Markscheme

November 2017

Chemistry

On-screen examination

12 pages

The following are the annotations available to use when marking responses.

Annotation	Explanation	Shortcut	Annotation	Explanation	Shortcut
	Correct point, place at the point in the response where it is clear that the candidate deserves the mark	Alt+1		No benefit of the doubt	Alt+4
AEr	Arithmetic error		NEX	No explanation given	
	Benefit of the doubt	Alt+3		Not good enough	
	Omission, incomplete	Alt+7		Not worthy of any marks	
CON	Contradiction	Alt+6	NWS	No working shown	
	Valid part (to be used when more than one element is required to gain the mark)			Test box used for additional marking comments	
	Error carried forward	Alt+8		Unclear	Alt+2
	Dynamic annotation, it can be expanded to surround work			Seen; must be stamped on all blank response areas	Alt+9
	Horizontal wavy line that can be expanded			Vertical wavy line that can be expanded	
	Highlight tool that can be expanded to mark an area of a response			Words to that effect	
	Not answered the question			Award 1, 2, 3, 4 marks. For use in holistically marked questions only	

Markscheme instructions

1 Mark positively. Give candidates credit for what they have achieved and what is correct. Do not deduct marks for incorrect responses.

2 Follow the markscheme provided and award only whole marks.

3 Each marking point appears on a separate line.

4 The maximum mark for each subpart is indicated in the "Total" column.

5 Where a mark is awarded a tick should be placed in the text at the precise point where it is clear the candidate deserves the mark.

6 Each marking point in a question part should be awarded separately unless there is an instruction to the contrary in the Notes column.

7 A question subpart may have more marking points than the total allows. This will be indicated by the word "**max**" in the Answer column. Further guidance may be given in the Notes column.

8 Additional instructions on how to interpret the markscheme are in bold italic text in the Answer column.

9 Alternative wording may be indicated in the Answer column by a slash (/). Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

10 Alternative answers are indicated in the Answer column by "***or***". Either alternative is equally acceptable but the candidate cannot be rewarded for both as they are associated with the same marking point.

11 If two related points are required to award a mark, this is indicated by "***and***" in the answer column.

12 Words in brackets ( ) in the Answer column are not necessary to gain the mark.

13 Words that are <u>underlined</u> are essential for the mark.

14 In some questions a reverse argument is also acceptable. This is indicated by the abbreviation *ORA* (or reverse argument) in the Notes column. Candidates should not be rewarded for reverse arguments unless *ORA* is given in the Notes column.

15 If the candidate's response has the same meaning or is clearly equivalent to the expected answer the mark should be awarded. In some questions this is emphasized by the abbreviation *WTTE* (words to that effect) in the Notes column.

16 When incorrect answers are used correctly in subsequent question parts the follow through rule applies. Award the mark and add *ECF* (error carried forward) to the candidate response.

17 The order of marking points does not have to be the same as in the Answer column unless stated otherwise.

18 Marks should not be awarded where there is a contradiction in an answer. Add *CON* to the candidate response at the point where the contradiction is made.

19 Do not penalize candidates for errors in units or significant figures unless there is specific guidance in the Notes column.

20 Questions with higher mark allocations will generally be assessed using a level response method using task specific clarifications developed with reference to the criteria level descriptors. A candidate's work should be reviewed to determine holistically the mark for each row of the holistic grid and a mark awarded for each row.

<table>
<tr><th colspan="2">Question</th><th>Answers</th><th>Notes</th><th>Total</th><th>Criterion</th></tr>
<tr><td rowspan="7">1</td><td>a</td><td>group 4

period 6</td><td>Accept group 14</td><td>2</td><td>A</td></tr>
<tr><td>b</td><td>2PbS + 3O₂ →2PbO + 2SO₂
Reactants correct
Products correct

2PbO + C → 2Pb + CO₂
Reactants correct
Products correct</td><td>Do not accept ? in place of a blank coefficient</td><td>4</td><td>A</td></tr>
<tr><td>c</td><td>SO_2 is formed

(which) contributes to the formation of acid rain

or

CO_2 is formed

(which) contributes to climate change</td><td>Do not accept “toxic” fumes as this is not specific enough</td><td>2</td><td>A</td></tr>
<tr><td>d</td><td>Any two from,
• electrical conductivity
• thermal conductivity
• malleability
• appearance</td><td>Any two

Do not accept high melting point for lead</td><td>2</td><td>A</td></tr>
<tr><td>e</td><td>(arsenic is a metalloid/semi-metal so) it would have different structure

different structure gives rise to different properties</td><td></td><td>2</td><td>A</td></tr>
<tr><td>f</td><td><table><tr><th>Isotope</th><th>Atomic Number</th><th>Atomic Mass</th><th>Protons</th><th>Electrons</th><th>Neutrons</th></tr><tr><td>^{65}As</td><td>33</td><td>65</td><td>33</td><td>33</td><td>32</td></tr><tr><td>^{70}As</td><td>33</td><td>70</td><td>33</td><td>33</td><td>37</td></tr></table></td><td></td><td>2</td><td>A</td></tr>
<tr><td>g</td><td>Same electron configuration

