91392M

913925

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

3

SUPERVISOR'S USE ONLY

Te Mātauranga Matū, Kaupae 3, 2017

91392M Te whakaatu māramatanga ki ngā mātāpono taurite i ngā pūnaha waiwai

2.00 i te ahiahi Rāapa 15 Whiringa-ā-rangi 2017
Whiwhinga: Rima

Paetae	Kaiaka	Kairangi
Te whakaatu māramatanga ki ngā mātāpono taurite i ngā pūnaha waiwai.	Te whakaatu māramatanga hōhonu ki ngā mātāpono taurite i ngā pūnaha waiwai.	Te whakaatu māramatanga matawhānui ki ngā mātāpono taurite i ngā pūnaha waiwai.

Tirohia mēnā e rite ana te Tau Ākonga ā-Motu (NSN) kei runga i tō puka whakauru ki te tau kei runga i tēnei whārangi.

Me whakamātau koe i ngā tūmahi KATOA kei roto i tēnei pukapuka.

He taka pūmotu kua whakaritea ki te Puka Rauemi L3-CHEMMR.

Mēnā ka hiahia whārangi atu anō mō ō tuhinga, whakamahia ngā whārangi wātea kei muri o tēnei pukapuka, ka āta tohu ai i ngā tau tūmahi.

Tirohia mēnā e tika ana te raupapatanga o ngā whārangi 2–19 kei roto i tēnei pukapuka, ka mutu, kāore tētahi o aua whārangi i te takoto kau.

HOATU TE PUKAPUKA NEI KI TE KAIWHAKAHAERE HEI TE MUTUNGA O TE WHAKAMĀTAUTAU.

TAPEKE

MĀ TE KAIMĀKA ANAKE

TŪMAHI TUATAHI

MĀ TE KAIMĀKA ANAKE

(a) Ka puta he mehanga waikawa i te hauwai pūkōwhai, HF, me te hauwai pūkane, HBr, ina tāpirihia ki te wai.

(i) Tuhia he whārite tauhohenga o ia waikawa ki te wai.

Hauwai pūkōwhai, HF, ki te wai:

Hauwai pūkane, HBr, ki te wai:

(ii) Whakatauritea te kawenga hiko o ngā mehanga 0.150 mol L^{-1} o te waikawa pūkōwhai, HF, me te waikawa pūkane, HBr.

I tō tuhinga, me:

- whakauru i ngā whakaritenga mō tētahi mehanga hei kawe hiko
- tautohu i ngā momo kei roto ME ngā kukūtanga hāngai.

Kāore he tātaihanga e hiahiatia.

QUESTION ONE

ASSESSOR'S USE ONLY

(a) Hydrogen fluoride, HF, and hydrogen bromide, HBr, both form acidic solutions when added to water.

(i) Write an equation for the reaction of each acid with water.

Hydrogen fluoride, HF, with water:

Hydrogen bromide, HBr, with water:

(ii) Compare and contrast the electrical conductivity of 0.150 mol L^{-1} solutions of hydrofluoric acid, HF, and hydrobromic acid, HBr.

In your answer, you should:

- include the requirements for a solution to conduct electricity
- identify the species present AND their relative concentrations.

No calculations are necessary.

(b) I tāpirihia he mehanga 40.0 mL o te 0.150 mol L^{-1} HBr ki te 25.0 mL o tētahi mehanga hiriwa pūkane tōpuni, AgBr.

MĀ TE KAIMĀKA ANAKE

(i) Tuhia he whārite mō te tauritenga kei roto i tētahi mehanga tōpuni o te AgBr.

(ii) Whakamāramahia ngā huringa ka puta ki ngā kukūtanga o ngā momo kei te mehanga tōpuni o te AgBr i te tāpiritanga o te mehanga HBr.

(iii) Tātaihia te kukūtanga o ngā katote hiriwa, Ag^+, i muri i te tāpiritanga o te mehanga HBr.

$K_s(AgBr) = 5.00 \times 10^{-13}$

Me kī he tino iti noa te kukūtanga Br^- kei te mehanga tōpuni taketake o te AgBr.

