AEO «Nazarbayev Intellectual Schools»
Center for Pedagogical Measurements

NIS
Nazarbayev
Intellectual
Schools

EXTERNAL SUMMATIVE ASSESSMENT
TEST SPECIFICATION
«COMPUTER SCIENCE»

Grade 12

Astana, 2025

Content

1 Purpose

The purpose of assessment is to identify learners' knowledge and abilities acquired in the process of learning as well as their abilities to apply high order thinking skills.

1.1 Relationship with International Standards

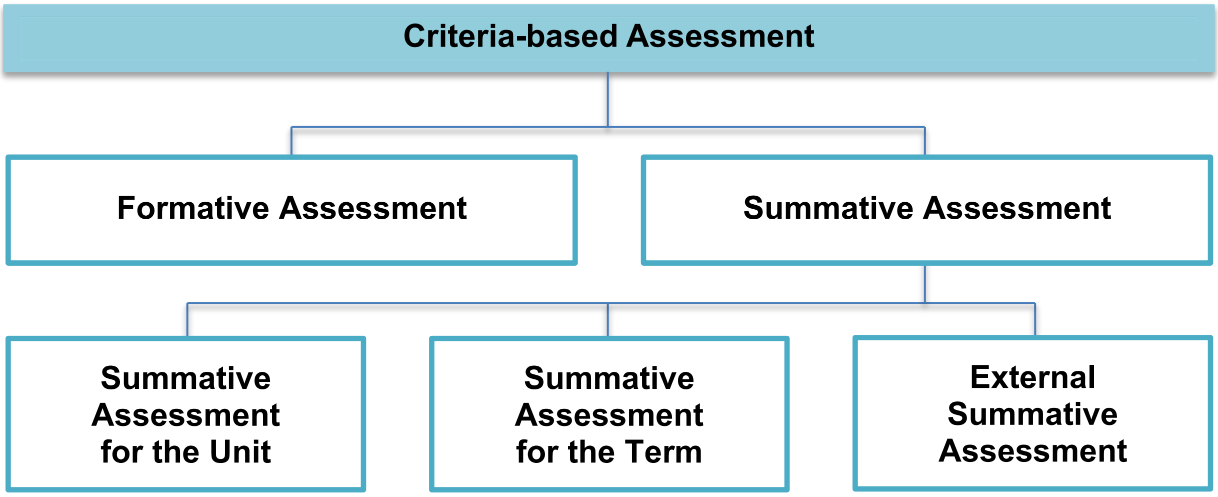
The Grade 12 Computer Science External Summative Assessment is designed to be comparable to the Cambridge International A-Level standard.

1.2 Relationship with Subject Programme

The Grade 12 External Summative Assessment will assess the content of AEO «Nazarbayev Intellectual Schools» Educational Programme – NIS-Programme for Garde 11 and Grade 12. The level of knowledge and abilities, as well as skills, will be defined by the expected outcomes within the Computer Science Subject Programme.

1.3 Relationship with Criteria-based Assessment System

External Summative Assessment forms one part of the Criteria-based Assessment System, which also consists of Formative Assessment and Summative Assessment for the unit and the term.


Criteria-based Assessment
Formative Assessment
Summative Assessment
Summative Assessment for the Unit
Summative Assessment for the Term
External Summative Assessment

2 External Summative Assessment Overview

2.1 Content overview

This specification is developed for the Computer Science Subject Programme (advanced level).

№	Strand	Sub-strand	Paper 1	Paper 2	Paper 3
1	**Data and information**	1.1 Data representation	✓		
		1.2 Information security	✓		
		1.3 Ethics and ownership	✓		
2	**Problem solving**	2.1 System life cycle		✓	
		2.2 Engineering		✓	
3	**Computer systems**	3.1 Software	✓		
		3.2 CPU	✓		
		3.3 Boolean logic		✓	
		3.4 Memory	✓		
4	**Information systems**	4.1 Databases		✓	
		4.2 SQL query language		✓	
		4.3 Artificial intelligence	✓		
5	**Programming**	5.1 Programming paradigms	✓*		✓**
		5.2 Algorithms and data structure			✓
		5.3 Programming and testing the system			✓
		5.4 Mobile applications development			✓
6	**Communication and networks**	6.1 Computer networks	✓		
		6.2 Principles of Internet operation	✓		
		6.3 Protocols	✓		

Note:

* exclude the following learning objectives 12.5.1.2, 11.5.1.3, 11.5.1.4.

** apply only the following learning objectives 12.5.1.2, 11.5.1.3, 11.5.1.4.

2.2 Description of External Summative Assessment papers

Paper 1. Theory fundamentals	**90 minutes**
Written paper. Learners answer a range of between eight and fourteen compulsory short-answer structured questions for 70 marks. These questions assess the learner's knowledge, understanding (AO1), analysis and application (AO2).	
70 marks - 35% of total marks	
Paper 2. Solution design	**90 minutes**
Written paper. Learners answer a range of between five and ten compulsory structured questions for 70 marks. These questions assess the learner's knowledge, understanding (AO1), application, analysis (AO2) and practical skills (AO3).	
70 marks - 35% of total marks	
Paper 3. Problem-solving and programming skills	**120 minutes**
Written paper. Learners answer a range of between five and ten compulsory structured questions for 60 marks. Learners write answers in a programming language or pseudocode. These questions assess the learner's knowledge, understanding (AO1), application, analysis (AO2) and practical skills (AO3).	
60 marks - 30% of total marks	

2.3 Assessment Objectives

AO1	**Knowledge and understanding** Learners should be able to: • understand and explain the characteristics of computer systems (hardware, software and communication); • demonstrate understanding of the main principles of solving problems using computers; • describe and explain the need of using various forms of data capture and processing; • use appropriate concepts and terminology in the description of computing processes; • describe the social, legal, ethical issues when using computers.
AO2	**Application and analysis** Learners should be able to: • apply knowledge and understanding to solve problems; • create a model to test hypotheses; • use the system development life cycle when solving a problem; • recognise and present information in a variety of forms; • use models to develop computer solutions to problems; • write program code using programming language; • comment on the social, legal, ethical and other consequences of the use of computers.

AO3	**High-level skills** Learners should be able to: • analyse the problem and determine the appropriate solution; • select, justify and apply appropriate techniques and principles to develop data structures and algorithms for the solution of problems; • create program code for the given / specific problem using appropriate programming language; • apply modelling skills to develop computer-based solutions to problems; • design and evaluate an effective solution.

2.4 Balance of marks

The balance of marks for each paper and for the assessment as a whole is shown in the table below:

Assessment Objectives	Paper 1	Paper 2	Paper 3	Total
AO1	45	15	5	**65**
AO2	25	25	20	**70**
AO3	0	30	35	**65**
Total	**70**	**70**	**60**	**200**

The skills shown in AO1 require a clear understanding of how computer systems function, and of how programmed solutions can address user-defined problems, before they can successfully demonstrate evidence of the application of understanding in AO2 and link knowledge and understanding to practical skills in AO3.

2.5 Language of assessment

The language of assessment is English.

3 Administration

All assessments must be conducted in compliance with all security measures in accordance with the Instruction on arranging and conducting External Summative Assessment of academic achievements of Nazarbayev Intellectual Schools' learners. The Instruction contains the following main points:

- examination materials and their safety;
- duties of teachers, invigilators and examination administrators;
- preparation of classrooms and materials for the examination;
- preparation of appropriate classrooms for written and practical examinations.

