National 5 Chemistry – Question Paper 2017

Question 2 (c)

(c) Calculate the number of moles of hydrogen that, researchers claim, can be stored by one litre of this structure. **2**

Show your working clearly.

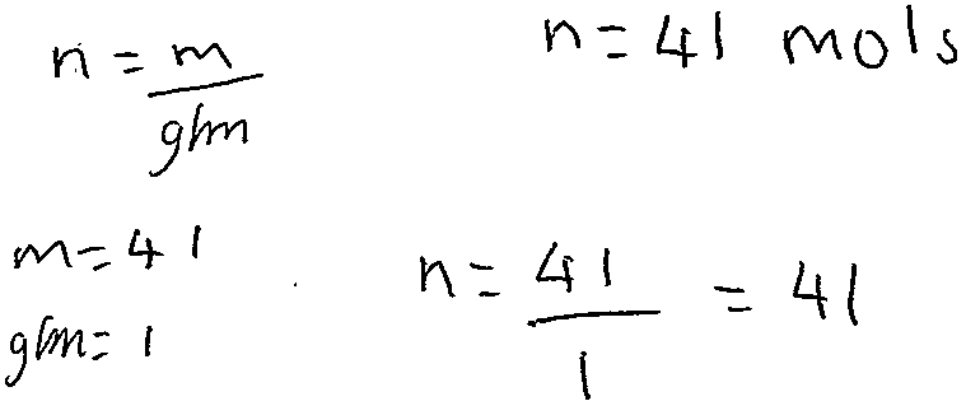
National 5 Chemistry – Course Report 2017

Comments on candidate performance

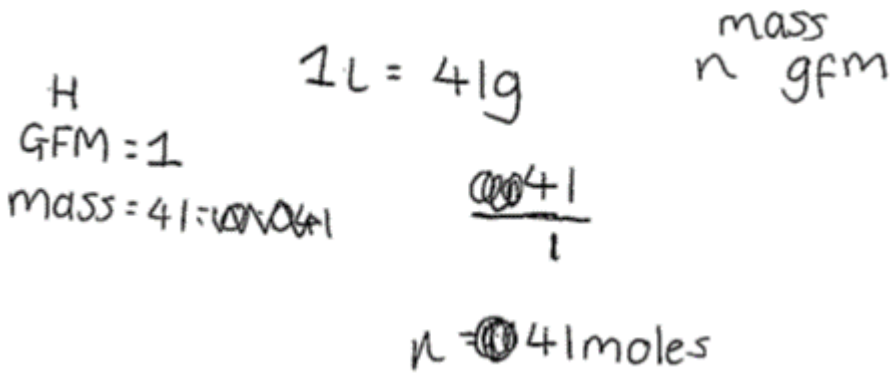
Question 2 (c)

Some candidates had difficulty using information in a passage to calculate the number of moles of hydrogen. Common incorrect answers included dividing 41 by 1 rather than the gfm of H_2 as 2 or multiplying the mass by the gfm.

