MARKSCHEME

MAY 2016

MYP CHEMISTRY

ON-SCREEN EXAMINATION

16 pages

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 (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.

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. Examiners should consider every statement in the holistic grid and identify the most appropriate mark band corresponding to the Candidate's response. Once the mark band is identified, the final mark is determine using a best fit approach.

Question		Answers	Notes	Total	Crit
1	a	exothermic		1	A
	b	1 (mole) of iron reacts with 0.75 (mole) of oxygen ***or*** mole ratio of 4:3 ***and*** iron:oxygen 5.6g of iron=0.1 (mole) 0.075 (moles) of oxygen needed	*award 2 marks only for 0.075 (moles) of oxygen if no working, incomplete or incorrect working is shown*	3	A
	c	ionic (bonding) / electrovalent		1	A
	d	3+	*accept +3*	1	A
	e	aluminium (only) aluminium can lose three electrons /has three electrons in its outer shell / valency of three/forms an ion with a charge of 3+	*ecf from part 1d* *accept answer in terms of Na/Ca/C not having 3 outer electrons* *do **not** accept group 3/13 alone* *for ecf to apply in second marking point, the justification should agree with the element selected in the first marking point*	2	A

2	**a**	physical (process) no new bonds are formed between atoms in the substance ***or*** no new substance is formed ***or*** physical processes are reversible changes		**2**	A
	b	substance/solid/solute is added until no more dissolves (at a certain temperature) ***or*** until undissolved substance/solid/solute/deposit remains (at a certain temperature)	*WTTE* *accept references greater than the solubility product constant*	**2**	A
	c	heat the heat pack energy increases (so) the crystals dissolve	*WTTE*	**2**	A
	d	$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$ sodium hydroxide/NaOH correct reactants correct products correctly balanced	*Ignore one error in subscripts if all others are correct* *Award 4 marks for a correct chemical equation* *Award 1 mark only for a correct word equation* *Accept condensed formula* $C_2H_4O_2$ *Accept* $\rightleftharpoons$ *or* =	**4**	A

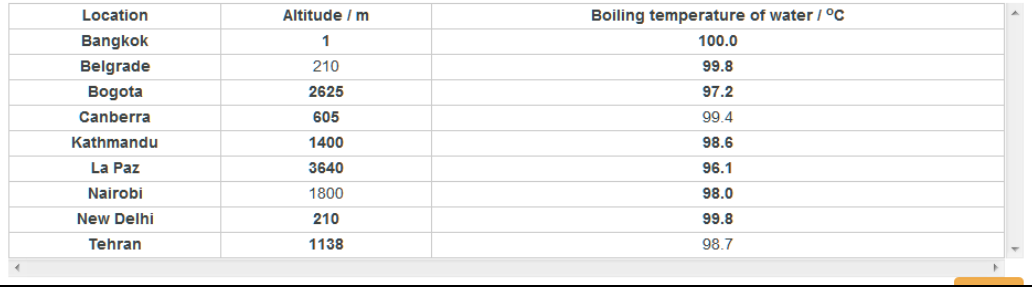
<table>
<tr><td>3</td><td>a</td><td>A problem associated with acid rain, for example
water ecosystem deterioration,
changes in the solubility of soil minerals
erosion by dissolution of monuments or building containing $CaCO_3$

<table><tr><td>• simple or incomplete statement</td><td>1</td></tr><tr><td>• complete statement
• chemistry mentioned but not in the context of the question</td><td>2-3</td></tr><tr><td>• detailed statement
• explicitly linked to relevant chemistry</td><td>4-5</td></tr><tr><td>• detailed statement
• fully explained using chemistry
• causes and effects explained in the context of acid rain</td><td>6-8</td></tr></table></td><td></td><td>8</td><td>B</td></tr>
<tr><td></td><td>b</td><td>a substance that speeds up a chemical reaction (is not used up/consumed in the reaction)</td><td>WTTE
accept “ hastens the reaction”</td><td>1</td><td>A</td></tr>
<tr><td></td><td>c</td><td>a catalyst gives a lower energy path for the reaction

because the Ea/energy barrier (is lower)
or
(by) providing an alternative reaction pathway
or
(by) altering the mechanism of the reaction</td><td>WTTE

accept more molecules have enough energy to react</td><td>2</td><td>A</td></tr>
<tr><td>4</td><td>a</td><td>ester</td><td>do not accept organic compounds</td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td>pentanol / pentan-1-ol</td><td>do not accept pentan-2-ol, pentan-3-ol</td><td>1</td><td>A</td></tr>
<tr><td></td><td>c</td><td>water</td><td>Do not accept H_20 because this is not the name</td><td>1</td><td>A</td></tr>
</table>

