OXFORD
INTERNATIONAL AQA EXAMINATIONS

INTERNATIONAL A-LEVEL CHEMISTRY

(CH04)

Unit 4: Organic 2 and Physical 2

Example responses with commentary

For teaching from September 2016 onwards
For AS exams in May/June 2018 onwards

This guide includes some examples of student responses to a selection of questions from the summer 2018 CH04 unit.

The question parts are reproduced, along with the final mark scheme, student responses and a commentary from the Lead Examiner on each of the students' answers.

Both teachers and students are encouraged to look at the published mark schemes and examiners reports after each examination series.

'Command' words (eg calculate, state, describe, identify) appear at the start of a sentence so students are in no doubt what is required in answering each question. To help students the answer space is often structured to help them e.g. if they are asked to 'identify a reagent...' and 'state what you observe...', then there will be one answer line for them to write their reagent and then one line for each observation.

Students should be aware that the number of marks awarded indicates the number of points required in their response. If there are several marks available then the first marking point in the mark scheme is M1. Any ideas 'underlined' in the mark scheme are essential to gain credit (although on occasions students can express these ideas in 'their own words').

Students should be aware that any contradiction in their answer is treated using a 'list' principle (refer to published mark scheme, page 3, section 3.1 Marking of lists). For example, if the student had stated that the effect is 'decrease' and had also written that the amount increases, then the examiner is likely to view this as one correct point and one incorrect, and is unable to award any marks.

Students should note that provided their answers are legible, they are awarded credit for correct chemistry. If a student wishes to change their first answer then this should be clearly crossed out. If they do not and write a different answer then the 'list principle' will be applied and zero marks will be scored. Do ensure that any working or alternative answers are clearly crossed out!

In calculations students should show what they are calculating in each step. Students should know how many significant figures they should use in their answer; 3 sig. fig. is standard practice. However, there are occasions when some other precision is required eg A_r and M_r must be stated to one decimal place, pH readings to two decimal places or when students are asked otherwise eg 'Give' your answer to the nearest whole number.

Oxford AQA produced a webinar on 'Improving exam performance for AO1 and AO2' in science. During the presentation an emphasis was placed upon the large amount of content that students must learn. These are available for viewing on the Oxford International AQA Examinations website.

Chemistry is a practically based subject and as a minimum students should carry out the 10 required practicals (summarised on p.49 of the specification). Wherever possible students should be provided with practical opportunities to reinforce their learning e.g. reacting Mg with steam, relative solubility of Group 2 hydroxides and sulfates, etc.

When drawing covalent bonds in organic molecules care must be taken e.g. in alcohols students must show the bond from C to O of the –OH alcohol group (refer to mark scheme pages 7-9, section 3.12 Organic structures for further examples). Another frequent mistake made is that the bond between O-H is not shown when students are asked to draw a displayed formula.

QUESTION

01.2

0 1 . 2 Isomers **A** and **B** both react with KCN followed by dilute acid.

Name the mechanism for this reaction.

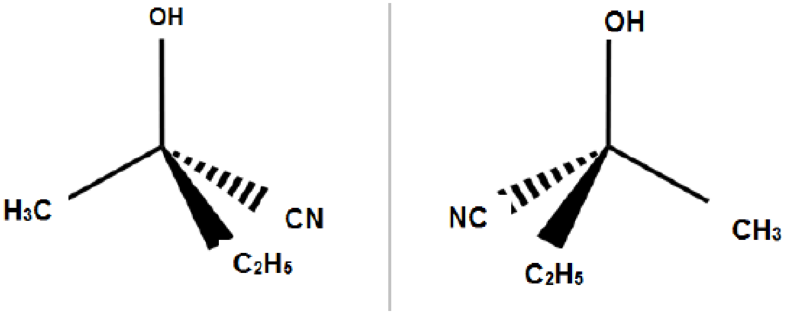
Draw the two enantiomers formed by isomer **A** in this reaction and show how the two enantiomers are related to each other.

