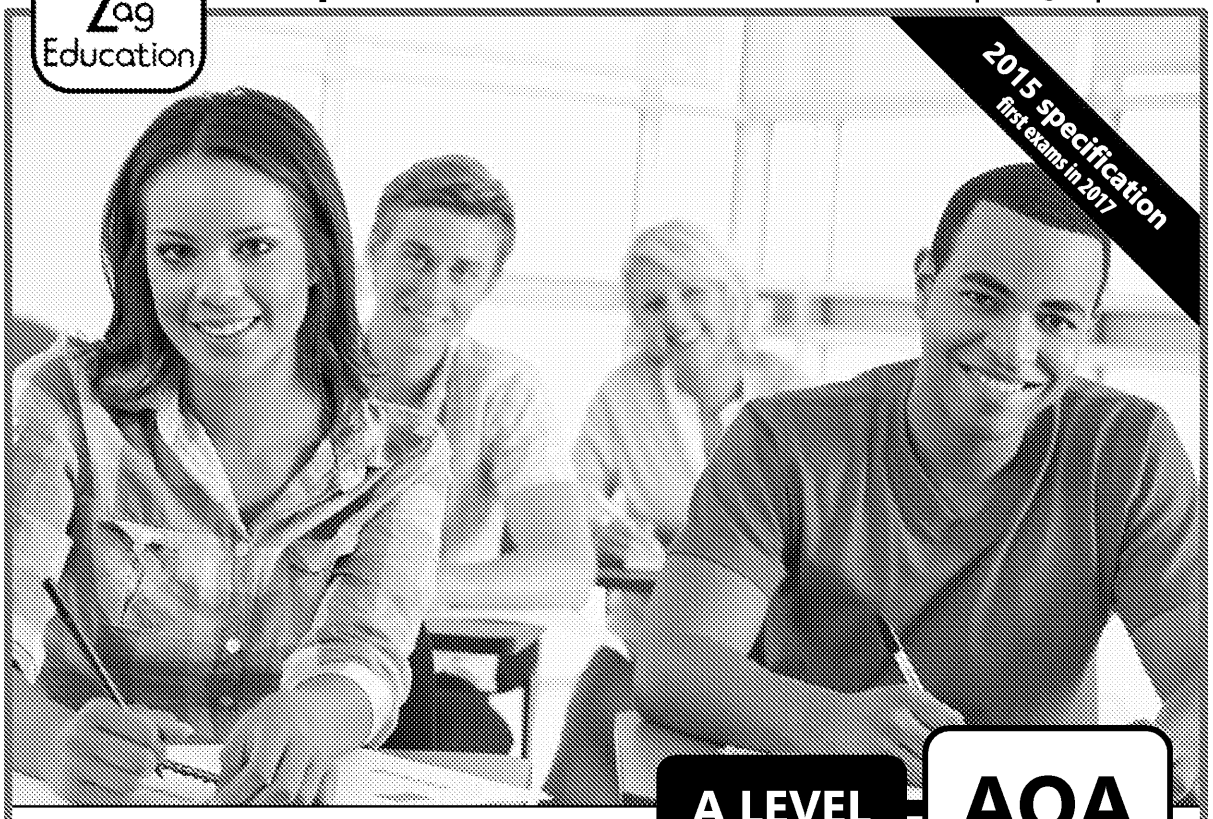
Zig Zag Education

Computer Science A Level | AQA | 7517



A LEVEL **AQA**

Topic Tests

for A Level AQA Computer Science

Paper 1 *Topics 4.1 – 4.4*

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POD 6069

Contents

Teacher's Introduction

This resource is designed to support teaching and learning of the A Level AQA specification (for first teaching in September 2015; first exams from June 2017).

These end-of-topic tests are designed as factual tests to check your students' understanding as they complete each topic*. Their primary focus is not to provide exam-style practice, but instead to test the knowledge, skills and understanding required by the AQA specification in a variety of styles and complexities – ranging from simple short-answer questions through to longer essay-style questions.

**The tests could also be used for homework or revision, but their best use is as summative assessments.*

There are a total of 8 tests covering the prescribed specification content for *Paper 1* of the A Level AQA specification – each provided in worksheet format (with answer lines) and a more photocopy-friendly format (without answer lines), to give you flexibility of use.

