

Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Chemistry
(5CH2H/01) Paper 01
Unit C2: Discovering Chemistry

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2016

Publications Code 5CH2H_01_1606_MS

All the material in this publication is copyright

© Pearson Education Ltd 2016

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question number	Answer	Notes	Marks
1(a)(i)	Z	allow Xe, xenon	1

Question number	Answer	Notes	Marks
1(a)(ii)	E,G,J – all three required OR T,X,Z – all three required	allow correct symbols / names of elements	1

Question number	Answer	Notes	Marks
1(b)	C element R		1

Question number	Answer	Notes	Marks
1(c)	A E and R		1

Question number	Answer	Notes	Marks
1(d)	An explanation linking <ul style="list-style-type: none"> (delocalised / sea of electrons) electrons (1) (electrons) (free to) move / mobile / carry the current (1) 2 nd mark dependent on electrons	reject incorrectly qualified electrons ignore metal {ions/atoms} / cations reject positive (electrons) / molecules / negative ions / protons move ignore electricity flows	2

Question number	Answer	Notes	Marks
1(e)	<p>An explanation linking (for element T) any two points from</p> <ul style="list-style-type: none"> • outer (shell) electron further from nucleus / greater shielding (1) • less attraction between nucleus and electron (1) • electron more easily {lost / removed} (1) 	<p>accept reverse arguments for element E</p> <p>allow T has more shells (1) but ignore T has more outer shells</p> <p>allow comparison between T and E</p>	2

Total for question 1 = 8 marks

Question number	Answer	Notes	Marks
2(a)	C 884 yes		1

Question number	Answer	Notes	Marks
2(b)(i)	C Na ₂ SO ₄		1

Question number	Answer	Notes	Marks
2(b)(ii)	D yellow		1

Question number	Answer	Notes	Marks
2(b)(iii)	<p>An explanation linking</p> <ul style="list-style-type: none"> {loss of / gives away / transfers} electron(s) (1) {one / an / outer shell} (electron) (1) <p>M2 dependent on scoring M1</p>	<p>reject sharing electrons / idea of covalency (0)</p> <p>incorrect reference to protons and/or neutrons max 1</p> <p>Na – e⁽⁻⁾ → Na⁺ (2)</p>	2

Question number	Answer	Notes	Marks
2(c)(i)	<p>A description including</p> <p>1st step:</p> <ul style="list-style-type: none"> filter / filtration / filtering / use filter paper (1) <p>AND either</p> <ul style="list-style-type: none"> wash / rinse (precipitate) (with water) (1) or any method of drying (1) <p>M2 dependent on M1</p>	<p>allow description or diagram of filtering ie funnel and filter paper</p> <p>do not allow sieving / sifting / draining / decanting</p> <p>do not allow separating funnel</p> <p>allow pour water through solid in filter paper</p> <p>allow leave to dry {on windowsill / in a warm place / in a hot oven etc}</p> <p>do not allow just 'dry'</p>	2

Question number	Answer	Notes	Marks
2(c)(ii)	<p>An explanation linking</p> <ul style="list-style-type: none"> {barium sulfate/it} {does not dissolve / is insoluble} (1) so it {cannot enter/cannot mix with/is not absorbed} into the {blood(stream)/body} or it passes through the body (unchanged)/is egested (1) 	<p>ignore 'barium salts' / barium sulfate is a precipitate allow barium is insoluble / does not dissolve (1)</p> <p>allow cannot enter / get into ignore diffuse / cannot be digested</p> <p>allow excreted</p> <p>allow 'barium sulfate does not dissolve into bloodstream' (2)</p>	2

Total for question 2 = 9 marks

Question number	Answer	Notes	Marks
3(a)	thermometer reading {falls / decreases} / condensation on outside of beaker	ignore temperature of surroundings / thermometer gets colder allow temperature {falls / decreases}	1

