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Markscheme

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Computer science

Standard level

Paper 2

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Subject details: **Computer science SL paper 2 markscheme**

Mark allocation

Candidates are required to answer **all** questions in **one** Option. Total 45 marks.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for that part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each statement worth one point has a separate line and the end is signified by means of a semi-colon (;).

- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.

- Words in (…) in the markscheme are not necessary to gain the mark.

- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the markscheme then award the mark.

- Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.

- Remember that many candidates are writing in a second language; be forgiving of minor linguistic slips. In this subject effective communication is more important than grammatical accuracy.

- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**FT**".

General guidance

Issue	Guidance
Answering more than the quantity of responses prescribed in the questions	• In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. • In the case of a "describe" question, which asks for a certain number of facts *eg* "describe two kinds", mark the first two correct answers. This could include two descriptions, one description and one identification, or two identifications. • In the case of an "explain" question, which asks for a specified number of explanations *eg* "explain two reasons …", mark the first two correct answers. This could include two full explanations, one explanation, one partial explanation *etc.*

Option A — Databases

1. (a) (i) *Award up to [1 max]*.
Greater financial control;
Sales analysis;
Better customer services/information; **[1]**

    (ii) *Award up to [1 max]*.
Cost of hardware / hardware maintenance;
Cost of software / software maintenance;
Training cost; **[1]**

  (b) (i) 5; **[1]**

    (ii) *Award up to [2 max]*.
Primary key should be unique for each record;
Many people can have the same name;
So the customer name does not uniquely identify the record (for example
Ann Low); **[2]**

    (iii) A candidate key that has not been chosen/field used for indexing; **[1]**

  (c) SELECT Item_Ordered FROM Customer_Table
WHERE Date ==19/04/15 AND Quantity_Ordered > 5

Award marks as follows, up to [4 max].
Award [1] for selecting correct field from the table.
Award [1] for correct logical operation.
Award [1] for correct date comparison.
Award [1] for correct quantity comparison.
Accept logically equivalent answers. **[4]**

  (d) Reorganize database to be relational;
So that records are accessed/retrieved faster;
Because relational reduces repeated data;
Defragment the disk;
In order to reduce search time;
Normalise the database;
To reduce redundancy; **[5]**

2. (a) *Award up to [3 max]*.
Acts as an interface between the user's view and the way in which data is actually held;
Allows users to store/restore/update information;
Protects database from accidental/deliberate corruption;
Protects from data theft;
Provides the ability to recover database in the event of system failure; **[3]**

(b) *Award up to [2 max]*.
Example answer:
The purpose of normalization is to separate different entities (columns);
To make the most efficient use of space;
And to allow for all possible relationships between data items; **[2]**

(c) *Example answers:*

(i) A table/relation is in 1NF if it does not contain repeating columns/attributes; **[1]**

(ii) A table/relation is in 2NF if it is in 1NF and no column/attribute that is not part of a primary key is dependent on only a portion of the primary key; **[1]**

(iii) A table/relation is in 3NF if every column/attribute is dependent on the key (and nothing but the key)/contains no transitive dependencies; **[1]**

(d)   *Award up to **[7 max]**.*

In the first normal form a primary key identifying the transaction is required

<u>Rental No</u>, HirerID, HName, HPhone, BikeID, TimeOut, TimeIn, BikeMake, BikeModel

*Award **[2]** for identifying the new attribute as a primary key.*
*(Alternatively, award **[2]** for identifying either HirerID and TimeOut or BikeID and TimeOut as a composite key.)*
*Award **[1]** if BikeID and HirerID are used as composite key.*

As there is only one primary key the 2nd Normal form is the same,

<u>Rental No</u>, HirerID, HName, HPhone, BikeID, TimeOut, TimeIn, BikeMake, BikeModel

*Award **[1]** for the same table as in 1NF. Allow FT for the use of composite keys for 1NF.*

In the 3rd Normal form

HIRERTABLE
          (**<u>HirerID</u>, HName, HPhone)**
BIKETABLE
          (**<u>BikeID</u>, BikeMake, BikeModel)**
RENTALTABLE
          (**<u>Rental_No</u>, TimeOut, TimeIn, BikeID*, HirerID*)**