The majority of tests are worth around 30-40 marks each, so that they can be completed within a single one-hour lesson.

Example answers are provided for every test. *Note that credit should also be given for any valid responses that are not explicitly included in this resource.*

4.1. Programming – Test 1

1. What data types would you use to best represent the following?

   a) A telephone number .....

   b) The name of a company .....

   c) The time that a file was last edited .....

   d) A set of test results (out of 100) for a class of 50 students .....

   e) Membership details of each member at a certain club .....

2. a) Describe what is meant by a 'language-defined' function.

   .....

   .....

   .....

   b) Give an example of a language-defined function for each of the following:

      i. Arithmetic

      .....

      ii. String Handling

      .....

      iii. Conversion

      .....

3. Consider the following basic pseudo code:

```
NoOfTurns ← Input                    (A)
IF NoOfTurns < 1 Then                (B)
    Output("Error - must be at least 1")
ELSE
    FOR X ←1 To NoOfTurns            (C)
        Output(X)
    ENDFOR
```

   Here is a list of statement types that can be used in programming languages:

   - Variable declaration
   - Constant declaration
   - Assignment
   - Iteration

   Identify what statement type best suits parts A, B and C of the pseudo code:

   A .....

   B .....

   C .....

4. You are writing a program for a local shop and you have been asked why and functions in your design. Give four advantages of using procedures a computer programs.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

5. Explain the difference between a procedure and a function.

.....

.....

.....

6. There are a number of programming paradigms which each have differen disadvantages.

a) Explain what procedural programming means.

.....

.....

.....

b) A common process when developing a program using procedural-pr define a data type and then write a number of functions which opera

i. What would be the object-oriented approach to this process?

.....

.....

ii. Give three advantages of using object oriented rather than pure languages in the development of large projects.

1 .....

.....

2 .....

.....

3 .....

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c) What is the main difference between a class and an object?

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.....

d) D[illegible] he term encapsulation.

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7. The Fibonacci sequence of numbers is defined as:

$$F_n = F_{n-1} + F_{n-2} \text{ where } F_0 = F_1 = 1$$

a) Write a recursive function called *fib* that accepts the number n as a p
the value of F_n.

b) S[illegible] advantage and a disadvantage of using recursion to solve a

Advantage .....

.....

Disadvantage.....

.....

4.1. Programming – Test 2

1. a) Explain the difference between a constant and a variable.

.....

.....

.....

b) Explain the difference between a global variable and a local variable.

.....

.....

.....

c) How can parameters be used to avoid the use of global variables?

.....

.....

.....

d) A colleague has decided that when they are programming they are g
in the order they are used, i.e. x1, x2, x3, x4... and so on. What is the
would you recommend they do instead?

.....

.....

.....

2. a) Explain the difference between div and mod operators.

.....

.....

.....

.....

b) Calculate the answers to the following operations.

i. 5 div 3 .....

ii. 5 mod 3 .....

iii. 25 div 5 .....

iv. 25 mod 5 .....

3. You have been asked to create a program that prints out details about a
below. Using the correct arithmetic and relation operators, write out a cas
to perform the task:

- A person with more than 50 medals and whose age is less than 30
medal success' printed.
- A person who has three or more times the number of bronze meda
combined should have 'medal prospect'.
- A person who has less than or equal to five medals should have 'do
- Everyone else should have 'insufficient details' printed.

4. The following procedure is designed to generate and print N random nu

```
PROCEDURE PRINTRANDOMNUMBERS(N)
    STATE = SEED(123)
    I = 0
    REPEAT
        PRINT(RANDOM(STATE))
        I = I + 1
    UNTIL I < N-1
ENDPROCEDURE
```


a) The program prints [illegible] to the screen even when $N = 0$. Explai

.....

.....

b) Identify one additional bug in the procedure.

.....

.....

.....

c) Describe the purpose of a seed value in random-number-generation
consequences of this procedure calling the `seed()` function with a c

.....

.....

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.....

