

## ESTERS HOMEWORK

1. Which is true of a compound with the following formula?

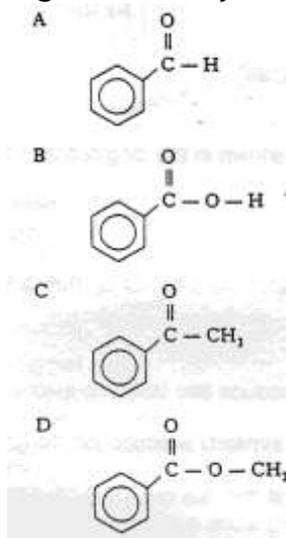


- A It is a primary alcohol  
B It can be oxidised to an aldehyde  
C It is a tertiary alcohol  
D It can be oxidised to a ketone.
32. Which process is used to convert methanol to methanal?
- A oxidation  
B condensation  
C hydration  
D hydrogenation
3. Which of the following alcohols can be oxidised to give a ketone?
- A 2-methylbutan-1-ol  
B 2,3-dimethylpentan-1-ol  
C 3-methylbutan-2-ol  
D 2-methylbutan-2-ol
4. Ethanol vapour is passed over hot aluminium oxide. What kind of reaction occurs?
- A Hydrogenation  
B Dehydration  
C Hydrolysis  
D Dehydrogenation
5. What compound is formed by the oxidation of propan-2-ol?
- A  $\text{CH}_3\text{CH}_2\text{CHO}$   
B  $\text{CH}_3\text{CO CH}_3$   
C  $\text{CH}_3\text{CH}_2\text{COOH}$   
D  $\text{CH}_3\text{CH}_2\text{ CH}_2\text{OH}$

6. The dehydration of butan-2-ol can produce two isomeric alkenes, but-1-ene and but-2-ene. Which of the following alkanols can similarly produce, on dehydration, a pair of isomeric alkenes?

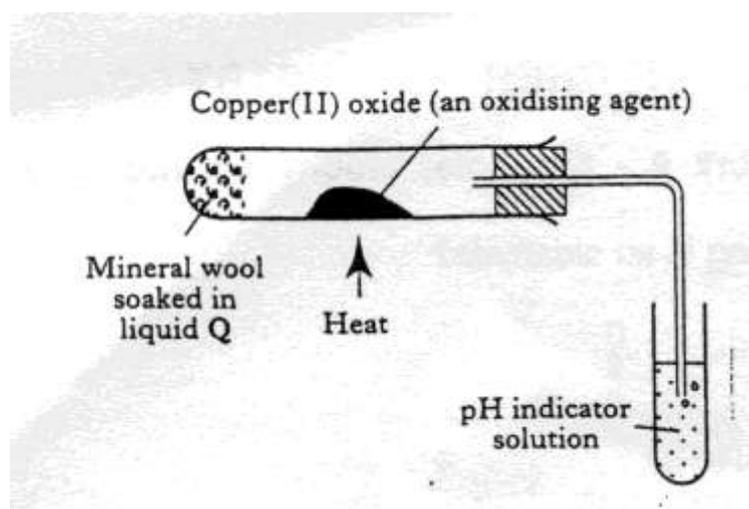
- A propan-2-ol
- B pentan-3-ol
- C hexan-3-ol
- D heptan-4-ol

7. Which of the following is an aldehyde?

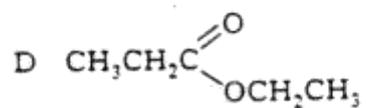
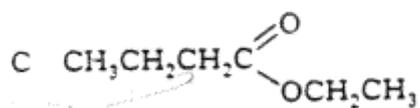
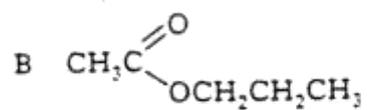
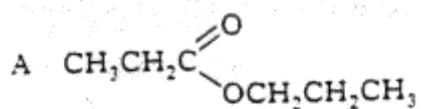


8. After heating for several minutes as shown in the diagram, the pH indicator solution turned red.  
Liquid Q could be,

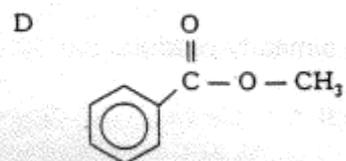
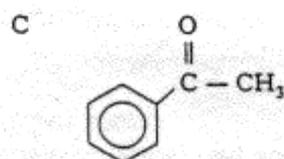
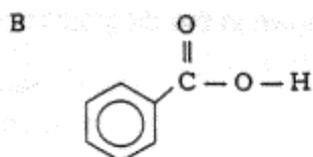
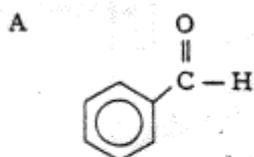
- A propanone
- B paraffin
- C propan-1-ol
- D propan-2-ol