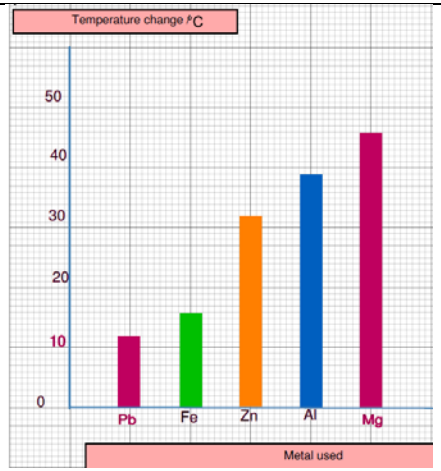
(So) the different isotopes will react in the same way</td><td>WTTE
only award the second mark if the first is given</td><td>2</td><td>A</td></tr>
</table>

2	**a**	How does the volatility of esters depend on the length of their hydrocarbon chain?	*WTTE – must relate to volatility of esters*	**1**	B
	b	If the length of the carbon chain increases (then) the volatility of the ester will reduce (because) the intermolecular forces are stronger	*WTTE* *ECF from part (a), accept a link between chain length and volatility* *Accept "bonds are stronger"*	**3**	B
	c	***Independent variable:*** ester ***or*** length of the carbon chain ***Dependent variable:*** time ***Control variables, any three reasonable variables (2 max) for example,*** • temperature • surface area • container size ***or*** shape • volume ***or*** mass • wind		**4**	B
	d	***low temperature:*** no heat added so avoids breakdown of the ester ***or*** position of equilibrium remains towards the right-hand side/shifts right ***dry:*** avoids adding water to the equilibrium mixture /no change in the concentration of water so avoids breakdown of the ester ***or*** so position of equilibrium remains towards the right hand side/shifts right (ORA)	*ORA* *Accept correct answers relating to intermolecular forces for the first two marking points*	**4**	A
	e	**A** ethanoic acid butanol		**3**	A

<table>
<tr><td>3</td><td>a</td><td colspan="2">C</td><td>1</td><td>C</td></tr>
<tr><td></td><td>b</td><td colspan="2">Thermometer or temperature probe</td><td>1</td><td>B</td></tr>
<tr><td></td><td>c</td><td colspan="2">
<table>
<tr><th></th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>Equipment</td><td>some equipment is listed</td><td>some equipment including a thermometer is listed</td><td>appropriate and complete equipment is listed: suitable solutions, thermometer or temperature probe, test tube, measuring cylinder</td></tr>
<tr><td>Variables</td><td>one control variable is stated</td><td>two control variables are stated</td><td></td></tr>
<tr><td>Method</td><td>attempt at a method</td><td>temperature is measured</td><td>some fine details of technique are included eg recording temperature only when stable, description of how to minimise heat loss</td></tr>
<tr><td>Measurements</td><td>one metal is investigated</td><td>more than two metals are investigated</td><td>all five metals are investigated</td></tr>
<tr><td>Sufficient data</td><td>appropriate number of trials</td><td>appropriate number of trials and plans to calculate averages</td><td></td></tr>
<tr><td>Safety</td><td>a safety precaution is stated</td><td>a safety precaution is stated and linked to hazard</td><td></td></tr>
</table>
</td><td>15</td><td>B</td></tr>
<tr><td></td><td>d</td><td colspan="2">Order: Lead – Iron – Zinc – Aluminium – Magnesium</td><td>1</td><td>C</td></tr>
</table>

all correct

<table>
<tr><td></td><td>e</td><td>the order of reactivity is based on the temperature rise

the larger the temperature change/rise the more reactive the metal is</td><td>WTTE</td><td>2</td><td>C</td></tr>
<tr><td></td><td>f</td><td>bar graph</td><td></td><td>1</td><td>C</td></tr>
<tr><td></td><td>g</td><td>
<table>
<tr><th>Metal added</th><th>Temperature change for the reaction / ºC</th></tr>
<tr><td>Aluminium</td><td>39</td></tr>
<tr><td>Iron</td><td>16</td></tr>
<tr><td>Lead</td><td>12</td></tr>
<tr><td>Magnesium</td><td>46</td></tr>
<tr><td>Zinc</td><td>32</td></tr>
</table>


labels for metal on the x axis

title linking temperature change to different metals

data for one metal correctly plotted

data for all metals plotted correctly

ºC</td><td></td><td>5</td><td>C</td></tr>
<tr><td></td><td>h</td><td>limited validity as results that produced once only are not reliable as errors may occur

more than one trial should be carried out to produce an average</td><td>WTTE</td><td>2</td><td>C</td></tr>
</table>