4 The Marking process

The marking process is carried out by the Examiners' Committee, which includes the Principal Examiner, Team Leaders and Examiners. To mark each examination work, groups of Examiners are formed, that are led by Team Leaders.

During the marking, all Examiners use the same version of the Mark Scheme. The Principal Examiner and Team Leaders selectively check papers marked by Examiners to ensure the correct application of the Mark Scheme and the objectivity of the evaluation.

5 The Grading Process

The grades will be A*, A, B, C, D and E, where A* is the highest grade and E is the lowest passing grade.

Grade U ('ungraded') will not represent a pass in a syllabus.

A learner's syllabus Grade will be calculated directly from the total of their marks on the components that they took (weighted in accordance with the set specifications), not from the component Grades.

The key grades identified in the Test Specification are Grades A, C and E and Grade Descriptors are provided for these. Awarding Bodies identify key grades for these grades based on professional judgment and learner outcomes. The arithmetic B boundary is set halfway between A and C and, similarly, the grade D boundary is set halfway between C and E.

Grades A *, A, B, C, D and E are translated into the final grades.

5.1 Grade Descriptions

Key Grade Descriptions are provided to give a general indication of the standards of achievement likely to have been shown by learners awarded particular grades. The grade awarded will depend in practice upon the extent to which the learner has met the assessment objectives overall.

Grade	Grade description
A	Learner: • demonstrates a wide knowledge of the subject and has a clear understanding of the principles on which the subject is based and the manner in which it functions. The principles can be applied in both familiar and unfamiliar situations; • applies practical skills to a high standard and has a comprehensive grasp of how computer systems can provide solutions in problem scenarios. Competently designs and documents programmed solutions, presenting evidence in a range of appropriate ways, and evaluates and suggests improvements to ensure the long-term integrity and viability of the solution; • has an extensive awareness of the different effects computing systems may have on individuals when interacting with computing systems in everyday life.
C	Learner: • demonstrates a sound knowledge of the subject and has an understanding of many of the principles on which the subject is based and the manner in which it functions. The principles can be applied most effectively in familiar and occasionally in unfamiliar situations; • applies practical skills to a reasonable standard and has an adequate grasp of how computer systems can provide solutions for problem scenarios. Designs and documents programmed solutions, in most cases presenting evidence in appropriate ways, and evaluates solutions in a straightforward way to enhance the longevity and validity of the solutions; • has a competent awareness of the different effects computing systems may have on individuals when interacting with the computing systems in everyday life.
E	Learner: • demonstrates a basic knowledge of the subject, has a limited understanding of the principles on which the subject is based and the manner in which it functions. The principles are generally only applied effectively in familiar situations; • has a limited grasp of the application of practical skills and how computer systems can provide solutions for real-life scenarios. Partially designs and documents part of a programmed solution. Partially evaluates solutions in a limited way to improve the validity but not the longevity of the solutions; • has a basic awareness of the different effects computing systems may have on individuals when interacting with the computing systems in everyday life.

Nazarbayev Intellectual Schools

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CENTRE NUMBER

CANDIDATE NUMBER

COMPUTER SCIENCE. SPECIMEN PAPER **Grade 12**

Paper 1

1 hour 30 minutes

Candidates answer on the Question Paper.

No additional materials are required.

No calculators allowed. **12CSCI/SP/01**

READ THESE INSTRUCTIONS FIRST

Write your centre number and candidate number in the spaces at the top of the page.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.
You should show all your working.

The total number of marks for this paper is 70.

Answer all questions in English.

For Examiner’s Use	
1	
2	
3	
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5	
6	
7	
8	
9	
10	
Total:	

This document consists of **11** printed and **1** blank page.

1 **(a)** A computer stores real numbers using floating-point representation. The floating-point numbers have:

- eight bits for the mantissa
- four bits for the exponent.

(i) Calculate the denary value of the following floating-point number. Show your working.

Mantissa

0	0	1	0	0	1	1	0

Exponent

0	0	1	1

....

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....

____ [3]

(ii) State why the floating-point number in **a(i)** is **not** normalised.

....

____ [1]

(iii) Give the floating-point number in **a(i)** in normalised two's complement format.

Mantissa

Exponent

[2]

(b) **(i)** Convert the denary number +9.125 into a normalised floating-point number.
Show your working.

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Mantissa

Exponent

[3]

(ii) Convert the denary number −9.125 into a normalised floating-point number. Show your working.

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Mantissa

Exponent

[3]

[Total: 12]

2 A city council uses a computer to control traffic lights.

(a) **(i)** This computer needs an operating system. Name **one** suitable type of operating system.

.... [1]

(ii) State **two** characteristics of this type of operating system.

....

____ [2]

(b) A second computer collects traffic data during the day. This computer processes the data overnight.

(i) This computer needs an operating system. Name **one** suitable type of operating system.

.... [1]

(ii) State **two** characteristics of this type of operating system.

....

____ [2]

[Total: 6]

3 Describe how artificial intelligence capabilities could be used in a medical treatment recommender system.

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____ [2]

[Total: 2]

4 A computer has:

- A 3 GHz CPU
- 4GB of RAM
- A mirrored pair of 512 GB hard disks.

(a) A program needs 6 GB of RAM to run. Explain how it is possible to run theprogram on this computer without increasing the amount of RAM.

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....

____ [2]

(b) The program runs very slowly on this computer. There are two options to upgrade the computer:

- Change the processor to a 3.2 GHz CPU
- Increase the RAM to 8 GB.

Explain why increasing the amount of RAM is the more appropriate option.

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____ [2]

(c) State **two** types of utility programs to improve the performance of the computer and justify your answer.

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____ [4]

[Total: 8]

5 **(a)** A CPU contains registers. Define the term *register*.

....

[1]

(b) Explain the use of a bus in a CPU.

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[1]

(c) Identify **three** features of a RISC processor.

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[3]

(d) Explain how pipelining works when processing instructions.

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[3]

[Total: 8]

6 **(a)** State **four** steps that occur during the Fetch-Decode-Execute cycle.

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.... [4]

(b) Define the term *clock speed*.

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....[1]

(c) Explain how increasing the clock speed can improve the performance of a computer.

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....[2]

(d) Identify **two** other changes that could be made to a computer to improve performance.

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....[2]

[Total: 9]

7 **(a)** Give **two** features of an assembly language.

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[2]

(b) Compare high and low-level languages.

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[4]

(c) There are several stages in the compilation of a program.

Describe what happens during lexical analysis.

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[3]

[Total: 9]

8 **(a)** A school is designing a new network for a classroom.

Draw and label a diagram of the Client-Server Model (CSM) that could be used.

[1]

(b) Give **two** benefits and **two** limitations of the Client-Server Model (CSM).

Benefits ____

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Limitations ____

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____ [4]

[Total: 5]

9 Explain the steps taken to convert the URL (http://nis.edu.kz) to an IP address.

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____ [6]

[Total: 6]

10 **(a)** In a computer network, explain the term default gateway using the terms IP addressand subnet mask.

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____ [2]

(b) How can the ping program be used to help detect network faults?

....

____ [1]

(c) Give two reasons why File Transfer Protocol (FTP) is often described as insecure.

