M14/4/COMSC/HP2/ENG/TZ0/XX/M

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MARKSCHEME

May 2014

COMPUTER SCIENCE

Higher Level

Paper 2

26 pages

General Marking Instructions

1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.

3. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded.**

4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use Scoris™ annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.

5. Personal codes/notations are unacceptable.

6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an "NR" in the mark panel on the right-hand side of the screen.

7. Please ensure you check all scanned pages. The candidate may have answered more than one option. **If the candidate has attempted Option B**, please raise this script as an "exception" (page 73, Scoris guide), choosing "Answer outside of guidance". This will be escalated to your PE to mark. This only concerns Option B, and only because the candidate numbers are relatively low.

8. **If a candidate has attempted more than one Option** within a paper mark all the candidate's work. Scoris™ will only award the marks for the higher scoring Option. Once all the work the candidate has attempted has been marked, please click "COMPLETE"; all the other questions from the other Options will auto complete to "NR" for "no response".

9. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp 'SEEN' on any page that contains no other annotation.

10. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the "CON" stamp.

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	• 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) *Award up to **[3 marks max]**, following this structure:*
Identifies what a database is;
The information system must have a database as a component;
Some expansion on the information system;

Example:
Database is where related data of a particular activity is stored;
Whereas the information system includes the database;
Together with other (hardware and software) components; ***[3 marks]***

(b) Same consistent view of data across all pharmacies at any time;
Centrally updated; ***[2 marks]***

(c) Query function / Requesting information about a product; ***[1 mark]***
(*Do not accept any function that implies writing or changing the data base.)*

(d) The database is accessed by multiple users;
At the same time;
Allowing equal access to the database; ***[3 marks]***

(e) *Award up to **[6 marks max]**.*
*Model answer – **TWO** separate interactions – requests, do not accept any that imply writing on the database.*
What is wanted;
Specific detail about what is wanted;
How the information will be accessed/interacted, technical points: menu option, SQL, QBE etc.;

Example 1:
A **view** of all drugs for influenza could be created;
From a menu bar with a drop down list of options leading to choices of diseases;
Selecting "flu" would give list of all available drugs;

Example 2:
Select "query" from list of options;
Type set of parameters prompted by field names;
symptom = cough age < 12 to give list of possible cough medicines for children;

Example 3:
Create a report from an icon to print out;
Template for report chosen from visual representation;
To print out showing all products from a specific drug company; ***[6 marks]***

2. (a) (i) A Data Base Management System for databases that are represented/related with logical relations; ***[1 mark]***

(ii) The logical structure/blueprint of the data in the entire database; ***[1 mark]***

(b) Structure of records on disk (files/pages/blocks);
Indexes and order of records; ***[2 marks]***

(c) *Award **[1 mark]** for a feature and **[1 mark]** for its importance, up to **[6 marks max]**. (Maximum of **[1 mark]** for mention of normalization – not modelling.)*
Examples:
Data must be modelled knowing the **purpose.**
- Otherwise the data will not do what is required.

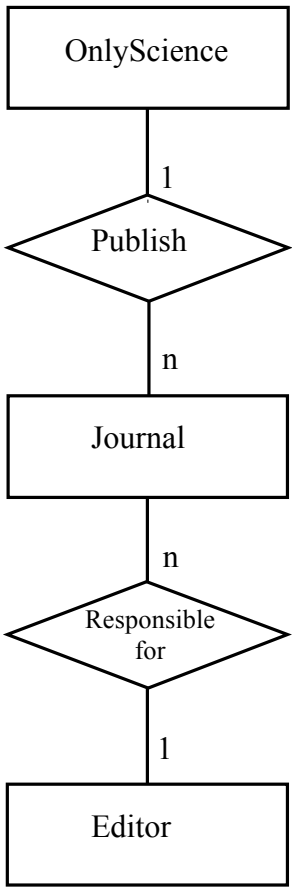
Identify the entities/tables.
- If incorrect they will not support the purpose of the DB.

