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MARKSCHEME

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COMPUTER SCIENCE

Standard Level

Paper 2

17 pages

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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

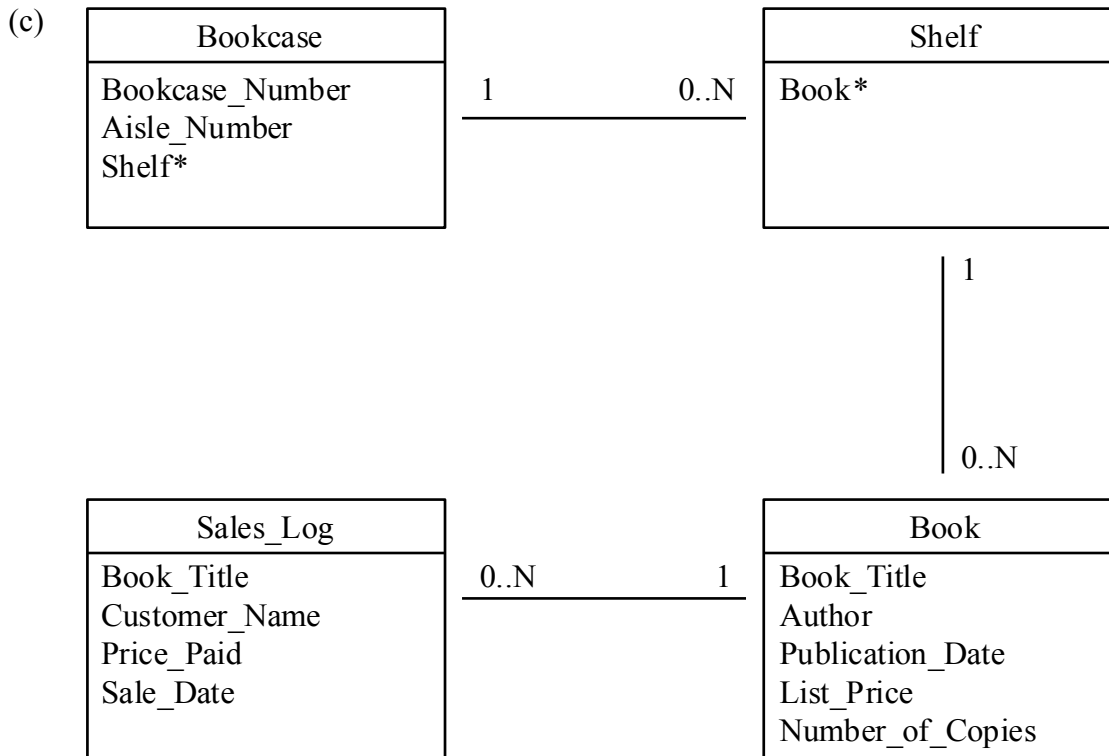| Issue	Guidance
Answering more than the quantity of responses prescribed in the questions	- In the case of an "identify" question read all answers and mark positively up to the maximum marks. Disregard incorrect answers. - In the case of a "describe" question, which asks for a certain number of facts *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) An operation is one of the minimal functions that a database can perform;
While a transaction may consist of multiple operations;
For example a withdrawal might consist of a query to determine the account balance followed by a second query to reduce the account balance;   *[3 marks]*

(ii) If the transaction could not be completed successfully;   *[1 mark]*

(iii) Returns the database to the state before the transaction was started;   *[1 mark]*

(b) *Award [1 mark] each for identifying two reasons, up to [2 marks max].*
Award [1 mark] each for an elaboration that goes beyond simply identifying reasons, up to [2 marks max].

Example:
A database engine provides standardized support for operations such as queries;
It has built-in capabilities for ensuring that transactions succeed;
Easy to sort/retrieve/analyse data;
No redundant data / no data entered twice;
This greatly reduces development time by providing a common platform that developers can reuse in multiple projects;   *[4 marks]*

(c) *Award up to [2 marks max] each for validation and verification, for a total of [4 marks max]. Award [1 mark] for correctly defining the term and [1 mark] for an example.*

Example:
Validation is making sure that the value entered is of the correct type;
For example, the user entered a currency value to deposit and not a date;
Verification is getting confirmation that the value entered is the one intended;
For example, making the user enter the deposit amount twice and ensuring that the entries match;   *[4 marks]*

(d) Isolation refers to the property of having transactions that are performed at the same time, produce the same results as if they were performed sequentially;
In either order;
For example, a deposit of $10 and a withdrawal of $50 should result in the account balance being decreased by $40, regardless of the order or simultaneity of the two transactions;   *[3 marks]*

