Questions

Q1.

This question is about amines.

Phenylamine is an aromatic amine and butylamine is an aliphatic amine.

Phenylamine can be prepared from nitrobenzene.

Butylamine can be prepared from butanenitrile.

$$C_3H_7CN \rightarrow C_4H_9NH_2$$

Compare and contrast these two preparations of amines.

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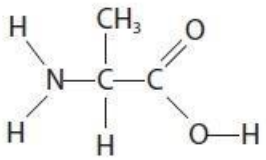
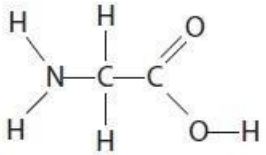
(Total for question = 3 marks)

Q2.

Organic compounds containing nitrogen include amides, amines, amino acids and nitriles.

* Alanine and glycine are amino acids.

Amino acid	Structure
alanine	
glycine	

Compare and contrast the structures, optical activity and reactions with acids and bases of alanine and glycine.

Include diagrams, structures and equations to illustrate your answer.

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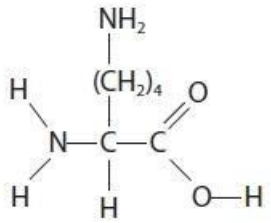
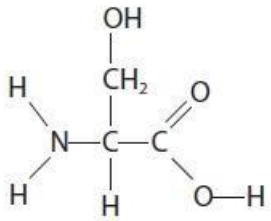
(Total for question = 6 marks)

Q3.

Organic compounds containing nitrogen include amides, amines, amino acids and nitriles.

Lysine and serine are two more amino acids.

Amino acid	Structure of amino acid
lysine	
serine	

Explain the difference in the volumes of 0.010 mol dm^{-3} hydrochloric acid required to completely react with separate 10.0 cm^3 samples of aqueous lysine and of aqueous serine, both of concentration 0.010 mol dm^{-3}.

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(Total for question = 2 marks)

Q4.

The chemistry of organic compounds containing a chlorine atom is affected by the presence of other groups.

Consider the reaction of ammonia, NH_3, with $CH_3CH_2CH_2Cl$ and with CH_3CH_2COCl.

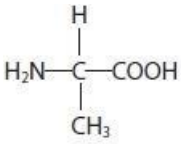
Draw the mechanism for the reaction of $CH_3CH_2CH_2Cl$ with an **excess** of ammonia to form the primary amine. Include curly arrows and relevant lone pairs.

(3)

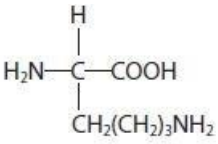
(Total for question = 3 marks)

Q5.

Alanine and lysine are amino acids.



alanine



lysine

(a) Draw the structure of a dipeptide formed when one molecule of alanine reacts with one molecule of lysine.

(1)

(b) The dipeptide formed in part (a) is hydrolysed under **acidic** conditions and the resulting mixture is analysed by column chromatography. The column uses a polar stationary phase.

Explain why lysine leaves the chromatography column after alanine.

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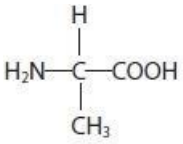
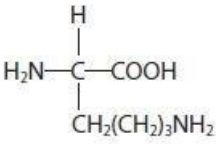
(Total for question = 3 marks)

Q6.

Alanine and lysine are amino acids.



alanine



lysine

Draw the **structure** of the organic product formed when **lysine** reacts with the following reagents:

(3)

aqueous sodium hydroxide, NaOH(aq)

excess dilute hydrochloric acid, HCl(aq)

methanol, with warming, in the presence of a few drops of concentrated sulfuric acid.

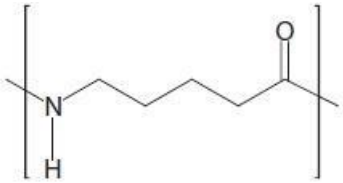
(Total for question = 3 marks)

Q7.

This is a question about polymerisation.

Deduce the single monomer that could be used to produce the polyamide shown.

(1)



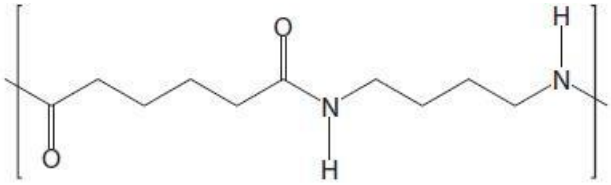
(Total for question = 1 mark)

Q8.

This is a question about polymerisation.

