This exam has 2 additional pages. Please answer each question on the page on which it is asked. You may write on the back of the facing page if you need to.
1. (a) For each of the following operations, state whether \texttt{ArrayList} is much better, \texttt{LinkedList} is much better, or whether both are basically the same.

- \texttt{add( 0, x )}
- \texttt{get( idx )}
- \texttt{remove( x )}
- \texttt{add( x )}

(b) For each of the following, state whether it is true for \texttt{Lists} only, \texttt{Sets} only, both \texttt{Lists} and \texttt{Sets}, or neither \texttt{Lists} nor \texttt{Sets}.

- has an efficient \texttt{contains} operation
- allows duplicates
- supports \texttt{add} and \texttt{remove} of a single object
2. Class `Multiset`, shown below is used to maintain a collection of `Strings`, in which duplicates are allowed. It stores a map in which the key is a `String`, and the value is the number of occurrences of the `String`.

class MultiSet
{
    // Constructor and most methods not shown
    
    private Map<String,Integer> counts;

    // Return size of the MultiSet
    // If counts = [ hello=2, world=1, zebra=1 ]
    // This routine returns 4
    public int size( )
        { /* You provide implementation */ }

    // Return true if x is in this Multiset
    public boolean contains( String x )
        { /* You provide implementation */ }

    // Add a new item
    public void add( String x )
        { /* You provide implementation */ }

    // Remove an item.
    // If x is not found, return false.
    // If x is present with count 1, remove it from the map.
    // If x is present with count > 1, lower the count by 1.
    // If x was present return true.
    public boolean remove( String x )
        { /* You provide implementation */ }
}

(a) Implement contains.
(b) Implement add.
(c) Implement remove.
(d) Implement size.