## SRJC 2014 Prelim H2 Chemistry Paper 3 Answers

1	Singapore has hosted the Formula One Grand Prix since 2008. This car racing event sees race car drivers from around the world compete in a circuit to win the top honour of a race car champion.								
	These race cars are fuelled by petrol, which is a mixture of hydrocarbons. One such hydrocarbon is pure liquid octane, $C_8H_{18}$ .								
	(a)	(i)	Define the ter	m standard enthalpy chan	ge of combustion.				
			Standard ent <u>evolved</u> whe under <u>standa</u> OR Cellia (I) + <sup>25</sup>	Standard enthalpy change of combustion $(\Delta H_c^{\theta})$ of a substance is the <u>energy</u> <u>evolved</u> when <u>one mole</u> of the substance is <u>completely burnt in oxygen</u> under <u>standard conditions</u> .					
		(ii)	$\frac{08118}{2}$	in the table below to calc	$\Sigma_{\rm cl}$	ny change of			
		()	combustion o	f octane. Hence calculate	the heat evolved per gram	of octane.			
				species	∆ <i>H</i> <sub>f</sub> / kJ mol <sup>-1</sup>				
				C <sub>8</sub> H <sub>18</sub> ( <i>l</i> )	-269				
				CO <sub>2</sub> (g)	-394				
				$H_2O(l)$	-286				
				$C_8H_{18}(l) + \frac{25}{2}O_2(g) -$	→ 8CO₂(g) + 9H₂O( <i>l</i> )				
				-269	8(-394) + 9(	-286)			
				8C(s) + 9H	$I_2(g) + \frac{25}{2}O_2(g)$	,			
			By Hess' L	aw.	2				
			$\Delta H_c = 269$	+ 8(-394) + 9(-286) = <u>- 546</u>	60 kJ mol <sup>-1</sup>				
			OR						
			$\Delta H_{c} = \Delta H_{f}$ $= 269 \pm 80$	$(\text{products}) - \Delta H_f (\text{reactants})$	s) I mol <sup>-1</sup>				
			$= 269 + 8(-394) + 9(-286) = -5460 \text{ kJ mol}^{-1}$ Heat evolved per gram of octane = $\frac{5460}{114} = \frac{47.9 \text{ kJ g}^{-1}}{114}$						

	(iii)	Methanol, CH <sub>3</sub> OH, is also commonly used as a fuel for high-performance engines in race cars. Due to the high temperature in car engines, methanol is converted to the vapour state. Use the bond energies given in the <i>Data Booklet</i> to calculate the standard enthalpy change of combustion of methanol. Hence calculate the heat evolved per gram of methanol. CH <sub>3</sub> OH( <i>l</i> ) + $\frac{3}{2}$ O <sub>2</sub> (g) $\rightarrow$ CO <sub>2</sub> (g) + 2H <sub>2</sub> O(g) Bonds broken in the reactants : 3C-H, C-O, O-H, $\frac{3}{2}$ O=O Bonds formed in the products: 2C=O, 4 O-H $\Delta$ H <sub>c</sub> = $\Sigma$ BE(reactants) – $\Sigma$ BE(products) = 3(410) + 360 + 460 + $\frac{3}{2}$ (496) – 2(740) – 4(460) = $\frac{-526 \text{ kJ mol}^{-1}}{1}$ Heat evolved per gram of methanol = $\frac{526}{32}$ = $\frac{16.4 \text{ kJ g}^{-1}}{1}$				
	(iv)	Using your answers in <b>(a)(ii)</b> and <b>(a)(iii)</b> , suggest an advantage of using liquid octane over methanol as the fuel in race cars.				
		It gives out <u>more heat energy</u> per gram of fuel.				
		[6]				
(b)	Methyl dehyd	benzene is a component of lead-free petrol. It is synthesised by cyclising and rogenating heptane.				
	Methyl straigh contair	Methylbenzene can be made by catalytic reforming of heptane. This process causes straight chain hydrocarbons between 6 to 8 carbon atoms to rearrange into compounds containing benzene rings.				
	This p about	process requires a platinum catalyst, high temperature of 500 °C and pressure of t 20 atm.				
	$C_7H_{16}(g) \longrightarrow C_7H_8(g) + 4H_2(g)  \Delta H > 0$					
	(i)	State Le Chatelier's Principle.				
	Le Ch system reache	atelier's Principle states that when a <u>system in equilibrium is disturbed</u> , the n will react to <u>counteract the effect</u> of the change until a <u>new equilibrium</u> is ed.				

