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# CHEMISTRY MULTIPLE CHOICE QUESTIONS

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Organic Chemistry  
Carbonyl Compounds

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2002 -2009

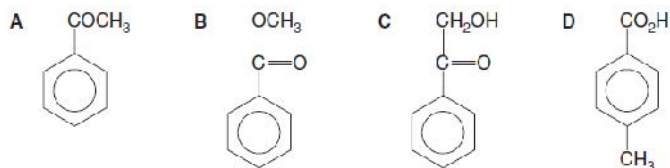
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1.

A compound **R** has all of the following properties:

- it is neutral;
- it gives an orange precipitate with 2,4-dinitrophenylhydrazine;
- it evolves hydrogen chloride when treated with  $PCl_5$  in the cold.

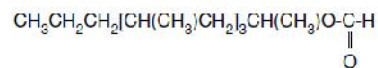
What could **R** be?



[2002 M/J (28)]

2.

30 The acarid mite releases *lardolure* to attract other mites to a host; this chemical can be destroyed by hydrolysis with acid.



A simplified formula for *lardolure* may be written as  $\text{RCH}(\text{CH}_3)\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$ .

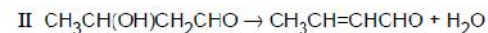
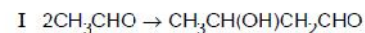
What are the products of its hydrolysis?

- A  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{CH}_3\text{OH}$
- B  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{HCO}_2\text{H}$
- C  $\text{RCH}(\text{CH}_3)\text{OH} + \text{CO}_2$
- D  $\text{RCH}(\text{CH}_3)\text{OH} + \text{HCO}_2\text{H}$

[2002 M/J (30)]

3.

The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction I). Aldol forms another compound on heating (reaction II).



Which of the following best describes reactions I and II?

	I	II
A	addition	elimination
B	addition	reduction
C	elimination	reduction
D	substitution	elimination

[2002 O/N (20)]

4.

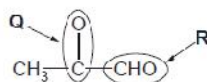
Oxidation of an alkene **Y** gives a diol; further oxidation gives a diketone.

What could be **Y**?

- A  $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)_2$
- B  $(\text{CH}_3)_2\text{CHCH}=\text{CH}_2$
- C  $\text{C}_6\text{H}_5\text{CH}=\text{CHC}_6\text{H}_5$
- D  $(\text{C}_6\text{H}_5)_2\text{C}=\text{CHCH}_3$

[2002 O/N (26)]

5. 27 Burnt sugar has a characteristic smell caused partly by the following compound. It has two functional groups indicated by **Q** and **R**.



When this compound is tested in a laboratory with 2,4-dinitrophenylhydrazine and Fehling's reagent, which functional groups are responsible for positive tests?

	2,4-dinitrophenylhydrazine	Fehling's reagent
<b>A</b>	<b>Q and R</b>	<b>Q and R</b>
<b>B</b>	<b>R only</b>	<b>Q and R</b>
<b>C</b>	<b>Q and R</b>	<b>R only</b>
<b>D</b>	<b>Q only</b>	<b>R only</b>

[2002 O/N (27)]

6. Ethanal may be converted into a three-carbon acid in a two-step process.

Which compound is the intermediate?

- A**  $\text{CH}_3\text{CO}_2\text{H}$     **B**  $\text{CH}_3\text{CN}$     **C**  $\text{CH}_3\text{CH}_2\text{CN}$     **D**  $\text{CH}_3\text{CH}(\text{OH})\text{CN}$

[2002 O/N (28)]

7. In the reaction between an aldehyde and HCN catalysed by NaCN, which statements about the reaction mechanism are true?

- 1 A new carbon-carbon bond is formed.
- 2 In the intermediate, the oxygen carried a negative charge.
- 3 The last stage involves the formation of a hydrogen-oxygen bond.

[2002 O/N (39)]

8. The product of the reaction between propanone and hydrogen cyanide is hydrolysed under acidic conditions.

What is the formula of the final product?

- A**  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$   
**B**  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$   
**C**  $(\text{CH}_3)_2\text{CHCONH}_2$   
**D**  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CO}_2\text{H}$

[2003 M/J (30)]

9.  $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$  reacts with hydrogen cyanide to form a cyanohydrin.

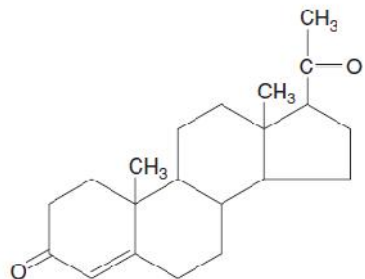
Which features apply to the product?

