

Markscheme

May 2015

Computer science

Higher level

Paper 2

23 pages

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Subject details: Computer science HL paper 2 markscheme

Mark allocation

Candidates are required to answer **all** questions in **one** Option. Total 65 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	<ul style="list-style-type: none"> • 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 <i>eg</i> “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 <i>eg</i> “explain two reasons ...”, mark the first two correct answers. This could include two full explanations, one explanation, one partial explanation <i>etc.</i>

Option A — Databases

1. (a) *Award up to [2 max].*

Data (the booking code) are unorganized/unstructured/unprocessed terms;
Whereas information (hotel's email) is organized/structured/processed data;

OR

Data lacks meaning e.g. on their own data elements, Code, name, room;
Whereas information is interpreted data (the code interpreted by the system) and
has meaning (*eg* email provides meaningful information to the tourist about the
use of the Code); [2]

- (b) *Award up to [2 max].*

*Accept answers that relate to the **scenario** but address the following points.*

- The **minimal step of operation/update** to be performed on a database;
- That guarantees **consistency/integrity** of the database;
- And **recovery** upon failure;

For example:

Minimal set of actions that complete/make the booking;
So that database is accurate/consistent/has integrity;
So that database is updated to prevent others booking room;
So that recovery can be run on failure; [2]

- (c) *Award up to [3 max].*

Accept answers that relate to the scenario but address the following points.

- Modifications on data are made persistent in the database only if the transaction terminates;
- A roll-back operation is performed if a failure occurs prior to termination of the transaction;
- And this keeps the database in the original consistent status;

For example:

*Transactions conform to rules before update to database;
Transactions must complete fully to make the changes permanent/persistent;
Allows roll-back operation in case of failure;
To ensure database is consistent while performing transactions;* [3]

- (d) *Award up to [2 max].*

*An example **must** be seen for the second mark to be awarded.*

(It means concurrent control;)

It says/defines/specifies **how and when** the changes of a process are visible to
concurrent operations;

For example, using **locks** on data to prevent concurrent writing that would lead to
inconsistency as in the case of two people booking the same room; [2]

- (e) *Award up to [6 max].
Award [2] for general technical explanation of benefits of data sharing and [2] for each of at least two plausible examples in the given setting (user, hotel, service provider). The general explanation points may come within the examples.*

General explanation (“What it is”)

Data sharing/replication: all/part of one/several source databases are shared/replicated according to the needs of different user groups;
The information needed by the group is made ‘closer’ to the user;
Hence, less focus on transmission/traffic (expensive or slow or not available or not convenient), but requires more storage space (but storage is cheap);

Tourist

Can quickly/efficiently access;
A wide choice of hotels/offers/prices;

Best Fare

Can efficiently display offers on a wide selection of hotels;
Can develop/extend existing software when new hotels are created;
Can develop/re-use the same application without major modifications;

Hotel

The hotel needs to rely on new applications and increasing speed is an issue (cost/maintenance);
Allowing the sharing of information in the source database gives more visibility to the hotel, making it more competitive;
The hotel can continue to locally operate only on part of the data in the source database, using less advanced software;
Allows hotel to change prices and offers in real-time; [6]

2. (a) *Award up to [2 max].*
Role of strategic importance for an organization and full of responsibilities;
Responsible for performance, integrity, security of the information of the organization, by taking care of;
Management/administration/development/maintenance/redesign/upgrades of the database to ensure security and integrity of data, of their use and access;
And any loss/bad performance implies a loss for the organization;

OR

Ensure performance of the database;
Make changes as required to functions of database;
Make sure data integrity is maintained;
Make sure database is backed up;
Make sure data security is maintained;
Authorizing access to the database;
Coordinating and monitoring use of database; [2]

- (b) *Award up to [2 max].*
It is a data structure that stores metadata;
eg meaning of data/relations among data/labelling and tags such as origin/use/format;

OR

Data Dictionary states the meaning of fields in a data table;
Data Dictionary states why the relationships between tables exists;
Data Dictionary stores information about the meaning of data; [2]

- (c) *Award marks as follows up to [6 max].*
Award [1] for stating why a specified type of user needs a certain type of view, and a further [1] for elaborating, for up to three groups of users.