	(ii)	Suggest reasons why these operating conditions are used.				
	•	At low pressure, by Le Chatelier's Principle, the position of equilibrium shifts to				
		the <b>right to increase total amount</b> (in mol) of gases. Hence, <b>high</b> yield of				
	<ul> <li>In addition, the reaction reaches equilibrium faster.</li> </ul>					
	• In addition, the reaction reaches equilibrium faster.					
	•	A <u>catalyst</u> is used to <u>increase the rate of reaction</u> / <u>to achieve equilibrium</u>				
		at a shorter time.				
		At high temperature, by Le Chatelier's Dringiple, the position of equilibrium				
	•	shifts to the <b>right to absorb heat</b> , favouring the endothermic reaction. Hence,				
		high yield of methylbenzene is obtained.				
		[4]				
 (c)	Comp	ound <b>P</b> has the molecular formula $C_5H_9ON$ .				
. ,	•					
	•	P exhibits optical isomerism, is neutral, and reacts with sodium metal.				
	•	On reacting <b>P</b> with lithium aluminium hydride, compound <b>Q</b> , $C_5H_{13}ON$ , is				
		formed.				
	•	When <b>Q</b> is refluxed with aqueous acidified potassium manganate(VII),				
		<b>R</b> , $C_5H_{11}O_2N$ is obtained.				
	•	The addition of thionyl chloride, $SOCl_2$ to <b>R</b> produces <b>S</b> .				
	•	Under suitable conditions, <b>S</b> forms <b>T</b> , $C_5H_9ON$ , which is neutral, along with				
white fumes of HC <i>l</i> .						
	Explai	n and identify the structures of <b>P, Q, R, S</b> and <b>T</b> .				
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Total 20 marks

2	Iron colo	forms compounds mainly in the +2 and +3 oxidation states. Iron compounds are ured and were widely used in paintings during the 19 <sup>th</sup> century.				
	(a)	Explain why iron exhibits variable oxidation states but not calcium.				
		[2]				
		<ul> <li>Iron possesses variable oxidation states due to the <u>small energy level</u> <u>difference between the 3d and 4s electrons</u>. This results in different numbers of 3d and 4s electrons lost to form stable ions and compounds of different oxidation states.</li> <li>Calcium is restricted to oxidation numbers of +2 (Group II) because once the s electrons are removed, further <u>removal of inner shell electrons will require too much energy</u>.</li> </ul>				
	(b)	Explain why most iron compounds are coloured.				
		[3]				
		<ul> <li>The presence of <u>ligands splits the 3d orbitals</u> of the iron atom or ion into <u>two</u> <u>energy levels</u>. This is called d-orbital splitting.</li> <li>A <u>3d electron absorbs certain wavelengths of light energy</u> from the <u>visible</u> <u>region of the electromagnetic spectrum.</u></li> <li>The <u>3d electron</u> undergoes d-d transition and is <u>promoted to a higher energy</u> <u>d orbital</u>.</li> <li>The <u>complementary wavelengths</u> are <u>transmitted/reflected</u> and appear as the <u>colour observed</u>.</li> </ul>				
	(c)	When Vincent van Gogh painted the "The Starry Night" in 1889, he used a lot of the pigment known as Prussian Blue, which is an iron complex, $Fe_4(Fe(CN)_6)_3$ .				
		Draw the structure of the complex ion in Prussian Blue, stating the oxidation number of iron in the complex ion. [2]				
		$\int_{NC} \int_{CN} $				