The attributes of the tables should be necessary and sufficient for purpose.
- Otherwise may get inefficiencies.

The keys for accessing the tables need to be identified.
- Otherwise the user cannot access the data.

Identify the relationships among tables.
- Otherwise the user cannot perform complex queries across several tables.
- Identify relationships and normalization that reduces data duplication ***[6 marks]***

3. (a) *Award **[1 mark]** for correct relation "publish";*
*Award **[1 mark]** for correct relation "responsible for";*
*Award **[1 mark]** for correctly indicating the connections;*



[3 marks]

(b) (i) Unique field or group fields within a table which identify a record ; ***[1 mark]***

(ii) The primary key of another relational schema/table; ***[1 mark]***

(c) Astrophysics; ***[1 mark]***

(d) *Award up to **[5 marks max]** as follows.*
*Award **[1 mark]** for selection of attribute p.phone.*
*Award **[1 mark]** for making the selection across the three tables.*
*Award **[1 mark]** for each correct test for equity. e.g. p.name=a.pers-d **or** equivalent would be awarded **[1 mark]**, up to **[3 marks max]**.*

```
SELECT p.phone
FROM person p, activity a, journal j,
WHERE  p.name = a.pers-id AND a.journal-id = j.title AND
j.number = "Special"
```

Accept reasonable table (QBE) examples such as Access.
*Include graphical solutions with tables, **provided** the sequence of steps for doing this is clear for the markers and not ambiguous.*
Accept descriptions that express similar operations.

For example:
from "journal" select all "titles" with number 'Special'
from "activity" select all "pers_id" with journal_id = "titles"
from "person" list phone where "name" = "per_id" ***[5 marks]***

(e) Data columns are filtered;
By conditions or field/parameter selection;
To display a sub-set of the data; ***[3 marks]***

(f) *Award up to **[3 marks max]**.*
The view is not part of the physical schema;
Hence there is no table corresponding to the view that is physically stored;
The view is defined on a query that operates on physically stored data;
And provides a mechanism for data aggregation (macro); ***[3 marks]***

(g) *Award **[1 mark]** for each correctly generated new table, up to **[3 marks max]**.*
Separate the columns into three tables, to have only one primary key (PK) and avoid, in each new table, dependencies on non-key attributes.
The new tables are

submission
- paper-id (PK)
- editor (FK)

editors
- editor (PK)
- journal-title
- number

reviewers
- paper-id (FK)
- reviewer (PK) ***[3 marks]***

4. (a) Award up to ***[2 marks max]***.
A consolidated repository/store of integrated data from different sources, of different nature;
Collected over long time periods;
Often augmented with some analytic information; ***[2 marks]***

(b) *Award **[1 mark]** for identifying a difference and **[1 mark]** for a description that elaborates, for **two** differences, up to **[4 marks max]**.*

Design purpose;
DB designed for recording records and perform transactions whereas DW is designed for large-scale reporting;

Size of Data Stored;
DW stores a much larger amount of information than a DB;

Operations on Data;
Information in DW must essentially be read whereas a DB (with transactions) supports update;

Data Redundancy;
DB are normalized to reduce redundant data and therefore space whereas DW may contain redundancy to reduce response time;

Data Model;
DW uses a multidimensional data model to support analysis, whereas a DB is essentially based on the ERD;

Importance of age (date) of data;
The DB will store the latest/current state, whereas the DW is time variant; ***[4 marks]***

(c) (i) A collection of methods and techniques to explore and analyse a large quantity of data; ***[1 mark]***

(ii) *Award up to **[3 marks max]**.*
Used to discover groups of data;
Which form related clusters;
And hence form patterns;
Otherwise unseen; ***[3 marks]***

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

In a DW, data vary their value over time (data is time-variant);
It is necessary to keep the history of data changes;
To be valid, analysis needs to be made on current and historical data;
Therefore analysis needs to be recomputed as data received; ***[3 marks]***