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____ [2]

[Total: 5]

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COMPUTER SCIENCE. SPECIMEN PAPER **Grade 12**

Paper 1

MARK SCHEME

The total number of marks for this paper is 70. **12CSCI/SP/01**

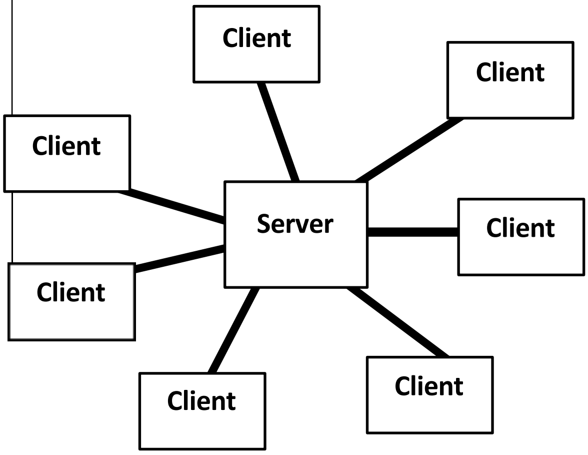
Mark Scheme

Part	Answer	Mark	AO	Further Information
1(a)(i)	Working: □ = 0. 0100110 x 2^3 places // exponent = 3 □ = 1101.11 (moving bp 5) Answer: □ = 2.375	1 1 1 [3]	AO2	2 marks for working 1 mark for correct answer
1(a)(ii)	The first two bits of the mantissa are 0 / the same / not different / are not 01	[1]	AO1	
1(a)(iii)	• Mantissa = 0.1001100 • Exponent = 0010	[2]	AO2	1 mark for mantissa 1 mark for exponent
1(b)(i)	Working: • 01001.001 • 0.1001001 □ 2^4 // showing calculation of exponent = 4 Answer: 0.1001001 0100	[3]	AO2	2 marks for working 1 mark for correct answer
1(b)(ii)	Working: • 10110.111 // 10110111 correct use of two's complement or another method • Exponent = 4 Answer: 10110111 0100	[3]	AO2	2 marks for working 1 mark for correct answer
	Total	12		
2(a)(i)	Real-time (operating system)	[1]	AO1	Allow RTOS
(ii)	Captures rapidly occurring events / data. It immediately processes data and makes decisions in real-time	1 1 [2]	AO1	Allow other suitable answers
(b)(i)	Batch (operating system)	[1]	AO1	
(ii)	No data processing takes place during the day All the data is stored Data is processed in batches	1 1 1 [max 2]	AO1	
	Total	6		

3	The AI system would link to a database of symptoms The AI system prompts the doctor to ask the patient if they have each symptom The AI continues to ask questions Eventually, the questions come to an end and the AI can suggest the illness to the doctor / treatment to give	1 1 1 1 [max 2]	AO2	
	Total	2		
4(a)	The computer uses part of the hard disk as virtual memory Data that is not currently needed in RAM is swapped to the virtual memory, freeing up RAM	1 1 [2]	AO1	1 mark for mentioning the use of hard disk 1 mark for mentioning virtual memory
4(b)	More RAM reduces the amount of swapping (pagefile) Swapping is a very slow process A more cost-effective option (RAM is cheaper to buy than CPUs)	1 1 1 [max 2]	AO1	Must mention removing swapping, need not mention RAM
4(c)	Defragmenter: Used to organise the distribution of data in the hard drive to be more efficient Increases read / write speeds Increases hard drive efficiency. Disc cleaner: It allows users to remove files that are no longer needed or that can be safely deleted. Removing unnecessary files, including temporary files, helps speed up and improve the performance of the hard drive and computer. Virus Scanner: Scans the computer to find and remove malware / viruses which slow down computer work. Protects the computer from viruses replicating themselves Isolates / quarantines viruses once they are found.	1 1 1 1 1 1 [max 4]	AO2	Allow other examples of utility programs
	Total	8		
5(a)	A section of storage (inside the CPU).	[1]	AO1	Accept any suitable description of a register but not just an example

5(b)	Transports bits (inside the CPU) Transfers data between components (inside the CPU)	1 1 [max 1]	AO1	Accept any suitable description of a bus (in a CPU)
5(c)	RISC architectures support a small number of very simple instructions Each instruction is completed in a single clock cycle Individual instructions are executed extremely quickly More instructions are needed to complete a given task RISC architecture requires more registers to provide faster access to data when programs are running less power usage / Less cooling required	1 1 1 1 1 1 [max 3]	AO1	Award 1 mark for each point up to a maximum of 3
5(d)	A CPU completes a Fetch-Decode-Execute cycle Multiple instructions are overlapped in execution The pipeline is divided into stages (fetch / decode / execute) Each stage completes a part of the instruction This happens in parallel	1 1 1 1 1 [max 3]	AO2	Award 1 mark only per point, up to a maximum of 3. Accept step by step description of pipelining For example, one instruction is fetched, while a previous instruction is being decoded, while a third is being executed
	Total	8		
6(a)	Instructions are fetched from an address in main memory / from the operand Data travels along the data bus The instruction is stored in the CPU's register The CPU decodes the instruction The instruction is executed The cycle repeats	1 1 1 1 1 1 [max 4]	AO1	Use data or instructions 1 mark per point up to a maximum of 4
6(b)	The clock speed indicates how fast a CPU can run	1 1	AO1	

	It indicates how many instructions the CPU can execute each second	[max 1]		
6(c)	Increasing the clock speed results in more instructions being processed each second. More instructions can be completed in a given time. The central processing unit (CPU) can retrieve and interpret instructions quicker. The higher number of gigahertz (GHz) in the CPU clock, the more tasks can be done faster.	1 1 1 1 [max 2]	AO1	1 mark for mentioning more number of instructions/operations/tasks 1 mark for mentioning one-time unit/less time
6(d)	Increase the RAM Use a CPU with more cores Use a CPU with more cache Overclock the CPU Use a hard disk with a faster read-write speed Upgrade HDD to an SSD Install a faster graphics card Install faster RAM	1 1 1 1 1 1 1 1 [max 2]	AO2	Allow other correct changes
	Total	9		
7(a)	Is classed as a low-level language Is written in mnemonics One assembly code instruction represents one machine code instruction Assembly language code resembles the machine code of the processor. Assembly code is converted to machine code using an assembler.	1 1 1 1 1 [max 2]	AO1	Award 1 mark per point up to a maximum of 2 marks
7(b)	**Indicative content** **Low Level** Close to machine code. Is faster to process as closer to machine code and produces faster programs Complex to understand Code written is often specific for a CPU Usually used to write programs for hardware **High Level** Closer to human language Slow to process Uses abstraction Can be run on many machines and different	 1 1 1 1 1 1 1 1 1	AO2	1 mark per comparison, must make a comparison or contrast up to a maximum of 4 marks Comparison can be: Low to high level Or High to low level Candidates cannot score 2 marks by stating the same feature for both low and high-level languages

	types of hardware Usually used to write application software	1 [max 4]		
7(c)	Takes source code from language Written in the form of sentences Creates a table of tokens If it finds an invalid token it generates an error Is the first phase of a compiler Removes white space	1 1 1 1 1 1 [max 3]	AO1	Takes source code from language Written in the form of sentences Creates a table of tokens If it finds an invalid token it generates an error Is the first phase of a compiler Removes white space
	Total	9		
8(a)	 Client Client Client Server Client Client Client Client	[1]	AO2	Accept 1 or more clients
8(b)	**Benefits** Networked peripherals can be shared Users can access data and peripherals from any client All files / data are stored in a central location Backups, updates, and security are all managed centrally **Limitation** Server hardware and setup are expensive Failure in parts of the network can cause issues for other users (less robust) Single point of failure Additional costs may be incurred to employ trained staff to manage the network	1 1 1 1 1 1 1 1 [max 4]	AO1	Award 1 mark for each benefit, up to a maximum of 2 marks. Award 1 mark for each limitation, up to a maximum of 2 marks. Do not award further marks for additional benefits or limitations
	Total	5		
9	The URL is split into sections at the full stops (.)	1	AO1	Accept correct flow charts