Deduce the two monomers needed to produce the polyamide shown.

(2)

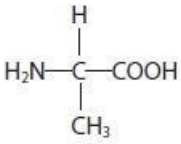


and

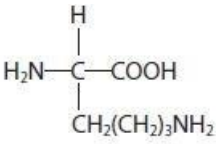
(Total for question = 2 marks)

Q9.

Alanine and lysine are amino acids.



alanine



lysine

Give the systematic (IUPAC) name for **lysine**.

(1)

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(Total for question = 1 mark)

Q10.

This question is about nitrogen and some nitrogen compounds.

Butylamine, $C_4H_9NH_2$, reacts with ethanoyl chloride.

$$2C_4H_9NH_2 + CH_3COCl \rightarrow C_4H_9NHCOCH_3 + C_4H_9NH_3^+Cl^-$$

Explain how this equation illustrates that butylamine acts as a nucleophile and as a base.

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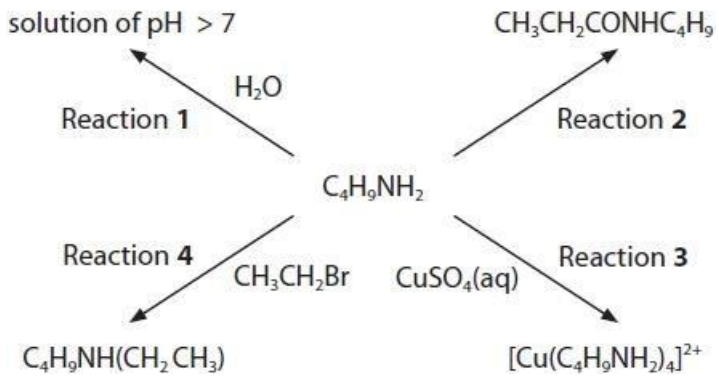
(Total for question = 4 marks)

Q11.

Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

This question is about the amines butylamine, $C_4H_9NH_2$, and phenylamine, $C_6H_5NH_2$.

The reaction scheme shows some reactions of butylamine, a primary amine.



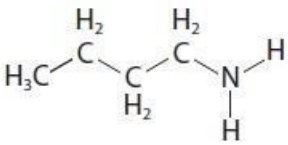
(i) What is the type and mechanism of the reaction in Reaction **4**?

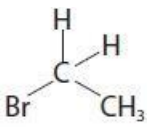
(1)

- ☐ **A** electrophilic addition
- ☐ **B** electrophilic substitution
- ☐ **C** nucleophilic addition
- ☐ **D** nucleophilic substitution

(ii) Complete the diagram to show the mechanism for Reaction **4**.
Include curly arrows, and relevant lone pairs and dipoles.

(4)



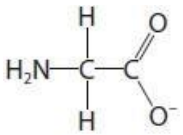


(Total for question = 5 marks)

Q12.

Some organic compounds contain metals.

Glycinate ions are formed from the amino acid glycine.



glycinate ion

(i) Explain the effect, if any, of an aqueous solution containing glycinate ions on plane-polarised monochromatic light.

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(ii) A hot aqueous solution of glycine is added to a hot solution of copper(II) ethanoate.

When the mixture is cooled, crystals of copper(II) glycinate are formed.
Write the equation for this reaction.
State symbols are not required.

(2)

(iii) In an experiment, the crystals are filtered, weighed and the percentage yield calculated.

Student **1** obtained a yield of 102.6%.
Student **2** obtained a yield of 56.4%.
The expected yield is 82% and the students carried out the calculation correctly.
Discuss possible reasons for the yields obtained by these students.

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(Total for question = 8 marks)

Q13.

Organic compounds containing nitrogen include amides, amines, amino acids and nitriles.

Propylamine, $CH_3CH_2CH_2NH_2$, may be formed from either a nitrile or a halogenoalkane.

(i) Give the reagent and essential condition for the formation of propylamine from a nitrile.

Include an equation for the reaction.

(2)

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(ii) Give the reagent and essential conditions for the formation of propylamine from a halogenoalkane.

Include an equation for the reaction.

(3)

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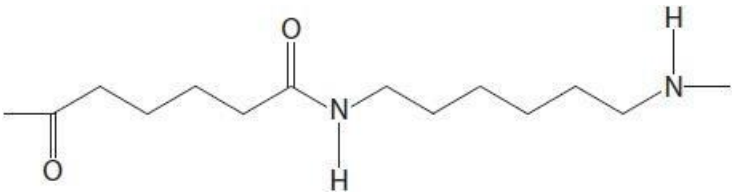
(Total for question = 5 marks)

Q14.

