

# ALyl Chem 21 EQ P1 22w to 09s Paper 1 Organic synthesis 62marks

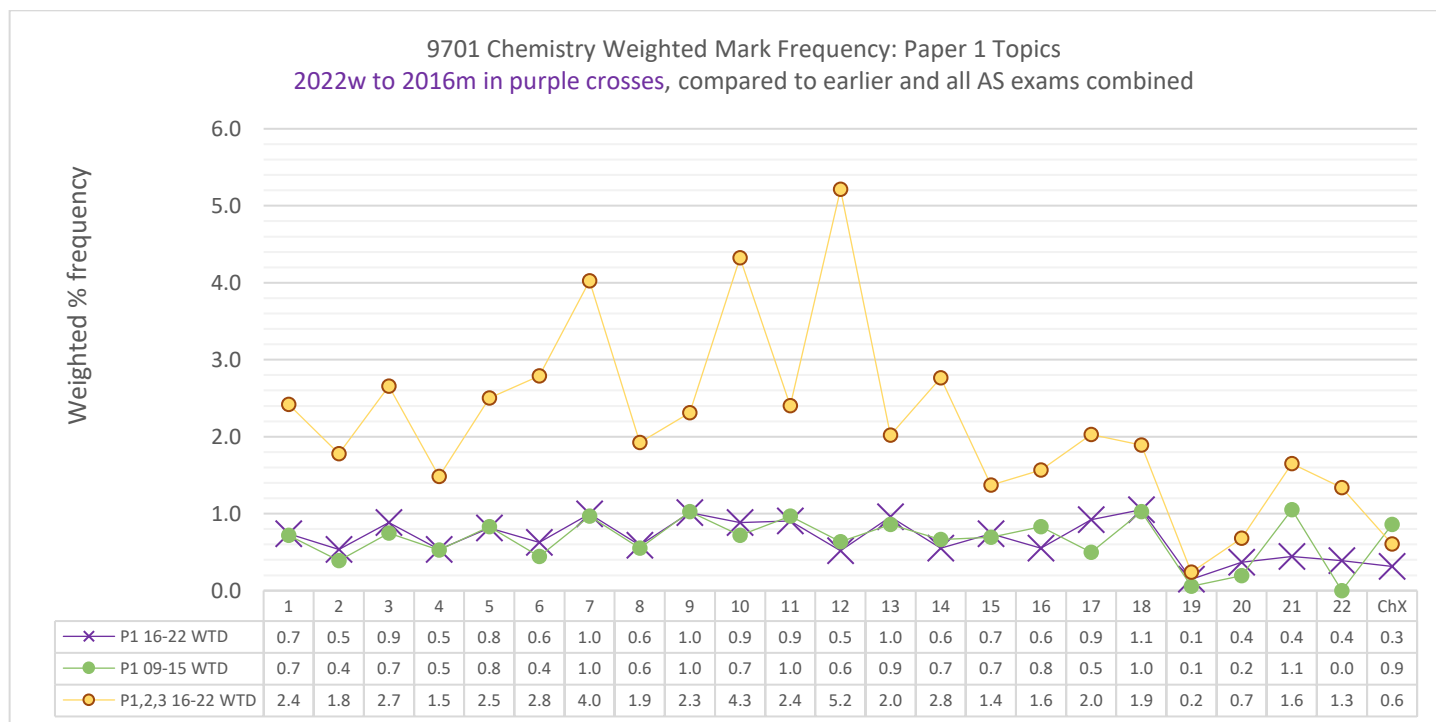
As you start and work through this worksheet you can tick off your progress to show yourself how much you have done, and what you need to do next. The first task is just to read the first question and should take you less than one minutes to complete.

## Paper 1 Topic 21

**Checklist** Tick each task off as you go along

RANK:

P1 Noob	P1 Novice	P1 Bronze	P1 Silver	P1 Gold	P1 <sup>1</sup> Winner	P1 Hero	P1 Legend
1 Q started	1 Q done	10% of marks	25% of marks	40% of marks	50% of marks	75% of marks	100% of marks
	1	6	16	25	31	47	62
	1	8	19	31	39	58	78



What the most thoughtful students will get out of their extensive studying will be a capacity to do meaningful brain-based work even under stressful conditions, which is a part of the self-mastery skillset that will continue to deliver value for the whole of their lives. Outstanding grades will also happen, but the most important goal from skillful action in study is being better at any important task, even if circumstances do not feel ideal.

As you are moving through your studies you can learn more about yourself by trying out new ways to manage yourself, and analysing how effective those new techniques were. In this reflective process not only will you get better at working positively and productively to deliver ambitious and successful outcomes, but you will be working towards one aspect of life's highest pursuit, summarised and inscribed on the Temple of Apollo at Delphi: "know thyself".

1. To complete these questions, as important as your answer, is checking your answer against the mark scheme.
2. For each page or group of 10 questions, convert your mark score into a percentage. This will allow you to see (and feel) your progress as you get more experience and understanding with each topic.
3. Multiple choice questions, done carefully where you explain and show yourself your thinking using written notes as you move through each question, can be more useful than just Paper 2 for students aiming for a C or B grade. Paper 2 should be the larger focus for students aiming for A and A\* grades, however.
4. If you find you get a higher percentage answering short answer questions than multiple choice questions that often means you are NOT using the marking scheme correctly; your correct answer might not be fully complete for all the marks you are awarding. The marks easiest to miss rely on providing the largest amount of detail.

<sup>1</sup> **DO NOT** work on these higher levels of completion in your A2 year unless you have also achieved at least a "Silver" (25%) in the same topic in **Paper 2**, which is **MOST** of your **AS grade**, and Paper 3 which is a smaller part of your year but still important.

## 21 Organic synthesis

### 21.1 Organic synthesis

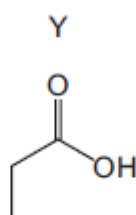
#### Learning outcomes

Candidates should be able to:

- 1 for an organic molecule containing several functional groups:
  - (a) identify organic functional groups using the reactions in the syllabus
  - (b) predict properties and reactions
- 2 devise multi-step synthetic routes for preparing organic molecules using the reactions in the syllabus
- 3 analyse a given synthetic route in terms of type of reaction and reagents used for each step of it, and possible by-products

Q# 1259/ AS Chemistry/2022/w/TZ 1/Paper 1/Q# 38//www.SmashingScience.org :o)

38 Which compounds can be used to make Y in a single-step reaction?

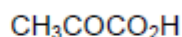
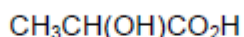
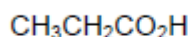


- 1 propanenitrile
- 2 ethanenitrile
- 3 propyl ethanoate
- 4 ethyl propanoate

A 1 and 3      B 1 and 4      C 2 and 3      D 2 and 4

Q# 1260/ AS Chemistry/2022/w/TZ 1/Paper 1/Q# 31//www.SmashingScience.org :o)

31 Three colourless liquids with the following formulae are contained in separate unlabelled bottles.



Which two tests, carried out on separate samples of each liquid, will successfully identify each liquid?

	test 1	test 2
A	$\text{NaHCO}_3$	2,4-DNPH reagent
B	$\text{NaHCO}_3$	Tollens' reagent
C	warm acidified dichromate	2,4-DNPH reagent
D	warm acidified dichromate	Tollens' reagent

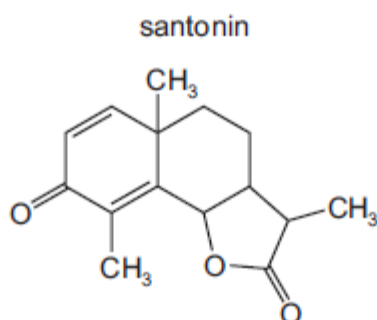


- 30 Compound R can be formed from 1-bromopropane using a nucleophilic substitution reaction followed by an oxidation reaction.