5. The factorial of a number ($n!$) is defined as:

$$n! = \begin{cases} 0 & if\ n = 0 \\ n \times (n-1)!\ if\ n > 0 \end{cases}$$

For example:

$$6! = 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 720$$

Write a recursive function called *factorial* that accepts the number n as a
of $n!$.

4.2. Data Structures – Test 1

1. Data structures are integral to modern programming.

   a) Define the term 'data structure'.

   .....

   b) Define the term 'array'.

   .....

   .....

   c) Users can define their own data structures or objects. These are said
   Explain what class methods are and give an example of your ow
   re fie names and an example method. The data structure can
   You are not required to write code in this question – simply describe th
   method.

   .....

   .....

   .....

   .....

   .....

   .....

   .....

2. Arrays are a very popular and commonly used data structure in programm
   language of your choice in this question wherever required.

   a) Write the code that would create a one-dimensional array (named 's
   sports that are played at a school: rugby, football, hockey, netball an

   b) In the ma languages, arrays are said to be 0-based. What doe

   .....

   .....

   c) Write the code that would output the first and last element.

d) It has been decided that football will no longer be played and they a
Write the code that would update the array with this information.

e) One way of printing out the elements of an array on screen is to writ
each element on screen, i.e. if you have five elements you will have fi
element individually. Describe, using words or annotated pseudocod
how you could efficiently print the items in a five-element array.

f) Considering your answer to part e), what issue would you have to co
used elsewhere with arrays of varying size? How do you get around t

3. Consider the following two-dimensional array that would be used by a sc
performance. The school uses a system called Grade Reviews (or GRs) wit
every half term. Each grade review contains an effort grade (A–E) and a sc
well the pupil is doing academically (with 10 being a top performer). A tw
'GRs') of a pupil's grade reviews is shown below. Use pseudocode or prog
choice in this question wherever required.

	GR1	GR2	GR3	
Maths	A,10	A,10	A,9	
[illegible]	A,9	A,8	B,8	
Computer Science	A,9	A,10	B,9	
Geography	B,7	B,7	B,8	

a) Write the code to define appropriate fields that will be part of a GR c

b) Write the code that will print out the pupil's GR for GR3 in Computer effort, attainment).

c) Write a routine that updates every element in the array to the values

d) How would this structure be updated to store multiple pupils' grade

4. A text file contains a list of names, passwords, and access codes. A name user. The program looks for the name and password in the file. If the na and the access code is N, the user is denied access; if it is Y, access is give code to implement this (on paper). If necessary, write it in rough first.

4.2. Data Structures – Test 2

1. Take the following example of a stack that is currently stored in memory.

Memloc	Data	TopOfStac
6		
5		
4		
3	Fish	←
2	Cat	
1	Dog	

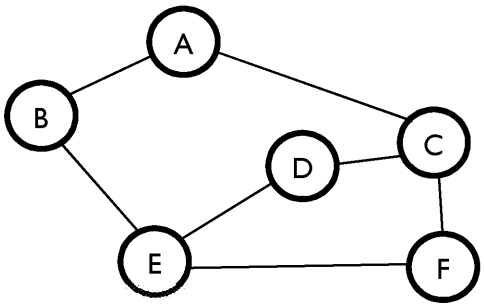
a) Complete the table after the following commands:
Push 'Mouse', Push 'Rat', Pop

Memloc	Data	TopOfStac
6		
5		
4		
3		
2		
1		

b) Complete the table after the following further commands:
Pop, Pop, Push 'Rabbit'

Memloc	Data	TopOfStac
6		
5		
4		
3		
2		
1		

2. Here is an example of an unlabelled graph:



a) Is this graph a tree? Explain your answer.

.....

b) What is a tree?

.....

.....

c) This graph can be converted into a directional graph (digraph); explain

.....

d) One way to represent a graph in a computer is to use an array. This allows different formats.

i. Complete the following adjacency list to represent the graph.

Vertex	Connected to
A	
B	
C	
D	
E	
F	

ii. Complete the following adjacency matrix to represent the graph

	A	B	C	D	E	F
A						
B						
C						
D						
E						
F						

iii. Give one advantage for each of the two representations shown a

.....

.....

.....

3. Hash tables are an important tool with databases.

   a) Describe how hashing works and state the benefit of hashing.