	A DNS server processes this URL It then finds the server dealing with .kz That then resolves the server for .edu.kz That then resolves nis.edu.kz The IP address is found	1 1 1 1 1 [6]		
	Total	6		
10(a)	When a host computer needs to send a message to a destination computer with a known IP address, the operating system uses the host's subnet mask and the destination IP address to determine if the destination IP the address is in the same subnet as the host. If the destination IP address is not on the same subnet, messages are sent to the default gateway for forwarding	[2]	AO1	1 mark for explaining subnet, 1 mark for default gateway An answer including only an explanation of default gateway as "used to by host to communicate with other networks" but not referring to subnet should get 1 mark
(b)	Ping sends a packet to a remote computer which will respond to show that it has received the packet	[1]	AO1	Both parts needed for 1 mark
(c)	FTP is insecure because the password is sent in plain text at logon and the data is sent unencrypted.	[2]	AO1	1 mark for plain text password; 1 mark for lack of encryption
	Total	5		

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CENTRE NUMBER							CANDIDATE NUMBER				

COMPUTER SCIENCE. SPECIMEN PAPER **Grade 12**

Paper 2

1 hour 30 minutes

Candidates answer on the Question Paper.

No additional materials are required.

No calculators allowed. **12CSCI/SP/02**

READ THESE INSTRUCTIONS FIRST

Write your centre number and candidate number in the spaces at the top of the page.
Write in dark blue or black pen.
Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.
You should show all your working.

The total number of marks for this paper is 70.

Answer all questions in English.

For Examiner’s Use	
1	
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Total:	

This document consists of **9** printed and **3** blank pages.

1 System Development Life Cycle (SDLC) includes the following phases:

- analysis
- design
- implementation
- testing
- maintenance

(a) Explain what activities include the ***implementation*** phase in SDLC.

....

....

____ [3]

(b) Agile and Waterfall are models of the SDLC. Provide **two** advantages of agile over waterfall model.

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....

....

____ [2]

(c) In the ***analysis*** phase data about the current system has to be collected.
Name **three** data collection methods.

....

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....

....

____ [3]

[Total: 8]

2 A software company is developing a website for the hospital. The website provides the following functionality:

- the doctors can authorize the system.
- the doctors and patients can see information about appointments.
- the patients can authorize to the system.
- the patients can book an appointment.
- the appointments are stored in a database.

(a) Describe **two** hardware and **two** software requirements to develop the system.

....

....

....

....

[4]

(b) The company shows a prototype of the website to the hospital administration.
Explain what a prototype is.

....

[2]

(c) Create a data flow diagram of the system.

[7]

[Total: 13]

3 A company stores details of the products that it sells in a database table. The table has the following definition.

PRODUCT	
Field	**Data type**
ProductID (primary key)	String
Description	String
Price	Decimal

(a) Write a SQL statement that will select the product description and price for all the products that cost more than 5000 tenge.

....

....

____ [3]

(b) The database also has a CUSTOMER table and an ORDER table with the following definitions.

CUSTOMER	
Field	**Data type**
CustomerID (primary key)	String
Name	String
Address	String
Email	String

ORDER	
Field	**Data type**
OrderID (primary key)	String
CustomerID	String
ProductID	String
OrderDate	Date/Time

Explain the meaning of the term *foreign key*. Refer to the **three** tables PRODUCT, CUSTOMER, and ORDER in your answer.

....

....

____ [2]

(c) The company sometimes changes the prices of its products.

(i) Write a SQL statement that could be used to increase the price of all items in the PRODUCT table by 5%.

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....

....

____ [2]

(ii) Write SQL statement to remove Address field from the CUSTOMER table.

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[2]

(d) Write a suitable definition for a new table that allows the company to keep a record of all product prices over time. It should include a composite primary key.

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[2]

(e) Explain the meaning of the following terms in the context of relational databases:

(i) relational

....

....

[1]

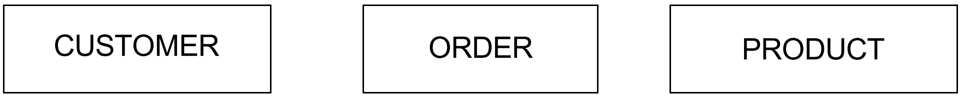
(ii) index

....

....

[1]

(iii) Draw a one-to-many relationship between tables.



[2]

[Total: 15]

4 Software engineer is designing a model of a mobile application for ordering a taxi.

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(a) To authorize the application user must enter the correct password and username. The application allows the user to reenter the username and password up to three times, in case the user enters incorrect data.

The software engineer decided to use a loop structure to solve the problem.

(i) Draw a flowchart of authorizing the application using a loop structure.

[5]

(ii) The following two components have been added to the authorization interface of the taxi ordering app:

- Drop-down list to choose a city.
- Two radio buttons to choose the mode (taxi driver or passenger)

Draw the authorization interface after adding the components.

[7]

For Examiner's Use

(b) After authorization, the user must enter their email address into the application. Write a pseudocode to check the validity of the entered email.

For Examiner's Use

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[7]

(c) Explain how the student can use a trace table to test the pseudocode he wrote.

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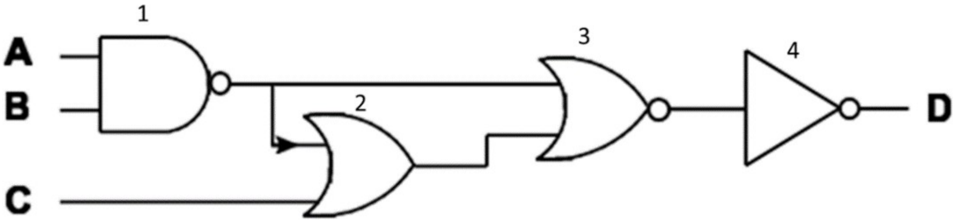
[3]

[Total: 22]

5 Logic circuit is given below.



(a) (i) Write the logical statement for the given logic circuit.

....

____ [4]

(ii) Fill column D in the truth table for the logic gate.
You can use columns 1-4 to help yourself.

A	B	C	1	2	3	4	D
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					
1	1	1					

[4]

(b) Simplify the following logic expression.

$$X . \overline{Y} + \overline{X} + Z$$

....

....

....

....

....