What is the identity of R?

- A propanoic acid
- B propanone
- C propylamine
- D propyl ethanoate

- 29 The structure of santonin is shown.



Santonin is first treated with warm dilute  $\text{H}_2\text{SO}_4$ . The product of this reaction is treated with cold dilute acidified  $\text{KMnO}_4$ . A final product, Q, is obtained.

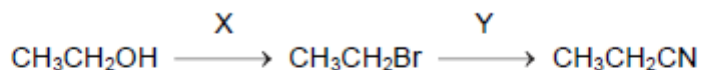
How many atoms of hydrogen in each molecule of product Q will react with sodium metal?

- A 2
- B 4
- C 5
- D 6

- 28 Which pair of reagents react together in a redox reaction?

- A  $\text{CH}_3\text{CHCH}_2 + \text{Br}_2$
- B  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{concentrated } \text{H}_3\text{PO}_4$
- C  $\text{CH}_3\text{COCH}_3 + \text{HCN}$
- D  $\text{HCO}_2\text{C}_2\text{H}_5 + \text{dilute } \text{H}_2\text{SO}_4$

- 26 Ethanol can be used to make propanenitrile in two steps.



What types of reaction are X and Y?

	X	Y
A	free-radical substitution	electrophilic substitution
B	free-radical substitution	nucleophilic substitution
C	nucleophilic substitution	nucleophilic substitution
D	nucleophilic substitution	electrophilic substitution

- 38 Compound Y is heated with a mild oxidising agent. One of the products of the reaction reacts with hydrogen cyanide forming 2-hydroxybutanenitrile.

What is compound Y?

- A butan-1-ol
- B butan-2-ol
- C propan-1-ol
- D propan-2-ol

- 30 Butanoic acid is prepared from 1-bromopropane.

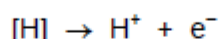
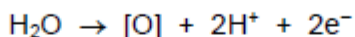
This synthesis requires a sequence of two reactions.

Which compound is prepared in the first stage of the synthesis?

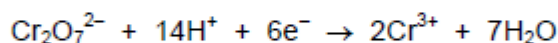
- A 1-aminopropane
- B propan-1-ol
- C butanal
- D butanenitrile

- 25 When an organic compound is oxidised, any oxygen atom gained by the organic molecule is considered to be from a water molecule also producing  $2\text{H}^+ + 2\text{e}^-$ . Any hydrogen atom lost may be considered to be lost as  $\text{H}^+ + \text{e}^-$ .

These changes can be represented by the following two equations.



Compound X is oxidised by heating under reflux with hot, acidified potassium dichromate(VI) for one hour. The half-equation for the reduction reaction is shown.



Under these conditions, one mole of potassium dichromate(VI) oxidises three moles of X.

What could X be?

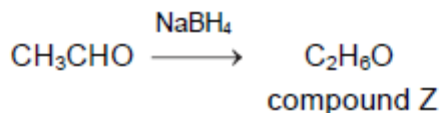
- A propanal
- B propan-1-ol
- C propan-1,2-diol
- D propan-1,3-diol



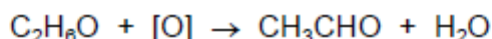
27 In this question you can assume that  $^1\text{H}$  and  $^3\text{H}$  have the same chemical properties.

A sample of ethanal contains only one isotope of hydrogen,  $^1\text{H}$ .

It is reduced to compound Z,  $\text{C}_2\text{H}_6\text{O}$ , in a nucleophilic addition reaction using  $\text{NaBH}_4$ . All the hydrogen atoms in the  $\text{NaBH}_4$  are the  $^3\text{H}$  isotope.



Compound Z is then oxidised back to ethanal and water.



Which statement about the final mixture of products is correct?

- A Both ethanal and water contain  $^3\text{H}$  atoms.
- B Ethanal is the only product containing  $^3\text{H}$  atoms.
- C Neither ethanal nor water contain  $^3\text{H}$  atoms.
- D Water is the only product containing  $^3\text{H}$  atoms.

Q# 1269/ AS Chemistry/2020/w/TZ 1/Paper 1/Q# 24//www.SmashingScience.org :o)

24 A student converts 1-iodopropane,  $\text{C}_3\text{H}_7\text{I}$ , into butanoic acid,  $\text{C}_3\text{H}_7\text{CO}_2\text{H}$ , by a two-stage chemical synthesis.

In the **first** of the two stages, which reagent is reacted with 1-iodopropane?

- A aqueous sodium hydroxide
- B ethanolic ammonia
- C ethanolic potassium cyanide
- D ethanolic sodium hydroxide

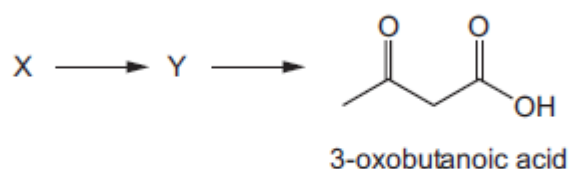
Q# 1270/ AS Chemistry/2018/w/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

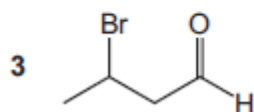
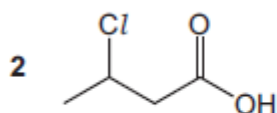
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct



39 3-oxobutanoic acid can be synthesised in a two-step process.



What could be the structure of X?



Q# 1271/ AS Chemistry/2017/w/TZ 1/Paper 1/Q# 29//

29 Ethene is reacted with steam in the presence of concentrated  $\text{H}_3\text{PO}_4$ . The product of this reaction is added to acidified potassium dichromate(VI) and heated under reflux for one hour. The final organic product is collected and labelled X.

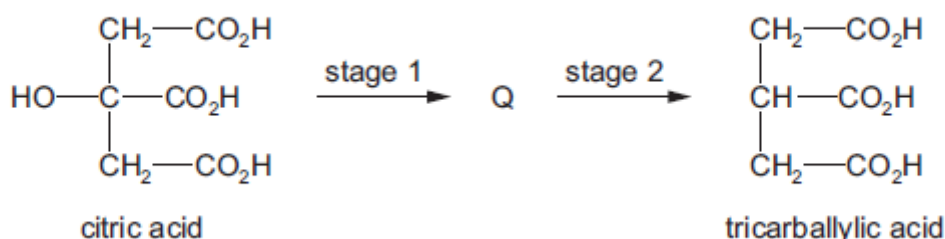
But-2-ene is treated with hot, concentrated, acidified potassium manganate(VII). The final organic product is collected and labelled Y.

Which statement is correct?

