1. Provide the pKa value (no decimal points) of the most acidic proton of the following compounds shown below:

a) What is the pKa of water?

b) 

2. Provide the major product of the following reactions:

\[ \text{one of the 2 major products:} \]

\[ \text{one of the 2 major products:} \]
3. Provide a detailed arrow pushing mechanism for the product of this reaction (HINT: the conditions are ideal for a subsequent Mannich reaction):

Mechanism:
4. Provide a detailed arrow pushing mechanism for the product of this reaction:

Mechanism:

```
N
H
```

1) POCl₃  
   DMF  

2) NaOH  
   H₂O

Major product:
5. For pyrroles, Paal-Knorr synthesis is perhaps the method that comes to many synthetic chemists’ minds. The reaction involves treatment of a 1,4-dione with ammonia or an amine. Draw a plausible mechanism for the reaction below.

\[
\text{O} - \text{C} - \text{C} \quad + \quad \text{NH}_3 \quad \rightarrow \quad \text{H} \quad \text{N} \quad \text{H}
\]
6. Complete the syntheses below showing the major (desired) product.

\[
\begin{align*}
\text{Ph} & \quad \text{O} \quad \text{O} \quad \text{Me} \\
\text{Me} & \quad \text{Ph} & \quad \text{MeOH}:\text{H}_2\text{O} & \quad 1:1 \\
& & & \text{cat. HCl} \\
\text{Cl} & \quad \text{O} \quad \text{CO}_2\text{Et} \quad \text{O} & \quad \text{Me} & \quad \text{NH}_3 \\
& & & \\
\text{O} & \quad \text{O} \quad \text{NH}_2 & \quad \text{cat. p-TsOH}
\end{align*}
\]
7. In class, we discussed several methods for synthesis of the pyridine rings. For any of those syntheses, give the starting materials, conditions, and product below. You can use \( R^1 \), \( R^2 \), etc for groups not undergoing transformation if you like.