____ [4]

[Total: 12]

AEO “Nazarbayev Intellectual Schools”

COMPUTER SCIENCE. SPECIMEN PAPER **Grade 12**

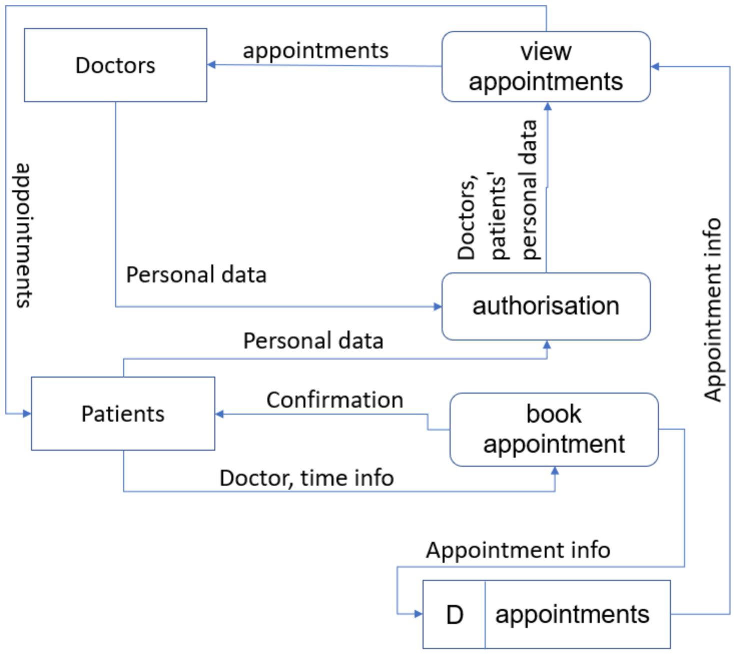
Paper 2

MARK SCHEME

The total number of marks for this paper is 70. **12CSCI/SP/02**

Mark Scheme

Part	Answer	Mark	AO	Further Information
1(a)	Constructing/creating/coding the system Testing the system Constructing/creating the database Building user interface Setting up all packages/libraries/hardware components	1 1 1 1 1 [max 3]	AO2	
1(b)	• Is a very realistic approach to software development. • Suitable for fixed or changing requirements • Delivers early partial working solutions. • Good model for environments that change steadily. • Enables concurrent development and delivery within an overall planned context. • Little or no planning required. • Easy to manage. • Gives flexibility to developers.	1 1 1 1 1 1 1 1 [max 2]	AO1	
1(c)	Interview Observation Survey Focus groups Secondary research Questionnaires	1 1 1 1 1 1 [max 3]	AO1	Accept any other reasonable answer
	Total	**8**		
2(a)	**Hardware requirements:** Web server Router Modem **Software requirements:** Integrated development environment Antivirus Database management system	1 1 1 1 1 1 [max 4]	AO1	Any other reasonable answer
(b)	A prototype is a model of the final product The prototype does not work but will allow users to seethe way in which it will function It will show screen layouts, menus, forms, etc.	1 1 1 [max 2]	AO1	
(c)	2 marks for two external entities (doctors, patients) 3 marks for three processes (authorisation, view appointments, book appointment) 1 mark for data storage (appointments) 1 mark for showing data flow (authorization details, appointment details, etc.)		AO3	

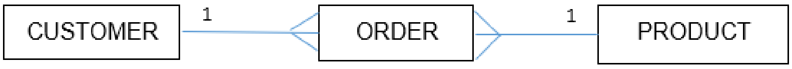
	 Doctors appointments view appointments appointments Doctors, patients' personal data Personal data authorisation Appointment info Personal data Patients Confirmation book appointment Doctor, time info Appointment info D appointments	[7]		
	Total	**13**		

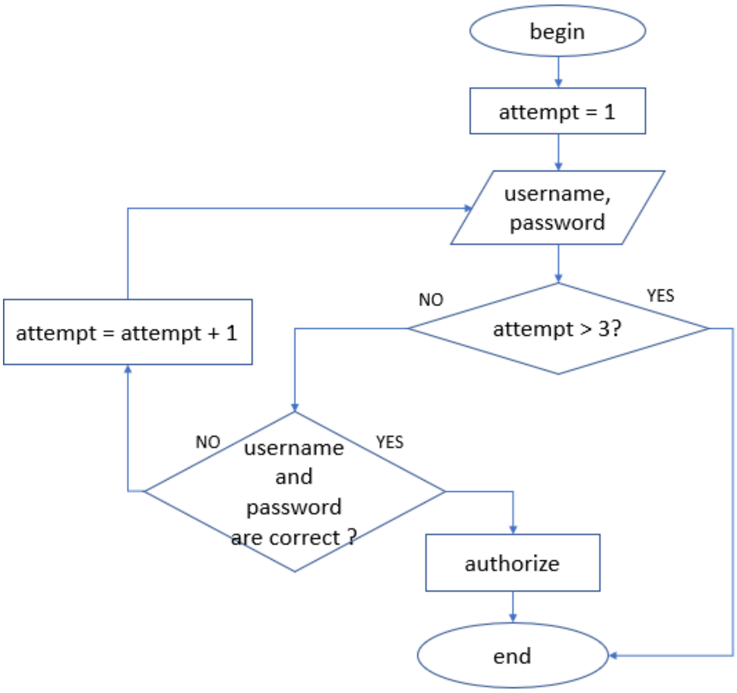
3(a)	SELECT Description, Price
	FROM PRODUCT
	WHERE Price > 5000
		1
		1
		1
		[3]
			AO3	1 mark for correct fields (no mark for *)
				Check each row (SELECT, FROM, WHERE)
				Accept SQL statements written in lowercase
				Also accept SELECT Price, Description FROM PRODUCT WHERE Price > 5000

3(b)	A primary key from one table used to identify a record in a second table is called a foreign key. CustomerID and ProductID in the ORDER table are foreign keys linking to the CUSTOMER and PRODUCT tables.	1 1 [2]	AO1	1 mark for stating that the foreign key links 2 tables 1 mark for identifying the specific keys (need to refer to all 3 tables in the answer)

3(c)(i)	UPDATE PRODUCT
	SET Price = Price * 1.05
		[2]	AO3	1 mark for update
				1 mark for set criteria

3(c)(ii)	ALTER TABLE Customers DROP COLUMN Address;	1 1 [2]	AO3	1 mark for alter table 1 mark for drop

3(d)	**PRODUCT_PRICE(** StartDate(Date/time), ProductID(String), Price(Double)**)** StartDate and ProductID can be used as a composite primary key.	1 1 [2]	AO2	The table name is not important 1 mark for structure (can show a composite primary key in the table definition) 1 mark for a composite key Field names are not important as long as they are clear (e.g. accept PriceStartDate, BeginDate, etc) Accept Decimal/Float for Price Don`t accept fields without data type
3(e)(i)	Relational means that the database comprises multiple tables / entities which are linked / related / joined to other tables.	1 [1]	AO1	
3(e)(ii)	An index links values stored in a table to their physical location in the database which makes it quicker to find data. An index links a value stored in a specific field or combination of fields in a table to the physical location of one or more records, which makes it quicker to find and sort records.	1 1 [max 1]	AO1	
3(e)(iii)		[2]	AO2	1 mark for each correct relation
	Total	**15**		

4(a)(i)	 begin attempt = 1 username, password NO YES attempt > 3? attempt = attempt + 1 NO YES username and password are correct ? authorize end	[5]	AO3	1 mark for input login and password 1 mark for counter (attempt) 1 mark for checking valid loginand password 1 mark for checking counter(attempt)>3 1 mark for authorize block Accept any other reasonable answers, e.g. with two separate input or decision blocks for login and password.
4(a)(ii)	1 mark for a username input component 1 mark for a password input component 1 mark for submit button 1 mark for a dropdown list of cities 1 mark for radio button for taxi driver mode 1 mark for radio button for taxi passenger mode 1 mark for labels	[7]	AO2	