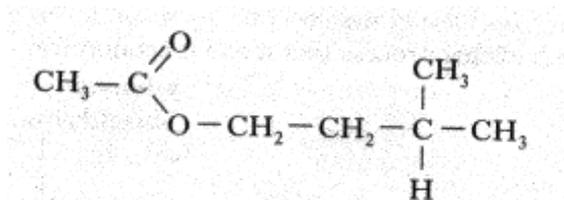
9. Propanoic acid is reacted with ethanol, one of the products is,



10. Which of the following is an ester?

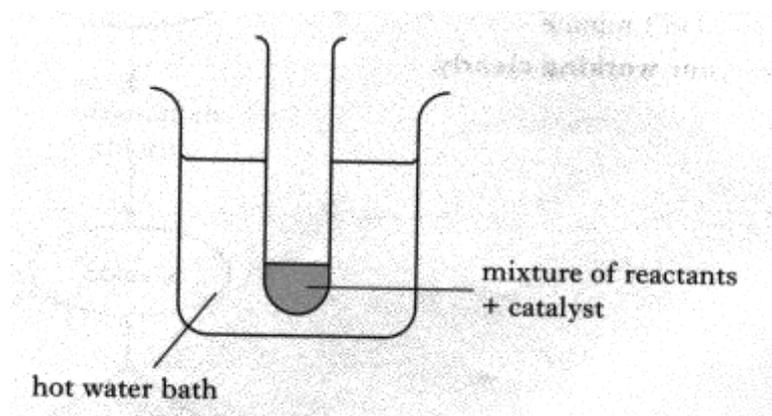


11. One of the chemicals released in a bee sting is an ester that has the structure shown.



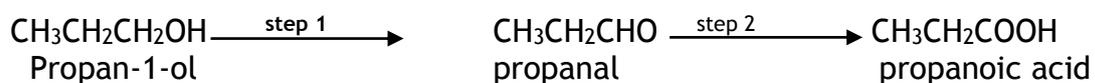
This ester can be produced by the reaction of an alcohol with an alkanolic acid.

- (a) Name this acid. (1)  
 (b) The ester can be prepared in the lab by heating a mixture of the reactant with a catalyst. Name the catalyst used in the reaction (1)



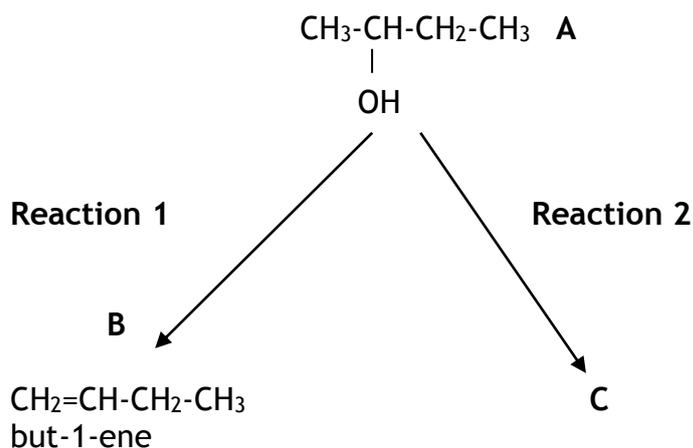
- (c) What improvement could be made to the experimental setup shown in the above diagram? (1)

12. Alkanols can be oxidised to alkanolic acids.

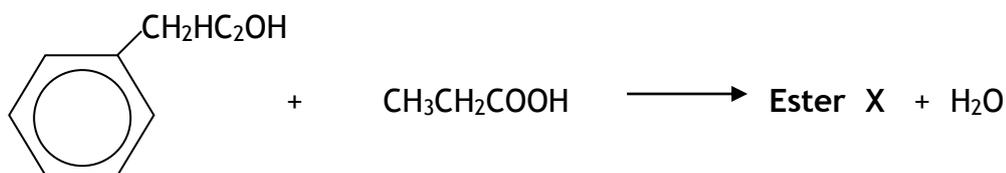


- (a) Why can **step 1** be described as an oxidation reaction? (1)  
 (b) Acidified potassium dichromate solution can be used to oxidise propanal in **step 2**. What colour change would be observed in this reaction? (1)

13. Two reactions involving a carbon compound, A, are shown.



- (a) Name compound C, an isomer of B (1)  
 (b) Name the type of reaction which took place. (1)
14. Synthetic perfumes are cheaper and easier to produce than natural perfumes. Phenylethanol has a smooth rose-like odour and is used in floral perfumes together with its propanoate ester.



