IB · HL · Chemistry

1 hour 9 questions

Structured Questions

From Models to Materials

Bonding Models / Bonding & Properties / Properties of Alloys / Polymers / Addition Polymers / Condensation Polymers (HL)

Easy (3 questions)	/18
Medium (3 questions)	/31
Hard (3 questions)	/21
Total Marks	**/70**

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Easy Questions

1 (a) Suggest why elements are found at the bottom of a triangular bonding diagram.

.....

(1 mark)

(b) Suggest the position of ionic and covalent materials within a triangular bonding diagram. Explain your answer.

.....

.....

(2 marks)

(c) Name the x-axis and y-axis on a standard triangular bonding diagram.

x-axis: .....

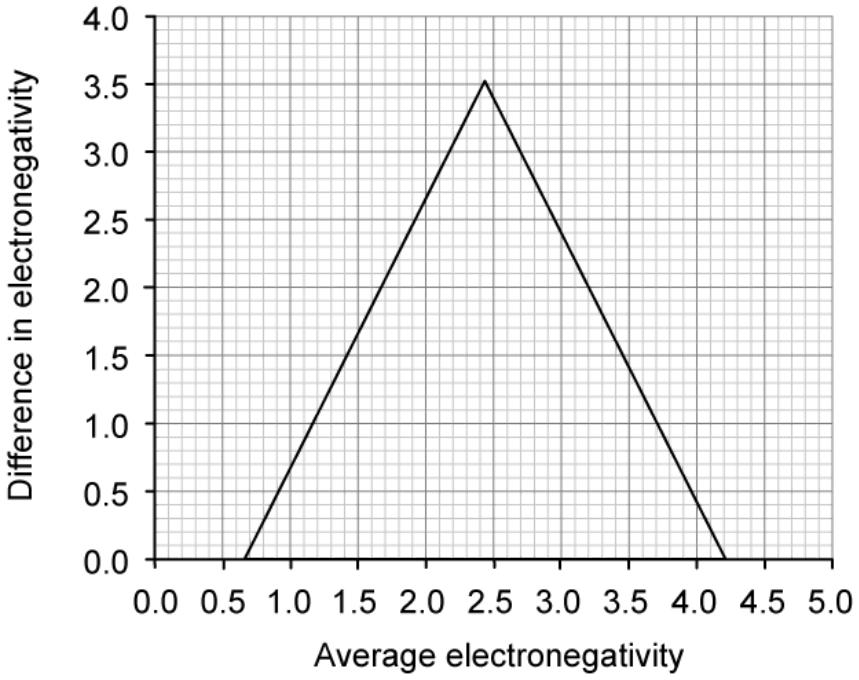
y-axis: .....

.....

.....

(2 marks)

(d) Using Sections 9 and 17 of the Data Booklet, plot nitrogen trifluoride (NF_3) on the triangular bonding diagram.



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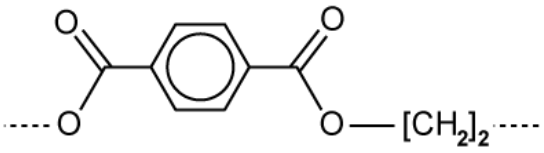
(1 mark)

2 (a) The structure of a synthetic polyester is shown below.



Deduce the structures of two monomers used to make this polyester.

.....

.....

(2 marks)

(b) One of the monomers is called benzene-1,4-dicarboxylic acid. State the name of the other one.

.....

(1 mark)

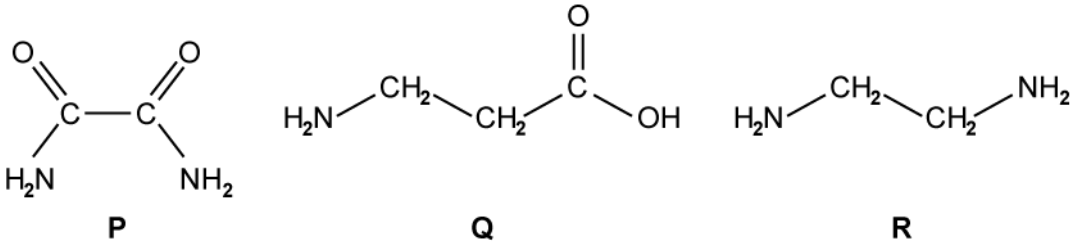
(c) Name the other product of the reaction between the two monomers in b).

.....

(1 mark)

(d) Benzene-1,4-dicarboxylic acid will also react to form a polyamide.

Which of the three molecules could react with benzene-1,4-dicarboxylic acid to form a polyamide?



P **Q** **R**

.....

(1 mark)

3 (a) Repeating monomer units can be manipulated in various ways to give polymers with different properties.

i) Draw the structural formula of 2-chloropropene.