(ii) *Award up to **[2 marks max]**.*

Time is a variable used in analysis;
New data entering the DW get a unique time-id; ***[2 marks]***

(e) *Award up to **[5 marks max]**.*

Factual data (*eg* address), analysis on data (*eg* likes/dislikes) and browsing habits can be easily grouped by purchasing online;

Use of cookies (or pixel tags in adverts) means having a permanent identifier on the computer (*eg* the refill-order option monitors our trends/habits);

By cross-referencing data, they may offer the same product at different prices for different groups of persons (*eg* higher price for those showing the profile of a wealthy person or no service at all if there is evidence of being insolvent);

E-commerce sites either must give out or do not care to protect enough some information to their third party partners;

Third party may breach the privacy of the e-commerce site;
E-commerce companies may be acquired and privacy policies may change/be revised, the acquirer may not be aware of the whole situation, especially with global companies/third parties; ***[5 marks]***

Option B — Modelling and simulation

5. (a) Each period GS, CD, I and GDP would be input;
Calculate debt;
Calculate % debt;
Store for that period; ***[4 marks]***

(b) *Award up to* ***[6 marks max]***.
Using named software;
Add fields for Tax and Bonds;
Calculate Income;
Calculate CD;
Repeat over time periods;
Alter values;
To see trends; ***[6 marks]***

(c) *Award up to* ***[6 marks max]***.
Governments can see what effect the decisions they are taking now will have on the long term future and not just in the coming year;
Hence they are warned and have time to take action in advance;
The simulation rules can then be repeated, changed and the simulation run on the current set of data for the next few years until a satisfactory level is achieved;
The disadvantages are that there is no guarantee that current trends will continue;
Patterns could be misleading if an unusual event occurred in the time period;
Both data and rules could change;
Too much dependence could prevent human initiatives being introduced; ***[6 marks]***

6. (a) Numbers and arithmetic operators for the arithmetic – generated randomly for each go;
Correct answer – calculated and held in store;
Player answer – input from keyboard;
Score – initialized at start of game and incremented each time player answer is correct;

Do not award a mark if the change during program is not given. ***[4 marks]***

(b) *Award up to* ***[2 marks max]****.*
Characters will be defined as mathematical models;
For 3D visualization they will need rendering to give 3D effect;
Each movement will need to be fluid and require rendering each time;
Game would be very boring with flat figures; ***[2 marks]***

(c) *Award up to* ***[8 marks max]****.*
Award up to ***[4 marks max]*** *for a discussion of two technical points.*
Award up to ***[4 marks max]*** *for a discussion of two social points.*

Technical
3D rendering takes time/or, slows down the game/needs fast processor but computers getting faster;
Given technical requirements it could be that some children would not have access to appropriate hardware such as dual processor/latest video card *etc*;

Social
Game much more exciting and attractive – children will be more willing to play – hence it could greatly help those who find maths difficult;
Negative aspects include addiction or even fear of frightening characters for very young children which could have the effect of putting them off maths;

There should be two technical elaborated points and two social elaborated points. ***[8 marks]***

7. (a) The data must be collected at all hours and in key places;
DO NOT accept questionnaires or surveys as they would not give the traffic situation.
Methods of data collection on traffic patterns would need constant monitoring such as sensors at certain points on the roads;
These would have to be placed at crossroads, roundabouts/traffic circles, traffic lights *etc*;
And could be backed up by cameras;
This will have to be done for a long period of time to cover weekdays, weekends, holiday periods, bad weather *etc*; ***[4 marks]***

(b) A mathematical model of the roads can be made showing distances between points;
Traffic lights, roundabouts *etc* and branches from these points;
The traffic flow can be calculated as a time stream from the data collected on traffic patterns;
This is then passed through the model of the roads showing the situation throughout a day/week/month; ***[4 marks]***

(c) *Award **[1 mark]** for identifying a suitable criterion and **[1 mark]** for outlining how it could be assessed, for two criteria, up to **[4 marks]**.*

