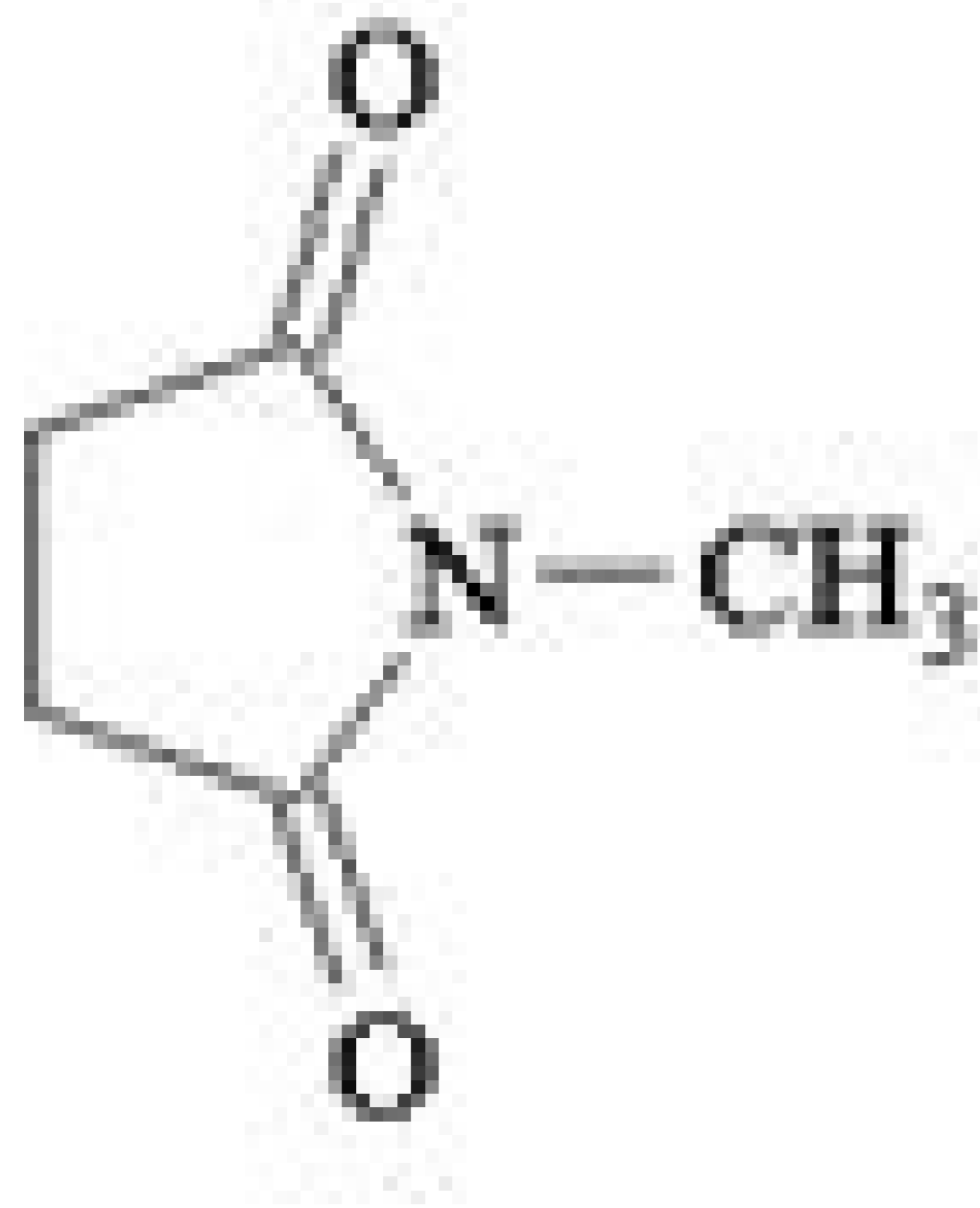
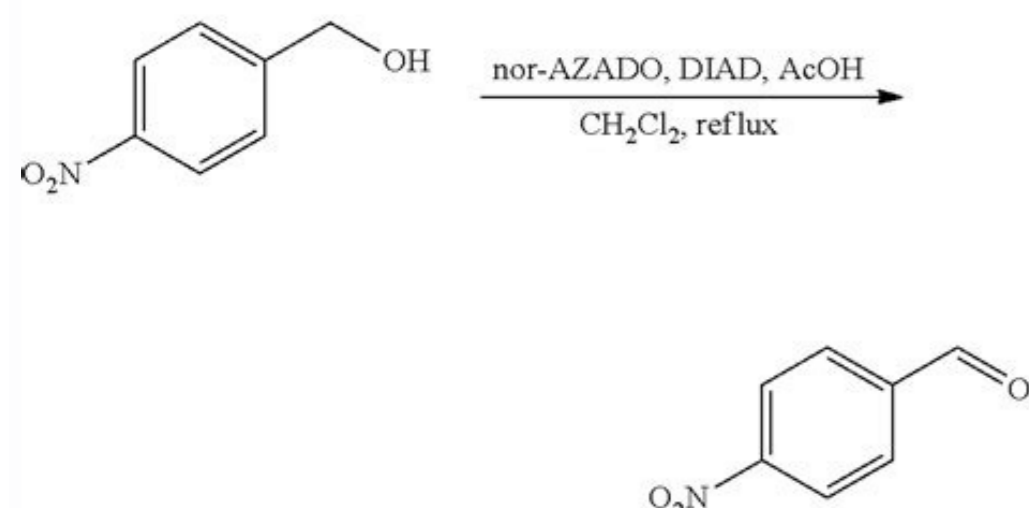