[3 marks]

Mechanism ______________________________

Enantiomer 1 Enantiomer 2

MARK SCHEME

Question	Marking guidance	Mark	Comments
01.2	(Mechanism) Nucleophilic addition (Enantiomers) or 2D equivalent mirror images. 	1 2	

STUDENT A

0 1 . 2 Isomers **A** and **B** both react with KCN followed by dilute acid.

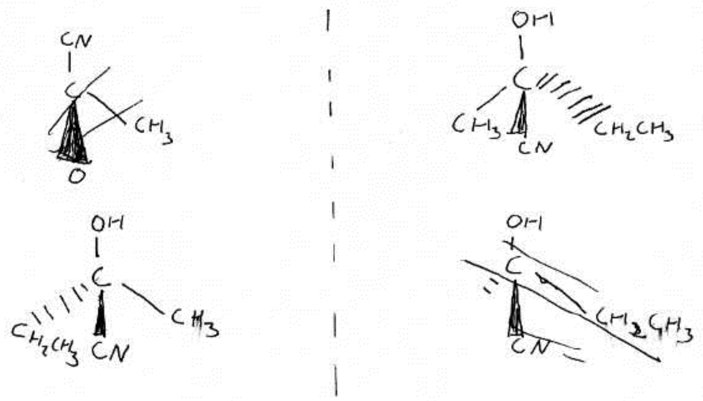
Name the mechanism for this reaction.

Draw the two enantiomers formed by isomer **A** in this reaction and show how the two enantiomers are related to each other.

[3 marks]

Mechanism Nucleophilic addition.

Enantiomer 1 Enantiomer 2



EXAMINER COMMENTARY

The student has drawn the two enantiomers as mirror images. It is important that working or any attempts at answering the question that the student does not want to be marked is crossed out, as shown here; otherwise the list principle is applied.

3 marks awarded.

STUDENT B

0 1 . 2 Isomers **A** and **B** both react with KCN followed by dilute acid.

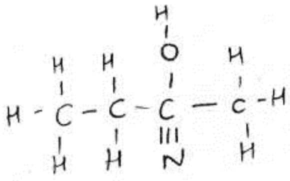
Name the mechanism for this reaction.

Draw the two enantiomers formed by isomer **A** in this reaction and show how the two enantiomers are related to each other.

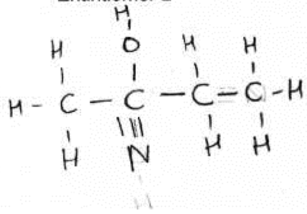
[3 marks]

Mechanism Nucleophillic Addition

Enantiomer 1



Enantiomer 2



EXAMINER COMMENTARY

Many students knew that the mechanism was nucleophilic addition but found identifying the product and drawing enantiomers more challenging. This response shows 2D equivalent mirror images which has gained all available marks.

3 marks awarded.

QUESTION

02.2

0 2 . 2 In the laboratory, the aspirin produced is impure. It is purified by recrystallisation using water as the solvent.

Complete the steps carried out in a recrystallisation practical.

[3 marks]

Step 1 ______________________________

Step 2 Filter whilst hot

Step 3 ______________________________

Step 4 Vacuum filter

Step 5 ______________________________

Step 6 Dry in a desiccator

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.2	(Step 1) dissolve in minimum (volume of) hot solvent	1	
	(Step 3) cool (to crystallise)	1	
	(Step 5) wash with cold solvent	1	

STUDENT A

0 2 . 2 In the laboratory, the aspirin produced is impure. It is purified by recrystallisation using water as the solvent.

Complete the steps carried out in a recrystallisation practical.

[3 marks]

Step 1 dissolve in a minimum volume of hot solvent

Step 2 Filter whilst hot

Step 3 allow to recrystallise

Step 4 Vacuum filter

Step 5 wash with a cold solvent

Step 6 Dry in a desiccator

EXAMINER REPORT

Generally students found the practical aspects of recrystallisation, from Required Practical 10, particularly difficult. The key point in this response is that after filtering hot, the solution needs to be cooled, during which crystallisation will occur; M2 has thus not been awarded.

2 marks out of a possible of 3 awarded.

STUDENT B

0 2 . 2 In the laboratory, the aspirin produced is impure. It is purified by recrystallisation using water as the solvent.

Complete the steps carried out in a recrystallisation practical.

[3 marks]

Step 1 dissowe in hot solvent

Step 2 Filter whilst hot

Step 3 put it in ice cold water to let crystals form.

Step 4 Vacuum filter

Step 5 Wash with cold solvent

Step 6 Dry in a desiccator

EXAMINER COMMENTARY

Generally students found the practical aspects of recrystallisation, from Required Practical 10, particularly difficult. In this case the student has not referred to the **minimum** amount of solvent being necessary (M1).

2 marks awarded.

QUESTION

02.4

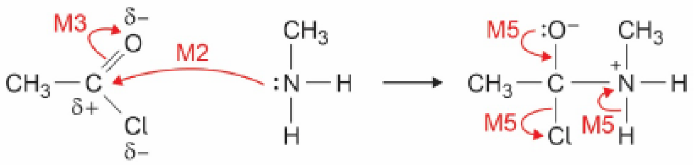
0 2 . 4 Ethanoyl chloride reacts with amines to produce amides.

Name and outline the mechanism for the reaction between ethanoyl chloride and methylamine.

[5 marks]

Name of mechanism ______________________________

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.4	(mechanism) nucleophilic addition-elimination	1	
	M2 arrow from lone pair on N to (δ+) C	1	
	M3 curly arrow from C=O to O	1	
	M4 correct intermediate <u>and</u> charges	1	
	M5 three correct curly arrows to eliminate Cl^- & H^+ and reform C=0	1	Can be over two intermediates
			

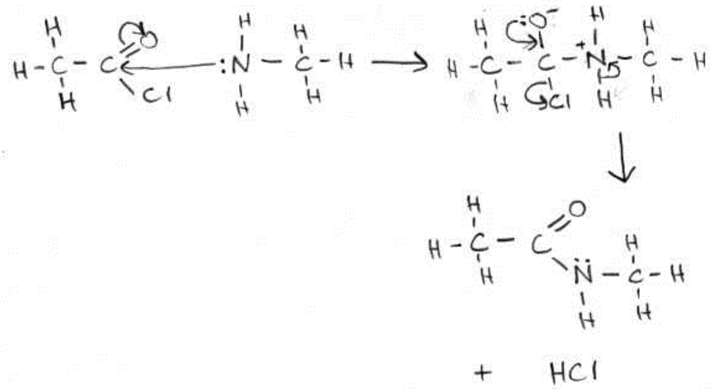
STUDENT A

0 2 . 4 Ethanoyl chloride reacts with amines to produce amides.

Name and outline the mechanism for the reaction between ethanoyl chloride and methylamine.

[5 marks]

Name of mechanism Nucleophilic ~~addition~~ Substitution



EXAMINER COMMENTARY

This student has correctly drawn the intermediate with charges (M4) and in one subsequent step has drawn three arrows to explain the formation of the amide group with the overall loss of HCl (M5). It is also possible to show this as two steps; a second intermediate is formed which then loses a proton. Students should appreciate that it is another amine, and not the chloride ion, that removes a proton in the final step.

4 marks awarded (not M1).

STUDENT B

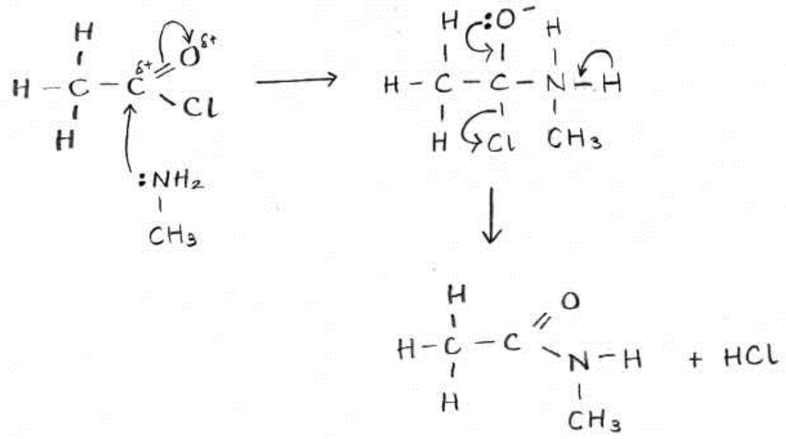
0 2 . 4 Ethanoyl chloride reacts with amines to produce amides.