- A One molecule of X has more carbon atoms than one molecule of Y.
- B One molecule of Y has more carbon atoms than one molecule of X.
- C X and Y have different functional groups.
- D X is the same compound as Y.

Q# 1272/ AS Chemistry/2017/w/TZ 1/Paper 1/Q# 25//

25 Citric acid can be converted into tricarballic acid in two stages. An intermediate, Q, is formed.



Which reagents are needed for each stage?

	stage 1	stage 2
A	concentrated $\text{H}_2\text{SO}_4$	$\text{H}_2(\text{g})$ and Ni
B	concentrated $\text{H}_2\text{SO}_4$	$\text{LiAlH}_4$
C	$\text{LiAlH}_4$	$\text{H}_2\text{SO}_4(\text{aq})$
D	$\text{NaOH}(\text{aq})$	$\text{H}_2(\text{g})$ and Ni





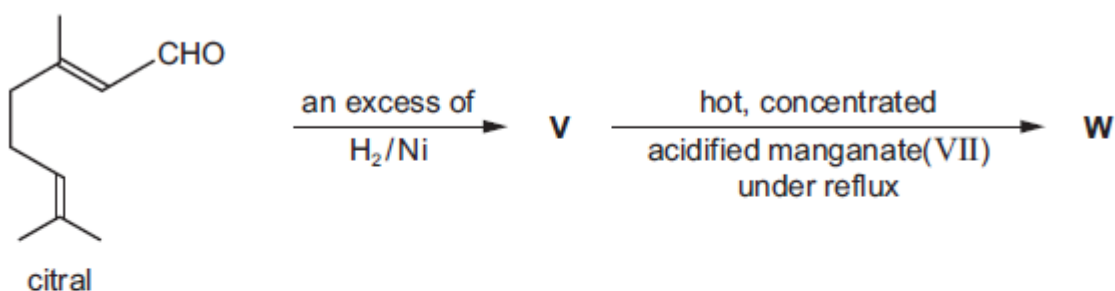
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

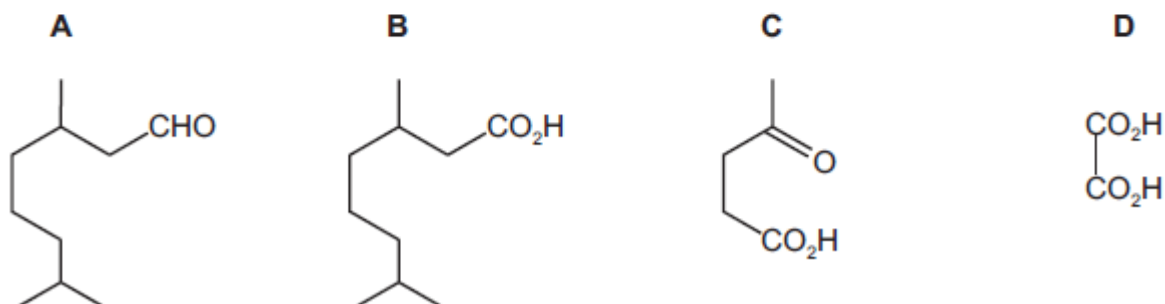
39 For which reactions are the colour changes described correctly?

	reagents	colour change
1	pentanal + hot, acidified potassium dichromate(VI)	orange to green
2	pentan-2-one + warm Fehling's reagent	no change
3	cyclohexane + cold, acidified potassium manganate(VII)	purple to colourless

30 Citral is found in lemongrass oil. It can react to give compound W.



What could compound W be?



25 Diols in which both hydroxy groups are bonded to the same carbon can spontaneously eliminate a molecule of water to produce a carbonyl compound.

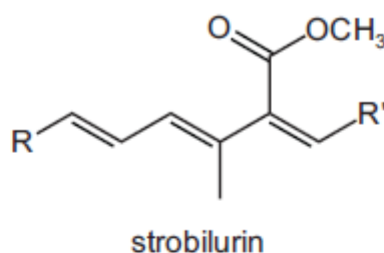
Which compound, after complete hydrolysis, gives a positive reaction with Tollens' reagent?

- A** 1,1-dibromobutane  
**B** 1,2-dibromobutane  
**C** 1,3-dibromobutane  
**D** 2,2-dibromobutane

28 Which reaction would **not** give ethanoic acid?

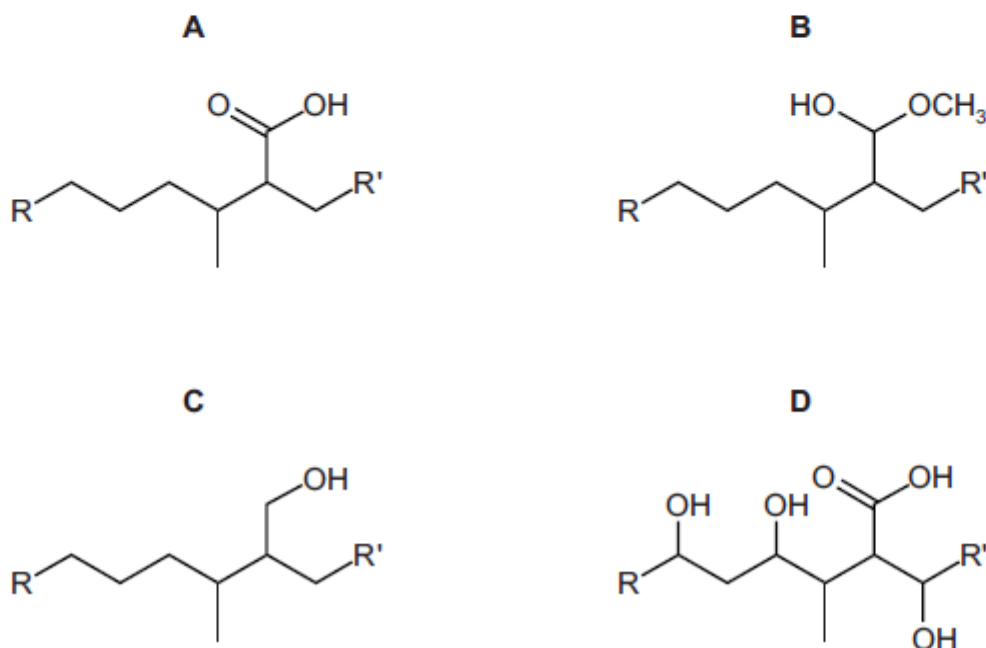
- A heating ethanenitrile under reflux with dilute sodium hydroxide
- B heating ethanenitrile under reflux with dilute sulfuric acid
- C heating ethanal under reflux with acidified sodium dichromate(VI)
- D heating ethanol under reflux with acidified sodium dichromate(VI)

23 Part of the structure of a fungicide, strobilurin, is shown. R and R' are inert groups.



In this reaction, strobilurin is warmed with aqueous sulfuric acid producing compound X. Compound X is then treated with hydrogen in the presence of a nickel catalyst producing compound Y.

What could be the structure of compound Y?