   .....

   .....

   .....

   b) Describe the three following terms.

      i. Hashing key

      .....

      ii. Hashing algorithm

      .....

      iii. Hashing value

      .....

4. Dictionaries are a method of accessing associated data via a key and can b
   Write a dictionary that would represent the following:

   THIS IS COMPUTER SCIENCE: THE SCIENCE OF C

5. Queues are a popular way of representing data within a computer.

   a) Queues operate on a first in, first out basis, whereas stacks operate o
   Explain what this means.

   .....

   b) One way of changing the way a queue behaves is by making it a prio
   and give a realistic example of where a priority queue could be used

   .....

   .....

   .....

   .....

   c) Explain the difference between a (statically sized) linear queue and a

   .....

   .....

   .....

d) Apart from the pointer to the actual buffer in memory, what two oth
implement a circular list?

.....

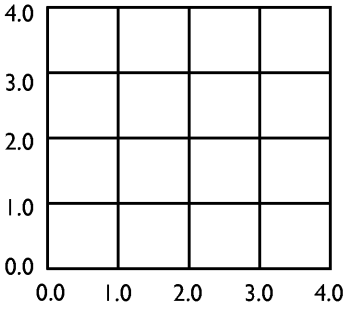
.....

e) Complete the following table showing the state of the queue at each
the queue at each state. You must complete the state of the queue a
NextFree values at each stage.

State 1	State 2	State 3	St
start state	H joins queue	served from queue	J joins q
1 2 3 4 5 A	1 2 3 4 5 A B C	1 2 3 4 5	1 2
Fr = 1 NextFree = 4	FrontPtr = NextFree =	FrontPtr = NextFree =	FrontP NextFr

6. You have been given a simple [0.0, 0.0, 2.0, 4.0].

a) Represent this vector as an arrow.



b) What is the name of the process that defines translating a vector?

.....

c) What is the name of the process that defines scaling a vector?

.....

d) Translate the vector we have been dealing with in this question so t
and three points right.

e) Scale the vector you have for part d) so that you double the size of t

Preview of Questions Ends Here

e) (17 – 5) / 83
f) (16 * 4) + 3
g) (54 / 37) * 15
h) ((17 + 3) / 2) * 5
i) *1 mark for any of the following:*
- Simpler/easier for a machine/computer to evaluate OR simpler/eas
simpler/easier to understand
- Do not need brackets (to show correct order of evaluation/calculati
- Operators appear in the order required for computation
- No need for order of precedence of operators
- No need to backtrack when evaluating; can use stack

4. a) *1 mark five elements in the correct order and 1 mark for a completely cor*
b) *1 mark five elements in the correct order and 1 mark for a completely cor*

5. a) There are alternative algorithms but the one they need to know for the s
b) The paths (e.g. [illegible] are not required in the answer
B: 1 (A-B)
C: 3 (A-C)
D: 5 (A-C-D)
E: 7 (A-B-E)
F: 9 (A-B-E-F)

6. *1 mark for the description of the process and one for the example. Description*
required to deal with a queue.
Example answer: A queue simulation requires a process to feed a queue by a
the queue and a process to remove/take elements from the front end of the
then change over time according to the imbalance between adding things to
[1]. One example of a use for a queue simulation in computing would be net
there are many others [1].

7. a) *1 mark for each correct stage (sorted pairs, groups of four, and then the fu*

Stage 1	10	12	1	7	4	22	3	
Stage 2	1	7	10	12	3	4	5	2
Stage 3	1	3	4	5	7	10	12	2

b) O(n log n)
c) No. Merges would overwrite values that have not yet been merged.