For example:
Traffic flow;
By seeing how traffic moves throughout the day when rules (such as traffic light timing *etc*) are changed;
Time to cross the city at rush hour;
Manipulate the rules to minimize the time taken for a vehicle to get from the suburbs to town and vice versa in the morning or evening;

Improvements on previous situation;
Key points will have emerged from the data collection;
These will be the base for evaluating change if they improve or not; ***[4 marks]***

Pollution;
This criterion would need more measures included such as looking at specific zones and ensuring that there is not more traffic in some areas than others;

(d) New factors are difficult to measure as there is no history as to their effect;
For example, the number of cyclists/people taking public transport could increase and reduce traffic with more cycle lanes/better transport but the amount is not measurable except by questionnaires which are not always reliable/are expensive;
Hence the input into the model without extensive research could cause false results in the simulation; ***[3 marks]***

8. (a) *Award up to **[6 marks max]**.*

Both languages have **vocabulary**;
In human language one word can have more than one meaning;
For example, foot could be human or measure;
Which makes word for word translation difficult;

Human language has **syntax** but this is not rigidly applied/there are too many exceptions;
Computer language syntax is strict;
Not flexible enough to apply to human language translation;

Semantics is the biggest area that causes problems attempting to apply vocabulary from a dictionary and arranging according to syntax can give a very different meaning to that intended. ***[6 marks]***

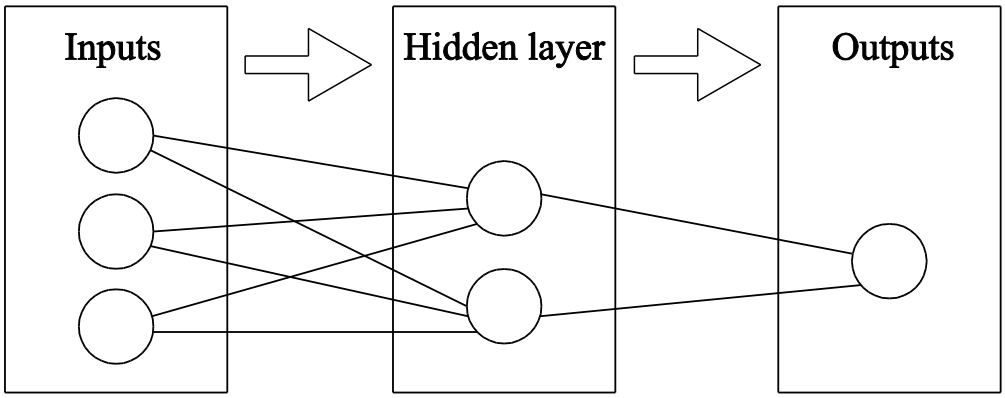
(b) *Three examples, each elaborated, for example:*
Translation – would help in international communication;
Important new discoveries on the web instantly translated;

Communication with the computer would aid the research for AI;

Effective chat bots expert machines *etc*;
Speech recognition to aid control – develop more efficient robots;

[6 marks]

(c)



Diagrams will vary but must show the Input - Hidden layer - Output sequence and the connections.
*Award **[1 mark]** for the layers in order;*
*Award **[1 mark]** for showing direction;* ***[2 marks]***

(d) *Award up to **[6 marks max]**.*
Various images of each letter in the input layer;
Fitness function would consist of ASCII code for each given letter;
Probabilities generated between the image and the ASCII code;
Passed between nodes in the hidden layer;
The best of these would be retained and used to generate another set;
The process would be repeated until a satisfactory recognition set was achieved;
Satisfactory depending on the correct letter for the ASCII code;
Once the learning is completed any handwritten letter could be input and the ASCII equivalent output;
With a probability of success stated; ***[6 marks]***

Option C — Web science

9. (a) The client submits a (request) message to the (appropriate) server;
The server's response is to send a response message back with (any) content requested; ***[2 marks]***