- A** It has one chiral centre.  
**B** It is formed by electrophilic addition.  
**C** It is formed via a C–OH intermediate.  
**D** Its formation requires the use of cyanide ions as a catalyst.

[2003 O/N (29)]

10.

The compound shown is a hormone produced during pregnancy to suppress ovulation.



Which reagents would give positive results with this compound?

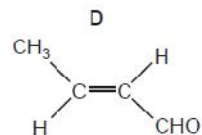
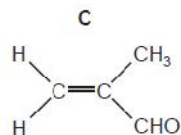
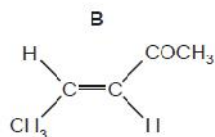
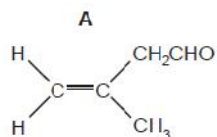
- 1 aqueous bromine
- 2 2,4-dinitrophenylhydrazine
- 3 Fehling's reagent

[2003 O/N (39)]

11.

Compound **P** displays *cis-trans* isomerism and gives a red-brown precipitate with Fehling's solution.

What is **P**?



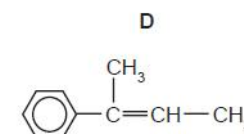
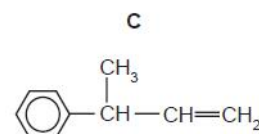
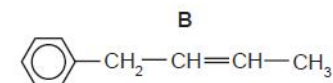
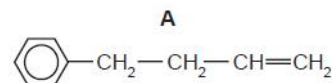
[2004 M/J (22)]

12.

Compound **X**

- has the molecular formula  $C_{10}H_{14}O$ ;
- is unreactive towards mild oxidising agents.

What is the structure of the compound formed by dehydration of **X**?



[2004 M/J (28)]

13.

For which pair of compounds can the members be distinguished by means of Tollens' test (the use of a solution containing  $Ag(NH_3)_2^+$ )?

- A**  $CH_3CHO$  and  $CH_3COCH_3$
- B**  $CH_3COCH_3$  and  $C_2H_5COCH_3$
- C**  $CH_3COCH_3$  and  $CH_3CO_2CH_3$
- D**  $CH_3CO_2H$  and  $CH_3CO_2CH_3$

[2004 M/J (29)]

14.

Compound **X** changes the colour of acidified sodium dichromate(VI) from orange to green. 1 mol of **X** reacts with 2 mol of  $HCN(g)$ .

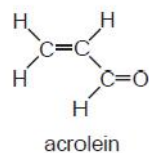
What could **X** be?

- A**  $CH_3COCH_2COCH_3$
- B**  $CH_3CH_2CH_2CHO$
- C**  $H_2C=CHCH_2CHO$
- D**  $OHCCH_2CH_2CHO$

[2004 M/J (30)]

15.

Acrolein is produced in photochemical smog. It has a strong smell, irritates eyes and mucous membranes and is carcinogenic.



What can be deduced from this structure?

- 1 All bond angles are approximately  $120^\circ$ .
- 2 It will undergo electrophilic addition reactions.
- 3 It will undergo nucleophilic addition reactions.

[2004 M/J (37)]

16.

Which carbonyl compounds could be easily oxidised to carboxylic acids that are readily soluble in cold water?

1  $\text{CH}_3\text{CH}_2\text{CHO}$

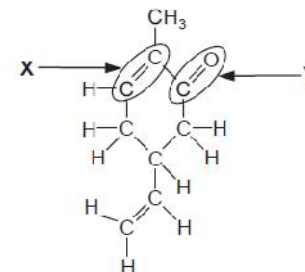
2

3

[2004 M/J (39)]

17.

This molecule is responsible for the flavour of spearmint chewing gum.



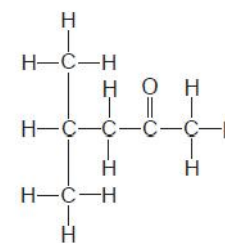
What is a true statement about the functional groups **X** or **Y**?

- A **X** will undergo nucleophilic addition.
- B **Y** will undergo nucleophilic addition.
- C **X** will undergo electrophilic substitution.
- D **Y** will undergo electrophilic substitution.

[2004 O/N (24)]

18.

The solvent methylisobutylketone, MIBK, can be made from propanone.



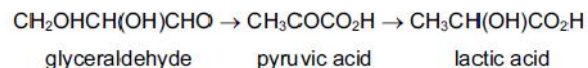
Which reagent could distinguish this compound from an aldehyde?