*Award **[4]** for a completely correct answer (including the indication of the foreign keys).*
          *Otherwise award **[1]** for each correct table and **[1]** for the use of foreign keys.*   **[7]**

3. (a) *Award up to [4 max]*.
Logical design will consist of definitions of tables and links between them;
Physical design will consist of implementing these tables with data types needed;

Logical design refers to what database is;
As opposed to how it operates;

Logical design is a detailed description of the database model from the users' perspective;
Whilst physical design specifies exactly how the data will be arranged and stored;

Logical design involves user information needs, analyzing data requirements and logical grouping;
Whilst physical design involves storing this data so it can be retrieved and updated as efficiently as possible;

Logical design should be completed first;
And then the next step is physical design;   **[4]**

(b) *Award up to [3 max]*.
Who owns or is responsible for the data;
What data is available;
Where the data is located;
Data descriptions;
How the data is used;
Access rights / who is allowed to access data;
Etc.   **[3]**

(c) *Award [1] for each responsibility and [1] for the explanation, up to [4 max]*.

Database design;
The DBA participates in the logical and physical phase;

Database implementation/operation;
This involves guiding the use of the database – this includes adding data, deleting data, controlling access to data;

Coordination with users;
Receiving and reviewing user requests for additional support;

Backup and recovery;
DBA is responsible for periodic backups and establishing processes for recovery from failures/archiving;

System security;
This involves assignment of user passwords and controlling users' access to the database;   **[4]**

(d)   *Award marks as follows up to [4 max].*
        Award [1] for identifying an advantage.
        Award [1] for identifying a disadvantage.
        Award [2 max] for a discussion that may focus on usability, performance or privacy.
        For example:

Advantage
All jobs are listed centrally and updated;
All jobs are accessible from one place for the applicants;
Accessible at any time by applicants;
Etc.

Disadvantage
Users' details could get hacked as stored online;
Employers may see details of current employees and know they are thinking of leaving;
Etc.   **[4]**

Option B — Modelling and simulation

4. (a) *Award [1] for clear access to 24 readings.*
Award [1] for "per day".
Award [1] for "per year".
Do not give the first mark if all months are on the same worksheet.
For example:

One worksheet/table for each year;
Each worksheet with a day per column/row;
Hourly readings in row/column; **[3]**

(b) *Award marks as follows, up to [5 max].*
Award [1] for keeping an overall count of days >50.
Award [1] for calculating averages each day.
Award [1] for correct data sent to press.
Award [1] for calculating yearly average.
Award [1] for correct data (including suitable summary of days) sent to EU.
Accept an Excel solution with correct formulae which is illustrated and/or described.

For example:
A count set to zero (could be one count for each sheet – then totalled) at the beginning
of the year
At the end of each day
        average for day calculated
        if >50 add one to count
send to press
At end of year
        calculate overall average
        present averages for each day (table or bar chart)
send to EU together with the overall count

Accept logically equivalent answers. **[5]**

(c) (i) *Award up to [2 max].*
        Averages for winter and summer *etc*;
        Year to year could be looked at;
        Different time of the day;
        Etc. **[2]**

(ii) Introduce times/dates where central heating should (not) be turned on;
        Adjust working/school hours, to change frequency of cars on the road;
        Accept reasonable suggestions that link to a pattern given in (c)(i). **[2]**

(d) *Award up to [5 max].*
Knowing the amount of reduction;
Creating a simulation of future weeks and months;
Based on the pattern so far;
Apply the reduction progressively;
Until satisfactory level achieved;
This would need repeating regularly as figures may not continue to follow the
same pattern;
Award marks for a reasonable strategy that uses current data to make an estimate. **[5]**

5. (a) 2, 5 or 11; **[1]**

(b) A goes to 3, then B to 11, 14 or 15. So move to 11 or 15 to win;
A goes to 6, then B can go to 15 to win;
A goes to 7, then B can go to 11 or 15 to win; **[3]**

(c) (i) *Award up to [2 max]*.
Table / 2-D array;
With i index being row and j index being column;

Represent A/B with two numbers;
One being its row position, one being its column position;
Distinguish between A and B using another variable;
Accept alternative solutions. **[2]**