phenylethanol

propanoic acid

ester

mass of one mole  
=122g

mass of one mole  
=74g

mass of one mole  
=178g

- (a) Draw the structural formula for ester X (1)  
 (b) 3.05 tonnes of phenylethanol was refluxed with excess acid.  
 Calculate the percentage yield if 9.05 tonnes of the ester was  
 obtained. (2)

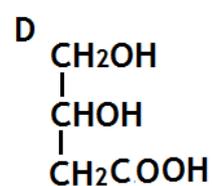
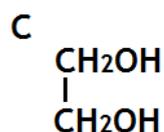
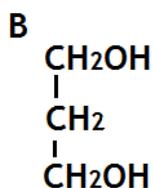
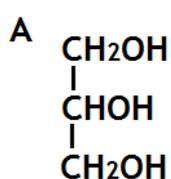
TOTAL = 20

## FATS AND SOAPS HOMEWORK

1. Fats and oils can be classified as

- A soaps
- B fatty acids
- C esters
- D polyesters

2. The structural formula for glycerol is



3. The production of fatty acids and glycerol from fats in foods is an example of

- A hydrolysis
- B hydrogenation
- C dehydration
- D dehydrogenation

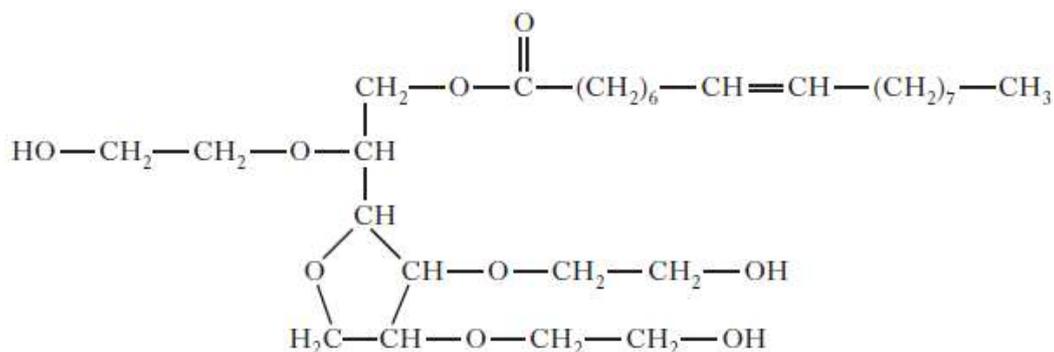
4. Which of the following decolorises bromine water least successfully?

- A palm oil
- B hex-1-ene
- C cod liver oil
- D mutton fat

5. In the formation of “hardened” fats from vegetable oils, the hydrogen...

- A causes cross-linking between the chains
- B causes hydrolysis to occur
- C increases the carbon chain length
- D reduces the number of carbon to carbon double bonds.

6. Both solid and liquid fats are  
 A mixtures of triglycerides in which the fatty acids are always identical.  
 B mixtures of different esters.  
 C mixtures of esters formed from unsaturated acids  
 D mixtures of triglycerides formed from fatty acids which can be the same or different.
7. Fats and oils are naturally occurring esters of fatty acids and glycerol. Explain fully why oils tend to have lower melting points than fats? (2)
8. The hydrolysis of a fat produces glycerol and fatty acids.
- a) What does the term “hydrolysis” mean? (1)  
 b) State the ratio of glycerol molecules to fatty acid molecules. (1)  
 c) What is the chemical name for glycerol? (1)  
 d) A triglyceride produces only glycerol and palmitic acid,  $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$ , on hydrolysis.  
 i) Draw the structural formula for the triglyceride. (1)  
 ii) Explain whether the triglyceride is likely to be a fat or an oil. (1)
9. Give one reason why fats can be a useful part of a balanced diet. (1)
10. Small children can find it difficult to swallow tablets or pills so ibuprofen is supplied as an “infant formula” emulsion. The emulsifier used is polysorbate 80. Its structure is shown below.



Explain why this molecule acts as an emulsifier. (1)



## PROTEINS HOMEWORK

1. On complete hydrolysis, a peptide produced 5 amino acids represented by the letters

P, Q, R, S and T.

The following fragments were produced on partial hydrolysis.



Which one of the sequences below could be the correct one for the arrangement of amino acids in the peptide?