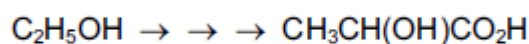


The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct



39 Several steps are involved in the synthesis of 2-hydroxypropanoic acid from ethanol.

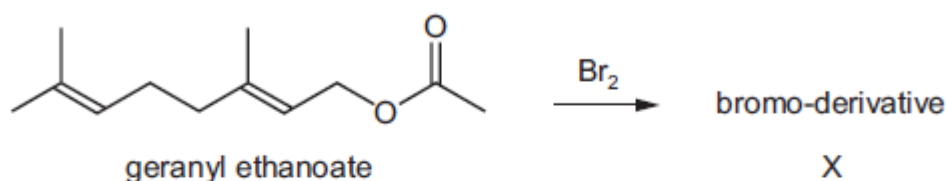


Which statements concerning this synthesis are correct?

- 1 The chain length can be increased during a step involving reaction between HCN and an aldehyde.
- 2 The carboxyl group can be made by hydrolysis of a nitrile by boiling with NaOH(aq) and then acidifying.
- 3 The ethanol should be first oxidised by heating it under reflux with an excess of acidified potassium dichromate(VI).

Q# 1279/ AS Chemistry/2016/s/TZ 1/Paper 1/Q# 30//www.SmashingScience.org :o)

30 Geranyl ethanoate is present in ginger and cocoa, and is used in shampoos and soaps as a perfume. It reacts with an excess of bromine in an organic solvent to give X, a bromo-derivative.



Including geranyl ethanoate, how many cis-trans isomers are there of geranyl ethanoate, and how many chiral centres are there in X?

	cis-trans isomers	chiral centres in X
A	2	3
B	2	4
C	4	3
D	4	4

Q# 1280/ AS Chemistry/2016/s/TZ 1/Paper 1/Q# 22//www.SmashingScience.org :o)

22 Which pair of reagents will take part in a redox reaction?

- A  $\text{CH}_3\text{CHCH}_2 + \text{Br}_2$
- B  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{concentrated H}_3\text{PO}_4$
- C  $\text{CH}_3\text{COCH}_3 + \text{HCN}$
- D  $\text{HCO}_2\text{C}_2\text{H}_5 + \text{dilute H}_2\text{SO}_4$

Q# 1281/ AS Chemistry/2016/m/TZ 2/Paper 1/Q# 40//www.SmashingScience.org :o)

The responses A to D should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct



40 Compound **X** has the molecular formula  $C_3H_6O_3$ .

Heating **X** under reflux with acidified  $K_2Cr_2O_7$  forms  $HO_2CCOCO_2H$ .

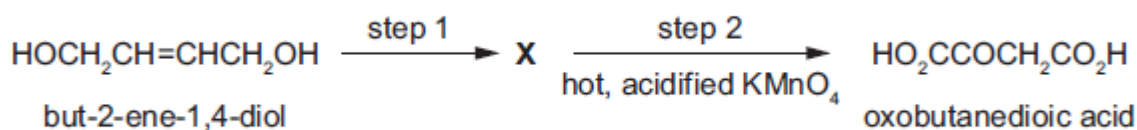
Reacting **X** with  $NaBH_4$  forms  $HOCH_2CH(OH)CH_2OH$ .

What is a possible structural formula for **X**?

- 1  $HOCH_2CH_2CO_2H$
- 2  $HOCH_2CH(OH)CHO$
- 3  $HOCH_2COCH_2OH$

Q# 1282/ AS Chemistry/2016/m/TZ 2/Paper 1/Q# 23//www.SmashingScience.org :o)

23 But-2-ene-1,4-diol is converted in two steps through an intermediate **X** into oxobutanedioic acid.



What could be the reagent for step 1 and what is the intermediate **X**?

	reagent for step 1	<b>X</b>
A	cold, acidified $KMnO_4$	$HOCH_2CH_2CH(OH)CH_2OH$
B	hot, acidified $K_2Cr_2O_7$	$HO_2CCH=CHCO_2H$
C	steam and concentrated $H_2SO_4$	$HOCH_2CH(OH)CH_2CH_2OH$
D	warm, acidified $K_2Cr_2O_7$	$OHCCH(OH)CH_2CHO$

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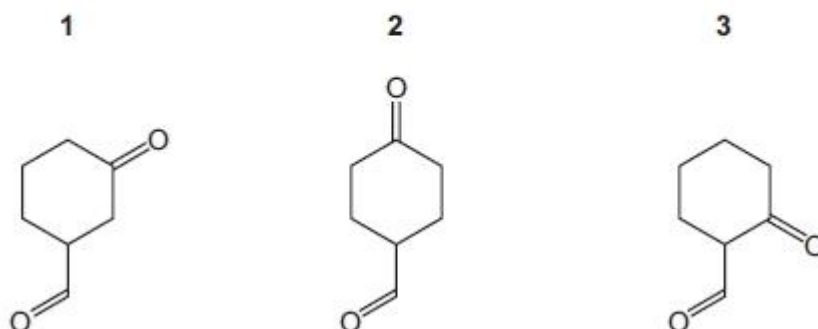
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

38 Each of the compounds below is treated separately with excess  $NaBH_4$ . The product of each reaction is then heated with excess concentrated  $H_2SO_4$ .

In each case, one or more products are formed with molecular formula  $C_7H_{10}$ .

Which compounds give **only one** final product with the molecular formula  $C_7H_{10}$ ?



27 Butan-2-ol can be made by reducing X with  $H_2/Ni$ .

Butan-2-ol can be dehydrated to form Y and Z which are structural isomers of each other.

Which row is correct?

	X is	<i>cis-trans</i> isomerism is shown by
A	an aldehyde	both Y and Z
B	an aldehyde	only one of Y and Z
C	a ketone	both Y and Z
D	a ketone	only one of Y and Z

Q# 1285/ AS Chemistry/2015/w/TZ 1/Paper 1/Q# 25//www.SmashingScience.org :o)

25 If the starting material is iodoethane, which sequence of reactions will produce propanoic acid as the main final product in good yield?

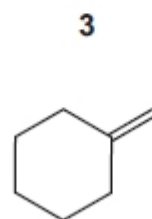
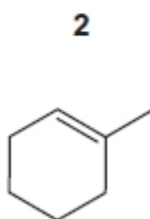
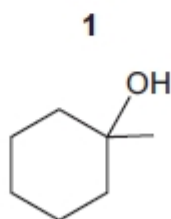
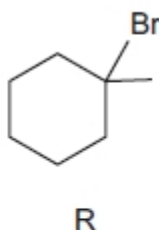
- A add  $NaOH(aq)$ , isolate the organic product, add acidified  $K_2Cr_2O_7$  and boil under reflux
- B add  $NaOH(aq)$ , isolate the organic product, add  $H_2SO_4(aq)$  and boil under reflux
- C heat with  $HCN$  in ethanol, isolate the organic product, add  $H_2SO_4(aq)$  and boil under reflux
- D heat with  $KCN$  in ethanol, isolate the organic product, add  $H_2SO_4(aq)$  and boil under reflux

Q# 1286/ AS Chemistry/2015/s/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

The responses A to D should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

39 Which compounds will react with  $HBr$  to give the compound R?



The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

39 For which mixtures of reagents are the colour changes described correctly?

	reagents	colour change
1	pentanal + hot, acidified potassium dichromate(VI)	orange to green
2	pentan-2-one + warm Fehling's reagent	no change
3	cyclohexane + cold, acidified potassium manganate(VII)	purple to colourless