Database Administrator

Must be able to see everything;
In order to make changes to data/types;

Hospital staff

Will need reading and/or writing access to patient/medicine data;
Will need to edit patient / medicine data;
Administrative role of quantities and orders;
Depending on role/responsibilities;

External hospital staff

Have read-only access to medicine data;
To compare with their own stock (in case of emergencies);

Views allow users to display/extract from the database only selected/filtered information;

And options are available to group/sort/aggregate the records on views;
Useful for different users that may retain more or less valuable the information depending on their use/need;

Examples may include:

needs from the surgeons on site / needs from the administration / needs for emergencies / needs for lending to nearby hospitals. [6]

3. (a) *Award up to [3 max].*
 Keys are not indicated;
 Some attributes are not displaying a value;
 Some values are not atomic (description);
- OR**
- Keys are not indicated;
 As a single order relates to many product codes;
 Rows have blank attributes/cells eg OrderNr, total price;
 Description contains two parts – not atomic; [3]
- (b) *Award up to [3 max].*
 Reduce total data storage;
 Update is easier;
 Easier to protect sensitive information through the use of keys;
 Atomic values in attributes give uniformity in writing queries;
 More complex operations can be implemented more easily by queries on rows/columns; [3]
- (c) *Award up to [2 max].*
 It cannot be a primary key;
 Because the same value is associated to two different orders / Not unique for a primary key; [2]
- (d) *Award up to [2 max].*
 Split the field into two fields;
 One for the type and one for the size; [2]
- (e) *Award up to [3 max].*
*Award [1] for returning **correct first table with key OrderNr.***
*Award [1] for returning **second table with correct composite primary key formed by both OrderNr and ProductCode.***
*Award [1] for **splitting description into two subfields.***

<u>OrderNr</u>	<u>OrderDate</u>	<u>TotalPrice</u>
100	10/10/2014	190.00
101	11/10/2014	190.00
102	11/10/2014	600.00

<u>OrderNr</u>	<u>ProductCode</u>	<u>Description1</u>	<u>Description2</u>	<u>Quantity</u>	<u>UnitPrice</u>
100	WS	Wood	Small	1	30.00
100	WL	Wood	Large	1	80.00
100	PS	Plastic	Small	2	40.00
101	PS	Plastic	Small	1	40.00
101	PM	Plastic	Medium	2	75.00
102	XX	Extra-Strong	Large	3	200.00

[3]

Note: Award partial marks to correct alternative solutions, if primary keys and primary composite keys are clearly indicated so that it is possible to verify the correctness of the tables. No marks awarded to attempted solutions that do not have evidence of keys.

(f) *Award up to [2 max].*
All non-key attributes are dependent on;
All parts of the primary key; [2]

(g) *Award up to [5 max].*
(Step 1: From 1NF to 2NF)
Award [1] for detecting that Description1, Description2 and UnitPrice do not obey the criterion in (f).
Award [1] for correct table with composite key OrderNr+Product Code and one more, non-key, field.
Award [1] for correct table with ProductCode and remaining fields.
Award [1] for removing duplicates in this latter.

(Step 2: From 2NF to 3NF)
Award [1] for verifying that 2NF is already in 3NF (ie all non-key attributes are not dependent on any other non-key attribute).

<u>OrderNr</u>	<u>OrderDate</u>	<u>TotalPrice</u>
100	10/10/2010	190.00
101	11/10/2010	190.00
102	11/10/2010	600.00

<u>OrderNr</u>	<u>ProductCode</u>	<u>Quantity</u>
100	WS	1
100	WL	1
100	PS	2
101	PS	1
101	PM	2
102	XX	3

<u>ProductCode</u>	<u>Description1</u>	<u>Description2</u>	<u>UnitPrice</u>
WS	Wood	Small	30.00
WL	Wood	Large	90.00
PS	Plastic	Small	40.00
PS	Plastic	Small	40.00
PM	Plastic	Medium	75.00
XX	Extra-strong	Large	200.00

[5]

Note: *Accept alternative solutions, for partial marks, provided that there is evidence of the keys/composite keys to verify their correctness with respect to normalisation.*

4. (a) *Award [3 max] as follows.
Award [2] for explanation and [1] for an example.*

Dimensions specify the features according to which the data shall be stored;
One of the dimensions is time;
Another dimension is identified *eg* Type (commercial, individual, trust...),
Location (Region1, Region2,...);
The basic unit of organization is a 3-dimensional cube, that can be linked
together to add more dimensions;

[3]