4	**A**	test with Lit splint/spill/stick gas burns with a (squeaky) pop (so it is hydrogen)	*Accept any reasonable alternative of splint*	**2**	A
	b	if the coin is 100 % copper (then) it will react the slowest (because) copper is the least reactive of these metals	*Accept "newer coins will react the fastest"*	**3**	B
	c	***Independent variable:*** the composition of the coin ***or*** date of coin ***Dependent variable:*** the volume of gas produced in a fixed time ***or*** the time taken to produce a fixed volume of gas ***Any two reasonable control variables (max 2), for example*** • temperature • concentration of acid • type of acid	*Do **not** award this mark for volume or time alone* *Do **not** accept pressure*	**4**	B
	d	***80s:*** date 1857-1864 ***100s:*** date 1857-1864 ***70s:*** date 1962-1982		**3**	C
	e	***Any three reasonable points, for example*** • the coins may not be the exact percentages as indicated in the chart • the results in the calibration graph were for averages and not specific coins • no repeats were possible so there may have been experimental errors • the collection of the gas was inaccurate		**3**	C
	f	destructive method so cannot keep the coin ***or*** cannot repeat results	*WTTE*	**2**	C

5	**a**	2.32183 x 10^4 g	*accept 2.32 x 10^4, 2.322 x 10^4, 2.3218 x 10^4*	**2**	D
	b	***Any three comments about the method, for example*** • method is destructive • the method is able to prove the metal is gold • no details of how the solution was measured • no safety precaution given • no repeats possible, method is not reproducible ***Comment about the validity of the result*** result is inconclusive ***or*** gold could be less than 24 k	*WTTE*	**4**	C
	c	***Any two evaluative points from the list below*** • react should be used rather than dissolve ***and*** concentrated should be used rather than strong • the hypothesis is invalid because gold is slow to react/unreactive • the relationship between the independent variable / purity of gold / number of Karat and dependent variable (concentration) is correct	*Allow use of concentration or strength for this last marking point*	**2**	C
	d	7.32 g		**2**	D
	e	7.32/7.89 X100 = 92.8% (to 3 significant figures)		**1**	C

<table>
<tr><td>6</td><td>a</td><td>Grey arrow = fuel + oxygen → carbon dioxide + water
Red arrow = glucose + oxygen → carbon dioxide + water
Green arrow = carbon dioxide + water → glucose + oxygen

one correct label

all labels correct</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>b</td><td>correct answer 0.44

correct unit ºC</td><td></td><td>2</td><td>C</td></tr>
<tr><td></td><td>c</td><td colspan="2"><table>
<tr><th></th><th>1</th><th>2</th><th>3</th></tr>
<tr><td>Activity that increases the carbon footprint</td><td>An activity that increases the carbon footprint or production of emissions</td><td>A relevant activity that increases the emissions or increases carbon footprint</td><td>More than one relevant activity that increases the emission of gases or carbon footprint</td></tr>
<tr><td>Activity that decreases the carbon footprint</td><td>An activity that decreases the carbon footprint</td><td>A relevant activity that decreases the carbon footprint</td><td>More than one relevant activity that decreases carbon footprint</td></tr>
<tr><td>Impact on individual/ society</td><td>a general reference to the result of an activity of either an individual or society on the carbon footprint</td><td>a specific reference to the result of an activity of either an individual or society on the carbon footprint</td><td>a specific reference to the result of an activity of either an individual and society on the carbon footprint and justification</td></tr>
<tr><td>Explanations</td><td>incomplete scientific explanation</td><td>complete scientific explanations of impact on carbon footprint for activities that either increase or decrease the carbon footprint</td><td>complete scientific explanations of impact on carbon footprint for all activities that increase and decrease the carbon footprint</td></tr>
</table></td><td></td><td>12</td><td>D</td></tr>
</table>

7

	1	2	3	4
Environmental impact	an environmental impact	an environmental impact for both cars	an environmental impact for both cars with supporting data	
Running costs/ economic impact	an economic impact	an economic impact for both cars	an economic impact for both cars with explicit supporting data	
Fuel sustainability	a relevant comment about sustainability for a fuel	a relevant comment about sustainability one fuel with justification ***or*** a relevant comment about sustainability for both fuels	a relevant comment about sustainability for both fuels with justification for one	a relevant comment about sustainability for both fuels with justification for both
Usefulness of cars - range and refuelling	a relevant comment about usefulness	a relevant comment about usefulness for both cars referring to data	more than one relevant comment about usefulness for both cars with supporting data	more than one relevant comment about usefulness for both cars with explicit supporting data
Appraisal	a concluding appraisal linked to previous arguments	a concluding appraisal with some scientific justification	a concluding appraisal with complete and detailed scientific justification	

17 D