2025/4445
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Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2024

Question/Answer booklet

COMPUTER SCIENCE

Place one of your candidate identification labels in this box.

Ensure the label is straight and within the lines of this box.

WA student number: In figures

In words

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time: three hours

Number of additional answer booklets used (if applicable):

Materials required/recommended for this paper

To be provided by the supervisor

This Question/Answer booklet
Source booklet

To be provided by the candidate

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: up to three calculators, which do not have the capacity to create or store programmes or text, are permitted in this ATAR course examination, Mathomat and/or Mathaid and/or any system flowchart template

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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Ref: 24-017
CSC

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of examination
Section One Short answer	21	21	70	108	40
Section Two Extended answer	5	5	110	87	60
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2024: Part II Examinations*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens. Wherever appropriate, fully labelled diagrams, tables and examples should be used to illustrate and support your answers.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question. Where no specific instructions are given, you should feel free to use a range of formats to express your knowledge and understandings.

4. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

5. The Source booklet is not to be handed in with your Question/Answer booklet.

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See next page

Section One: Short answer **40% (108 Marks)**

This section contains **21** questions. You must answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 70 minutes.

Question 1 **(2 marks)**

Write the expected output for the following Python code:

```
def count_numbers():
    print("Let's count!")
    max_count = 5
    for num in range(max_count):
        print(num)
    print("Finished counting!")

count_numbers()
```

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Question 2 **(9 marks)**

(a) Using an example, explain a difference between a primary key and a foreign key in a relational database. (3 marks)

A relational database must enforce the presence of primary keys in its tables.

(b) Describe **one** effect of not having primary keys in tables in a relational database. (2 marks)

(c) Describe **two** factors that influence data integrity in a relational database. (4 marks)

One:

Two:

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Question 3 **(6 marks)**

The table below stores student results for each of their subjects.

Results

ID	Mathematics	Physics	English	Science
S1712001	79.6	85.2	82.1	93.5
S1723487	92.1	76.5	89.3	85.4
S1724121	88.9	80.2	67.8	88.1
S1730886	61.3	54.8	78.2	76.9

(a) List the most suitable data type for each column listed below: (2 marks)

ID: _____

English: _____

(b) Write an SQL query to calculate the average results for each student (identified by ID) across their four subjects. The output should group the results by ID and have two columns: ID and AverageResults. (4 marks)

_____

_____

_____

_____

_____

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Question 4 **(2 marks)**

Describe a zero day vulnerability.

Question 5 **(4 marks)**

Use pseudocode to answer the following question.

Write a function named APPLY_DISCOUNT which takes an input membership_level as a string (e.g. “Bronze”) representing the customer’s membership status. The function should determine the discount percentage based on the membership level as follows:

- No membership (Null): No discount
- Bronze membership: 5% discount
- Silver membership: 10% discount
- Gold membership: 15% discount.

The function should return the discount as a decimal value, using a selection statement based on the membership_level.

See next page

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Question 6 **(5 marks)**

Insertion sort and selection sort are two sorting algorithms.

(a) Describe a scenario where an insertion sort would work faster than a selection sort. (2 marks)

(b) Explain why a selection sort is generally slower than an insertion sort. (3 marks)

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Question 7 **(5 marks)**

A substitution cipher is an early method of cryptography, where each letter in the top row is replaced with the corresponding letter in the bottom row.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
O	Q	H	M	R	N	B	G	V	U	A	X	E	F	K	T	Y	C	P	I	S	W	J	D	Z	L

For example, a plaintext “hello” would be encrypted to a ciphertext “grxxk”.

Note, there is no differentiation between upper-case and lower-case letters, and non-alphabetic characters are not encrypted (i.e. they remain the same).

(a) Encrypt the message “this is a secret message”. (1 mark)

(b) Decrypt the message “FKIGVFB VP NCRR”. (1 mark)

(c) Explain **one** weakness of a substitution cipher. (3 marks)

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Question 8 **(4 marks)**

(a) Describe how a system might authenticate data being sent across a network. (2 marks)

(b) Describe a potential external network security threat of the method described in part (a). (2 marks)

Question 9 **(2 marks)**

Describe **one** way developers ensure that their software addresses inclusivity issues.