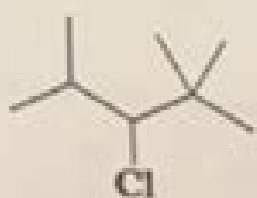
Continue



[Formula 32]

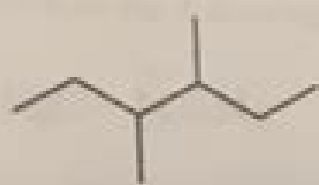


8. Identify the condensed formula of the following structure:



- A) $(\text{CH}_3)_2\text{CHCHClCH}(\text{CH}_3)_2$ C) $(\text{CH}_3)_2\text{CHCHClC}(\text{CH}_3)_3$
 B) $\text{CH}_3\text{CH}(\text{CH}_3)\text{CHClCH}(\text{CH}_3)_2$ D) $(\text{CH}_3)_3\text{CCHClCH}(\text{CH}_3)_2$

9. What is the chemical formula of the following carbon skeleton diagram?



- A) C_8H_{14} B) C_8H_{16} C) C_8H_{18} D) C_8H_{20}

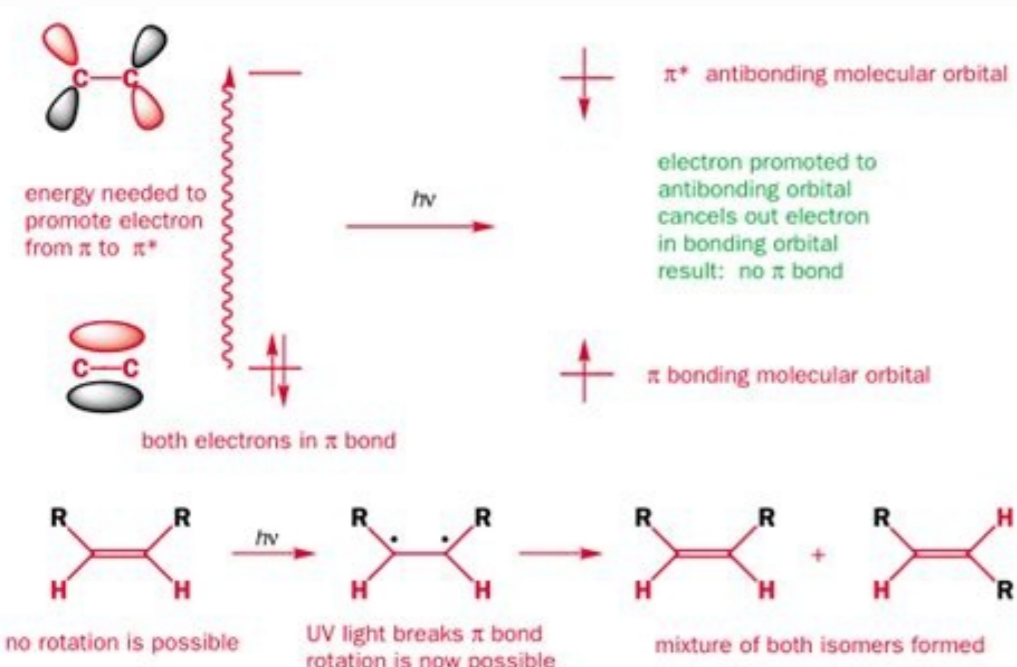
10. How many $\text{C}_3\text{H}_8\text{O}$ constitutional isomers are possible?
 A) one B) two C) three D) four

11. Which of the following best describes the relationship between the following two structures?



- A) identical compounds
 B) resonance structures
 C) constitutional isomers
 D) different compounds with different constitutions

12. How many constitutional isomers of $\text{C}_4\text{H}_9\text{Br}$ are possible?
 A) one B) two C) three D) four



Acetic anhydride IUPAC name Ethanoic anhydride Other names Acetic anhydrideAcetic acid anhydrideAcetylacetateAcetyl oxideAcetic oxideEthanoic anhydride Identifiers CAS number 108-24-7 RTECS number AK1925000 SMILES CC(=O)OC(=O)C InChI InChI=1/C4H6O3/c1-3(5)7-4(2)6/h1-2H3 Properties Molecular formula $\text{C}_4\text{H}_6\text{O}_3$ Molar mass 102.1 g/mol Appearance clear liquid Density 1.08 g/cm³, liquid Melting point $-73.1\text{ }^\circ\text{C}$ Boiling point $139.8\text{ }^\circ\text{C}$ Solubility in water 2.6% by weight; rapidly reacts to form acetic acid Hazards EU classification Corrosive (C) R-phrases R10, R20/22, R34 S-phrases (S1/2), S26, S36/37/39, S45 Flash point $54\text{ }^\circ\text{C}$ Related Compounds Related acid anhydrides Propionic anhydride Related compounds Acetic acidAcetyl chloride Except where noted otherwise, data are given for materials in their standard state(at 25 $^\circ\text{C}$, 100 kPa)Infobox disclaimer and references Acetic anhydride is the chemical compound with the formula $(\text{CH}_3\text{CO})_2\text{O}$. Commonly abbreviated Ac₂O, it is one of the simplest acid anhydrides and is a widely used reagent in organic synthesis. It is a colorless liquid that smells strongly of acetic acid, which is formed by its reaction with the moisture in the air. Acetic anhydride is produced by carbonylation of methyl acetate:[1] $\text{CH}_3\text{CO}_2\text{CH}_3 + \text{CO} \rightarrow (\text{CH}_3\text{CO})_2\text{O}$ This process involves the conversion of methyl acetate to methyl iodide and an acetate salt. Carbonylation of the methyl iodide in turn affords acetyl iodide, which reacts with acetate salts or acetic acid to give the product. Rhodium and lithium iodides are employed as catalysts. Because acetic anhydride is not stable in water, the conversion is conducted under anhydrous conditions. In contrast, the Monsanto acetic acid synthesis, which also involves a rhodium catalyzed carbonylation of methyl iodide, is at least partially aqueous. To a decreasing extent, acetic anhydride is also prepared by the reaction of ketene with acetic acid. Ketene is generated by dehydrating acetic acid at elevated temperatures. Due to its low cost, acetic anhydride is purchased, not prepared, for use in research laboratories. Ac₂O is mainly used for the acetylation of cellulose to cellulose acetate for photographic film and other applications. In general alcohols and amines are acetylated.[2] For example, the reaction of acetic anhydride with ethanol is: $(\text{CH}_3\text{CO})_2\text{O} + \text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3 + \text{CH}_3\text{CO}_2\text{H}$ Often a base such as pyridine is added to function as catalyst. Lewis acidic scandium salts are also effective catalysts.[3] Aspirin, acetyl salicylic acid, is prepared by the acetylation of salicylic acid using acetic anhydride. Because of its use for the synthesis of heroin by the diacetylation of morphine, acetic anhydride (known as 'AA' in clandestine chemistry circles) is listed as a DEA List II Precursor,[4] and restricted in many other countries. Acetic anhydride dissolves in water to approximately 2.6% by weight.[5] Aqueous solutions have limited stability because, like most acid anhydrides, acetic anhydride hydrolyses to give acetic acid:[6] $(\text{CH}_3\text{CO})_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{CH}_3\text{CO}_2\text{H}$ Acetic anhydride is an irritant and flammable. Because of its reactivity toward water, alcohol foam or carbon dioxide are preferred for fire suppression.[7] The vapour of acetic anhydride is harmful.[8] ~ Zoeller, J. R.; Agreda, V. H.; Cook, S. L.; Lafferty, N. L.; Polichnowski, S. W.; Pond, D. M. "Eastman Chemical Company Acetic Anhydride Process" *Catalysis Today* (1992), volume 13, pp.73-91.

