edexcel

Mark Scheme (Results)

Summer 2016

Pearson Edexcel International GCSE in Chemistry (4CH0) Paper 1CR

Pearson Edexcel International in Science Double Award (4SC0) Paper 1CR

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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.
- 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.

Question number	Answer	Notes	Marks
1 a	atomic number	Accept proton number Accept number of protons	1
b	(relative) atomic mass	Reject mass number	1
c i	electrons		1
ii	electrons		1
iii	protons AND neutrons	Names can be in either order	1
iv	protons AND electrons	Names can be in either order	1
v	neutrons		1

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>2 a</td><td>
<table>
<tr><th>Change of state</th><th>State symbol before change</th><th>State symbol after change</th></tr>
<tr><td>Water boils in a kettle</td><td>l</td><td>g</td></tr>
<tr><td>Ethene is converted to poly(ethene)</td><td>g</td><td>s</td></tr>
<tr><td>Crystals of iodine sublime on heating</td><td>s</td><td>g</td></tr>
</table>
</td><td>M1 l AND g in first row
M2 g AND s in second row
M3 s AND g in third row

Accept upper case letters, eg S in place of s
Accept words, eg liquid in place of l
Accept answers in brackets</td><td>3</td></tr>
<tr><td>b</td><td>$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$</td><td>Award 1 mark for s and g correct
Award 1 mark for other 3 correct
Accept upper case
Reject words</td><td>2</td></tr>
<tr><td>c</td><td>s / solid</td><td>Accept upper case S in place of s</td><td>1</td></tr>
</table>

Question number	Answer	Notes	Marks
3 a	D / simple distillation		1
b	C / fractional distillation		1
c	B / filtration		1
d	A / crystallisation		1

<table>
<tr><th>Question number</th><th>Answer</th><th>Notes</th><th>Marks</th></tr>
<tr><td>4 a</td><td>C (green)</td><td></td><td>1</td></tr>
<tr><td>b</td><td>value in range 120 - 250</td><td>If range given, it must be wholly within 120 - 250</td><td>1</td></tr>
<tr><td>c</td><td>(colour) dark(er) grey / black

(state) solid</td><td>Do not accept grey alone
Reject any other colour given with black eg blue/black
Ignore just darker than iodine

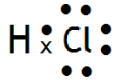
Accept correct state symbol</td><td>2</td></tr>
<tr><td>d</td><td>C (outer electrons)</td><td></td><td>1</td></tr>
<tr><td>e</td><td><table><tr><th>Incorrect word</th><th>Correct word</th></tr><tr><td>positive</td><td>negative</td></tr><tr><td>potassium</td><td>sodium</td></tr><tr><td>reducing</td><td>oxidising</td></tr></table></td><td>one mark for each correct row

Accept minor variations and alternatives and extra words
eg for negative, accept negatively / minus
eg for oxidising, accept oxidation / electron acceptor /oxidating
Accept potassium bromide and sodium bromide
Accept K for potassium and Na for sodium</td><td>3</td></tr>
</table>

Question number	Answer	Notes	Marks
5 a i	to prevent spots/them dissolving/mixing (in the solvent) / OWTTE	Accept substance(s)/pigment(s)/dye(s) for spots Ignore references to diffusion/absorption Ignore references to spots smudging/running Accept spots would be washed off/away Ignore water for solvent	1
ii	Any two from: M1 evaporation /loss of solvent / OWTTE M2 risk of fire M3 fumes may be toxic/poisonous	Accept water for solvent Ignore gas escaping Ignore it is flammable only Ignore harmful/dangerous Ignore references to substances entering tank/spillage Ignore references to reaction with air	2

b	M1 cross in box A (chlorophyll is **not** present in carrots, sweet potatoes or tomatoes) M2 cross in box C (both beta-carotene and lycopene are present in sweet potatoes) M3 cross in box E (Both carrots and tomatoes contain a pigment **other than** beta-carotene, chlorophyll and lycopene)	If more than three answers given mark on list principle: eg four answers given with 3 correct and 1 incorrect scores 2 marks eg all five answers given so 3 correct and 2 incorrect scores 1 mark	3
c	M1 (distance between start line and solvent front) = 6(.0) M2 correct evaluation of R_f value 1.3/6.0 = 0.22	Accept answer to 1 or more dp, eg 0.2, 0.217, Accept 0.216recurring Reject 0.216 correct answer with no working scores 2 M2 CQ on M1	2
d	(there is a substance in sweet potatoes that) does not dissolve/is insoluble (in the solvent)	Ignore mix Ignore water for solvent Reject not very soluble/partially soluble	1