4(b)	`flag1 ← false`
	`flag2 ← false`
	`FOR i ← 1 TO LENGTH(EMAIL) DO`
	`   IF EMAIL[i] = '@'`
	`      flag1 ← true`
	`      FOR j ← [i+1] TO LENGTH (EMAIL) DO`
	`         IF EMAIL [j] = '.'`
	`            flag2 ← true`
	`         ENDIF`
	`      ENDFOR`
	`   ENDIF`
	`ENDFOR`
	`IF (flag1 = true and flag2 = true)`
	`   OUTPUT 'email is valid'`
	`ENDIF`
		[7]	AO3	1 mark for initializing the counter/ flag
				1 mark for the outer loop
				1 mark for the inner loop
				1 mark for checking the symbol «@».
				1 mark for checking symbol «.».
				1 mark for checking the flags
				1 mark for the output

4(c)	A trace table shows the values of each variable at each stage of the process The steps of the algorithm are manuallyfollowed The variables in the table are updated to showthe result of each step	1 1 1 [3]	AO2	
	Total	**22**		
5(a)(i)	$D = \overline{\overline{((\overline{AB} + C) + \overline{AB})}}$	[4]	AO2	1 mark for each gate

<table>
<tr><td>5(a)(ii)</td><td><table><tr><th>A</th><th>B</th><th>C</th><th></th></tr><tr><td>0</td><td>0</td><td>0</td><td></td></tr><tr><td>0</td><td>0</td><td>1</td><td></td></tr><tr><td>0</td><td>1</td><td>0</td><td></td></tr><tr><td>0</td><td>1</td><td>1</td><td></td></tr><tr><td>1</td><td>0</td><td>0</td><td></td></tr><tr><td>1</td><td>0</td><td>1</td><td></td></tr><tr><td>1</td><td>1</td><td>0</td><td></td></tr><tr><td>1</td><td>1</td><td>1</td><td></td></tr></table></td><td>[4]</td><td>AO2</td><td>1 mark for each 2 correct filled rows</td></tr>
<tr><td>5(b)</td><td>$X.\overline{Y}+\overline{X}+Z$
$X.\overline{Y}+\overline{X}+\overline{X}.\overline{Y}+Z$
$\overline{Y}(X+\overline{X})+\overline{X}+Z$
$\overline{Y}(1)+\overline{X}+Z$
Answer: $\overline{Y}+\overline{X}+Z$</td><td>1
1
1
1
[4]</td><td>AO3</td><td></td></tr>
<tr><td></td><td><b>Total</b></td><td><b>12</b></td><td></td><td></td></tr>
</table>

AEO “Nazarbayev Intellectual Schools”

STICK BARCODE HERE

CENTRE NUMBER							CANDIDATE NUMBER				

COMPUTER SCIENCE. SPECIMEN PAPER Grade 12

Paper 3

2 hours

Candidates answer on the Question Paper. No additional materials are required.

No calculators allowed.

12CSCI/SP/03

READ THESE INSTRUCTIONS FIRST

Write your centre number and candidate number in the spaces at the top of the page. Write in dark blue or black pen.
Do not use staples, paper clips, glue or

correction fluid. DO **NOT** WRITE IN ANY

BARCODES.

Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.
You should show all your working.

The total number of marks for this

paper is 60. Answer all questions in

English.

For Examiner’s Use	
1	
2	
3	
4	
5	
6	
7	
8	
Total:	

This document consists of **12** printed pages.

For Examiner's Use

1 Analyse the code snippet below.

Line number	Address	Instruction
1	00	`LDA 16`
2	01	`STA 13`
3	02	`LDA 13`
4	03	`BRZ 10`
5	04	`SUB 14`
6	05	`STA 13`
7	06	`LDA 15`
8	07	`ADD 16`
9	08	`STA 15`
10	09	`BRA 02`
11	10	`LDA 15`
12	11	`OUT`
13	12	`HLT`
14	13	`DAT 00`
15	14	`DAT 01`
16	15	`DAT 00`
17	16	`DAT 03`

(a) State what the code does.

....

....

____ [1]

(b) Identify the line number where the condition is used.

____ [1]

Note: use the table below for an explanation of mnemonics.

Mnemonic	Explanation
`INP`	Retrieve user input and stores it in the accumulator.
`OUT`	Output the value stored in the accumulator.
`LDA`	Load the Accumulator with the contents of the memory address given.
`STA`	Store the value in the Accumulator in the memory address given.
`ADD`	Add the contents of the memory address to the Accumulator
`SUB`	Subtract the contents of the memory address from the Accumulator
`BRP`	Branch/Jump to the address given if the Accumulator is zero or positive.
`BRZ`	Jump to the address given in case the Accumulator is zero.
`BRA`	Jump to the address given.
`HLT`	Stop the code
`DAT`	Used to associate a label to a free memory address. An optional value can also be used to be stored at the memory address.

(c) Complete the trace table.

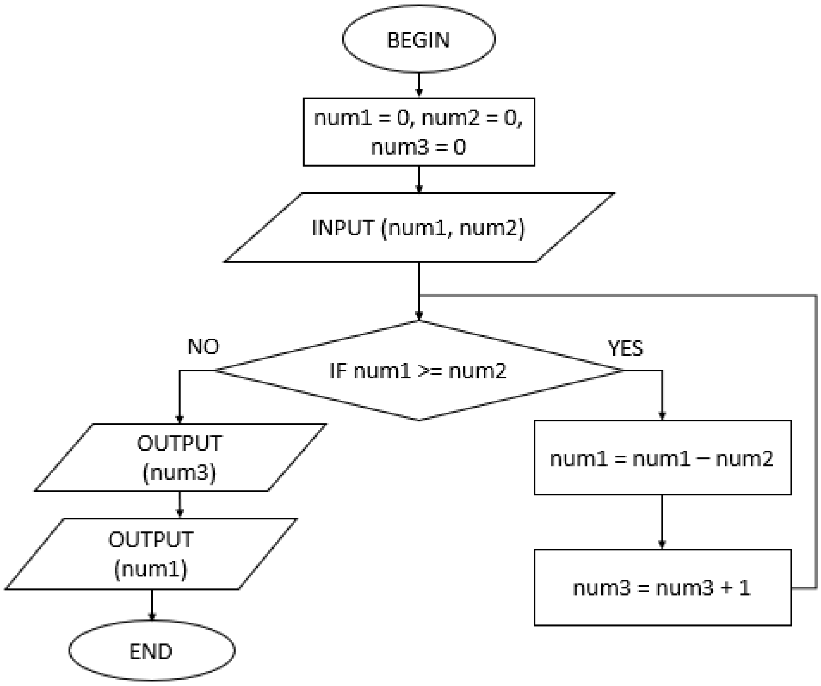
The first instruction has been completed for you.

Instruction address	**Accumulator**	**Memory address**				**Output**
		13	**14**	**15**	**16**	
		0	1	0	3	
00	3					

[4]

[Total: 6]

2 **(a)** Write pseudocode of the algorithm illustrated in the flowchart below.



....

....

....

....