- A. P-T-S-Q-R
- B. R-T-S-P-Q
- C. Q-P-T-S-R
- D. R-T-S-Q-P

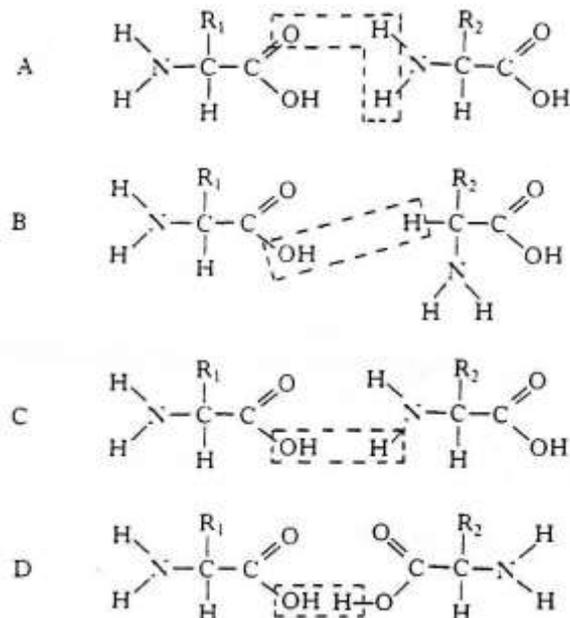
2. Which of the following must contain nitrogen?

- A an enzyme
- B an oil
- C a polyester
- D a carbohydrate

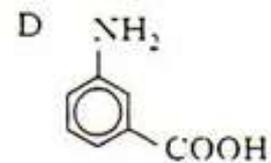
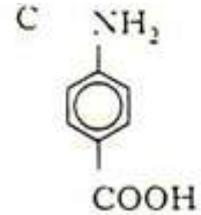
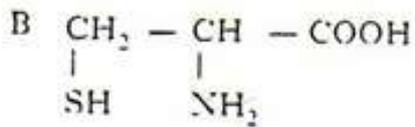
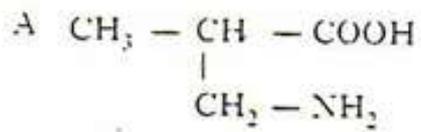
3. Proteins can be denatured under acid conditions. During this denaturing, the protein molecule

- A changes shape
- B is dehydrated
- C is neutralised
- D is polymerised

4. When two amino acids condense together, water is eliminated and a peptide link is formed. Which of the following represents this process?



5. Some amino acids are called  $\alpha$ (alpha) amino acids because the amino group is on the carbon atom next to the acid group.  
Which of the following is an  $\alpha$ (alpha) amino acid?



6. Essential amino acids are

- A found in all plant proteins
- B only made by the human body
- C necessary for making all proteins
- D needed by but not made in the body

7. A protein with the shape shown here is known as



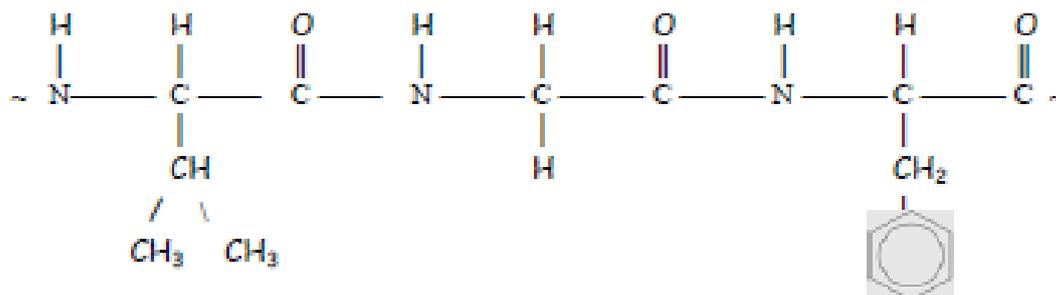
- A fibrous
- B cyclic
- C tubular
- D globular

8. What type of reaction is digestion?

- A Hydrolysis
- B Condensation
- C Dehydration
- D Hydration



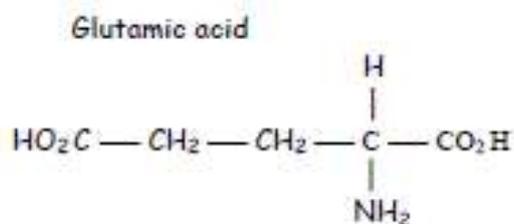
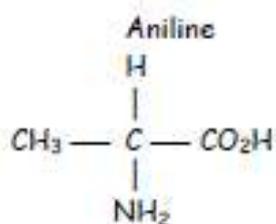
12.



Draw the structural formulae for the 3 molecules formed when the fragment is hydrolysed.

(1)

13. Peptides are molecules built up from amino acids: a dipeptide is formed from two amino acid molecules, a tripeptide from three amino acid molecules and a polypeptide from many amino acid molecules.



a) Draw the structural formula of the dipeptide formed from alanine and glutamic acid.

