

53rd INTERNATIONAL CHEMISTRY OLYMPIAD 2021 UK Round One STUDENT ANSWER BOOKLET

In order to print your certificate, we need to store your name, school and mark in a database: these details are only viewable by your school and the RSC Chemistry Olympiad Working Group.

Your participation in the competition indicates that you are happy for us to do this.

Please PRINT details clearly:

Name

Nationality

Date of birth

School Year (e.g. Year 12, Scottish Higher)

☐

Paper taken in school

☐

Paper taken at home

School use:

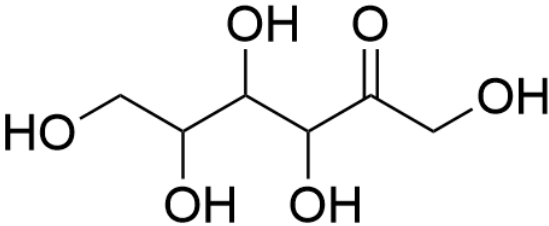
Centre number

Question	1	2	3	4	5	6	Total
Marks Available	9	9	16	13	21	17	85
Marks Scored							

1.	This question is about life on Venus		Mark
(a)			<input type="checkbox"/>
(b)	(i)	phosphine phosphoric acid	<input type="checkbox"/>
	(ii)		<input type="checkbox"/>
(c)	(i)		<input type="checkbox"/>
	(ii)		<input type="checkbox"/>
	(iii)		<input type="checkbox"/>
(d)	(i)		<input type="checkbox"/>
	(ii)		<input type="checkbox"/>
Total out of 9			<input type="checkbox"/>

2.	This question is about capturing carbon	Mark
(a)		<input type="checkbox"/>
(b)		<input type="checkbox"/>
(c)		<input type="checkbox"/>
(d)		<input type="checkbox"/>
(e)		<input type="checkbox"/>
(f)		<input type="checkbox"/>

(g)	<input type="checkbox"/> The standard enthalpy change is positive <input type="checkbox"/> The standard enthalpy change is zero <input type="checkbox"/> The standard enthalpy change is negative <input type="checkbox"/> More information is needed to calculate the standard enthalpy change	<input type="checkbox"/>
(h)	<input type="checkbox"/> The entropy change of the universe is positive <input type="checkbox"/> The entropy change of the universe is negative <input type="checkbox"/> The entropy change of the universe is zero <input type="checkbox"/> More information is needed to calculate the entropy change of the universe <input type="checkbox"/> The entropy change of this direct air capture process is positive <input type="checkbox"/> The entropy change of this direct air capture process is negative <input type="checkbox"/> The entropy change of this direct air capture process is zero <input type="checkbox"/> More information is needed to calculate the entropy change of this direct air capture process	<input type="checkbox"/> <input type="checkbox"/>
<div>Total out of 9</div>		<input type="checkbox"/>

3.	This question is about levulinic acid	Mark
(a)	<div> <input type="checkbox"/> ester <input type="checkbox"/> aldehyde <input type="checkbox"/> ketone <input type="checkbox"/> acetal </div> <div> <input type="checkbox"/> carboxylic acid <input type="checkbox"/> alkene <input type="checkbox"/> alcohol <input type="checkbox"/> hemiacetal </div>	<div></div>
(b)		<div></div>
(c)		<div></div>
(d)	<div>(i) Alkene A</div>	<div></div>
	<div>(ii) Other trisubstituted alkenes</div>	<div></div> <div></div>

(e)

Compounds C and D



(f)

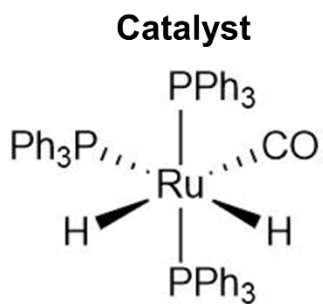
Compound F

☐

(g)

☐

(h)



Has enantiomer

Has enantiomer

Yes

No

Yes

No

Has enantiomer

Has enantiomer

Yes

No

Yes

No



Not all boxes have to be used.

