ADELAIDE UNIVERSITY
DEPARTMENT OF MECHANICAL ENGINEERING

EXAMINATION FOR THE DEGREE OF B.E.

2068: COMPUTER PROGRAMMING 1M

NOVEMBER, 2001

TIME: 2 HOURS and 10 MINUTES

[It is recommended that you spend ten minutes reading the paper and planning your approach before the exam begins.]

[The use of notes, textbooks and calculating devices is permitted in the examination room.]

Attempt **ALL FOUR** questions

QUESTION 1 [20 marks]

a) All labels used in a C++ program must follow certain rules. State two of these rules.

[1 marks]

b) Briefly describe two functions of an operating system.

[2 marks]

c) How many bytes are used in a windows PC to store the following data types: char, int, float and double.

[2 marks]

d) Write a C++ statement for each of the following expressions using routines available from the standard maths library.

$$val = \sqrt{a^2 + b^2 + c^2}$$

$$sum = \frac{a(r^n - 1)}{r + 4}$$

[2 marks]

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e) Write a complete C++ program that asks the user to input two floating-point numbers. After your program accepts these numbers check the numbers using an if-statement. If the first number entered is greater than the second number, print the message "The first number is greater". Otherwise print the message "The second number is greater".

[3 marks]

f) $$\pi = 2\arcsin(1)$$

Given that the above formula for Pi hold true, write a function named "Pi" that accepts no arguments and returns the double precision value of Pi. ***Hint:*** The "arcsin" of a value is available in the standard mathematics library under the name "asin".

[2 marks]

g) Three integer arguments are to be used in a call to a function named "time". Write a suitable function header for the "time" function that accepts these variables as the reference parameters "sec", "min" and "hours" and returns no value to its calling function.

[1 mark]

h) Determine the output of the following program:

```
#include <iostream.h>

int main() {
    int a, b;
    int val[3][4] = {4, 3, 5, 1, 8, 4, 67, 3, 6, 23, 7, 9};

    for (a = 0; a < 3; a++) {
        for (b = 0; b < 4; b++)
            cout << setw(5) << val[a][b];
        cout << endl;
    }

    return 0;
}
```

[2 marks]

i) What is wrong with the following C-string array definition?

```
char OOPs[3] = "C++";
```

[1 mark]

j) Write a class <u>declaration</u> section for a class named "Circle", that has integer data members "m_xCentre" and" m_yCentre", and a double precision data member named "m_radius". Include a prototype for a constructor and a method called "consoleOut". The constructor should accept two integer arguments and a double precision argument. The "consoleOut" method should not accept or return any values.

[2 marks]

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k) Given the following code sections, write the definition of an appropriate destructor function.

```
class MathsVector {
public:
    MathsVector(int);
    ~MathsVector();
private:
    int m_size;
    double *m_data;
};

MathsVector::MathsVector(int length) {
    m_size = length;
    m_data = new double[m_size];
}
```

[2 marks]

QUESTION 2 [40 marks]

a) Write a C++ program to calculate the volume of a cylinder. The program should prompt the user for the radius of the cylinder and its height, both in millimetres. Display the calculated volume of the cylinder in both metres cubed (to 3 decimal places) and in feet cubed (to 1 decimal place). Recall from assignment 1 that there is 35.31 ft^3 per m^3.

[5 marks]

b) Write the declaration and definition of a class named Rectangle that has floating point data members "m_length" and "m_width". The class should have a constructor that accepts a length and a width. The class should also have a method named "perimeter" that returns the perimeter of the rectangle and a method named "area" that returns the area of the rectangle. Both of these methods should not accept any arguments.

[5 marks]

c) Rewrite the following logical expressions using parentheses (brackets) to indicate the correct order of evaluation. Then evaluate each expression, assuming:

```
int a = 1, d = 4, e = 10, f = -1;
```

i. `1 <= d && d <= 6`
ii. `a == !d && !a`
iii. `e % d - 2 || f + d`
iv. `e < 6 || 10 <= e && !a`
v. `!d || e % a < -f`

[5 marks]

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d) Each disk drive in a shipment is stamped with a code from 1 to 4, where the codes indicate the following drive manufacturers:

Code	Disk Drive Manufacturer
1	Western Digital
2	Maxtor
3	Seagate
4	Samsung

Write a C++ program that prompts the user for a code number and uses a switch statement to print out the corresponding manufacturer name. Inform the user if an unknown code number is entered.

[4 marks]

e) Even though the C++ language is "descended" from ANSI C, there are many important differences. Describe, using code from both C++ and ANSI C, two of the differences that were explained in the lectures.

