Quiz (Dehydration of Alkanols)

1. When an alcohol *X* ($C_5H_{12}O$) with a straight carbon chain is added to acidified sodium dichromate solution, the colour of the dichromate solution changes from orange to green, and compound *Y* ($C_5H_{10}O$) is produced. Given that *X* has a chiral carbon atom and *Y* is not a chiral compound.

   (a) Deduce the structural formulae of *X* and *Y*.

   (b) State the change in oxidation number of chromium during the oxidation reaction.

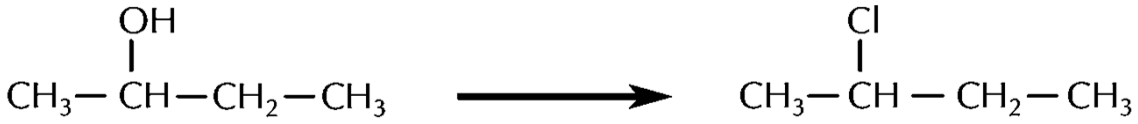
   (c) *X* exists as a pair of enantiomers. Draw the three-dimensional structures of these enantiomers.

2. State the reagents and conditions required for the following reactions.

   (a)

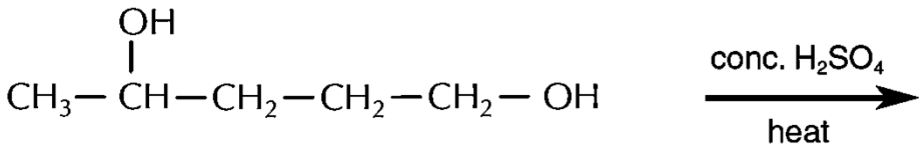
   (b)

   (c)

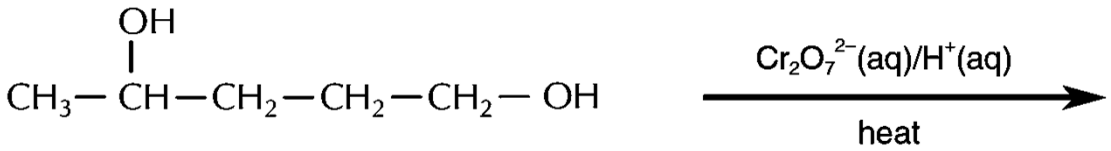


3. Write the structural formulae of the products of the following reactions:

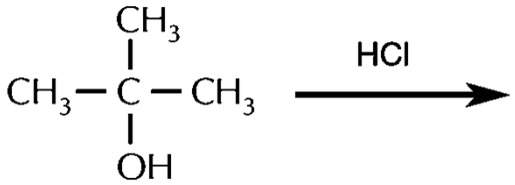
   (a)



   (b)



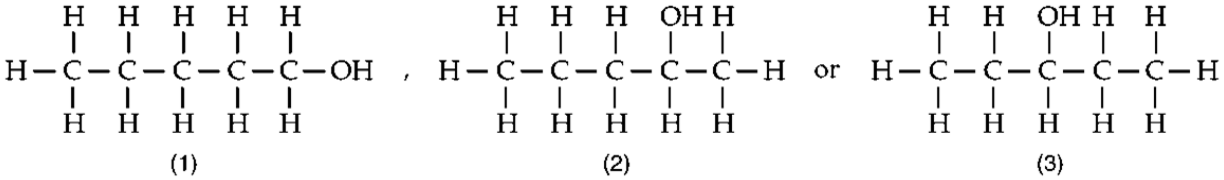
   (c)



Suggested Answer

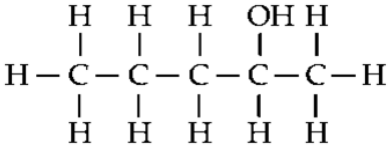
1. (a) As *X* can be oxidized by acidified sodium dichromate solution, it should be a 1° alcohol or 2° alcohol:

Three possible structures of *X*:



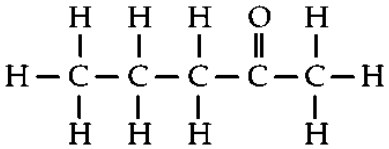
(1) , (2) or (3)

However, as *X* contains a chiral carbon atom, it could only be:



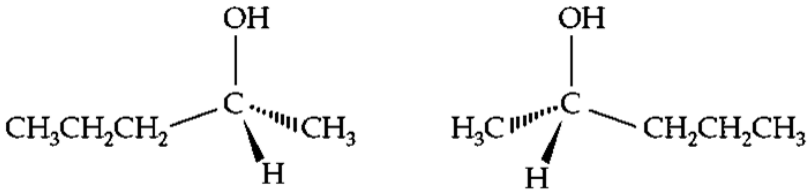
(2)

If *X* is a 2° alcohol, when it undergoes oxidation, a ketone would be produced. The structural formula of *Y* should be:



(b) The oxidation number of chromium changes from +6 to +3.

(c) The three-dimensional structures of the two enantiomers of *X* are:



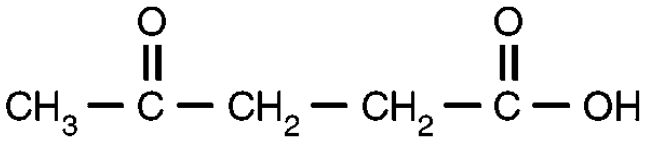
2. (a) Conc. H_2SO_4, heat **OR** Al_2O_3, heat

(b) $Cr_2O_7^{2-}(aq)$ / $H^+(aq)$, heat

(c) HCl **OR** PCl_3

3. (a)

(b)



(c)