- A  $\text{Br}_2(\text{aq})$
- B 2,4-dinitrophenylhydrazine
- C  $\text{NaBH}_4$
- D Tollens' reagent

[2004 O/N (29)]

19.

Lactic acid builds up in muscles when oxygen is in short supply. It can cause muscular pain. Part of the reaction sequence is shown.



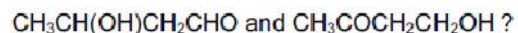
Which statements about the reaction sequence are correct?

- 1 An aldehyde is oxidised to a carboxylic acid.
- 2 A ketone is reduced to a secondary alcohol.
- 3 A secondary alcohol is oxidised to a ketone.

[2004 O/N (40)]

20.

Which reagent could be used to distinguish between

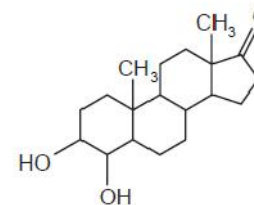


- A acidified potassium dichromate(VI)
- B dilute sulphuric acid
- C 2,4-dinitrophenylhydrazine
- D Fehling's reagent

[2005 M/J (28)]

21.

The steroid shown is an intermediate compound obtained during the synthesis of *Formestane* which is used in the treatment of breast cancer.



Which statements about this compound are correct?

- 1 It reacts with hydrogen cyanide in a nucleophilic addition reaction.
- 2 It can be oxidised by warm acidified potassium dichromate(VI) to a carboxylic acid.
- 3 It will react with Fehling's solution.

[2005 M/J (39)]

22.

Compounds X, Y and Z all react with  $\text{PCl}_5$  to release hydrogen chloride, but only one of them reacts with 2,4-dinitrophenylhydrazine reagent.

Which one of the following combinations could be X, Y and Z?

- |          | X  | Y   | Z  |
|----------|--|---|--|
| <b>A</b> | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CH}_2\text{OH} \end{array}$ | $\begin{array}{c} \text{CHO} \\   \\ \text{CHO} \end{array}$                    | $\begin{array}{c} \text{CO}_2\text{H} \\   \\ \text{CO}_2\text{H} \end{array}$ |
| <b>B</b> | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CH}_2\text{OH} \end{array}$ | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CHO} \end{array}$          | $\begin{array}{c} \text{CHO} \\   \\ \text{CO}_2\text{H} \end{array}$          |
| <b>C</b> | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CHO} \end{array}$           | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CO}_2\text{H} \end{array}$ | $\begin{array}{c} \text{CHO} \\   \\ \text{CO}_2\text{H} \end{array}$          |
| <b>D</b> | $\begin{array}{c} \text{CH}_2\text{OH} \\   \\ \text{CO}_2\text{H} \end{array}$  | $\begin{array}{c} \text{CHO} \\   \\ \text{CO}_2\text{H} \end{array}$           | $\begin{array}{c} \text{CO}_2\text{H} \\   \\ \text{CO}_2\text{H} \end{array}$ |

[2005 O/N (25)]

23. In 1903 Arthur Lapworth became the first chemist to investigate a reaction mechanism. The reaction he investigated was that of hydrogen cyanide with propanone.

What do we now call the mechanism of this reaction?

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

[2005 O/N (26)]

24. What is formed when propanone is refluxed with an anhydrous solution of  $\text{NaBH}_4$ ?

- A propanal
- B propan-1-ol
- C propan-2-ol
- D propane

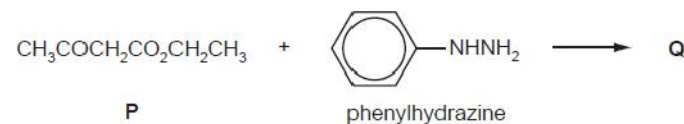
[2005 O/N (27)]

25. Which alcohol may be oxidised to a product which reacts with 2,4-dinitrophenylhydrazine reagent but not with Fehling's reagent?

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

[2006 M/J (27)]

26. The first stage in the synthesis of antipyrine, a drug used in reducing fever, is the reaction between compound **P** and phenylhydrazine.



What is the product **Q** of this first stage?

- A
- B
- C
- D

[2006 M/J (28)]

27. Aldehydes and ketones are carbonyl compounds.

Which of them react both with  $\text{NaBH}_4$  and with Tollens' reagent?