(ii) *Award marks for answers consistent with the answer in (c)(i), showing A and B to be in correct position.*
For example:
2-D Array, A would be in 1, 2 and B in 3, 2 (accept 2, 1 and 2, 3);
Three variable methods: 0 represents A and 1 represents B, so A is 012 and B is 132;
Etc. **[1]**

(iii) *This will depend on the structure chosen. Award marks as follows:*
Adjacent squares correct in terms of chosen structure with "off board" checked;
If opponent in possible square then check "jump over" square is on board; **[2]**

(iv) For each possible move from above calculate the possible moves for the opponent;
For each possible opponent move, identify all possible moves for next go;
Until player or opponent gets to HOME;
Choose move on shortest winning path; **[3]**

(d) *Award [2] for explaining time taken and [2] for the effect on the game, up to [4 max]*.

The number of possible paths would increase rapidly;
For each extra row and column;
This would mean more processing;
And slow down the game; **[4]**

6. (a) *Award marks for an answer which outlines the relationship between the maps and current inputs. For example:*
The camera and lasers can interpret the immediate surroundings;
Car needs a destination (path to follow);
High definition maps will combine map and input (relate present position to destination); **[2]**

(b) *Award marks that give reference to:*
Detail of environment;
Movement relative to time;
Avoidance of objects;

For example:
The 3D image shows the environment at any instant in time;
With the possibility to distinguish movement;
In relation to previous instant in time;
Hence objects can be avoided using the projected path; **[3]**

(c) Visualization must be in real time;
As car is moving in real time;
Requires massive memory to manipulate multiple images in colour/greater depth; **[3]**

(d) (In theory) they should be safer;
More economical/environmentally friendly than humans – human error eliminated – rules set for safety and economy;
Essential to include fail-safe measures in case of malfunction;
Computers cannot react to unknown situations;
Who is responsible/liable in case of an accident?;
Etc. **[4]**

Option C — Web science

7. (a) The first DVD tag is not closed; **[1]**

   (b) Allows users to add to HTMLs tag set;
By using tags (tag names) of their own choice; **[2]**

   (c) *Award up to [2 max].*
Saves time (for the web designer) as there is no need to add/change formatting to each HTML document;
Because the same CSS file can be applied to many HTML documents;
Because any change in the CSS file can be applied across many documents; **[2]**

   (d) The TCP protocol causes data from the application (browser);
To be divided up into packets;
The IP protocol takes these packets and adds a header to them;
This includes routing information;
Etc. **[4]**

   (e) (i) JavaScript;
Could be used to validate the input data;
eg checking for the @ sign in the email address; **[3]**

      (ii) Less processing is required at the server-side;
So it can handle more requests at the same time / use a less powerful server; **[2]**

   (f) *Award up to [4 max].*
A scripting language is present on the (user's) web page;
This sends the request from the user to the web server;
Where using SQL (to link to the database);
The user's photograph is retrieved;
And returned to the specific section of the web page / And only the photo is reloaded; **[4]**

8. (a) *Award up to [5 max].*
        Lossy compression results in data being lost from a file;
        Positive effect on the user's experience as the time of transmission is reduced/delivery
        is possible;
        Because of smaller file size;
        And the data removed may be irrelevant/not discernible;
        eg Excess detail in a photo (which would not be discernible to the human eye);
        Negative effect on the user's experience if the data removed is significant;
        This outweighs the reduced time of delivery;   **[5]**

   (b) *Crawling:*   Exploration of every link/page in the web;
                      Returning a copy of that page;
        Indexing: Each web page is analysed for key words;
                      After which the page is added to an index;
        Searching: Queries are entered;
                      And the index is searched for matches;   **[6]**

   (c) The ranking produced by the PageRank algorithm is based on examining (the number
        and importance of) back-links;
        A new site will initially have few/none of these;
        So will receive a low ranking;   **[3]**

   (d) *Award up to [3 max].*
        A (search engine's) web-crawler works continuously;
        So new pages will eventually be found;
        As long as they have links from other pages;
        Web-site administrators can notify search engines of any new pages;   **[3]**

