



GCSE

Chemistry B

Unit **B742/02**: Modules C4, C5, C6 (Higher Tier)

General Certificate of Secondary Education

Mark Scheme for June 2015

OCR (Oxford Cambridge and RSA) is a leading UK awarding body, providing a wide range of qualifications to meet the needs of candidates of all ages and abilities. OCR qualifications include AS/A Levels, Diplomas, GCSEs, Cambridge Nationals, Cambridge Technicals, Functional Skills, Key Skills, Entry Level qualifications, NVQs and vocational qualifications in areas such as IT, business, languages, teaching/training, administration and secretarial skills.

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotation	Meaning
	correct response
	incorrect response
BOD	benefit of the doubt
NBOD	benefit of the doubt not given
ECF	error carried forward
	information omitted
I	ignore
R	reject
CON	contradiction
L1	Level 1
L2	Level 2
L3	Level 3

ADDITIONAL OBJECTS: You **must** assess and annotate the additional objects for each script you mark. Where credit is awarded, appropriate annotation must be used. If no credit is to be awarded for the additional object, please use annotation as agreed at the SSU.

When you open the script if the message appears that there are additional objects you must check these additional objects.

The additional objects are normally additional sheets of answers that must be marked. You should immediately link each extra answer with the appropriate question using the paper clip icon.

PLEASE ASK YOUR TEAM LEADER IF YOU DO NOT KNOW HOW TO DO THIS.

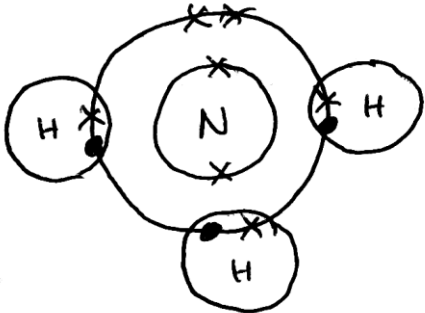
It is vitally important that all parts of the candidate's answer are marked.

15. Subject-specific Marking Instructions

Abbreviations, annotations and conventions used in the detailed Mark Scheme.

/	=	alternative and acceptable answers for the same marking point
(1)	=	separates marking points
allow	=	answers that can be accepted
not	=	answers which are not worthy of credit
reject	=	answers which are not worthy of credit
ignore	=	statements which are irrelevant
()	=	words which are not essential to gain credit
—	=	underlined words must be present in answer to score a mark (although not correctly spelt unless otherwise stated)
ecf	=	error carried forward
AW	=	alternative wording
ora	=	or reverse argument

Mark each blank page and the periodic table with the 'seen' annotation.

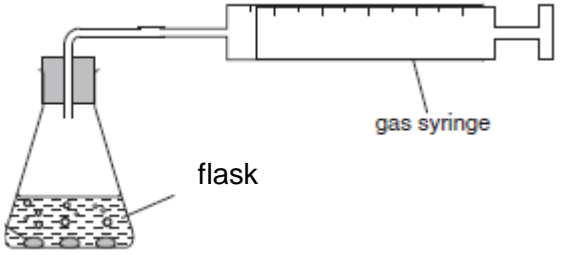
Question	Answer	Marks	Guidance
1 a i	W (1)	1	allow sodium / Na
ii	Z (1)	1	allow argon / Ar
iii	W and Y (1)	1	both required but order is unimportant allow sodium or Na and chlorine or Cl
b	<p>At least one pair of electrons shared correctly between nitrogen and hydrogen (1)</p> <p>remainder of structure correct (1)</p> 	2	<p>can use all dots or all crosses</p> <p>not ionic structures = 0 for the question</p> <p>allow Lewis diagrams i.e. without circles</p> <p>allow lone pair electrons as two single electrons</p> <p>ignore inner electrons on nitrogen</p>
c	<p>solid – ions not free / ions cannot move / ions held in a lattice / ions in a giant structure (1)</p> <p>dissolved in water – ions can move (1)</p>	2	<p>ignore electrons / particles cannot move in a solid</p> <p>allow has free ions</p> <p>not electrons can move in a liquid</p> <p>ignore particles can move in a liquid</p>
Total		7	

Question	Answer	Marks	Guidance
2 a		3	
	Chlorine atom		
	Number of protons		
	Number of neutrons		
	Number of electrons		
	chlorine - number of protons and number of neutrons correct (1) oxide ion – number of neutrons correct (1) - number of electrons correct (1)		
b	J J Thomson - discovered the electron (1) Bohr suggested - that electrons occupy orbits / electrons in shells / electrons in energy levels (1)	2	ignore reference to plum pudding model allow discovered that atoms have electrons not electrons were found in the nucleus / discovered that electrons orbit the nucleus / reference to ions not discovered neutrons or protons negative particles in shells is not sufficient allow reference to orbitals ignore reference to other aspects of atomic structure e.g. protons and neutrons
	Total	5	

Question	Answer	Marks	Guidance
3	<p>Level 3 Candidate applies knowledge to predict the name of both products AND predicts a reaction time for rubidium AND writes a correctly balanced symbol equation. Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>Level 2 EITHER Candidate applies knowledge to predict the names of both products AND predicts a reaction time for rubidium OR predicts a reaction time for rubidium AND attempts a symbol equation. Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 EITHER Candidate applies knowledge to predict the names of both products OR predicts a reaction time for rubidium and the name of one product OR candidate attempts a symbol equation. Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0marks)</p>	6	<p>This question is targeted at grades up to A*.</p> <p>Indicative scientific points may include:</p> <p>Names of Products</p> <ul style="list-style-type: none"> hydrogen must be stated but can be in a word equation rubidium hydroxide must be stated but can be in a word equation <p>Reaction Time</p> <ul style="list-style-type: none"> any time less than 7 seconds / reaction time less than potassium <p>Equation</p> <ul style="list-style-type: none"> $2\text{Rb} + 2\text{H}_2\text{O} \rightarrow 2\text{RbOH} + \text{H}_2$ or correct multiple <p>note $\text{Rb} + \text{H}_2\text{O} \rightarrow$ product / formula is an attempt to write an equation</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		6	

Question	Answer	Marks	Guidance
4 a	(purification processes) do not remove dissolved or soluble substances (1)	1	allow they are soluble / they are dissolved
b	large energy requirement (1) expensive (1)	2	allow heat for energy allow high cost of equipment allow issues related to scaling up / needs lots of water (1) ignore takes a long time
c	Pete is right about A but wrong about B (no mark) A contains copper (ions) because it gives a blue (ppt) with sodium hydroxide (1) A contains sulfate (ions) because it gives a white (ppt) with barium chloride (1) B contains iron(III) (ions) because it gives a brown (ppt) with sodium hydroxide (1) B does not contain sulfate (ions) as it does not give a white (ppt) with barium chloride (1)	4	allow Pete is wrong not Pete is wrong about A for marks about A not Peter is correct for B for marks about B copper sulfate goes blue with sodium hydroxide is not sufficient copper sulfate goes white with barium chloride is not sufficient iron(III) sulfate goes brown with sodium hydroxide is not sufficient B is not iron(III) sulfate because it does not go white with barium chloride is not sufficient allow B does not contain sulfate as it does not give a ppt allow A and B both cannot be sulfates since they do not both go white with barium chloride (2)
	Total	7	

Question	Answer	Marks	Guidance									
5 a	239 (1)	1										
b	FIRST LOOK AT THE ANSWER IF ANSWER = 33% AWARD 2 MARKS 0.33 g (1) 33 (%) (1)	2	allow ecf from wrong mass									
c	C ₂ H ₅ (1)	1	allow any order of symbols not C ² H ⁵ / C2H5 / or use of lower case H									
d	FIRST LOOK AT THE ANSWER IF ANSWER = Fe₂O₃ AWARD 3 MARKS <table border="1"><tr><td>symbols</td><td>Fe</td><td>O</td></tr><tr><td>mole ratio</td><td>$\frac{70}{56}$ or 1.25</td><td>$\frac{30}{16}$ or 1.875</td></tr><tr><td>simplest mole ratio</td><td>$\frac{1.25}{1.25}$ or 1</td><td>$\frac{1.875}{1.25}$ or 1.5</td></tr></table> mole ratio (1) simplest mole ratio (1) empirical formula is Fe ₂ O ₃ (1)	symbols	Fe	O	mole ratio	$\frac{70}{56}$ or 1.25	$\frac{30}{16}$ or 1.875	simplest mole ratio	$\frac{1.25}{1.25}$ or 1	$\frac{1.875}{1.25}$ or 1.5	3	If fraction is the wrong way around = 0 marks for the question If divide by atomic number = 0 marks for the question If just use ratio of masses = 0 for the question allow ecf from mole ratio allow ecf from simplest ratio allow FeO _{1.5} = 2 marks for the question
symbols	Fe	O										
mole ratio	$\frac{70}{56}$ or 1.25	$\frac{30}{16}$ or 1.875										
simplest mole ratio	$\frac{1.25}{1.25}$ or 1	$\frac{1.875}{1.25}$ or 1.5										
	Total	7										

Question	Answer	Marks	Guidance
6 a	<p>any two from:</p> <p>correct piece of apparatus to collect and measure gas e.g. (gas) syringe, upturned measuring cylinder with water or upturned burette with water (1)</p> <p>workable and gas tight (1)</p>	2	 <p>The diagram shows a conical flask containing a reaction mixture. A delivery tube is inserted into the flask, passing through the stopper. The tube is connected to a gas syringe, which is labeled 'gas syringe'. The flask is labeled 'flask'.</p> <p>The measuring apparatus must be graduated and does not need to be assembled. The apparatus does not need to be named if there is no ambiguity from the diagram</p> <p>allow even if the syringe / measuring cylinder is not graduated</p> <p>allow the tube can be a single line</p> <p>ignore if tube does not appear to go through the stopper</p> <p>not the delivery tube must not go in the reaction mixture</p>

Question	Answer	Marks	Guidance
6 b	<p>Level 3 Describes the difference between strong and weak acids AND explains the different shapes of the graphs in terms of collision frequency and hydrogen ions Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>Level 2 EITHER Describes the difference between strong and weak acids <u>and</u> explains the different shapes of the graphs in terms of rate of reaction and strength of acid OR explains the different shapes of the graphs in terms of collision frequency or hydrogen ions Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 EITHER Describes the difference between strong and weak acids OR explains the different shapes of the graphs in terms of rate of reaction and strength of acid Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0marks)</p>	6	<p>This question is targeted at grades up to A.</p> <p>Indicative scientific points at level 3 must include:</p> <p>Shapes of graph</p> <ul style="list-style-type: none"> • reference to hydrogen ions e.g. nitric acid has more hydrogen ions / greater concentration of hydrogen ions • reference to collision frequency e.g. nitric acid has more collisions per second / collisions more often / greater collision frequency <p>allow references to increased chance of collision, collisions more often, collisions more likely, as alternatives to increased collision frequency</p> <p>allow ora for propanoic acid</p> <p>Indicative scientific points at all levels may include:</p> <p>Strength of acid</p> <ul style="list-style-type: none"> • strong acid completely dissociates / ionises completely • weak acid partially dissociates / does not completely ionise <p>Shapes of graph</p> <ul style="list-style-type: none"> • nitric acid faster than propanoic acid • nitric acid has more reacting particles / greater concentration of reacting particles • nitric acid has more collisions • nitric acid has particles closer together <p>allow ora for propanoic acid</p> <p>ignore comments about similarities of the graph</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
6 c i	Moles = $0.0025 / 2.5 \times 10^{-3}$ (1)	1	

Question	Answer	Marks	Guidance
ii	Mass = 0.25 (g) / 2.5×10^{-1} (1)	1	allow ecf from number of moles, i.e. moles \times 100
	Total	10	