- (b) *Award up to [3 max].*

The tax data warehouse has comprehensive taxpayer information;
eg business type, business nature, income, geographic location, associations
with other taxpayers, property details;
And taxpayers may be profiled to detect cases of tax fraud or tax non-
compliance;

The data in a data warehouse may be enriched with data from external sources
(census, credit bureau);
And data mining techniques/specific queries may assist in analysing past
behaviours and future trends/expectations;
Possibly the analysis may be drilled down along some dimensions, *eg* the
region/location helping the decision-making process;

[3]

- (c) *Award up to [3 max] as follows.
Award [2] for a general description and [1] for an example.*
Statistical techniques are used to detect outlying data;
That does not fit the assumed model;

Example:

Can be used to predict future trends;
Can be used to infer the parameters where the gap with the model is wider;
And identify/detect events or subset of data;

[3]

- (d) *Award up to [3 max].*

No, because;
A database management system (in the majority of their models) is oriented to
support transactions;
Whereas a data warehouse is oriented to support analysis of subject-oriented
historical collections of data;
The temporal dimension is absent in data in a database management system; [3]

- (e) (i) *Award up to [2 max].*
Data originate from different external sources and have different formats;
And need to be transformed/standardized into a common format;
eg a field “Gender” may have a different number of possible values in
different sources or different range. [2]
- (ii) *Award up to [6 max].*
Award [3] for each of the two required applications.

For **data migration** (from one database to another):

Data are extracted from different sources/locations;
Transformed to make it conform with the target destination;
And loaded in the new system;
The script that implements the ELT process can introduce links
among data, and this is what makes them useful;
eg migration of mail applications (managing attachments, problem of
formats, links to attached files, tags, filters, date);
eg conversion of one database to another one of different type;

To **consolidate historical data** (in a data warehouse):

A data warehouse can be set to collect historical data from several
diverse smaller databases with ETL;
Not all data extracted are necessary for the archive;
Data can be manipulated/filtered/interpreted thinking of their long-
term uses in the data warehouse;
The archive can be cleaned up to remove duplicates/corrupt
information after Transformation;
Eventually the archive is separated from the transactional component
of the system;
This architecture is simpler to maintain *eg* archiving old dispatched
orders for which the return by date has passed by more than one
year;

To **create data marts**:

A data mart can be defined by means of ETL;
A data mart is a “slice” of a data warehouse (with a role comparable
to a view in database);
It can be created at lower costs for the needs of a specific group of
users in a big organization;
eg the marketing department for its business intelligence activities; **[6]**

Option B — Modelling and simulation

5. (a) *Award up to [4 max].*
Group the five samples into “number in sample” and “lengths in sample”;
Record the total number divided by the number of samples as the representative total for that year;
Lengths added and divided by total number as the average length;
Store as data for that year; [4]
- (b) *Award up to [2 max].*
Date;
The number of fish in the lake (*accept “Amount of Fish”*);
(Average) length of fish in the lake; [2]
- (c) *Award [1] for using sample data, [1] for correct calculation and [1] for correct decision up to [3 max].*
For example:
In a spreadsheet, date, estimated number of fish, estimated **average** length would be in columns A – C, one row per year;
Column D could hold % decrease since 5 years ($D6 = 100*(B6 - B1)/B1$);
No license if $D6 < -5$;
No license if $C6 \leq 20$; [3]
- (d) *Award up to [6 max].*
*Award [2] for testing the **effectiveness** of the rules, [2] for how changes could be made if needed.*
By looking at the trend in number of fish;
Change % up or down if needed;
And size should increase or decrease;
Making tolerance bigger or smaller if need be;
*Award [2] for testing the **effectiveness of data collection.***
By sampling more often and comparing for similar yearly results;
By sampling in different places and comparing;
If results are not very different, improve sampling method; [6]

6. (a) *Award [1] for two reasonable factors, up to [2 max].*
For example:
Temperature, precipitation, hours of sunshine, wind speed, wind direction, humidity. [2]
- (b) *Award up to [3 max].*
For example:
Each factor plotted separately;
For one year;
In a bar chart or line graph;
Which would show the time trend;
Accept answers that work on analysing differences. [3]
- (c) *Award up to [4 max]. Accept any reasonable method of analysing the model over time.*
For example:
Displacement measurement would mean keeping measurements over more years;
Fitting a mathematical model to the shape;
And comparing for change in model;
Could be done by “sliding” (translating) the shape or calculating differences between months; [4]
- (d) *Award [2] for advantages, [2] for disadvantages and [2] for consistent conclusion, up to [6 marks max].*
For example:
The advantages are that some external factors (such as carbon emissions) could be examined and possibly rectified;