	(i)	Use diagrams, like the one on page 4 a Fe <sup>3+</sup> ion in a high spin state and in th	, to show the electronic configuration of ne low spin state.		
		Show in your diagram, the relative size of the energy gap, $\Delta E$ , for each spin state.			
			[6]		
		Fe <sup>3+</sup> ion: 1s <sup>2</sup> 2s <sup>2</sup> 2p <sup>6</sup> 3s <sup>2</sup> 3p <sup>6</sup> 3d <sup>5</sup>			
		11			
		energy gap, ∆l	=1		
		high spin state			
		energy gap, $\Delta E_2$			
		low spin state $\Delta E_1 < \Delta E_2$			
		Many transition elements and their	compounds are paramagnetic, which		
		means that they are attracted to a ma presence of unpaired electrons in the	ignetic field. This property is due to the doubter of the doubtero		
		Relative paramagnetism is directly proportional to the number of unpaired electrons in the d orbitals.			
		The table below shows the relative paramagnetism of some iron complexes.			
		formula of complex relative paramagnetism			
		[Fe(H <sub>2</sub> O) <sub>6</sub> ] <sup>3+</sup>	5		
		[Fe(CN) <sub>6</sub> ] <sup>3–</sup>	1		

	(ii)	Using your answer to <b>(e)(i)</b> and the information given above concerning paramagnetism of the different complexes, state and explain which ligand, $H_2O$ or $CN^-$ , will cause a larger energy gap, $\Delta E$ , between its d orbitals.				
		CN <sup>-</sup> will cause a larger energy gap E between its d-orbitals				
		In the presence of CN <sup>-</sup> ligands, the relative paramagnetism is lower. This means that <u>electrons are paired up/ less unpaired electrons and</u> <u>arranged in a low spin state</u> . Hence, the energy gap is larger.				
		OR In the presence of H <sub>2</sub> O ligands, the relative paramagnetism is higher. This means that <u>electrons are not paired up/ more unpaired electrons and</u> <u>arranged in a high spin state</u> . Hence, the energy gap is smaller.				
	(iii)	Deduce the relative paramagnetism of $[Co(H_2O)_6]^{2+}$ , given that a solution containing $[Co(H_2O)_6]^{2+}$ is pink in colour.				
		Co <sup>2+</sup> : [Ar] 3d <sup>7</sup>				
		Relative paramagnetism is <u>1</u> .				
		energy gap, $\Delta E_2$				
		Since the color seen is in the long wavelength region, it means that the 3d electrons absorbs light energy corresponding to the shorter				
		wavelengths/ wavelength corresponding to green light. Hence, the energy gap is large and the electrons are paired up and arranged in a				
		low spin state.				
(f)	Sider	ite is a mineral composed of iron(II) carbonate. It is a valuable iron mineral,				
	SINCE	ce it is 48% by mass of iron and contains no sulfur or phosphorus.				
	Limes	estone which compose of calcium carbonate, is a common substance found				
	(i)	Explain, with reasoning, why calcium carbonate has a higher decomposition				
		<ul> <li>Fe<sup>2+</sup> has a <u>smaller ionic radius</u> compared to Ca<sup>2+</sup>.</li> <li>Fe<sup>2+</sup> has <u>higher charge density and greater polarising power</u>, hence <u>greater polarising effect on CO<sub>3</sub><sup>2-</sup> anion</u> electron cloud.</li> <li>FeCO<sub>3</sub> is less thermally stable than CaCO<sub>3</sub>.</li> <li>CaCO<sub>3</sub> has a higher decomposition temperature.</li> </ul>				