(b) It provides website authentication;
Which prevents man-in-the-middle attacks (or equivalent answer);
It encrypts data;
Preventing the data being understood (accept "read") if intercepted; ***[4 marks]***

(c) (i) The JavaScript file called "anyFile.js" is executed; ***[1 mark]***

(ii) *Award up to* ***[2 marks max]***.
Possible answers include:
- Allows interaction;
- Submitting of data to the server;
- Loading of new content (without reloading the whole page);
- Playing of video/audio;
- Resizing/repositioning of text;
- Validation of user input;
- Animation of page; ***[2 marks]***

(d) *Award marks as follows, up to* ***[6 marks max]***.
Server-side scripts are present on the page requested by the client;
The script(s) is code that is executed before the HTTP page is returned (as plain HTTP);
Scripts are written in languages such as ASP/PHP /Java/Coldfusion;
Can store and retrieve customers' preferences;
Resulting in specific offers being sent to the user/customize the page sent to the user;
Can provide (dynamic) interaction with the server's database;
Allowing purchases to be made/payments to be carried out/items to be selected *etc*; ***[6 marks]***

10. (a) *Award up to **[3 marks max]**.*
The web crawler is given an initial page;
It recursively...;
... visits each link on that page;
Which is repeated for each page visited (or until an end condition is reached); ***[3 marks]***

(b) (i) Because there are no links going **to** them from the main/surface web (*accept "they are not linked to ..."*) / lack of static incoming links / the pages are only generated dynamically in response to user input / pages are in protected intranet areas; ***[1 mark]***

(ii) They might be generated by database queries / php scripts; ***[1 mark]***

(c) A hub is a web page that points to many other pages;
An authority is a website that has many links pointing to it;
The importance of a hub or authority is determined by the ranking/importance of the sites pointing from it/pointed to it;
The ranking of that web page is a factor of its importance both as a hub and as an authority; ***[4 marks]***

(d) *Award up to **[3 marks max]** for relevant points discussed regarding search engine designers and up to **[3 marks max]** for relevant points regarding website developers.*

***NOTE**: To gain the full **[3 marks]** for each, a clear discussion involving both acceptable and unacceptable practices must be present.*

Points to be considered include:
Search engine designers
- The algorithm used must result in an index for that page that reflects its importance to the search query;
- This ranking must be based on some genuine analysis;
- They must remain neutral / not offer any bias to certain sites/companies;
- Any paid-for links must be clearly shown to be so;

Website developers
- Developers use search engine optimization (SEO);
- They should only use white-hat techniques to legitimately improve their visibility to search engines/web crawlers;
- *eg* Use of site diagrams / site promotion to increase back-links / careful choice of key-words;
- They should not use black-hat techniques to mislead search-engines;
- *eg* Hidden text / text off-screen / spamdexing / invisible div / cloaking; ***[6 marks]***

11. (a) Ubiquitous computing is the incorporation of information processing devices into everyday objects;
such as tagged food items, biometric devices incorporated into clothing *etc*; ***[2 marks]***

(b) *Award up to **[1 mark max]**.*
- Power consumption/battery problems;
- Interference;
- Lack of bandwidth;
- Weakened security;
- Coverage issues; ***[1 mark]***

(c) *Award **[1 mark]** per feature and **[1 mark]** per expansion, up to **[4 marks max]**.*
Cost;
Large scale purchasing of desk-top computers is considerably less than a comparable supercomputer;
A large number of users might volunteer computer time;

Connection speed;
How important this factor is as connection speeds for grid computing is considerably slower than internal connections in a supercomputer;

Reliability/security;
Is the data too sensitive to allow into the public domain / how trustworthy are the results? (*eg* tampering);

Hardware control;
Computers might drop out / inconsistent number / does this matter?;

Software;
Can readily available packages be used, or is specialty software needed?; ***[4 marks]***