Question number	Answer	Notes	Marks
6 a	covalent	Ignore references to polar bonding and electron sharing	1
b	M1 weak forces (of attraction) between molecules / weak intermolecular forces M2 (therefore) little (thermal/heat) <u>energy</u> required to overcome the forces / separate the molecules	Accept bonds for forces for both M1 and M2 Reject atoms for both M1 and M2 Accept particles for molecules Accept correctly named IMF eg van der Waals' Ignore more easily separated / easier to break if any reference to/implication of breaking covalent or ionic bonds scores 0/2 M1 and M2 indep	2
c	M1 (strong) attraction between bonding/shared pair of electrons M2 (and) nuclei of (both atoms) **OR** M1 bonding/shared pair of electrons M2 (strongly) attracted to nuclei (of both atoms)	Do not award M2 if reference to only one nucleus Do not award M2 if reference to only one nucleus	2

d		M1 for 2 electrons shared between one H and one Cl M2 rest of molecule fully correct M2 DEP on M1 Accept any combination of dots and crosses Ignore inner shells of electrons in chlorine if overlapping touching/circles are used both electrons must be within the overlapping/touching area symbols do not need to be shown if overlapping touching /circles are used	2
e	M1 (effervescence) due to hydrogen (gas) M2 solution A is acidic / contains H^+ / contains hydrochloric acid M3 solution B is not acidic / does not contain H^+ / does not contain hydrochloric acid	Accept hydrogen chloride/HCl does not ionise/ dissociate If only reference to HCl ionises/dissociates allow max one mark for M2 and M3, ie reference to either H^+ or acid(ic) needed to score both marks Ignore the bonds between H and Cl are not broken (when HCl dissolved) in methylbenzene Do not award M3 if any reference to methylbenzene reacting or dissociating	3

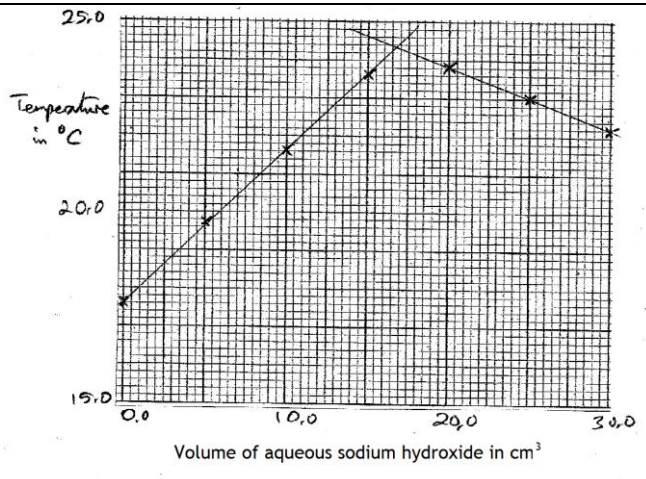
Question number	Answer	Notes	Marks
7 a	M1 (they/all) contain hydrogen and carbon (atoms) M2 only	Accept H and C Accept particles/elements in place of atoms Reject ions/molecules/compounds in place of atoms Reject element instead of they/all Reject H_2 Reject mixture Accept words with other meaning (eg solely/ exclusively) M2 DEP on reference to hydrogen and carbon even if M1 not awarded	2
b	double bond	Accept multiple in place of double Accept contain C=C Ignore references to single bonds	1
c	A		1
d	B and E and F	All three correct scores 2 marks Two correct scores 1 mark If more than three answers given lose one mark for each error eg BCEF scores 1 mark	2
e	because it has no double bond(s) / has only single bonds / is saturated	Accept because only unsaturated compounds decolourise bromine water Accept because only alkenes decolourise bromine water Accept because it's not an alkene Accept because it's not unsaturated Accept because it's a (cyclo)alkane	1

