TITRATION ERRORS – TOPIC TEST 1

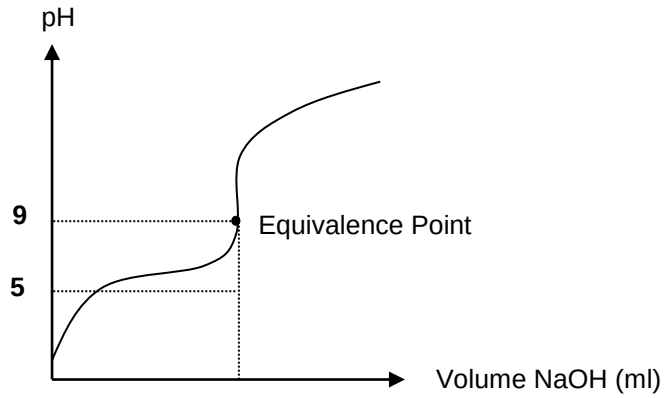
QUESTION 1
While a student was performing a titration, some of the unknown solution splashed out of the conical flask while it was being swirled. This would cause the calculated value of the unknown solution to be

A lower than it should be
B higher than it should be
C the expected value
D unable to be determined

QUESTION 2
Benzoic acid, a weak acid, dissociates according to the following equation:

$$C_6H_5COOH_{(aq)} \rightleftharpoons C_6H_5COO^-_{(aq)} + H^+_{(aq)}$$

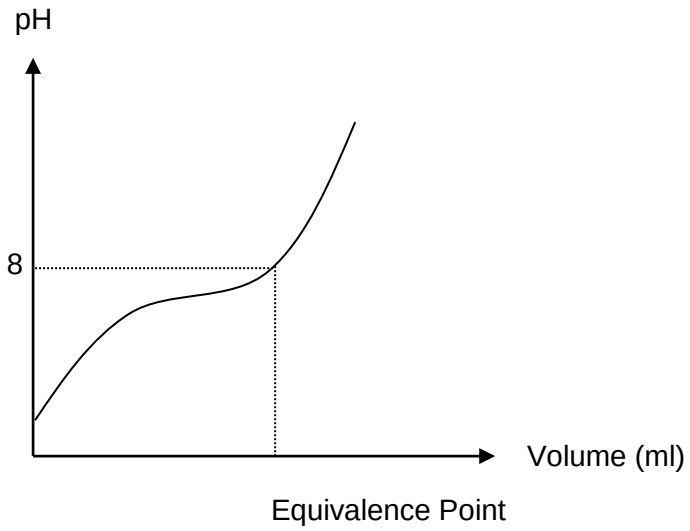
The diagram below shows the pH changes which occur when $20.0\,ml$ of $0.100M$ benzoic acid is titrated with $0.200M$ sodium hydroxide solution.



Methyl orange indicator changes colour from red to yellow between a pH of 2.1 and 4.4. How would the calculated concentration compare to the true value if methyl orange were used as the indicator for this reaction?

A There would be no difference between the two concentrations.
B The calculated concentration will be higher than the true value.
C The calculated concentration will be lower than the true value.
D The difference in concentrations cannot be determined from the given information.

QUESTION 3
The changes that occur in the pH during the titration of acetic acid and sodium hydroxide is shown below.



If phenolphthalein was used as the indicator in this titration (colour change occurs between pH 8 and 10), the calculated concentration of acetic acid would be:

A Equal to the true value
B Higher than the true value
C Lower than the true value
D Unable to be determined

QUESTION 4
Which of the following errors would lead to a higher than expected concentration of the unknown species regardless of whether the unknown was placed in the burette or conical flask?

A The burette is rinsed with distilled water.
B The end point occurs before equivalence point.
C The pipette is rinsed with distilled water.
D The standard solution is prepared from a deliquescent primary standard.

QUESTION 5
For a normal order titration where the unknown is in the flask and the standard solution is in the burette, which of the following errors results in the concentration of the unknown being lower than it should be?

i. The burette is rinsed with water
ii. The conical flask is rinsed with the unknown solution
iii. The endpoint occurs after the equivalence point

A All of the above
B None of the above
C iii
D ii and iii

QUESTION 6
In a particular titration, the unknown solution was placed in the burette. If the pipette used to deliver the standard solution to the conical flask was rinsed with water, what would happen to the calculated value of the unknown?