		(ii)	(ii) Explain, with reasoning, whether the third ionisation energy of Ca is larger or smaller than that of iron					
			smaller than that of Iron. [4]					
			$\begin{array}{cccc} Ca^{2+} & \rightarrow & Ca^{3+} + e \\ 1s^2 2s^2 2p^6 3s^2 3p^6 & 1s^2 2s^2 2p^5 3s^2 3p^5 \\ & Fe^{2+} & \rightarrow & Fe^{3+} + e \\ 1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 & 1s^2 2s^2 2p^5 3s^2 3p^5 3d^5 \\ \bullet & \underline{Ca \text{ will have a higher 3}^{rd} \text{ IE.}} \\ \bullet & \text{The removal of the 3}^{rd} \text{ electron form Ca is from } \underline{an \text{ inner 3p subshell.}} \\ \bullet & \underline{Electrostatic \text{ forces of attraction}} \text{ between the } \underline{nucleus} \text{ and} \\ & \underline{valence electrons is stronger.} \end{array}$					
3	Mag appli relat	nesiur ication ionshi	n and its compounds are used as commercial products and in industrial is. Lithium compounds resemble those of magnesium due to their diagonal p in the Periodic Table.					
	(a)	(i)	In aqueous solutions, both magnesium and lithium cations exist as $[M(H_2O)_n]^{y+}$ , where <i>n</i> is the solvation number and <i>y</i> is its overall charge. Construct a balanced equation to illustrate the behaviour of magnesium ion in					
			water. Hence, suggest a pH value of the resulting solution.					
			$Mg^{2+} (aq) + 6H_2O (l) \rightarrow [Mg(H_2O)_6]^{2+} (aq)$ [Mg(H <sub>2</sub> O) <sub>6</sub> ] <sup>2+</sup> (aq) ≈ [Mg(H <sub>2</sub> O) <sub>5</sub> (OH)] <sup>+</sup> (aq) + H <sup>+</sup> (aq)					
			<u>рН 6.5 (accept 5.5 to 6.9)</u>					
		(ii)	Despite having similar charge density, the solvation number, <i>n</i> , is 4 for Li <sup>+</sup> . Suggest one reason for this. [3]					
			Lithium has a very <b>small ionic radius</b> , hence it may only accommodate 4 water molecules around it due to steric reasons.					
			Or Lithium has <u>no energetically accessible d orbitals</u> to accept the lone pair of electrons from ligands.					
			Or Lithium is in <u>period 2</u> thus <u>cannot expand its octet structure</u> .					
	(b)	Magi reag piece follov	nesium forms an important group of covalent compounds known as Grignard ents. In preparation of Grignard reagents, a halogenoalkane is added to small es of magnesium in a flask containing dry ether as solvent. The reaction is as ws: $CH_2Br + Mq \rightarrow CH_2MqBr$					
		$CH_3Br + Mg \rightarrow CH_3MgBr$ This Grignard reagent can be used to synthesise propan-2-ol from ethanal. The reaction takes place in two stages as shown below:						

	Stag	$ge 1: CH_3MgBr + \underbrace{H}_{CH_3}C=0 \longrightarrow CH_3 - \underbrace{H}_{CH_3}O-MgBr$ $ge 2: CH_3 - \underbrace{H}_{CH_3}O-MgBr \xrightarrow{H_2O} CH_3 - \underbrace{H}_{CH_3}O-H + Mg(OH)Br$ $GH_3 - \underbrace{H}_{CH_3}O-H + Mg(OH)Br$
	(i)	State the type of reaction taking place in Stage 1.
		Nucleophilic addition
	(ii)	Organolithium compounds are synthesised in the similar way as the Grignard reagent described above. An additional lithium salt is produced as by- product. Write an equation to show how the lithium alkyl is formed when bromoethane is added to lithium metal.
		$CH_3CH_2Br + 2Li \rightarrow CH_3CH_2Li + LiBr$
	(iii)	Compound U, shown below, may be synthesised using the lithium alkyl produced in (b)(ii) reaction.
		Suggest a suitable carbonyl compound that can be used to synthesise compound <b>U</b> . [3]
		O H Carbonyl compound:
(c)	In th hydro Magu Final	e production of magnesium from seawater, magnesium is precipitated as its oxide and converted to its chloride by reaction with hydrochloric acid. nesium chloride is then recovered by evaporation of its aqueous solution. Ily, magnesium metal is obtained by electrolysis of the molten salt.