(1)

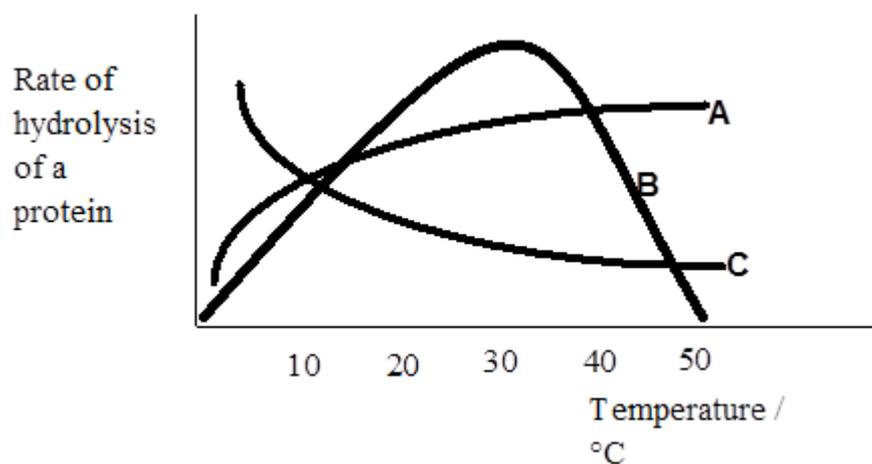
b) Name the other product of the reaction.

(1)

c) Name the type of reaction involved.

(1)

14. Examine the graphs below.



a) Which graph is likely to represent the results from a series of reactions using an enzyme? Explain your answer

(1)

b) To which family of compounds do enzymes belong?

(1)

c) Name the four elements which must be present in all enzyme molecules.

(1)

d) What name is given to the temperature at which the enzyme works best?

(1)

TOTAL = 20

## CHEMISTRY OF COOKING AND OXIDATION OF FOOD HOMEWORK

1. Two compounds A and B, both have the formula  $C_4H_8O$ . They were both mixed

separately with Fehling's solution and the mixtures warmed in a water bath.

Only compound B gave an orange-red precipitate.

a) Name compounds A and B. (1)

b) Draw the full structural formulae of A and B. (2)

c) Name another reagent which could also be used to show the difference between compound A and B and say what would happen when this reagent is reacted with A and B (2)

2.

A	$CH_3CH_2OH$	B	$CH_3CHOHCH_3$	C	$CH_3CH_2COOH$
D	$CH_3COCH_3$	E	$CH_3CH_2CHO$	F	$CH_3COOH$

Which box, or boxes, show(s) a substance which:

a) can be oxidised to an alkanal (aldehyde)?

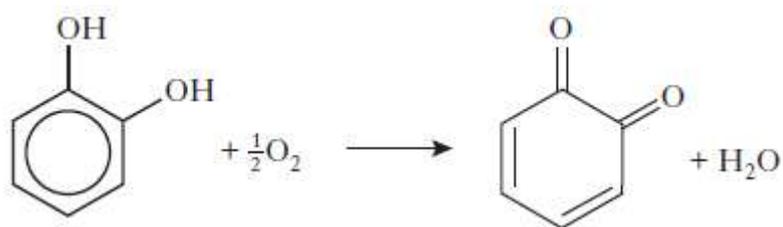
b) is an alkanone (ketone)?

c) is an alkanonic (carboxylic) acid?

d) is a primary alcohol?

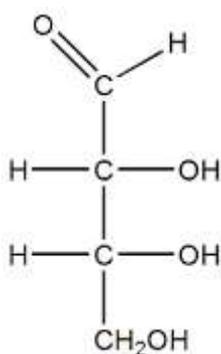
e) can be formed by the oxidation of B? (5)

3. Apples and bananas turn brown when cut or bruised. The first step of the reaction causing the browning is shown below.

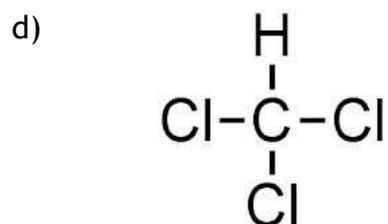
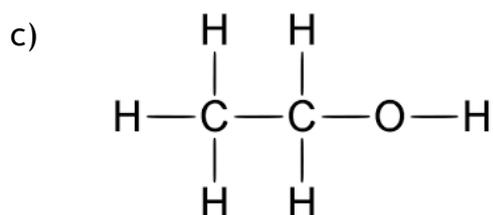
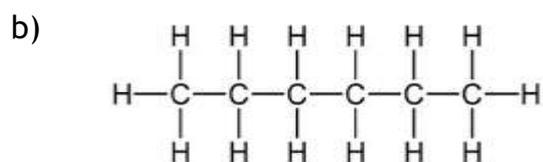
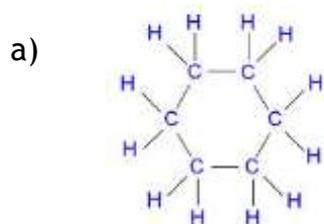


What type of reaction is this? (1)