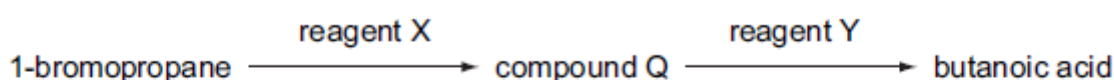
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

37 Which pairs of reagents will take part in a redox reaction?

- 1  $\text{CH}_3\text{COCH}_3$  + Tollens' reagent
- 2  $\text{CH}_3\text{CH}_2\text{CHO}$  + Fehling's reagent
- 3  $\text{CH}_3\text{CH}=\text{CH}_2$  +  $\text{Br}_2$

30 Butanoic acid can be produced from 1-bromopropane using reagents X and Y as shown below.



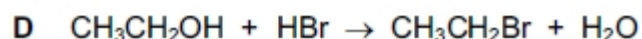
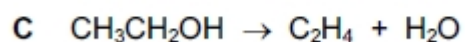
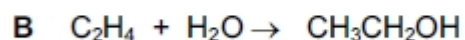
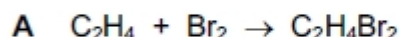
What could be reagents X and Y?

	X	Y
A	KCN in ethanol	$\text{HCl(aq)}$
B	KCN in ethanol	$\text{NaOH(aq)}$
C	$\text{NH}_3$ in ethanol	$\text{HCl(aq)}$
D	$\text{NaOH(aq)}$	$\text{H}^+/\text{Cr}_2\text{O}_7^{2-}(\text{aq})$



20 Many organic reactions need to be heated before reaction occurs, but some do not require heating.

Which reaction occurs quickly at room temperature?



Q# 1291/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 40//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

40 The compounds below are treated with hydrogen cyanide.

Which compounds react and produce a molecule containing a chiral centre?

- 1 butanal
- 2 pentan-3-one
- 3 2-chlorobutane

Q# 1292/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

39 Which reactions can be used to make an alcohol in the laboratory?

- 1 hydrolysis of a bromoalkane with  $\text{NaOH(aq)}$
- 2 reduction of a ketone with  $\text{NaBH}_4$
- 3 reduction of an aldehyde with  $\text{NaBH}_4$

Q# 1293/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 38//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct





- 38 An organic compound **Y**, molecular formula  $C_6H_{14}O$ , may be oxidised to compound **Z**, molecular formula  $C_6H_{12}O_2$ .

What could be the structural formula of **Y**?

- 1  $CH_3CH_2CH(CH_2OH)CH_2CH_3$
- 2  $(CH_3)_3CCH_2CH_2OH$
- 3  $CH_3CH_2CH(CH_3)CH_2CH_2OH$

Q# 1294/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 28//www.SmashingScience.org :o)

- 28 In which reaction is the organic compound oxidised?

- A  $CH_3CH_2OH + \text{concentrated } H_3PO_4$
- B  $CH_3CH_2CH_2CHO + \text{Tollens' reagent}$
- C  $CH_3COCH_3 + \text{2,4-dinitrophenylhydrazine reagent}$
- D  $CH_3CN + \text{dilute } H_2SO_4$

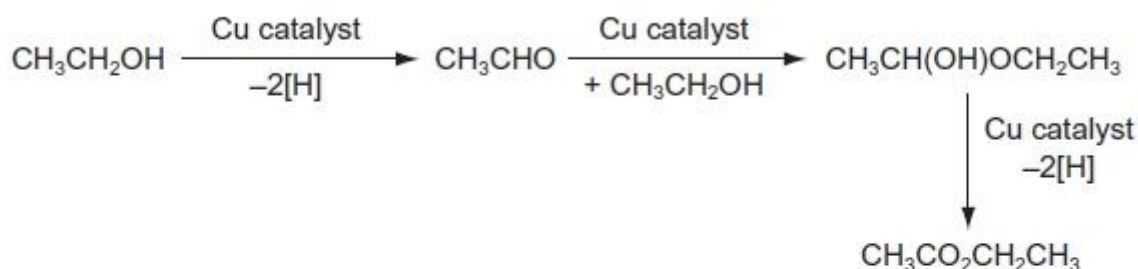
Q# 1295/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 21//www.SmashingScience.org :o)

- 21 Which reaction will give the best yield of 1-chloropropane?

- A chlorine gas with propene gas in the dark
- B propan-1-ol with dilute  $NaCl(aq)$
- C propan-1-ol with  $PCl_5$
- D propene with dilute  $HCl(aq)$

Q# 1296/ AS Chemistry/2013/w/TZ 1/Paper 1/Q# 20//www.SmashingScience.org :o)

- 20 A new industrial preparation of ethyl ethanoate has been developed using cheap sources of ethanol.



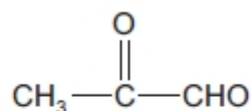
Which process is involved at some stage in this reaction sequence?

- A electrophilic addition
- B nucleophilic addition
- C nucleophilic substitution
- D reduction





27 Burnt sugar has a characteristic smell caused partly by the following compound.



This compound contains two functional groups.

Which reagent will react with **only one** of the functional groups?

- A acidified potassium dichromate(VI)
- B 2,4-dinitrophenylhydrazine
- C hydrogen cyanide
- D sodium hydroxide

Q# 1298/ AS Chemistry/2013/s/TZ 1/Paper 1/Q# 21//www.SmashingScience.org :o)

21 Lactic acid (2-hydroxypropanoic acid),  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$ , is found in sour milk.

Which reaction could occur with lactic acid?

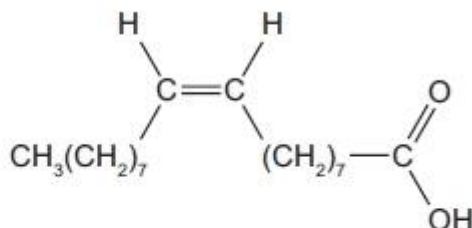
- A  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H} + \text{CH}_3\text{OH} \rightarrow \text{CH}_3\text{CH}(\text{OCH}_3)\text{CO}_2\text{H} + \text{H}_2\text{O}$
- B  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H} + \text{HCO}_2\text{H} \rightarrow \text{CH}_3\text{CH}(\text{O}_2\text{CH})\text{CO}_2\text{H} + \text{H}_2\text{O}$
- C  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H} + \text{NaHCO}_3 \rightarrow \text{CH}_3\text{CH}(\text{ONa})\text{CO}_2\text{H} + \text{H}_2\text{O} + \text{CO}_2$
- D  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H} + \text{Cl}_2 \rightarrow \text{CH}_3\text{CH}(\text{Cl})\text{CO}_2\text{H} + \text{HOCl}$

Q# 1299/ AS Chemistry/2012/w/TZ 1/Paper 1/Q# 40//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

40 Oleic acid is found in olive oil. It has the following formula.



Which reagents will give a positive result with oleic acid?

- 1 aqueous bromine
- 2 acidified potassium dichromate(VI)
- 3 Fehling's reagent



The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

39 Which reagents react with butanone,  $C_2H_5COCH_3$ ?

- 1 Tollens' reagent
- 2 sodium borohydride
- 3 2,4-dinitrophenylhydrazine reagent

29 Many, but not all, organic reactions need to be heated before reaction occurs.

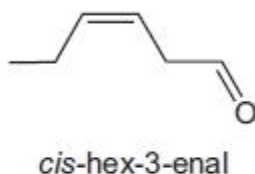
Which reaction occurs at a good rate at room temperature ( $20^\circ C$ )?

