# HWA CHONG INSTITUTION
# C2 PRELIMINARY EXAMINATION 2025

## COMPUTING
## Higher 2

**15 Sept 2025** **Paper 1 (9569 / 01)** **1400 -- 1700 hrs**

---

**READ THESE INSTRUCTIONS FIRST**

An answer booklet will be provided with this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer ***ALL*** questions.

Approved calculators are allowed.

The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is **100**.

---

This document consists of **6** printed pages.

**1** **(a)** Describe the purpose of Internet Protocol (IP) and state the format of an IPv4 address. [2]

**(b)** Describe **one** disadvantage of packet switching and how the problem can be handled. [2]

**(c)** Explain the term Domain Name Server (DNS) and how it works. [5]

**2** **(a)** An airline website is designed for customers to book air tickets.

**(i)** State the purpose of data validation and give **one** example of how the website implements it on the customers' date of birth. [2]

**(ii)** State the purpose of data verification and give **one** example of how the website implements it on the bookings. [2]

**(iii)** Describe **two** differences between a web application and a native application. [2]

**(b)** Give **two** purposes of using digital signature and describe how it works. [8]

**(c)** Describe how a firewall protects computer networks and one limitation of a firewall. [2]

**3** A system processes user input and performs encoding and validation using character and number representations.

**(a)** The ASCII code (in denary) for the character 'A' is 65.

**(i)** Express 'D' in 7-bit binary. [1]

**(ii)** Express 'D' as a hexadecimal value. [1]

**(iii)** State the range of values that are common to both ASCII and Unicode. [1]

**(b)** A user inputs the number 365, which must be stored in a 7-bit binary format. Explain the problem, and how this could be resolved. [2]

**(c)** Give **one** example of a software or platform that relies on Unicode and explain its benefit in that context. [2]

**4** A collectible toy store sells Libaba figurines that come in many series. Each series is released in a different year, and within a series release, multiple toy figurines may be produced. The following unnormalised table is used to track sales of these toys:

`LibabaSale`

| SaleID | SaleDate | ToyID | ToyName | SeriesName | ReleaseYear | NumSold |
|---|---|---|---|---|---|---|
| S101 | 1/4/2025 | T001 | Polar Pixie | Starborn | 2024 | 1 |
| | | T002 | Misty Mewling | Fairytails | 2025 | 3 |
| S102 | 3/4/2025 | T003 | Nutty Nimlet | Arborealis | 2023 | 1 |
| S103 | 5/4/2025 | T002 | Misty Mewling | Fairytails | 2025 | 2 |
| | | T004 | Jungle Jinx | Arborealis | 2023 | 2 |

**(a)** State **one** data redundancy and **one** anomaly issue present in the `LibabaSale` table above. [2]

**(b)** Identify **one** transitive dependency that exist in the table. [2]

**(c)** Normalise the `LibabaSales` table into Third Normal Form (3NF) and draw the Entity-Relationship (E-R) diagram showing the relationships between the resulting tables. [3]

**(d)** A table description can be expressed as:

```
TableName (Attribute1, Attribute2, Attribute3, ...)
```

The primary key is indicated by underlining one or more attributes. Foreign keys are indicated by using a dashed underline.

Write table descriptions for the tables obtained from part **(c)**. [4]

**(e)** Write an SQL query to display each SeriesName and the total number of Libaba sold, grouped by series and ordered from highest to lowest total. [6]

**(f)** Explain **one** advantage and **one** disadvantage of archiving sales data. Determine whether weekly archiving is appropriate. [4]

**(g)** Explain what constitutes personal data under PDPA and give **two** examples of personal data that the toy shop may have of their customers. [2]

**(h)** What should the toy shop do when attaining personal data from their customers? [2]

**5** A car dealership is building a system to manage its vehicle inventory. The company sells Internal Combustion Engine (ICE) vehicle and Electric Vehicles (EV)**.** They want to store and manage information about each car's key specifications, and allow the system to estimate how far the car can travel based on its current fuel or charge level.

For every vehicle, the following data is recorded:

- `BMY`: the brand, model and year of manufacture of the car
- `mileage`: total distance driven in kilometers
- `trip_mileage`: distance driven since the engine was last started in kilometers
- `estimated_distance`: distance which the vehicle can be driven.

All vehicles reset the `trip_mileage` to zero when the engine of the vehicle starts.