Question number	Answer	Notes	Marks
3(b)	An explanation linking <ul style="list-style-type: none"> {heat / energy} needed to break bonds / {heat / energy} released when bonds formed (1) more {heat / energy} is released than needed (1) M2 dependent on scoring M1	bond breaking is endothermic / bond making is exothermic ignore numbers of bonds eg more bonds formed than broken if any contradictory statements are made in M1, the mark cannot be awarded (and M2 cannot be awarded either) more energy is released forming bonds than needed to break bonds (2)	2

Question number	Answer	Notes	Marks
3(c)(i)	$\text{CaCO}_3 + 2 \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$ LHS 2 (1) RHS $\text{CO}_2 + \text{H}_2\text{O}$ (either order) (1)	allow multiples eg $2\text{CaCO}_3 + 4\text{HCl} \rightarrow 2\text{CaCl}_2 + 2\text{H}_2\text{O} + 2\text{CO}_2$ allow H_2CO_3 as <u>only</u> other product reject incorrect subscripts eg H^2O , CO_2 reject incorrect cases eg Co reject incorrect balancing numbers on RHS ignore OH_2 , state symbols	2

Question number	Answer	Notes	Marks
3(c)(ii)	<p>An explanation linking</p> <ul style="list-style-type: none"> (smaller chips =) rate increases / reaction is faster (1) smaller marble chips = larger surface area or more collisions between reacting particles (1) 	<p>allow rate is faster</p> <p>accept 'molecules' or 'ions' but not atoms ignore frequent / chance</p>	2

Question number	Answer	Notes	Marks
3(c)(iii)	<p>An explanation linking</p> <ul style="list-style-type: none"> more particles (in the same volume) (of hydrochloric acid) (1) more frequent collisions (between hydrochloric acid and marble) or (hydrochloric acid) particles collide more often or higher rate of collisions (between hydrochloric acid and marble) or more collisions (between hydrochloric acid and marble) in given time (1) 	<p>accept 'molecules' or 'ions' but not atoms</p> <p>allow (reacting) particles are closer together (1)</p> <p>ignore just 'more ({productive/successful/effective}) collisions'</p> <p>ignore collisions are more likely</p> <p>ignore greater {chance/probability} of collisions</p> <p>ignore particles move faster / faster collisions</p>	2

Total for question 3 = 9 marks

Question number	Answer	Notes	Marks
4(a)(i)	protons 19 neutrons {39-19} or 20 electrons 19 (2)	any two correct (1)	2

Question number	Answer	Notes	Marks
4(a)(ii)	A description linking <ul style="list-style-type: none"> protons and neutrons in nucleus (1) electrons in shells/orbitals/energy levels (1) 	allow electrons {surrounding/orbit} nucleus / electrons (move) around outside ignore outer / number of sub-atomic particles	2

Question number	Answer	Notes	Marks
4(a)(iii)	2.8.8.1 (1)	Note : if answer here is blank but electronic configuration is given in (ii), score it here allow correct electron configuration consequential to number of electrons in (i) up to 20 allow electron shell diagram	1

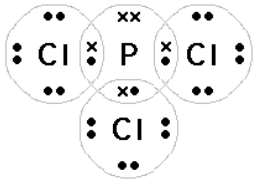
Question number	Answer	Notes	Marks
4(a)(iv)	1/1837 (1)	allow 1/1800 to 1/2000, 0.0005 – 0.00056, negligible, 0 ignore 'neg'	1

Question number	Answer	Notes	Marks
4(b)(i)	C same number of protons but different numbers of neutrons		1

Question number	Answer	Notes	Marks
4(b)(ii)	<p>total mass of Ga-69 atoms 60.2×69 (1) = 4153.8</p> <p>total mass of Ga-71 atoms 39.8×71 (1) = 2825.8</p> <p>calculate relative atomic mass $\frac{4153.8 + 2825.8}{100}$ (1) (= 69.8)</p>	<p>check working first – if approximated to 60% and 40% or similar initial rounding – max (2)</p> <p>4153.8 alone (1)</p> <p>2825.8 alone (1)</p> <p>also percentage route $60.2 \times \underline{69} = 41.538 / 41.54 / 41.5$ (1) 100 $39.8 \times \underline{71} = 28.258 / 28.26 / 28.3$ (1) 100</p> <p>allow TE for third mark</p> <p>69.796 or 69.8 alone (3) = 69.7 (2) (rounding error)</p> <p>ignore 70 as answer</p> <p>70 alone with no working scores 0</p>	3