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Question 10 **(3 marks)**

Explain why a software developer should be responsible for addressing ergonomic issues in software design.

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Question 11 **(6 marks)**

In some hospitals, patient data is stored digitally. Due to an increasing number of data breach attacks, one hospital decided to let patients carry their own data on a USB drive. The patient must bring the USB drive to all appointments and treatments, where the patient data will be updated by the doctor or other approved user. The data on the USB drive is encrypted.

(a) Outline **three** advantages of this approach in terms of mitigating data breach attacks. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

(b) Outline **three** disadvantages of this approach in terms of mitigating data breach attacks. (3 marks)

One: _____

_____

Two: _____

_____

Three: _____

_____

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Question 12 **(6 marks)**

An algorithm is described below:

Step 1 You are given a number (num)
Step 2 If the number is odd, you multiply it by 3, then add 1 e.g. 7 becomes 22, and increment the step counter
Step 3 If the number is even, you divide it by 2 e.g. 4 becomes 2, and increment the step counter
Step 4 Repeat Steps 2 and 3 until num becomes 1
Step 5 Return the number of steps.

Write the above algorithm in Python programming language and name the function 'step_counter'.

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Question 13 **(11 marks)**

Use Python programming language to answer all parts of this question.

In a zoo management system, each animal has the basic attributes of name, age and habitat. A specific type of animal for example, a bird, has additional attributes such as wingspan.

In the system, the Animal class defines these basic attributes. The Bird class utilises the Animal class's attributes through inheritance. The Bird object can access all attributes, including those inherited from the Animal.

Example attributes for the Bird object:
- Name: Parrot
- Age: 5
- Habitat: Tropical Rainforest
- Wing_Span: 0.25 metres.

(a) Define a class named 'Animal' that has attributes 'name', 'age' and 'habitat'. (3 marks)

(b) Define a class named 'Bird' that inherits from the 'Animal' class and adds one new attribute called 'wing_span'. (3 marks)

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(c) Write a new method, 'display_details', that will print each of the **four** attributes to display their values. (3 marks)

(d) Instantiate a 'Bird' object with all the attributes listed above and display its details. (2 marks)

Question 14 **(3 marks)**

A programmer was doing some testing of logical equivalence using Boolean expressions. Here are some of the expressions tested:

1. (a and b) or not c
2. not (c or not a) and not (c or not b)
3. (not c or a) and (not c or b)
4. (not a or not b) and not c
5. not (not (a and b) and c)

State which **three** of the above Boolean expressions are equivalent.

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Question 15 **(6 marks)**

Identify **two** of the four properties of the acronym ACID and describe a role of each in database transactions.

Property One:

Role:

Property Two:

Role:

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Question 16 **(6 marks)**

A school database includes the following two tables: Students and Courses.
The Students table contains student IDs, names, and enrolled course IDs. The Courses table contains course IDs, course names, and teacher names.

Sample of Data from the Students Table

StudentID	StudentName	CourseID
1	Jack Smith	101
2	Mia Nguyen	102
3	Liam Brown	103
4	Noah Wilson	101

Sample of Data from the Courses Table

CourseID	CourseName	TeacherName
101	Maths	Mrs Taylor
102	English	Mr Pike
103	Science	Ms Johnson

Describe each of the following anomalies and provide an example of each from the tables above. (Assume the database does not enforce referential integrity.)

Insert anomaly:

Delete anomaly:

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Question 17 **(6 marks)**

You were tasked to develop an online educational game named PenTestMountain. It allows up to eight students to play at once and interact with each other, with an option for a supervisor, e.g. a teacher to observe and moderate the game. Due to a fast approaching deadline, you have made a difficult decision to focus on only two good programming practices that you feel will have the most impact on developing the project and ignore the rest of the good programming practices.