[1]

ii) Deduce the repeating unit of poly(2-chloropropene).

[1]

.....

.....

(2 marks)

(b) Poly(2-chloropropene) is formed by the addition polymerisation of 2-chloropene. Deduce the percentage atom economy for this polymerisation reaction.

.....

(1 mark)

(c) Suggest why poly(2-chloropropene) is:

i) Unreactive.

[2]

ii) Strong.

[1]

iii) Water-resistant.

[1]

.....

.....

.....

.....

(4 marks)

Medium Questions

1 (a) The type of bonding and percentage ionic / covalent character of binary compounds can be deduced using triangular bonding diagrams.

Complete the table by calculating Σχ and Δχ for the given compounds.

Use section 9 of the data booklet.

Compound	Σχ	Δχ
Ammonia		
Graphite		
Silica		

(3 marks)

(b) Use data from sections 9 and 17 of the data booklet to percentage covalent character and bonding type in the following compounds:

i) BBr_3

[1]

ii) BeH_2

[1]

iii) SrMg

[1]

(3 marks)

(c) Deduce the chemical that is found in the bottom left of a triangular bonding diagram by using sections 9 and 17 of the data booklet.

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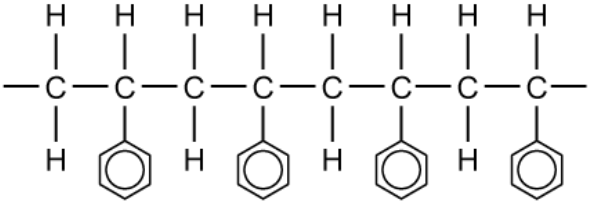
(1 mark)

2 (a) Poly(phenylethene) is widely used as a polymer for many purposes such as packaging. The structure of poly(phenylethene) is shown below.



i) State the type of polymerisation required to form poly(phenylethene).

[1]

ii) Draw the monomer used to form poly(phenylethene).

[1]

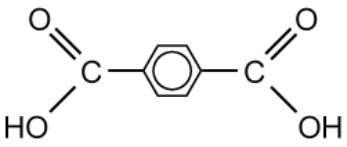
iii) Suggest why the monomer is liquid at room temperature but the polymer poly(phenylethene) is in the solid state at room temperature.

[2]

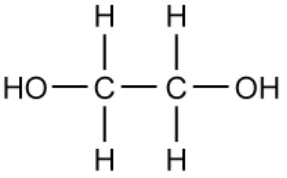
(4 marks)

(b) Terylene was one of the first man-made polymers produced to be used as fibres for clothing. The structures of the two monomers used to make Terylene are shown below.

Compound A



Compound B



i) Give the IUPAC names for Compound **A** and Compound **B**.

[2]

ii) Draw the structure of the repeating unit produced from these two monomers.

[1]

iii) Give the name of the linkage once the polymer has been formed.

[1]

iv) Explain why this is condensation polymerisation.

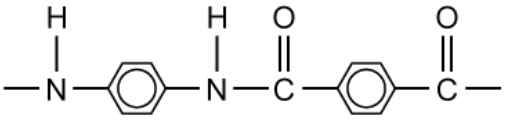
[1]

(5 marks)

(c) Explain why poly(phenylethene) drawn in part (a) is less reactive than Terylene described in part (b).

(6 marks)

3 (a) Kevlar is a polymer that is known for its use in bulletproof vests. Part of the structure of a Kevlar molecule is shown below.

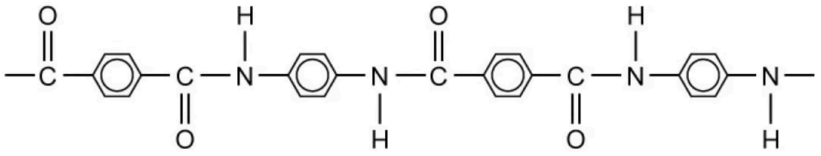


Draw the structural formulae of the monomers used to form Kevlar.

(2 marks)

(b) i) Draw a second strand of Kevlar underneath to show how the strands are attached to one another.

[2]



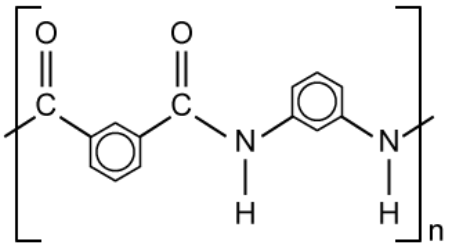
ii) Use your diagram to explain why Kevlar can be used for making items that require high strength.

[2]

(4 marks)

(c) Nomex is a condensation polymer related to Kevlar which is used to make the flame-resistant body suits worn by racing drivers.

