

© International Baccalaureate Organization 2021

All rights reserved. No part of this product may be reproduced in any form or by any electronic or mechanical means, including information storage and retrieval systems, without the prior written permission from the IB. Additionally, the license tied with this product prohibits use of any selected files or extracts from this product. Use by third parties, including but not limited to publishers, private teachers, tutoring or study services, preparatory schools, vendors operating curriculum mapping services or teacher resource digital platforms and app developers, whether fee-covered or not, is prohibited and is a criminal offense.

More information on how to request written permission in the form of a license can be obtained from <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organisation du Baccalauréat International 2021

Tous droits réservés. Aucune partie de ce produit ne peut être reproduite sous quelque forme ni par quelque moyen que ce soit, électronique ou mécanique, y compris des systèmes de stockage et de récupération d'informations, sans l'autorisation écrite préalable de l'IB. De plus, la licence associée à ce produit interdit toute utilisation de tout fichier ou extrait sélectionné dans ce produit. L'utilisation par des tiers, y compris, sans toutefois s'y limiter, des éditeurs, des professeurs particuliers, des services de tutorat ou d'aide aux études, des établissements de préparation à l'enseignement supérieur, des fournisseurs de services de planification des programmes d'études, des gestionnaires de plateformes pédagogiques en ligne, et des développeurs d'applications, moyennant paiement ou non, est interdite et constitue une infraction pénale.

Pour plus d'informations sur la procédure à suivre pour obtenir une autorisation écrite sous la forme d'une licence, rendez-vous à l'adresse <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

© Organización del Bachillerato Internacional, 2021

Todos los derechos reservados. No se podrá reproducir ninguna parte de este producto de ninguna forma ni por ningún medio electrónico o mecánico, incluidos los sistemas de almacenamiento y recuperación de información, sin la previa autorización por escrito del IB. Además, la licencia vinculada a este producto prohíbe el uso de todo archivo o fragmento seleccionado de este producto. El uso por parte de terceros —lo que incluye, a título enunciativo, editoriales, profesores particulares, servicios de apoyo académico o ayuda para el estudio, colegios preparatorios, desarrolladores de aplicaciones y entidades que presten servicios de planificación curricular u ofrezcan recursos para docentes mediante plataformas digitales—, ya sea incluido en tasas o no, está prohibido y constituye un delito.

En este enlace encontrará más información sobre cómo solicitar una autorización por escrito en forma de licencia: <https://ibo.org/become-an-ib-school/ib-publishing/licensing/applying-for-a-license/>.

Computer science
Higher level
Paper 1

Tuesday 11 May 2021 (afternoon)

2 hours 10 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is **[100 marks]**.

Section A

Answer **all** questions.

1. Identify **two** roles that a computer can perform in a network. [2]
2. Describe **one** method of implementation for a new computer system. [2]
3. Draw the logic circuit represented by the following truth table. [2]

A	B	Z
0	0	1
0	1	0
1	0	0
1	1	1

4. (a) Identify **two** reasons why patches may be necessary for an operating system. [2]
(b) Identify **two** methods that can be used to obtain these patches. [2]
5. Calculate the denary (base 10) equivalent of the hexadecimal number BF. [2]
6. Identify **two** reasons why fibre optic cable would be preferred over wireless connectivity. [2]
7. Distinguish between a *variable* and a *constant*. [2]

8. List the output from the given algorithm for the following input. [3]

2, 6, 8, 9, 12, 15, 18, 20

```
loop for Count from 0 to 7
  input NUMBER
  if NUMBER div 2 = NUMBER / 2 then
    if NUMBER div 3 = NUMBER / 3 then
      output NUMBER
    end if
  end if
end loop
```

9. Identify **one** advantage of using a dedicated operating system on a mobile phone. [1]

10. Identify **two** characteristics of a dynamic data structure. [2]

11. Sketch a balanced binary tree that would allow the following output when traversed using inorder traversal:

Zebra, Tango, Hotel, Foxtrot, Delta, Bravo, Alpha. [3]

Blank page

Section B

Answer **all** questions.