Knowing in advance that a climate is changing makes it possible to plan for agricultural changes such as crop replacements *etc*;

Can repeat the simulation many times/with altered variables;
Can simulate with historic data to validate model;

A disadvantage is that the predictions may not be correct as other unknown factors are not included;
Cyclic pattern is difficult to include;
Problem is too complex to simulate;

Overall, if it is possible to know about impending changes, as long as these are constantly monitored and updated;
The advantages outweigh the disadvantages since disasters may be prevented; [6]

7. (a) Award **[1]** for the fact that the source comes from (binary) data, **[1]** for changing the format to image.

For example:

Visualization is the transfer of (binary) data in memory;

To an image (visual representation of pixels);

[2]

Note: Do not award marks for answers that are not relevant to Computer Science.

- (b) Award **[1]** for representation of image in colour, **[2]** for explaining the effect of light on an object, **[2]** for transformation by rendering.

All images are represented in memory pixel by pixel or via vector methods;

With associated colour;

A 3D object has varying shades of colour according to the source of light;

Direction of view, reflection;

(Mathematical equations based on angle of view etc;)

Transform each pixel into the appropriate shade of colour;

Hence the object (image) is rendered to give impression of 3D;

[5]

- (c) Since the game is online there is no need for the program to be on the computer. Award up to **[2]** for hardware and **[2]** for software, limited to a total of **[3 max]**.

Software:

Operating system needs to be able to handle fast input/output;

Suitable application programs (Direct X) to handle multimedia;

Hardware:

Fast video card;

Enough hard disk to hold data;

Large RAM;

Efficient sound card;

GPU;

[3]

Note: Answers addressing joysticks/special goggles for augmented reality etc. should not get marks as they play no role here.

- (d) Award **[2]** for advantages, **[2]** for disadvantages and **[1]** for a conclusion, up to **[5 marks max]**.

For example:

Fun / Break from routine activity / Relax;

Possible to meet new friends online;

In some cases develops strategy skills;

Addictive, things that need to be done can get ignored;

Isolation from human contact into an unreal world;

Start confusing reality with virtual world;

As long as addiction is avoided/time spent restricted, participating is harmless and enjoyable/a part of modern life which will not change;

[5]

8. (a) *Award up to [3 max].*
(Each of the hidden units/nodes internal to the system and not on the input/output layer;)
Receive values from the input nodes;
These are multiplied by weights – predetermined values;
And sent to each of the output nodes;
(Combining to form a solution;)
More nodes allows a greater number of possibilities; **[3]**
- (b) *Award marks [2] for similarities, and [2] for differences up to [4 max].*
Both are created using a training set;
And adjusted to meet a predetermined fitness function;

In OCR, most input will resemble the characters defined in the fitness function;
Handwriting excepted;
In speech recognition it is important that the input resembles what was input during the training;
Which may not be the case as voices have more variation than text; **[4]**
- (c) *Award up to [2 max].*
Speech synthesis is ‘only’ text-to-speech;
Natural language generation involves semantics;
(eg generating answers from databases in response to queries.) **[2]**
- (d) *Award up to [4 max].*
Heuristics uses probabilities and supervised learning sets;
Limits the learning to the breadth of the learning sets;

Cognitive approach uses unsupervised learning;
With an attempt to create the appropriate syntax and semantics;
In the way a child learns language; **[4]**
- (e) *Award [2] for inputs, [1] for setting an acceptable value, [1] for setting priorities, [2] for evolving new solutions from old, [1] for finishing when an acceptable level reached, up to [7 max].*

The inputs would need to be a set of constraints;
For example, number of hours for each teacher;
Number of classes – students in class etc;
Put priority on those that must be met;
To create a % corresponding to success;
Create random solutions;
Evolve new solutions from first set, involving methods such as mutation or crossover;
Measure success and repeatedly combine most successful;
Until measure of success is acceptable; **[7]**

