

Commentary on candidate evidence

The candidate evidence has achieved the following marks for each question.

Question 2(a)

Question	Candidate	Mark available	Mark awarded	Comments
2(a)	A	1	0	The candidate has not stated the meaning of the order of the reaction.
	B	1	0	The candidate has attempted to describe the reaction mechanism rather than the order of a reaction.
	C	1	0	The candidate has given a description of the reaction mechanism rather than the order of reaction.
	D	1	0	The candidate has not referred to the number of moles of reactants.
	E	1	1	The candidate has correctly stated that the order of the reaction is the number of species reacting in the rate determining step.
	F	1	0	The candidate has correctly described what is meant by the order of a reaction with respect to a reactant, rather than the overall order of a reaction.

Question 5(a)

Question	Candidate	Mark available	Mark awarded	Comments
5(a)	A	1	0	The candidate has not stated what has caused the electrons to become excited and in addition has confused emission spectroscopy with how colour arises in transition metal complexes.
	B	1	0	The candidate has described what happens when an electron gets excited rather than explaining the cause of the excitement.
	C	1	0	The candidate has incorrectly stated that light is absorbed.
	D	1	0	The candidate has stated that the electrons are heated. The candidate describes this in terms of light being absorbed and so this is a cancelling error.
	E	1	1	The candidate has correctly identified that high temperatures have caused the electrons to become excited.

Question 7(b)(i)

Question	Candidate	Mark available	Mark awarded	Comments
7(b)(i)	A	1	0	The candidate has given a description of sp^3 hybridisation, not sigma bonds.
	B	1	0	The candidate has not stated that the orbitals overlap end-on.
	C	1	0	The candidate has stated that the orbitals overlap side-on.
	D	1	0	The candidate has not referred to atomic orbitals nor of end-on overlap.
	E	1	1	The candidate has correctly stated that end-on overlap occurs. The orbitals stated, sp^3 , are a type of atomic orbital and so this is not a cancelling error and the mark was awarded.

Question 7(b)(ii)

Question	Candidate	Mark available	Mark awarded	Comments
7(b)(ii)	A	1	0	Although the candidate has correctly stated that one s orbital and two p orbitals combine, there is an incorrect statement that only one hybrid orbital forms.
	B	1	0	The candidate has incorrectly stated that an s block orbital combines with a p block orbital and has incorrectly stated that only one 'hybrid' forms.
	C	1	0	The candidate has incorrectly stated that an s electron and p electrons combine.
	D	1	0	The candidate has incorrectly stated that the s subshell combines with all of the p subshells and has confused hybrid orbitals with pi (double) bonds.
	E	1	0	The candidate has incorrectly referred to s orbitals rather than one s orbital and has also incorrectly stated that four new hybrid orbitals are formed.
	F	1	1	The candidate has correctly stated that one s orbital mixes with two p orbitals to form three sp^2 orbitals.

Question 7(d)(ii)(A)

Question	Candidate	Mark available	Mark awarded	Comments
7(d)(ii)(A)	A	2	0	The candidate has not mentioned bonds vibrating and so the first mark was not awarded. The second mark was not awarded as there is no reference to infrared radiation being absorbed.
	B	2	1	The candidate has correctly stated that infrared radiation causes bonds to vibrate so the first mark was awarded. Although the candidate has the correct idea that different functional groups will vibrate differently, there is no link to the absorption of infrared radiation given.
	C	2	1	The candidate has correctly stated that infrared radiation causes bonds to vibrate so the first mark was awarded. Although the candidate has the correct idea that different bonds vibrate differently, there is no link to the absorption of infrared radiation given.
	D	2	1	The candidate has correctly stated that infrared radiation causes bonds to vibrate so the first mark was awarded. Although the candidate has the correct idea that different functional groups will vibrate differently, there is no link to the absorption of infrared radiation given.
	E	2	1	The candidate has correctly stated that infrared radiation causes bonds to vibrate so the first mark was awarded. Although the candidate has the correct idea that different functional groups will vibrate differently, there is no link to the absorption of infrared radiation given.

Question	Candidate	Mark available	Mark awarded	Comments
	F	2	1	The candidate has correctly stated that infrared causes the bonds to vibrate and bend. There is no mention of the absorption of energy and so the second mark was not awarded.
	G	2	2	The candidate has correctly stated that the bonds stretch and so the first mark was awarded. The statement 'each bond absorbs a unique range of wavenumber' is correct for the second mark.