doi:10.1016/0920-5861(92)80188-S ^ Science in Fun... Chemical of the Week. Retrieved on 2006-03-25. ^ Macor, J.; Sampognaro, A. J.; Verhoest, P. R.; Mack, R. A. "(R-+)-2-Hydroxy-1,2,2-Triphenylethyl Acetate" Organic Syntheses, Collected Volume 10, p.464 (2004). ^ British Petroleum. Acetic Anhydride: Frequently Asked Questions (PDF). Retrieved on 2006-05-03. ^ Celanese. Acetic Anhydride: Material Safety Data Sheet (PDF). Retrieved on 2006-05-03. ^ Data Sheets, International Occupational Safety and Health Information Centre. Retrieved on 2006-04-13. ^ NIOSH. Pocket Guide to Chemical Hazards. Retrieved on 2006-04-13. Chemguide: Support for CIE A level Chemistry/Learning outcome 16: Hydroxy compounds Statement 16.1.2 This statement covers a whole lot of reactions of alcohols. You will need to keep referring to your syllabus as you read down this page. Important Despite the fact that this is all included in one statement, there is a lot of chemistry to learn here. Take your time over it. This statement does not require any knowledge of the mechanisms for the reactions covered. Background work Start by reading the page introducing alcohols. This covers how the alcohols are named, and their physical properties. Make sure you understand the importance of hydrogen bonding in the physical properties of the alcohols. Technically, you don't need to know about the differences between primary, secondary and tertiary alcohols until statement 16.1.3. However, you will find these terms used throughout the Chemguide pages you will read, and you need to get this sorted out now. In fact, the use of these terms is exactly the same as with halogenoalkanes, so there is nothing very difficult involved. Statement 16.1.2(a): Combustion You will find the combustion of alcohols discussed briefly on the page about uses of alcohols. Make sure that you can write the equation for the complete combustion of methanol and ethanol, or any other given alcohol. Do not try to learn these equations - just make sure that you can work them out if you need to. Statement 16.1.2(b): Substitution to give halogenoalkanes You will find this described at some length on the page about replacing the -OH in alcohols by a halogen. This page covers several different ways of doing this, and you need to be familiar with all of them. Every single one of these methods has cropped up either in an exam question or as a possible answer in a mark scheme. Don't forget to notice that the addition of PCl5 can be used to test for an -OH group. Notice that the syllabus talks about "PCl3 and heat". I haven't mentioned the need for heat on the Chemguide page, and actually haven't been able to find another source which mentions it either. In fact the PCl3 reaction is more complicated than this anyway. Just learn what CIE want. You will find an exact copy of this statement in statement 15.1.1(c) as a means of preparing halogenoalkanes. Statement 16.1.2(c): Reaction with sodium This is covered on the page about the reactions of alcohols and sodium. You can ignore the section about the reactions of alkoxide ions. Statement 16.1.2(d): Oxidation to carbonyl compounds and carboxylic acids There is no logic in the syllabus at this point! This can't be done until you know about primary, secondary and tertiary alcohols - which is why I stressed at the beginning of this page that you should sort this out first. This statement includes the facts about the oxidation of the various sorts of alcohols. You will