(d) Intellectual property refers to the ownership/author of content (which is created by the mind);
Copyright gives the owner of intellectual property exclusive/legal rights (for a certain time); ***[2 marks]***

(e) *Award up to **[2 marks max]** for including a (generic) description of what is meant by the democratic web.*
*Award up to **[2 marks max]** for a clear example of two contrasting retailers.*
*Award up to **[2 marks max]** for consequences of democratization being lost*

Points to be considered include:
Democratic web means that any one web site can be accessed as easily as any other;
Therefore there is no physical bias between multi-national companies and the individual seller;
Or between retailers in developed or developing countries;
A specific example (Amazon versus Joe Bloggs);

Statements needed for consequences, for example:
Could lead to a 2-tier internet where big companies can buy exposure;
Starting on-line retailers may not get a fair change /treatment offering their products on-line;
Certain ISP could become very powerful and operate as a monopoly;
Larger countries may dominate;
Economies of small countries maybe adversely affected; ***[6 marks]***

12. (a) (i) There are 524970 web pages in the web graph; ***[1 mark]***

(ii) There are 6345270 separate links between them; ***[1 mark]***

(b) A faculty/department at the university; ***[1 mark]***

(c) (i) The arrows;
Which determine the direction in which the links go; ***[2 marks]***

(ii) In a strongly connected graph navigation is possible from any one page to any other;
It is not possible to link to Node A from the other nodes; ***[2 marks]***

(d) *Award up to **[4 marks max]**.*
Text based queries try to match the text in the user query with the text in the picture tags;
This can produce poor quality results because the quality of the tags depends upon the subjectivity of the person doing the tagging;
Image based queries compare the features of the query image to find matching images on the web;
Image based requires intensive processing;
But can potentially produce more relevant results;
Uses facial/pattern recognition; ***[4 marks]***

13. (a) *Award up to **[3 marks max]**.*
Folksonomies provide a structure to the way data is included in pages;
They are created by users (not the authors) tagging data such as particular sites or photos;
Relies on the emergence of shared vocabularies;
Allows web pages to be machine/computer readable/improvement in search engine efficiency; ***[3 marks]***

(b) *Award up to **[2 marks max]** for showing a clear understanding of ambient intelligence.*
*Award up to **[2 marks max]** for a detailed scenario involving the two people leading to different consequences.*
*Award up to **[2 marks max]** for describing the technology involved (eg sensors, biometrics).*

Ambient intelligence (AmI) refers to an environment that reacts to the presence of people
eg Sensors to register someone's presence and/or biometrics (face / iris / speech etc recognition) to recognize the person
AmI then responds according to the person

Examples

The mother enters and sensors detect who she is through something she is wearing or through biometrics. The entrance hall screen displays messages left for her / shows her where her family is / puts the kettle on *etc*

The daughter enters, is recognized, and her bedroom heating is switched on together with her computer / music *etc* ***[6 marks]***

Option D — Object-oriented programming

14. (a) The `Species` class inherits from the `Genus` class;
Accept "`Species` extends `Genus`". ***[1 mark]***

(b) The `Specimen` class has a member variable that is a `Species` object; ***[1 mark]***

(c) *Award up to **[4 marks max]**.*
Correct visible 3 tiered diagram eg box diagram;
Correct class name in top box; *Accept variations eg. "Species extends Genus".*
Correct member variable in middle box;
ALL Correct member functions in lower box;

Species
String: speciesName
setSpeciesName(String s) String getSpeciesName() String toString() boolean equals(Species s)

[4 marks]

(d) *Award **[1 mark]** for identifying a benefit and **[1 mark]** for an elaboration, for **two** benefits, up to **[4 marks max]***
Benefits:
Avoids duplicate code;
Simplifies testing;
Faster development;
Can mimic real-world object relationships;
Accept other reasonable benefits

Example:
Avoids duplicate code;
Since all functionality of the parent class is inherited, it is not necessary to duplicate the code to reproduce that functionality in the new class;
Simplifies testing;
Functionality inherited from a parent class does not need to be re-tested in the new class; ***[4 marks]***