4. Erythrose can be used in the production of a chewing gum that helps prevent tooth decay.

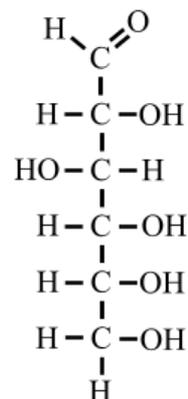


Which of the following compounds will be the **best** solvent for erythrose? (1)

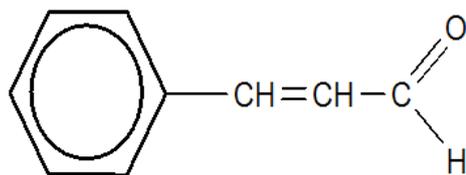


5. Glucose is a simple sugar that is used as an energy source by many living organisms.

Is glucose soluble in water or in hexane?  
Justify your answer with reference to the functional groups present. (1)

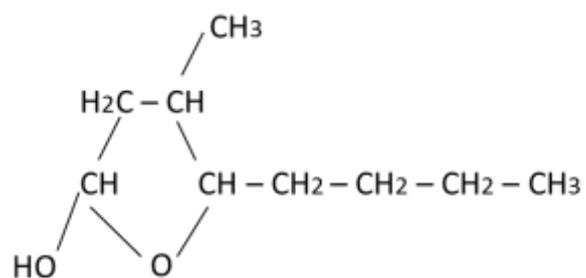


6. Cinnamon is a tasty spice used to flavour biscuits, cakes and pies. Cinnamon also has medicinal properties.

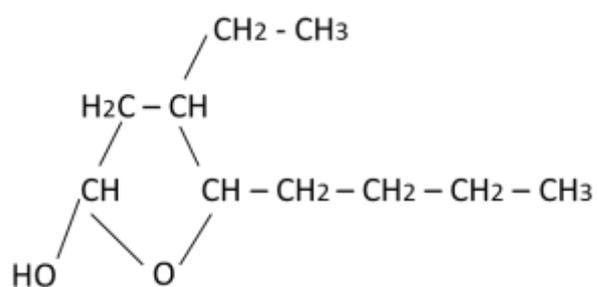


- Can you identify and name two functional groups in cinnamon? (1)
- Is cinnamon an aldehyde or a ketone? Explain your answer. (1)
- What is the strongest type of intermolecular force of attraction between cinnamon molecules? (1)

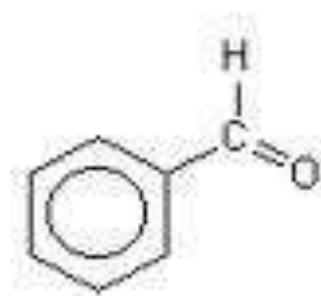
7. 5-Butyl-4-methyltetrahydrofuran-2-ol is a flavour compound found in whisky stored in oak barrels.



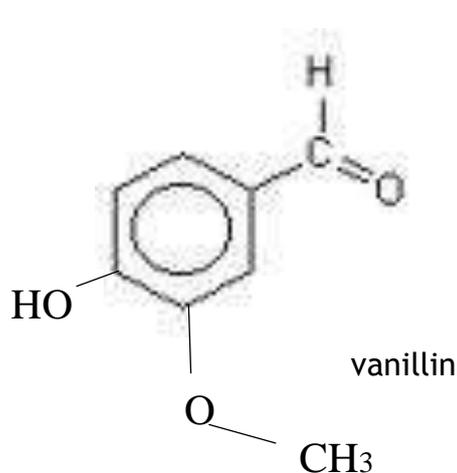
Write the systematic name for the compound shown below.  
(1)



8. Benzaldehyde and vanillin are examples of flavour molecules.



Benzaldehyde



vanillin

Vanillin is soluble in water and is fairly volatile (evaporates fairly easily).

Which line in the table correctly compares benzaldehyde to vanillin?

(1)

	Solubility in Water	Relative Volatility
A	greater than Vanillin	greater than Vanillin
B	greater than Vanillin	less than Vanillin
C	less than Vanillin	less than Vanillin
D	less than Vanillin	greater than Vanillin

9. Vitamin C is a common antioxidant. Many fruits and fruit juices are high in vitamin C. Give details as to how you would determine which fruit or fruit juice contains the highest level of vitamin C.

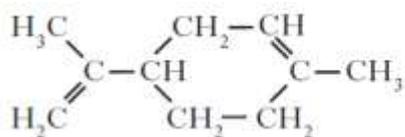
(You may wish to include a labelled diagram with your answer.)