Question	Answer	Marks	Guidance
7 a	<p>The rate of the forward reaction is faster than the rate of the backward reaction <input type="checkbox"/></p> <p>The position of equilibrium will not change if more product is added <input type="checkbox"/></p> <p>The concentration of the reactants does not change <input checked="" type="checkbox"/></p> <p>The rate of the forward reaction is the same as the rate of the backward reaction <input checked="" type="checkbox"/></p> <p>The concentration of the reactants is the same as the concentration of the products <input type="checkbox"/></p> <p>The position of equilibrium moves to the left when product is removed from the equilibrium <input type="checkbox"/></p> <p>one correct answer (1) but two correct answers (2)</p>	2	
b	<p>(yes) it is exothermic because the percentage yield goes down as temperature increases (1)</p> <p>(no) there are less moles on right hand side because the percentage yield goes up as pressure increases (1)</p>	2	<p>Answers must refer to yield, or amount of product reference to only position of equilibrium is not sufficient</p> <p>ignore references to bond making and bond breaking</p> <p>allow ora if specified</p>
	Total	4	

Question	Answer	Marks	Guidance
8 a	collision frequency (between ions) is high (1)	1	<p>allow large number of collisions (between ions) every second / lots of collisions (between ions) per unit time / high chance of collision (between ions) / highly likelihood of collisions (between ions)</p> <p>not collision frequency between atoms or molecules is high</p> <p>allow collision frequency between Pb^{2+} and I^- is high</p> <p>allow positive and negative ions attract / oppositely charged ions attract</p> <p>allow has a low activation energy</p> <p>ignore ions cancel out</p>
b	idea of ion that is in the solution at start and at the end of the reaction (1)	1	<p>allow an ion present that takes no part in the reaction / ion that does not react / they do not contribute towards the reaction</p> <p>ignore they do not change state during the reaction</p>
c	<p>Any two from:</p> <p>idea of results can be replicated / allows peer review (1)</p> <p>idea that further evidence can be collected / can be used by other scientists to develop the work (1)</p> <p>to gain funding (1)</p> <p>idea of recognition (1)</p>	2	<p>allow so the work can be checked</p> <p>allow so other scientists can help</p>
	Total	4	

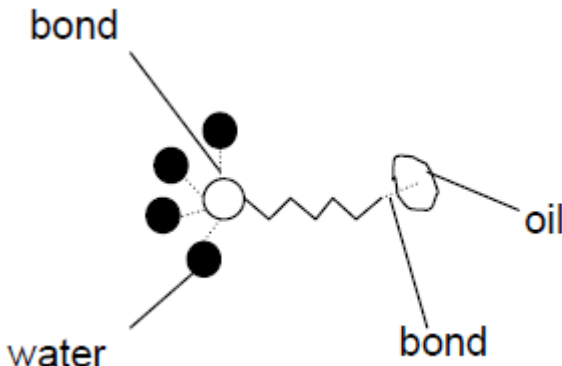
Question	Answer	Marks	Guidance
9 a	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ correct formulae (1) balancing (1) balancing mark is conditional on correct formulae	2	allow any correct multiple e.g. $4\text{H}_2 + 2\text{O}_2 \rightarrow 4\text{H}_2\text{O}$ (2) allow = or \Rightarrow for arrow not 'and' or & for + allow one mark for correct balanced equation with minor errors in case, subscript and superscript e.g. $2\text{h}_2 + \text{O}^2 \rightarrow 2\text{H}_2\text{o}$ (1)
b	horizontal line on the LHS is above the horizontal line on RHS (1) reactants i.e. hydrogen and oxygen and products i.e. water correctly labelled (1) <div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; height: 100px; margin-right: 10px;"></div> <div style="text-align: center;"> $(2)\text{H}_2 + \text{O}_2$ <hr style="width: 100px; margin: 0 auto;"/> </div> </div> <div style="display: flex; align-items: center; margin-top: 100px;"> <div style="border-left: 1px solid black; height: 100px; margin-right: 10px;"></div> <div style="text-align: center;"> $(2)\text{H}_2\text{O}$ <hr style="width: 100px; margin: 0 auto;"/> </div> </div>	2	ignore any labelling on the lines ignore any lines linking the reactants and products ignore transition states or free atoms in the middle of the diagram – focus on reactants and products only this mark is independent of the first marking point allow words instead of formulae / reactant and product allow H—H and O—O
c	provides water that astronauts can use / light / lightweight / low density / compact / no moving parts (1)	1	allow idea that makes a usable product i.e. water (for astronauts) / can be used as drinking water ignore efficient / reliable