9. (a) *Award up to [2 max], [1] for the concept and [1] for a good description, for any two of
        the following:*
        Virtualization that allows the sharing/pooling of resources;
        Use of distributed/grid systems that allows fast communication between the different
        components;
        Self-service interface which allows customers to select required services;
        Scalability which allows rapid increase in services on-demand;   **[4]**

   (b) It might use its own private cloud for holding all sensitive data;
        And for normal operations;
        But use the public cloud when increased computing facilities / network capacity
        is required;
        As over the Christmas period;
        Or in periods of development when temporary extra storage is required;
        Or for its mailing operations;
        As public clouds have dedicated services for this;   **[6]**

Option D — Object-oriented programming

10. (a) *Award [1] for a definition, such as:*
A (special) method (with the same name as the class) that instantiates an object of
that class;

Award [1] for the example:
public Patient(String i, String n, **int** p)   **[2]**

(b) *Award [1] for a field and its data type.*
For example:
String phoneNumber;   **[2]**

(c) *Award [1] for any indication of aggregation.*
Award an additional [1] for a full description.

Example answer:
The WaitingRoom object stores up to 10 instances of the Patient object;
The WaitingRoom **has a** Patient;

Accept a correctly labelled diagram.   **[2]**

(d) *Award marks as follows up to [3 max].*
Award [2] for correct loop, award [1] for loop with one condition.
Award [1] for correct test.
Award [1] for assigning max.

Example answer:
```
    int i=1;
    while ((i<10) && (patients[i]!=null))
    {
      if (patients[i].priority > patients[max].priority)
      {
        max = i;
      }
      i = i+1;
    }
```
                                                                                     [3]

(e) *Award marks as follows up to [6 max].*
Award [1] for including the correct signature.
Award [1] for correct output of patient details.
Award [1] for any loop.
Award [1] for correct loop.
Award [1] for correct assignment to shift a patient instance.
Award [1] for assigning null.

Example answer:
```
    public void remove(int n)
    {
      System.out.println(patients[n].toString());
      for (int i=n; i<9; i=i+1)
      {
        patients[i] = patients[i+1];
      }
      patients[9] = null;
    }
```
                                                                                     [6]

11. (a) *Award [1] for a suitable definition, for example:*
Encapsulation means having private variables;
Variables not directly accessible from outside the class;
Methods and variables are all included in the class definition;

Award [1] for relating an advantage to the Patient class, such as:
So that patient data cannot be accessed/modified accidentally;
So that patient data is more secure;   **[2]**

(b) *Award [1] for identifying an ethical issue and [1] for an elaboration.*
Award [1] for relating this issue to the Treatment class and [1] for an elaboration.

Example answer:
Sensitive information should be separated from identity data;
In order to avoid information misuse;
The consultation object does not include the patient's name (only an ID);
So that a sensitive diagnosis (like AIDS) is not directly linked to a name;   **[4]**

(c) *Award marks as follows up to [3 max].*
Award [1] for including `String name` *with correct getter and setter methods.*
Award [1] for including `String phone` *with correct getter and setter methods.*
Award [1] for including `Boolean present` *with correct getter and setter methods;*

Example answer:

```
Doctor
String name
String phone
Boolean present
setName(String name)
setPhone(String phone)
setPresent(Boolean present)
String getName()
String getPhone()
Boolean getPresent()
String toString()  //optional
```
                                                                                        [3]

(d) *Award [1] for identifying an appropriate need for extended character sets and an additional [1] for an elaboration of this need. Award [1] for relating to the Doctor object.*