Name and outline the mechanism for the reaction between ethanoyl chloride and methylamine.

[5 marks]

Name of mechanism nucleophilic addition-elimination

$R-NH_2$



EXAMINER COMMENTARY

M1-M3 are correct; the name of the mechanism and the first two steps. A positive charge is missing off the N atom in the intermediate, so M4 has not been gained. Also the right hand arrow starts at the H atom and finishes at the N-H bond (which suggests a double bond is formed) rather than an arrow which starts from the N-H bond and finishes as a lone pair on the N atom; M5 not awarded.
Curly arrows must start at a drawn lone pair of electrons or in the middle of a covalent bond and finish at an atom (or between two atoms).

3 marks awarded.

QUESTION

02.5

Amines can be prepared from different compounds.

0 2 . 5 Propylamine ($CH_3CH_2CH_2NH_2$) can be prepared in two different **one-step** reactions.

For each reaction, identify:

- the organic starting material, and
- the reagent and condition(s).

[4 marks]

Reaction 1

Organic starting material ______________________________

Reagent and condition(s) ______________________________

____

Reaction 2

Organic starting material ______________________________

Reagent and condition(s) ______________________________

____

MARK SCHEME

Question	Marking guidance	Mark	Comments
02.5	(reaction 1)		Reactions can be in either order
	C_2H_5CN/propanenitrile	1	
	Nickel and hydrogen catalyst or $LiAlH_4$ and dry ether	1	Ignore heat/pressure
	(reaction 2)		
	bromopropane/chloropropane	1	
	excess ammonia	1	

STUDENT A

Do not write outside the box

Amines can be prepared from different compounds.

0 2 . 5 Propylamine ($CH_3CH_2CH_2NH_2$) can be prepared in two different **one-step** reactions.

For each reaction, identify:

- the organic starting material, and
- the reagent and condition(s).

[4 marks]

Reaction 1

Organic starting material propanenitrile

Reagent and condition(s) - $LiAlH_4$ in ether

- room temperature

Reaction 2

Organic starting material 1-chloropropane

Reagent and condition(s) - excess NH_3

- reflux

16

EXAMINER COMMENTARY

Students generally found identifying starting materials and reagents for reactions difficult.

4 marks awarded.

STUDENT B

Amines can be prepared from different compounds.

0 2 . 5 Propylamine ($CH_3CH_2CH_2NH_2$) can be prepared in two different **one-step** reactions.

For each reaction, identify:

- the organic starting material, and
- the reagent and condition(s).

[4 marks]

Reaction 1

Organic starting material CH_3CH_2Br

Reagent and condition(s) ~~ageous KCN~~

KCN in ageous ethanol

Reaction 2

Organic starting material CH_3CH_2CN

Reagent and condition(s) $LiAlH_4$ in ether

EXAMINER COMMENTARY

For Reaction 1, this student has started with a two-carbon halogenalkane and has added a reagent to convert this compound into a three-carbon nitrile; this nitrile could then be reduced to the correct amine. However, this is a two-step synthesis and not the one-step synthesis for the reaction of a halogenalkane with (excess) ammonia; it is important that students read the question carefully!

3 marks awarded.

QUESTION

03.7

0 3 . 7 Some modifications to the GC apparatus were considered to improve the separation of the same mixture of components.

Predict the effect, if any, of each modification on the retention times of the components.

