

Interactive Example Candidate Responses

Paper 42 (May/June 2016), Question 4

Cambridge International AS & A Level Chemistry 9701

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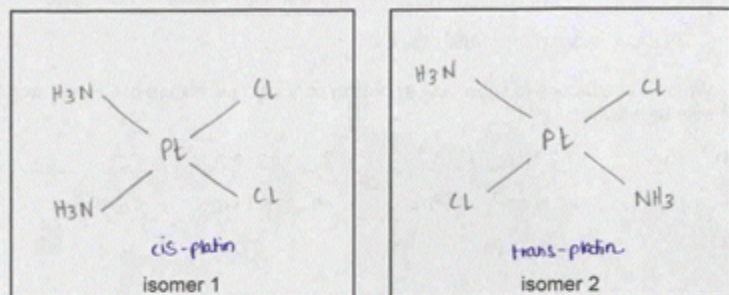
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- 4 (a) There are two isomeric complexes with the formula $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$, one of which is an anti-cancer drug.

(i) Draw diagrams to show the three-dimensional structures of the two isomers.



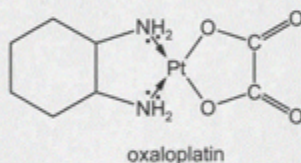
[2]

(ii) Comment on the polarity of the two isomers of $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$. Explain your answer.

Isomers are polar. The structure is square planar. The net dipoles on both isomers cancel out. They are both non-polar.

[1]

Oxaloplatin is another successful anti-cancer drug in which the stereochemistry around the platinum atom is the same as that in $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$.



oxaloplatin

(iii) Explain why there are no isomers of oxaloplatin.

No cis trans isomers can exist because the rings prevent the angles between the two ends of the rings changing. The oxalate for e.g. cannot be across each other.

[1]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

4(b)(ii)

Q4 Mark scheme

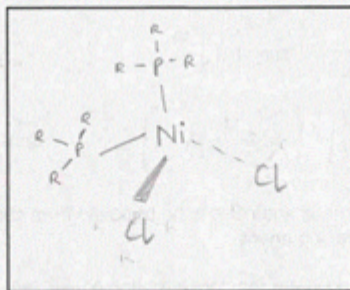
(a)(i)	<p>(cis) (trans)</p>	[2]
(a)(ii)	<p>cis is (more) polar due to both Cl^- on same side or cis is (more) polar as dipoles do not cancel / unsymmetrical or trans is non-polar as it is bond dipoles cancel</p>	[1]
(a)(iii)	<p>(This can only be cis) its mirror image is the same / superimposable or the distance between two coordinating nitrogens / oxygens is too small to bond trans or difficult for the NH_2 and O to change places (since 5-membered rings can only bridge adjacent positions)</p>	[1]
(b)(i)	It's not square planar or it's tetrahedral	[1]
(b)(ii)	<p>must be 3D structure (i.e. tetrahedral-like)</p> <p>etc</p>	[1]
		[Total: 6]

(b) Only one structure of the complex $[\text{Ni}(\text{R}_3\text{P})_2\text{Cl}_2]$ is known. ($\text{R} = \text{CH}_3$, R_3P is a monodentate ligand)

(i) What does this indicate about the stereochemistry around the nickel atom?

It is tetrahedral (if square planar there could be isomers) [1]

(ii) Draw a three-dimensional diagram showing the structure of this complex.



[1]

[Total: 6]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

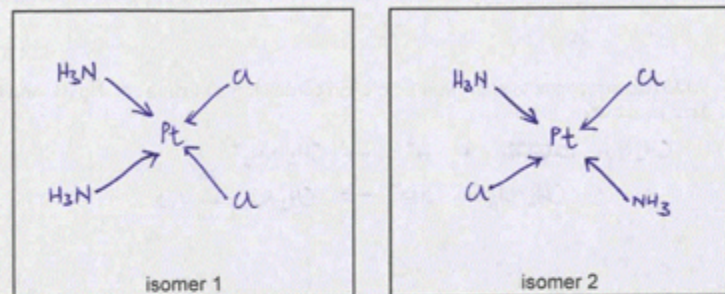
4(b)(ii)

Q4 Mark scheme

(a)(i)	<p>(cis) (trans)</p>	[2]
(a)(ii)	<p>cis is (more) polar due to both Cl^\ominus on same side or cis is (more) polar as dipoles do not cancel / unsymmetrical or trans is non-polar as it is bond dipoles cancel</p>	[1]
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- 4 (a) There are two isomeric complexes with the formula $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$, one of which is an anti-cancer drug.

(i) Draw diagrams to show the three-dimensional structures of the two isomers.