2. (a) Size: integer;
Price: float;
Maker: String;
Accept reasonable alternatives, eg size could be float or price could be integer.   ***[3 marks]***

(b) Creation of a database;
Manipulation of the database;
Interrogation of the database;   ***[3 marks]***

(c) *Award up to **[2 marks]** for each security feature, up to **[4 marks max]**. For each feature, award **[1 mark]** for identifying the feature and **[1 mark]** for further elaboration.*

Example:
Data Validation;
Ensuring that only data of the correct type is stored in the database: No dates in the balance column, for example;

Access Rights;
Ensuring that users can only access data to which they are authorized: Customer A cannot access Customer B's data, for example;

Data Locking;
Preventing data values from being accessed by a transaction while another transaction involving the same data is in progress;   ***[4 marks]***

(d) *Award up to **[2 marks max]**.*
A data dictionary describes the data in a database;
Its meaning;
Its format;
Its relationship to other data;   ***[2 marks]***

(e) *Award up to **[3 marks max]**.*
The data model is the "blueprint" for the physical database;
Ensure that all data objects required are identified;
Ensure that all data objects are accurately specified;
Provide a description of the database that can be understood/reviewed by customers/end-users;   ***[3 marks]***

3. (a) *Award up to [2 marks max].*
A normalized database is one which minimizes/reduces/eliminates redundancies;
And/or dependencies;
So that manipulation of a field only needs to be performed in one table;   *[2 marks]*

(b) *Award up to [2 marks max].*
Redundant data in a database wastes space;
Creates the potential for inconsistency;
Requires extra work to keep updated;   *[2 marks]*

(c)

Bookcase
Bookcase_Number Aisle_Number Shelf*

1 ——————— 0..N

Shelf
Book*

1
|
0..N

Sales_Log
Book_Title Customer_Name Price_Paid Sale_Date

0..N ——————— 1

Book
Book_Title Author Publication_Date List_Price Number_of_Copies

NOTE: The graphical notation of the ERD is not being evaluated: Only its content.
Award marks as follows, up to [3 marks max].
Award [1 mark] for creating separate tables.
Award [1 mark] for showing three suitable tables.
Award [1 mark] for showing relationships as links between tables.
Award [1 mark] for showing the nature of the relationships.   *[3 marks]*

(d) (i) *Award [1 mark max].*
No primary keys are identified;
The Book column in the Shelf table will be duplicative and/or not atomic;
The Shelf column in the Bookcase table will be duplicative and/or not atomic;   *[1 mark]*

(ii) *Award up to [3 marks max].*
Group the related data into a table;
For example, make a Shelving table with Booktitle, ShelfNumber, and BookcaseNumber rows;
Remove subsets of data that apply to multiple rows in a table;
For example, CustomerName will duplicate the name of a repeat customer for each transaction; *[3 marks]*

(e) *Award [1 mark] for identifying an issue. Award an additional [2 marks] for discussion.*
Customer information might be made available;
Police could identify suspicious reading/purchasing habits;
This may represent a breach of the customer's privacy;
The information may prove unreliable; *[3 marks]*

Option B — Modelling and simulation

4.   (a) $50 \times 1.5 = 75$ mg ;   *[1 mark]*

(b)   *Award [1 mark] for the variables and [1 mark] for the calculation.*
Variables: age, weight, amount;
Calculation: (total amount) = (weight) × (amount per kg for their age group);   *[2 marks]*

(c)   *Award marks as follows, up to [4 marks max].*
Award [1 mark] for correct inputs.
Award [1 mark] for calculating amount.
Award [1 mark] for correct day loop.
Award [1 mark] for correct time loop.

Example:
```
input weight, age
calculate amount
output amount, "to be taken at these times"
loop day from 1 to 10
    output day
    loop time from 0 to 2
        output 8 + time*8
    end loop
end loop
```
                                                                                                     [4 marks]

(d)   (i)   *Award [2 marks] for describing how the software is used and [2 marks] for correct calculations. Spreadsheet is most likely to be used (the only one compulsory in the guide) but accept any suitable software reference.*

Example: (using a spreadsheet, description or illustration)
Construct column headings to show dose number (day and time) and amount of dose given (calculated from age and weight);
Amount in blood at the moment in one (last) column;
First dose entered is the first amount;
From second dose onwards;
(amount) = (first dose) + (0.2 × (previous amount));
Copy down to last dose;

Dose #	Dose Given	Amount in Blood
1	D	= B2
2	D	=B2+0.2*C2
3	D	(copy down)
4	D	etc.