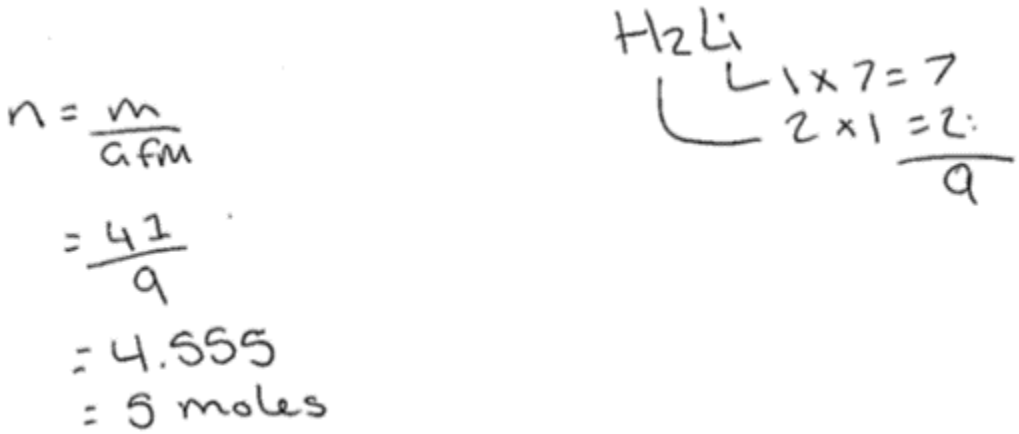
Candidate A



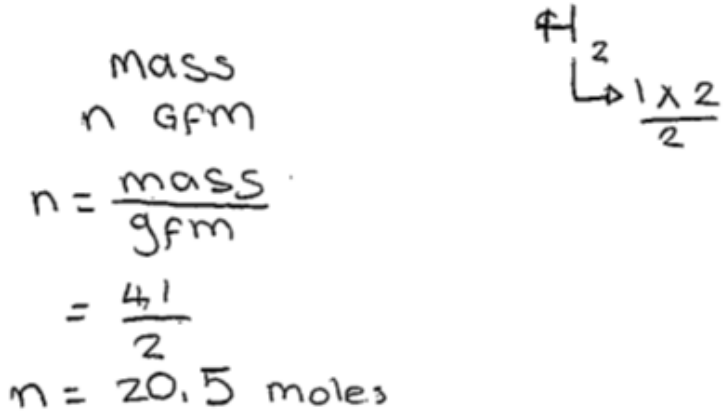
Candidate B



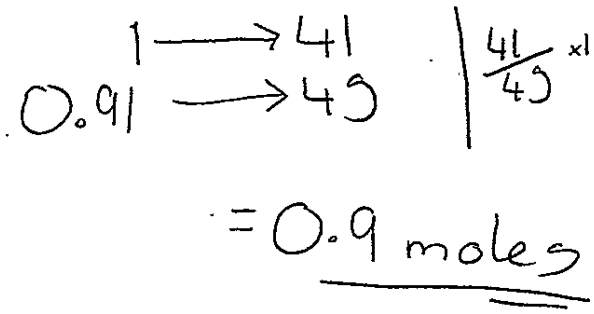
Candidate C



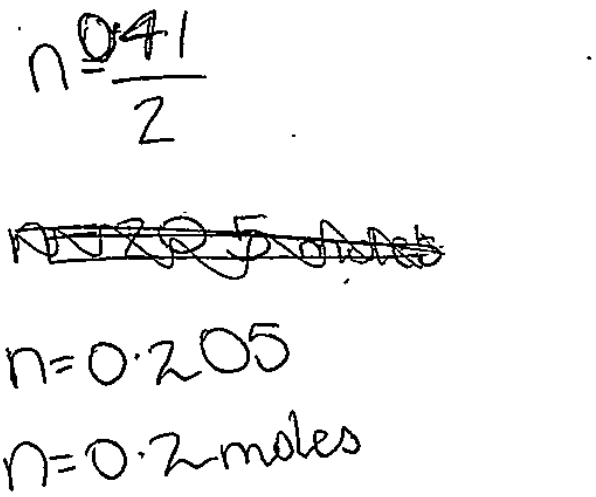
Candidate D



Candidate E



Candidate F



National 5 Chemistry – Question Paper 2017

Question 3 (a)

Chlorine can form covalent and ionic bonds.

(a) Chlorine gas is made up of diatomic molecules.

Draw a diagram, showing all outer electrons, to represent a molecule of chlorine, Cl_2. 1

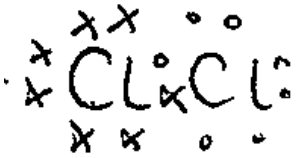
National 5 Chemistry – Course Report 2017

Comments on candidate performance

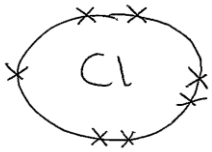
Question 3 (a) - No comment written in report

Candidate A

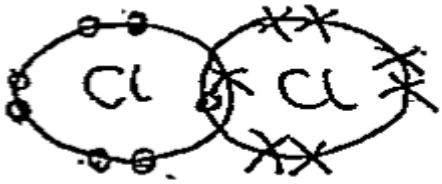
Candidate B



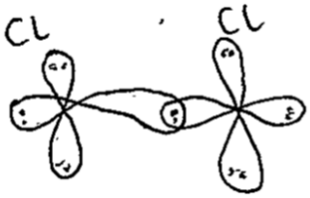
Candidate C



Candidate D



Candidate E



National 5 Chemistry – Question Paper 2017

Question 3 (c)

(c) When chlorine reacts with sodium the ionic compound sodium chloride is formed.

A chloride ion has a stable electron arrangement.

Describe how a chlorine atom achieves this stable electron arrangement. 1

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 3 (c)

Some candidates had difficulty describing how a chlorine atom achieves a stable electron arrangement. Common incorrect answers included it shared an electron with sodium or that it gained electrons.

Candidate A

chlorine needs ~~are~~ more electron to get a full outer shell and sodium needs to get rid of one so chlorine gains sodiums electron giving chlorine a stable electron arrangemeant and a 1- charge.

Candidate B

Chlorine has ~~one~~ 7 outer electron whereas sodium has 1 and so ~~to~~ for both to become stable, sodium loses an electron and gives it to the chloride ion making both stable.

Candidate C

Chlorine atom ~~received~~ receives one electron from the sodium atom so that it has 8 outer electrons rather than 7.

Candidate D

As sodium has 1 outer electron and chlorine has 7 sodium loses its outer electron to complete its outer shell this electron also completes chlorines outer shell.

National 5 Chemistry – Question Paper 2017

Question 4 (a) (ii)

(a) (continued)

(ii) Explain why the temperature at the bottom of the blast furnace should not drop below 1538 °C. 1

You may wish to use the data booklet to help you.

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 4 (a) (ii) - No comment written in report

Candidate A

The melting point of iron is 1538°C
If the temperature drops below 1538°
the iron will be solid.

Candidate B

As 1538°C is the melting point of
iron so any lower and the iron would
form a solid.

Candidate C

because Irons melting point is 1538°c
so the iron would begin to melt if
it went below this.

Candidate D

As the melting point of iron is 1538°C for iron to turn into a liquid which is necessary, so if it is below 1538°C the iron will not be able to flow off at the bottom of the furnace.