ASSESSOR'S USE ONLY

(b) 40.0 mL of 0.150 mol L^{-1} HBr solution was added to 25.0 mL of a saturated silver bromide, AgBr, solution.

(i) Write an equation for the equilibrium occurring in a saturated solution of AgBr.

(ii) Explain the changes that occur to the concentrations of the species in the saturated solution of AgBr on the addition of the HBr solution.

(iii) Calculate the concentration of the silver ions, Ag^+, after the HBr solution has been added.

$K_s(AgBr) = 5.00 \times 10^{-13}$

Assume the concentration of Br^- in the original saturated solution of AgBr is insignificant.

TŪMAHI TUARUA

MĀ TE KAIMĀKA ANAKE

(a) He pāpāhua ngoikore te haukini, NH_3.

$pK_a(NH_4^+) = 9.24$ $K_a(NH_4^+) = 5.75 \times 10^{-10}$

(i) Tātaitia te pH o tētahi mehanga 0.105 mol L^{-1} NH_3.

(ii) Ka tāpirihia te waikawa pūhaumāota waimeha, HCl, ki te mehanga NH_3 kia tae rā anō ki te 5:1 te ōwehenga o te NH_3 ki te NH_4^+ i roto i te mehanga.

Whakatauhia te pH o tēnei mehanga, ka arotake i te kaha ki te pare i tētahi huringa o te pH ina tāpirihia ngā rahinga iti o te waikawa kaha, pāpāhua kaha rānei

QUESTION TWO

ASSESSOR'S USE ONLY

(a) Ammonia, NH_3, is a weak base.

$pK_a(NH_4^+) = 9.24$ $\quad\quad$ $K_a(NH_4^+) = 5.75 \times 10^{-10}$

(i) Calculate the pH of a 0.105 mol L^{-1} NH_3 solution.

(ii) Dilute hydrochloric acid, HCl, is added to the NH_3 solution until the ratio of NH_3 to NH_4^+ in the solution is 5:1.

Determine the pH of this solution, and evaluate its ability to resist a change in pH when small volumes of strong acid or base are added.

MĀ TE KAIMĀKA ANAKE

(b) (i) Tuhia te whārite mō te tauritenga kei roto i tētahi mehanga tōpuni o te konukura(II) waihā, $Cu(OH)_2$.

(ii) Tuhia te kīanga mō te $K_s(Cu(OH)_2)$.

(iii) Tātaihia te memehatanga o te $Cu(OH)_2$ i rō wai i te 25°C.

$K_s(Cu(OH)_2) = 4.80 \times 10^{-20}$

(c) Whakamāramahia mai he aha i piki ai te memehatanga o te $Cu(OH)_2$ ina tāpirihia te waikawa pūhaumāota waimeha.

ASSESSOR'S USE ONLY

(b) (i) Write the equation for the equilibrium occurring in a saturated solution of copper(II) hydroxide, $Cu(OH)_2$.

(ii) Write the expression for $K_s(Cu(OH)_2)$.

(iii) Calculate the solubility of $Cu(OH)_2$ in water at 25°C.

$K_s(Cu(OH)_2) = 4.80 \times 10^{-20}$

(c) Explain why the solubility of $Cu(OH)_2$ increases when dilute hydrochloric acid is added.

TŪMAHI TUATORU

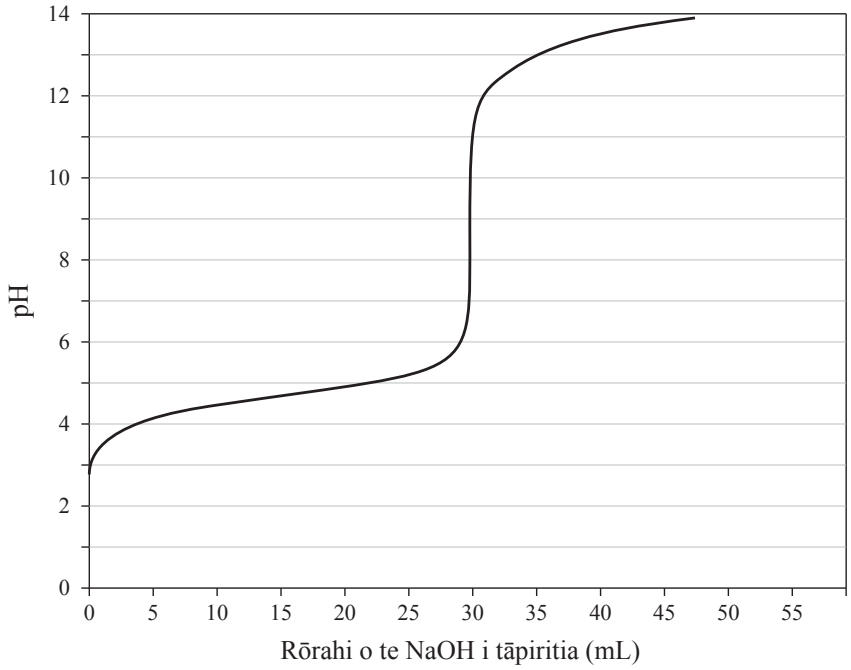
MĀ TE KAIMĀKA ANAKE

I whakahaerehia he tātairanga kukū mā te tāpiri i te mehanga konutai waihā 0.112 mol L^{-1}, NaOH(*aq*), ki te 20.0 mL o te mehanga waikawa ewaro, $CH_3COOH(aq)$.

Ko te whārite mō te tauhohenga ko:

$CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(\ell)$ $\quad K_a(CH_3COOH) = 1.74 \times 10^{-5}$

Te ānau tātairanga kukū mō te CH_3COOH ki te NaOH



(a) Whakamahia te kōrero mō te ānau tātairanga kukū i runga ake, ka tohu ki te taha o te tūtohu e tino hāngai ana hei tautohu i te pae ōritenga.

Tūtohu	**pK_a**	**Tohua kia KOTAHI te pouaka i raro**
Kōwhai mewaro	3.1	
Poroporo waikawa pūkane	6.3	
Penopeirini (Phenolphthalein)	9.6	

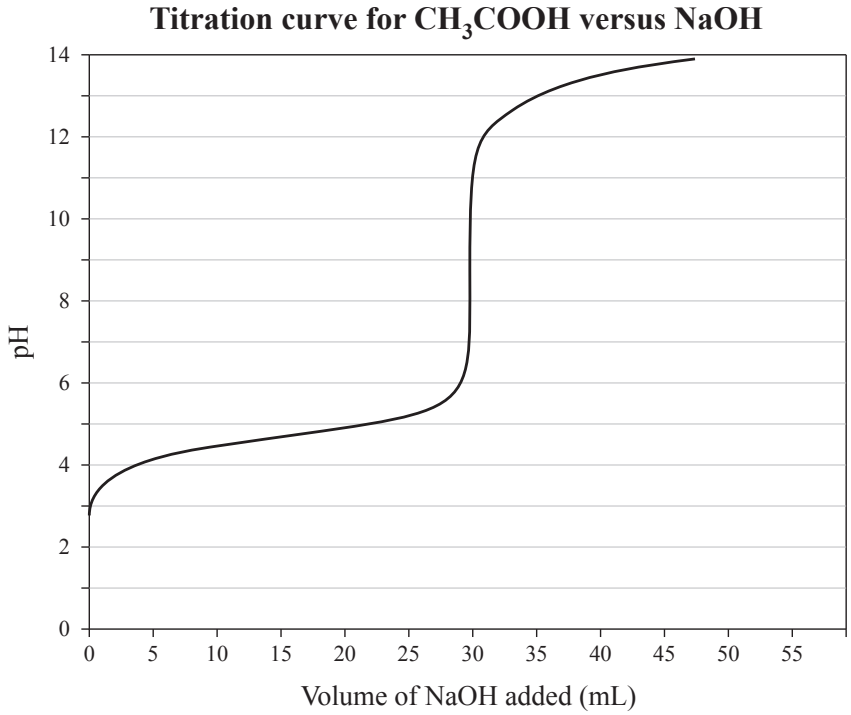
QUESTION THREE

ASSESSOR'S USE ONLY

A titration was carried out by adding 0.112 mol L^{-1} sodium hydroxide solution, NaOH(*aq*), to 20.0 mL of ethanoic acid solution, $CH_3COOH(aq)$.