- A both aldehydes and ketones
- B aldehydes only
- C ketones only
- D neither aldehydes nor ketones

[2006 M/J (29)]

28. How can the rate of reaction between ethanal and aqueous hydrogen cyanide be increased?

- 1 by irradiation with ultraviolet light
- 2 by a rise in temperature
- 3 by the addition of a small quantity of aqueous sodium cyanide

[2006 M/J (39)]

29. Which compound

- is unaffected by hot alkaline potassium manganate(VII);
- gives hydrogen when treated with sodium?

- A  $(\text{CH}_3)_2\text{CHCOCH}_3$
- B  $(\text{CH}_3)_3\text{COH}$
- C  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- D  $\text{CH}_3\text{CO}_2\text{CH}(\text{CH}_3)_2$

[2006 O/N (27)]

30. A common industrial solvent is a mixture of propanone,  $\text{CH}_3\text{COCH}_3$ , and pentyl ethanoate  $\text{CH}_3\text{CO}_2(\text{CH}_2)_4\text{CH}_3$ .

Which reagent would have no effect on this solvent?

- A Na(s)
- B  $\text{NaBH}_4$
- C  $\text{NaOH}(\text{aq})$
- D 2,4-dinitrophenylhydrazine reagent

[2006 O/N (28)]

31. Which reagent gives the same visible result with propanal and with propan-2-ol?

- A 2,4-dinitrophenylhydrazine reagent
- B acidified potassium dichromate(VI)
- C sodium
- D Tollens' reagent

[2007 M/J (27)]

32. Compound X will decolourise a warm acidified solution of manganate(VII) ions and forms orange crystals on reaction with 2,4-dinitrophenylhydrazine.

What is X?

- A  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{OH}$
- B  $\text{CH}_3\text{COCH}_2\text{CH}_3$
- C  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- D  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CO}_2\text{H}$

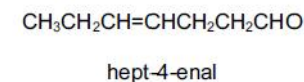
[2007 M/J (28)]

33. Which compound would undergo nucleophilic addition?

- A ethene,  $\text{C}_2\text{H}_4$
- B bromoethane,  $\text{C}_2\text{H}_5\text{Br}$
- C ethanal,  $\text{CH}_3\text{CHO}$
- D ethane,  $\text{C}_2\text{H}_6$

[2007 M/J (29)]

34. Hept-4-enal is present in cow's milk.



What is formed when hept-4-enal is reduced with either hydrogen and a nickel catalyst or sodium borohydride?

- A with  $\text{H}_2/\text{Ni}$   $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{OH}$
- B with  $\text{H}_2/\text{Ni}$   $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$
- C with  $\text{NaBH}_4$   $\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{OH}$
- D with  $\text{NaBH}_4$   $\text{CH}_3(\text{CH}_2)_5\text{CHO}$

[2007 O/N (28)]



35.

Which of these reactions is shown by butanone,  $\text{CH}_3\text{COCH}_2\text{CH}_3$ ?

- A On warming with acidified potassium dichromate(VI) the solution turns green.
- B On heating with Fehling's reagent a red precipitate is formed.
- C With 2,4-dinitrophenylhydrazine reagent an orange precipitate is formed.
- D With hydrogen cyanide an aldehyde is formed.

[2007 O/N (29)]

36.

In the reaction between an aldehyde and HCN catalysed by NaCN, which statements about the reaction mechanism are true?

- 1 A new carbon-carbon bond is formed.
- 2 In the intermediate, the oxygen carries a negative charge.
- 3 The last stage involves the formation of a hydrogen-oxygen bond.

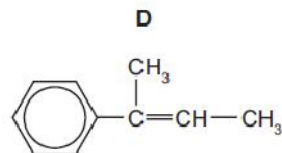
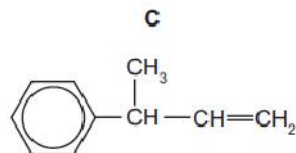
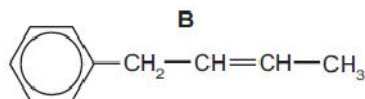
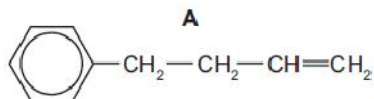
[2007 O/N (39)]

37.

Compound X

- has the molecular formula  $\text{C}_{10}\text{H}_{14}\text{O}$ ;
- is unreactive towards mild oxidising agents.

What is the structure of the compound formed by dehydration of X?



[2008 M/J (27)]

38.

Ethanal,  $\text{CH}_3\text{CHO}$ , can be reduced using an aqueous methanolic solution of  $\text{NaBH}_4$  as the reducing agent.