Candidate E

The metal iron would melt at 1538°C so it wouldn't be produced as a metal

National 5 Chemistry – Question Paper 2017

Question 4 (b)

(b) Rusting occurs when iron is exposed to air and water.

During rusting, iron initially loses two electrons to form iron(II) ions. These ions are further oxidised to form iron(III) ions.

Write an ion-electron equation to show iron(II) ions forming iron(III) ions. **1**

You may wish to use the data booklet to help you.

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 4 (b)

Some candidates had difficulty writing an ion-electron equation to show an iron(II) ion forming an iron(III) ion

Candidate A

$Fe^{2+} - e^- \longrightarrow Fe^{3+}$

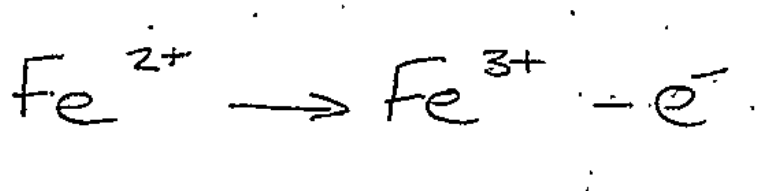
Candidate B

$Fe \longrightarrow Fe^{2+} + e^-$

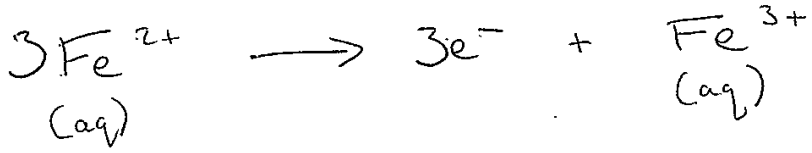
Candidate C

$Fe^{2+}(aq) \longrightarrow Fe^{3+}(aq) + e^-$

Candidate D



Candidate E



National 5 Chemistry – Question Paper 2017

Question 5 (a) (ii)

(ii) Using your answer to part (a) (i), calculate the time, in days, it would take for the mass of a 20 g sample of the radioisotope to decrease to 2·5 g. **2**

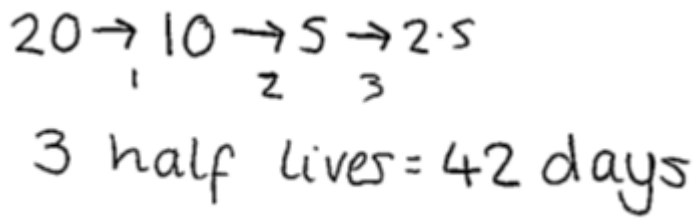
National 5 Chemistry – Course Report 2017

Comments on candidate performance

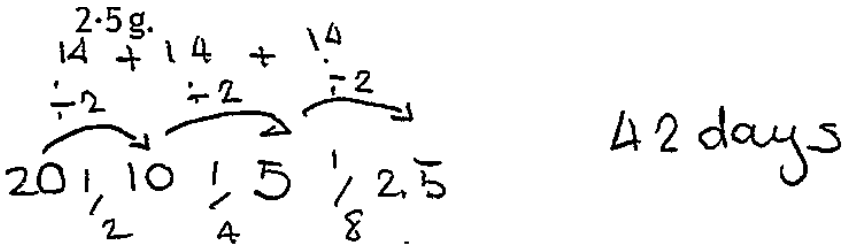
Question 5 (a) (ii)

Most candidates could calculate the time it would take for the mass of a 20g sample of a radioisotope to decrease to 2·5 g.

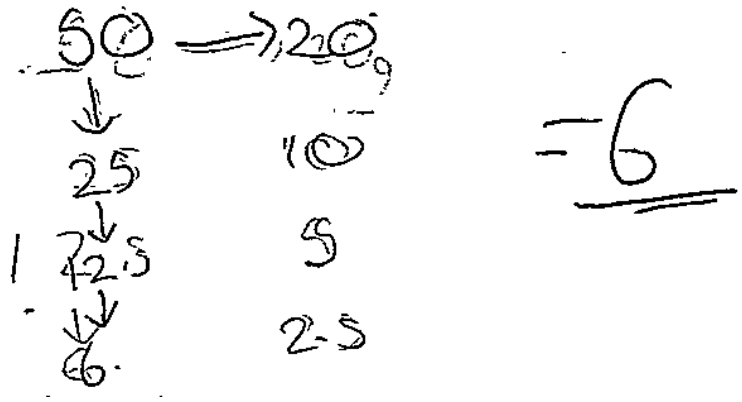
Candidate A



Candidate B

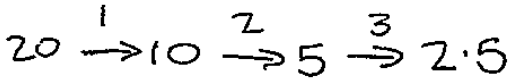


Candidate C



Candidate D

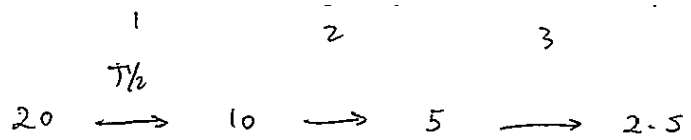
The candidate answer to 5a (i) is 100 days



3 half lifes

100 x 3 = 300 days

Candidate E



3 x 14 = 42

National 5 Chemistry – Question Paper 2017

Question 7 (b) (i)

7. Carboxylic acids can be used in household cleaning products.

(a) Name the functional group found in all carboxylic acids. 1

(b) Carboxylic acids have a range of physical and chemical properties. Melting point is an example of a physical property.