Example answer:
Different languages use different characters, which are not included in the basic 8-bit ASCII character set;
Extended character sets (like Unicode) include all possible characters from all languages;
For example, the doctor's name could not be spelled correctly in ASCII;   **[3]**
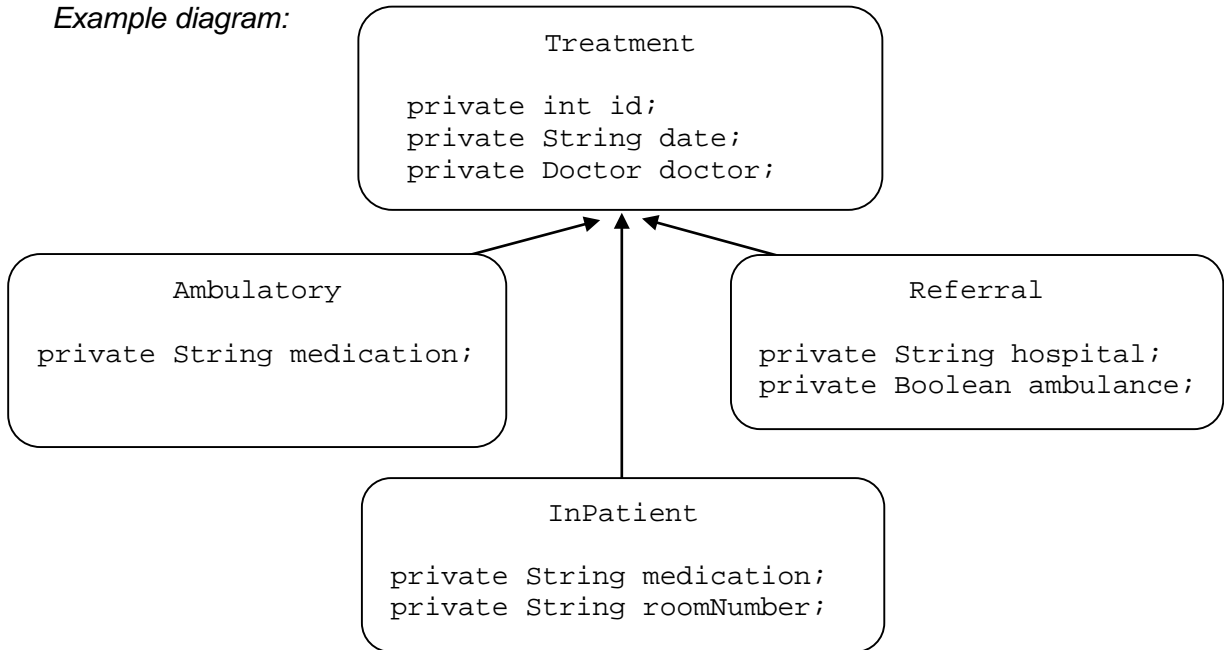
12.   *Award marks as follows up to **[6 max]**.*
*Award **[1]** for correctly initialized method.*
*Award **[1]** for creating a new `Treatment` object.*
*Award **[1]** for loop through treatment file.*
*Award **[1]** for setting `current` equal to next in file.*
*Award **[2]** for correct if statement that checks names.*
*Award **[1]** for correct output statement.*

```
void showMedicationByDoctor(String name)
{
   Treatment current;
   while (treatmentFile.hasNext())
   {
      current = treatmentFile.getNext();
      if (current.getDoctor().equals(name))
      {
         output(current.getMedication());
      }
   }
}
```
[6]

13. (a) *Award marks as follows up to **[6 max]**.*
*Award **[1]** for a common super-class.*
*Award **[1]** for all common fields: `id` field (integer) `date` field (String) `doctor` field (String).*
*Award **[1]** for three sub-classes and award **[1]** for arrows with correct direction.*
*Award **[1]** for the `medication` fields in `Ambulatory` and `InPatient`, but not in `Referral`.*
*Award **[1]** for the additional fields (`Hospital` and `Ambulance`) in `Referral`.*
*Award **[1]** for the additional fields (`RoomNumber` and `ReleaseDate`) in `InPatient`.*

Example diagram:

```
                         Treatment

                  private int id;
                  private String date;
                  private Doctor doctor;


     Ambulatory                              Referral

private String medication;          private String hospital;
                                    private Boolean ambulance;



                         InPatient

                  private String medication;
                  private String roomNumber;
```

Do not penalize if data types are not specified.   **[6]**

(b) *Award **[1]** for identifying each advantage and an additional **[1]** for an elaboration of this advantage, up to **[6 max]**.*

Example answer:
Faster development;
Because different programming teams can work on different modules;

Easier to debug;
Because the smaller modules will have fewer mistakes than one big program;

Easier to update (in the future);
Because it is easier to update a module than the full program;

Re-usability;
Modules can be stored in libraries and reused for different programs;   **[6]**