QUESTION 1
MC33g

Which best describes the product of the following reaction sequence?

1. 1 Equiv. MeMgBr
2. $\text{H}_3\text{O}^+$
3. PCC
4. Excess $\text{NaBH}_4$/EtOH

remember, all Grignard reactions have to be performed in the absence of any water or other source of protons
Give the best product for the following reaction

![Reaction Diagram]

The 1 equivalent of the diol must "choose" between the aldehyde and the ketone. Aldehydes are more reactive than ketones, ketones have two weak donating alkyl groups to stabilize the partial positive charge on the carbon of the C=O bond, aldehydes only have one.

Neither donating or withdrawing

Neither donating or withdrawing

Addition of the diol to the aldehyde yields the cyclic acetal.

This is a "cute" idea, adding the -OH at one end of the diol to the aldehyde and the other -OH to the ketone, but with two hemiacetals, it can hardly be described as the "best" product.

If both oxygens of the diol add to the carbonyl carbon, then the original oxygen must be lost, this is impossible.
Give the best product for the following reaction

\[
\begin{align*}
\text{HCl (cat.)} & \quad \rightarrow \\
\text{H} & \quad \text{O} \\
\end{align*}
\]

The 1 equivalent of the 2° amine must "choose" between the aldehyde and the ketone. Aldehydes are more reactive than ketones, ketones have two weak donating alkyl groups to stabilize the partial positive charge on the carbon of the C=O bond, aldehydes only have one.

Neither donating or withdrawing

\[
\begin{align*}
\text{aldehyde} & \quad \rightarrow \\
\text{ketone} & \quad \\
\end{align*}
\]

Addition of a 2° amine to a C=O bond forms an ENAMINE

This is the initial nucleophilic addition product, which normally deprotonates to form the enamine, although formed, it can't be described as the "best" product.

Neither of the 2 possible enamines for the ketone will be formed, since the aldehyde is more reactive.
QUESTION 4

The Wittig reaction starts with an alkyl halide and a carbonyl compound and ends with an alkene. Which are the BEST alkyl halide and carbonyl compounds to use in a Wittig synthesis of the alkene below?

\[ \text{Ph} \]

\[ \begin{array}{c}
\text{H} & \text{Br} \\
\text{H} & \text{Br} \\
\text{H} & \text{Br} \\
\text{H} & \text{Br}
\end{array} \]

\[ \begin{array}{c}
\text{A} \\
\text{B} \\
\text{C} \\
\text{D}
\end{array} \]

A makes correct alkene, but needs SN2 on a 2° halide at the start.

B makes incorrect alkene.

C makes incorrect alkene AND SN2 on 2° halide (poor reaction).

D makes correct alkene, AND SN2 on a benzylic halide, GOOD!
QUESTION 5
MC33s

Give the product of the following reaction sequence

1. NBS/\text{hv}
2. K^+ -O-t-Bu
3. BH_3.THF
4. OH/H_2O_2
5. PCC
6. MeNH_2/HCl(cat.)
QUESTION 6
MC32k

For the following reactions indicated as 1, 2 and 3, which is the correct order of INCREASING rate of electrophilic aromatic substitution?

1. This is a strongly donating, and thus strongly activating substituent (speeds reaction a lot)
   - Cl₂, AlCl₃
   - as far as the benzene ring is concerned, this is a withdrawing, and thus DEactivating substituent (slows reaction)

2. This is a weakly donating, and thus weakly activating substituent (speeds reaction a little bit)
   - Cl₂, AlCl₃
   - this is a very weakly donating, and thus weakly activating substituent (speeds reaction a little bit)

3. This is a withdrawing, and thus DEactivating substituent (slows reaction)
   - Cl₂, AlCl₃
   - this is a strongly donating, and thus strongly activating substituent (speeds reaction a lot)

A  1 (slowest) < 2 < 3 (fastest)
B  2 (slowest) < 3 < 1 (fastest)
C  1 (slowest) < 3 < 2 (fastest)
D  3 (slowest) < 2 < 1 (fastest)
QUESTION 7
MC34f

Which is the STRONGEST BRONSTED acid among the following? This is a long question! First, find the most acidic proton in each structure and then compare them. The most acidic proton will allow be an enolizable proton.

A

B

C

D

The strongest Bronsted acid has the weakest conjugate Bronsted base, i.e. the most stable anion, in this case the most resonance stabilized anion that is NOT also destabilized by a donating group on the conjugated anion \( \pi \)-system.

A

B

C

D

Fewer resonance structures

Same \# and kind of resonance contributors as A, but, the -OR donating group destabilizes the negative charge.

Fewer resonance structures
QUESTION 8
MC34u

Rank the following in order of INCREASING Bronsted Acidity

A  I < II < IV < III
B  I < II < III < IV
C  III < II < I < IV
D  IV < I < II < III

for enolizable hydrogen atoms
aldehydes are more acidic than .... ketones which are more acidic than esters

 donating groups destabilize the enolate anion, the stronger the donating group the more the destabilization

least stable anion

third most stable anion

second most stable anion

most stable anion

least stable anion