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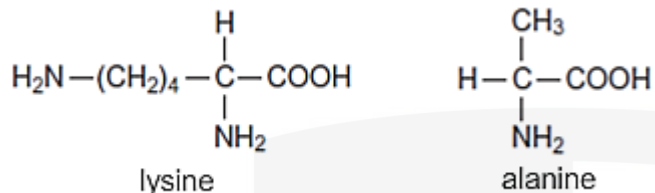
INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AMINO ACIDS, PROTEIN AND DNA
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	10
TOTAL MARKS	45

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Amino Acids, Protein and DNA

1. Lysine and alanine are two amino acids.



(a) Give the IUPAC name of lysine.

(1)

(b) Draw structures to show the product formed in each case when lysine reacts with

- an excess of aqueous HCl
- an excess of aqueous NaOH
- methanol in the presence of a small amount of concentrated H_2SO_4

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(3)

(c) The mass spectrum of alanine gives a major peak at $m/z = 44$

Write an equation for the fragmentation of the molecular ion of alanine to give an ion that produces this peak.

In your answer, draw the displayed formula for this fragment ion.

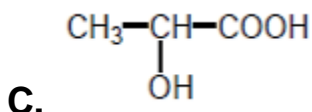
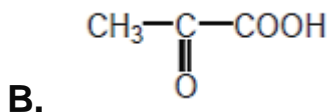
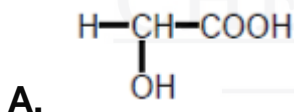
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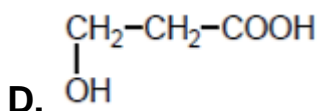
(d) Draw a dipeptide formed from one molecule of lysine and one molecule of alanine.

(1)

2. A drug is designed to simulate one of the following molecules that adsorbs onto the active site of an enzyme.

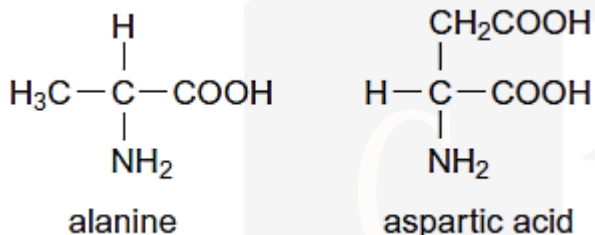
Which molecule requires the design of an optically active drug?





(1)

3. Alanine and aspartic acid are naturally occurring amino acids.



(a) Draw the structure of the zwitterion formed by alanine.

(1)

(b) Draw the structure of the compound formed when alanine reacts with methanol in the presence of a small amount of concentrated sulfuric acid.

(1)

(c) Draw the structure of the species formed by aspartic acid at high pH.

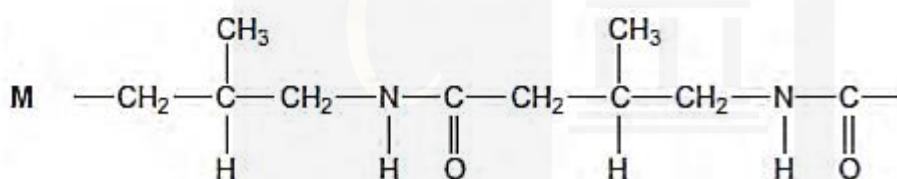
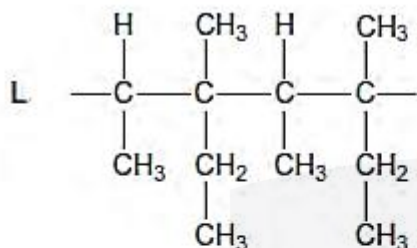
(1)

(d) Draw the structure of a dipeptide formed by two aspartic acid molecules.

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(1)

4. Sections of two polymers, L and M, are shown.



(a) Give the IUPAC name of a monomer that forms polymer L.

(1)

(b) Give the IUPAC name of the monomer that forms polymer M.

(1)

(c) Draw the section of a polymer made from a dicarboxylic acid and a diamine that is isomeric with the section of polymer M shown.

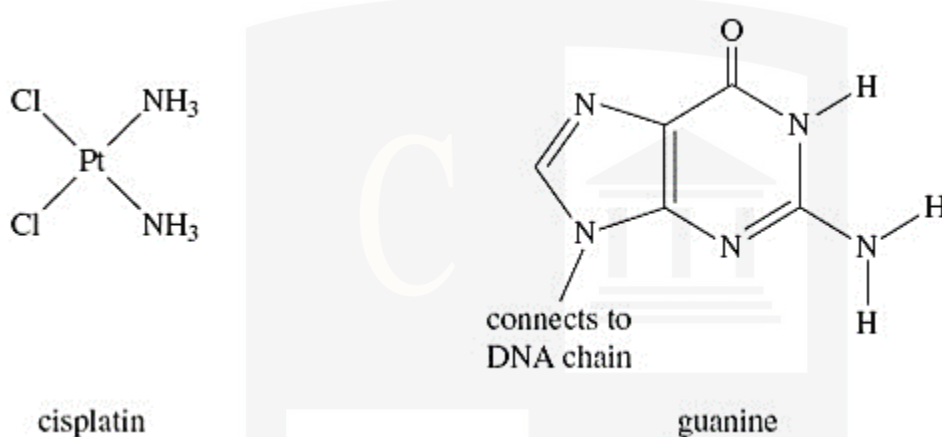
(1)

(d) Explain why polymer L is non-biodegradable.