List **two** good programming practices that could be chosen and describe why each was chosen.

One: _____

Description: _____

_____

_____

_____

Two: _____

Description: _____

_____

_____

_____

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Question 18 **(5 marks)**

A school is tracking the attendance of a student over a one-week period, Monday through Friday, with six periods each day. The attendance data is stored in a two-dimensional array where each row corresponds to a day and each column corresponds to a period. A True value in the array indicates that the student was present for the period, and a False value indicates an absence.

Write a Python function named count_absences that takes a two-dimensional array attendance_record as an argument. This function should count and return the total number of absences (False values) that the student has accumulated over the week.

The function should count the number of False values in the array and output the total count.

Example Output: Total absences this week: 8
The following attendance data provided for the student over a week.

```
attendance_record = [
    [True, False, True, True, False, True],    # Monday
    [True, True, True, True, True, True],      # Tuesday
    [False, True, False, True, True, True],    # Wednesday
    [True, True, True, False, True, False],    # Thursday
    [True, False, True, True, False, True]     # Friday
]
```

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Question 19 **(3 marks)**

Explain a role of a domain name system (DNS) in relation to the accessing web pages on the internet.

Question 20 **(4 marks)**

Identify a role of a router and a switch. Indicate which layer of the Department of Defence (DoD) transmission control protocol/internet protocol (TCP/IP) model they typically operate on.

Router

Role:

Layer:

Switch

Role:

Layer:

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See next page

Question 21 **(10 marks)**

You have been provided with a sample code in the form of a Python dictionary which contains book information. Each key is the ISBN and each value is another dictionary with details about the book, including its title.

Write a Python function called find_book_title that takes in two parameters: library, the dictionary of books, and isbn_search, the ISBN provided by the user. Your function should search the library for the given isbn_search value and return the title of the associated book.

If the ISBN is not found in the library, your function should return a message saying "ISBN not found in the library."

(a) Complete the incomplete Python script below: (5 marks)

```
# truncated Library dictionary with ISBNs as keys and book information as values
library = {
        '1234567890123': {'title': 'Python Programming', 'author': 'John Doe'},
        '9876543210987': {'title': 'Data Structures', 'author': 'Jane Smith'}
}


def find_book_title(
```

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To add improved functionality to the previous script, validate the ISBN numbers to ensure they conform to the standard format before being processed. An ISBN is considered valid if it contains only numeric characters and meets the required length of either 10 or 13 characters.

Write a Python function named validate_isbn that takes one parameter: isbn_search, a string containing the ISBN entered by the user. Your function should check whether this ISBN is in a correct format, adhering to the following criteria:

- the ISBN is composed entirely of digits (0-9)
- the ISBN is either 10 or 13 characters in length.

The function should return True if the ISBN is valid based on these conditions and False otherwise.

(b) Complete the incomplete Python script below: (5 marks)

```
def validate_isbn( _____
_____
_____
_____
_____
_____
_____
_____
_____
_____
```

End of Section One

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Section Two: Extended answer **60% (87 Marks)**

This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 110 minutes.

Refer to the Source booklet to answer Questions 22 and 23.

Question 22 **(25 marks)**

Refer to the information on Pages 2 and 3 of the Source booklet to answer part (a).

The Equipment booking system has been moved online and an example of the duplicate tutor data set is provided to you.

(a) Using the data from the WA Children's Art Institute's tutor data set, answer parts (i) and (ii).

(i) Explain the purpose of normalising the data to 1st Normal Form (1NF). (3 marks)

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(ii) Explain the purpose of normalising the data from 1st Normal Form (1NF) to 2nd Normal Form (2NF). (3 marks)

Using the data from the WA Children's Art Institute's tutor data set, demonstrate the process of normalising using relational notation.

(iii) Normalise the data to 3rd Normal Form (3NF). (5 marks)

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Question 22 (continued)

Refer to the data provided on page 4 of the Source booklet to answer parts (b) and (d).

The WA Children's Art Institute has introduced a computer-based booking system for the use of the rooms and the equipment carts for the tutors.