This is a nucleophilic addition reaction.

What could be the first step of this mechanism?

- A attack of an  $\text{H}^+$  ion at the carbon atom of the carbonyl group
- B attack of an  $\text{H}^+$  ion at the oxygen atom of the carbonyl group
- C attack of an  $\text{H}^-$  ion at the carbon atom of the carbonyl group
- D attack of an  $\text{H}^-$  ion at the oxygen atom of the carbonyl group

[2008 M/J (28)]

39.

Compound X,  $\text{C}_6\text{H}_{12}\text{O}$ , is oxidised by acidified sodium dichromate(VI) to compound Y.

Compound Y reacts with ethanol in the presence of a little concentrated sulphuric acid to give liquid Z.

What is the formula of Z?

- A  $\text{CH}_3(\text{CH}_2)_2\text{CH}=\text{CHCO}_2\text{H}$
- B  $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{COCH}_2\text{CH}_3$
- C  $\text{CH}_3(\text{CH}_2)_4\text{CO}_2\text{CH}_2\text{CH}_3$
- D  $\text{CH}_3\text{CH}_2\text{CO}_2(\text{CH}_2)_4\text{CH}_3$

[2008 M/J (30)]

40.

The product of the reaction between propanone and hydrogen cyanide is hydrolysed under acidic conditions.

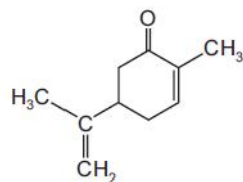
What is the formula of the final product?

- A  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$
- B  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- C  $(\text{CH}_3)_2\text{CHCONH}_2$
- D  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CO}_2\text{H}$

[2008 O/N (29)]

41.

Carvone gives the characteristic flavour to caraway and spearmint.



carvone

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

[2009 M/J (28)]

42.

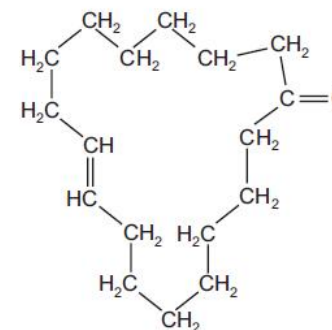
How can the rate of reaction between ethanal and aqueous hydrogen cyanide be increased?

- 1 by irradiation with ultraviolet light
- 2 by a rise in temperature
- 3 by the addition of a small quantity of aqueous sodium cyanide

[2009 M/J (39)]

43.

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



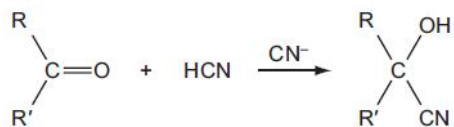
civetone

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)

[2009 O/N-11 (27)]

44. Cyanohydrins can be made from carbonyl compounds by generating  $\text{CN}^-$  ions from HCN in the presence of a weak base.



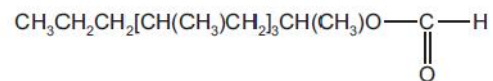
In a similar reaction,  $^-\text{CH}_2\text{CO}_2\text{CH}_3$  ions are generated from  $\text{CH}_3\text{CO}_2\text{CH}_3$  by strong bases.

Which compound can be made from an aldehyde and  $\text{CH}_3\text{CO}_2\text{CH}_3$  in the presence of a strong base?

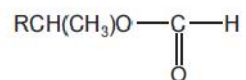
- A  $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{CH}_3$   
 B  $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$   
 C  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CO}_2\text{CH}_3$   
 D  $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{CO}_2\text{CH}_3$

[2009 O/N-11 (28)]

45. The acarid mite releases *lardolure* to attract other mites to a host. This chemical can be destroyed by hydrolysis with acid.



A simplified formula for *lardolure* may be written as follows.



What are the products of its hydrolysis?

- A  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{CH}_3\text{OH}$   
 B  $\text{RCH}(\text{CH}_3)\text{CO}_2\text{H} + \text{HCO}_2\text{H}$   
 C  $\text{RCH}(\text{CH}_3)\text{OH} + \text{CO}_2$   
 D  $\text{RCH}(\text{CH}_3)\text{OH} + \text{HCO}_2\text{H}$

[2009 O/N-11 (30)]

46. A compound has a relative molecular mass of 88 and its molecule contains only four carbon atoms.

What could this compound be?

- 1 a saturated non-cyclic diol  
 2 a secondary alcohol containing an aldehyde group  
 3 a primary alcohol containing a ketone group

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47.