The table gives information about propanoic acid and butanoic acid.

Carboxylic acid	*Melting point* (°C)
propanoic acid	–21
butanoic acid	–5

(i) Draw a structural formula for butanoic acid. 1

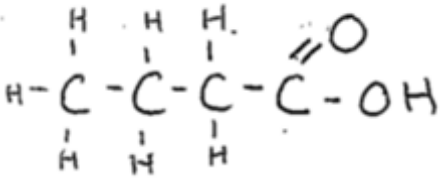
National 5 Chemistry – Course Report 2017

Comments on candidate performance

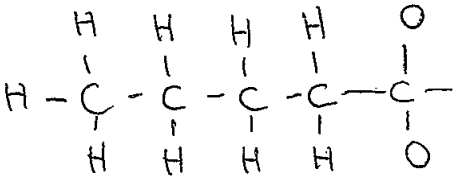
Question 7 (b) (i)

Many candidates had difficulty drawing a structural formula for butanoic acid.

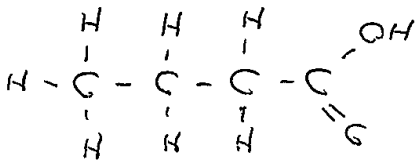
Candidate A



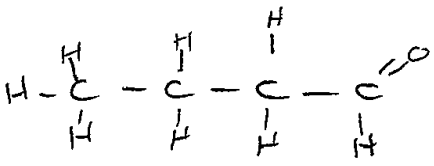
Candidate B



Candidate C



Candidate D



National 5 Chemistry – Question Paper 2017

Question 7 (b) (ii)

7. Carboxylic acids can be used in household cleaning products.

(ii) Explain why butanoic acid has a higher melting point than propanoic acid. 2

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 7 (b) (ii)

Many candidates had difficulty explaining why butanoic acid has a higher melting point than propanoic acid. Very few candidates were able to explain this in terms of stronger intermolecular bonding, with many candidates only stating that butanoic acid is a larger molecule. Another common incorrect answer referred to strong bonds within the molecule.

Candidate A

As it contains more carbon-carbon bonds which need to be broken, for it to melt.

Candidate B

because there is more carbons and hydrogens so it takes longer for them to melt.

Candidate C

As more bonds are required to break in butanoic acid compared to propanoic acid. Therefore more energy is required to break these bonds.

Candidate D

as it has more carbon chains between the molecules.

Candidate E

It has a longer carbon chain. This means the intermolecular forces are greater ~~making~~ and harder to break, so the melting point is higher.

National 5 Chemistry – Question Paper 2017

Question 9 (a)

9. The alkanes are a homologous series of saturated hydrocarbons.

(a) State what is meant by the term homologous series. 1

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 9 (a)

Some candidates had difficulty stating the meaning of the term homologous series. Some candidates stated that it was a family of compound with the same molecular or structural formula and/or same physical properties.

Candidate A

homologous series is different groups or families which have different properties.

Candidate B

A ~~pair~~ set of hydrocarbons with similar chemical properties

Candidate C

A group of Compounds with the same General ~~Formula~~ formula ~~or~~ and similar chemical properties.

National 5 Chemistry – Question Paper 2017

Question 9 (c) (i)

(i) Write a general statement linking the structure of the alkane to the length of time taken to pass through the column. 1

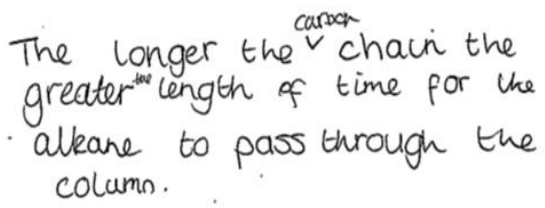
National 5 Chemistry – Course Report 2017

Comments on candidate performance

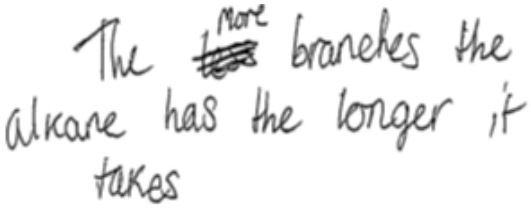
Question 9 (c) (i)

Most candidates could write a general statement linking the structure of an alkane to the length of time taken to pass through a column using a separation technique called HPLC.

