.



The $\text{p}K_\text{b}$ value of ammonia is 4.75 at 298 K. What is the $\text{p}K_\text{a}$ value of the ammonium ion?

A. $\frac{10^{-14}}{4.75}$

B. $\frac{14.00}{4.75}$

C. $14.00 - 4.75$

D. $\frac{10^{-14}}{10^{-4.75}}$

Which compound will produce an aqueous solution which has a pH greater than 7?

A. CuSO_4

B. FeCl_3

C. Na_2CO_3

D. NH_4NO_3

Which mixture is a buffer solution?

A. 25 cm^3 of 0.10 mol dm^{-3} NH_3 (aq) and 50 cm^3 of 0.10 mol dm^{-3} HCl (aq)

B. 50 cm^3 of 0.10 mol dm^{-3} NH_3 (aq) and 25 cm^3 of 0.10 mol dm^{-3} HCl (aq)

C. 25 cm^3 of 0.10 mol dm^{-3} NaOH (aq) and 25 cm^3 of 0.10 mol dm^{-3} HCl (aq)

D. 50 cm^3 of 0.10 mol dm^{-3} NaOH (aq) and 25 cm^3 of 0.10 mol dm^{-3} HCl (aq)

The values of K_w, the ionic product constant of water, are:

K_w	T / °C
6.4×10^{-15}	18
1.0×10^{-14}	25

Which statements are correct?

I. The $[OH^-]$ in water is less than the $[H^+]$ at 18 °C.

II. The ionization of water is an endothermic process.

III. The pH of water is lower at 25 °C than at 18 °C.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

What is the approximate pH of a $0.01\ mol\,dm^{-3}$ ammonia solution?

A. 2

B. More than 2 but less than 7

C. More than 7 but less than 12

D. 12

What is the order of increasing acidity?

Acid	pK_a
HClO	7.4
HIO_3	0.8

Acid	K_a
HF	5.6×10^{-4}
CH_3CH_2COOH	1.3×10^{-5}

A. $HClO < CH_3CH_2COOH < HF < HIO_3$

B. $HClO < HF < CH_3CH_2COOH < HIO_3$

C. $HIO_3 < HF < CH_3CH_2COOH < HClO$

D. $HIO_3 < CH_3CH_2COOH < HF < HClO$

What is the order of increasing acidity of the following acids?

Acid	K_a
chloroethanoic	1.3×10^{-3}
ethanoic	1.7×10^{-5}

Acid	pK_a
hydrogen fluoride	3.3
hydrogen cyanide	9.3

A. chloroethanoic < ethanoic < hydrogen fluoride < hydrogen cyanide

B. ethanoic < chloroethanoic < hydrogen fluoride < hydrogen cyanide

C. chloroethanoic < ethanoic < hydrogen cyanide < hydrogen fluoride

D. hydrogen cyanide < ethanoic < hydrogen fluoride < chloroethanoic

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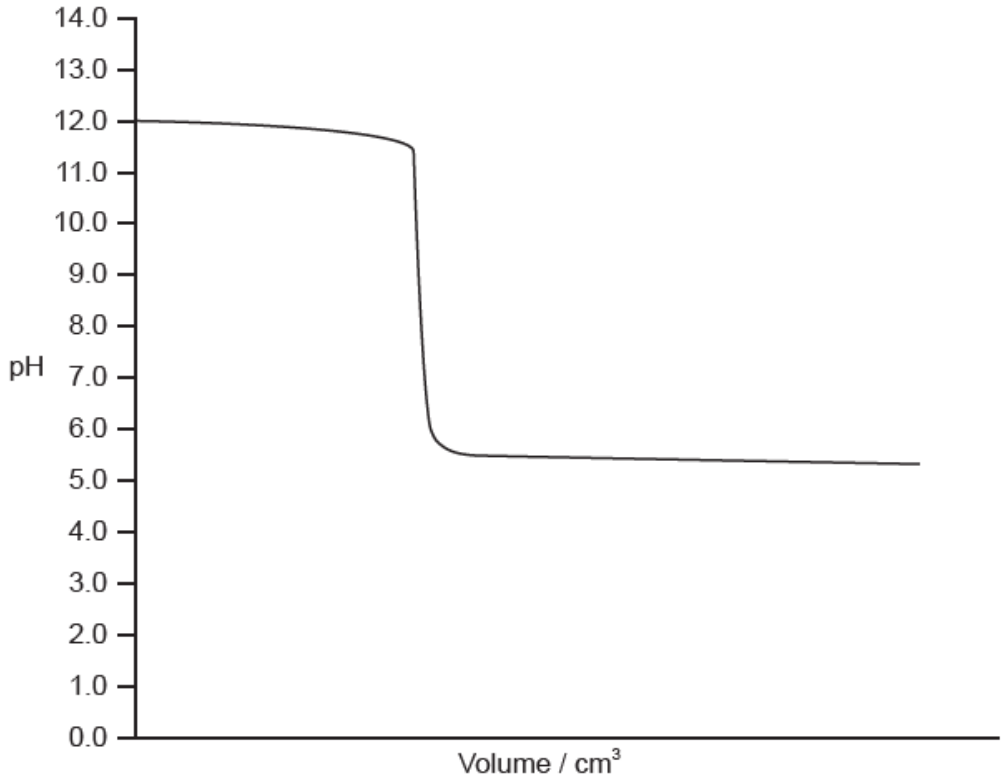
Which indicator is appropriate for the acid-base titration shown below?