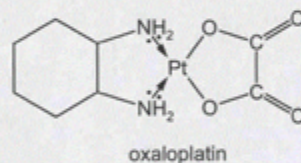


[2]

(ii) Comment on the polarity of the two isomers of $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$. Explain your answer.

Isomer 1 is more polar than isomer 2 as both of the electronegative chlorine atoms are at the same side of complex.

Oxaloplatin is another successful anti-cancer drug in which the stereochemistry around the platinum atom is the same as that in $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$.



(iii) Explain why there are no isomers of oxaloplatin.

The orientation position of bonds of ~~the~~ amine and platinum are fixed and cannot be changed.

[1]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

4(b)(ii)

Q4 Mark scheme

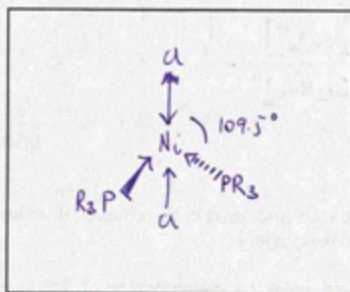
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		[Total: 6]

(b) Only one structure of the complex $[\text{Ni}(\text{R}_3\text{P})_2\text{Cl}_2]$ is known. ($\text{R} = \text{CH}_3$, R_3P is a monodentate ligand)

(i) What does this indicate about the stereochemistry around the nickel atom?

It shows a tetrahedral shape and has no isomers. [1]

(ii) Draw a three-dimensional diagram showing the structure of this complex.



[1]

[Total: 6]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

4(b)(ii)

Q4 Mark scheme

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(b)(i)	<p>It's not square planar or it's tetrahedral</p>
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[2]

[1]

[1]

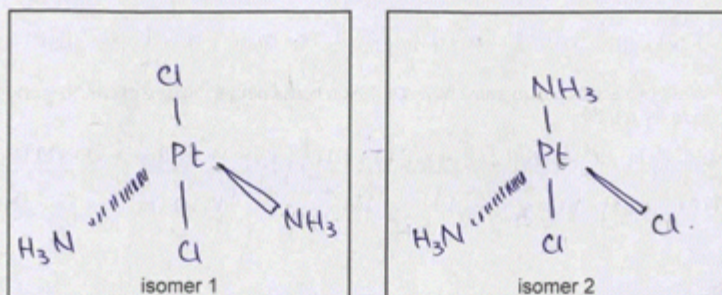
[1]

[1]

[Total: 6]

- 4 (a) There are two isomeric complexes with the formula $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$, one of which is an anti-cancer drug.

(i) Draw diagrams to show the three-dimensional structures of the two isomers.



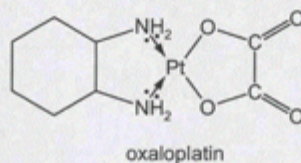
[2]

(ii) Comment on the polarity of the two isomers of $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$. Explain your answer.

Both have same polarity.

[1]

Oxaloplatin is another successful anti-cancer drug in which the stereochemistry around the platinum atom is the same as that in $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$.



(iii) Explain why there are no isomers of oxaloplatin.

Because there is no possibility to switch the atoms.

[1]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

4(b)(ii)

Q4 Mark scheme

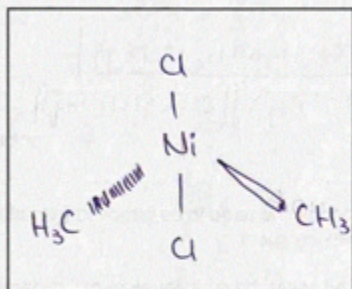
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(b)(i)	It's not square planar or it's tetrahedral	[1]
(b)(ii)	<p>must be 3D structure (i.e. tetrahedral-like)</p> <p>$\text{R}_3\text{P}-\text{Ni}-\text{Cl}$ or $\text{R}_3\text{P}-\text{Ni}-\text{Cl}$ etc</p>	[1]
		[Total: 6]

(b) Only one structure of the complex $[\text{Ni}(\text{R}_3\text{P})_2\text{Cl}_2]$ is known. ($\text{R} = \text{CH}_3$, R_3P is a monodentate ligand)

(i) What does this indicate about the stereochemistry around the nickel atom?

It will either have a trigonal a a four shape. [1]

(ii) Draw a three-dimensional diagram showing the structure of this complex.



[1]

[Total: 6]

Your
Mark

4(a)(i)

4(a)(ii)

4(a)(iii)

4(b)(i)

4(b)(ii)

Q4 Mark scheme

(a)(i)	<p>(cis) (trans)</p>	[2]
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		[Total: 6]

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