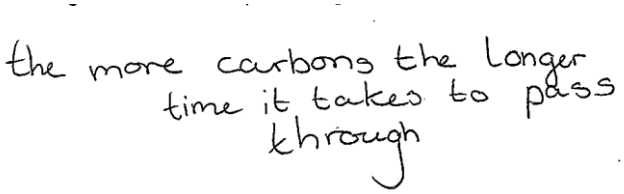
Candidate A



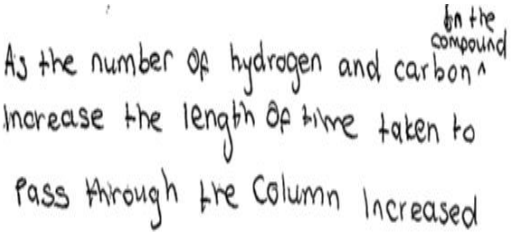
Candidate B



Candidate C



Candidate D



National 5 Chemistry – Question Paper 2017

Question 10 (a) (i)

10. A student set up an electrochemical cell using aluminium and copper electrodes as well as aluminium sulfate solution and copper(II) sulfate solution.

(a) (i) Complete the labels on the diagram to show the electrochemical cell which would give the direction of electron flow indicated. 1

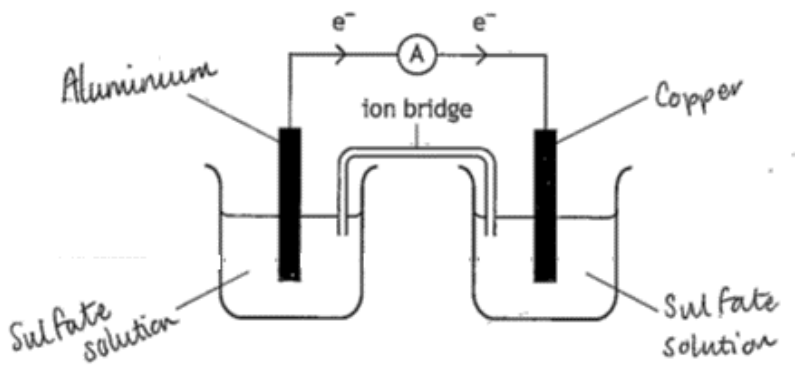
National 5 Chemistry – Course Report 2017

Comments on candidate performance

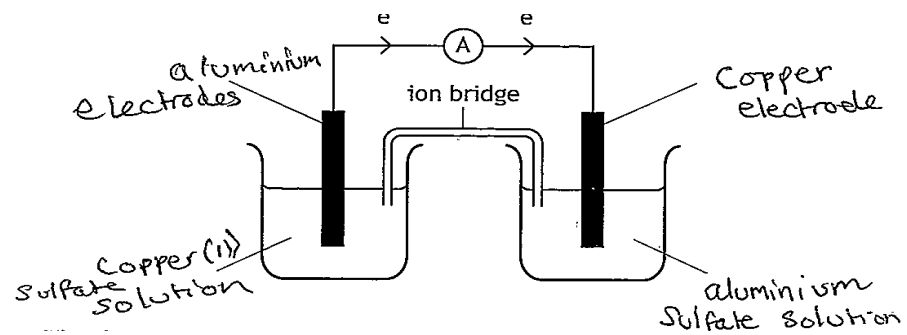
Question 10 (a) (i)

Most candidates had difficulty completing the labels on the diagram to show the electrochemical cell which would give the direction of electron flow indicated. A common incorrect answer was the label for each solution placed in the incorrect position.

Candidate A



Candidate B



National 5 Chemistry – Question Paper 2017

Question 10 (a) (ii)

(ii) The two reactions which take place in the cell are

$$Al(s) \longrightarrow Al^{3+}(aq) + 3e^-$$
$$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$$

Write the redox equation for the overall reaction. 1

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 10 (a) (ii) - No comment in course report

Candidate A

$2Al(s) + 3Cu^{2+}(aq) \longrightarrow 2Al^{3+}(aq) + 3Cu(s)$

Candidate B

$Al(s) + Cu^{2+} \longrightarrow Al^{+}(aq) + Cu(s)$

Candidate C

$3Cu^{2+} + 6Al \longrightarrow 6Cu + 2Al^{3+}$

Candidate D

$Al(s) + Cu^{2+}(aq) \longrightarrow Al^{3+}(aq) + Cu(s)$

National 5 Chemistry – Question Paper 2017

Question 11 (a)

11. Sulfur dioxide is an important industrial chemical.
Sulfur dioxide dissolves in water to produce sulfurous acid.

$$SO_2(g) + H_2O(\ell) \longrightarrow H_2SO_3(aq)$$

(a) Explain the change in the pH of the solution as sulfur dioxide dissolves. 2

National 5 Chemistry – Course Report 2017

Comments on candidate performance

Question 11 (a)

Many candidates had difficulty explaining the change in pH as sulfur dioxide dissolves in water to produce sulfurous acid. Some could state that the pH would decrease but were not able to explain this in terms of a higher concentration of H^+ ions.

Candidate A

as the sulfur dioxide dissolves the pH will move towards 7. It will go from 1 towards 7. as it is an acid being diluted. H^+ ions being diluted by OH^- ions.

Candidate B

The pH will decrease from 7.

Candidate C

pH would increase closer to 7 as water dilutes and neutralises the acid

Candidate D

The pH moves towards below 7 as it becomes an acid, and so the pH changes to below 7

Candidate E

The pH of the solution decreases as non-metal oxides dissolve in water to produce acids. The addition of H^+ ions makes the solution more acidic

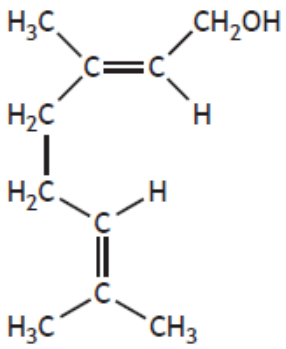
Candidate F

The pH decreases as the sulfur dioxide increases the number of hydrogen atoms in the water, making it acidic.