5	**a**	***liquid – gas - solid*** all correct		**1**	A
	b	melting the particles gain (kinetic) energy / particle movement increases (the particles) move further apart (than in the solid) ***or*** intermolecular forces weaken ***or*** intermolecular bonds break **or** entropy / disorder /S increases		**3**	C
	c	condensation the particles lose energy / particle movement decreases the particles get closer together compared to gas ***or*** intermolecular forces increase ***or*** intermolecular bonds form ***or*** entropy / disorder /S decreases		**3**	C
	d	no change in state the particles lose (kinetic) energy / movement of the particles decreases the particles get closer together compared to gas ***or*** intermolecular forces increase ***or*** intermolecular bonds form ***or*** entropy / disorder /S decreases		**3**	C

<table>
<tr><td>6</td><td>a</td><td>hydrogen/H and oxygen/O</td><td>not H_2 /O_2/ H_2O</td><td>1</td><td>A</td></tr>
<tr><td></td><td>b</td><td>Any two of the following [2 max]
• the point at which molecules escape from the surface
• increased molecular motion (compared to lower temperatures)
• because they have enough (kinetic) energy (to escape)
• bubbles of gas/vapour are produced</td><td></td><td>2</td><td>A</td></tr>
<tr><td></td><td>c</td><td>three marks for four correct values, two marks for three correct values, one mark for two correct values
 
<table>
<tr><th>Location</th><th>Altitude / m</th><th>Boiling temperature of water / °C</th></tr>
<tr><td>Bangkok</td><td>1</td><td>100.0</td></tr>
<tr><td>Belgrade</td><td>210</td><td>99.8</td></tr>
<tr><td>Bogota</td><td>2625</td><td>97.2</td></tr>
<tr><td>Canberra</td><td>605</td><td>99.4</td></tr>
<tr><td>Kathmandu</td><td>1400</td><td>98.6</td></tr>
<tr><td>La Paz</td><td>3640</td><td>96.1</td></tr>
<tr><td>Nairobi</td><td>1800</td><td>98.0</td></tr>
<tr><td>New Delhi</td><td>210</td><td>99.8</td></tr>
<tr><td>Tehran</td><td>1138</td><td>98.7</td></tr>
</table></td><td>accept ± 25 (m) for altitude

accept ±0.2 (°C) for temperature</td><td>3</td><td>C</td></tr>
<tr><td></td><td>d</td><td>a hypothesis linking the independent and dependent variables in the table in part c</td><td>accept an incorrect hypothesis for this mark</td><td>1</td><td>B</td></tr>
<tr><td></td><td>e</td><td>Variables:
independent: altitude/height/(atmospheric pressure)

Dependent: (boiling) temperature

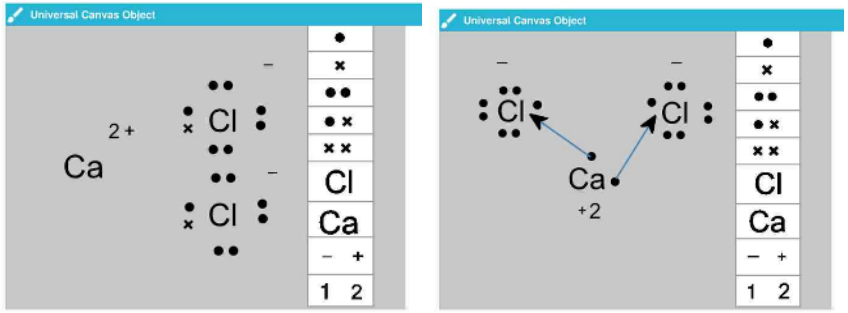
Any reasonable control variables [2 max], for example
• volume
• mass of water
• type of water
• container</td><td></td><td>4</td><td>B</td></tr>
</table>

<table>
<tr>
<td></td>
<td>f</td>
<td>
<table>
<tr><td>• includes equipment for measuring temperature or altitude
• attempts a method</td><td>1-2</td></tr>
<tr><td>• includes equipment for measuring temperature or altitude
• method includes details of one control variable
• diagram includes incomplete equipment
• care is needed with hot objects</td><td>3-6</td></tr>
<tr><td>• includes equipment for measuring temperature and altitude
• method includes details of more than one control variable
• diagram includes complete equipment not assembled correctly
• plans to repeat experiment
• care is needed with hot objects</td><td>7-11</td></tr>
<tr><td>• includes equipment for measuring temperature and altitude
• includes a statement of when a measurement should be made (boiling or steady temperature) and includes care is needed with hot objects
• method includes details of more than one control variable with justification for at least one
• diagram includes complete equipment assembled correctly
• plans to repeat experiment a minimum of three times and calculate average and a reference to range of data</td><td>12-16</td></tr>
</table>
</td>
<td></td>
<td>complete equipment list:
water
thermometer/temperature probe
heat source
container
GPS/altimeter/barometer
measuring cylinder or balance
tripod or clamp stand

accept measurement of pressure when this is correctly linked to altitude either in part d, part e or part f</td>
<td>16</td>
<td>B</td>
</tr>
</table>