The repeating unit of a Nomex molecule is shown below.



i) Draw the structural formulae of the monomers that are used to manufacture Nomex.

[2]

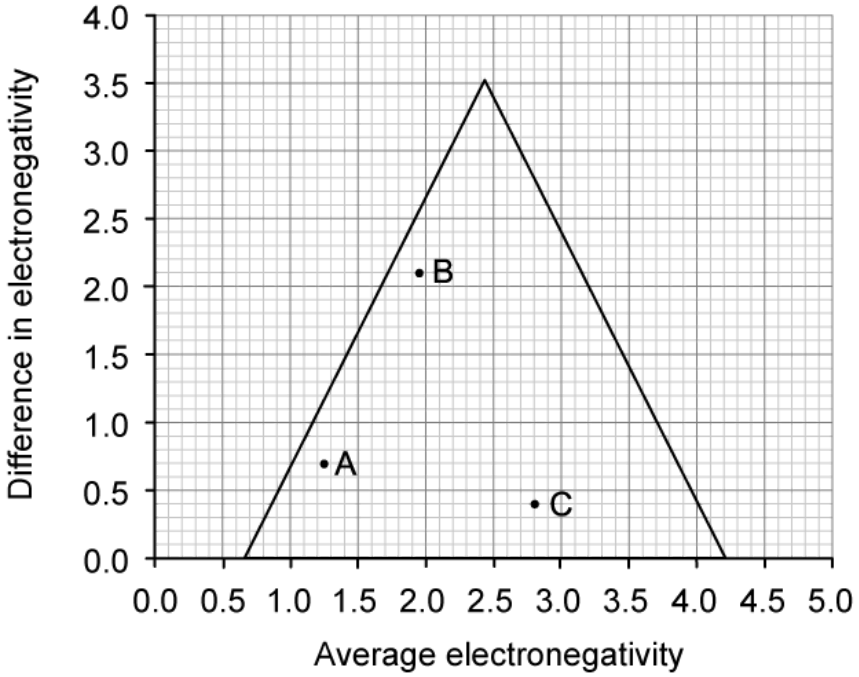
ii) State the formula of any by-products produced in the manufacture of Nomex.

[1]

(3 marks)

Hard Questions

1 (a) Substances **A**, **B** and **C** are located in the bonding triangle as shown.



Suggest, giving a reason, a physical property that substances **A** and **B** would have in common.

Use the bonding triangle and section 17 of the data booklet.

.....

.....

.....

(3 marks)

(b) Substance **A** is an alloy containing a Group 1 metal and a Group 2 metal.

Identify the constituent metals in substance **A**, giving a reason.

Use the bonding triangle in (a) and section 9 of the data booklet.

(2 marks)

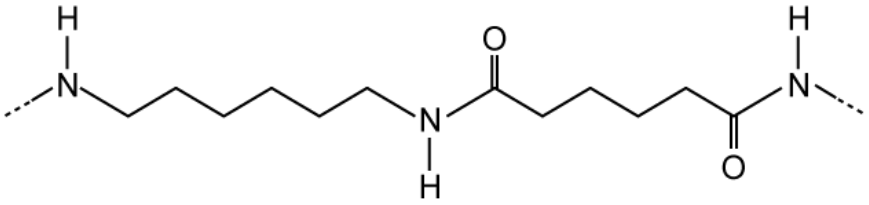
(c) Silicon tetrachloride is used to produce high purity silicon and silica for commercial applications.

Explain whether silicon tetrachloride has a higher boiling point than substance **C**.

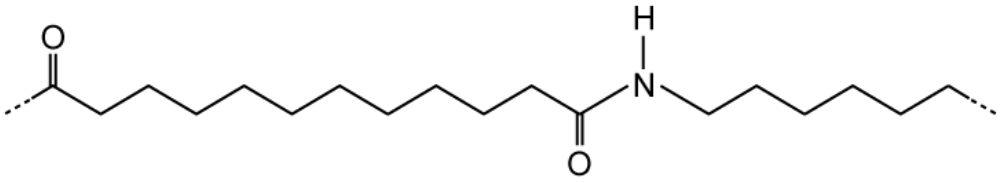
Use the bonding triangle in (a) and sections 9 and 17 of the data booklet.

(1 mark)

2 (a) Nylon-6,6 and nylon-6,12 are two condensation polymers made from hexane-1,6-diamine and another monomer.