Total for question 4 = 10 marks

Question number	Answer	Notes	Marks
5(a)(i)	<p>An explanation linking</p> <ul style="list-style-type: none"> • shared electron(s) (1) • {pair of / two} (electrons) (1) <p>2nd mark dependent on 1st</p>	any mention of ions / electron transfer (from one atom to another) scores 0	2

Question number	Answer	Notes	Marks
5(a)(ii)	<p>Diagram showing one phosphorus and three chlorine atoms eg</p>  <ul style="list-style-type: none"> • three pairs of electrons shared between the phosphorus and chlorine atoms (1) • fully correct (1) 	<p>allow use of dots or crosses or mixture of both do not allow PCl₅</p> <p>non-bonding electrons do not have to be in pairs</p> <p>circles do not need to be shown / ignore circles</p> <p>ignore inner shells even if incorrect</p> <p>ignore symbols even if incorrect or missing</p>	2

Question number	Answer	Notes	Marks
5(a)(iii)	<p>2Al + 3Cl₂ → 2AlCl₃ (2)</p> <p>correct formulae (1)</p> <p>balancing of correct formulae (1)</p>	<p>allow multiples</p> <p>allow = for →</p> <p>ignore state symbols / word equations</p> <p>reject incorrect subscripts eg Cl₂, Cl² / incorrect case</p>	2

Question number		Indicative content	Mark
QWC	*5(b)	<p>An explanation including some of the following points</p> <p>chlorine</p> <ul style="list-style-type: none"> • weak intermolecular forces / weak forces between molecules • requires little energy • to separate molecules <p>diamond</p> <ul style="list-style-type: none"> • strong covalent bonds between all atoms • each atom bonded to four carbon atoms • requires lots of energy • to break all bonds / separate atoms <p>sodium chloride</p> <ul style="list-style-type: none"> • electrostatic forces of attraction between oppositely charged ions • giant ionic lattice • requires lots of energy • to separate ions <p>zinc</p> <ul style="list-style-type: none"> • electrostatic forces of attraction between oppositely charged metal ions and delocalised electrons • giant (metallic) lattice • requires lots of energy • to separate metal ions <p>solubility</p> <ul style="list-style-type: none"> • diamond does not dissolve • sodium chloride dissolves in water • water separates ions of sodium chloride / group 1 salts are soluble • water does not separate the atoms in diamond 	(6)
Level	0	No rewardable content	
1	1 – 2	<ul style="list-style-type: none"> • a limited explanation e.g. explains link between bonding between particles and melting point for one substance OR explains solubility of diamond or sodium chloride • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy 	
2	3 – 4	<ul style="list-style-type: none"> • a simple explanation e.g. explains link between bonding between particles and melting point for more than one substance OR explains solubility of diamond and sodium chloride OR explains link between bonding between particles and melting point for one substance and explains solubility of diamond or sodium chloride • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy 	

3	5 – 6	<ul style="list-style-type: none">• a detailed explanation e.g. explains link between bonding between particles and melting point for more than two substances OR explains link between bonding between particles and melting point for one substance and explains solubility of diamond and sodium chloride OR explains link between bonding between particles and melting point for more than one substance and explains solubility of diamond or sodium chloride• the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately• spelling, punctuation and grammar are used with few errors
---	-------	---