[4 marks]

f) Write two functions, one called "average" and another called "variance". The average function should accept a double precision array and return the average of the values in that array. The variance function should return the *variance* of the data in the array. Variance is calculated by subtracting the average from each value in the array, squaring the values obtained, adding them, and dividing by the number of values in the array minus one. This can be represented by the formula

$$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right),$$

where s^2 is the variance.

Your variance function should call your average function.

Hint: When passing arrays to functions two parameters should be passed. One parameter for the size of the array, and another for the pointer to the data.

[7 marks]

g) Write the declaration and definition of a Time class that has integer data members "m_seconds", "m_minutes", and "m_hours". The class should have a constructor that accepts three integer arguments, and a method called "tick" that accepts no arguments and returns no value. The "tick" method should increment the time by one second. Assume that the time is stored as a 24 hour clock.

[5 marks]

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h) Determine the output of the following program:

```
#include <iostream.h>

void displayVals(int, int, float);

int main() {
    int i = 1, j = 2, k = 3;
    float x = 2.5;

    displayVals(i, j, x);

    i *= 5, j -= 2, k /= 2;
    displayVals(i, j, x);

    x += ++j*x;
    displayVals(i, j, x);

    j = (++k+j)*x;
    displayVals(i, j, x);

    i += j-= ++k;
    displayVals(i, j, x);

    return 0;
}

void displayVals(int i, int j, float x) {
    cout << "i = " << i
         << ",j = " << j
         << ", and x = " << x << endl;
}
```

[5 marks]

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QUESTION 3 [20 marks]

a) A dimension on a part drawing indicates that the length of the part is 30.00 ± 0.25 mm. This means that the minimum acceptable length of the part is $30.00 - 0.25 = 29.75$ mm, and the maximum acceptable length of the part is $30.00 + 0.25 = 30.25$ mm.

i.)
Develop an algorithm that will display "EXACT" if the part is within 1×10^{-8} mm of 30.00 mm, "ACCEPTABLE" if the part is within tolerance ($\pm$ 0.25 mm) and "UNACCEPTABLE" is the part is out of tolerance.

ii.)
Write a C++ program that reads in part sizes (one per line) from the file "tolerance.dat" until the end of the file is reached. For each part size read, your program should display the appropriate message – either EXACT, ACCEPTABLE or UNACCEPTABLE.

iii.)
Draw the flow chart that shows the flow of execution of your program.

[10 marks]

b) A palindrome is a word that is the same forwards as backwards. e.g. Glenelg is a palindrome. Write a function that returns true if a word is a palindrome and false if it is not. Assume that the string that is passed to the function is in lower case.

i.)
Develop an algorithm for the process of checking if a string is a palindrome. To do this think about each of the steps that are necessary to determine if a string is a palindrome.

ii.)
Write C++ code that implements the algorithm as a function.

Hints: because a string is an array of characters, each character can be referenced as an array element normally would be. Your function will be of the form:

```
bool palindrome(char *word) {
    // You fill in the body of the function!
}
```

[10 marks]

QUESTION 4 [40 marks]

You are working for a computer games company that is developing a real-time adventure game. This game will be set in a city, so there will be many vending machines that the player will be able to purchase items from. Each of these vending machines will be an object of class "VendingMachine". It is your job to write the code for the "VendingMachine" class. Assume the vending machine accepts \$2, \$1, 50c, 20c, 10c and 5c coins.

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a) List all of the *attributes* that are important for a vending machine in a computer game that will give the player a lot of freedom.

[6 marks]

b) What are four of the main *methods* that must be developed as part of the vending machine class? ***Hint:*** think of the main actions that you perform when purchasing an item from a vending machine.

[4 marks]

c) Write the code for the declaration of class VendingMachine. Include all of your attributes from part a) as member variables in the private section of the class. Make sure an appropriate data type is used to represent each member variable. Include a declaration for each of your four methods from part b) in the public section of the class. Make sure the declaration of each method returns an appropriate data type and accepts realistic parameters. Declare any additional methods that you think may be used during the computer game. An example of an "additional method" would be `bool boltedDown();`

[10 marks]

d) When the player purchases an item from a vending machine, change must be given. Develop a *detailed* algorithm (as much detail as you can) that calculates the least number of coins needed to make up any change that must be returned to the player.

Example: if the total amount of change to be returned to the player were 95c, it would be returned as 1×50c, 2×20c and 1×5c coins.

[10 marks]

e) Write the code for the "change" method for class VendingMachine. The "change" method should take 6 integer reference parameters and not return any value. The reference parameters should be used to pass the change out of the method. Each of the reference parameter will represent the number of coins passed out as change from a denomination that the vending machine accepts.

[10 marks]

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