This exam consists of 9 questions.
Good Luck.

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1 (a) What is the output of the following.

```cpp
class int SIZE = 11;
int i, temp[SIZE];

for (i = 0; i < SIZE ; i++)
    temp[i] = (7 * i) % SIZE;

for (i = 0; i < SIZE ; i++)
    cout << temp[i] << " ";
    cout << endl;

for (i = 0; i < SIZE ; i = i + 2)
    cout << temp[i] << " ";
```

(b) What is value of the following expression?.

```cpp

for (int i = 0; i < 7; i++)
    cout << vect[i] << " ";
    cout << endl;

for (int i = 0; i < 7; i++)
    if (vect[i] % 4 == 3)
        cout << vect[i] << " ";
```
2 (a) Let \( a = 5, b = 10, c = 20 \) and \( d = 15 \). Evaluate the following expressions.

(i) \(! (b \leq 12) \&\& (a \% 2 == 0) \&\& (a + b \geq c)\)  
\[ \text{true} \quad \text{false} \]

(ii) \((d == (a + b)) || (c == d)\)  
\[ \text{true} \quad \text{false} \]

(b) What is value of the following expression? Show all the steps used in evaluating this expression.

\[ 2 < 7 \% 3 * 3 + 2 * 7 \&\& 3 == 4 || 3 < 1 + 4 \]
(a) Implement the function

```c
int min_array (int an_array[ ], int size)
```

that, given an integer array with n elements, returns the smallest integer in the array.

(b) Implement the function

```c
void array_exchange (int an_array[ ], int size, int i, int j)
```

that, given an integer array with n elements, exchanges the i-th and j-th element. For example,

```c
int my_array[6] = {3, 4, 5, 6, 7, 8};
array_exchange (my_array, 6, 1, 5);
```

results in `my_array = {3, 8, 5, 6, 7, 4}`. If either i or j is out of range, the array is not altered.
Consider the following declarations.

```cpp
struct student
{
    bool status;
    string name;
    int midterm[3];
    int final;
};

student class67[30];

const bool ENROLLED = true;
const bool WITHDRAWN = false;

float computeGrade(student stu);
//Post: Returns a grade based on the midterms and finals
```

4 (a) Write a C++ statement which assigns the status `ENROLLED` to each student in `class67`.

(b) Assign the name "James Bond", and midterm grades of 98, 99 and 100 to `class67[7]`.

(c) Write a C++ statement that outputs for each student enrolled in `class67` their name and their grade on a formatted line.
5 Implement the function `computeGrade` if each midterm is worth 20% and the final is worth 40%
#ifndef RATIONALH_
#define RATIONALH_

class Rational
{
    public:
        // Default constructor
        Rational();

        // Default constructor with arguments
        Rational (int, int);

        // Set a value
        void set_value (int, int);

        // Returns numerator
        int numer () const;

        // Returns denominator
        int denom () const;

        // Display a rational number in the form: numer / denom
        void display_rat () const;

        // Add a rational number
        Rational Rational::add_rat (Rational rat2) const;

        // Subtract a rational number
        Rational Rational::sub_rat (Rational rat2) const;

        // Multiply with a rational number
        Rational Rational::mul_rat (Rational rat2) const;

        // Divide by a rational number
        Rational Rational::div_rat (Rational rat2) const;

        // Returns the floor of the rational number
        int Rational::floor_rat () const;

    private:
        int num;
        int den;
    
};

#endif // RATIONAL_H_
6 (a) On the right, display the output of the following.

```cpp
Rational rat1(7, 3), rat2, rat3;
Rational ratArray[10];
rat2.set_value(rat1.numer() - 2, rat1.denom() + 1);
rat1.display_rat();
cout << endl;
rat2.display_rat();
cout << endl;
rat3 = rat1.div_rat(rat2);
rat3.display_rat();
cout << endl;
cout << rat1.floor() << endl;
for (int i = 0, i < 10, i++)
    ratArray[i].set_value(i, i + 1);
ratArray[5].display_rat();
```

(b) Implement the member function `floor_rat`. 
7 (a) (8pts) What is the output of the following.

```cpp
struct electric
{
    string current;
    int volts;
};

typedef electricPtr * electric;
electricPtr p, q, r;

p = new electric;
p->current = "HT";
p->volts = 110;
cout << p->current << " " << p->volts << endl; ________________
q = new electric;
q->volts = 220;
q->current = "DC";
r = q;
r->current = p->current;
q->volts = 240;
cout << p->current << " " << p->volts << endl; ________________
cout << q->current << " " << q->volts << endl; ________________
cout << r->current << " " << r->volts << endl; ________________
```

(b) (4pts) What is the output of the following?

```cpp
void figure_me_out (int x, int *y, int& z);

void main()
{
    int a = 2, b = 3, c = 5;
    figure_me_out(a, &b, c);
    cout << a << " " << b << " " << c << endl;
}

void figure_me_out (int x, int *y, int& z);
{
    x = x + z;
    *y = x + 4;
    z = x * *y;
    cout << x << " " << *y << " " << z << endl;
}
```
Consider the following members of the \texttt{string} class.

- \texttt{aString.length()} - returns the count of characters \texttt{aString}
- \texttt{aString.at(i)} - returns the character at position \texttt{i} in \texttt{aString}

8. Write the following function (using only the member functions given above).

\begin{verbatim}
int vowelCount(string aString) {
  // Your implementation here
}
\end{verbatim} - returns the number of vowels in \texttt{aString}
9 Using `getline` and `vowelcount` (view as part of the string class), write a program that opens an external file "words.txt" and prints out to the screen the following:

(a) The number of lines.
(b) The total number of vowels.
(c) The average number of vowels per line.