	(i)	During the electrolysis of molten magnesium chloride using inert electrodes, a current of 8.0 A was passed through the cell for 67 hours.					
		Calculate the mass of magnesium extracted.					
		Mg <sup>2+</sup> + 2e → Mg Amt of magnesium = $\frac{It}{n_eF} = \frac{8.0 \times 67 \times 3600}{2 \times 96500} = 10.0$ mol Mass of magnesium formed = 10.0 x 24.3 = <b>243 g</b>					
	(ii)	Chlorine gas produced at the anode is then pumped into reinforced cylinders each with a capacity of 2.0 dm <sup>3</sup> . All cylinders are maintained at a pressure of 1100 kPa and 25 °C. Determine the amount of chlorine gas produced and hence the number of cylinders needed to store the chlorine gas produced in this duration.					
		Let n be the amount of chlorine gas stored in each cylinder. PV = nRT $1100000 \times 0.002 = n(8.31 \times (25+273))$ n = 0.8884  mol Since Mg $\equiv Cl_2$ Amt of chlorine gas produced = 10.0 mol Number of cylinders filled = 10.0 / 0.8884 = 11.2 Thus, <u>12 cylinders</u> are needed.					
	(iii)	In a similar electrolytic set-up involving magnesium chloride, oxygen gas and hydrogen gas were produced instead. Construct an overall equation for this electrolysis. Hence, draw a fully labelled diagram of the electrolytic cell you would set up to collect these gases under standard conditions. Show clearly the relative volume of gases on your diagram. [9]					
		Overall reaction: $2H_2O \rightarrow 2H_2 + O_2$					



4	Before the mid 1800s, major surgery was often fatal due to post-operative infections. This changed in the 1860s when Joseph Lister developed antiseptic surgery using phenol to sterilise wounds and instruments.						
	In fa	In fact, most phenolic derivatives have antiseptic properties. The active germ-killing ingredient in <i>Dettol<sup>®</sup></i> is 4-chloro-3,5-dimethylphenol, also known as PCMX.					
		ОН					
		Ċ <i>l</i> PCMX					
	(2)	The pK values of weak acids are given below					
	(a)	• PCMX $pK_a = 9.7$					
		• phenol p $K_a = 9.9$					
		• ethanol $pK_a = 15.9$ Account for the difference in acidity of the acids. [4]					
		<ul> <li>Ethanol: The electron-donating alkyl group increases the intensity of the negative charge on the oxygen atom of the alkoxide ion compared to OH<sup>-</sup>.</li> <li>The CH<sub>3</sub>CH<sub>2</sub>O<sup>-</sup> ethoxide ion (conjugate base/anion) is destabilised</li> <li>Hence, ethanol is a weaker acid.</li> </ul> Phenol and PCMX: The p-orbital of oxygen overlaps with the <u>π electron cloud</u> of the benzene ring This results in the delocalisation of negative charge on the oxygen into the ring which reduces the intensity of the negative charge on the oxygen atom. Conjugate base is <u>stabilised</u> by resonance Hence, phenol is more acidic than ethanol. PCMX contains electron withdrawing Cl which further disperse the negative charge on the conjugate base. PCMX is the most acidic					
	(b)	Given that the solubility of PCMX is 330 mg dm <sup>-3</sup> , use relevant information from <b>(a)</b> to calculate the pH of a saturated solution of PCMX. <b>[2]</b>					
		330 mg = 0.33 g 0.33 / 156.6 mol = 2.11 x 10 <sup>-3</sup> mol in 1 dm <sup>3</sup> initial [PCMX <sub>(aq)</sub> ] = <b>2.11 x 10<sup>-3</sup> mol dm<sup>-3</sup></b> $[H^+] = \sqrt{K_a xc}$ $= \sqrt{(1.99 x 10^{-10}) x (2.11 x 10^{-3})}$ $= 6.48 x 10^{-7} mol dm^{-3}$ pH = -log <sub>10</sub> [H <sup>+</sup> ] = <u>6.19</u>					







