Hydrocarbons – 2022 Nov A2 Chemistry 9701

1. Nov/2022/Paper_41/No.7

(a) The structure of compound P is shown in Fig. 7.1.

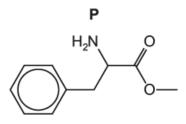


Fig. 7.1

(i) P is optically active.

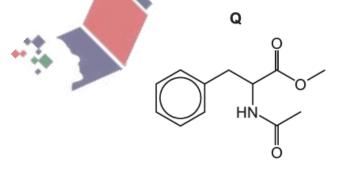
Use an asterisk (*) to identify all chiral carbon atoms on the structure of **P** in Fig. 7.1. [1]

(ii) Plane polarised light is passed through a pure sample of one enantiomer of **P**. This is then repeated with a pure sample of the other enantiomer of **P**.

Describe the results of these two experiments, stating the similarities and differences of the results.

2		
4		•
	(1)	1
	T	-1

(b) P can be used to make compound Q in a single step reaction.



(i) Give the structural formula of the compound that is added to **P** to make **Q** and give the formula of the other product of this reaction.

other product

[1]

(ii) When an ester is treated with LiA*l*H₄ in dry ether the ester linkage is cleaved by the addition of four hydrogen atoms and two alcohols are produced.

Draw the structures of the compounds formed when ${\bf Q}$ is treated with an excess of LiA lH_4 in dry ether.

(iii)	Compare the relative basic	ities of compound P , compound Q and phenylamine.	
	least basic	most basic	
	Explain your answer.		
			3]

(c) P can be used to make compound R in a two-step reaction, shown in Fig. 7.2.

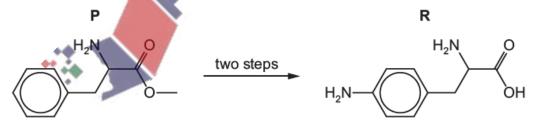


Fig. 7.2

[2]

[3]

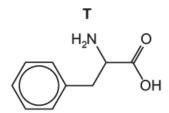
(ii) Complete Table 7.1 by drawing the structures of the organic products formed when R is treated separately with the reagents given.

Table 7.1

reagent	product
HNO₂(aq) at 4°C	
an excess of Br₂(aq) at room temperature	aildoe
	apacanni

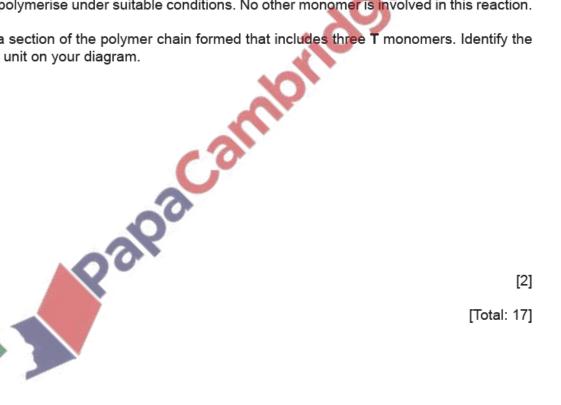
[2]

(d) P can be used to produce compound T.



- (i) In aqueous solution, T has a property called an isoelectric point. Explain what is meant by isoelectric point.
- (ii) T can polymerise under suitable conditions. No other monomer is involved in this reaction. Draw a section of the polymer chain formed that includes three T monomers. Identify the repeat unit on your diagram.

......[1]



2. Nov/2022/Paper_41/No.8

Benzene, C₆H₆, is an aromatic molecule.

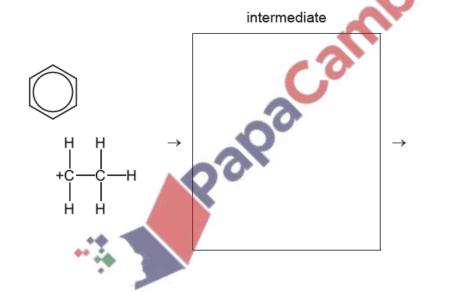
(a	a)	State the C	C-C-C	bond	angle	and t	the h	vbridisatio	n shown	bv th	e carbon	atoms i	in	benzene
١-	~,			~~	~	—		. ,		. ~ ,				~~~

bond angle	
hybridisation	
	[1]

- (b) Benzene reacts with chloroethane in the presence of a catalyst. The reaction mechanism is called electrophilic substitution.
 - (i) The first step in the reaction is the generation of the ⁺CH₂CH₃ electrophile.

Write an equation for the reaction that generates this electrophile.

(ii) Describe the mechanism for the reaction between benzene and the ⁺CH₂CH₃ electrophile. Include all relevant curly arrows and charges.



products

[3]

(c)		orobenzene and chloroethane have different reactivities in nucleophilic substitution ctions.
	(i)	Identify a suitable reagent to illustrate this difference in reactivity.
		The reagent chosen should give ${\it visibly}$ different results with chlorobenzene and chloroethane.
		[1]
	(ii)	Write equations to describe any reactions that occur.
		[1]
(iii)	Explain the difference in the reactivities of chlorobenzene and chloroethane in nucleophilic substitution reactions.
		[1]
		[Total: 8]

3. Nov/2022/Paper_42/No.7

(a) The structural and displayed formulae of three aromatic compounds, A, B and C, are shown in Fig. 7.1.

	С	₆ H ₅ CH ₂ CH ₂ COOH	CH ₃ C ₆ H ₄ OH	$C_6H_5CH_2CHC1CO_2H$
		HOO	OH	HOOCI
		Α	В	.0
			Fig. 7.1	20
	Cor	mpare the relative acidit	ies of A, B and C.	
		most acidic	>	least acidic
	Exp	olain your answer.	(311	
) 0	[3]
(b)	Me	thylb <mark>en</mark> zene, C ₆ H ₅ CH ₃ , o		an electrophilic substitution reaction.
	(i)	Identify a compound the Identify the catalyst us	nat reacts with benzene to forr ed.	n methylbenzene.
		compound		
		catalyst		[1]
	(ii)	The first step in the rea	action is the generation of the	
		Write an equation for t	he reaction that generates this	s electrophile.
				[1]

(iii) Describe the mechanism for the reaction between benzene and the CH₃⁺ electrophile. Include all relevant curly arrows and charges.



[3]

(iv) Identify a suitable reagent to oxidise methylbenzene to benzoic acid, C₆H₅COOH.

Write an equation for this reaction using [O] to represent one atom of oxygen from the oxidising agent.

reagent	
equation	
- 1	[2]

(v) Methylbenzene and benzoic acid are both nitrated with a mixture of concentrated nitric acid and sulfuric acid to give mononitrated products. The structural formulae of these products are CH₃C₆H₄NO₂ and HOOCC₆H₄NO₂ respectively.

Draw the structures of these two products.



[1]

(c) A reaction scheme is shown in Fig. 7.2.

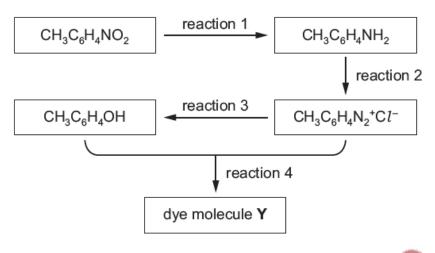


Fig. 7.2

(1)	reaction 2.	conditions to produce	CH ₃ C ₆ H ₄ N ₂ Ct	Trom Ch ₃ C ₆ h₄Nh ₂ in
	reagents			
		N N		
	conditions			

- (ii) Describe how $CH_3C_6H_4OH$ can be produced from $CH_3C_6H_4N_2^+Cl^-$ in reaction 3.
- (iii) Draw the structure of the dye molecule Y formed when $CH_3C_6H_4N_2^+Cl^-$ and $CH_3C_6H_4OH$ react together in reaction 4. Describe the conditions for this reaction.





conditions[2]

[Total: 15]

[1]