....

....

....

....

....

[3]

(b) Describe the function of the algorithm.

....

....

[2]

[Total: 5]

For Examiner's Use

3 The table below demonstrates a two-dimensional array that stores 5 shopping carts with 10 product ids each.

15	7	19	3	7	11	17	10	12	16
1	11	3	4	9	18	10	5	9	2
6	19	2	18	16	14	17	3	5	10
4	19	12	2	11	15	6	5	16	1
5	14	15	4	17	3	1	8	16	12

Write code/pseudocode to find the frequency of each product id using a one-dimensional array of size 20.

....

....

....

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....

....

....

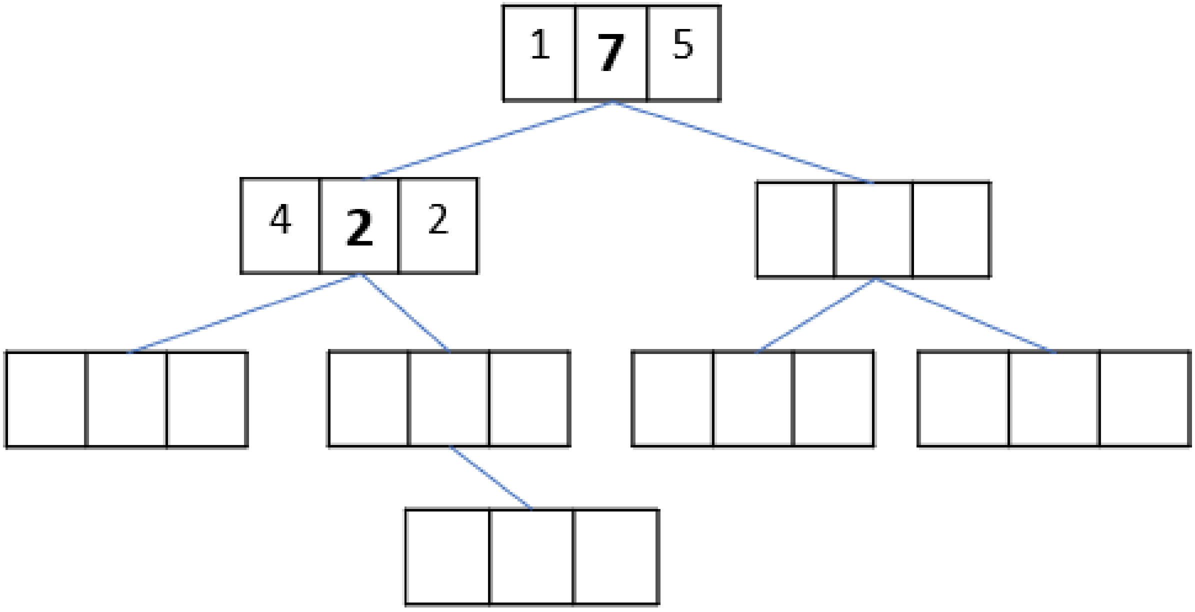
____ [7]

[Total: 7]

4 Fill in the nodes with appropriate data and pointers to create a binary search tree from the given array [7, 2, 3, 5, 1, 9, 8, 11] using the following format:

Left pointer	**Data**	Right pointer

Nodes for 7 and 2 are done for you.



[6]

[Total: 6]

For Examiner's Use

5 The code below represents facts and rules about people.

```
1  occupation(nurbol,musician).
2  occupation(asan, lawyer).
3  occupation(nazira,doctor).
4  occupation(asiya,teacher).
5  occupation(arman,musician).
6
7  is_a(dombyra,musical_instrument).
8  is_a(ukulele,musical_instrument).
9  is_a(cats,pet).
10 is_a(cars,vehicle).
11
12 loves(nurbol,dombyra).
13 loves(asan,cars).
14 loves(nazira,ukulele).
15 loves(asiya,cats).
16 loves(arman,ukulele).
17
18 can_play(X,Y) IF loves(X,Y) AND is_a(Y,musical_instrument).
```

Line number	Meaning
1	Nurbol`s occupation is a musician
7	Dombyra is a musical instrument
12	Nurbol loves dombyra
18	X can play Y if X loves Y and Y is a musical instrument

(a) Write more facts. There is a Dentist Ainur and she loves roses.

....

____ [2]

Using the variable A, the goal
`loves(A, ukulele).`
returns
A = nazira, arman

(b) Write the result returned by the goal
`loves(asiya,B).`

B = ____________________________ [1]

(c) Write the goal to find musicians. Use variable C to complete the task.

____ [2]

(d) Write a rule to represent the following condition:

All who love musical instruments, but are not musicians, can play the musical instrument.
`can_play(X,Y)`

`IF` ________________________________ [6]

(e) Write the result of the following goal.
`can_play(asan,cars)`

____ [1]

[Total: 12]

6 The array `Items[1:70]` stores numbers. A **binary search** algorithm is used to find a sought number.

(a) Complete the pseudocode algorithm for a binary search.

```
INPUT(sought_item)
first ← 0
last ← 70
middle ← int(..........................................................)
counter ← 0
WHILE(sought_item <> ................................. )
   middle ← ..........................................................................................
   IF sought_item > Items[ ........................ ]
      first ← middle
   ELSE:
      last ← .......................................................................................
   counter ← ....................................................................................

OUTPUT("The item is found at index: "+ .................. )
OUTPUT("The Search performed: "+ str(counter)+" comparisons")
```

[7]

Note:
`int` – *function that returns the integer part of the number (quotient) after division.*
For example: *`int (11/2) = 5.`*

(b) **(i)** Work out a number of comparisons for the sought item that is the last item in the array `Items[1:70]`.

.... [1]

(ii) Explain your answer to the question (b)(i).

....

....

.... [3]

(c) Explain what operation has to be performed on the array before applying **binary search**.

....

....

.... [2]

[Total: 13]

7 The picture below illustrates the code of a browser game.

```
1  // Declaring variables
2  var points = 0;
3  var i = 0;
4  var user_num, rand_num;
5  var rounds = prompt("Enter a number of rounds from 1 to 10.
6  ");
7  
8  // Running a loop to count number of rounds.
9  while (i > rounds) {
10    // Prompt user to input a number from a keyboard.
11    user_num = prompt("Enter a number from 1 to 3. ROUND
12 "+(i+1));
13    // Generate random number in range from 1 to 3.
14    rand_num = Math.floor(Math.random() * 3) + 1;
15    // Check if user number is equal to Computer`s random
16 number
17    if (user_num == rand_num) {
18       alert("You guessed the number! ");
19       points = points + 1;
20    } else {
21       alert("You lost the round. The number is: "+rand_num);
      }
      i = i + 1;
   }
```

(a) The code contains a logic error. Write the line number of the error and explain it.

....

....

____ [2]

(b) On line 5 user is prompted to enter a number of rounds in the range from 1 to 10. But, there is no code to check the validity of the entered numbers.

Write a program that prompts the user to enter the number, until the entered number is in the correct range from 1 to 10 using any programming language.

....

....

....

....

____ [3]

[Total: 5]

For Examiner's Use

8 The stack below contains the following values 25, 17, 31, 22.

22	←Top of stack
31	
17	
25	

(a) Show the contents of the stack after completing the operations below.

POP()
PUSH(18)
PUSH(23)
PUSH(14)

[1]

(b) The stack is implemented using one-dimensional array `Items[1:100]`.