(2)

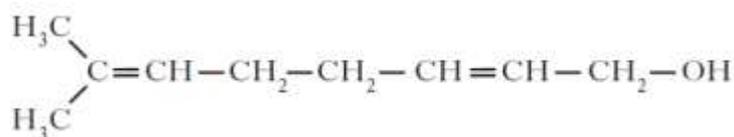
TOTAL = 20

## FRAGRANCES AND SKINCARE HOMEWORK

1. Two typical compounds that are present in many perfumes are shown.



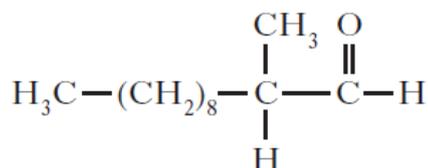
C<sub>10</sub>H<sub>16</sub>  
limonene



C<sub>9</sub>H<sub>16</sub>O  
geraniol

a) Why does geraniol evaporate more slowly than limonene? (1)

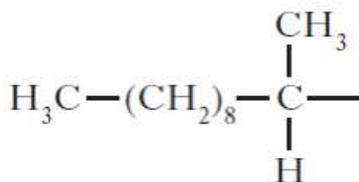
b) The structure of one of the first synthetic scents used in perfume is shown below.



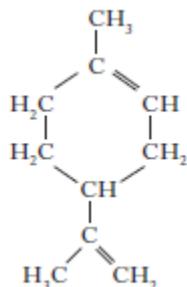
Name the family of carbonyl compounds to which this synthetic scent belongs. (1)

c) Copy and complete the structure below to show the product formed when this scent is oxidised.

(1)



2. Limonene is one of the terpene molecules responsible for the flavour of lemons.



How many isoprene units are used in the production of one limonene molecule? (1)

3. A team of chemists are developing a fragrance for use in a shower gel for men.

To give the gel a fruity smell the chemists are considering adding an ester.

They synthesise six isomeric esters.

Volunteers smell each ester and give it a rating out of one hundred, depending on how fruity the smell is.

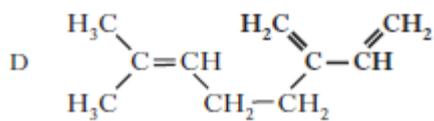
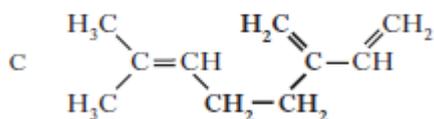
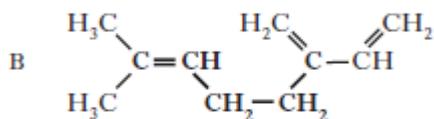
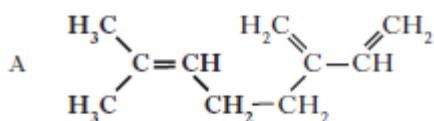
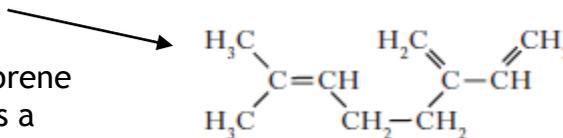
Structure	Fruit-smell rating	Structure	Fruit-smell rating
$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{C} \\ \diagdown \\ \text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$	100	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}_2-\text{C} \\ \diagdown \\ \text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$	92
$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{C} \\ \diagdown \\ \text{O}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	34	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{CH}-\text{C} \\   \quad \diagdown \\ \text{CH}_3 \quad \text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$	44
$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3-\text{C} \\ \diagdown \\ \text{O}-\text{C}-\text{CH}_2-\text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	0	$\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3-\text{C}-\text{C} \\   \quad \diagdown \\ \text{CH}_3 \quad \text{O}-\text{CH}_2-\text{CH}_3 \end{array}$	32

a) Name the ester with the fruit-smell rating of 92. (1)



4. Myrcene is a simple terpene.

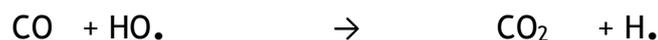
Terpenes contain at least one isoprene unit. Which of the following shows a correctly highlighted isoprene unit? (1)



5. Carbon monoxide gas is produced as a result of the incomplete combustion of fuels. The amount of carbon monoxide in the atmosphere is controlled by a series of free radical reactions.