A There would be no change to the calculated value
B It would be higher than it should be
C It would be lower than it should be
D It is impossible to predict the effect

QUESTION 7

(a) What liquid or solution should be used to rinse out the following pieces of equipment prior to their use?

(i) burette
(ii) conical flask
(iii) pipette
(iv) Volumetric flask

(b) Why would NaOH not be used as a primary standard solution?

(c) In making up a primary standard, the student did not fill the volumetric flask sufficiently, so that the meniscus was actually below the mark. How would this alter/effect the calculated concentration of any solution that is standardised against such a primary standard?

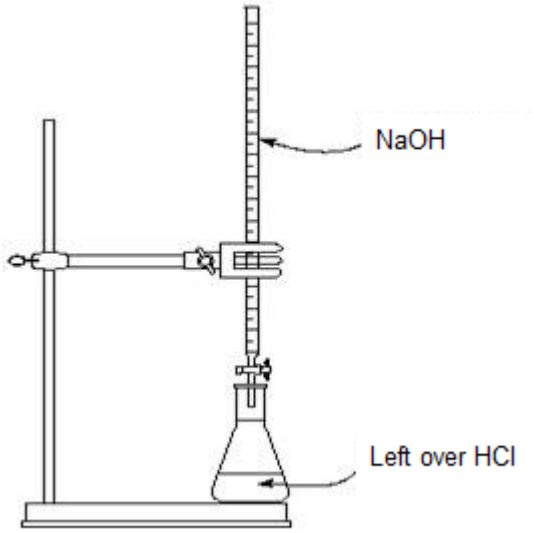
Solution

QUESTION 8

The concentration of $Mg(OH)_2$ in a brand of antacid was determined via back titration. 20.00 mL of antacid was firstly reacted with excess HCl via the following reaction.

$$Mg(OH)_{2(s)} + 2HCl_{(aq)} \rightarrow MgCl_{(aq)} + 2H_2O_{(l)}$$

The excess acid was then reacted with NaOH via a titration.



If the NaOH solution had not been standardised properly and its concentration was actually less than its quoted value, how would the calculated value of the $Mg(OH)_2$ be affected?

Solution

ANSWERS

QUESTION 1 Answer is A

QUESTION 2 Answer is C

QUESTION 3 Answer is B

The end point would occur AFTER the equivalence point

$\therefore$ $V_{burette}\uparrow$ than true value

$\therefore$ $n_{burette}\uparrow$

$\therefore$ $n_{unknown}\uparrow$

$\therefore$ $c = \frac{n\uparrow}{V}$ $\therefore$ conc $\uparrow$.

QUESTION 4 Answer is D

A deliquescent substance, such as sodium hydroxide, absorbs moisture from the atmosphere. This means that when a certain mass of the compound is measured, you end up with less of the substance than you think you have. If this mass is then used to make a primary standard, the solution will be less concentrated than it should be.
A basic standard solution that has a lower concentration than expected will always make the acid it is reacting with seem more concentrated.

Acid in the burette: If you add the acid to a set volume of the base, less volume of acid will be needed to neutralise the base making it seem concentrated
$C_{acid} = \frac{n}{V\downarrow}$ if V is smaller than it should be then [acid] will be larger than it should be.

Base in the burette: The volume of base needed to neutralise a set volume of acid will be larger than expected which indicates that the acid is concentrated.

V(base)↑ n(base)↑ n(acid)↑ c(acid)↑ since $c_{acid} = \frac{n\uparrow}{V(constant)}$

QUESTION 5 Answer is B

QUESTION 6 Answer is B

QUESTION 7

(a) i. burette: solution to be used in it
ii. conical flask: water
iii. pipette: solution to be used in it
iv. Volumetric flask: water

(b) $NaOH$ reacts with the air and changes in molar mass since it absorbs H_2O and reacts with CO_2.

(c) If the flask was not filled to the mark the actual concentration of the standard solution would be higher than the calculated concentration which means that more of any solution titrated against it would be required to neutralise the standard. This increase in the volume would mean that the concentration calculated for the unknown would be lower than it actually was (since $C = \frac{n}{v\uparrow}$).

QUESTION 8

The v(NaOH) needed to neutralise the left over HCl would be ↑ than it should be.

The calculated n(NaOH) would be ↑ than it should be.

The calculated n(HCl) left over would be ↑ than it should be.

The n(HCl) that reacted would be ↓ than it should be.

The n($Mg(OH)_2$) would be ↓ than it should be.

The % $Mg(OH)_2$ would be ↓ than it should be.