Option C — Web science

9. (a) *Award up to [2 max].*
HTML is a programming/scripting/markup language;
HTTP is a protocol/standard; [2]
- (b) *Award [1 max].*
Both are scripting/markup languages;
Both make use of tags/elements; [1]
- (c) XML can use easily identifiable field names for data;
As in the *name* or *species* field; [2]
- (d) *Award up to [2 max].*
The XML code contains records;
Each record contains data identified by field names;
These field names match with the field names in the database; [2]
- (e) *Award up to [2 max].*
It will (successfully) map the URL to an IP address in its own database;
If it cannot, it will pass the request to (a more authoritative) name server;
Returns NXDOMAIN when the requested domain is known to be
unassigned/invalid; [2]
- (f) (i) *Award up to [2 max].*
A protocol is a rule that must be followed (for a certain successful process
to take place);
Whilst a standard is a set of (technical) specifications that should be
followed (to allow for functionality); [2]
- (ii) *Award marks as follows:*
- Protocol:*
Award [1] for identifying a web protocol.
Award [1] for identifying the problem if absent.
Award [1] for discussing this problem with an example.
- Standard:*
Award [1] for identifying a web standard.
Award [1] for identifying the problem if absent.
Award [1] for discussing this problem with an example.
- For example:*
TCP;
If there was no transport protocol;
Packets would be lost;
- HTML;
If there was no standard scripting language for displaying webpages;
Different web browsers may not display all pages;
- Note:** Do not accept answers that only say that “something will not
work”. [6]

10. (a) *Award up to [2 max].*
To give a (rating) value;
For a specific search query/term;
- Note: Do not award marks for a general answer such as “returns/identifies the most popular web page”.* [2]
- (b) *Award up to [2 max].*
The PageRank value of page A;
The number of outlinks from page A; [2]
- (c) *Award up to [2 max].*
The keyword in a meta-tag might have different meanings;
eg “star”;
So a webpage about astronomy might be listed by a search engine when the search query/user was searching for a famous actor;
Even though the page was indexed correctly; [2]
Accept any reasonable examples.
- (d) *Award [2 max] for a good explanation of any example (even if terminology is missing) for up to three examples, [6 max].*
- For example:*
Hidden content;
Extra keywords are hidden in places that are not visible to the user, *eg* text in background colour/off screen/in comment tags *etc*;
- Keyword stuffing;
Repeating the keywords many times in the meta-tags;
- Use of link farms;
Creating/making use of dummy pages that link to your page (to increase the number of inlinks); [6]

11. (a) *Award up to [2 max].*
Audio;
Video;
Picture;
(ie files with colour, sound or movement) [2]
- (b) *Award up to [4 max].*
Open standards are a freely available set of specifications;
For example, the use of (freely available) HTML;
- Interoperability allows different systems to work together;
In the above example, different web browsers can download and read the same web pages / different software systems (eg web server and SQL server) can interact; [4]
- (c) *Award [2 max] for each example, for two examples, up to [4 marks].*
Incorporation of multimedia into web pages;
Which allows users to incorporate videos;
Interactive webpages;
That allows friends to write on their walls etc;
User-generated content;
That allows users to personalize their webpage;
Instant-messaging;
That allows (fast) communication between friends; [4]
- (d) *Full marks can only be awarded if the discussion compares the security issues of both alternatives.*
Award [3 max] if only one alternative has been addressed.
Award [2] for addressing in detail each alternative, [1] for an outline.
Award [2] for a reasoned conclusion for either side.

Cloud storage:

Operations are hidden from the company which could lead to doubts
No company loyalty so not the same level of dedication and care
The cloud operators are professionals in this area – this is what they do
The cloud operators are likely to have the most up-to-date systems

Company storage:

Operations are not hidden from the company
Due to company loyalty a (potential) better level of dedication and care
It is a small company so IT department will be small / not of the highest expertise
No need to continue updating security systems

Example conclusion: Cloud storage has been around long enough to have demonstrated that it is a very secure method of storing your data, so the security concerns are unfounded and the cost savings make it a sensible decision.