National 5 Chemistry – Question Paper 2017

Question 12 (a)

12. Geraniol is an essential oil known to have anti-inflammatory properties. A structure for the geraniol molecule is shown.



(a) Circle a functional group found in the geraniol molecule. 1

National 5 Chemistry – Course Report 2017

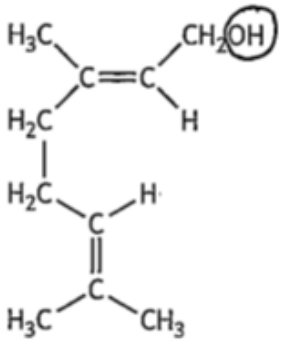
Comments on candidate performance

Question 12 (a)

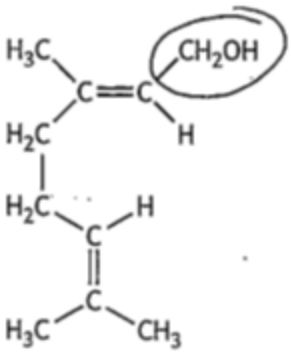
Some candidates had difficulty circling a functional group in a given structure.

Many candidates circled CH_2OH rather than OH or C=C.

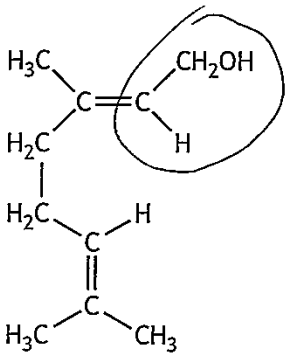
Candidate A



Candidate B



Candidate C



National 5 Chemistry – Question Paper 2017

Question 12 (c)

(c) A student prepared a sample of geranyl propanoate from geraniol and propanoic acid.

geraniol	+	propanoic acid	⟶	geranyl propanoate	+	water
$C_{10}H_{18}O$	+	$C_3H_6O_2$	⟶	$C_{13}H_{22}O_2$	+	H_2O

15·4 g of geraniol was reacted with excess propanoic acid.

Calculate the mass, in grams, of geranyl propanoate which would be produced. 3

Show your working clearly.

National 5 Chemistry – Course Report 2017

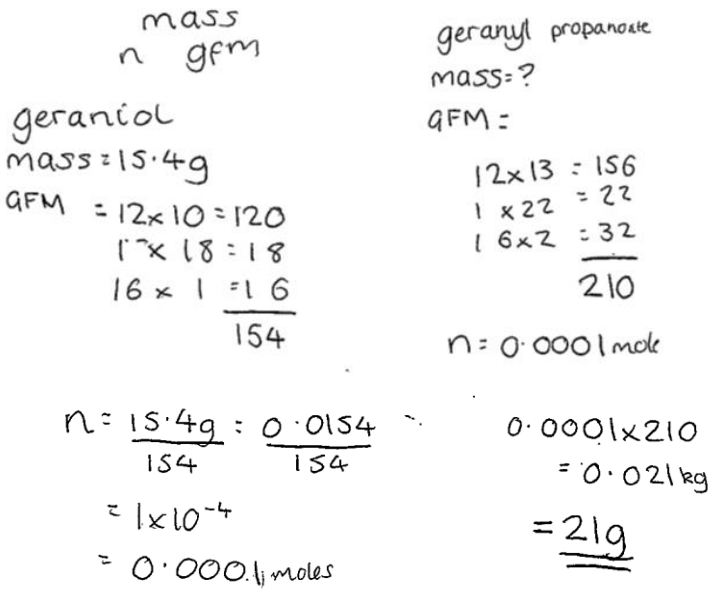
Comments on candidate performance

Question 12 (c)

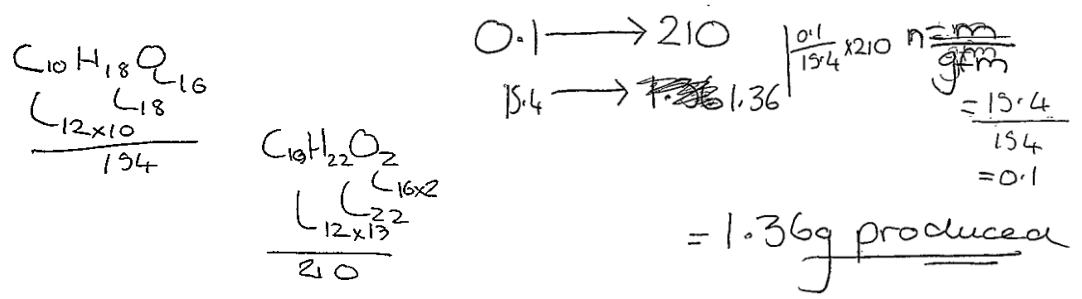
In all calculations worth more than 1 mark, candidates should be aware that credit will be given for the correct demonstration of chemical concepts or for intermediate results in a multiple-step calculation.

Candidates should be reminded that page 3 of the data booklet contains relationships which can be used for National 5 calculations.

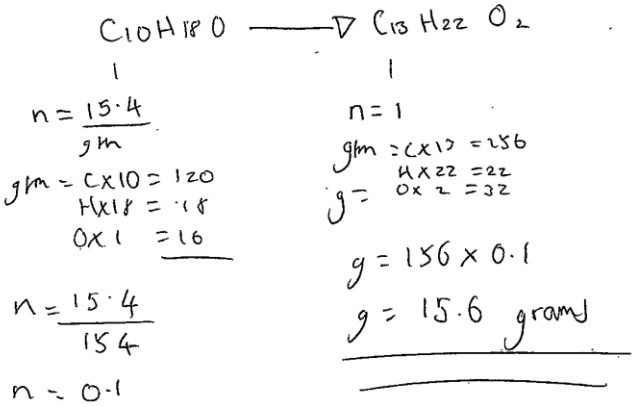
Candidate A



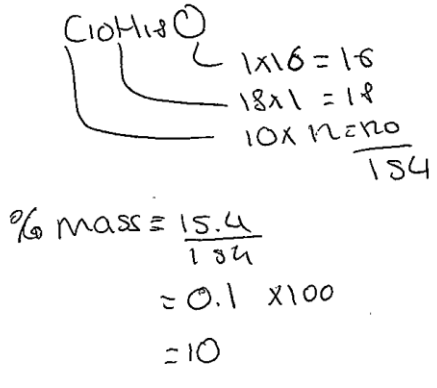
Candidate B



Candidate C



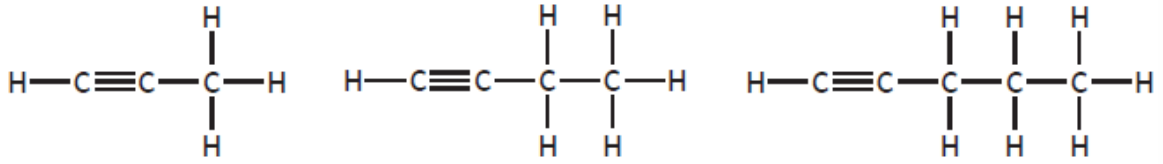
Candidate D



National 5 Chemistry – Question Paper 2017

Question 13 (a)

13. The alkynes are a family of hydrocarbons which contain a carbon to carbon triple bond. Three members of this family are shown.



propyne but-1-yne pent-1-yne

(a) Suggest a general formula for the alkyne family. 1

National 5 Chemistry – Course Report 2017

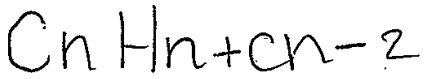
Comments on candidate performance

Question 13 (a)

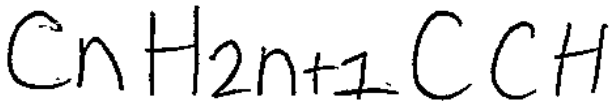
Some candidates had difficulty writing a general formula for the alkyne family given the full structural formulae for three alkynes.

Candidate A

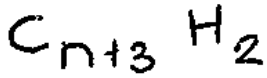
Candidate B



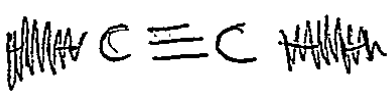
Candidate C



Candidate D



Candidate E

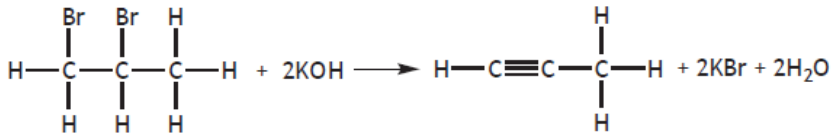


National 5 Chemistry – Question Paper 2017

Question 13 (c) (i)

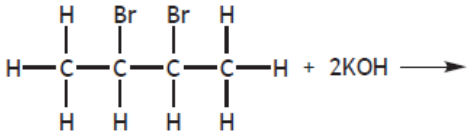
13. (continued)

(c) Alkynes can be prepared by reacting a dibromoalkane with potassium hydroxide solution.



1,2-dibromopropane propyne

(i) Draw the **full** structural formula for the alkyne formed when 2,3-dibromobutane reacts with potassium hydroxide. 1



2,3-dibromobutane

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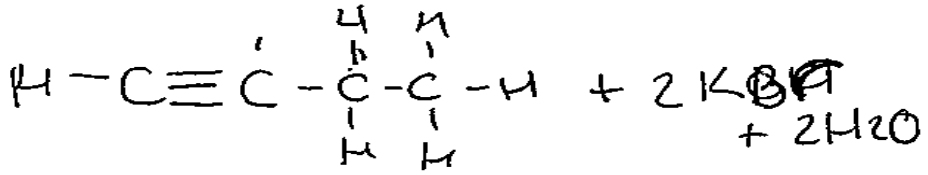
Comments on candidate performance

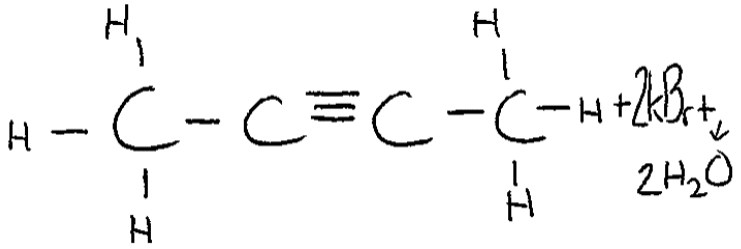
Question 13 (c) (i)

Many candidates had difficulty using information to draw the full structural formula for the alkyne formed when 2,3-dibromobutane reacts with potassium hydroxide. A common incorrect answer was the full structural formula for but-1-yne.

