

1998 Paper 2 Question 1

Twenty-part question (*One mark per part*)

(a) Using O -notation, specify the complexity class described by the recurrence

$$\begin{aligned}T(1) &= 1 \\T(n) &= T(n/2) + 1.\end{aligned}$$

(b) How (in outline) does mergesort work?

(c) What are curried functions and what are their advantages?

(d) Use Euclid's algorithm to find the highest common factor of 221 and 247, and to express it as a linear combination of these numbers.

(e) Suppose that A and B are sets whose numbers of elements are a and b respectively. How many subsets does A have? How many relations are there between A and B ? How many total functions are there from A to B ?

(f) Give explicit injections from \mathbb{N} to $\mathbb{N} \times \mathbb{N}$ and from $\mathbb{N} \times \mathbb{N}$ to \mathbb{N} .

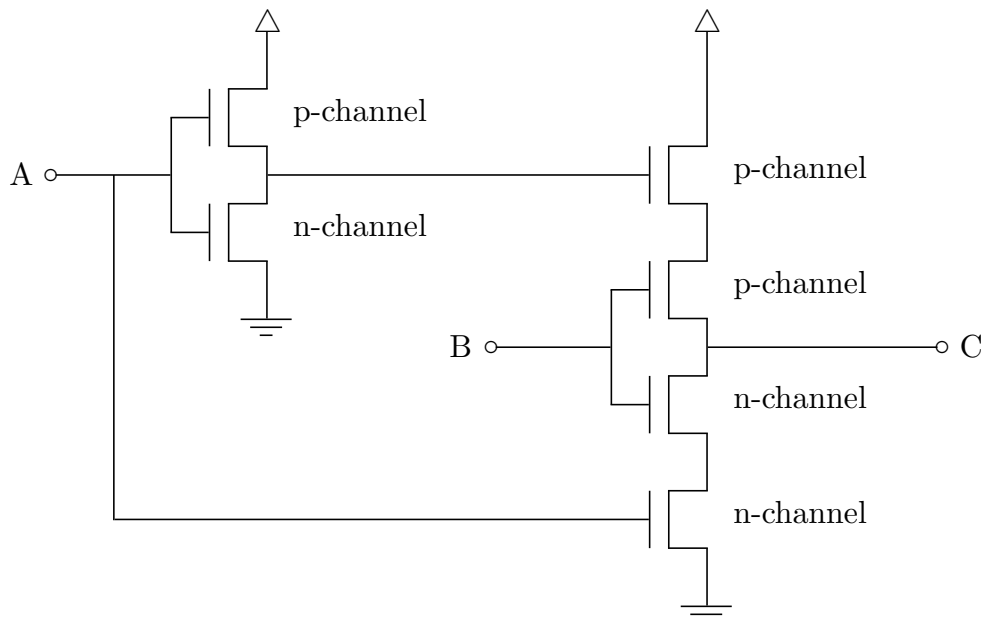
(g) List the eight Java primitive types.

1998 Paper 2 Question 1 (continued)

- (h) What result will be printed if the following fragment of Java code is executed? Why?

```
double d = 6.6;
try
{   d = 1.0 / 0.0;
}
finally
{   System.out.println("d = " + d);
}
```

- (i) What is meant by the terms *big endian* and *little endian*? Illustrate your answer by showing how the characters of the word “fleamarkets” would be represented in a machine with a 4-octet word and processor endian of each type.
- (j) How does an I/O device which supports DMA operate?
- (k) What is this?



- (l) What function is represented by the following map (give the simplest form)?

	a			
b	1	1	1	1
		1	1	
	c			

1998 Paper 2 Question 1 (continued)

(*m*) Why is it important for the maintenance of their professional status, that computer professionals continue to upgrade their professional knowledge and skill?

(*n*) Why should you never expect the following response from an ML program?

```
val it = 3.14 : integer
```

(*o*) If X is distributed Geometric(p), what is $E(X)$?

(*p*) If X and Y are two random variables, what is the covariance $W(X,Y)$?

(*q*) Is it more economic to have one person testing a program for 6 months, or six people testing it in parallel for 1 month?

(*r*) What is stepwise refinement?

(*s*) Give a finite deterministic automaton with alphabet of input symbols $\{a,b\}$ which accepts the language consisting of just the null string ε and the letter a .

(*t*) Give a reliable circuit for gating the clock to a D-type flip-flop that has the effect of a clock enable.