The WA Children's Art Institute has made a new room available for use by the tutors.

(b) Write an SQL statement to add the details of the new room to the RoomsTable. It will be the third room in Building 2 and the room is named 'Monet'. (4 marks)

The WA Children's Art Institute wants to analyse the usage of rooms to determine which rooms are the most popular. This will be based on the number of bookings each room has had.

(c) Write an SQL query to display a count of the bookings for each room, using an alias NumberOfBookings. (4 marks)

See next page

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The WA Children's Art Institute wants to further analyse the usage of rooms.

(d) Write an SQL query to show the average duration for all bookings. Ensure the output displays the room name and the average duration in minutes. (6 marks)

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Question 23 **(19 marks)**

Refer to the information on page 5 of the Source booklet to answer Question 23 parts (a) to (e).

(a) Identify the most suitable IP version to use in the scenario. Explain your answer. (4 marks)

(b) Identify and explain which protocol, transmission control protocol (TCP), or user datagram protocol (UDP), would be more suitable for the tutors to use. (4 marks)

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(c) Explain why the WA Children's Art Institute could consider the use of subnetting in their network. (4 marks)

(d) When subnetting, routers can be included into a network. Describe **one** advantage and **one** disadvantage of including routers within a subnetted LAN. (4 marks)

Advantage:

Disadvantage:

(e) Describe a potential network security threat with having a wireless network. State **one** mitigation strategy to address the identified issue. (3 marks)

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Question 24 **(14 marks)**

The WA Children's Art Institute uses databases to store student data. The tutors use their personal laptops to access the available student data, including personal and private data.

(a) Outline **one** external network threat and describe **one** strategy to mitigate this threat. (3 marks)

Network threat: _____

_____

Strategy: _____

_____

_____

_____

A student's private data is viewed by an unauthorised member of the public on a tutor's laptop.

(b) Describe the required actions the WA Children's Art Institute should take in accordance with Australian Privacy Principle (APP 11) to ensure that this does not occur in the future. (2 marks)

_____

_____

_____

_____

The WA Children's Art Institute is exploring the use of symmetric encryption as opposed to asymmetric encryption for sending large amounts of data.

(c) Explain why symmetric encryption is generally preferred to asymmetric encryption for sending large amounts of data. (3 marks)

_____

_____

_____

_____

_____

_____

See next page

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(d) Explain how current best practice in common methods of encryption could benefit the WA Children's Art Institute. (3 marks)

To ensure that the network security the WA Children's Art Institute has implemented is working effectively, they contracted a company to perform penetration testing.

(e) Explain the role of blue team vs red team in penetration testing. (3 marks)

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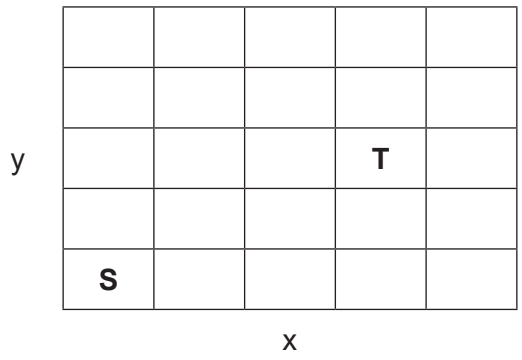
Question 25 **(13 marks)**

You are part of a game development team working on a large-scale project. The application includes a selection of mini-games. One game in particular is a treasure game where pirates hunt for treasure in remote areas of the ocean. During the treasure hunt, players can use a magic crystal ball to determine the direction of the treasure by signalling “left”, “right”, “forward”, “back” or “here”. However, using the crystal ball requires the player to sacrifice one gold coin, making it a costly tool. The aim is to encourage players to use the crystal ball as sparingly as possible.

The crystal ball will always give one of these directions, based on the player’s current location on the map, and it will always give the same direction from the same point. If the crystal ball gives multiple possible directions, “left” and “right” take precedence over “forward” and “back”. The map is structured as an n by n grid, with each cell representing an island on which the treasure could be hidden. The map orientation remains constant.