	Amount of propanone = $\frac{1.00}{58}$ = 0.01724 mol							
			$[propanone] = \frac{0.01724}{0.025} = 0.6897 \text{ mol dm}^{-3}$					
				CH₃COCH₃ (a	q) + H₂O (/)	$\stackrel{\simeq}{}$ (CH <sub>3</sub> ) <sub>2</sub> C(OH) <sub>2</sub> (aq)		
			<u>I</u> nitial conc / mol dm <sup>-3</sup>	0.6897	55.5	0		
			Change in conc /         -0.0497         -         +0.0497           mol dm <sup>-3</sup> -         -					
			Equilibrium conc / mol dm <sup>-3</sup>	0.6400	55.5	0.0497		
			K <sub>c</sub> = [1,1 diol] [propanone][	$\frac{0.0497}{1120} = \frac{0.0497}{0.6400 \ x \ 55.5}$	<del>5</del> = 1.40 x 10 <sup>-3</sup> mol <sup>-1</sup>	dm <sup>3</sup>		
			$\Delta G^{\Theta} = -RT \ln F$	≪ =- (8.31) (29	8) ln (1.40 x 10 <sup>-3</sup> ) = ;	<u>+1.63 x 10<sup>4</sup> J</u> mol⁻¹		
		(iii)	Comment and	explain on the s	ign of $\Delta G^{\circ}$ with refe	erence to relative stability of		
			$\Delta G^{\circ}$ is positive. This means that <u>reactants is more stable</u> . This is because there is <u>more steric hindrance</u> in the ketone / the two <u>electron-donating</u> <u>CH<sub>3</sub> groups stabilised the partial positive charge on the carbonyl carbon.</u>					
	(1.)	_				[9]		
	(a)	Prop	anone reacts wit	in loaine in the p	resence of an acid (			
			CH₃COCH	$_{3}(aq) + I_{2}(aq) -$	$\rightarrow$ CH <sub>3</sub> COCH <sub>2</sub> I (aq) -	+ H <sup>-</sup> (aq) + I (aq)		
		The iodin	The rate of reaction was studied via a colorimeter method, in which the colour of iodine was measured at regular time intervals.					
		The	The mechanism of this reaction is thought to be as follows:					
CI	H <sub>3</sub>	О Ё—С⊦	H₃ <del></del> CH	ОН   СН3		$\begin{array}{cc} I & & \\ -CH_3 & \xrightarrow{\mathrm{I}_2, \text{ fast}} CH_2ICOCH_2I \end{array}$	- H	
		(i)	The rate of rea	ction is directly	proportional to [H <sup>+</sup> ].	. Using this information and		
			$\frac{\text{Rate} = \text{k}[\text{CH}_3\text{C}]}{\text{Rate} = \text{k}[\text{CH}_3\text{C}]}$	OCH <sub>3</sub> ][H <sup>+</sup> ]				