Example: (using Insightmaker.com – a free simulation download)
Set [initial] to dose calculated from weight and age;
Set variable [amount] to initial dose;
Set equation to [initial] + 0.2*[amount];
Number of simulations = 29 (accept 30);
Run simulation to see graph or table of amounts;   *[4 marks]*

(ii)   *Award [1 mark max].*
Input errors that could occur are age category and weight.

Example:
If input age was not within the categories due to mistyping then no dose would be given;
If weight was wrongly measured or rounded then the wrong dose could be given;   *[1 mark]*

(iii)   By measuring medicine levels in the blood at each dosage;
And calculating/checking with the results expected from software;
Errors in the input or in the model can be identified;   *[3 marks]*

5.   (a)   Input the current population. For each successive year, multiply the previous year by 1.07 / increase by 7%;   *[1 mark]*

(b)   *Award up to [3 marks max].*
Change in birth rate;
Change in death rate;
Immigration;
Emigration;   *[3 marks]*

(c)   *Award up to [3 marks max]. Award [1 mark] for each of the factors included in a logical way.*

Example:
Build up percentage change from rise in birth rate;
(Use previous trend figures to change the birth rate over the 10 years;)
Minus the death rate;
(Use previous trend figures to change the death rate over the 10 years;)
Seen from registry;
Immigration – most difficult to predict but could work on figures in similar new towns to give an average number/percentage rise;
Any planned new factories/companies or known redundancies could be factored into immigration/emigration;   *[3 marks]*

(d)   *Award [2 marks] for each source of inaccuracy which is discussed, up to [4 marks max]. A list of four or more which are not elaborated should get no more than [3 marks max].*

Example:
This method assumes that the change in population can be expressed as a combination of factors listed above;
But there are many other factors that have not been included such as economic climate of the country;
It also assumes a ten year span can be calculated on past figures;
Whereas a new town has different population patterns from an established one;
For example the early years could see an influx which stops after a short while/or the opposite – takes time to get established;   *[4 marks]*

(e)   *Award [1 mark] for each consequence identified and [1 mark] for a description,
      up to [4 marks max].*

      Example:
      Predicted population is used to build schools/hospitals;
      If the population is far greater there will not be enough services – if it is smaller
      then too much money will have been invested and the community could have
      economic problems;   *[4 marks]*

6.   (a)   *Award up to [2 marks max].*
               A wire frame is a representation of a 3D object;
               Which shows the structure of the object;
               As a series of vectors (lines) joining the vertices (corners);
               Which are stored in memory;
               And positioned on screen according to the desired view;   *[2 marks]*

         (b)   (i)   *Award up to [1 mark max] for any reasonable example.*
                      For example change a three door car to a five door car;
                      Changing the shape of the car from one form to another;   *[1 mark]*

               (ii)   *Award up to [2 marks max].*
                      Change the points/coordinates;
                      By changing the vectors;
                      Which would change the shape;
                      Lengths and positions of lines change;   *[2 marks]*

               (iii) *Award up to [2 marks max].*
                      By using a graphics pen/mouse;
                      On a touch screen;
                      Entering different coordinates;
                      Sections can be copied from one part to another;   *[2 marks]*

         (c)   *Award up to [2 marks max].*
               Experiment with colour combinations of interior and exterior;
               Change the fabric of the seats;
               Fit different forms of headlights;   *[2 marks]*

         (d)   The wire frame needs to be rendered;
               So that the surface made by joining the lines and points are seen;
               Each time the model is moved or rotated the rendering has to be repeated;
               Colour is also added to show light and shade;
               Ray tracing is one on the techniques that apply a realistic 3D picture;
               By working from a point of presumed light;
               *Accept any other optimization techniques that are outlined including shading,
               rasterization etc.*   *[6 marks]*

Option C — Web science

7. (a) *Award up to [2 marks] for clearly showing the difference between the two. Only award the third mark if a complete answer that is in context (as shown below) is included.*
    The internet is the interconnected networks and communication links that allow data to be transferred between the newspaper's web server and the user's computer in the UK;
    The World Wide Web represents the actual resources held on the various servers that are linked to the internet including the text, video, graphics *etc* held by the newspaper's server;   *[3 marks]*

    (b) *Award up to [2 marks max].*
    Audio clips;
    Video clips;
    Blogs;
    RSS feeds;
    Search facilities;
    Social networking links;   *[2 marks]*