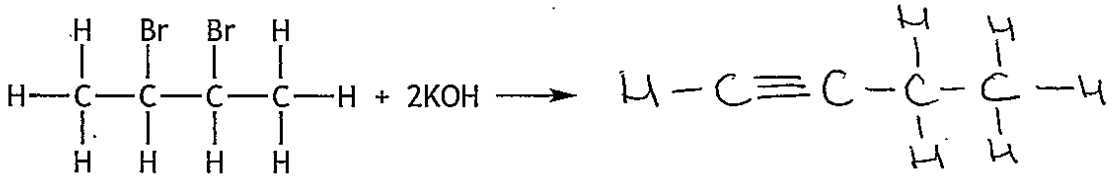
Candidate A



Candidate B



Candidate C



2,3-dibromobutane

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Question 14 (a) (i)

(i) Draw a structural formula for hexan-1-ol. 1

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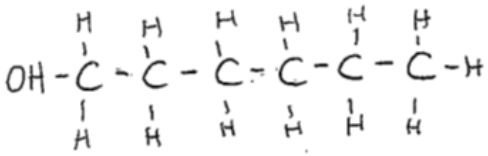
Comments on candidate performance

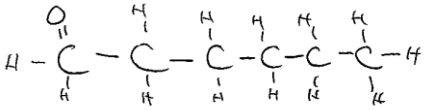
Question 14 (a) (i)

Some candidates had difficulty drawing a structural formula for hexan-1-ol. Many candidates did not draw the bond from the carbon to the oxygen of the OH group while others had the incorrect number of carbon atoms.

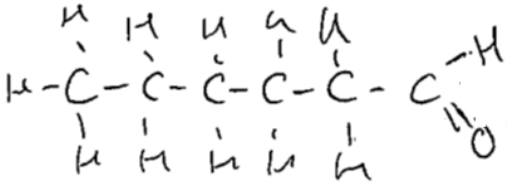
Candidate A



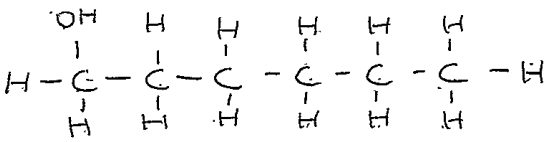
Candidate B



Candidate C



Candidate D



National 5 Chemistry – Question Paper 2017

Question 14 (b)

14. (continued)

(b) The energy released when an alcohol burns can be used to heat liquids other than water.

The data below was collected when the energy released, by burning an alcohol, was used to heat a sodium chloride solution.

Energy released when the alcohol was burned (kJ)	13·3
Initial temperature of sodium chloride solution (°C)	15
Final temperature of sodium chloride solution (°C)	49
Mass of sodium chloride solution heated (g)	100

Calculate the specific heat capacity, in $kJ\,kg^{-1}\,°C^{-1}$, of the sodium chloride solution. 3

You may wish to use the data booklet to help you.

Show your working clearly.

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Comments on candidate performance

Question 14 (b)

There has been an increase in candidate performance in calculations in the 2017 examination. In all calculations worth more than 1 mark, candidates should be aware that credit will be given for the correct demonstration of chemical concepts or for intermediate results in a multiple-step calculation.

Candidate A

$Eh = mc\Delta T$

$13300 = 0{\cdot}1 \times C \times 34$

$13300 = 3{\cdot}4 \times C$

$\frac{13300}{3{\cdot}4} = 3911{\cdot}76\ldots$

$= 3{\cdot}9\ kJ\,kg^{-1}\,°C^{-1}$

Candidate B

$Eh = cm\Delta T$

$Eh = 4.18 \times 100 \times 34$

$Eh = 1421.2\ KJkg^{-1}°C^{-1}$

Candidate C

$c = \frac{Eh}{m\Delta T} = \frac{13.3}{(0.1 \times 34)}$

$= 3.91\ kJkg^{-1}°C^{-1}$

Candidate D

$Eh = cm\Delta T$

$13.3 = C \times 0.1 \times 34$

$13.3 = C \times 3.4$

$C = \frac{13.3}{3.4}$

$C = 3.91\ kJkg^{-1}°C^{-1}$

Candidate E

$Eh = cm\Delta T$

$13.3 = C \times 0.01 \times 34$

$C = \frac{13.3}{0.01 \times 34}$

$C = 39.11764705882352 94$

$C = 39.1\ kJkg^{-1}°C^{-1}$