Write an algorithm in pseudocode for function `Top,` which returns the index of the top element in the stack when the stack is not empty, otherwise returns -1.

```
FUNCTION Top()
```

....

....

....

....

....

....

....

....

....

....

[5]

[Total: 6]

AEO “Nazarbayev Intellectual Schools”

COMPUTER SCIENCE. SPECIMEN PAPER **Grade 12**

Paper 3

MARK SCHEME

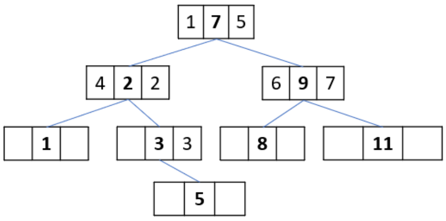
The total number of marks for this paper is 60. **12CSCI/SP/03**

Mark Scheme

<table>
<tr><th>Part</th><th>Answer</th><th>Mark</th><th>AO</th><th>Further Information</th></tr>
<tr><td>1(a)</td><td>Squaring a Number
If input is 3, then output is 9</td><td>1
1
[max 1]</td><td>AO2</td><td></td></tr>
<tr><td>1(b)</td><td>4</td><td>[1]</td><td>AO1</td><td></td></tr>
<tr><td>1(c)</td><td>
<table>
<tr><td rowspan="2">Instruction address</td><td rowspan="2">Accumulator</td><td colspan="4">Memory address</td><td rowspan="2">Output</td><td rowspan="2">Marks</td></tr>
<tr><td>13</td><td>14</td><td>15</td><td>16</td></tr>
<tr><td></td><td></td><td>0</td><td>1</td><td>0</td><td>3</td><td></td><td></td></tr>
<tr><td>00</td><td>3</td><td></td><td></td><td></td><td></td><td></td><td rowspan="10">1</td></tr>
<tr><td>01</td><td></td><td>3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>02</td><td>3</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>03</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>04</td><td>2</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>05</td><td></td><td>2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>06</td><td>0</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>07</td><td>3</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>08</td><td></td><td></td><td></td><td>3</td><td></td><td></td></tr>
<tr><td>09</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>02</td><td>2</td><td></td><td></td><td></td><td></td><td></td><td rowspan="8">1</td></tr>
<tr><td>03</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>04</td><td>1</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>05</td><td></td><td>1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>06</td><td>3</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>07</td><td>6</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>08</td><td></td><td></td><td></td><td>6</td><td></td><td></td></tr>
<tr><td>09</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>02</td><td>1</td><td></td><td></td><td></td><td></td><td></td><td rowspan="8">1</td></tr>
<tr><td>03</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>04</td><td>0</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>05</td><td></td><td>0</td><td></td><td></td><td></td><td></td></tr>
<tr><td>06</td><td>6</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>07</td><td>9</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>08</td><td></td><td></td><td></td><td>9</td><td></td><td></td></tr>
<tr><td>09</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>02</td><td>0</td><td></td><td></td><td></td><td></td><td></td><td rowspan="4">1</td></tr>
<tr><td>03</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>9</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>11</td><td></td><td></td><td></td><td></td><td></td><td>9</td></tr>
</table>
</td><td>1
1
1
1
[4]</td><td>AO2</td><td>All lines have to match to award 1 mark.</td></tr>
<tr><td></td><td>**Total**</td><td>**6**</td><td></td><td></td></tr>
<tr><td>2(a)</td><td>num1 ← 0
num2 ← 0
num3 ← 0
INPUT (num1, num2)
WHILE num1 > num2 DO
    num1 ← num1 – num2
    num3 ← num3 + 1
ENDWHILE
OUTPUT(num3)
OUTPUT(num1)</td><td>[3]</td><td>AO2</td><td>1 mark for both inputs
1 mark for loop/while
1 mark for both outputs</td></tr>
<tr><td>2(b)</td><td>Output a quotient after division
Output a remainder after division</td><td>1
1</td><td>AO3</td><td></td></tr>
</table>

		[2]		
	Total	**5**		

3	ids = [[15,7,19,3,7,11,17,10,12,16],
	[1,11,3,4,9,18,10,5,9,2],
	[6,19,2,18,16,14,17,3,5,10],
	[4,19,12,2,11,15,6,5,16,1],
	[5,14,15,4,17,3,1,8,16,12]]
	
	nums = [0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0]
	
	for i in range(5):
	for j in range(10):
	ind = ids[i][j]
	nums[ind] = nums[ind] + 1
	print(nums)
		1
		1
		1
		1
		1
		1
		1
		[7]
			AO3	1 mark for declaring array to store ids
				1 mark for declaring array (nums) to store frequency of each id
				1 mark for outer loop
				1 mark for inner loop
				1 mark for correct ranges
				1 mark for incrementing nums[ind]
				1 mark for printing result
				
				Accept other reasonable solutions

	Total	**7**		
4		[6]	AO2	1 mark for each correctly completed node.
	Total	**6**		
5(a)	occupation(ainur,dentist). loves(ainur,roses).	1 1 [2]	AO1	
5(b)	B = cats	[1]	AO2	
5(c)	occupation (C,musician) occupation(C,musician).	1 1 [2]	AO3	
5(d)	loves(X,Y) AND is_a(Y,musical_instrument) AND NOT occupation(X,musician).	1 1 1 1 1 1 [6]	AO3	Also can be accepted: can_play(X,Y) :- loves(X,Y), is_a(Y,musical_instrument), \+ occupation(X,musician).
5(e)	False/no	[1]	AO3	
	Total	**12**		

6(a)	middle = int((first+last)/2)
	counter = 0
	while (sought_item != Items[middle]):
	middle = int((first+last)/2)
	if sought_item > Items [middle]:
	first = middle
	else:
	last = middle
	counter = counter + 1
		1
		
		1
		1
		1
		
		1
		1
			AO3	

	print("The item is found in index: "+ str(middle)) print("The Search performed: "+ str(counter)+" comparisons")	1 [7]		
6(b)(i)	7 comparisons	[1]	AO2	
6(b)(ii)	Time complexity of the binary search is (O)log(n) => (O)log(70); 64 < 70 < 128, hence worst case is 2^7; If the first or last elements of the array are sought items, then it`s the worst case.	1 1 1 [3]	AO2	
6(c)	The array has to be sorted in ascending or descending order; The binary search isn`t working with an unsorted array.	1 1 [2]	AO1	
	Total	**13**		
7(a)	Line number: 8 Comparison operator must be changed Variable i equals to 0, hence if the input number is in the range from 1 to 10, the loop will never work.	1 1 1 [max 2]	AO3	
7(b)	while (rounds <1 || rounds >10) {rounds = prompt("Enter a number of rounds from 1 to 10."); } while(rounds <1 || rounds >10) { rounds = prompt("Enter a number of rounds from 1 to 10."); }	1 1 1 [3]	AO3	
	Total	**5**		
8(a)	14 23 18 31 17 25	[1]	AO2	1 mark for the correct stack.

8(b)	`Top ← -1`
	`FOR i ← 0 TO 100`
	`  IF Items[i] <> " " THEN`
	`    Top ← i`
	`  ENDIF`
	`ENDFOR`
	`RETURN Top`
		1
		1
		1
		1
		1
		[5]
			AO3	

	Total	**6**		