- A  $CH_3OH + PCl_5 \rightarrow CH_3Cl + POCl_3 + HCl$
- B  $CH_3CH_2Br + KCN \rightarrow CH_3CH_2CN + KBr$
- C  $CH_3CH_2OH \rightarrow C_2H_4 + H_2O$
- D  $CH_3CH_2CN + 2H_2O \rightarrow CH_3CH_2CO_2H + NH_3$

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

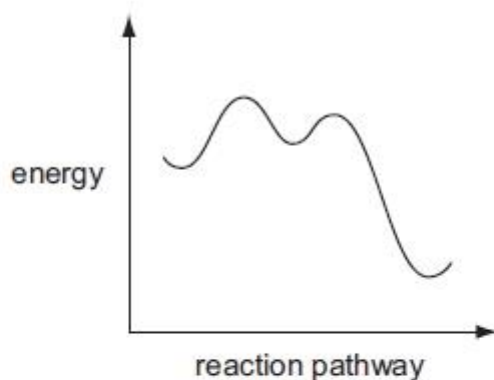
39 The compound *cis*-hex-3-enal is responsible for the characteristic smell of cut grass. The human nose is particularly sensitive to this compound, being able to detect 0.25 parts per billion in air.



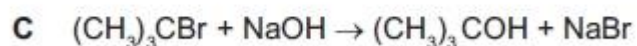
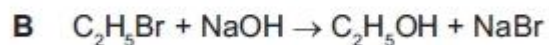
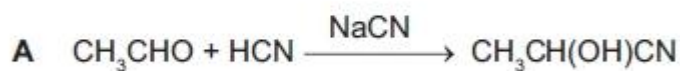
Which reagents will react with *cis*-hex-3-enal?

- 1 sodium
- 2 sodium borohydride
- 3 Fehling's reagent

28 A reaction pathway diagram is shown.



Which reaction does **not** have such a profile?

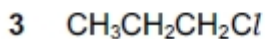
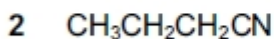
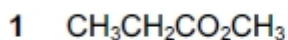


Q# 1304/ AS Chemistry/2011/w/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

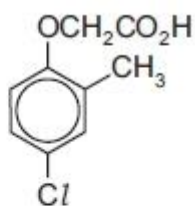
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

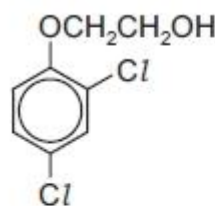
39 On acid hydrolysis, which compounds produce propanoic acid?



23 Y and Z are two widely-used selective weed killers.



Y



Z

Which reagent will distinguish Y from Z?

- A acidified  $\text{AgNO}_3(\text{aq})$
- B Fehling's solution
- C Na
- D  $\text{Na}_2\text{CO}_3(\text{aq})$

Q# 1306/ AS Chemistry/2011/s/TZ 1/Paper 1/Q# 30//www.SmashingScience.org :o)

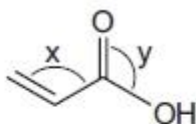
30 The functional group in a primary alcohol is  $-\text{CH}_2\text{OH}$ .

Which reagent reacts with a primary alcohol, under suitable conditions, to give an organic product with the same number of oxygen atoms as the alcohol?

- A  $\text{Al}_2\text{O}_3$
- B  $\text{CH}_3\text{CO}_2\text{H}$
- C HBr
- D Na

Q# 1307/ AS Chemistry/2011/s/TZ 1/Paper 1/Q# 20//www.SmashingScience.org :o)

20 Acrylic acid is produced from propene, a gaseous product of oil refineries.



acrylic acid

Which statement about acrylic acid is **not** correct?

- A Both bond angles x and y are approximately  $120^\circ$ .
- B It decolourises aqueous bromine.
- C It gives an orange precipitate with 2,4-dinitrophenylhydrazine reagent.
- D It reacts with an alcohol to give an ester.

Q# 1308/ AS Chemistry/2010/w/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

The responses A to D should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 39 An organic compound decolourises aqueous bromine and reacts with sodium to produce hydrogen.

Which molecular formula could represent this compound?

- 1  $C_3H_6O$
- 2  $C_3H_4O_2$
- 3  $C_3H_8O$

Q# 1309/ AS Chemistry/2010/w/TZ 1/Paper 1/Q# 38//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

- 38 Glyceraldehyde,  $HOCH_2CH(OH)CHO$ , is formed during photosynthesis, and contains a chiral carbon atom.

Which reagents will react with glyceraldehyde to produce an organic product **without** a chiral carbon atom?

- 1 warmed acidified  $K_2Cr_2O_7$
- 2  $NaBH_4$
- 3 Tollens' reagent

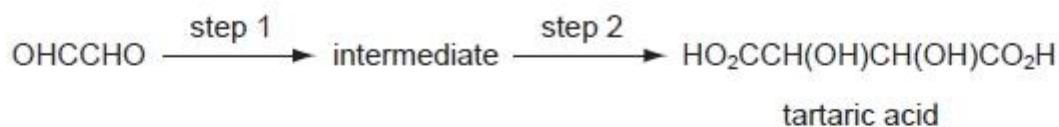
Q# 1310/ AS Chemistry/2010/w/TZ 1/Paper 1/Q# 27//www.SmashingScience.org :o)

- 27 Which compound would undergo nucleophilic addition?

- A bromoethane,  $C_2H_5Br$
- B ethanal,  $CH_3CHO$
- C ethane,  $C_2H_6$
- D ethene,  $C_2H_4$

Q# 1311/ AS Chemistry/2010/w/TZ 1/Paper 1/Q# 23//www.SmashingScience.org :o)

- 23 Tartaric acid is present in some wines. It may be synthesised in the laboratory in two steps.



Which reagents could be used for this synthesis?

	step 1	step 2
A	$HCl(aq)$	$HCN(g)$
B	$HCN, NaCN(aq/alcoholic)$	$H_2SO_4(aq)$
C	$H_2SO_4(aq)$	$K_2Cr_2O_7 / H_2SO_4(aq)$
D	$KCN(aq/alcoholic)$	$K_2Cr_2O_7 / H_2SO_4(aq)$

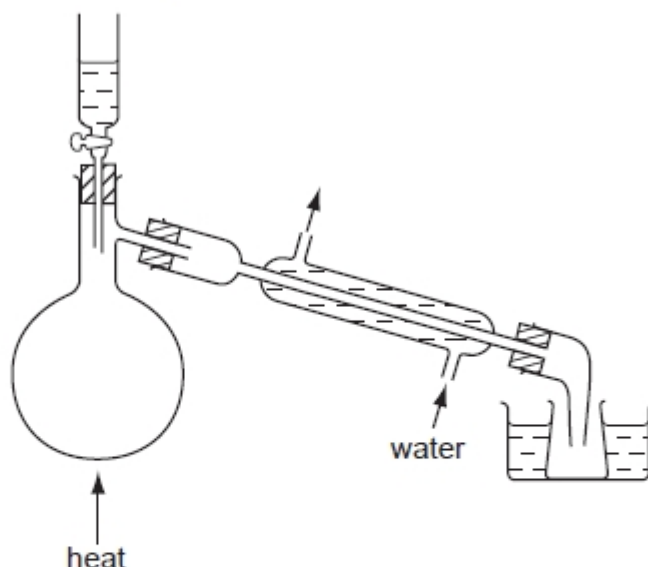




The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

40 The diagram shows some laboratory apparatus.



Which preparations could this apparatus be used for?