Question	Answer	Marks	Guidance
d	idea that fuel cells contain poisonous catalysts (which need to be disposed of) (1) (idea of pollution) from the burning of fossil fuels associated with fuel cell production or manufacture of raw materials (1)	2	allow catalyst could be pollutants (when disposed of) / contain harmful catalysts ignore dangerous catalysts allow makes waste when they are thrown away allow mining for some of the materials used in a fuel cell (will cause pollution)
	Total	7	

Question	Answer	Marks	Guidance
10 a	<p>X- temporary Y- permanent Z- temporary and permanent / both (types of hardness)</p> <p>all three correct (2) but any two correct (1)</p> <p>then any two from:</p> <p>X is temporary as hardness removed (by boiling) (1)</p> <p>Y is permanent as no hardness removed (by boiling) (1)</p> <p>Z contains both temporary and permanent as some hardness is removed (by boiling) (1)</p>	4	<p>These marks are dependent on correct identification of X, Y or Z</p> <p>allow X is temporary since volume of soap goes down (to that of distilled water)</p> <p>allow Y is permanent since the volume of soap does not go down (after boiling) / permanent does not change from 20 cm³ (1)</p> <p>allow Z contains both temporary and permanent as volume does go down but not to volume of distilled water / does not go down to minimum volume of soap</p>
b	<p>reacts with calcium or magnesium ions (to make calcium carbonate or magnesium carbonate) (1)</p> <p>calcium carbonate or magnesium carbonate are insoluble / are formed as a precipitate (1)</p>	2	<p>allow reacts with calcium or magnesium salts or compounds</p> <p>allow reacts with named soluble calcium or magnesium salt or compound</p> <p>allow removes calcium ions or magnesium ions</p> <p>allow calcium ions removed by forming insoluble carbonate</p>
	Total	6	

Question	Answer	Marks	Guidance
11	<p>Level 3 Analyses table to evaluate advantages AND disadvantages of <u>all three</u> types of treatment AND explains fully how attaching magnesium to iron helps to prevent rusting.</p> <p>Quality of written communication does not impede communication of the science at this level. (5 – 6 marks)</p> <p>Level 2 EITHER Analyses table to evaluate advantages AND disadvantages of <u>all three</u> types of treatment OR Analyses table to evaluate advantages AND disadvantages of <u>two</u> types of treatment AND attempts to explain how attaching magnesium to iron helps to prevent rusting.</p> <p>Quality of written communication partly impedes communication of the science at this level. (3 – 4 marks)</p> <p>Level 1 EITHER Analyses table to evaluate an advantage AND a disadvantage of <u>one</u> type of treatment OR attempts to explain how attaching magnesium to iron helps to prevent rusting.</p> <p>Quality of written communication impedes communication of the science at this level. (1 – 2 marks)</p> <p>Level 0 Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p>This question is targeted at grades up to A/A*.</p> <p>Indicative scientific points may include:</p> <p>Evaluations</p> <ul style="list-style-type: none"> • idea that painting is cheap but does not last long • idea that alloying is the best method of rust prevention but is the most expensive • idea that alloying is difficult to do • idea that attaching magnesium is expensive but lasts a long time <p>How attaching magnesium to iron helps prevent rusting</p> <ul style="list-style-type: none"> • idea that magnesium is a sacrificial metal • idea that magnesium is more reactive than iron and so reacts instead of the iron • magnesium loses electrons in preference to iron • magnesium is a better reducing agent • magnesium is easier to oxidise <p>ignore reference to magnesium rusting</p> <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks.</p>
		6	