This question is about amines.

A section of a polyamide is shown.



Identify, by name or formula, the amine monomer that reacts to form this polyamide.

(1)

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(Total for question = 1 mark)

Q15.

The chemistry of organic compounds containing a chlorine atom is affected by the presence of other groups.

Consider the reaction of ammonia, NH_3, with $CH_3CH_2CH_2Cl$ and with CH_3CH_2COCl.

Predict the mechanism for the reaction of CH_3CH_2COCl with ammonia. Include curly arrows and relevant lone pairs.

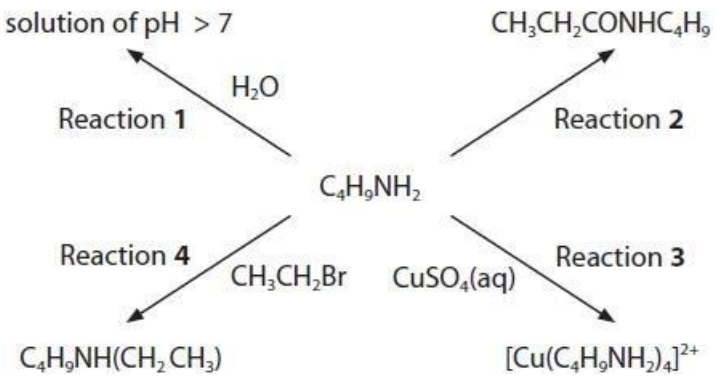
(3)

(Total for question = 3 marks)

Q16.

This question is about the amines butylamine, $C_4H_9NH_2$, and phenylamine, $C_6H_5NH_2$.

The reaction scheme shows some reactions of butylamine, a primary amine.



(i) Write the equation for Reaction **1** to show why the pH of the solution is greater than 7. State symbols are not required.

(1)

(ii) Explain why phenylamine is a weaker base than butylamine.

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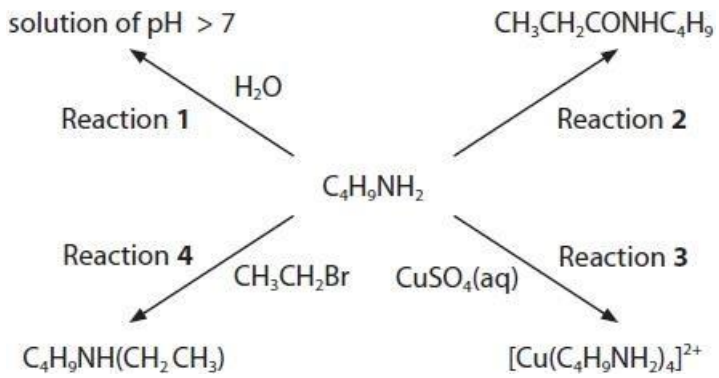
(Total for question = 4 marks)

Q17.

This question is about the amines butylamine, $C_4H_9NH_2$, and phenylamine, $C_6H_5NH_2$.

The reaction scheme shows some reactions of butylamine, a primary amine.



Give the name and structural formula of the compound needed to react with butylamine in Reaction **2**.

(2)

Name.....

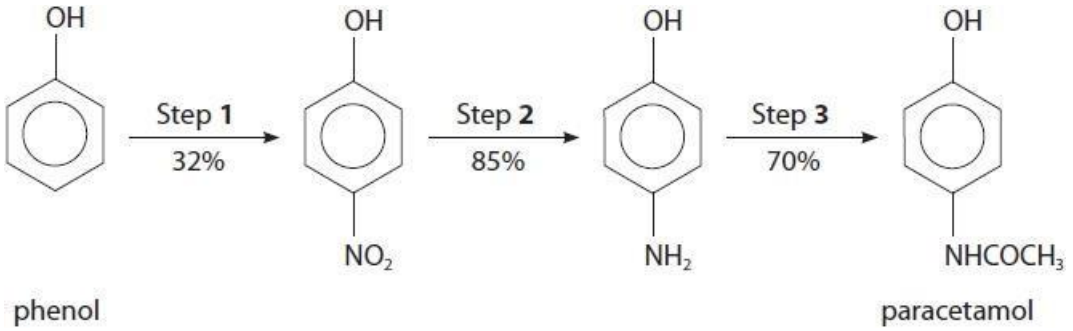
Structural formula.....