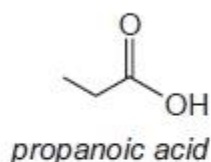
- 1 bromoethane, from ethanol, sodium bromide and concentrated sulfuric acid
- 2 ethanal, from ethanol, sodium dichromate(VI) and sulfuric acid
- 3 1,2-dibromoethane, from bromine and ethene

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct



- 37 Propanoic acid occurs naturally as a result of the bacterial fermentation of milk, and is partly responsible for the flavour of Swiss cheese.



Which starting materials could be used to synthesise propanoic acid?

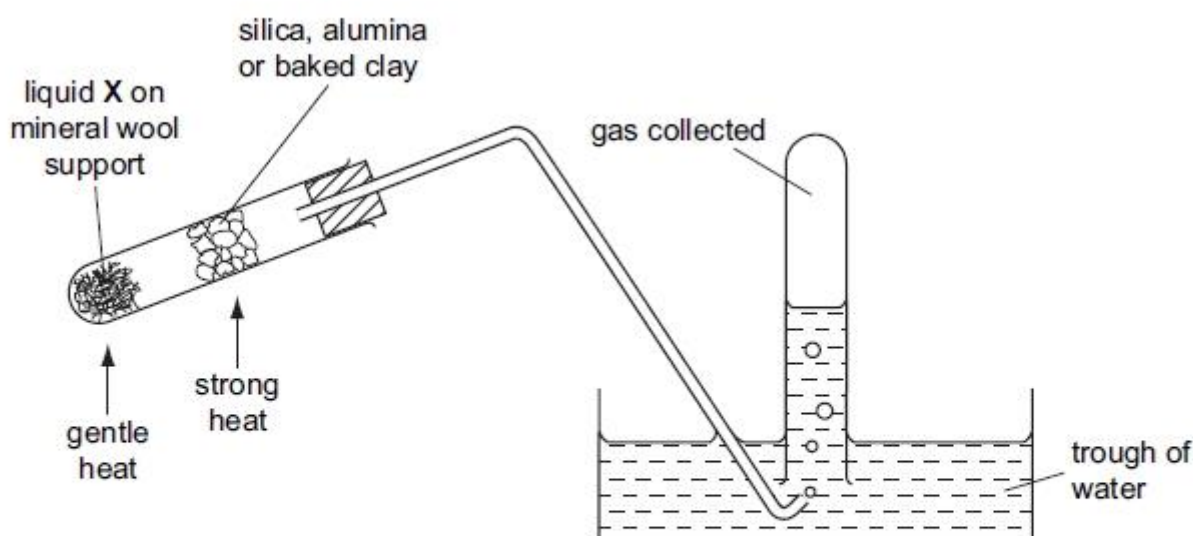
- 1  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- 2  $\text{CH}_3\text{CH}_2\text{CN}$
- 3  $\text{CH}_3\text{CH}_2\text{CHO}$

Q# 1314/ AS Chemistry/2009/w/TZ 1/Paper 1/Q# 39//www.SmashingScience.org :o)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

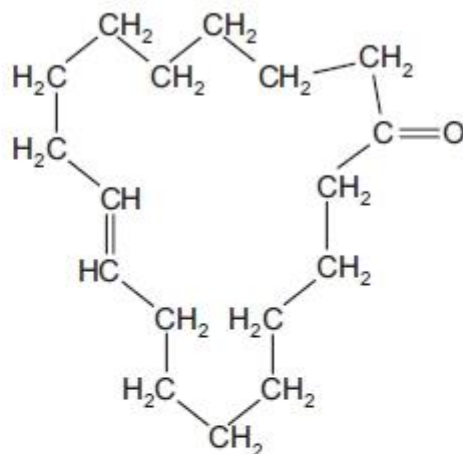
- 39 The diagram shows an experiment.



Which processes could be demonstrated by using the above apparatus?

- 1 the oxidation of ethanol (the liquid **X**)
- 2 the dehydration of ethanol (the liquid **X**)
- 3 the cracking of paraffin (the liquid **X**)

- 27 The naturally-occurring molecule civetone is found in a gland of the African civet cat and has been used in perfumery.

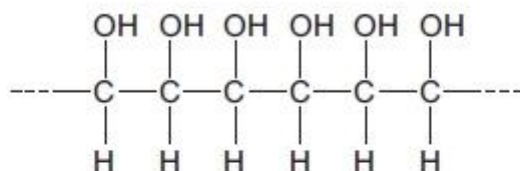


civetone

With which reagent will civetone **not** react?

- A 2,4-dinitrophenylhydrazine reagent
- B Fehling's reagent
- C hydrogen bromide
- D sodium tetrahydridoborate(III) (sodium borohydride)

- 23 The following diagram represents the structure of a possible polymer.



By which method might this polymer be made?

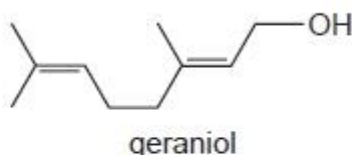
- A polymerise ethene followed by hydration
- B polymerise ethene followed by oxidation with cold acidified KMnO<sub>4</sub>
- C polymerise 1,2-dichloroethene followed by hydrolysis
- D polymerise 1,2-dichloroethene followed by oxidation with cold acidified KMnO<sub>4</sub>

- 6 In which reaction does the carbon-containing product have a smaller bond angle than the organic reactant?
- A bromoethane refluxed with ethanolic sodium hydroxide
  - B complete combustion of methane in air
  - C methane and an excess of chlorine under ultraviolet light
  - D polymerisation of ethene

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

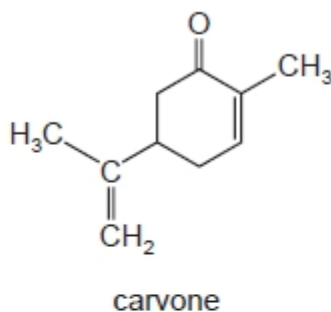
- 38 Geraniol is one of several compounds produced by the scent glands of honey bees to help them mark nectar-bearing flowers and locate the entrances to their hives.



Which reactions will geraniol undergo?

- 1 reaction with hot concentrated acidic  $\text{KMnO}_4$  to give propanone
- 2 addition of halogens
- 3 reaction with aqueous  $\text{NaHCO}_3$  to give  $\text{CO}_2$

- 28 Carvone gives the characteristic flavour to caraway and spearmint.



Prolonged heating of carvone with hot concentrated acidified potassium manganate(VII) produces carbon dioxide and a compound **X**.

**X** contains nine carbon atoms and reacts with 2,4-dinitrophenylhydrazine reagent.

What is the maximum number of molecules of 2,4-dinitrophenylhydrazine that will react with one molecule of **X**?