4.3. Algorithms – Test 2

1. a) i. *1 mark for four elements in correct c[illegible] 2 marks for completely cor*
ii. *1 mark for four elements in [illegible] order, 2 marks for completely cor*
b) Discovered and Comple[illegible]ed

2. a) O(1)
b) O(n)
c) O(1)
d) O(n)
e) There are two permissible answers for this question:
As the size of the list increases, the time taken to search for an answer incre
linear search looks at each item in the list in turn (until it reaches the end of
for is found) (1) so if there are n items in the list the worst case would be n
f) The algorithm sequentially checks each element in the list, comparing e
turn (1). This continues until the required field is found or the search co

3. a) Bubble sort

b) *Any two of the following.* A bubble sort:
- steps through the list comparing each pair of items in the list
- swaps them if they are in the wrong order
- repeats the pass through the list until no swaps are needed

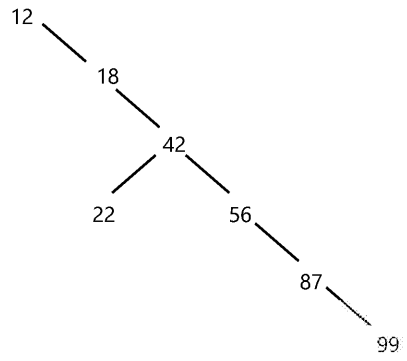
c) *1 mark for each of the three 'bubbles' (line 2, 4, 6) and 1 for overall accura*

Swapped	Count	Length(A)	Temp	1	2	3	4
False		4	null	90	7	99	63
True	1		90	7	90		
	2						
True	3		99			63	99
False	1						
True	2		90		63	90	99
	1						
	2						
	3						

d) i. Callum, Fred, James, Mike
ii. C, H, A, M, C, Q
iii. 11, 0, 20, 10, 58

4. a) *1 mark for an indication of searching for an element*
2 marks for Binary Search
b) O(log n)

5) a) Hashing
b)



c) 6 steps
d) No – the tree is not balanced and s[illegible]ca[illegible]ake close to O(n) time to find

4.4. The[illegible] of Computation – Test 1

1. a) W[illegible]se runtime

b) i. $O(n^2)$
ii. $O(n)$
iii. $O(n^3 \times 2^n)$

c) The one with O(n) (the second one – ii)

2. a) Abstraction means removing unnecessary detail from a representation. This c

b) i. An intractable problem is a problem which, in the worst-case, has a polynomial time. This means that they take an impractical amount o

ii. A heuristic approach. This means using extra knowledge, which in s
complexity of the problem to polynomial time.

c) This is not possible (1). It is an example of the halting problem OR descr

3. a) Yes, No, Yes, No.

b) i. DOB\s\d\d/\d\d/\d\d\d\d NB: \d is equivalent to [0-9]
ii. \d\d\.\d\d\.\d\d\d\d

c) i. The regular expression will not just match valid inputs. For example
month!
ii. (JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | D

4. *1 mark for iterative loop from 1 to 100*
1 mark for checking if number divisible by 5
1 mark for printing a number that is divisible with no remainder AND printing
1 mark for adding any other than to an array or some alternative storage

```
Start Prog
Defi tal, k
FOR m 1 to 100
   IF k mod 5 equals 0
      PRINT k
      SET total equal to total + k
      PRINT total
   ELSE add k to array of fails
End Program
```

5. a) This program reads in a value from the user (1) and then, if it is greater t
are in the black' (1). If the value is less than zero it prints 'You are in the
program otherwise it continues to loop (1).

b) *1 mark for each of the following*
- A step-by-step solution to a given problem
- Independent of programming language
- That always terminates

6. a) Mealy machine outputs values whereas a finite-state automaton does n

b) *1 mark for each correct Accepted and Output entry*

Input String	Accepted? (Yes/No)	Output
021133	Yes	130201
111203	No	020
233	Yes	301
3111103	Yes	2202031
001123	No	11022

c) *1 mark for a correct set of input and new state entries for each of the thre*