- a) What is meant by the term 'free radical'? (1)  
 b) Why do free radicals form in the atmosphere? (1)

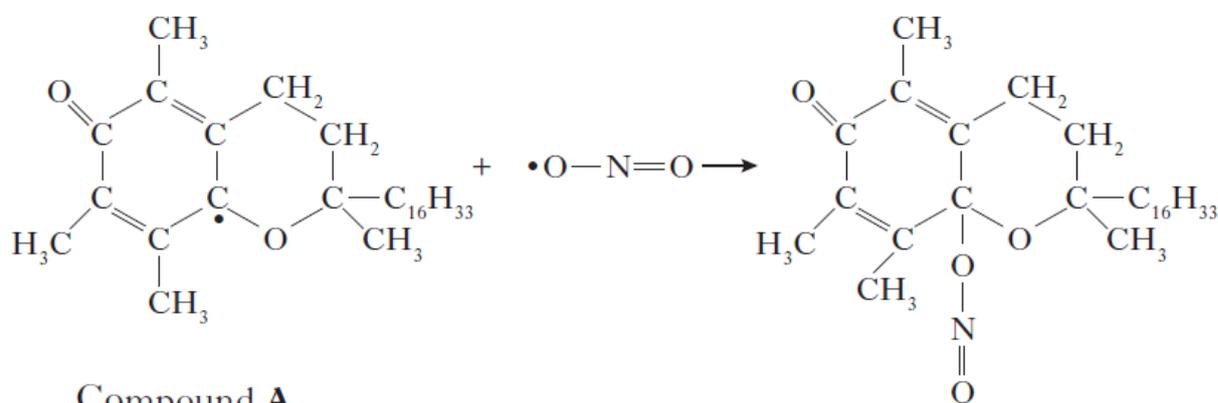
The equation shows one of the steps in the free radical chain reaction which controls the level of carbon monoxide:



- c) What term describes this type of step in the free radical chain reaction? (1)

6. Sun creams contain antioxidants.

The antioxidant, compound A, can prevent damage to skin by reacting with free radicals such as  $\text{NO}_2\cdot$ .



Why can compound A be described as a free radical scavenger in the reaction shown above?

(1)

7. Fluorine reacts with methane via a free radical chain reaction.

Some steps in the chain reaction are shown in the table below.

Reaction step	Name of step
$\text{F}_2 \rightarrow 2\text{F}\cdot$	
$\text{F}\cdot + \text{CH}_4 \rightarrow \text{HF} + \cdot\text{CH}_3$ $\cdot\text{CH}_3 + \text{F}_2 \rightarrow \text{CH}_3\text{F} + \text{F}\cdot$	propagation
$\cdot\text{CH}_3 + \text{F}\cdot \rightarrow \text{CH}_3\text{F}$	termination
	termination

Copy and complete the table by:

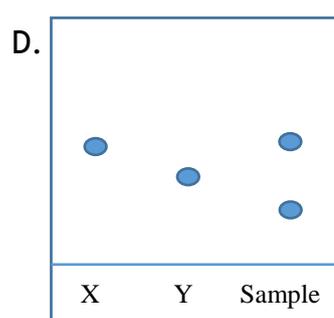
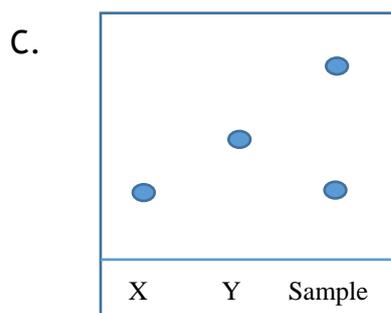
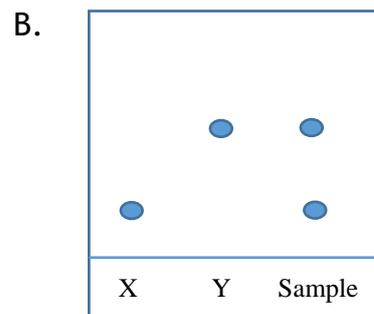
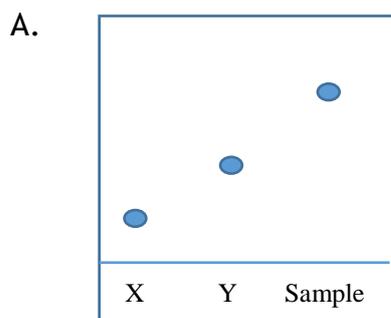
a) inserting the missing name for the first step (1)

b) showing another possible termination reaction in the final row of the table. (1)

8. An organic chemist is attempting to synthesise a fragrance compound by the following chemical reaction:



After 1 hour, a sample is removed and compared with pure samples of compounds X and Y using Chromatography. Which of the following chromatograms shows that the reaction has produced a pure sample of the fragrance compound? (1)



9. Humulene is a terpene which contributes to the aroma of beer.  
How many isoprene units were used to form a humulene molecule? (1)

10. Traces of a liquid were discovered in a bottle believed to contain perfume belonging to Queen Hatshepsut, ruler of Egypt over 3500 years ago.

Perfumes were made by dissolving plant extracts containing pleasant smelling terpenes and esters in an edible oil. A little ethanol and water may have also been added.



Using your knowledge of chemistry, comment on the possible smell(s) when such a bottle is opened after being stored for thousands of years. (3)



TOTAL = 20