Sample solution for COP 5536/ AD 711R \\
Make-up Exam, Spring 2005
}
\end{center}

\begin{enumerate}

\item(10) See attached sheet.

\item(10)

  Note that we need 2 dummy runs (run length is zero)
  for optimal 4-way merge which must merged first to be optimal. \\

  \begin{itemize}
   \item 4-way merge : \\
    step 1: (0,0,100,200) = 300 \\
    step 2: (300,300,400,500) = 1500 \\
    step 3: (1500,600,700,800) = 3600 \\

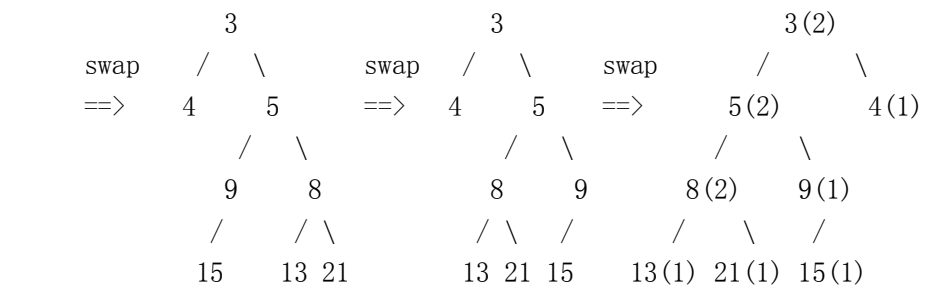
   \item 8-way merge : \\
    (100,200,300,400,500,600,700,800) = 3600
  \end{itemize}

  \begin{enumerate}
   \item Number of comparisons \\
      In 4-way scheme: For each step,
      loser tree initialization needs 3 comparisons (one record produced)
      and then each record needs 2 comparisons to output. \\

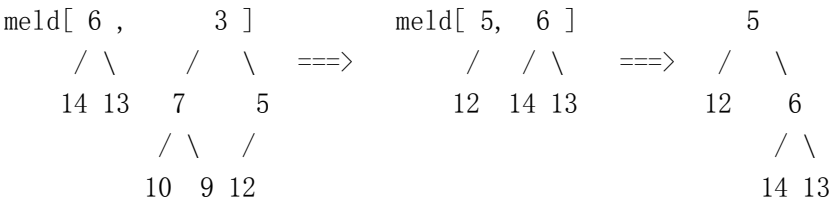
      So, the total number of comparisons in the 4-way scheme is
      3+(300-1)*2 + 3+(1500-1)*2 + 3+(3600-1)*2 = 10803 \\

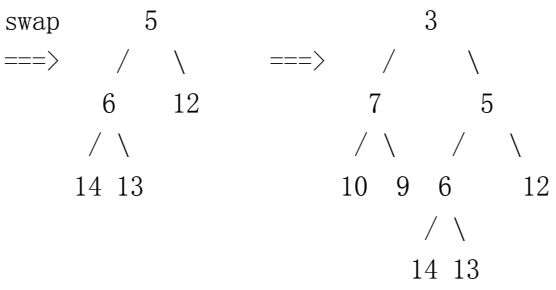
      In 8-way scheme: 7 + (3600-1)*3 = 10804. \\

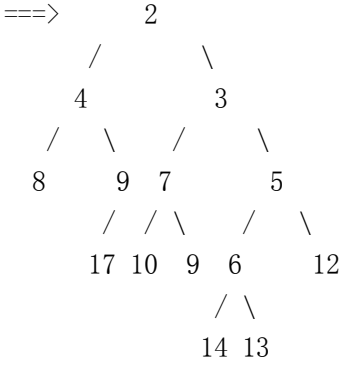
   \item Number of disk IOs \\
     Each merge step need 2 disk IOs: one for input and one for output.
     4-way scheme needs 3*2 + 15*2 + 36*2 = 108 and 8-way scheme 36*2 = 72.
   \item 8-way merge is better scheme than 4-way merge scheme
     due to the number of disk IOs.
  \end{enumerate}

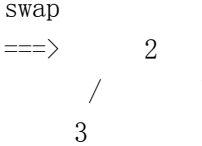
\item (10)
 \begin{enumerate}
 \item (4)
   \begin{verbatim}


   \end{verbatim}
 \item (6) Meld right subtree with smaller root and all of the other tree.
   \begin{verbatim}

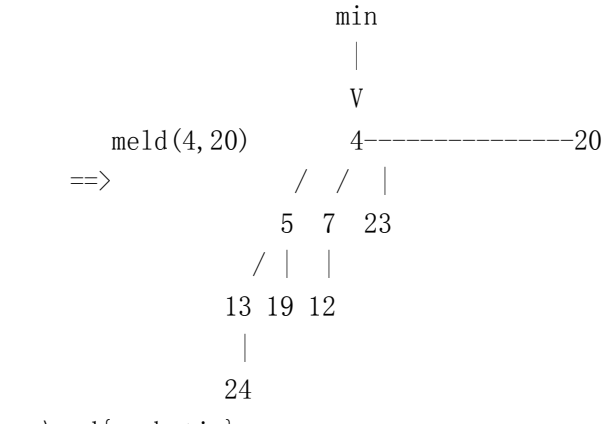








```
      /     \     /   \
     7       5   8     9
    / \    /   \      /
   10  9  6     12   17
         / \
        14 13
  \end{verbatim}
\end{enumerate}


\item (10)
 \begin{enumerate}
 \item (4) $Insert$ does not need pairwise combine.
  \begin{verbatim}
                          min
                           |
                           V
         7 - 12 - 4 - 23 - 3 - 24 - 13 - 20 - 19 - 5
  \end{verbatim}
 \item (6)
  \begin{verbatim}

    meld(7,12)  7    ==>  meld(4,23)  7      4
                |                     |      |
               12                    12     23

       meld(7, 4)            4      meld(24,13)  13
    ==>     |  |   ==>     / |   ==>             |
           12 23          7  23                 24
                          |
                         12

       meld(19,5)  5      meld(13, 5)         5
    ==>            |  ==>       |  |        / |
                  19           24 19      13  19
                                           |
                                          24

       meld(4,5)        4
    ==>             /  /  |
                   5  7  23
                 / |  |
               13 19 12
                |
               24
```



\end{verbatim}
\end{enumerate}

\end{enumerate}
\end{document}