(e) (i) The two methods are related to the specific class declared;
The complier selects the correct method; ***[2 marks]***

(ii) Polymorphism **OR** overriding;
*Award **[1 mark]** for either.* ***[1 mark]***

15. (a) Encapsulation refers to the practice of hiding the structure and representation of data within a class and making it accessible outside that class via accessor functions;

Accept "Refers to bundling the data and methods that operate on the data into one unit the methods and data can be accessed via dot notation or accessor methods." ***[1 mark]***

(b) *Award* ***[1 mark]*** *for identifying a benefit and* ***[1 mark]*** *for an elaboration, for two benefits, up to* ***[4 marks max]****.*
Advantages:
Data hiding and security;
Ease of maintenance;
Ease of testing;
Speed of development;

Accept other reasonable advantages.

Example:
Advantage: Ease of testing;
By putting all the structure of the data in a single class, other classes which make use of that data can be easily tested by simply providing them with data values even before the "real" data class is available for testing;

Advantage: Ease of maintenance;
If there are changes to the data, or how it is stored or accessed internally, only the one class needs to be changed to accommodate that. All the other classes will continue to use the public accessor methods and will not need to be changed; ***[4 marks]***

(c) Any accessor method in the `Specimen` class;
Example: `getName()`, `getCage()`, `getTOA()` are accessor methods in the `Specimen` class. ***[1 mark]***

(d) Any instance variable in the `Specimen` class;
Example: `cageNumber`, `name` and `TOA` are instance variables in the `Specimen` class. ***[1 mark]***

(e) *Award up to **[3 marks max]**.*
*Award **[1 mark]** for a constructor method requiring a single string as a parameter;*
*Award **[1 mark]** for* `String getGenusName()` *and a set method for the genus name;*
*Award **[1 mark]** for* `String toString()` *method that returns a valid string;*

Example:

```
public class Genus
{
     private String genusName;
     public Genus(String g)
     {
          setGenusName(g);
     }
     public void setGenusName( String g ) { genusName = g; }
     public String getGenusName() { return genusName; }
     public String toString()
     {
     return "Genus: " + genusName;
     }
}
```

[3 marks]

(f) *Accept any reasonable advantage and disadvantage. Award **[1 mark]** for identifying the (dis)advantage and **[1 mark]** for an elaboration, for one advantage and one disadvantage, up to **[4 marks max]**.*

Example:

Advantage: The `Specimen` objects would inherit all the attributes of the `Species` object;
This would allow code in the `Specimen` object to access species-related methods directly rather than having to invoke them on a `Species` object using dot-notation;
Disadvantage: Logically inconsistent, in that data in the Species class may not be consistent across the associated Specimens;
Potential data duplication / waste of memory space;

Example 2:

Advantage: The Specimen object, as a subclass, will inherit all methods and instance variables applying to the Species object;
This would take up less space and make access to all common methods between specimens easier;
Disadvantage: Not all methods and variables are consistent between all specimens;
This means that changes made to methods or variables in the Species class may not apply to all specimens; ***[4 marks]***

16. (a) The markings are a characteristic of an individual animal;
Therefore the description of markings should be an instance variable(s) within the `Specimen` class;
There should be accessor (get/set) methods for the markings;
The `toString()` method should include the description of the markings;
*If candidate creates a new class for the markings then award marks appropriately, **[2 marks max]**, for the variables.* ***[4 marks]***

.