    (c) *(http://www.southafricantimes.com/football/mon/rt)*

    http://
    Identifies the protocol/scheme used (which will determine how the website is accessed);

    www.southafricantimes.com
    Identifies the domain/server;

    /football/mon/rt
    Identifies the specific pathway through the directories to the required file;   *[3 marks]*

    (d) *Award up to [4 marks max].*
    The CGI (is a specification which) allows web pages to be connected to the server's database;
    The form contains a link to a CGI script on the web site;
    This script is a server-side script;
    When the script is executed it uses the option chosen by the user;
    To select the required data from the database;
    This data is incorporated into an HTML page and sent back to the user;   *[4 marks]*

    (e) IP protocol;
    Which determines the number of bits used to represent an address;
    And increasing the number of bits increases the number of addresses / mathematical demonstration of this;   *[3 marks]*

8.   (a)   In the HITS algorithm the page is ranked on a combination of its importance as a hub and an authority;
Its value as an authority will depend upon the ranking of the in-links (pages pointing to it);
Its value as a hub will depend upon the ranking of the out-links;
So if high profile scientific magazines (*eg* Nature, Science) have more links to one of these magazines than the other, the page rankings will be different (or similar);
Only award the fourth mark if an example in context (last point above) is given.   *[4 marks]*

   (b)   Lossless compression would be used when no (significant) data can be lost;
As in the delivery of text;
Lossy compression can be used when (certain) images are downloaded;
As reduced resolution may not be noticeable/an issue;   *[4 marks]*

   (c)   This can happen as a result of browsing history being recorded;
For example, the search term "Paris Hilton" for a businessman who travels frequently might produce hotel links;
Whilst someone who regularly accesses society magazines might be linked with the website of this celebrity;
Accept other examples of search terms that could be interpreted in different ways by the search engine depending on the user eg car models or film titles.   *[3 marks]*

   (d)   *Award [1 mark] for each system identified, up to [2 marks max].*
Award [1 mark] for each example, up to [2 marks max].

   Examples:
Grid computing;
Used to share out work amongst different computers, *eg* analyzing astronomical data;
Peer-2-peer networks;
Used for sharing data, *eg* music files;
Also allow answers referring to ubiquitous and mobile computing.   *[4 marks]*

9.   (a)   (i)   Applications are accessed through the internet (and not stored locally);
                    Storage space is accessed online (and not locally);   *[2 marks]*

          (ii) As access to resources is through the browser;
                The user will need to have internet access (Wi-Fi) in order to use (most) resources;
                The user will not be able to use their favourite software;
                As they will be restricted to that provided by the supplier;
                Security issues;
                Files/documents are not directly protected by the user;
                Performance issues;
                Load/response time of an application is dependent on the connection;   *[4 marks]*

     (b)   *Award up to [2 marks] for a well-defined argument for control.*
           Award up to [2 marks] for a well-defined argument against control.
           Award a further [1 mark] for a justified conclusion (based on the arguments presented).

           Examples:
           Positive
           Allows free flow of information;
           Prevents individual countries from exercising censorship;
           Creates equal opportunities for businesses of all sizes;
           Negative
           Subversive information freely available (*eg* bomb making);
           Incorrect information can spread freely (*eg* Twitter);   *[5 marks]*

     (c)   *Award [1 mark] for identifying the particular intellectual property (eg film, music etc).*
           Award [1 mark] for describing a measure that is currently in force.
           Award a further [2 marks max] for a sound evaluation of the success of this measure.

           Examples:
           Theses of university students;
           Sites exist such as *Turnitin* which crosscheck a submitted essay with a database of previously written essays;
           This will return a statistical evaluation of the authenticity of the submitted piece;
           This will generally find examples of plagiarism although it is generally only successful for essays written in the English language;
           Music;
           Some countries now track the movements on peer-2-peer networks to identify individual offenders;
           The number of prosecutions is low, but the publicity may be an important deterrent;
           Illegal downloading still exists extensively, but at the same time record number of legal downloads are taking place, suggesting that an "acceptable" balance may exist;   *[4 marks]*

Option D — Object-oriented programming

10. (a) *Award up to [2 marks max].*
It is the method that instantiates/creates a new object;
It may be used to initialize variables (of the new object);   *[2 marks]*

(b) *Award [1 mark] for identifying an advantage.*
Award [1 mark] for identifying an example.
Award [1 mark] for an elaboration.