Question number	Answer	Notes	Marks
7 f i	M1 for setting out calculation If division upside down or division by one or more atomic numbers, then 0/3	C H Br $\frac{22.2}{12}$ $\frac{3.7}{1}$ $\frac{74.1}{80}$	
	M2 for obtaining ratio Accept any number of sig figs except one Allow 0.92	1.85 3.7 0.93	
	M3 for whole number ratio M3 DEP on M2	2 : 4 : 1	
	allow alternative method: M1 calculation of M_r C_2H_4Br = 108 M2 expression for % of <u>each</u> element eg C: 24/108 x100 M3 evaluation to show these equal 22.2%, 3.7%, 74.1%		3
ii	M1 ((2×12) + (4×1) + (1×80) =) 108 M2 (216 ÷ 108 = 2) (so molecular formula is) $C_4H_8Br_2$	correct answer with no working scores 2	2

Question number	Answer	Notes	Marks
8 a i	**2**NdF_3 + **3**Ca → **2**Nd + **3**CaF_2	Accept fractions and multiples	1
ii	calcium fluoride AND neodymium fluoride (in either order)	Accept formulae	1
iii	ionic	Accept electrovalent Ignore giant Ignore electron transfer Reject covalent bonding/ intermolecular forces	1
iv	Nd_2O_3	penalise incorrect use of symbols and subscripts	1

b	M1 (neodymium ions in) layers/rows/planes/sheets/OWTTE	Accept atoms/cations/particles for ions Reject molecules	4
	M2 slide/slip (over each other)	Allow OWTTE, eg flow/shift/roll/move M2 DEP on mention of **EITHER** layers or equivalent **OR** mention of ions or equivalent Do not award M2 if molecules/protons/electrons/nuclei in place of ions etc If reference to ionic bonding / covalent bonding /molecules / intermolecular forces, no marks	
	M3 delocalised electrons OR sea of electrons	Not just electrons Ignore free electrons	
	M4 (can) flow/travel/move (through structure) / are mobile (when voltage/pd is applied)	Ignore carry charge M4 DEP on M3 or near miss	

Question number	Answer	Notes	Marks
9 a	(polystyrene is an) insulator / prevents/reduces heat loss	Accept is a poor conductor (of heat) Accept keeps heat in Accept doesn't conduct (heat) as well (as glass) Ignore does not heat up Ignore references to accuracy/safety/breakages Reject to keep the temperature constant	1
b	M1 (after) 19.4(0) M2 (before) 15.9(0) M3 3.5(0)	If readings are correct but in the wrong order, award 1 mark for M1 and M2 M3 CQ on (M1 – M2)	3

c	i		M1+M2 all seven points plotted to nearest gridline Deduct 1 mark for each error M3 best fit straight line through first 4 points drawn with aid of a ruler M4 best fit straight line through last 3 points drawn with aid of a ruler No penalty if lines do not cross or if the two straight lines are joined by a curve values correctly read from candidate's graph Do not award these marks if lines do not cross or if curve drawn	4
	ii	M1 (temperature) M2 (volume)	temperature to ± 0.1 ºC volume to ± 0.25 cm^3 If values correct but in wrong places allow 1/2	2

Question number	Answer	Notes	Marks
9 d	M1 mass = 47.7 (g) M2 temperature change = 5.8 (°C) M3 (47.7 × 4.2 × 5.8 =) 1200 (J)	Accept 1160, 1162, 1161.97, 1161.972 Reject 1161.9 M3 CQ on M1 and M2 answer correct to two or more sig fig Correct final answer with or without working scores 3 marks Accept answer in kJ if unit included Ignore sign	3