12. A school currently has a cabled network but wants to add wireless networking across the whole campus.

(a) Describe **two** hardware components the school will need to implement the wireless network. [4]

(b) Identify **two** advantages to the students of the new wireless network. [2]

There are concerns that unauthorized people could access the data on the wireless network.

(c) Outline **two** methods the school could employ to prevent network data from being accessed over their wireless system. [4]

The school has decided to implement a virtual private network (VPN) to provide access to its network.

(d) Identify **two** technologies the school would require to provide a VPN. [2]

(e) Explain **one** benefit to the staff of using a VPN to remotely access the school network. [3]

13. A company has 600 employees whose names are currently stored using a collection called `NAMES`. The names are stored as surname, first name. For example: Smith, Jane, Uysal, Rafael, Ahmed, Ishmael, Jonsonn, Sara, ...

(a) Construct a pseudocode algorithm that will store the surnames in one array and first names in another. [4]

The names in the collection are kept in a random order. However, it would be more useful if they were kept in alphabetical order.

(b) Construct a pseudocode algorithm that will sort the surnames into alphabetical order using the *bubble sort* method. The order of the first names must also be changed so that they keep the same index as their corresponding surname. [5]

The company's staff list is now organized in the arrays in alphabetical order.

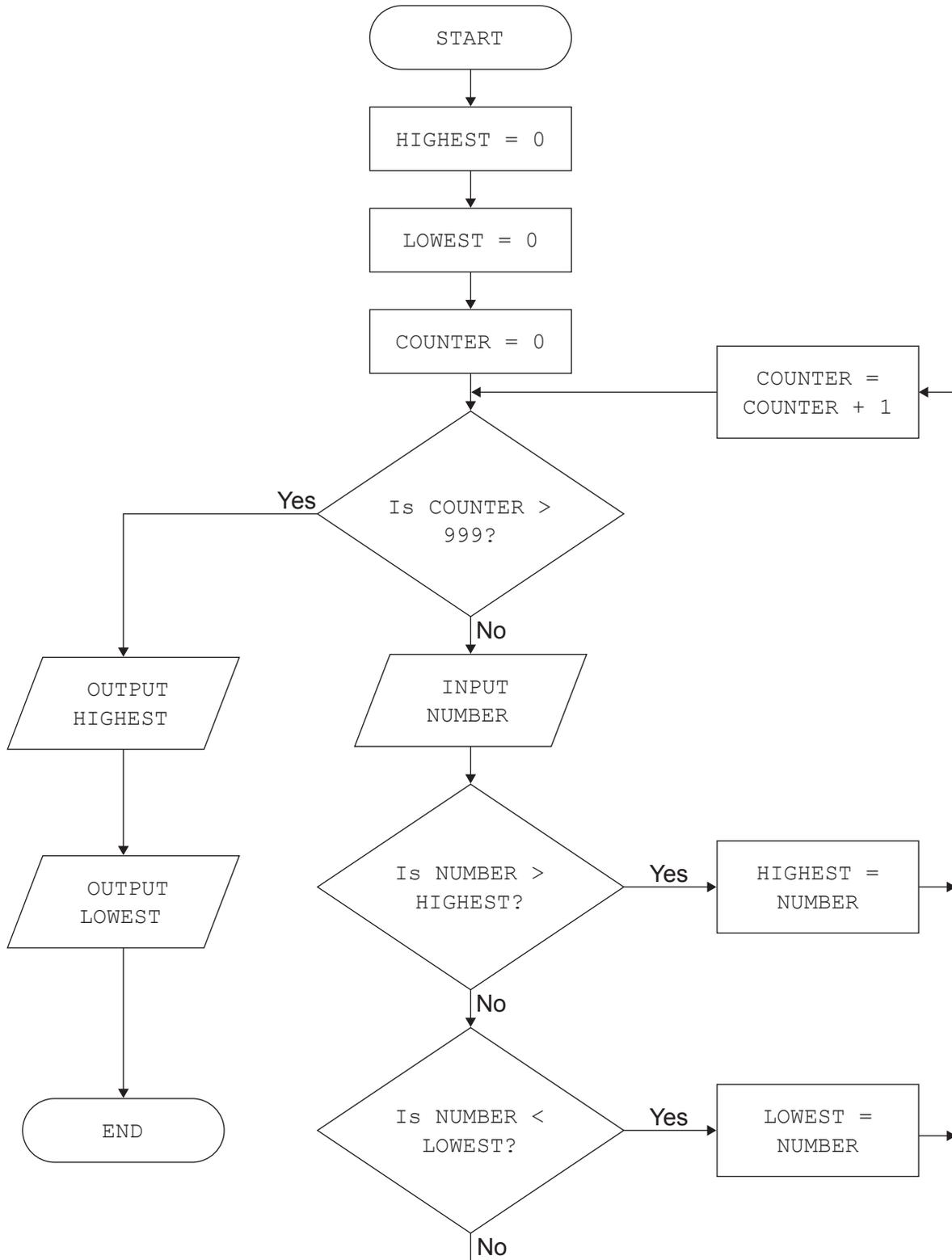
A binary search was used to find a specific name in the array.