The equation for the reaction is:

$CH_3COOH(aq) + NaOH(aq) \rightarrow CH_3COONa(aq) + H_2O(\ell)$ $\quad K_a(CH_3COOH) = 1.74 \times 10^{-5}$



(a) With reference to the titration curve above, put a tick next to the indicator most suited to identify the equivalence point.

Indicator	pK_a	Tick ONE box below
Methyl yellow	3.1	
Bromocresol purple	6.3	
Phenolphthalein	9.6	

(b) (i) Ko te pH o te mehanga waikawa ewaro, $CH_3COOH(aq)$, he 2.77 i mua i te tāpiritanga o tētahi NaOH.

MĀ TE KAIMĀKA ANAKE

Whakaaturia mā te tātai ko te kukūtanga o te mehanga CH_3COOH he 0.166 mol L^{-1}.

(ii) Tātaihia te pH o te mehanga i roto i te puoto i muri i te tāpiri i te 10.0 mL o te 0.112 mol L^{-1} NaOH ki te 20.0 mL o te mehanga waikawa ewaro, $CH_3COOH(aq)$.

Ka haere tonu te Tūmahi Tuatoru i te whārangi 14.

ASSESSOR'S USE ONLY

(b) (i) The ethanoic acid solution, $CH_3COOH(aq)$, has a pH of 2.77 before any NaOH is added.

Show by calculation that the concentration of the CH_3COOH solution is 0.166 mol L^{-1}.

(ii) Calculate the pH of the solution in the flask after 10.0 mL of 0.112 mol L^{-1} NaOH has been added to 20.0 mL of ethanoic acid solution, $CH_3COOH(aq)$.

Question Three continues on page 15.

(c) Ko te pH i te pae ōritenga mō te tātairanga kukū o te waikawa ewaro ki te konutai waihā he 8.79.

MĀ TE KAIMĀKA ANAKE

(i) Tautohua ngā momo matū kei roto i te pae ōritenga, i tua atu i te wai.

(ii) I tētahi tātairanga kukū tuarua, ka tātai kukūtia he mehanga 0.166 mol L^{-1} o te waikawa mewaro, HCOOH(*aq*), ki te mehanga NaOH. Ko te pH i te pae ōritenga mō tēnei he 8.28.

Ko te pH i te pae ōritenga mō te tātairanga kukū CH_3COOH he 8.79.

Whakatauritea ngā uara pH i te pae ōritenga mō ngā tātairanga kukū e rua.

$K_a(HCOOH) = 1.82 \times 10^{-4}$ $K_a(CH_3COOH) = 1.74 \times 10^{-5}$

Kāore he tātaihanga e hiahiatia.

ASSESSOR'S USE ONLY

(c) The equivalence point pH for the titration of ethanoic acid with sodium hydroxide is 8.79.

(i) Identify the chemical species present at the equivalence point, other than water.

(ii) In a second titration, a 0.166 mol L^{-1} methanoic acid solution, HCOOH(*aq*), is titrated with the NaOH solution. The equivalence point pH for this titration is 8.28.

The equivalence point pH for the CH_3COOH titration is 8.79.

Compare and contrast the pH values at the equivalence point for both titrations.

$K_a(HCOOH) = 1.82 \times 10^{-4}$ $K_a(CH_3COOH) = 1.74 \times 10^{-5}$

No calculations are necessary.

He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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He whārangi anō ki te hiahiatia.
Tuhia te (ngā) tau tūmahi mēnā e tika ana.

TAU TŪMAHI

MĀ TE KAIMĀKA ANAKE

Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

ASSESSOR'S USE ONLY

English translation of the wording on the front cover

Level 3 Chemistry, 2017

91392 Demonstrate understanding of equilibrium principles in aqueous systems

2.00 p.m. Wednesday 15 November 2017
Credits: Five

91392M

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of equilibrium principles in aqueous systems.	Demonstrate in-depth understanding of equilibrium principles in aqueous systems.	Demonstrate comprehensive understanding of equilibrium principles in aqueous systems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L3–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–19 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.