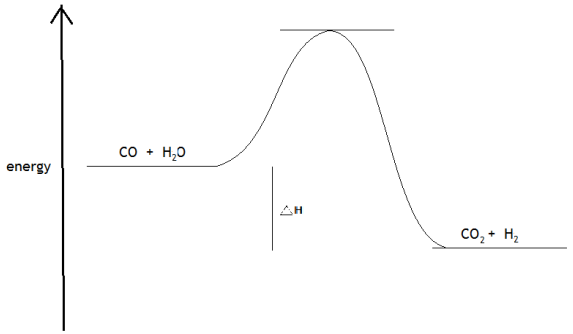
Question number	Answer	Notes	Marks
10 a i	M1 $n(Na_2S_2O_3) = \frac{0.300 \times 20}{1000}$ OR 0.006(0) mol (= $n(SO_2)$)		3
	M2 *M*r of SO_2 = 32 + (2 x16) OR 64		
	M3 mass of SO_2 = (0.006 × 64) = 0.38 (g)	Mark CQ throughout Accept any number of sig fig Correct final answer with or without marking scores 3 marks	
ii	M1 mass of SO_2 in 1 dm^3 = $\frac{0.38(4) \times 1000}{50}$	M1 CQ on M3 in ai	
	= 7.6(8) (g)	Accept any number of sig fig	
	M2 this is less than 100 so no SO_2 will escape	If candidate value for M1 is greater than 100, award M2 for opposite argument If no answer to M1 then M2 cannot be awarded	
	OR		
	M1 volume of solvent is 50cm^3 which would dissolve (100/20) = 5(g) M2 0.384(g) is less than 5(g) so no SO_2 would escape	If answers based on volume of solvent = 20cm^3 eg 20cm^3 which would dissolve (100/50) = 2(g) 0.384(g) is less than 2(g) so no SO_2 would escape worth 1 mark	

b	as the (hydrochloric) acid/HCl is added	Allow (immediately) after (all) the acid/HCl added Ignore when the solutions are mixed	1
c i	timer started too late / stopped too early OR thermometer (scale) read incorrectly / timer read incorrectly	 Allow misread/incorrectly recorded the temperature/time	1
ii	19.5 (s)	Accept range 19-20	1

Question number	Answer	Notes	Marks
10 d i	M1 times are (very) short	Accept reaction happens too/very/so quickly (so hard to time accurately/precisely) Ignore reaction is quicker Ignore hard(er) to measure rate Allow human reaction time becomes significant Allow references to shorter times producing greater percentage (measurement) uncertainties/errors	2
	M2 heat loss greater	Accept heat loss occurs more quickly Accept difficult to maintain a higher temperature/keep temperature constant Ignore references to evaporation occurring	
ii	M1 more collisions/particles have energy equal to/greater than the activation energy	Ignore particles have more (kinetic) energy Ignore harder/more vigorous collisions Ignore references to speed of particles	2
	M2 (therefore there are) more successful collisions (per second)	if state activation energy is lowered scores 0/2 references to concentration scores 0/2	

e	Any three from M1 concentration of the (hydrochloric/nitric) acid M2 volume of the (hydrochloric/nitric) acid M3 volume of sodium thiosulfate M4 temperature	Allow amount for volume If neither M2 or M3 scored allow 1 mark for total volume of the mixture OR depth of liquid in the flask Ignore reference to volume of water Ignore references to size of flask/same apparatus Ignore references to distance of eye from flask/ the X/references to timing	3

Question number	Answer	Notes	Marks
11 a	$CH_4 + H_2O \rightarrow CO + 3H_2$	Accept fractions and multiples	1
b i	M1 (increased pressure) has no effect (on yield) M2 because equal numbers of (gas) moles/molecules on each side	Ignore no effect on other factors eg equilibrium (position) Do not award M2 if M1 is incorrect	2
ii	M1 (at higher temperature equilibrium position shifts to left so yield of hydrogen) decreases M2 because (forward) reaction is exothermic	Accept because backward reaction is endothermic Accept because reaction moves in the endothermic direction Ignore references to Le Chatelier's principle eg increase in temperature favours the endothermic reaction Do not award M2 if M1 is incorrect	2

