1) To initiate enolate formation, which proton should be removed?

![Chemical structure](image)

1) 1  2) 2  3) 3  4) 4  5) 5

2) If the following aldol product were formed, which reagents formed the carbon skeleton?

![Chemical structures](image)

1) I & II  2) II & IV  3) I & V  4) IV & V  5) I & III

3) Why was your product yellow and what color light did the aldol product absorb?

1) polarity, red  2) **conjugation, blue**  3) chromaphoric disturbance, green
4) IR shifting, blue  5) isotopic abundance, silver

4) What is the purpose of adding NaOH to the acetone in the aldol experiment?

1) protonation of the carbonyl  
2) converting the carbonyl to an ester  
3) oxidizing the ketone to an ester  
4) sodium metal acts like an hydride source  
5) **removes the α protons**
5) What are the necessary organic reagents to prepare the following compound?

1)1 & 3  2)1 & 4  3)2 & 3  4)2 & 4  5)1 & 3

6) The Diels-Alder reaction is

1) Substitution  2) Stepwise reaction  3) **Pericylic reaction**  4) Condensation

7) Of the following statements, which is NOT the reason of using xylene as the solvent in a Diels Alder reaction?

1) Xylene’s boiling point is high enough facilitate the reaction
2) The product could recrystallize in xylene upon cooling down the reaction.
3) Xylene could solubilize both anthracene and maleic anhydride when boiling
4) Xylene is a non-polar solvent which is **good for the Diels Alder reactions: this aids stabilizing the resonance hybrids**

8) Which is incorrect about boiling chips?

1) help the reactants to mix well
2) make the liquid boil more smoothly
3) provide nucleation sites so the liquid boils easily without becoming superheated.
4) typically made of a porous material, such as alumina, calcium carbonate, porcelain or carbon

9) Fischer esterification happens between a:

1) Carboxylic Acid and Base
2) **Carboxylic Acid and Alcohol**
3) Base and Alcohol
4) Ether and Alcohol

10) What is the purpose of the sulfuric acid for a Fischer esterification?

1) It reacts with amino group
2) It helps to decompose the side products
3) **It is the catalyst for the reaction**
4) It neutralizes the bases that forms during the reaction
11) Water is a product in esterifications. Where does the oxygen in the water originate?

1) p-aminobenzoic acid  
2) Ethyl alcohol  
3) Sulfuric acid  
4) Oxygen gas from the air  
5) From water in the acid

12) In Fischer Esterification of p-aminobenzoic acid with ethyl alcohol to obtain benzocaine, after the reaction has ended we used Na₂CO₃ to neutralize sulfuric acid after cooling the reaction mixture to room temperature under open atmosphere. Which one of these cannot be the reason for doing this?

1) Neutralization is an exothermic process and it will lead to further temperature increase.  
2) Gas formation will be too fast at elevated temperatures.  
3) Accumulation of high amount of gas in a closed flask will cause formation of ice around the flask that will reverse the reaction.  
4) Performing the neutralization in a completely closed flask will increase the inside pressure.

13) In a Fischer Esterification, which one of the followings will result with a better yield?

1) Using a base instead of acid.  
2) Decreasing the concentration of sulfuric acid.  
3) Removing water as the reaction progress  
4) Adding sodium chloride to the reaction mixture to provide an ionic condition for the reaction.  
5) Heating the reaction mixture with a live flame

14) What does FTIR stand for?

1) Fun Trends In Reading  
2) Fourier Transform Infrared Spectrometer  
3) Fluorescence Temperature Inductive Resonance  
4) Failure To Investigate Rhinoceros

15) Why is it important to control the temperature of the reaction of sulfuric acid and nitric acid?

1) It’s an exothermic reaction, and the nitronium ion is not stable at high temperatures.  
2) It’s an endothermic reaction and the nitronium ion is not stable at low temperatures.  
3) It’s an isothermic reaction and the nitronium ion is not stable at any temperature.  
4) MU makes too much ice and we need to get rid of it.
16) Write out the equation of the reaction of nitric acid with sulfuric acid.

\[ \text{HNO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{NO}_2^+ + \text? + \text{H}_2\text{O} \]

1) H_2SO_4  
2) HSO_4^-  
3) No reaction  
4) SO_3

17) What is the role of \( \text{NO}_2^+ \) in the nitration reaction?

1) Electrophile  
2) Nucleophile  
3) Catalyst  
4) Spectator ion

18) Carbonyl groups attached to a ring will direct substitution to which position?

1) Ortho  
2) Para  
3) Meta

19) When converting camphor to isoborneol, sodium borohydride is:

1) The reducing agent  
2) The oxidizing agent  
3) A really neat chemical  
4) The compound being reduced

20) The definition of oxidation is:

1) The loss of electrons  
2) The gain of electrons  
3) Oxidative respiration  
4) A compound which contains many oxygen atoms.

21) When converting isoborneol to camphor, sodium hypochlorite (bleach) is the:

1) reducing agent  
2) oxidizing agent  
3) cleaning agent  
4) secret agent

22) The conversion of camphor to isoborneol creates a new chiral center.

1) True  
2) False
23) A positive KI-starch test indicates the presence of
   1) Bleach
   2) Camphor
   3) Starch
   4) Smartness

\[
\begin{align*}
\text{CH}_3\text{CH}_2\text{CH}_3 \quad + \quad & \text{OH}^- & \rightarrow & \quad \text{CH}_3\text{CH}_2\text{CH}_3 \\
\text{H}_3\text{C}^+\text{Cl} & & & \quad + \quad \text{Cl}^-
\end{align*}
\]

24) For the above reaction, which of the following rate laws does it obey?
   1) Rate = K \([(S)-2\text{-chloropentane}]\)
   2) Rate = K \([\text{OH}^-]\)
   3) Rate = K \([(S)-2\text{-chloropentane}] \cdot [\text{Cl}^-]\)
   4) Rate = K \([(S)-2\text{-chloropentane}] \cdot [\text{OH}^-]\)

25) Rank the following compounds from the least reactive to most reactive towards SN2 reaction.

<table>
<thead>
<tr>
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<th>Least reactive</th>
<th>Most reactive</th>
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Least reactive Most reactive
26) What are the characteristics of an $S_N2$ reaction?
   a. First order reaction
   b. One step reaction
   c. Inversion of configuration at the carbon atom
   d. The reaction rate does not depend on the concentration of nucleophile
   e. Second order reaction.

1) a, c, d
2) a, b, c
3) b, c, e
4) a, b, d

27) Which one is the best leaving group in $S_N2$ reaction?
   1) F⁻
   2) Br⁻
   3) I⁻
   4) Cl⁻

28) What is the disadvantage of using OH⁻ as a nucleophile?
   1) Hydroxide is a good nucleophile: this is no disadvantage.
   2) Hydroxide is a good leaving group, so it is also a good nucleophile.
   3) Hydroxide is a good nucleophile, so it effectively substitutes for bromide.
   4) Hydroxide is a good base, so it also effectively promotes elimination reactions.

29) Ammonia reacts with diatomic oxygen to form nitric oxide and water vapor:
    \[ 4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O} \]
    When 20.0 g NH₃ and 50.0 g O₂ are allowed to react, which is the limiting reagent?
    1) NH₃.
    2) O₂.
    3) NO.
    4) H₂O.

30) Ammonia reacts with diatomic oxygen to form nitric oxide and water vapor:
    \[ 4\text{NH}_3 + 5\text{O}_2 \rightarrow 4\text{NO} + 6\text{H}_2\text{O} \]
    What is the theoretical yield of water, in moles, when 40.0 g NH₃ and 50.0 g O₂ are mixed and allowed to react?
    1) 1.30 moles
    2) 1.57 moles.
    3) 1.87 moles
    4) 3.53 moles