Nylon - 6,6



Nylon - 6,12

Draw the skeletal formula of the other monomer that could be used to make nylon-6,12

(1 mark)

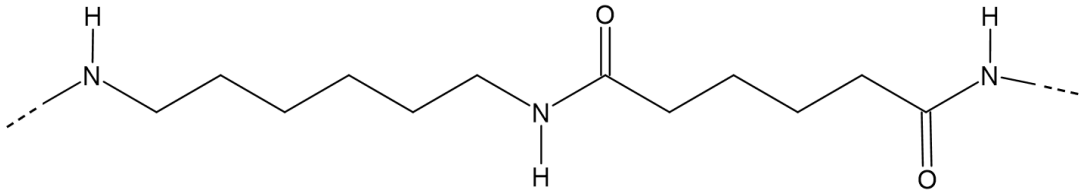
(b) Suggest why nylon-6,12 has a lower melting point and lower strength than nylon-6,6.

(2 marks)

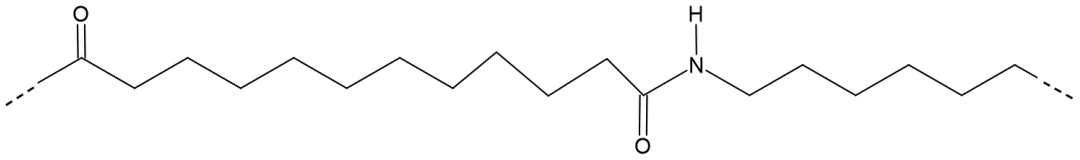
(c) Another type of nylon is nylon-6. Suggest how it is possible to make nylon-6 and draw the repeat unit.

(2 marks)

(d) Sections of the polymer chain for nylon-6,6 and nylon-6,12 are shown below.



nylon-6,6



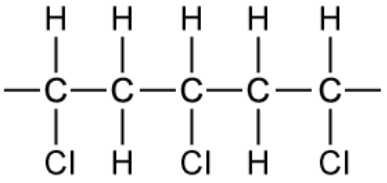
nylon-6,12

Complete the table by adding information about the repeat units.

Polymer	**Nylon-6,6**		**Nylon-6,12**	
Group	$-CH_2-$	-CONH -	$-CH_2-$	-CONH-
Number of groups in the repeat units				

(2 marks)

3 (a) The structure shows a section of a polymer found in some plastics.



i) State the type of polymerisation involved in forming this polymer.

[1]

ii) Draw the repeating unit for this polymer.

[1]

iii) Name the monomer used to form this polymer.

[1]

.....

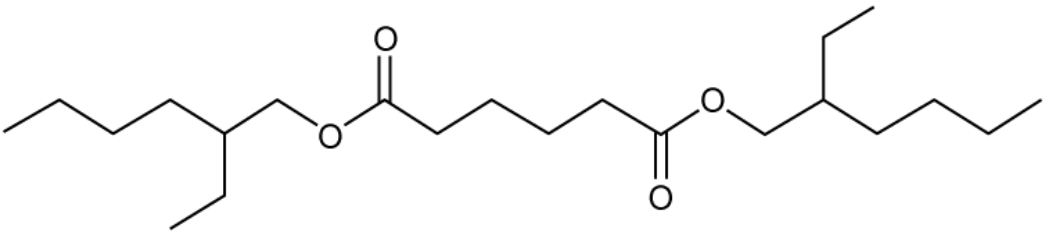
.....

.....

(3 marks)

(b) Bis(2-ethylhexyl) adipate, shown in **Figure 2**, was one of the first plasticisers used to soften polychloroethene from the rigid plastic used for drain pipes and guttering to its more flexible version used in clingfilm.

Figure 2



Explain how this plasticiser softens polychloroethene.

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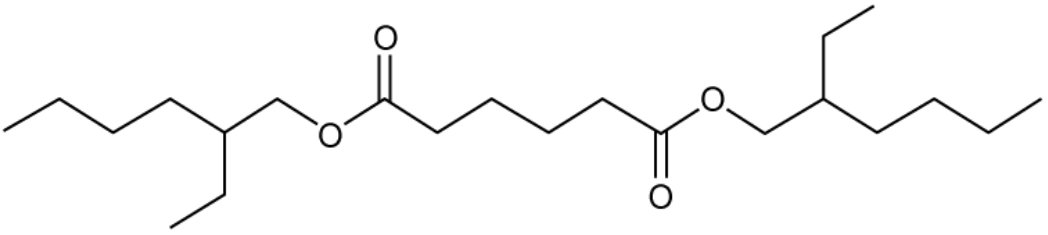
(2 marks)

(c) The structure of bis(2-ethylhexyl) adipate is shown.



It was one of the first plasticisers used to soften polyvinyl chloride from the rigid plastic used for drain pipes and guttering to its more flexible version used in clingfilm.

Name the chemicals used to make bis(2-ethylhexyl) adipate.

.....

(1 mark)

(d) Explain why the chemicals, identified in (c), that are used to make bis(2-ethylhexyl) adipate cannot form a condensation polymer.

.....

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(2 marks)