

U2120

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EXAMINATION - CANDIDATES MAY
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MATERIAL DURING THE SITTING

Calculators may be used in this examination
provided they are not capable of being used to
store alphabetical information other than
hexadecimal numbers.

THE UNIVERSITY OF BIRMINGHAM

Degree of B.Sc. with Honours

Artificial Intelligence and Computer Science. First Examination
Computer Science/Software Engineering. First Examination
Computer Science/Software Engineering with Business Studies. First Examination

Joint Degree of B.Sc. with Honours

Mathematics and Computer Science. First Examination

Joint Degree of B.A. with Honours

Ancient History and Archaeology and Computer Science. First Examination

06 02367

(SEM 103)
Software Workshop 1

January 2000 2 hours

[Answer ALL Questions]

Turn Over

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1. The following program is intended to print a conversion table between kilometres and miles:

```
public class KmToMiles
{
    public static void main (String[] args)
    {
        double mi,km;
        System.out.println("km  miles");
        for (km=0; km<200; km+=15)
        {
            mi = 5/8 * km;
            System.out.println(km + " " + mi);
        }
    }
}
```

The program uses the fact that a mile is five-eighths of a kilometre.

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- (a) When it is run, the program prints out the following:

```
km  miles
0.0  0.0
15.0  0.0
30.0  0.0
45.0  0.0
60.0  0.0
75.0  0.0
90.0  0.0
105.0  0.0
120.0  0.0
135.0  0.0
150.0  0.0
165.0  0.0
180.0  0.0
195.0  0.0
```

Explain how to make one change to the program to correct it, so that the following is output.

```
km  miles
0.0  0.0
15.0  9.375
30.0  18.75
45.0  28.125
60.0  37.5
75.0  46.875
90.0  56.25
105.0  65.625
120.0  75.0
135.0  84.375
150.0  93.75
165.0  103.125
180.0  112.5
195.0  121.875
```

[5%]

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- (b) Now we would like to store the miles and kilometer values as integers, rounding the mile values to the nearest integer. The resulting table should look like

km	miles
0	0
15	9
30	19
45	28
60	38
75	47
90	56
105	66
120	75
135	84
150	94
165	103
180	113
195	122

Explain how to make two changes to the program to achieve this.

[5%]

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- (c) Now, we would like the table to be nicely aligned, as follows:

km	miles
0	0
15	9
30	19
45	28
60	38
75	47
90	56
105	66
120	75
135	84
150	94
165	103
180	113
195	122

A method looking like

```
static String threeChars(int n)
{
    // for n in the range 0 <= n <= 999,
    // return a three-character string for n in decimal.
    // E.g., if n=5 we return the string " 5".

}
```

is to be used by replacing the line of the program

```
System.out.println(km + " " + mi);
```

with the line

```
System.out.println(threeChars(km) + " " + threeChars(mi));
```

Write the code for the body of the method `threeChars`.

[5%]

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2. (a) In a loop, what is the break command for? What is the output of the following program?

```
public class Balance
{
    public static void main (String[] args)
    {
        int balance=1000;
        while (true)
        {
            if (balance<9) break;
            balance = balance - 9;
        }
        System.out.println(balance);
    }
}
```

[5%]

- (b) Rewrite the program given in part (a) so that it does the same calculation but does not use the break command. [5%]
- (c) Write down exactly what the following program outputs.

```
public class Stars
{
    public static void main (String[] args)
    {
        int i,j;
        for (i=0; i<=5; i++)
        {
            for (j=0; j<5-i; j++)
            {
                System.out.print(' ');
            }
            for (j=0; j<2*i; j++)
            {
                System.out.print('*');
            }
            System.out.println();
        }
    }
}
```

[5%]

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3. The method `crypt` given in the program below is intended to be used in a program which performs naïve encryption. The idea is that each word will be rotated by selecting the first letter which is not a vowel after the initial letter, to begin the word. (Vowels are the letters a, e, i, o, u.) For example, the word “material” will become “terialma” because the first letter which is not a vowel after the initial letter is “t”. If we encrypt each word in

java in a nutshell by david flannagan

using this method, we would get

vaja ni a tshellnu yb vidda lannaganf

The program is written as follows, and contains errors.

```
public class Crypt
{
    public static void main (String[] args)
    {
        for(int j=0;j<args.length;j++)
        {
            System.out.print(crypt(args[j])+" ");
        }
        System.out.println();
    }

    static String crypt(String str)
    {
        // i represents the position of the first non-vowel after
        // the first character
        int i=0;
        while (i<str.length() && vowel(str.charAt(i))) i++;
        // if i has not overshot, return the rotated string
        // else return the original string
        if (i<str.length()) return str.substring(i)+str.substring(0,i);
        return str;
    }

    static char vowel (char c)
    { return c=='a' || c=='e' || c=='i' || c=='o' || c=='u'; }
}
```

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- (a) When we try to compile the program, we get the following error message.

```
Crypt.java:18: Incompatible type for &&. Can't convert char to boolean.  
    while (i<str.length() && vowel(str.charAt(i))) i++;  
                        ^  
Crypt.java:26: Incompatible type for return. Can't convert boolean to char.  
    { return c=='a' || c=='e' || c=='i' || c=='o' || c=='u'; }  
      ^  
2 errors
```

In fact, there is only one error in the program. Explain the error and how to fix it.

[5%]

- (b) Now the program compiles correctly, let us see if it works as we intended. As it is currently written, the crypt method works correctly on words beginning with a vowel. For example, `crypt("adding")` returns "ddinga". What is the result of `crypt("eerily")`? What is the value of `i` at the end of the execution of the method call? [5%]
- (c) As it is currently written, the crypt method does not work correctly on words which do not begin with a vowel. What is the result of `crypt("numbers")`? What is the value of `i` at the end of the execution of the method call? What should be done to fix the method? [5%]
- (d) We now want to alter crypt so that if a word has precisely one capital letter at the beginning, then the resulting string also has precisely one capital letter at the beginning. For example, `crypt("Nutshell")` should result in "Tshellnu". Briefly explain what changes are needed to achieve this. [5%]

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4. A novice programmer wishes to write a program which prints

1 2 4 8 16 32 64 128 256 512 1024 2048 4096 8192

- (a) The first attempt uses a method `doubleIt`, which is intended to double the value of the variable `n`:

```
public class Twice
{
    public static void main (String[] args)
    {
        int n=1;
        while (n<10000) {
            System.out.print(n+" ");
            doubleIt();
        }
        System.out.println();
    }

    static void doubleIt()
    {
        n = n*2;
    }
}
```

Explain precisely why this program fails to compile.

[5%]

- (b) The programmer tries to fix the problem by changing the program to the following:

```
public class Twice
{
    public static void main (String[] args)
    {
        int n=1;
        while (n<10000) {
            System.out.print(n+" ");
            doubleIt(n);
        }
        System.out.println();
    }

    static void doubleIt(int n)
    {
        n = n*2;
    }
}
```

This time, the program compiles, but does not produce the intended output. What output is produced?

[5%]

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- (c) What changes are now required to the program so that the program compiles and produces the correct output? [5%]

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Section B: Multiple choice

These questions are multiple choice. Detach the answer sheet from this examination paper, write your registration number on it, and write a number inside the box for each question. Please attach the answer sheet *inside* the booklet for written answers, and use a treasury tag to hold them together. [Each Question is worth 4%].

5. Only one of the following is true - which?
- 1) To obtain the length of a string `s`, use `len=(int)s`.
 - 2) If `d` is a double and `i` is an int, the assignment `d=i` is legal.
 - 3) If `f` is a float and `d` is a double, the assignment `f=d` is legal.
 - 4) If `c1` and `c2` are chars, the expression `c1+c2` evaluates to a char.
 - 5) All variables must be initialised at the time they are declared.
6. What is output by the following program?

```
class TestBreak
{
    public static void main(String[] args)
    {
        int sum = 0;
        int item = 0;

        do
        {
            item ++;
            sum += item;
            if (sum >= 6) break;
        } while (item < 5);
        System.out.println(sum);
    }
}
```

- 1) 2.
- 2) 4.
- 3) 5.
- 4) 6.
- 5) 10.

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7. Which of the following is true?
- 1) Java does not detect array bound violations.
 - 2) You can mix `ints` and `doubles` in the same array.
 - 3) An element of an array must be of primitive data type.
 - 4) Array elements are numbered from 0.
 - 5) You can change the size of an array after you have created it.
8. Suppose `s1` and `s2` are strings. Which of the following statements is correct?
- 1) `String s3 = s1 + s2;`
 - 2) `String s3 = s1 - s2;`
 - 3) `boolean b = s1 >= s2;`
 - 4) `int j = length(s1);`
 - 5) `char c = s1.charAt(s1.length());`
9. Which one is false?
- 1) A method can have several return statements.
 - 2) Every method returns a value.
 - 3) Java supports call-by-value for methods.
 - 4) Methods can call themselves.
 - 5) A method can return an object.
10. Which is true?
- 1) Every instance variable is static.
 - 2) Constructors cannot be overloaded.
 - 3) A static method is visible only in its own class.
 - 4) Every class must have a main method.
 - 5) Every object is an instance of some class.

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11. What is the output of the following program?

```
class Mystery
{
    public static void main(String[] args)
    {
        System.out.println(mystery(5,4));
    }

    static int mystery (int a, int b)
    {
        if (b==1) return a;
        else return a + mystery(a, b-1);
    }
}
```

- 1) 4.
- 2) 5.
- 3) 9.
- 4) 12.
- 5) 20.

12. Which of the statements below is true of the following program?

```
public class Mystery
{
    public static void main (String[] args)
    {
        int[] data = {40};
        increment(data);
        System.out.println(data[0]);
    }

    static void increment(int[] d)
    {
        d[0]++;
    }
}
```

- 1) The program will not compile because the line `increment(data);` is meaningless.
- 2) The program outputs 40.
- 3) The program outputs 41.
- 4) The program produces an index bound violation.
- 5) The program causes the computer to crash.

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13. Consider the Roman class:

```
class Roman
{
    private int num;

    public Roman (String str)
    {
        // sets instance variable num to be the number
        // represented by str
        . . .
    }

    public int getValue()
    {
        return num;
    }

    public String toString()
    {
        // returns string representing the Roman numeral for num
        . . .
    }

    public void add (Roman r)
    {
        // adds r to num
        num += r.num;
    }

    public boolean equals (Roman r)
    {
        // returns whether r represents the same number as n
        return r.num==num;
    }
}
```

Suppose `r1` and `r2` are objects of the class `Roman`. Which of the following is a legal statement (i.e. it will not cause a compiler error)?

- 1) `boolean b = r2.equals(5);`
- 2) `Roman r1 = "IV".add("IX");`
- 3) `new Roman("IV").add(new Roman("II"));`
- 4) `System.out.println(r2.add(5));`
- 5) `System.out.println(r2.add("VI").equals("X"));`

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Answer Sheet for Section B

Please attach the answer sheet *inside* the booklet for written answers, and use a treasury tag to hold them together.

5.

6.

7.

8.

9.

10.

11.

12.

13.