- A** 1                      **B** 2                      **C** 3                      **D** 4

- 25 Which reaction would **not** give propene as one product?

- A** adding an excess of concentrated sulfuric acid to propan-1-ol
- B** adding warm aqueous sodium hydroxide to 2-bromopropane
- C** adding warm ethanolic sodium hydroxide to 1-bromopropane
- D** passing propan-2-ol vapour over heated aluminium oxide



**Q# 1259/** AS Chemistry/2022/w/TZ 1/Paper 1/Q#

38//www.SmashingScience.org :o)

38 | B

**Q# 1260/** AS Chemistry/2022/w/TZ 1/Paper 1/Q#

31//www.SmashingScience.org :o)

31 | C

**Q# 1261/** AS Chemistry/2022/w/TZ 1/Paper 1/Q#

30//www.SmashingScience.org :o)

30 | A

**Q# 1262/** AS Chemistry/2022/w/TZ 1/Paper 1/Q#

29//www.SmashingScience.org :o)

29 | D

**Q# 1263/** AS Chemistry/2022/w/TZ 1/Paper 1/Q#

28//www.SmashingScience.org :o)

28 | A

**Q# 1264/** AS Chemistry/2022/s/TZ 1/Paper 1/Q#

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26 | C

**Q# 1265/** AS Chemistry/2022/m/TZ 2/Paper 1/Q#

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38 | C

**Q# 1266/** AS Chemistry/2021/s/TZ 1/Paper 1/Q#

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30 | D

**Q# 1267/** AS Chemistry/2021/s/TZ 1/Paper 1/Q#

25//www.SmashingScience.org :o)

25 | A

**Q# 1268/** AS Chemistry/2021/m/TZ 2/Paper 1/Q#

27//www.SmashingScience.org :o)

27 | A

**Q# 1269/** AS Chemistry/2020/w/TZ 1/Paper 1/Q#

24//www.SmashingScience.org :o)

24 | C

**Q# 1270/** AS Chemistry/2018/w/TZ 1/Paper 1/Q#

39//www.SmashingScience.org :o)

39 | A

**Q# 1271/** AS Chemistry/2017/w/TZ 1/Paper 1/Q# 29//

29 | D

**Q# 1272/** AS Chemistry/2017/w/TZ 1/Paper 1/Q# 25//

25 | A

**Q# 1273/** AS Chemistry/2017/s/TZ 1/Paper 1/Q#

39//www.SmashingScience.org :o)

39 | B

**Q# 1274/** AS Chemistry/2017/s/TZ 1/Paper 1/Q#

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30 | B

**Q# 1275/** AS Chemistry/2017/m/TZ 2/Paper 1/Q#

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25 | A

**Q# 1276/** AS Chemistry/2016/w/TZ 1/Paper 1/Q#

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28 | A

**Q# 1277/** AS Chemistry/2016/w/TZ 1/Paper 1/Q#

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23 | A

**Q# 1278/** AS Chemistry/2016/s/TZ 1/Paper 1/Q#

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39 | B

**Q# 1279/** AS Chemistry/2016/s/TZ 1/Paper 1/Q#

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30 | A

**Q# 1280/** AS Chemistry/2016/s/TZ 1/Paper 1/Q#

22//www.SmashingScience.org :o)

22 | A

**Q# 1281/** AS Chemistry/2016/m/TZ 2/Paper 1/Q#

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40 | C

**Q# 1282/** AS Chemistry/2016/m/TZ 2/Paper 1/Q#

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23 | C

**Q# 1283/** AS Chemistry/2015/w/TZ 1/Paper 1/Q#

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38 | C

**Q# 1284/** AS Chemistry/2015/w/TZ 1/Paper 1/Q#

27//www.SmashingScience.org :o)

27 | D

**Q# 1285/** AS Chemistry/2015/w/TZ 1/Paper 1/Q#

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25 | D

**Q# 1286/** AS Chemistry/2015/s/TZ 1/Paper 1/Q#

39//www.SmashingScience.org :o)

39 | A

**Q# 1287/** AS Chemistry/2014/w/TZ 1/Paper 1/Q#

39//www.SmashingScience.org :o)

39 | B

**Q# 1288/** AS Chemistry/2014/s/TZ 1/Paper 1/Q#

37//www.SmashingScience.org :o)

37 | C

**Q# 1289/** AS Chemistry/2014/s/TZ 1/Paper 1/Q#

30//www.SmashingScience.org :o)

30 | A

**Q# 1290/** AS Chemistry/2014/s/TZ 1/Paper 1/Q#

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20 | A





**Q# 1291/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
40//www.SmashingScience.org :o)

40 D

**Q# 1292/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 A

**Q# 1293/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
38//www.SmashingScience.org :o)

38 A

**Q# 1294/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
28//www.SmashingScience.org :o)

28 B

**Q# 1295/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
21//www.SmashingScience.org :o)

21 C

**Q# 1296/** AS Chemistry/2013/w/TZ 1/Paper 1/Q#  
20//www.SmashingScience.org :o)

20 B

**Q# 1297/** AS Chemistry/2013/s/TZ 1/Paper 1/Q#  
27//www.SmashingScience.org :o)

27 A

**Q# 1298/** AS Chemistry/2013/s/TZ 1/Paper 1/Q#  
21//www.SmashingScience.org :o)

21 B

**Q# 1299/** AS Chemistry/2012/w/TZ 1/Paper 1/Q#  
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40 D

**Q# 1300/** AS Chemistry/2012/w/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 C

**Q# 1301/** AS Chemistry/2012/w/TZ 1/Paper 1/Q#  
29//www.SmashingScience.org :o)

29 A

**Q# 1302/** AS Chemistry/2012/s/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 C

**Q# 1303/** AS Chemistry/2012/s/TZ 1/Paper 1/Q#  
28//www.SmashingScience.org :o)

28 B

**Q# 1304/** AS Chemistry/2011/w/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 D

**Q# 1305/** AS Chemistry/2011/w/TZ 1/Paper 1/Q#  
23//www.SmashingScience.org :o)

23 D

**Q# 1306/** AS Chemistry/2011/s/TZ 1/Paper 1/Q#  
30//www.SmashingScience.org :o)

30 D

**Q# 1307/** AS Chemistry/2011/s/TZ 1/Paper 1/Q#  
20//www.SmashingScience.org :o)

20 C

**Q# 1308/** AS Chemistry/2010/w/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 B

**Q# 1309/** AS Chemistry/2010/w/TZ 1/Paper 1/Q#  
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38 B

**Q# 1310/** AS Chemistry/2010/w/TZ 1/Paper 1/Q#  
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27 B

**Q# 1311/** AS Chemistry/2010/w/TZ 1/Paper 1/Q#  
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23 B

**Q# 1312/** AS Chemistry/2010/s/TZ 1/Paper 1/Q#  
40//www.SmashingScience.org :o)

40 B

**Q# 1313/** AS Chemistry/2010/s/TZ 1/Paper 1/Q#  
37//www.SmashingScience.org :o)

37 A

**Q# 1314/** AS Chemistry/2009/w/TZ 1/Paper 1/Q#  
39//www.SmashingScience.org :o)

39 C

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**Q# 1319/** AS Chemistry/2009/s/TZ 1/Paper 1/Q#  
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