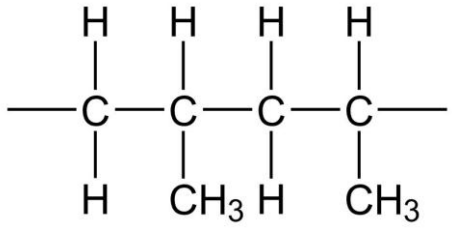
c	i		M1 for CO_2 + H_2 / products below CO + H_2O M2 for approximately vertical line/arrow with ΔH symbol/enthalpy change/-41kJ/mol between reactants and products M2 CQ on M1 unless if products above the activation energy	2
	ii	no effect / OWTTE		1
	iii	M1 provides alternative pathway / route / OWTTE M2 with lower activation energy	Accept words such as another / different in place of alternative, but not just route Accept lowers the activation energy Accept less energy needed to start the reaction Reject (catalyst) provides energy for M1 and M2 Ignore references to providing surface for reaction	2

Question number	Answer	Notes	Marks
11 d	M1 identifying reaction 3 or reaction 4 M2 a correct explanation for either eg in reaction 3, there is gain of hydrogen in reaction 4, there is gain of oxygen	Ignore reactions 5 and 6 Accept increase in oxidation number of H / changes from 0 to (+)1 Accept decrease in oxidation number of N / changes from 0 to -3 Ignore references to gain/loss of electrons Accept decrease in oxidation number of O/ changes from 0 to -2 Accept increase in oxidation number of N / changes from -3 to (+)2 Ignore references to gain/loss of electrons Ignore other explanations Allow: Identifying both Reaction 3 and 4 <u>only</u> for 2 marks Ignore any explanations	2

e	M1 $n(NH_3) = \frac{34 \times 1000}{17} = 2000$ (mol) M2 M_r (NH_4NO_3) = 80 M3 mass (NH_4NO_3) = 80 × 2000 = 160 000 g / 160 kg **OR** M1 M_r (NH_4NO_3) = 80 M2 (so) 17 (kg NH_3) gives 80 (kg NH_4NO_3) M3 (so) 34 (kg NH_3) gives $\frac{80}{17}$ x 34 = 160 kg / 160 000 g	Correct final answer with or without working scores 3 marks Do not award M3 if unit missing or incorrect Mark CQ throughout	3

Question number	Answer	Notes	Marks
12 a i	fuel oil		1
ii	fuel oil		1
iii	gasoline		1
b i	alumina / silica	Accept aluminosilicates/zeolites Accept aluminium oxide/silicon dioxide/silicon oxide/silicon (IV) oxide Accept correct formulae	1
ii	M1 for correct formula - C_4H_8	Accept $C_4H_8 + C_4H_8$ for 2 marks	2
	M2 for correct coefficient - 2	Award 1 mark for $4C_2H_4$ Award 1 mark for C_8H_{16} Award 1 mark for two alkenes which have a total of 8C and 16H eg $C_3H_6 + C_5H_{10}$	

iii	M1	over/greater supply of long-chain hydrocarbons/molecules/ heavy/heavier fractions / OWTTE	Accept long chain hydrocarbons/molecules heavy/heavier fractions are of less use (as fuels)	3
	M2	high demand/more use for short-chain/small hydrocarbons/ light/lighter fractions / OWTTE	Accept answers in terms of petrol / fuel (for cars) Short chain hydrocarbon molecules are more useful/in greater demand than long chain hydrocarbons/molecules scores M1 and M2	
	M3	Alkenes used to make polymers	Accept specific alkene and product eg ethene to make poly(ethene)/ethanol/alcohol	
c	M1	forms sulfur dioxide (when burned)		2
	M2	which causes specified problem for environment OR specified problem for humans	eg acid rain / damages trees / kills fish eg toxic / respiratory irritant / triggers asthma attacks Ignore harmful gas	

Question number	Answer	Notes	Marks
12 d		M1 for only <u>two</u> (of the four) carbon atoms both with two H eg $-CH_2-CH_2-CH_2-CH_2-$ scores 0 M2 for (the other) <u>two</u> carbon atoms each with one H and one CH_3 No M2 if methyl groups on 1st + 2nd, or on 3rd + 4th carbons in chain Do not penalise bonds to H of CH_3 Max 1 if chain extended correctly Ignore brackets and n each carbon must have four bonds eg $-CH_2-CH-CH-CH_2-$ scores 0 if terminal Hs added max 1 0/2 if any double bonds shown	2

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