Question 9(a)(ii)

Question	Candidate	Mark available	Mark awarded	Comments
9(a)(ii)	A	1	0	Although the candidate has correctly stated that optical isomers cannot be superimposed, they have not stated that optical isomers are mirror images of each other.
	B	1	0	Although the candidate has correctly stated that optical isomers cannot be superimposed, they have not stated that optical isomers are mirror images of each other.
	C	1	0	The candidate has attempted to describe the effect of plane polarised light rather than describe optical isomers.
	D	1	0	The candidate has described optical rotation rather than optical isomers.
	E	1	0	The candidate has correctly stated that optical isomers are mirror images of each other but not that they are non-superimposable. They have also drawn an incorrect diagram with only 3 substituents, which therefore does not provide a correct diagram showing that the structures are non-superimposable.
	F	1	0	The candidate has correctly mentioned mirror images but has incorrectly stated that the mirror images should be superimposable and so the mark was not awarded.
	G	1	0	The answer given correctly states that optical isomers are non-superimposable. There is a good attempt at drawing a diagram to show that optical isomers are mirror images however the structure used has

Question	Candidate	Mark available	Mark awarded	Comments
				only three different substituents and so will not be non-superimposable, and so the mark was not awarded.

Question 5(b)(ii)

Question	Candidate	Mark available	Mark awarded	Comments
5(b)(ii)	A	2	0	The candidate has not stated that the d orbitals are full so the first mark was not awarded. The candidate has correctly stated that it will absorb ultraviolet light but has also made reference to the HOMO and LUMO gap, which is a cancelling error for the second mark.
	B	2	0	The candidate has not mentioned that the 3d subshell is full and so the first mark was not awarded. The statement that the colour absorbed is in the ultraviolet region is correct however electrons falling back down has also been mentioned, which is a cancelling error for the second mark.
	C	2	0	The candidate has shown by diagram that the d orbitals are full however they have stated that the energy gap must be high so the first mark was not awarded. The second mark was not awarded as the candidate mentions the wavelength emitted is ultraviolet.
	D	2	1	The candidate has stated that d-orbitals are full so only the first mark was awarded.
	E	2	1	The candidate has not stated that the d orbitals are full so the first mark was not awarded. The second mark was awarded for correctly stating the wavelength absorbed is in the ultraviolet part of spectrum.

Question 7(c)

Question	Candidate	Mark available	Mark awarded	Comments
7(c)	A	2	0	The candidate has not stated the direction of electron transition or that the complementary colour (to red) or blue-green light was absorbed so no marks were awarded.
	B	2	0	The candidate has given an incorrect direction of electron transfer so the first mark was not awarded (an incorrect abbreviation of LOMO as lowest occupied molecular orbital has been used instead of LUMO as lowest unoccupied molecular orbital). The candidate has incorrectly stated that electrons fall back emitting energy and so the second mark was not awarded.
	C	2	0	The candidate has given an incorrect direction of electron transition so the first mark was not awarded. The candidate has correctly stated that the complementary colour is shown but has said energy is released, which is a cancelling error for the second mark.
	D	2	0	The candidate has incorrectly stated the direction of electron transition so the first mark was not awarded. The candidate has correctly stated the energy absorbed is complementary to that transmitted but also mentions electrons dropping back down, which is a cancelling error so the second mark was not awarded.
	E	2	0	While the direction of electron transition has been given, the candidate has used an incorrect abbreviation of LOMO instead of LUMO so the first mark was not awarded. A correct statement that blue-green wavelengths are absorbed has been given however electrons release red wavelengths of light has also been stated. This is a cancelling error for the second mark.

Question	Candidate	Mark available	Mark awarded	Comments
	F	2	1	The candidate has not mentioned HOMO to LUMO so the first mark was not awarded. The candidate has correctly stated that blue green light is absorbed so the second mark was awarded.
	G	2	1	The candidate has given the correct direction for electron transition so the first mark was awarded. The candidate has incorrectly stated that the energy absorbed corresponds to red so the second mark was not awarded.
	H	2	2	The candidate has correctly stated the direction of electron transition and that the complementary colour to the photon absorbed gives the red colour so both marks were awarded.
	I	2	2	The correct direction of electron transition has been given so the first mark was awarded. The candidate has correctly stated that the colour seen (red) is complementary to the colour absorbed so the second mark was awarded.