[3 marks]

Increasing the column temperature ____________________

____

Decreasing the column length ____________________

____

Decreasing the carrier gas flow rate ____________________

____

MARK SCHEME

Question	Marking guidance	Mark	Comments
03.7	(increasing the column temperature) decreased	1	In all cases, accept equivalent wording such as shorter/smaller/lower/longer/bigger/greater
	(decreasing the column length) decreased	1	Allow faster/slower
	(decreasing the carrier gas flow rate) increased	1	

STUDENT A

0 3 . 7 Some modifications to the GC apparatus were considered to improve the separation of the same mixture of components.

Predict the effect, if any, of each modification on the retention times of the components.

[3 marks]

Increasing the column temperature decrease

Decreasing the column length decrease

Decreasing the carrier gas flow rate increase.

EXAMINER COMMENTARY

Students generally knew the impact of altering conditions on retention times.

3 marks awarded.

STUDENT B

0 3 . 7 Some modifications to the GC apparatus were considered to improve the separation of the same mixture of components.

Predict the effect, if any, of each modification on the retention times of the components.

[3 marks]

Increasing the column temperature decreas

Decreasing the column length ~~no change~~ increase

Decreasing the carrier gas flow rate ~~decrease~~ no change

EXAMINER COMMENTARY

Decreasing the column length would result in a shorter retention time (M2) and decreasing the carrier flow rate would increase retention time (M3).

1 mark awarded.

QUESTION

04.6

0 4 . 6 Name the interactions that hold protein chains in a β-pleated sheet.

Explain how these interactions are formed.

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
04.6	N and O both very electronegative or C=O and N–H are polar	1	
	Lone pair on O attracted to the $^{\delta+}$H of N-H	1	
	hydrogen bond formed	1	

STUDENT A

0 4 . 6 Name the interactions that hold protein chains in a β-pleated sheet.

Explain how these interactions are formed.

[3 marks]

hydrogen bonding holds protein chains. ~~They~~ It occurs in C=O bond and the N-H bond as one element is more electronegative than the other.

EXAMINER COMMENTARY

In the previous question students were clear that the required protein structure was secondary. However, many then failed to identify that hydrogen bonds were responsible for holding the protein chain in a β–pleated sheet and also struggled to describe how the hydrogen bonds form.

1 mark awarded.

STUDENT B

0 4 . 6 Name the interactions that hold protein chains in a β-pleated sheet.

Explain how these interactions are formed.

[3 marks]

Hydrogen bonding ~~occurs~~ occurs in β-~~pl~~pleated sheet between O and H. As it is not a ~~a~~ straight chain, the oxygen will interact with hydrogen on the sheet due to a high difference in electronegativity hydrogen bonds are formed

EXAMINER COMMENTARY

The hydrogen bond arises due to the large electronegativity difference between H and either N (in N-H) or O (in C=O). The hydrogen bond forms as an attraction e.g. between the lone pair on O and the $^{\delta+}$H of N-H.

1 mark awarded.

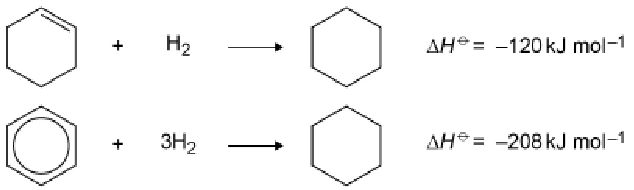
QUESTION

05.1

0 5 . 1 The molecule cyclohexa-1,3,5-triene does not exist and is described as theoretical.

State and explain the stability of benzene compared with the theoretical cyclohexa-1,3,5-triene.

Use the following data.



[4 marks]

MARK SCHEME

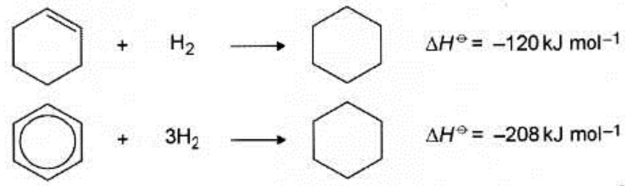
Question	Marking guidance	Mark	Comments
05.1	Benzene is more stable than cyclohexatriene	1	more stable than cyclohexatriene must be stated or implied If benzene more stable than cyclohexene, then penalise M1 but mark on If benzene less stable: can score M2 only
	Expected ΔH° hydrogenation of C_6H_6 is 3(–120) = –360 kJ mol^{-1}	1	Allow in words eg expected ΔH° hydrogenation of benzene is three times the ΔH° hydrogenation of cyclohexene
	Actual ΔH° hydrogenation of benzene is (152 kJ mol^{-1}) less than expected	1	Ignore energy value
	Because of delocalisation **or** electrons spread out **or** resonance	1	

STUDENT A

0 5 . 1 The molecule cyclohexa-1,3,5-triene does not exist and is described as theoretical.