Example:
Polymorphism allows an external program to use the same method action on all subclasses;
By allowing overridden functions in child classes to add only the code that is needed for the unique processing of that sub-class;
In this example, the `getWeight()` method returns the weight of each piece of `RollingStock`. In the case of a wagon, the additional computation needed to add the weight of the cargo is added;   *[3 marks]*

(c) *Award [1 mark] for correct UML box.*
Award [1 mark] for correct member variables.
Award [1 mark] for correct member functions.

```
                    Train
-mEngines : Engine[]
-mWagons : Wagon[]
-mEngineCount : int
-mWagonCount : int
-mTrainNumber : int
-mWeight : double
+Train(number : int)
+addEngine(newEngine : Engine)
+removeEngine() : Engine
+addWagon(newWagon : Wagon)
+removeWagon() : Wagon
+getWeight() : double
```

[3 marks]

(d) *Award [1 mark] for correct function declaration line, including* `public`.
Award [1 mark] for returning the correct value.

Example:
```
public int getNumberOfWagons()
{
   return mWagonCount;
}
```
[2 marks]

(e)   *Award [1 mark] for correct function declaration line, including* `public`.
      Award [1 mark] for reducing `WagonCount`.
      Award [1 mark] for return statement.
      Award [1 mark] for returning the correct object.
      Award [1 mark] for checking the value of the counter.

Example:
```
public Wagon removeWagon()
{
  if (mWagonCount > 0 )
  {
    mWagonCount--;
    return mWagons[mWagonCount];
  }
  else
  {
    return null;
  }
}                                                          [5 marks]
```

11.   (a)   *Award [1 mark] for stating an advantage and [1 mark] for a more complete outline, up to [2 marks max].*

Example:
Supports code reuse;
Programmers can select an appropriate object class from the library and not have to design, implement and test it;   *[2 marks]*

(b)   *Award [1 mark] for stating the difference and [1 mark] for describing it, for two differences, up to [4 marks max].*

Example:
Programmers can be specialized;
Some programmers can develop special expertise in testing, while others focus on User Interfaces, *etc*;
Information hiding can be used to reduce module dependencies;
Different programmers can work on different classes independently because the internals of those classes are hidden;
Easier to resolve problems when many heads;   *[4 marks]*

(c)   (i)   String;   *[1 mark]*

      (ii)   int;   *[1 mark]*

      (iii) Boolean;   *[1 mark]*

(d)   It needs to modify the instance variable declarations;
       Change the formal parameters of the constructor;
       Add "get" and "set" methods;   *[3 marks]*

(e)   Inheritance avoids duplicating code in the two new classes;
       The new `DestinationAddress` class will have a member variable to store the
       special delivery instructions;
       The `OriginAddress` class will have a member variable indicating where the
       parcel was collected from;
       They will inherit common attributes from the parent;
       Examples of these;   *[3 marks]*

12. (a)   (i)   *Award [1 mark] for showing the correct engines (7 and 9).*
                    Award [1 mark] for showing the engines in the correct order.

[0]	[1]	[2]	…
7	9		

                                                                                 [2 marks]

         (ii) 2;   *[1 mark]*

         (iii) *Award [1 mark] for showing the correct Wagons (23 and 214).*
                    Award [1 mark] for showing the wagons in the correct order.

[0]	[1]	[2]	…
23	214		

                                                                                 [2 marks]

(b)   *Award [1 mark] for calling `getWeight()` on parent class.*
       Award [1 mark] for adding weight of individual parcels in a loop.
       Award [1 mark] for using correct loop index endpoints.
       Award [1 mark] for returning the correct value.

       Example:
```
public double getWeight()
{
  double totalWeight = super.getWeight();  //  or totalWeight=32000
  for(int i=0; i < mParcelCount; i++)
  {
    totalWeight += mParcels[i].getWeight();
  }
  return totalWeight;
}
```
                                                                                 [4 marks]

(c) *Award **[1 mark]** for intitializing total weight to zero.*
*Award **[1 mark]** for correctly adding the weights of all the engines.*
*Award **[1 mark]** for correctly adding the weights of all the wagons.*
*Award **[1 mark]** for returning the correct value.*

Example:
```
public double getWeight()
{
  double totalWeight = 0;
  for (int i = 0; i < mEngineCount; i++ )
  {
    totalWeight += mEngines[i].getWeight();
  }
  for (int i = 0; i < mWagonCount; i++ )
  {
    totalWeight += mWagons[i].getWeight();
  }
  return totalWeight;
}
```
[4 marks]

(d) The compiler can tell which is which;
The compiler checks to see what class of object the method is being invocated on
and therefore choose the correct one;
They are in different classes; *[2 marks]*