(c) Describe the process a binary search would follow to find a record in the surname array. [4]

(d) Outline **one** benefit of using sub-programmes to implement your algorithms from parts (a) and (b). [2]

14. The following flowchart is intended to represent an algorithm in which numbers that are input cannot be negative.

The flowchart contains a logic error that will affect the algorithm's functionality.



(This question continues on the following page)

(Question 14 continued)

- (a) (i) Identify the logic error in the algorithm. [1]
- (ii) Outline how the error in the algorithm identified in part (i) can be corrected. [2]

The algorithm is to be altered to restrict the values that are input to whole numbers between 0 and 1000.

- (b) State the name of the method that could be used to restrict the values that are input. [1]

A further change has been requested for the algorithm to enable it to calculate the average of all the numbers entered. The average will be output when the algorithm terminates.

- (c) Based on the flowchart, construct this algorithm using pseudocode. You must include the required changes:
 - correction of logic error
 - only allow input of integers between 0 and 1000
 - calculation of average of all numbers entered
 - output of final average. [8]

15. A business has a range of different computers within the organization, including laptops, desktops and file servers. Wherever possible the organization uses a common operating system on its computers.

- (a) Outline **two** resource management techniques that are likely to be carried out by the operating system of a desktop computer. [4]
- (b) Outline **one** way the operating system hides the complexity of the hardware from the computer user. [2]

Memory requirements and processor speed will vary depending on the tasks required of the computer.

- (c) (i) Contrast the memory requirements of a laptop computer and a file server. [2]
- (ii) Contrast the processor speed requirements of a laptop computer and a file server. [2]

The business has decided to implement a computer-based system to switch the room lights on and off automatically. The lights will only be switched on if the level of light is below a specific reading and there are people in the room. The lights will be switched off when the room has been unoccupied for at least five minutes.

- (d) State **two** types of sensor that are required to control the lighting to ensure it switches on when it is required. [2]
- (e) Explain how the system makes use of the data it receives from the sensors to determine when to switch the lights on. [4]
- (f) Outline how the system will prevent the lights from being switched off too quickly when it thinks the room is unoccupied. [2]

16. A network is set up with shared printers so that when a user wishes to print, print jobs are sent to a queue until the printer is available.

- (a) Outline why a queue is the appropriate data structure to manage print jobs. [2]
- (b) Draw a diagram to show how a print queue may be implemented using a linked list. [3]
- (c) Explain why a stack would not be appropriate as a data structure for managing print jobs. [3]

The *factorial* of the positive integer n , which is written $n!$, is the product of all the positive integers less than or equal to n . A stack may be used to perform a factorial calculation as shown by the algorithm:

```
//stack for factorial(NUM)
//creates a stack of (NUM - 1) elements
//when NUM = 6
NUM = 6
loop while NUM > 1
    stack.push(NUM)
    NUM = NUM - 1
end loop
PRODUCT = 1
loop while not stack.isEmpty()
    NUM = stack.pop()
    PRODUCT = PRODUCT * NUM
end loop
output PRODUCT
```

- (d) Copy and complete the trace table for the algorithm shown for $NUM = 6$. [3]

NUM	PRODUCT	OUTPUT
6		

- (e) Explain how a stack may be used in the implementation of a recursive function. [4]

References: