

Q1.

This question is about amines.

- (a) An incomplete equation for Step 1 in the reaction between bromoethane and an amine is shown.



Complete the equation.

In Step 2 of this reaction, the product of Step 1 forms a secondary amine.

Name the secondary amine formed.

Amine name _____

(2)

- (b) $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ reacts with NH_3

Draw the skeletal formula of the major organic product formed when

- an excess of NH_3 is used
- an excess of $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$ is used.

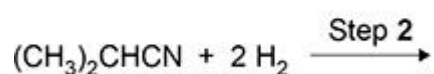
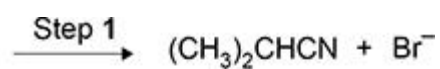
Product with excess NH_3

Product with excess $\text{CH}_3\text{CHBrCH}_2\text{CH}_3$

(2)

- (c) **Figure 1** shows a two-step synthesis to make amine **G**.

Figure 1



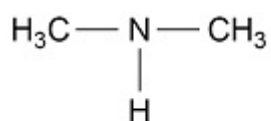
Amine G

Complete **Figure 1** by drawing the mechanism for Step 1 and the displayed formula of amine **G**.

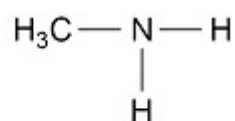
(3)

- (d) **Figure 2** shows two amines, **P** and **Q**.

Figure 2



Amine P



Amine Q

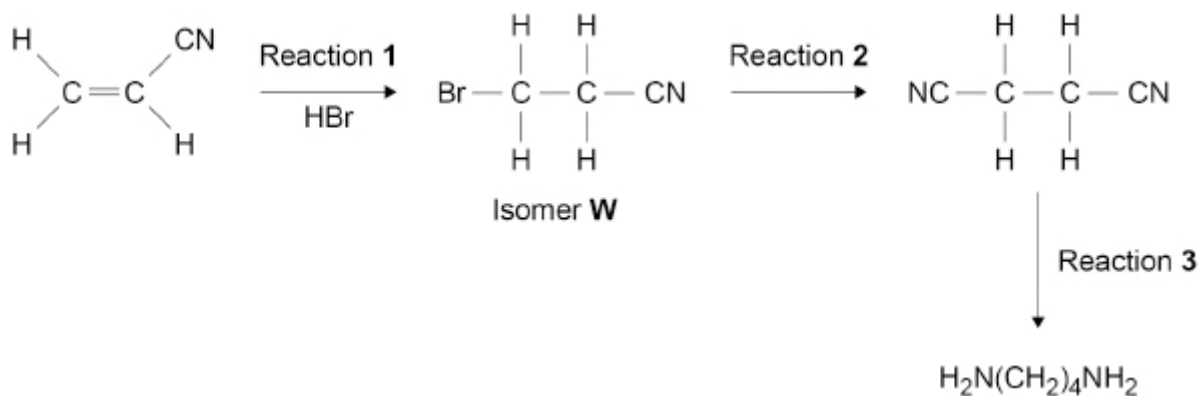
Explain why **P** is a stronger base than **Q**.

(2)

(Total 9 marks)

Q2.

Acrylonitrile, $\text{H}_2\text{C}=\text{CHCN}$, can be used as a starting material for the synthesis of butane-1,4-diamine, as shown in this reaction scheme.



- (a) Use IUPAC rules to name isomer **W**.

(1)

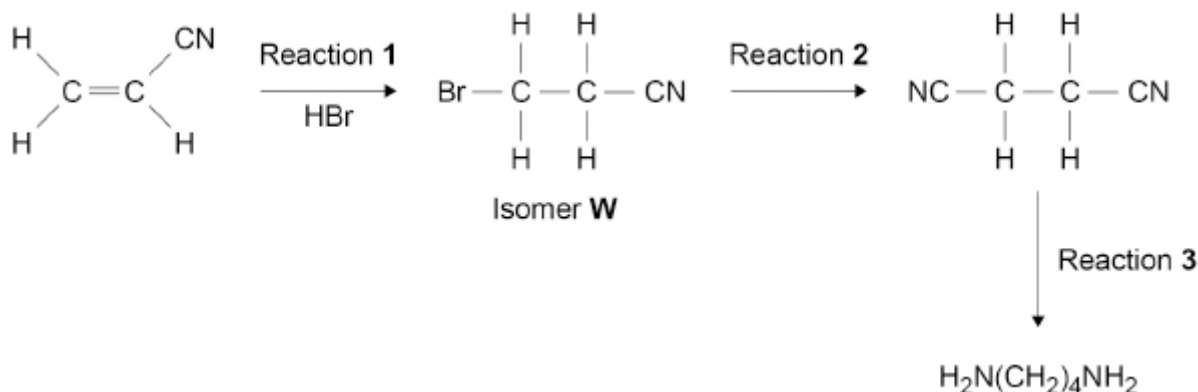
- (b) Reaction **1** produces a mixture of **W** and two other isomers.

Draw the structures of the two other isomers.

Explain, by considering the mechanism of this reaction, why all three isomers are formed.

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The reaction scheme is repeated here.



- (c) Identify the reagent that is warmed with isomer **W** in reaction **2**.

State the other reaction condition needed.

Reagent _____

Condition _____

(2)

- (d) State the reagent and reaction conditions needed for reaction **3**.

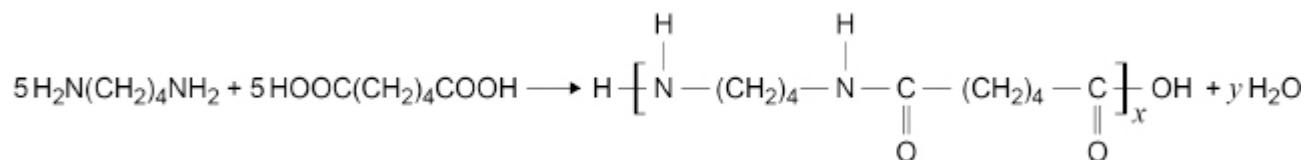
Give an equation for reaction **3**.

Reagent and conditions _____

Equation

(2)

- (e) An incomplete equation for the formation of nylon 4,6 from five molecules of butane-1,4-diamine and five molecules of hexanedioic acid is shown.

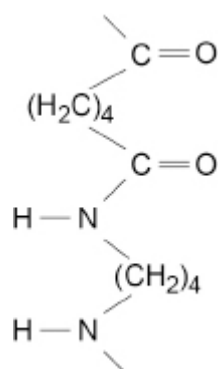


Deduce the values of x and y in this equation.

x _____ y _____

(2)

- (f) The figure below shows a section of the nylon 4,6 polymer molecule.



Draw, on the figure above, another section of nylon 4,6 polymer showing two hydrogen bonds between the two sections.

Draw, on the figure above, another section of nylon 4,6 polymer showing two hydrogen bonds between the two sections.

(2)

(Total 15 marks)