State and explain the stability of benzene compared with the theoretical cyclohexa-1,3,5-triene.

Use the following data.



[4 marks]

$-120 \times 3 = -360$ kJ mol^{-1}

~~-360~~ $-208 - (-360) = 152$ kJ mol^{-1}

~~Ben~~ This shows that benzene is 152 kJ mol^{-1} more stable than cyclohexa-1,3,5-triene due to delocalised ring of electrons.

EXAMINER COMMENTARY

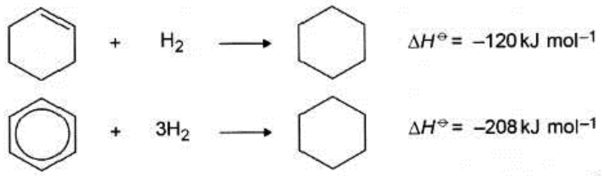
4 marks awarded.

STUDENT B

0 5 . 1 The molecule cyclohexa-1,3,5-triene does not exist and is described as theoretical.

State and explain the stability of benzene compared with the theoretical cyclohexa-1,3,5-triene.

Use the following data.



[4 marks]

Benzene is more stable than Cyclohexa Cyclohexa-1,3,5-triene because ΔH for one double bond is $-120\ kJmol^{-1}$ so for 3 double bonds the ΔH value will be $-360\ kJmol^{-1}$ and benzene has a higher ΔH value so is therefore more stable.

EXAMINER COMMENTARY

Students who recognised that a less negative enthalpy of hydration means a substance is more stable answered this question well. This is an example of such a response gaining only M1 and M2.

2 marks awarded.

QUESTION

06.2

0 6 . 2 Barium hydroxide, $Ba(OH)_2$, is a strong alkali.

Calculate the pH of a 0.0120 mol dm^{-3} solution of barium hydroxide at 298K

Give your answer to two decimal places.

The ionic product of water, $K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6} at 298K

[3 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.2	M1 $[OH^-] = 2 \times 0.0120 = 0.0240$	1	If ×2 missed or used wrongly can only score M3 for correct calculation of pH from their $[H^+]$.
	M2 $[H^+] = (1\times10^{-14} \div 0.240 =) = 4.166 \times 10^{-13}$ OR pOH = 1.62	1	
	M3 pH = <u>12.38</u>	1	pH must be to 2dp

STUDENT A

0 6 . 2 Barium hydroxide, $Ba(OH)_2$, is a strong alkali.

Calculate the pH of a 0.0120 mol dm^{-3} solution of barium hydroxide at 298K

Give your answer to two decimal places.

The ionic product of water, $K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6} at 298K

[3 marks]

$$K_w = [H^+][OH^-].$$

$$[H^+] = \frac{K_w}{[OH^-]} = \frac{1.00 \times 10^{-14}}{[0.0120 \times 2]} = 4.17 \times 10^{-13}$$

$$pH = -\log_{10}[4.17 \times 10^{-13}]$$

pH ~~12.4~~ 12.38

EXAMINER COMMENTARY

3 marks awarded.

STUDENT B

0 6 . 2 Barium hydroxide, $Ba(OH)_2$, is a strong alkali.

Calculate the pH of a 0.0120 mol dm^{-3} solution of barium hydroxide at 298K

Give your answer to two decimal places.

