

Chemguide – answers

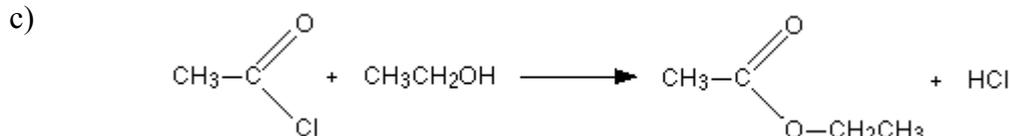
ADDITION / ELIMINATION REACTIONS

1. a) A nucleophile is a species (an ion or a molecule) which is strongly attracted to a region of positive charge in something else. Water has active lone pairs of electrons on an oxygen atom which is also fairly negative because of the electronegativity of the oxygen pulling electrons towards it in the hydrogen-oxygen bond.

b) In stage 1: The carbon in the carbon-oxygen double bond is fairly positive because both the electronegative oxygen and the chlorine are pulling electrons away from it. A lone pair on the oxygen of the water molecule moves towards that carbon, forming a bond with it, and forcing the electrons in the pi part of the carbon-oxygen double bond out entirely on to the oxygen, making it negatively charged. The movement of electrons away from the oxygen in the water molecule leaves it with a positive charge.

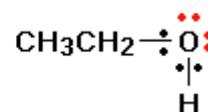
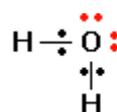
In stage 2: The double bond between the carbon and oxygen is re-formed, and in the process, the bond between the carbon and chlorine is broken, with the electrons in the bond moving on to the chlorine, leaving it negatively charged.

In stage 3: A lone pair on a chloride ion moves to form a bond with one of the hydrogens attached to the oxygen. Hydrogen chloride is formed. The electrons in the hydrogen-oxygen bond move back to the oxygen, neutralising the positive charge.

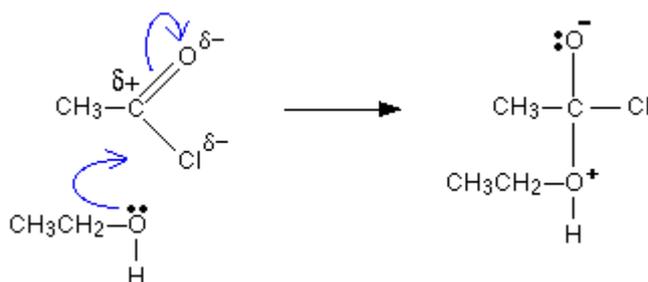


The organic product is ethyl ethanoate.

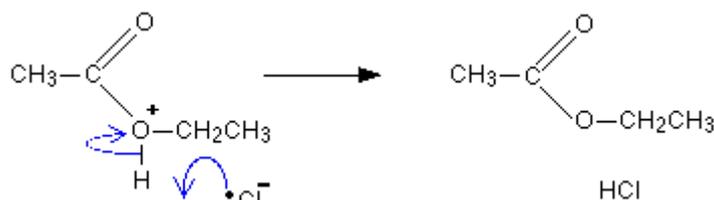
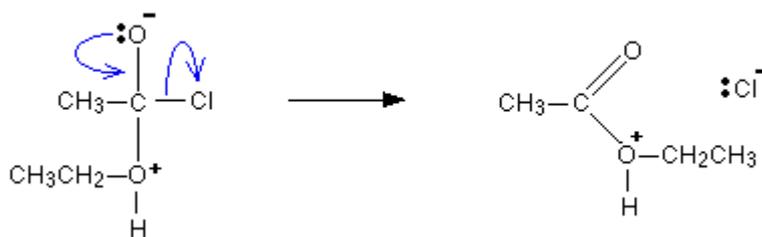
d) The important thing about water and ethanol is the presence of the lone pairs on the oxygen. These are involved in the mechanism. The presence (or absence) of the ethyl group doesn't affect this.