Consider a 5 x 5 map with the treasure located at a point marked ‘T’, which is represented by an (x, y) coordinate. The T location is not visible to players:



Starting from position (0, 0), marked ‘S’, the sequence to find the treasure is as follows:

1. the crystal ball indicates “right”, and you move to (1, 0)
2. it then suggests “right” again, prompting a move to (2, 0)
3. another “right” leads you to (3, 0)
4. the ball signals “forward”, so you proceed to (3, 1)
5. “forward” is indicated once more; you advance to (3, 2)
6. finally, the crystal ball reveals “here”, and you unearth the treasure.

Using this method, you would reach the treasure in 5 moves, at the cost of 5 gold coins.

(a) This algorithm operates on a map that is n by n in size. Explain how the Big O notation could be used to describe the complexity of this algorithm. (3 marks)

See next page

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(b) Write a function in pseudocode named find_treasure(start, treasure) that will determine the path to the treasure. The function takes **two** parameters: start and treasure. Both are lists containing **two** values representing the x and y coordinates on the grid map. Your function should return a string indicating the sequence of moves to find the treasure using the directions provided by the crystal ball. (10 marks)

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Question 26 **(16 marks)**

You are participating in an apple picking competition. The competition runs as follows:

1. You are given the number of apples on each tree at the beginning of the competition.
2. When the competition starts, you must carry your ladder to the tree of your choice.
3. You pick apples from the tree.
4. Once you finish picking up the apples, you can move your ladder to the next tree of your choice.
5. You have a set number of minutes. However, when the time is up, you are allowed to pick the rest of the apples from the tree you are currently on.

For simplicity, we will assume the time to pick the desired number of apples from a tree is one minute per 10 apples i.e. 0.1 minute per apple, and moving the ladder to another tree takes a constant time of 5 minutes, regardless of what tree you pick.

You have come up with a strategy to win the competition and call this “strategy max”. The strategy is to pick the tree with the most apples first, pick all apples, then move to the next tree with the most apples, and repeat this until the time is up.

The function strategy_max has three parameters:
- trees: is a list of integers representing the number of apples on each tree
- move_ladder: is an integer representing the time (in minutes) to move the ladder to another tree
- time_limit: is an integer representing the length of the competition (in minutes).

The function returns the total number of apples expected to be picked using the devised strategy.

For example, if you are given:
- trees = [15, 20, 50, 30, 40]
- move_ladder = 5
- time_limit = 25

Then using the strategy_max, we will be able to pick 120 apples:
1. Move the ladder to tree with 50 apples -> 5 minutes has passed.
2. Pick 50 apples, taking 5 minutes. -> 10 minutes has passed.
3. Move the ladder to tree with 40 apples -> 15 minutes has passed.
4. Pick 40 apples, taking 4 minutes -> 19 minutes has passed.
5. Move the ladder to tree with 30 apples -> 24 minutes has passed.
6. Pick 30 apples, taking 3 minutes -> 27 minutes has passed, so stop.
7. In total, picked 50 + 40 + 30 = 120 apples.

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(a) Write the function for strategy_max in Python programming language. (12 marks)

def strategy_max(trees, move_ladder, time_limit):

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See next page

Question 26 (continued)

Your competitor has used your strategy algorithm from part (a) on page 35. To avoid the plagiarism being detected, they have decided to modify the strategy a little. The competitor will be selecting trees with the least number of apples. They call this “strategy min”. That is, instead of selecting trees with the largest number of apples, your competitor will select those with the least number of apples first.

It uses the same example above, that is with parameters:

- trees = [15, 20, 50, 30, 40]
- move_ladder = 5
- time_limit = 25.

(b) Calculate the total number of apples the competitor would be able to pick in the competition. Explain why the “strategy_min” results in the total number of apples collected. (4 marks)

Note: that you do not need to write code for the function “strategy_min” to solve this question.

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End of questions

Supplementary page

Question number: _____

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