The ionic product of water, $K_w = 1.00 \times 10^{-14}$ mol^2 dm^{-6} at 298K

[3 marks]

$1 \times 10^{-14} = [H^+][0.0120]$

$[H^+] = \dfrac{[1 \times 10^{-14}]}{[0.0120]} = 8.33 \times 10^{-13}$

$pH = -\log[8.33 \times 10^{-13}] = 12.08$

pH 12.08

EXAMINER COMMENTARY

Students were less successful in calculating the pH of barium hydroxide, a strong **diprotic** base. Mark scheme (right hand column) states that if ×2 is missed when calculating the $[OH^-]$ then students can only score M3 for their correct calculation of pH from their $[H^+]$; this chemical error (CE) is penalised by a two mark penalty.

1 mark awarded.

QUESTION

06.3

0 6 . 3 The value of the acid dissociation constant (K_a) for benzenecarboxylic (benzoic) acid (C_6H_5COOH) is 6.31×10^{-5} mol dm^{-3}

Calculate the pH of a 0.0120 mol dm^{-3} solution of this acid.
Give your answer to two decimal places.

[3 marks]

pH ______________________

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.3	M1 $K_a = \dfrac{[H^+]^2}{[C_6H_5COOH]}$ **OR** with numbers	1	
	M2 $[H^+] = \sqrt{(6.31 \times 10^{-5} \times 0.0120)} = 8.70 \times 10^{-4}$ OR $= \sqrt{(K_a \times [C_6H_5COOH])}$ $(= \sqrt{(7.572 \times 10^{-7})}$ $(= 8.70 \times 10^{-4})$	1	
	M3 pH = <u>3.06</u>	1	pH must be to 2dp

STUDENT A

0 6 . 3 The value of the acid dissociation constant (K_a) for benzenecarboxylic (benzoic) acid (C_6H_5COOH) is 6.31×10^{-5} mol dm^{-3}

Calculate the pH of a 0.0120 mol dm^{-3} solution of this acid.
Give your answer to two decimal places.

[3 marks]

$$Ka = \frac{[H^+]^2}{[HA]}. \qquad [H^+] = \sqrt{Ka \times [HA]}.$$

$$= \sqrt{6.31 \times 10^{-5} \times 0.0120}$$

$$= 8.70 \times 10^{-4}$$

$$pH = -\log_{10}[8.70 \times 10^{-4}]$$

pH 3.06

EXAMINER COMMENTARY

This question was generally well answered with working clearly shown. Students should appreciate that calculating the pH of a weak acid is the only occasion that the approximation $[H^+] = [X^-]$ can be made.

3 marks awarded.

STUDENT B

0 6 . 3 The value of the acid dissociation constant (K_a) for benzenecarboxylic (benzoic) acid (C_6H_5COOH) is 6.31×10^{-5} mol dm^{-3}

Calculate the pH of a 0.0120 mol dm^{-3} solution of this acid.
Give your answer to two decimal places.

[3 marks]

$\cancel{K_a = [H^+][A^-]}$

$$ka = \frac{[C_6H_5COO^-][H^+]}{[C_6H_5COOH]}$$

$$ka = \frac{[H^+]^2}{[C_6H_5COOH]} \qquad 6.31 \times 10^{-5} = \frac{[H^+]^2}{[0.0120]}$$

$$[H^+] = \sqrt{6.31 \times 10^{-5} \times 0.012} = 8.7 \times 10^{-4}$$

$$pH = -\log[8.7 \times 10^{-4}] = 3.06$$

pH 3.06

EXAMINER COMMENTARY

In each step this student has clearly shown what they are calculating.

3 marks awarded.

QUESTION

06.4

0 6 . 4 1.09 g of sodium benzenecarboxylate (C_6H_5COONa) is added to 200 cm^3 of a 2.4×10^{-3} mol dm^{-3} solution of benzenecarboxylic acid.

Calculate the pH of the buffer solution produced.