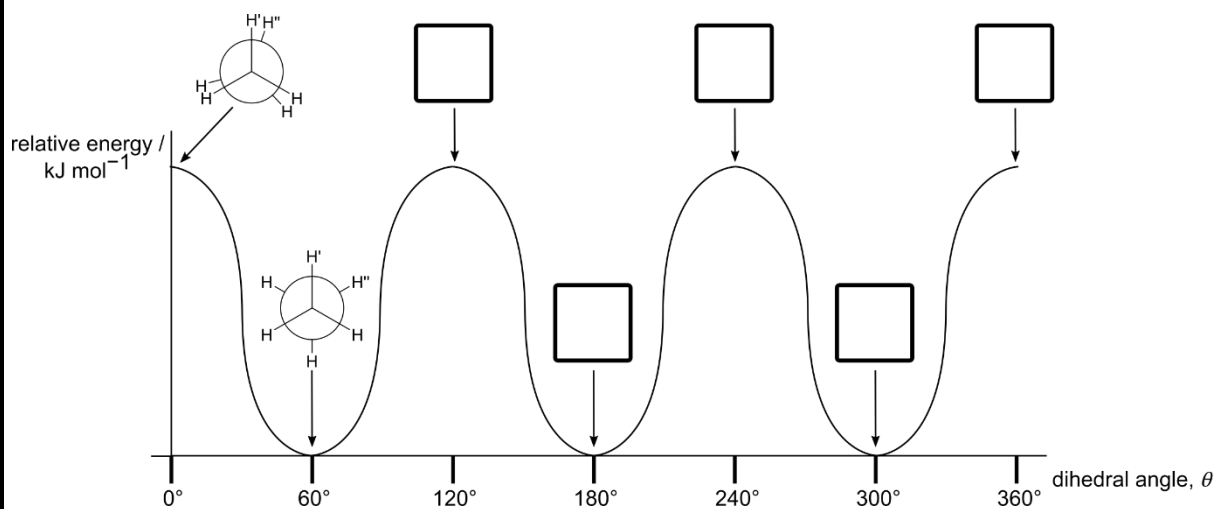
(i)	<input type="checkbox"/> one singlet	<input type="checkbox"/> one doublet and one singlet	<input type="checkbox"/>									
	<input type="checkbox"/> one doublet	<input type="checkbox"/> one triplet and one singlet										
	<input type="checkbox"/> one triplet	<input type="checkbox"/> one triplet and one doublet	<input type="checkbox"/>									
	<input type="checkbox"/> two singlets	<input type="checkbox"/> three singlets										
	<input type="checkbox"/> two doublets	<input type="checkbox"/> three doublets										
	<input type="checkbox"/> two triplets	<input type="checkbox"/> three triplets										
(j)	<table border="1"> <tr> <td>H^J-H^K</td> <td>H^K-P^W</td> </tr> <tr> <td>H^J-P^W</td> <td>H^K-P^X</td> </tr> <tr> <td>H^J-P^X</td> <td>H^K-P^Y</td> </tr> <tr> <td>H^J-P^Y</td> <td></td> </tr> </table>			H^J-H^K	H^K-P^W	H^J-P^W	H^K-P^X	H^J-P^X	H^K-P^Y	H^J-P^Y		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
	H^J-H^K	H^K-P^W										
	H^J-P^W	H^K-P^X										
	H^J-P^X	H^K-P^Y										
	H^J-P^Y											
<div>Total out of 16</div>			<input type="checkbox"/>									

4.

This question is about 'social distancing' within molecules

Mark

(a)



(b)

A	B	C	D	E	F

(c)

(i)

	$\text{G}_1 \rightleftharpoons \text{AP}$	$\text{AP} \rightleftharpoons \text{G}_2$	$\text{G}_2 \rightleftharpoons \text{G}_1$
ΔG^\ominus	$-3.63 \text{ kJ mol}^{-1}$		
K			

(ii)

(d)

☐

(e)

	W	X	Y	Z	None
7					
8					
9					
10					
11					
12					

☐☐☐

Total out of 13

☐

5.	This question is about Donald Trump and the coronavirus	Mark
(a)		<input type="checkbox"/>
(b)	<div>B</div> <div>C</div>	<input type="checkbox"/> <input type="checkbox"/>
(c)	<input type="checkbox"/> Br ₂ / UV light <input type="checkbox"/> KMnO ₄ <input type="checkbox"/> H ₂ / Ni catalyst <input type="checkbox"/> acidified K ₂ Cr ₂ O ₇ <input type="checkbox"/> OsO ₄ <input type="checkbox"/> ethylamine <input type="checkbox"/> O ₂ / UV light <input type="checkbox"/> H ₂ SO ₄ catalyst	<input type="checkbox"/>
(d)	<div>D</div> <div>E</div> <div>F</div>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
(e)	Anion V ⁻	<input type="checkbox"/> <input type="checkbox"/>

(f)	Cation W ⁺		<input type="checkbox"/>
	Cation X ⁺		<input type="checkbox"/> <input type="checkbox"/>
	Intermediate Y	Reagent Z	<input type="checkbox"/> <input type="checkbox"/>
	G		<input type="checkbox"/> <input type="checkbox"/>

H	<input type="checkbox"/> <input type="checkbox"/>
I	<input type="checkbox"/> <input type="checkbox"/>
J	<input type="checkbox"/>
Total out of 21	
<input type="checkbox"/>	

6.	This question is about fluorides of xenon	Mark												
(a)		<div></div>												
(b)		<div></div>												
(c)	<table><tr><td></td><td></td></tr><tr><td>Adopts this arrangement</td><td>Adopts this arrangement</td></tr><tr><td></td><td></td></tr></table>			Adopts this arrangement	Adopts this arrangement			<div><div></div><div></div></div>						
Adopts this arrangement	Adopts this arrangement													
(d)	<table><tr><td></td><td></td></tr><tr><td>Adopts this arrangement</td><td>Adopts this arrangement</td></tr><tr><td></td><td></td></tr><tr><td></td><td></td></tr><tr><td>Adopts this arrangement</td><td></td></tr><tr><td></td><td></td></tr></table>			Adopts this arrangement	Adopts this arrangement					Adopts this arrangement				<div><div></div><div></div><div></div></div>
Adopts this arrangement	Adopts this arrangement													
Adopts this arrangement														

(e)		<input type="checkbox"/>
(f)		<input type="checkbox"/>
(g)		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
(h)		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

(i)



Total out of 17