A. Thymol blue (pK_a = 1.5)
B. Methyl orange (pK_a = 3.7)
C. Bromophenol blue (pK_a = 4.2)
D. Phenolphthalein (pK_a = 9.6)

A buffer is produced by mixing 20.0 cm^3 of 0.10 mol dm^{-3} ethanoic acid, $CH_3COOH(aq)$, with 0.10 mol dm^{-3} sodium hydroxide, NaOH(aq).

What is the volume of NaOH required and the pH of the buffer?

	Volume of NaOH / cm^3	pH of buffer
A.	40.0	9.2
B.	40.0	4.8
C.	10.0	9.2
D.	10.0	4.8

The forward reaction of this equilibrium is endothermic.

$$H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq) \; K_w = 1.0 \times 10^{-14} \text{ at } 25\ ^\circ C$$

What is correct about water at 50 °C?

A. $[H^+] > [OH^-]$

B. $[H^+] < [OH^-]$

C. $pH < 7.0$

D. $pH = 7.0$

Which indicator would be the most appropriate for titrating aqueous ethylamine, $CH_3CH_2NH_2$, with nitric acid, HNO_3?

A. Bromophenol blue $(pK_a = 4.1)$

B. Bromothymol blue $(pK_a = 7.3)$

C. Phenol red $(pK_a = 8.0)$

D. Thymolphthalein $(pK_a = 10.0)$

Which mixture of solutions can be used to prepare a buffer solution?

A. $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ HCl$ and $100.0\ cm^3\ 0.100\ mol\ dm^{-3}\ NH_3$

B. $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ HCl$ and $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ NH_3$

C. $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ HCl$ and $100.0\ cm^3\ 0.100\ mol\ dm^{-3}\ NH_4Cl$

D. $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ HCl$ and $50.0\ cm^3\ 0.100\ mol\ dm^{-3}\ NH_4Cl$

An equal amount of each of the following salts is added separately to the same volume of water.

Which salt will have the greatest effect on the pH of water?

A. $Al(NO_3)_3$

B. Na_2SO_4

C. RbCl

D. KBr

Which compound forms an acidic solution when dissolved in water?

A. $FeCl_3$

B. CH_3NH_2

C. $NaNO_3$

D. Na_2CO_3

Which compounds can be mixed together as aqueous solutions of equal volume and concentration to form an acidic buffer solution?

A. Sodium hydrogensulfate and sulfuric acid

B. Sodium propanoate and propanoic acid

C. Ammonium chloride and ammonia solution

D. Sodium chloride and hydrochloric acid

Which statements about an acid–base indicator are correct?

I. It can be a weak acid.

II. It is a substance in which the conjugate acid/base pair are different colours.

III. It can be a weak base.

A. I and II only

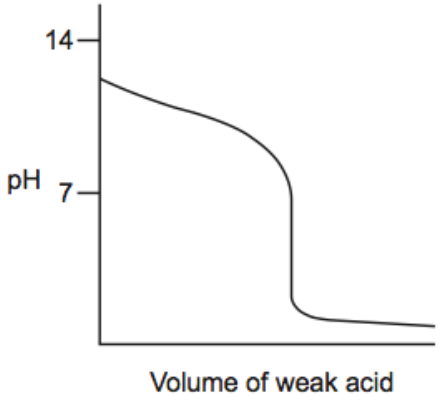
B. I and III only

C. II and III only

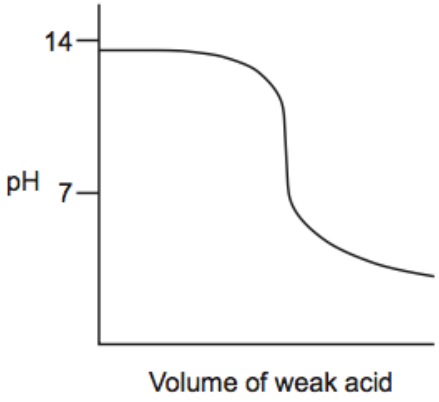
D. I, II and III

Which titration curve would occur when a weak acid is added to a strong base?

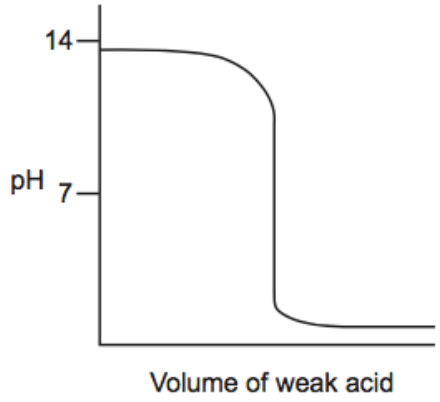
A.


14
pH
7
Volume of weak acid

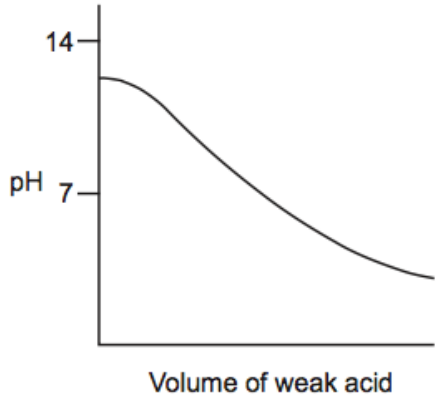
B.


14
pH
7
Volume of weak acid

C.


14
pH
7
Volume of weak acid

D.


14
pH
7
Volume of weak acid