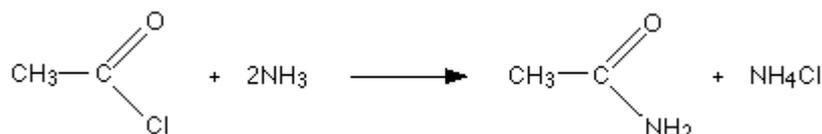
e)



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2. a)



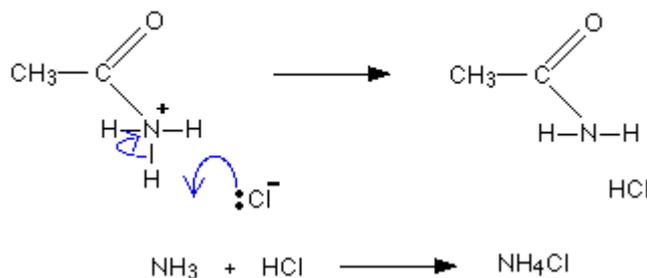
(You could write the ethanoyl chloride as CH_3COCl , and the ethanamide as CH_3CONH_2 if you wish.)

b) In stage 1: The carbon in the carbon-oxygen double bond is fairly positive because both the electronegative oxygen and the chlorine are pulling electrons away from it. The lone pair on the nitrogen of the ammonia molecule moves towards that carbon, forming a bond with it, and forcing the electrons in the pi part of the carbon-oxygen double bond out entirely on to the oxygen, making it negatively charged. The movement of electrons away from the nitrogen in the ammonia molecule leaves it with a positive charge.

In stage 2: The double bond between the carbon and oxygen is re-formed, and in the process, the bond between the carbon and chlorine is broken, with the electrons in the bond moving on to the chlorine, leaving it negatively charged.

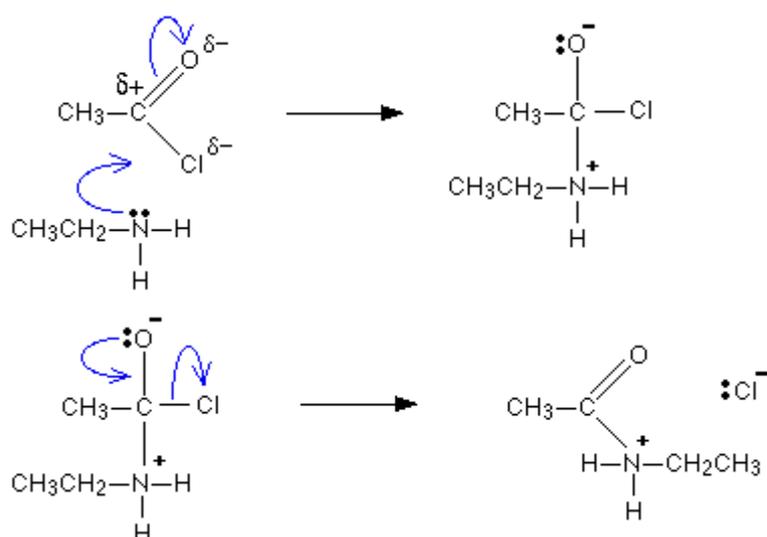
In stage 3: A lone pair on an ammonia molecule (the ammonia is in excess) moves to form a bond with one of the hydrogens attached to the nitrogen. An ammonium ion is formed. The electrons in the nitrogen-hydrogen in the organic ion move back to the nitrogen, neutralising the positive charge.

c)

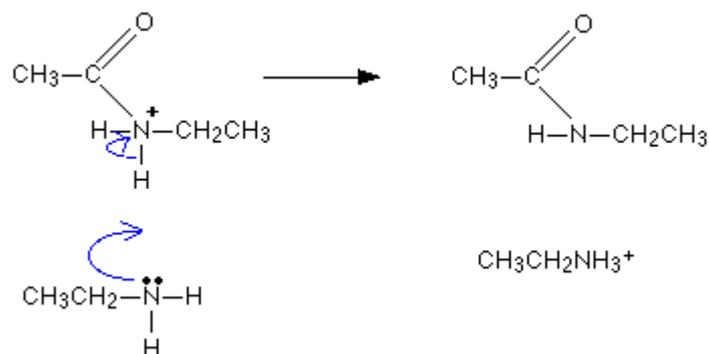


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d)



And then *either*:



Or:

