Multiple Choice

1. Choose the synthetic scheme that would not give the amine shown as the major product.

```
A = 1  B = 2  C = 3  D = 4  E = 3 +4
```

2. Predict the major product of the following reaction.

```
Br
HNO3  H2SO4  H2, Ni  Cl2  HCl, NaNO2  HBF4
```

3. Choose the order that has the following amines correctly arranged with respect to increasing basicity.

```
1  2  3
```

```
A 1 < 2 < 3  B 1 < 3 < 2  C 2 < 3 < 1  D 2 < 1 < 3  E 3 < 2 < 1
```
4. Identify where the amine 1 would be found in the following extraction procedure.

```
  | 1. add NaOH | 2. add ether |
  | 1. acidify with HCl | 2. add ether |
  | H₂O layer | ether layer |
  | A |
  | 1. add ether |
  | 1. basify with NaOH |
  | H₂O layer | ether layer |
  | B |
  | 1. basify with NaOH |
  | H₂O layer | ether layer |
  | C |
  | 1. add ether |
  | 1. basify with NaOH |
  | H₂O layer | ether layer |
  | D |
  | 1. add ether |
  | 1. basify with NaOH |
  | H₂O layer | ether layer |
  | E |
```

5. Choose the structure consistent with the name p-aminobenzoic acid.

```
A
B
C
D
E
```

6. Choose the number (n) of triphenylphosphine ligands necessary to give the following rhodium compound the noble gas configuration.

```
(Ph₃P)ₙRhCl
```

```
A = 0    B = 1    C = 2    D = 3    E = 4
```

7. Predict the major product when the carbohydrate mannose reacts with dry methanol.

```
Mannose
```

```
A
B
C
D
E
```
8. Choose the intermediate that is the result of oxidative addition in the mechanism of the Heck reaction.

![Heck Reaction Diagram](image)

9. Choose the most acidic hydrogen in the following compound.

![Compound Diagram](image)

10. Choose the structure that is identical to the Fischer projection formula for

![Fischer Projection Diagram](image)

**Short Answer**

11. Give the major product of the following reaction. 5 pts. (*J. Org. Chem. 2008, 73, 5651–5653*)

![Reaction Diagram](image)

12. Give the structure of the following Mannich reaction. 5 pts

![Mannich Reaction Diagram](image)
13. Give the reactant(s) in the following reaction sequence that would give the ketone shown below. 5 pts.

\[
? \xrightarrow{\text{Me-O}} \xrightarrow{\text{OH}} \xrightarrow{\text{H}^+} \text{heat} \xrightarrow{\text{Claisen condensation}} \begin{array}{c}
\text{?} \\
\text{H}_2\text{O}
\end{array}
\]

14. Give the reactant(s) that would give the following amine. 5 pts.

\[
? \xrightarrow{\text{1. cat. HA}} \xrightarrow{\text{2. NaBH}_3\text{CN}} \begin{array}{c}
\text{?} \\
\text{H}_2\text{C-N=NN}
\end{array}
\]

15. Propose a good mechanism for the following reaction. 10 pts

\[
\text{O} \xrightarrow{\text{?}} \text{H}_2\text{C-N=NN} \xrightarrow{\text{?}} \text{O} \quad \text{N=NN}
\]

Below is a synthesis of fentanyl, an analgesic 100 times more potent than morphine.

16. Suggest reactions (1) that could be used to convert benzylcyanide into the first intermediate \( A \) in the above scheme. (more than one reaction may be necessary). 5 pts

17. Give the structure of intermediate \( B \) in the above reaction scheme. 5 pts

18. Give a reaction mechanism for the conversion of \( C \) into \( D \). 10 pts

\[
\begin{align*}
\text{C} & \xrightarrow{\text{?}} \text{OEt} \xrightarrow{\text{HOEt}} \text{H}^+ \xrightarrow{\text{?}} \text{D} \\
\text{O} & \xrightarrow{\text{?}} \text{OEt} \xrightarrow{\text{HOEt}} \text{H}^+ \xrightarrow{\text{?}} \text{D}
\end{align*}
\]