OR

The company has data that is extremely sensitive, eg a bank, therefore all security must be kept in house. [6]

12. (a) (i) *Award up to [2 max].*
The nodes represent web pages;
The lines (of the arrows) represent links;
The arrows show the direction of the linkage; [2]
- (ii) *Award up to [2 max].*
Because by following the links;
It is not possible to go to Page A (or Page F) from any of the others; [2]
- (b) **IN**
This contains web pages which only have outlinks;
Such as newly formed pages;
- OUT**
This contains pages which only have inlinks;
Such as reference pages; [4]
- (c) *Award marks as follows, up to [4 max].*
Award [1] for the idea of working through a page looking for page links.
Award [1] for jumping to that page if found.
Award [1] for the idea of returning to the previous page (recursively) if it comes to a dead end.
Award [1] for repeating this process for an extended period of time.
- Example:*
1: return the (current) web page;
2: the algorithm works its way down the page looking for a URL (link to another page);
3: if it finds it, it jumps to that page and repeats steps 1 and 2;
4: if it does not, it returns the previous URL and continues (recursively) from where it left off; [4]

13. Award up to [2 max].

Award [1] for showing that they understand what an ontology is.

Award [1] for giving an example showing the conflict.

Award [1] for showing how the conflict is resolved by the ontology.

Award [1] for indicating that the use of standard tags will enable data to be more easily processed.

An ontology is a standardized form of tagging;

If two different tags for the same file name are used (eg Publisher, Publishing House);

The alternatives will be mapped onto one standard tag (eg Publisher);

If all book publishers used the same tags, the book seller would be able to import data without problems; **[2]**

14. Award up to [6 max].

Award [3 max] for references to technology, and [2] for each ethical issue, up to a maximum of two issues.

Each employee would have a badge (or similar) that would contain a sensor or RFID tag;

That would identify them;

And register their position;

These would wirelessly connect to a central server that tracks their movements;

Examples of ethical issues include:

Employers could argue that as employees are being paid for all of the time that they are at work;

Then they (the employers) have the right to establish exactly where they are in relation to where they should be;

Employees could point to privacy issues;

And that any relationships formed at work with colleagues should not be recorded;

Note: *To gain [2] for an ethical issue, the issue must be both specifically identified and relevant.* **[6]**

Option D — Object-oriented programming

15. (a) *Award up to [4 max].
Award [1] for an advantage and [1] for an elaboration for up to two advantages.*
- Re-use objects/modules across sub-groups;
Which will speed up development;
Work can be split up across the sub-groups;
Which will speed up development;
Sub-groups can re-use objects;
Without having to re-program;
Quicker to test;
As each module is small/independent; **[4]**
- (b) *Award up to [4 max].
Award [1] for an issue and [1] for an explanation stating its importance, for two issues, up to [4 max].*
- Testing;
Of system is extremely important to see that loans, fines, borrowing and rights work correctly;
(Any one of the reasons on the list, not all required)
Acknowledgement of code sources;
Important to avoid any potential legal issues;
Accept other reasonable explanations that clearly refer to ethical aspects for the work of the programmers. **[4]**
- (c) *Award up to [3 max].
By using private for variables for example studentID;
Data can be protected from accidental changes;
From outside the object;* **[3]**
- (d) *Award up to [2 max].
Student newStudent = new Student(93003, "Smith")
Award [1] for Student newStudent
Award [1] for new Student(93003, "Smith").* **[2]**
- (e) *Award up to [3 max].
Static means that the variable is declared once only;
Static variable is a class variable not re-declared in each object;
And not each time an object is created;
The variable represents the number of times a Loan object is created;
And hence is a total of how many books have been borrowed;* **[3]**
- (f) *Award up to [3 max].
ST.addLoan (new Loan(212000, "The Stars"))
Award [1] for ST.addLoan.
Award [1] for new.
Award [1] for Loan (212000, "The Stars").* **[3]**

16. (a) (i) Jones; [1]
 (ii) The Spooks; [1]
 (iii) The Animals; [1]

- (b) *Award up to [7 max].*
Award [1] for correct signature (do not accept non-void/return methods. StudentID must be passed as a parameter).
Award [1] for correct identification of student s.
Award [1] for printing student's name.
Award [1] for correct loop with limit of $i < 10$ or equivalent expressions.
Award [1] for correct identification of current loan.
Award [1] for test on loan.
Award [1] for printout of both Title and Date of the current loaned book.