$M_r(C_6H_5COONa) = 144.0$

[5 marks]

MARK SCHEME

Question	Marking guidance	Mark	Comments
06.4	M1 $[H^+] = \dfrac{Ka \times [HA]}{[A]}$	1	May be shown later with numbers
	M2 Moles C_6H_5COONa = 1.09 / 144 = 7.569 x 10^{-3}	1	
	M3 $[C_6H_5COO^-]$ = 7.569 x 10^{-3} / (200/1000) = 0.03785	1	
	M4 $[H^+]$ = 6.31 x 10^{-5} x 2.4 x 10^{-3} / 0.03785 (= 4.001 x 10^{-6})	1	
	M5 pH (= - $\log_{10}$ 4.001 x 10^{-6}) = <u>5.40</u>	1	Must be to 2 decimal places

STUDENT A

0 6 . 4 1.09 g of sodium benzenecarboxylate (C_6H_5COONa) is added to 200 cm^3 of a 2.4 × 10^{-3} mol dm^{-3} solution of benzenecarboxylic acid.

Calculate the pH of the buffer solution produced.

M_r (C_6H_5COONa) = 144.0

[5 marks]

moles of A^- ⇒ $\frac{1.09}{144} = 7.569 \times 10^{-3}$ mol

moles of HA ⇒ $2.4 \times 10^{-3} \times \frac{200}{1000} = 4.8 \times 10^{-4}$ mol

$[A^-]$ ⇒ $\frac{7.569 \times 10^{-3}}{200 \div 1000} = 0.0378$ mol dm^{-3}

$[HA]$ ⇒ $\frac{4.8 \times 10^{-4}}{200 \div 1000} = 2.4 \times 10^{-3}$ mol dm^{-3}

$$Ka = \frac{[H^+][A^-]}{[HA]}$$

$$6.31 \times 10^{-5} = \frac{[H^+][0.0378]}{[2.4 \times 10^{-3}]}$$

$$[H^+] = \frac{[6.31 \times 10^{-5}][2.4 \times 10^{-3}]}{[0.0378]} = 4 \times 10^{-6}$$

$$pH = -\log[4 \times 10^{-6}] = 5.40$$

pH 5.40

EXAMINER COMMENTARY

The concentration of the acid was given (2.4 x 10^{-3}) and students were expected to calculate the concentration of the salt produced when 1.09 g was dissolved into 200 cm^3 of solution.
This student has failed to appreciate the information provided; in steps 2 and 4 has calculated the number of moles of acid and then the concentration! There is no loss of credit for this, although the student would have wasted time carrying this out. The working is clear and each step well set out.

5 marks awarded.

STUDENT B

0 6 . 4 1.09 g of sodium benzenecarboxylate (C_6H_5COONa) is added to 200 cm^3 of a 2.4×10^{-3} mol dm^{-3} solution of benzenecarboxylic acid.

Calculate the pH of the buffer solution produced.

M_r (C_6H_5COONa) = 144.0

[5 marks]

Do not write outside the box

moles of $C_6H_5COONa = \frac{1.09}{144} = 7.57 \times 10^{-3}$

moles of acid $= \frac{200}{1000} \times 2.4 \times 10^{-3} = 4.8 \times 10^{-4}$

$$K_a = \frac{[H^+][C_6A^-]}{[HA]}$$

$$[H^+] = \frac{K_a \times [HA]}{[A^-]}$$

$$[H^+] = \frac{6.31 \times 10^{-5} \times (2.4 \times 10^{-3})}{(4.8 \times 10^{-4} \div \frac{100}{1000})}$$

$$[H^+] = 63.1 \times 10^{-6}$$

$$-\log(63.1 \times 10^{-6})$$

$$= 4.20$$

pH 4.20

EXAMINER REPORT

Frequent incomplete and confusing working showed that most students were not secure in calculating pH of buffer solutions.
This student has calculated the number of moles of acid and not realised that concentration is required and is provided in the question.
In the rearranged equation for K_a this student has used their value for moles (acid) for both [HA] and [A^-]; these have cancelled each other out.

2 marks awarded.

FURTHER GUIDANCE AND CONTACTS

You can contact the subject team directly at **english@oxfordaqaexams.org.uk**

Please note: We aim to respond to all email enquiries within two working days.

Our UK office hours are Monday to Friday, 8am – 5pm local time.

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