find this covered on the page about oxidation of alcohols. Before you start on this page, you will need to follow the second link in the red box at the top of the page so that you understand what aldehydes and ketones are. Read the whole of the first section of that page explaining what aldehydes and ketones are. In the Bonding and Reactivity section, just read the short bit about where aldehydes and ketones differ. Ignore the rest of the page for now. In the equations on the main page about the oxidation of alcohols, you can ignore the full versions or the electron-half-equations. All CIE will expect are the versions involving oxygen in square brackets. You can ignore the use of these reactions in distinguishing between primary, secondary and tertiary alcohols until statement 16.1.3. The syllabus statement also talks about using acidified potassium manganate(VII) as the oxidising agent and that isn't included on the page you have read. You can use the same equations (the ones with oxygen in square brackets) for potassium manganate(VII) as with potassium dichromate(VI). For CIE purposes the products are the same. The only essential difference is the colour change. When acidified potassium manganate(VII) oxidises things it turns from deep purple to colourless. Statement 16.1.2(e): Dehydration to alkenes You will find this on the page about the dehydration of alcohols. You need to know about both the catalytic dehydration, and also dehydration using concentrated sulfuric or phosphoric(V) acids. There was one question about using an apparatus similar to the catalytic dehydration which asked why you why you had to remove the delivery tube from the water before you stopped heating the horizontal tube. If you have done any practical work at all, this will be obvious to you. If you haven't, the answer is that as the very hot horizontal tube cools, the pressure inside it falls, and cold water is sucked back into it, cracking it. (Actually, if you want to be pedantic, water is forced into the hot tube by the higher air pressure acting on the water in the beaker.) Don't forget to read about the dehydration of more complicated alcohols at the bottom of the page. You may well be asked a question about this. What you need to remember is that the -OH group gets removed together with a hydrogen atom from the next-door carbon atom. Obviously, if the -OH group is in the middle of the chain, it has two next-door carbon atoms, and a hydrogen could get removed from either of them. Therefore there is more than one possible alkene formed. Make sure that you understand how you can get 3 different alkenes from the dehydration of butan-2-ol. This has appeared in a past question. Statement 16.1.2(f): Ester formation from carboxylic acids Read the page about esterification. It is essential to take your time over the names and structures of esters. You will eventually meet these again in Section 18.2, but you need to understand these names and structures now. You can ignore the formation of esters using acyl chlorides or acid anhydrides at the bottom of the page for now. You will meet the acyl chloride reaction in statements in the second half of your course. The acid anhydride reaction isn't on the syllabus anywhere. Go to the Section 16 Menu . . . To return to the list of learning outcomes in Section 16 Go to the CIE Main Menu . . . To return to the list of all the CIE sections Go to Chemguide Main Menu . . . This will take you to the main part of Chemguide.