For an Internal Combustion Engine vehicle, the following data is recorded:

- `fuel_capacity`: maximum capacity of fuel in liter
- `current_fuel`: current capacity of fuel in liter
- `fuel_consumption`: distance driven in kilometer per liter of fuel

Each internal combustion engine vehicle resets the `trip_mileage` to zero when the engine of the vehicle starts. The vehicle computes the `estimated_distance`, based on the `fuel_consumption` and the `current_fuel` amount of the vehicle, when it is driven.

For an electric vehicle, the following data is recorded:

- `battery_capacity`: maximum energy the battery can store in kWh
- `current_charge`: current battery level as a percentage of total
- `energy_consumption`: energy used in kWh to travel one kilometer

Each electric vehicle resets the `trip_mileage` to zero and check the `current_charge` value to ensure it is above certain threshold when the engine of the vehicle starts. The vehicle computes the `estimated_distance`, based on the `energy_consumption` and the `current_charge` value of the vehicle, when it is driven.

**(a)** State the purpose of a superclass and subclass. [2]

**(b)** State the purpose of polymorphism. Give **one** example of polymorphism from the vehicle inventory system. [2]

**(c)** Draw a class diagram for the described situation, showing:

- any derived classes and inheritance from the base class
- the properties needed in the base and any derived classes
- suitable methods, in each class, to support the system. [7]

**(d)** State **one** reason for a method of a class to be private. Give **one** example from the vehicle inventory system. [2]

**6** A hash function and associated hash table are commonly used when finding storage space for a new record and searching for a specific record within a data set.

**(a)** State **three** features of an effective hash function. [3]

**(b)** Explain the meaning of a collision in the context of finding storage space for a new record. [1]

**(c)** A method of collision resolution is chaining. Explain what happens when a new record causes a collision and how the search operation works. [3]

**(d)** Explain why the chains, used in chaining, are usually not sorted. [2]

Each node in the chain of the hash table contains the following:

- record – the value of the record
- next – reference to the next node in the chain.

The following pseudocode performs the search on the chain.

```
FUNCTION find_value (head, target)
    current ← head
    WHILE current <> NULL
        IF current.record = target THEN
            RETURN current.record
        ENDIF
        current ← current.next
    ENDWHILE
    RETURN NULL
ENDFUNCTION
```

**(e)** Write in pseudocode the equivalent recursive function `find_value_recursive(node, target)` that performs the same task. [6]

**(f)** State **one** advantage and disadvantage of using recursion in this context. [2]

**7** A binary search tree holds the lower-case words in a piece of text in alphabetical order, together with the number of times each word occurs in the array `bst`. Each element of the array contains four values. `leftPtr` and `rightPtr` are integers, `word` is a string and `frequency` is an integer.

| **leftPtr** | **word** | **frequency** | **rightPtr** |
|---|---|---|---|

The root of the binary search tree is stored in an integer variable, `rootPtr`.
The unused elements of the array are in a free space list that starts from `freePtr`.
The contents of the array `bst` is shown below. –1 represents the null pointer.

| Index | **leftPtr** | **word** | **frequency** | **rightPtr** |
|---|---|---|---|---|
| 0 | 1 | the | 6 | –1 |
| 1 | 2 | man | 1 | 5 |
| 2 | 4 | chased | 3 | 3 |
| 3 | –1 | cow | 2 | –1 |
| 4 | –1 | cat | 2 | –1 |
| 5 | –1 | panther | 1 | –1 |
| 6 | 7 | | | –1 |
| 7 | 8 | | | –1 |
| 8 | 9 | | | –1 |
| 9 | –1 | | | –1 |

| **rootPtr** |
|---|
| 0 |

| **freePtr** |
|---|
| 6 |

An individual value in the array can be accessed in the following format:
`bst[0].leftPtr`

**(a)** Draw the binary search tree represented by the array `bst`. Give the output of the words performing the pre-order traversal. [3]

**(b)** The word, man, is to be removed from the binary search tree. Identify the changes that will be made to any pointers and the contents of the array `bst`. [2]

**(c)** Write a recursive pseudocode function `Search()` that takes the value of `index` and `target` word, and returns `True` if `target` is found in the binary search tree, and `False` otherwise. [4]

**(d)** If, after building a complete tree, all the words had to be printed in order of decreasing frequency. Words with the same number of occurrences are printed in reverse alphabetical order. Describe briefly how this could be accomplished. [4]