		(ii)	Hence, sketch the graph of $[I_{2}]$ against time that you would expect to obtain		
		()	$[I_2]$ $(I_2)$ time		
		()	half-life of propanone was 4 min.		
			Propanone: 4.00 mol dm <sup>-3</sup> , lodine: 0.005 mol dm <sup>-3</sup> , H <sup>+</sup> : 1.00 mol dm <sup>-3</sup>		
			Predict and explain the half-life of propanone if the concentration of $H^+$ used was 2.00 mol dm <sup>-3</sup> instead.		
			2 min $H^+$ is a catalyst in this reaction. Hence, $[H^+]$ stay constant throughout.Rate = k'[propanone]where k' = k[H^+] $t_{1/2} = ln 2 / k'$ = ln 2 / k[H^+]		
			1 <sup>st</sup> order w.r.t H <sup>+</sup> . Hence, when [H <sup>+</sup> ] doubles, rate doubles, time taken to consume the same amount of propanone will then be halved.		
		(iv)	Suggest another method, other than colorimetric method, that can be used to study the rate of this reaction.		
			Pipette out a certain volume of reaction mixture at regular time intervals. Quench reaction by using NaHCO <sub>3</sub> and titrate with sodium thiosulfate.		
	(c)	Prop halog	[5] Janone is a methyl ketone. Longer chain methyl ketones can be prepared from genoalkanes by the acetoacetic ester synthesis.		
		Acet react	oacetic ester, can be converted into its enolate ion, which is then alkylated by tion with a halogenoalkane.		
α-hydro	ogen	On h whic	neating the alkylated acetoacetic ester with aqueous $HCl$ , a keto acid is formed h will then lose $CO_2$ to yield the ketone product.		
$H O H - C - C - C H_3$ COOCH <sub>2</sub> CH	Сң <sub>6</sub> СІ	H₂O <sup>-</sup> Na → I	$ \overset{\mathfrak{g}^{+}}{_{H}} \overset{O}{\underset{C}{_{OOCH_{2}CH_{3}}}} \overset{RX}{_{II}} \overset{RX}{_{H}} \overset{R}{\underset{C}{_{OOCH_{2}CH_{3}}}} \overset{R}{_{II}} \overset{R}{_{H}} \overset{O}{\underset{C}{_{OOCH_{2}CH_{3}}}} \overset{H_{3}O^{+}, heat}{_{H}} \overset{R}{\underset{C}{_{OOCH_{2}CH_{3}}}} \overset{R}{_{H}} \overset{O}{\underset{C}{_{OOCH_{2}CH_{3}}}} \overset{-CO_{2}}{_{III}} \overset{H}{_{OOCH_{3}}} \overset{-CO_{2}}{_{III}} \overset{H}{_{OOCH_{3}}} \overset{-CO_{2}}{_{III}} \overset{H}{_{OOCH_{3}}} \overset{H}{$	R O ⊢ ⊫ ⊢C—C—CҢ₃ H	
acetoacetic est	er		enolate ion keto acid		

Image: State of the end
(ii)       State the type of reaction for steps II and III.         Step II: nucleophilic substitution         Step III: acidic hydrolysis         Deduce the structure of the halogenoalkane that can be used to prepare         5-phenylpenta-2-one using an acetoacetic ester synthesis.         CH <sub>2</sub> CH <sub>2</sub> Br
Step II: nucleophilic substitution         Step III: acidic hydrolysis         (iii)       Deduce the structure of the halogenoalkane that can be used to prepare 5-phenylpenta-2-one using an acetoacetic ester synthesis.         CH <sub>2</sub> CH <sub>2</sub> Br
(iii) Deduce the structure of the halogenoalkane that can be used to prepare 5-phenylpenta-2-one using an acetoacetic ester synthesis.
CH <sub>2</sub> CH <sub>2</sub> Br
(iv) The following keto ester can also undergo the same sequence of reactions as acetoacetic ester. O $COOCH_2CH_3$ 1. $CH_3CH_2O^{-}Na^{+}$ X $H_3O^{+}$ Y 2. $CH_3CH_2Br$ X $H_3O^{+}$ Y
Suggest the structures for <b>X</b> and <b>Y</b> .
X: Y:
END