

King's College London

UNIVERSITY OF LONDON

This paper is part of an examination of the College counting towards the award of a degree. Examinations are governed by the College Regulations under the Authority of the Academic Board.

B.Sc. EXAMINATION

CP/1710 COMPUTING FOR PHYSICAL SCIENCES

JANUARY 2000

Time allowed: **THREE HOURS**

Candidates must answer any SIX questions from SECTION A, and TWO questions from SECTION B.

Separate answer books must be used for each section of the paper.

The approximate mark for each part of a question is indicated in square brackets.

Good answers to the questions in Section B will consist of plans or explanations in addition to C or C++ code. You can gain marks for later sections of a question even if you cannot do the earlier sections.

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SECTION A – Answer SIX parts of this section

- 1.1) What do the following statements in C tell you about the variables **x**, **y**, **z**, and **title**?

```
int x=3;
float y=10.2;
bool z=true;
char title[]="CP1710 examination";
```

[7 marks]

- 1.2) What does the following section of code print out?

```
for (int i=5;i>0;i--)cout << i << " ";
```

Mark the spaces and new lines carefully.

[7 marks]

- 1.3) What is a pointer in C or C++? When would you use one?

[7 marks]

- 1.4) Write down the lines of C code which would read ten integers from a file called **input.d** into an array **a[10]**.

[7 marks]

- 1.5) Write a short (void) function in C which interchanges two integers.

[7 marks]

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- 1.6) What would the following line of code (written before the main function) do?

```
#define SUMSQ(x,y) (x)*(x)+(y)*(y)
```

Explain why the brackets are necessary.

[7 marks]

- 1.7) Write the lines of C code which would calculate the mean of 10 float numbers, read in from the keyboard, and print it out.

[7 marks]

- 1.8) If a C program initialises **x** and **a** in this way:

```
int i=5;  
float a=2, x=2;
```

what are the values of **x** after the following sections of code?

- a) `x=i/3+a;`
- b) `x=i/(3+a);`
- c) `x=i/3.+a;`
- d) `x=a=4;`
- e) `x=int(a)%i;`
- f) `x+=5;`
- g) `x=pow(a,3);`

[7 marks]

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SECTION B – Answer TWO questions

- 2) Write a function in C or C++ that takes as its argument a value of x (a float in radians in the range $-\pi < x < \pi$) and returns the value of $\cos(x)$ (accurate to 4 places of decimals) using the series:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} \dots$$

[18 marks]

Write a main function that could be used to test your function.

[5 marks]

If the restriction $-\pi < x < \pi$ did not apply, explain (without programming it) how you could adapt your function to cope with values of x outside this range.

[7 marks]

- 3) Write a function in C which calculates the value of the expression:

$$\frac{x-10}{(x+1)(x-3)} \text{ for any value of } x.$$

Your function should print a warning if the expression is difficult to calculate.

[12 marks]

Adapt your function to evaluate the more general expression:

$$\frac{x+a}{(x^2+bx-c)} \text{ for any values of } x, a, b \text{ and } c.$$

[8 marks]

Suppose that the values of a , b and c are read in the first time you use this function and then the **same** values of a , b and c are used for many subsequent calls to the function with different values of x . Explain the problems that this requirement brings up and how you would solve them.

[10 marks]

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- 4) Write a program which reads in 100 int variables, with values between zero and 99, and calculates a histogram of their values, in bins of width 10. (That is, it counts, and prints out, how many of the numbers have values in the ranges 0-9, 10-19, ... 90-99. For this part of the question, the values read in do not need to be stored.)

[15 marks]

Adapt your program so that the values are read from a file, called input.d.

[5 marks]

Adapt your program to deal with an indefinite number of variables and store them after reading them. The first number in the input file gives the number of variables to be read in. Allocate just enough space for the stored variables.

[10 marks]

- 5) Increasingly accurate estimates of the Golden Ratio are given by the ratio of successive members of the Fibonacci sequence.

The Fibonacci sequence starts 1, 1, 2, 3, 5, 8, 13 ..., such that the next member is the sum of the preceding two members.

So, estimates of the Golden Ratio are given by: $1, \frac{1}{2}, \frac{2}{3}, \frac{3}{5}, \frac{5}{8}, \frac{8}{13}, \dots$

Write a program to estimate the Golden Ratio to 5 significant figures.

[30 marks]

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