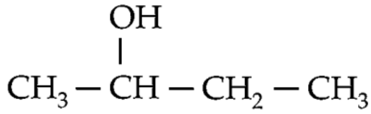
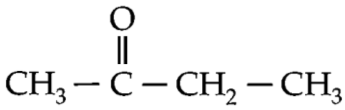
Quiz (Oxidation and Reduction of Aldehyde and Ketone)

1. Explain whether acidified potassium dichromate solution can be used to distinguish the following pair of compounds:



A

and



B

2. *E* is an acyclic carbon compound with a molecular formula of C_5H_8O. It can be converted to *F* and then G as shown below:

$$\underset{E}{C_5H_8O} \xrightarrow[H_2O]{NaBH_4} \underset{F}{C_5H_{10}O} \xrightarrow{H_2,\ Pt} \underset{G}{C_5H_{12}O}$$

The following table gives us more information about compounds *E* and *F*.

Compound	Additional information
E	- It exist as a pair of *cis-trans* isomers. - There is no observable change when it is added to acidified potassium dichromate solution.
F	- It has one chiral carbon atom.

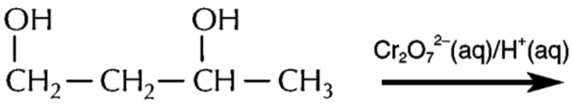
(a) Deduce the structural formulae of *E* and *F*.

(b) Draw the structures of the *cis-trans* isomers of *E*.

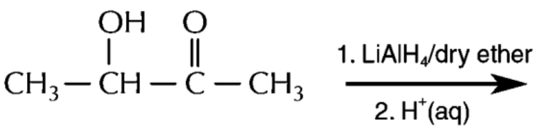
(c) Draw the three-dimensional structures of the stereoisomers of *F*.

3. Write the structural formulae of the products of the following reactions.

(a)



(b)



(c)

$$CH_2{=}CHCH_2CHO \xrightarrow[H_2O]{NaBH_4}$$

Suggested Answer

1. Yes, it can.

   Acidified potassium dichromate solution can oxidize compound *A* (butan-2-ol) to butanone. The orange dichromate ions are reduced to green chromium(III) ions.

   However, acidified potassium dichromate solution cannot oxidize compound *B* (butanone) and there is no observable change when they are mixed.

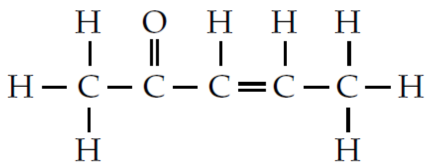
2. (a) As *E* can exist as a pair of *cis-trans* isomers, it should contain a carbon-carbon double bond and the double bond should not be at the terminal position of the molecule.

   In addition, as *E* can be reduced by $NaBH_4$, it may be an aldehyde or ketone. However, as *E* cannot be oxidized by $Cr_2O_7^{2-}(aq)/H^+(aq)$, it should be a ketone, but not an aldehyde.

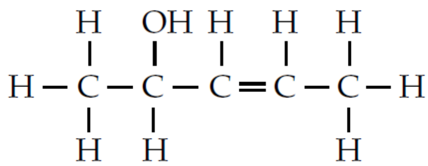
   F should be a secondary alcohol as it is produced by the reduction of *E* (a ketone). As it can undergo hydrogenation, it should contain a carbon-carbon double bond.

   Furthermore, as it is a chiral compound, the –OH group should be attached to the fourth carbon atom of the molecule so that a chiral carbon exists in the molecule. Therefore, the structures of *E* and *F* are:

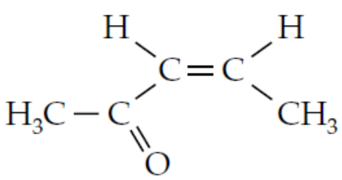
E:



F:

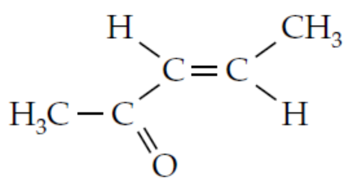


(b) The structure of *cis-trans* isomers of *E* are:



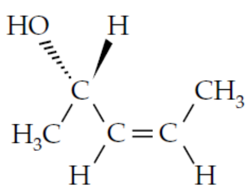
cis isomer

and

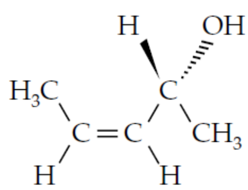


trans isomer

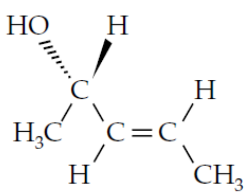
(c) The three-dimensional structures of the stereoisomers of *F* are:



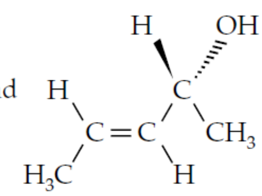
and



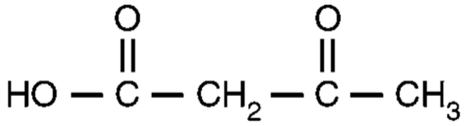
;



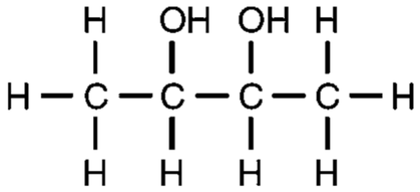
and



3. (a)



(b)



(c)