Markscheme

November 2016

Chemistry

On-screen examination

13 pages

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 (or 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.

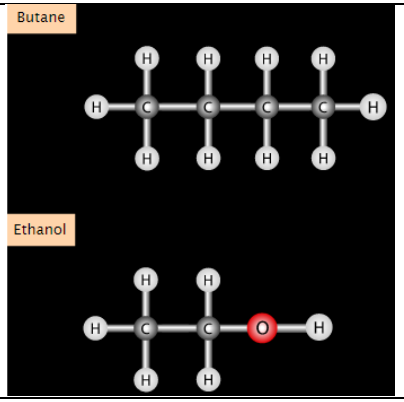
18 Marks should not be awarded where there is a contradiction in an answer. Add CON to the candidate response at the point where the contradiction is made.

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. Candidate's work should be marked using a best fit approach. A candidate's response should be reviewed to determine holistically the band in which the response falls. Once this has been determined, each bullet point within that band should be assessed to see if the candidate has met the requirements of the statement. Where those requirements are met, marks should be awarded, starting from the lowest available mark for that band.

Once this process has been completed if the highest (or lowest) mark available for that band has been determined, the examiner must check the band above (or below) to ensure that the initially correct determination of the band was correctly allocated. For example, there may be sufficient detail in the candidate's response to award the lowest mark of the band above.

NB. Marks are distributed unevenly across the mark bands as candidates have to include much more detail in their responses to access the highest mark bands.

Question		Answers	Notes	Marks	Criterion
1	a			**2**	A
	b	(butane:) alkane/hydrocarbon (ethanol:) alcohol / alkanol		**2**	A
	c	attempt to substitute into equation (energy released =) 147.488 kJ ***or*** 147 488 J (mass of ethanol = 147.488/30.0 =) 4.91626… answer given correctly to 3 sig figs 4.92 (g) unit of g/gram	 *Seen or implied* *Accept incorrect use of kJ for 3rd marking point* *Unit required* *Award unit mark separately*	**5**	A
	d	so 1 g releases 49.6 kJ ***or*** ethanol releases 1380 $kJmol^{-1}$ and butane release 2877$kJmol^{-1}$ butane is a better fuel for portable heaters because it releases more energy per gram ***or*** butane is a better fuel as it releases more energy per mole	*ECF from 1c* *WTTE*	**2**	A

<table>
<tr><td>2</td><td>a</td><td>
<table>
<tr><th></th><th>Property 1</th><th>Property 2</th></tr>
<tr><td>Aluminium</td><td>malleable</td><td>corrosion resistant</td></tr>
<tr><td>Carbon</td><td>high strength to weight ratio</td><td>does not react easily or rigid</td></tr>
</table>
</td><td>Accept the properties listed in any order for the correct element</td><td>4</td><td>C</td></tr>
<tr><td></td><td>b</td><td>Sc reacts with air or water</td><td></td><td>1</td><td>C</td></tr>
<tr><td></td><td>c</td><td>(adding scandium) increases

the yield strength</td><td></td><td>2</td><td>C</td></tr>
<tr><td>3</td><td>a</td><td>orange-red and bright red and green</td><td>All correct</td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td>energy/heat is released
or
release (much) more energy/heat than they absorb

(so) the reaction is exothermic</td><td>WTTE

Only award second mark if first is awarded</td><td>2</td><td>A</td></tr>
<tr><td></td><td>c</td><td>Cu (copper) or Fe (iron)</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>d</td><td>isotopes are atoms of the same element and have different number of neutrons/mass numbers
or
isotopes are atoms that have the same number of protons and have different number of neutrons/mass numbers</td><td></td><td>1</td><td>A</td></tr>
<tr><td></td><td>e</td><td>12 (neutrons)</td><td>Do not accept 12.31</td><td>1</td><td>A</td></tr>
<tr><td>4</td><td>a</td><td>air is mostly a combination of N_2 and O_2
or
air is a mixture of gases and mostly N_2

(and N_2 and O_2/molecules in air) are bigger or have a greater mass than He atoms
or
(and N_2 and O_2/molecules in air) move at a slower speed

(so) He molecules will diffuse through the balloon's membrane faster at the same temperature</td><td></td><td>3</td><td>A</td></tr>
</table>

	b	hot air rises ***or*** the density of warm air is less than the density of colder air (because) the kinetic energy of the molecules is greater in warm air (so) the same mass of gas has a bigger volume it is the lower density of the warm air inside the balloon that will make it float up in the sky		**4**	A
	c	the size of the bag increases/inflates (because) the external pressure decreases and the internal pressure is unchanged		**2**	A

5	**a**	• plans to test metal but incomplete details given • one relevant piece of equipment suggested	1-2		**18**	B
		• a dependent variable is suggested but measurement is qualitative only • metal identified as independent variable • two relevant pieces of equipment • attempt at a method but detail is insufficient for another student to follow	3-6			
		• a correct dependent variable identified and measurement is quantitative • metal identified as independent variable • a control variables identified with details of how it is controlled • at least two relevant pieces of equipment likely to generate quantitative data • method is described and could easily be followed by another student • care is needed with acids	7-12			
		• a correct dependent variable identified and measurement is quantitative • metal identified as independent variable • at least two control variables identified • control variables justified with details • complete details of equipment likely to generate quantitative data • complete method is described, fully explained and could easily be followed by another student • plans to repeat experiment and calculate average • care is needed with acids	13-18			