Total for question 5 = 12 marks

Question number	Answer	Notes	Marks
6(a)	rel formula mass $\text{NH}_4\text{NO}_3 = (2 \times 14) + (4 \times 1) + (3 \times 16)$ (1) $(= 80)$ $\frac{\quad (2 \times 14) \text{ or } 28}{\quad} \times 100$ (1) (= 35%) rel formula mass NH_4NO_3 (from above)	80 alone (1) allow TE for rel formula mass credit (2×14) or 28 only in numerator of % calculation 35% alone (3) common errors include 17.5% (2) 22.4% (2) – mp 3 incorrect 70% (2) allow 33% (1) (atomic numbers used in place of relative atomic masses)	3

Question number	Answer	Notes	Marks
6(b)	190 tonnes TiCl_4 produces 48 tonnes Ti (1) 500 tonnes TiCl_4 produces $\frac{48 \times 500}{190}$ (1) $(= 126.3 / 126)$ tonnes Ti	first mark – 190, 48 may be given under the equation allow any number of sig figs allow 126 / 126.3 alone (2) common errors include $\frac{190 \times 500}{48} = 1979.17 / 1979.2 / 1980$ 48 (1) early rounding $\frac{48}{190} = 0.25$ $0.25 \times 500 = 125$ (1) allow calculation using moles $\frac{500}{190} (\times 10^6)$ moles $\text{TiCl}_4 \rightarrow \frac{500}{190} (\times 10^6)$ moles Ti 190 190 $(= 2.63 (\times 10^6))$ (1) $\text{mass Ti} = 2.63 (\times 10^6) \times 48$ (1) $= 126.3 / 126$ (tonnes)	2

Question number	Answer	Notes	Mark
6(c)	any one of <ul style="list-style-type: none"> waste product needs to be separated (cost, means, product not pure, energy cost) waste product may not be commercially useful / effect on profit waste product can present problems for disposal (cost, hazardous nature - any acceptable eg harmful, toxic, effect on environment, storage of waste product, effect on landfill) 	ignore reduces atom economy / waste means less than 100% yield / may harm product / more waste / efficiency / side reactions	1

Question number	Indicative content	Mark
QWC	<p>* 6(d) An explanation including some of the following points</p> <p>experimental method</p> <ul style="list-style-type: none"> find mass of crucible / suitable container (+ lid) find mass of container (+ lid) + magnesium heat container (+lid) + magnesium lift lid occasionally to allow oxygen in minimise loss of magnesium oxide heat until no further change (credit 'add water and heat' as this removes any magnesium nitride formed) allow to cool find mass of container (+ lid) + magnesium oxide repeat heating until constant mass <p>calculation</p> <ul style="list-style-type: none"> mass magnesium = [mass of container (+ lid) + magnesium] – [mass of container (+ lid)] mass magnesium oxide = [mass of container (+ lid) + magnesium oxide] – [mass of container (+ lid)] mass of oxygen = mass of magnesium oxide – mass of magnesium = 0.700 – 0.420 mass of oxygen = 0.280 g ratio magnesium atoms = $\frac{0.420}{24} = 0.0175$ to oxygen atoms = $\frac{0.280}{16} = 0.0175$ 	

		<ul style="list-style-type: none"> ratio magnesium atoms : oxygen atoms = 1:1 empirical formula MgO 	(6)
Level	0	No rewardable content	
1	1 – 2	<ul style="list-style-type: none"> a limited description e.g. burn magnesium to form magnesium oxide OR finds mass of oxygen from results OR attempts calculation the answer communicates ideas using simple language and uses limited scientific terminology spelling, punctuation and grammar are used with limited accuracy 	
2	3 – 4	<ul style="list-style-type: none"> a simple description e.g. gives a brief experimental method and attempts calculation OR gives a complete experimental method OR calculates empirical formula the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately spelling, punctuation and grammar are used with some accuracy 	
3	5 – 6	<ul style="list-style-type: none"> a detailed description e.g. gives a brief experimental method and calculates empirical formula OR gives a complete experimental method and attempts calculation The answer communicates ideas clearly and coherently uses a range of scientific terminology accurately spelling, punctuation and grammar are used with few errors 	

Total for question 6 = 12 marks