Question 6(c)

Question	Candidate	Mark available	Mark awarded	Comments
6(c)	A	1	0	Although the candidate has stated that the reactants had impurities this is not a specific enough answer to be awarded the mark.
	B	1	0	Although the candidate has stated that the vodka had impurities or contamination, there is no link to these impurities reacting with the dichromate and so the mark was not awarded.
	C	1	0	The candidate has correctly stated that the concentration of the potassium dichromate may be wrong but has not provided the added detail that the concentration may have been greater than 0.010 mol l^{-1} .
	D	1	0	The candidate has suggested that the concentration of the potassium dichromate may have been less than 0.010 mol l^{-1} however this would lead to a lower than expected concentration of alcohol being determined.
	E	1	0	The answer given by the candidate would have resulted in a lower concentration of ethanol being determined and so is an incorrect response.
	F	1	1	The candidate has correctly stated that other substances may have reacted with the dichromate.

Question 1(b) — units

Question	Candidate	Mark available	Mark awarded	Comments
1(b)	A	2	1	The numerical answer is correct and is within the range allowed for the number of significant figures. Although units were not required as they were given in the question, the candidate has written units and these have an incorrect uppercase k for kilo and so one mark was not awarded.
	B	2	2	The numerical answer is correct and although units were not required as they were given in the question, the candidate has written the units. The k for kilo has been written to be smaller than the J and so is acceptable, and 2 marks were awarded.
	C	2	1	The numerical answer is correct and is within the range allowed for the number of significant figures. Although units were not required as they were given in the question, the candidate has written units and these have an incorrect uppercase k for kilo and so one mark was not awarded.
	D	2	1	The numerical answer is correct and is within the range allowed for the number of significant figures. Although units were not required as they were given in the question, the candidate has written units and these have an incorrect uppercase k for kilo and so one mark was not awarded.

Question 2(b)(ii) — constants

Question	Candidate	Mark available	Mark awarded	Comments
2(b)(ii)	A	1	0	The candidate has written an uppercase k for rate constant. As the k in this question is a constant and not a unit, this mark was not awarded regardless of whether general marking instruction (i) had already been applied.
	B	1	0	The candidate has correctly written a lower case k for the rate constant however, r is not a symbol for rate and so the mark was not awarded. As this is not a unit, this mark would not be awarded even if general marking instruction (i) had already been applied
	C	1	0	The candidate has written an R instead of writing the word rate, and as this is not a symbol for rate, the mark was not awarded. The rate constant k, is clearly uppercase and this would be a second reason to not award the mark for this question.
	D	1	1	The rate constant is smaller than the letters used for the formulae and although it is not clearly a lower case k, the mark was awarded.

Question 1(b) and 4(c)(ii)(B) — significant figures

Question	Candidate	Mark available	Mark awarded	Comments
1(b)	A	2	1	The candidate has the correct numerical answer however the data given in the question is quoted to three significant figures and so the answer should have been given to three significant figures. The numerical answer given has seven significant figures and this is outwith the acceptable range, which is two to five for this question (one fewer and two more).
	B	2	1	The candidate has the correct numerical answer however the data given in the question is quoted to three significant figures and so the answer should have been given to three significant figures. The numerical answer given has seven significant figures and this is outwith the acceptable range, which is two to five for this question (one fewer and two more). The candidate has also given an incorrect unit for kilo however general marking instruction (i) states that: This marking instruction must only be applied a maximum of once per paper and cannot be applied if instruction (h) (significant figures) has already been applied in the paper.
	C	2	1	The candidate has the correct numerical answer however the data given in the question is quoted to three significant figures and so the answer should have been given to three significant figures. The numerical answer given has six significant figures and this is outwith the acceptable range, which is two to five for this question (one fewer and two more).
4(c)(ii)(B)	D	2	1	The candidate has the correct numerical answer however the data being used in the question from (A) has only one significant figure and so the answer should have been given to one significant figure. The numerical answer given has four significant

Question	Candidate	Mark available	Mark awarded	Comments
				figures and this is outwith the acceptable range, which is one to three for this question (one fewer and two more).