	b	needs to include all metals dependent variable – eg mass lost after set time, rate of production of gas unit for dependent variable included columns for repeats column for average calculation		**5**	C
6	**a**	<u>ion(s)</u>	*Do **not** accept positive ions*	**1**	A
	b	ions cannot move through the salt bridge ***or*** electrons cannot flow circuit is now broken / incomplete ***or*** no more charge exchange possible (so) the circuit is broken / incomplete	*ECF from part a* *Accept "no electricity can flow"*	**2**	B
7	**a**	Voltage / V 1.607 3.155 2.227 2.707 0.000 one value correctly recorded		**1**	B
	b	the bigger the difference in reactivity ***and*** the higher the cell potential	*Accept "further apart in the reactivity series"* *Accept "the elements become more reactive"*	**1**	B
	c	independent variable – metal in the positive half cell dependent variable – cell potential ***any two controlled variables, for example*** size of electrodes, surface area of the electrodes, volume of the electrolyte, concentration of the electrolyte, temperature, pressure, <u>magnesium</u> in the negative/left half cell		**4**	B

	d	***Any four reasonable points, for example*** • non-standard conditions might have been used • different concentrations • the electrodes may not have been clean • the temperature might not have been constant • heat may have been lost		**4**	C
	e	***Any reasonable precaution, for example*** • eye protection should be worn • wash hands after experiment		**1**	B
	f	***Anode*** oxidation ***or*** electrons are lost electrons are lost ***and*** oxidation ***Cathode*** electrons are gained ***or*** reduction electrons are gained ***and*** reduction	*1 mark for correct identification of reduction and oxidation in terms of electron gain or loss wherever seen*	**2**	A
	g	metal atoms deposited at the cathode (so) mass of the cathode increases anode dissolves in the solution (so) mass of anode decreases	*no ECF*	**4**	C
8	**a**	(diluting the copper ions solutions) increases the cell voltage		**1**	C
	b	colour becomes paler fewer Cu^{2+} / copper ions are present Cu^{2+} / copper ions give the blue colour	 *Do **not** accept copper/Cu*	**3**	C
	c	(diluting the silver ions solutions) decreases the cell voltage		**1**	C
	d	$Cu(s) + 2Ag^{+}(aq) \rightarrow 2Ag(s) + Cu^{2+}(aq)$ reactants and products all correct no electrons shown correct balancing correct use of arrow rather than equilibrium sign ***and*** correct state symbols		**4**	D

9	**a**	the lower the temperature, the longer the time the charge is maintained	*WTTE*	**1**	B
	b	xy scatter graph selected		**1**	C
	c	70±5%	*Accept a range of % as long as the full range falls within 70±5 %*	**1**	C
	d	30±5 %	*Accept a range of % as long as the full range falls within 30±5 %*	**1**	C
	e	for the value at 50°C the estimate is valid because it falls within the data set/interpolation for the value at 80°C the estimate may be invalid because it falls outside the data set/extrapolation	*WTTE*	**2**	C

10	**a**	***Any reasonable answer, for example*** • countries not chosen are politically unstable • majority of countries not chosen are in the Southern hemisphere • poorer economic conditions / LEDC (less economically developed country) • identification of the fact that Olympic Games are hosted by rich/developed countries only • link between economics and (un)equal opportunities		**1**	D
	b	hydrogen ion concentration decreases iron oxide is a basic oxide/alkaline hydroxide ions react/neutralize with (some of) hydrogen ions in the water		**3**	A
	c	***a change in pH, for example*** living organisms in the water can survive only within a certain range of pH ***an effect of changing pH, for example*** change in pH / hydrogen ion concentration of water will cause many organisms to die ***a change in colour, for example*** the soil that gets washed into the water changes the clarity/colour of water causing less sunlight to penetrate ***an effect of change in clarity/colour, for example*** (this) affects the photosynthesis of aquatic plants poor visibility for aquatic animals reduced oxygen for fish	*WTTE*	**4**	D

<table>
<tr>
<td>11</td>
<td></td>
<td>
<table>
<tr><td>• brief account of an impact on either environment or community
• a comment about industrial process eg roads/noise/power demand/dust/technology</td><td>1–2</td></tr>
<tr><td>• brief account of an impact on environment
• brief account of an impact on community
• an account of the impact of an industrial process eg about roads/noise/power demand/dust/technology</td><td>3–5</td></tr>
<tr><td>• account of more than one impact on environment
• account of more than one impact on community
• more than one impact of an industrial process
• a detailed account of the impact of at least one industrial process eg about roads/noise/power demand/dust/technology supported with specific examples
• suggestion for the future unsupported by science</td><td>6–10</td></tr>
<tr><td>• account of more than one impact on environment
• account of one positive impact on community
• account of one negative impact on community
• a detailed account of the impact of more than one industrial process eg about roads/noise/power demand/dust/technology supported with specific examples
• consideration of tech that could be used to counter industrial impacts
• more than one suggestion for the future supported by science
• a concluding appraisal linking all the issues discussed previously</td><td>11–17</td></tr>
</table>
</td>
<td></td>
<td>17</td>
<td>D</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>Any reasonable points, for example max 4
• conserving finite raw materials
• conserving natural resources
• (conserving natural resources) for other uses
• reduction in CO_2 emissions/reduction in climate change
• reduction in waste as products are recycled/waste management
• reduction in waste material associated with mining
• reduced destruction of environment/habitats</td>
<td></td>
<td>4</td>
<td>D</td>
</tr>
</table>