For example:

```
public void showDetails (int StudentID )
{
    Student s = borrowers[StudentID];
    System.out.println(s. getName());
    for (int i=0; i<10; i++)
    {
        Loan currentLoan = s.getLoan(i);
        if (currentLoan != null)
        {
            System.out.println(currentLoan.getBookTitle());
            System.out.println(currentLoan.getDate());
        }
    }
}
```

[7]

Note: *Award [1] for both final System.out.println statements. Marks are not awarded if methods are used that are not defined or already present in the specification.*

- (c) *Award up to [3 max].*
 There is no way to determine the fines;
 There is no way to differentiate between the short term and long term loan books;
 There is no way to indicate if a student's borrowing rights are suspended;
 Nothing to prevent error or check number of books borrowed [3]

- (d) *Award up to [2 max] for any acceptable description.*

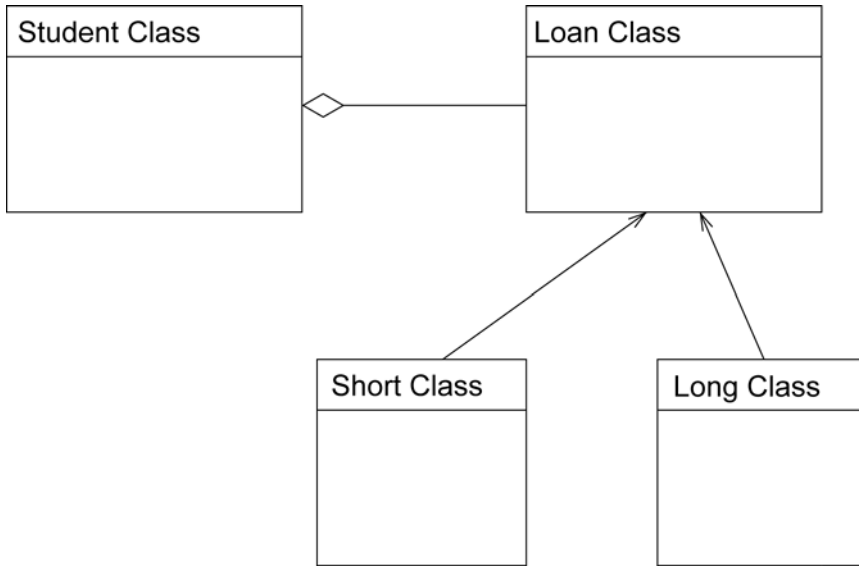
For example:

Add a Boolean variable to represent the borrowing rights;
 Initially set this variable to true;
 The variable is set to true unless rights are suspended when it is set to false;
 etc; [2]

- 17. (a) *Award up to [2 max].*
Inheritance reduces the amount of coding / reduces repetition of code;
By allowing sub-classes to inherit the methods / attributes of their superclass; [2]

- (b) *Award up to [2 max].*
Variable for the fine (per day);
Variable for the borrowing limit;
Variable timeLimit; [2]

- (c) *A suitable diagram will look like this.*



Award [1] for all four correct classes as shown.
Award [1] for showing the links in the correct place (any arrow or line).
Award [2] for distinguishing either with labels (Student has a Loan / Short is a Loan) or use of different arrows for the different relationships between Student–Loan and Loan–Short/Long. [4]

- (d) *Award up to [3 max].*
Add a static count variable;
To the `shortTerm` class and to the `longTerm` class;
A method can be called to display count by adding the two above together; [3]

18. (a) *Award up to [4 max].*
 The books are stored in separate arrays;
 In separate objects;
 These can only be searched using a linear search;
 As no index is available;
 Also, parts of each array will be empty;
 So this would be slow/inefficient; [4]
- (b) (i) *Award up to [2 max].*
 A binary tree;
 Using the book ID as the index; [2]
- (ii) *Award up to [4 max].*
 Every time a loan object is created;
 Book object inserted using bookID;
 The student ID stored also;
 To locate the student ID the binary tree would be searched;
 Using the bookID;
 The studentID returned;
 Used to access the borrowers array to find the student name; [4]
- (c) *Award up to [4 max].*
Award [1] for an advantage and [1] for an elaboration, [1] for a disadvantage and [1] for an elaboration.
- Advantage:**
 There will be less wasted memory;
 As only the required number of locations will be used;
- Disadvantage:**
 It will be slower to locate a specific student;
 As a linear search will be needed compared to direct access with the array; [4]
- (d) *Award up to [6 max]. Award [1] for each correct line of code (shown below; accept equivalents).*
- LinkedList p = new LinkedList ()
 LinkedList head = p.getHead()
 Set temp to head
 Moving through the list
 Recognizing that the last node has been reached
 Setting the shortTerm object to be the last and its pointer to null [6]
-