(1)

5. The complex cisplatin acts as an anticancer drug by changing the properties of DNA when it reacts with guanine, a component of DNA.

When cisplatin is absorbed into the human body, it undergoes a ligand substitution reaction and one chloride ligand is replaced by a water molecule forming a complex ion Q.



- (a) Write an equation for this substitution reaction to form the complex ion Q.

(2)

- (b) The complex ion Q can bond to guanine in two different ways.

The first way involves a hydrogen atom, from one of the ammonia ligands on Q, bonding to an atom in a guanine molecule.

State the type of bond formed to guanine and identify an atom in guanine that could form a bond to this hydrogen atom.

(2)

(c) The second way involves a ligand substitution reaction in which an atom in a guanine molecule bonds to platinum by displacing the water molecule from Q.

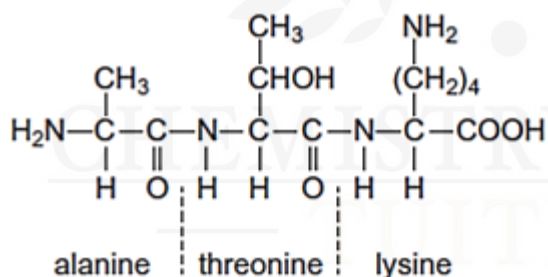
State the type of bond formed between guanine and platinum when a water molecule is displaced and identify an atom in guanine that could bond to platinum in this way.

(2)

(d) State and explain one risk associated with the use of cisplatin as an anticancer drug.

(2)

6. The tripeptide shown is formed from the amino acids alanine, threonine and lysine.



(a) Draw a separate circle around each of the asymmetric carbon atoms in the tripeptide.

(1)

(b) Draw the zwitterion of alanine.

(1)

(c) Give the IUPAC name of threonine.

(1)

(d) Draw the species formed by lysine at low pH.

(1)

7. Leucine (2-amino-4-methylpentanoic acid) is a naturally occurring α -amino acid that is often used in protein supplements.

Leucine has a structural formula of $(\text{CH}_3)_2\text{CHCH}_2\text{CH}(\text{NH}_2)\text{COOH}$.

Leucine can exist as a zwitterion.

(a) State what is meant by the term zwitterion.

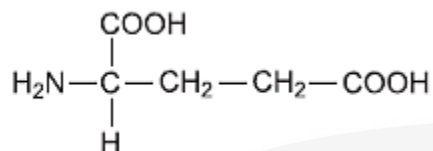
(1)

(b) Explain with the aid of a diagram how the zwitterion is formed from the functional groups in leucine.

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(2)

8. The amino acid, glutamic acid, is shown below.



Draw the structure of the organic species formed when glutamic acid reacts with each of the following.

(a) an excess of sodium hydroxide

(1)

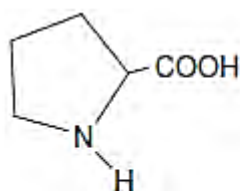
(b) an excess of methanol in the presence of concentrated sulfuric acid

(1)

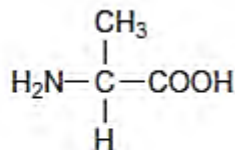
(c) ethanoyl chloride

(1)

9. The structures and common names of two amino acids are shown.



proline



alanine

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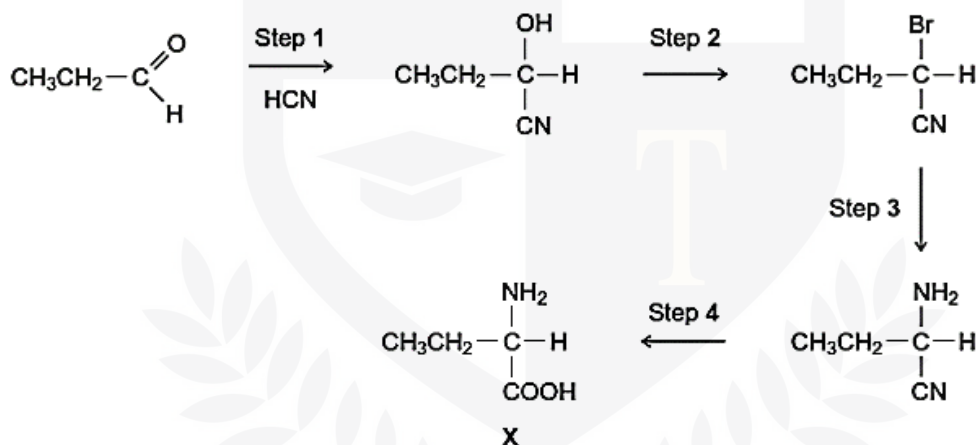
(a) Draw the structure of the zwitterion of proline.

(1)

(b) Draw the structure of the tripeptide formed when a proline molecule bonds to two alanine molecules, one on each side.

(2)

10. A possible synthesis of the amino acid X is shown below.



(a) Name and outline a mechanism for Step 1.

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(5)

(b) Give the IUPAC name of the product of Step 2.

(1)

(c) For Step 3, give the reagent, give a necessary condition and name the mechanism.

(3)



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