Question	Answer	Marks	Guidance
12 a	<p>formula C (1)</p> <p>because it contains (a) carbon to carbon double bond(s) (1)</p>	2	<p>allow contains C=C (double bonds) (1)</p> <p>must be clear it is a carbon-carbon double bond and not a carbon-oxygen double bond</p> <p>ignore carbon double bond / double carbon bond</p>
b	<p>any two from:</p> <p>saponification involves reacting (a fat or oil) with sodium hydroxide (1)</p> <p>soap is made (1)</p> <p>glycerol is made (1)</p> <p>it is a hydrolysis reaction (1)</p>	2	<p>allow caustic soda / potassium hydroxide instead of sodium hydroxide</p> <p>allow propane-1,2,3-triol instead of glycerol</p> <p>allow marks to be awarded from a word equation even if equation is incorrect e.g. fat or oil + sodium hydroxide → soap + glycerol (2)</p> <p>allow correct products from A, B or C if specified e.g. saponification of A gives methanol and soap</p> <p>ignore reference to enzymes</p>

Question	Answer	Marks	Guidance
c	<p>any two from:</p> <p>hydrophobic tail (1)</p> <p>(hydrophobic end) attracted to fat or oil / bonds to fat or oil / intermolecular attraction with fat or oil (1)</p> <p>(hydrophilic) head attracted to water / intermolecular attraction with water (1)</p> <p>idea that tail lifts off grease (1)</p> <p>idea that detergent molecules surround grease and so prevent it returning to clothes (1)</p>	2	<p>marks may be awarded from a labelled diagram</p> <p>allow stain = oil or fat in the context of the question</p> <p>allow hydrophobic end or hydrophobic head (1)</p> <p>allow attached to / sticks to / binds to</p> <p>dissolved in or goes into not sufficient</p> <p>allow hydrophilic end bonds with water / attached to water / sticks to water / binds to water (1)</p> <p>dissolved in or goes into not sufficient</p> 
Total		6	

Question	Answer	Marks	Guidance
13 a	NO _x (1) greatest (negative) gradient (1)	2	The second marking point is dependent on the correct pollutant allow greatest (negative) slope / steepest graph allow correct comparison of mass change shown by quoting values e.g. 190, 80 and 20 (within ±1 square) has greatest change in mass is not sufficient unless supported by data – one piece of data is sufficient
b i	$\frac{52}{3600} \times 100$ (1) 1.44 (%) (1)	2	FIRST LOOK AT ANSWER IF ANSWER = 1.44 or 1.4 AWARD 2 MARKS do not allow 1 / 1.45
ii	Other countries make more than their share (of ammonia) / Sweden makes less (ammonia) than expected / Sweden makes less (ammonia) per million of population (1)	1	allow Sweden has better anti-pollution laws ignore values are roughly the same allow Sweden makes less than average allow ecf from percentage above 1.9% in (b)(i)
iii	FIRST LOOK AT ANSWER IF ANSWER = 25 AWARD 2 MARKS $\frac{974}{39}$ (1) 25 (1)	2	allow 24.974 correctly rounded up for the first mark

Question	Answer	Marks	Guidance
iv	Poland makes more (sulfur dioxide) than expected / Poland makes more (sulfur dioxide) than the average / Poland makes more (sulfur dioxide) per million of population (1)	1	allow Poland uses a fuel that makes lots of sulfur dioxide allow fewer pollution control laws in Poland / Poland cannot afford (modern) pollution controls allow some countries produce less than the average allow pollution instead of sulfur dioxide allow ecf from (b)(iii) if below 9.1
v	Quotes some evidence that indicates a higher population gives more pollutants / ora e.g. Germany has a higher population than Estonia and makes more pollutants (1) Quotes some evidence that indicates a higher population gives less pollutants / ora e.g. UK has a higher population than Poland and makes less pollutants (1)	2	The data quoted must be able to be checked to see if it is correct and not ambiguous allow the higher populated countries like Germany Poland and the UK produces a lot more pollution
	Total	10	

OCR (Oxford Cambridge and RSA Examinations)
1 Hills Road
Cambridge
CB1 2EU

OCR Customer Contact Centre

Education and Learning

Telephone: 01223 553998

Facsimile: 01223 552627

Email: general.qualifications@ocr.org.uk

www.ocr.org.uk

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OCR (Oxford Cambridge and RSA Examinations)
Head office
Telephone: 01223 552552
Facsimile: 01223 552553

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