edexcel

Mark Scheme (Results)

Summer 2016

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

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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 • (delocalised / sea of electrons) **electrons (1)** • (electrons) (free to) move / mobile / carry the current **(1)** 2nd 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)	An explanation linking (for element T) any **two** points from • outer (shell) electron further from nucleus / greater shielding **(1)** • less attraction between nucleus and electron **(1)** • electron more easily {lost / removed} **(1)**	**accept** reverse arguments for element E **allow** T has more shells **(1) but** ignore T has more outer shells **allow** comparison between T and E	**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_2SO_4		1

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

Question number	Answer	Notes	Marks
2(b)(iii)	An explanation linking • {loss of / gives away / transfers} **electron**(s) **(1)** • {one / an / outer shell} (electron) **(1)** M2 dependent on scoring M1	 **reject** sharing electrons / idea of covalency **(0)** incorrect reference to protons and/or neutrons max 1 $Na - e^{(-)} \rightarrow Na^{+}$ **(2)**	2

Question number	Answer	Notes	Marks
2(c)(i)	A description including 1st step: • filter / filtration / filtering / use filter paper **(1)** AND **either** • wash / rinse (precipitate) (with water) **(1)** **or** • any method of drying **(1)** M2 dependent on M1	 **allow** description or diagram of filtering ie funnel **and** filter paper **do not allow** sieving / sifting / draining / decanting **do not allow** separating funnel **allow** pour water through solid in filter paper **allow** leave to dry {on windowsill / in a warm place / in a hot oven etc} do not allow just 'dry'	2

Question number	Answer	Notes	Marks
2(c)(ii)	An explanation linking • {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)**	 **ignore** 'barium salts' / barium sulfate is a precipitate **allow** barium is insoluble / does not dissolve **(1)** **allow** cannot enter / get into **ignore** diffuse / cannot be digested **allow** excreted **allow** 'barium sulfate does not dissolve into bloodstream' **(2)**	**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 • {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)	$CaCO_3$ + **2** HCl $\rightarrow$ $CaCl_2$ + **H_2O** + **CO_2** LHS **2 (1)** RHS **CO_2** + **H_2O** (either order) **(1)**	**allow** multiples eg $2CaCO_3$ + **4**HCl $\rightarrow$ $2CaCl_2$ + 2**H_2O** + 2**CO_2** **allow** H_2CO_3 as <u>only</u> other product **reject** incorrect subscripts eg H^2O, CO2 **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)	An explanation linking • (smaller chips =) rate increases / reaction is faster **(1)** • smaller marble chips = larger surface area **or** more collisions between reacting particles **(1)**	 **allow** rate is faster **accept** 'molecules' or 'ions' but not atoms **ignore** frequent / chance	**2**

Question number	Answer	Notes	Marks
3(c)(iii)	An explanation linking • 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)**	 **accept** 'molecules' or 'ions' but not atoms **allow** (reacting) particles are closer together **(1)** **ignore** just 'more ({productive/successful/effective}) collisions' **ignore** collisions are more likely **ignore** greater {chance/probability} of collisions **ignore** particles move faster / faster collisions	**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 • 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**

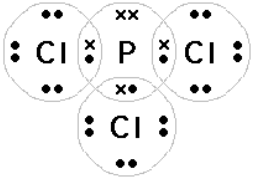
Question number	Answer	Notes	Marks
4(a)(iv)	1/1837 **(1)**	**allow** 1/1800 to 1/2000, 0.0005 – 0.00056, negligible, 0 **ignore** 'neg'	**1**

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

Total for question 4 = 10 marks

Question number	Answer	Notes	Marks
5(a)(i)	An explanation linking • **shared electron**(s) **(1)** • {pair of / two} (electrons) **(1)** 2nd mark dependent on 1st	any mention of ions / electron transfer (from one atom to another) scores 0	**2**

Question number	Answer	Notes	Marks
5(a)(ii)	Diagram showing one phosphorus and three chlorine atoms eg  • three pairs of electrons shared between the phosphorus and chlorine atoms **(1)** • fully correct **(1)**	**allow** use of dots or crosses or mixture of both do not allow PCl_5 non-bonding electrons do not have to be in pairs circles do not need to be shown / ignore circles **ignore** inner shells even if incorrect **ignore** symbols even if incorrect or missing	**2**

Question number	Answer	Notes	Marks
5(a)(iii)	$2Al + 3Cl_2 \rightarrow 2AlCl_3$ **(2)** correct formulae **(1)** balancing of correct formulae **(1)**	**allow** multiples **allow** = for $\rightarrow$ **ignore** state symbols / word equations **reject** incorrect subscripts eg Cl2, Cl^2 / incorrect case	**2**

Question number		Indicative content	Mark
QWC	*5(b)	An explanation including some of the following points **chlorine** • weak intermolecular forces / weak forces between molecules • requires little energy • to separate molecules **diamond** • strong covalent bonds between all atoms • each atom bonded to four carbon atoms • requires lots of energy • to break all bonds / separate atoms **sodium chloride** • electrostatic forces of attraction between oppositely charged ions • giant ionic lattice • requires lots of energy • to separate ions **zinc** • electrostatic forces of attraction between oppositely charged metal ions and delocalised electrons • giant (metallic) lattice • requires lots of energy • to separate metal ions **solubility** • 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**	• 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**	• 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**	• 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 NH_4NO_3 = (2x14) + (4x1) + (3x16) **(1)** (= 80) (2 x 14) or 28 **(1)** x 100 **(1)** (= 35%) rel formula mass NH_4NO_3 (from above)	80 alone **(1)** allow TE for rel formula mass credit (2 x 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 48 x 500 **(1)** 190 (= 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 190 x 500 = 1979.17 / 1979.2 / 1980 48 **(1)** early rounding 48 = 0.25 0.25 x 500 = 125 **(1)** 190 **allow** calculation using moles 500 ($x10^6$) moles $TiCl_4 \rightarrow$ 500 ($x10^6$) moles Ti 190 190 (= 2.63 ($x10^6$) **(1)** mass Ti = 2.63 ($x10^6$) x 48 **(1)** = 126.3 / 126 (tonnes)	**2**

Question number	Answer	Notes	Mark
6(c)	any one of • 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	*6(d)	An explanation including some of the following points **experimental method** • 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 **calculation** • 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	

		• ratio magnesium atoms : oxygen atoms = 1:1 • empirical formula MgO	**(6)**
Level	**0**	No rewardable content	
1	**1 – 2**	• 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**	• 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**	• 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

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