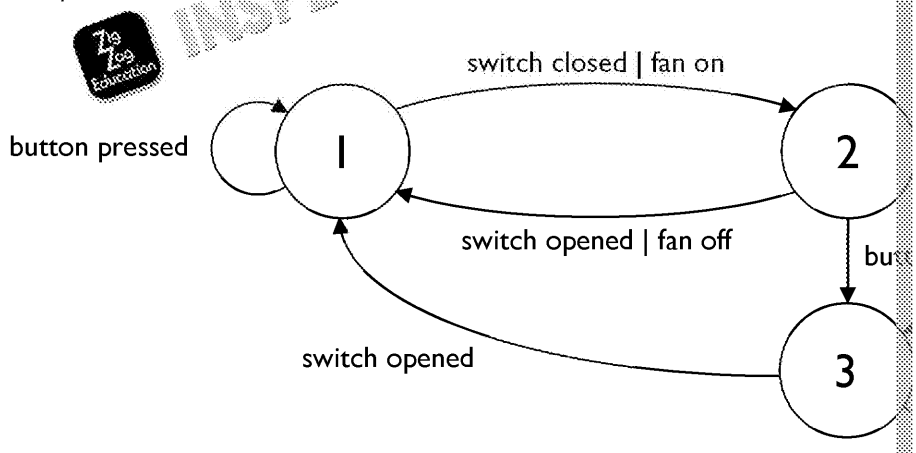
Original State	Input	New State
S4	3	S5
S3	1	S2
S3	2	S5
S3	3	S4
S0	0	S0
S0	1	S2
S0	2	S3
S0	3	S1

4.4. Theory of Computation – Test 2

1. a) *1 mark for correct entry for state 1, 1 mark for state 2 and 1 mark for stat*
Example table:

Current State	Input Symbol	Output Symbol(s)	Next State
1	button pressed		1
1	switch closed	fan on	2
2	button pressed	fan off	3
2	switch opened	fan off	2
3	button pressed		3
3	switch opened		1

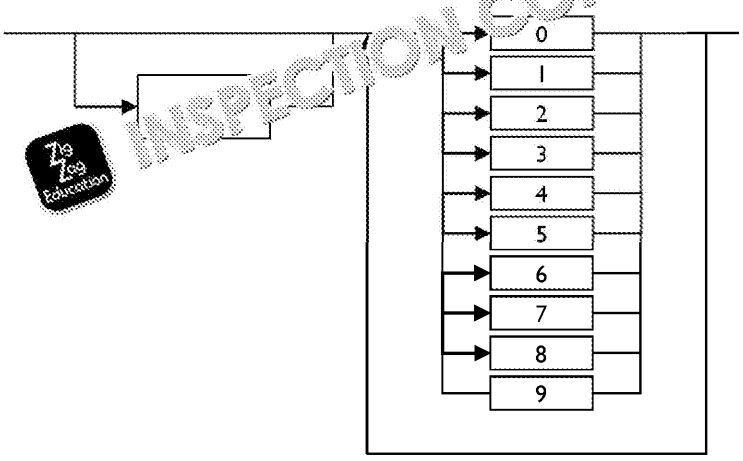
b) *1 mark for a diagram that correctly represents states of the fan being on and o*
1 mark for a completely correct diagram
Example state transition diagram:



c) No – finite-state automatons do not have outputs.

2. a) i. Right
ii. Eight
b) The Turing machine goes into an infinite loop
c) Subtracts (1) the second number from the first (1)

3. a) The '-' symbol can only appear at the start of the number and there can
b) *1 mark for having a minus symbol as the first stage in the diagram follow*
1 mark for a completely correct diagram
Example diagram:



c) *1 mark for assigning a value for <real>*
1 mark for an int being assigned first. 1 mark for a <dot> or .
1 mark for a posint after the dot.

Example answer:

```
<real> ::= <int> <dot> <posint>
<dot> ::= .

OR

<real> ::= : <int> . <posint>
```

4.

```
while true
  temp = acquire()
  if temp >= 50
    heater(off)
  else
    heater(on)
  end if
end while
```

Loop structure so that the check happens rep
Selection structure to check the value of tem
Switches heater on when below 50°C [1]
Switches heater off when above or equal to
Concise implementation [1]

5.

Input String	Accepted? (Yes/No)
BBAB	Yes
ABACB	Yes
AABA	No
BABACBB	No
BABAACBA	Yes

6. a) i. There is 0 or 1 of the preceding element
ii. There is 0 or more of the preceding element
iii. There is 1 or more of the preceding element

b) *1 mark for an explanation of what each could create*
a|b+ - denotes {"a", "b", "bb", "bbb", "bbbb", ...}
(a|b)+ denotes the set of all strings with no symbols other than "a" or "b"
"aaa"...}

c) The same strings would be acceptable although you could also now hav

Preview of Answers Ends Here