(Total for question = 2 marks)

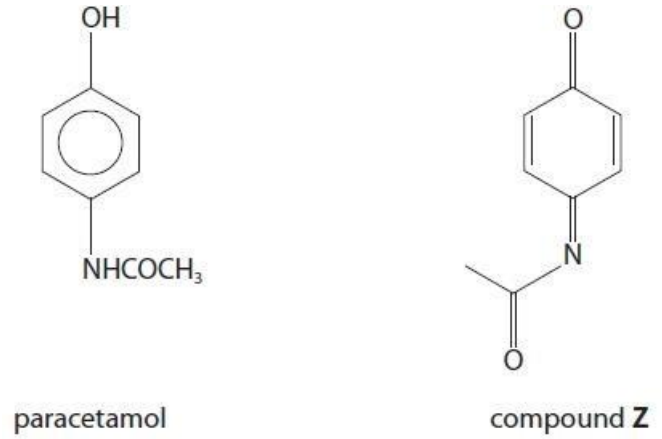
Q18.

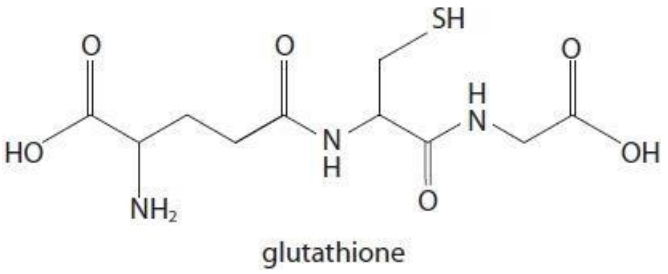
Answer the question with a cross in the box you think is correct ☒ . If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒ .

The painkiller paracetamol can be synthesised from phenol in three steps.
The percentage yield for each step is shown.



When metabolised in the body, paracetamol forms a toxic compound **Z**.
This is then removed in the liver by a reaction with the tripeptide glutathione.





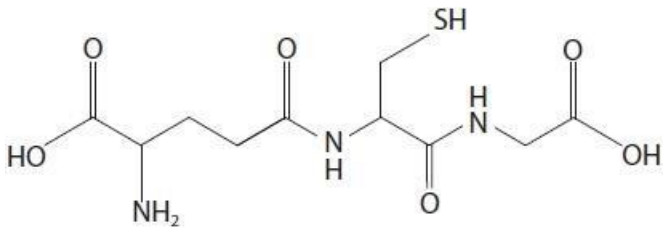
(i) The conversion of paracetamol to compound **Z** is

(1)

- ☐ **A** addition
- ☐ **B** hydrolysis
- ☐ **C** oxidation
- ☐ **D** reduction

(ii) Draw a circle around each of the chiral carbon atoms in glutathione.

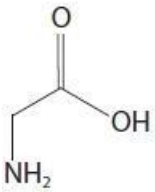
(1)



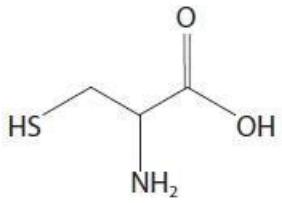
(iii) Glutathione is formed from glycine and two other amino acids.

Which two amino acids combine with glycine to form glutathione?

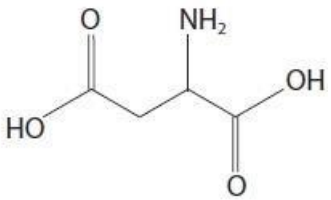
(1)



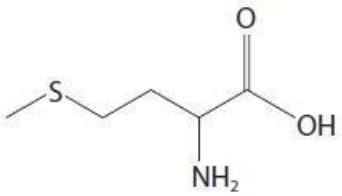
glycine



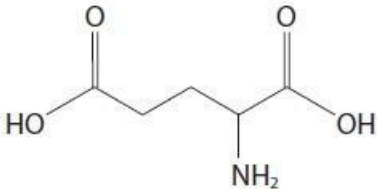
cysteine



aspartic acid



methionine



glutamic acid

- ☐ **A** aspartic acid and cysteine
- ☐ **B** glutamic acid and cysteine
- ☐ **C** glutamic acid and methionine
- ☐ **D** aspartic acid and methionine

(Total for question = 4 marks)

Q19.

This question is about amines.

Compare and contrast the basicity of phenylamine and butylamine.

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(Total for question = 3 marks)

Q20.

This question is about amines.

Write the equation for the reaction between propanoyl chloride and pentylamine.
Include the name of the amide formed.

State symbols are not required.

(2)

Name of amide
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(Total for question = 2 marks)