7	**a**	***x axis:*** altitude (km) ***and y axis:*** O_2 (% / percent(age)) units included in both axis labels <u>all</u> numbers (in boxes) given in even increments on both axes ***plotting points*** four points plotted correctly (x±10, y ±0.5) all points plotted correctly (x±10, y ±0.5)	*accept incorrect use of brackets eg altitude (km)* *that is* *one mark for four correct,* *two mark for eight correct,* *points plotted correctly on inverted axes can score both marks*	**5**	C
	b	all data should not be included because of the trend ***reference to a correctly plotted graph in part a or the data in the table*** (because) the point at <u>500 (km)</u> is an outlier ***or*** because %O_2 at <u>500 (km)</u> is higher than expected ***or*** (it is possible that) the data at <u>500 (km)</u> was measured incorrectly	*WTTE* *do not accept "the data should be included" without relating it correctly to the trend*	**2**	C
	c	a hypothesis linking the percentage of oxygen with time for the flame to extinguish ***or*** a hypothesis linking the percentage of oxygen with time for the flame to extinguish change in water level	*do **not** accept altitude in place of oxygen* *accept an incorrect hypothesis for this mark*	**1**	B
	d	***independent variable:*** percentage of oxygen ***dependent variable:*** water level ***or*** time to extinguish the flame	*must be correctly linked to answer from part c*	**2**	B

	e	***accept any reasonable improvement, for example*** • use burette/ measuring cylinder • support the test tube • increase the volume of water		**1**	C
	f	***test:*** bubble gas through lime water/calcium hydroxide solution ***observation:*** calcium hydroxide solution turns milky/cloudy/white suspension ***conclusion:*** (so) CO_2 must be present	*WTTE* *award this mark independently*	**3**	C

8	**a**	correct reactants ***and*** products: $2CO_2(g) \rightarrow O_2(g) + 2CO(g)$ correct balancing correct states	*No credit for restating word equation* *all subscripts must be correct* *Accept* ⇌ *or* =	**3**	A
	b	oxygen is needed for life/breathing/respiration ***any additional point, for example [1 max]*** • processes using combustion • manufacturing • fuel		**2**	D
9	**a**	hypothesis is not supported by the data (because) not all of the salts contain a group one ion Ca/Mg are in group two (not in group one) ***or*** NH_4^+ ion is not in group one/it is a polyatomic/compound ion all the salts contain a chloride ion (so) the salty taste is caused by the chloride ion (present in each of the five salts)		**4**	C
	b	either diagram 1 ***or*** diagram 2  *Accept* x • *in any order on correct location.*		**1**	D

	c	evidence of a correct method e.g. number of neutrons for all isotopes seen in response (20, 22, 23, 24, 26) average = 23	*award 2 marks for correct answer if no working*	**2**	A

10	**a**	prevents the oxygen from reaching the fire ***or*** removes the oxygen. ***Any three further points [3 max] from*** • water has a lower boiling point that oil or grease • water is immiscible with oil or grease so the fire would float • the water would boil to produce steam which is a hazard • water conducts electricity so would be hazardous to use on an electrical fire	*accept any other reasonable and equally valid point to a maximum of 3*	**4**	D
	b	(the $NaHCO_3$)behaves as a base ***or*** removes H^+ ions ***or*** neutralizes the acid		**1**	D
	c	acid/H^+/hydronium ion reacts with OH^-/hydroxide/hydroxyl ions (which causes the) position of equilibrium shifts to the right ***or*** towards the products ***or*** the forward reaction is favoured amount/concentration of HCO_3^- decreases ***or*** OH^- decreases (so) amount/concentration of H_2CO_3 increases	*WTTE* *do **not** accept water decreases*	**4**	D

11	**a**	the gelatine / network is broken ***or*** melts above 15°C there is a large enough increase in (kinetic) energy to break the network ***or*** above 15°C there is enough molecular movement to break the network	*WTTE* *accept gelatine molecule/particle* *ignore references to water*	**2**	D
	b	***needed:*** citric acid ***and*** flavour ***and*** water ***not needed:*** adipic acid ***and*** colouring ***and*** gelatine	*ignore sugar regardless of which column it appears in*	**2**	D

	c	• a statement about additives in food • an attempt to link the use of additives with a limitation ***or*** benefit	1-2			**12**	D
		• a statement about a specified additive • an attempt to link the use of additives with a limitation ***and*** a benefit • an attempt at a social or ethical implication for an individual ***or*** a community	3-5				
		• a statement about a specified additive linked to either a social or an ethical implication • a relevant social or ethical implication for an individual ***or*** a community • a correct link to the limitations ***or*** benefits of the use of additives	6-8				
		• a statement about a specified additive linked to either a social or an ethical implication with scientific justification • a correct social or ethical impact on an individual ***and*** a community • a correct link to the limitations ***and*** benefits of the use of additives • a concluding appraisal linking all the issues discussed previously	9-12				