(b) *Award up to **[8 marks max]**.*
*Award **[1 mark]** for correct method declaration (accept void or int as method type);*
*Award **[1 mark]** for initializing species count to zero;*
*Award **[1 mark]** for correctly determining array length;*
*Award **[1 mark]** for correctly looping through the array elements;*
*Award **[1 mark]** for retrieving species object from each specimen;*
*Award **[1 mark]** for comparing species object retrieved with species being counted using equals();*

> ***Note:** To earn this mark, the student must either use the equals method of the Species class or use the getSpeciesName() method to retrieve the name as a string and then use the String class equals() method.*

*Award **[1 mark]** for incrementing species count correctly;*
*Award **[1 mark]** for outputting species count (accept "output" in lieu of System.out.println);*

Example:

```
void countSpecimens( Specimen[] animals, Species s )
{
     int sCount = 0;
     int i;
     for (i=0; i< animals.length; i++)
     {
        if (s.equals(animals[i].getTOA())
        OR
        if(s.getSpeciesName().equals(animals[i].getTOA().getSpeciesName()))

        sCount++;
     }
     System.out.println( sCount );
}
```

[8 marks]

(c) *Award up to **[6 marks max]**.*
*Award **[1 mark]** for initialisation of variables;*
*Award **[1 mark]** for appropriate use of loops and selection*
*Award **[1 mark]** for creating something to hold a list of unique species;*
*Award **[1 mark]** for looping through the input array of Specimen objects;*
*Award **[1 mark]** for searching the list of unique species for each animal's species;*
*Award **[1 mark]** for inserting the animal's species into the list if it is not there already;*
*Award **[1 mark]** for producing the list of unique species as output;*

***Note:** In this question the term "pseudocode" indicates that syntax is not being tested; the emphasis is on the algorithm.*

Example 1:

```
//ANIMALS is an array containing Specimen objects
//UNIQUE is a collection, initially empty
//SPECIES is a Species object

loop BEAST from 0 to the number of elements in ANIMALS
     NEW_SPECIES = true
     UNIQUE.resetNext()
     loop while UNIQUE.hasNext()
          if UNIQUE.getNext() = species of ANIMALS[BEAST] then
               NEW_SPECIES = false
          end if
     end loop
     if NEW_SPECIES then
          UNIQUE.addItem( species of ANIMALS[BEAST] )
     end if
end loop

UNIQUE.resetNext()
loop while UNIQUE.hasNext()
     SPECIES = UNIQUE.getNext()
     output SPECIES.toString()
end loop
```

***Note:** The output does not need to be generated in a second pass after finding all the unique species. An alternative would be to generate the output for each new unique species as it is found.*

An alternative approach would be to pass through the array, and test each object. Using a second array into which the unique species name is stored as these are found. ***[6 marks]***

17. (a) No implementation details are known;
The actions/methods are standard; ***[2 marks]***

(b) *Award up to **[4 marks max]**.*
*Award **[1 mark]** for correctly creating a LinkedList object;*
*Award **[1 mark]** for looping through the array elements;*
*Award **[1 mark]** for inserting the animals into the linked list **(accept addHead, addTail, or insert);***
*Award **[1 mark]** for returning the linked list;*

Example:

```
LinkedList makeList( Specimen [] animals )
{
     LinkedList llist = new LinkedList();

     for (int i=0; i<animals.length; i++ )
     {
          llist.addHead( animals[i] );
     }

     return llist;
}
```

[4 marks]

(c) *Award up to **[6 marks max]**.*
*Award **[1 mark]** for correctly creating a new LinkedList object to hold the species;*
*Award **[1 mark]** for correctly looping through the specimen objects in the input list;*
*Award **[1 mark]** for retrieving the species object for each individual animal;*
*Award **[1 mark]** for inserting each species object into the new linked list;*
*Award **[1 mark]** for returning the new linked list;*
*Award **[1 mark]** for not failing if the input list is empty;*

Example:

```
public LinkedList makeSpeciesList( LinkedList animals )
{
     LinkedList SpeciesList = new LinkedList();
     Specimen individual = (Specimen) animals.getHead();
     while (individual != null)
     {
          SpeciesList.addHead( individual.getTOA() );
          individual = (Specimen) animals.getNext();
     }
     return SpeciesList;
}
```

[6 marks]

(d) *Award up to **[8 marks max]**.*
*Award **[1 mark]** for creating a list to keep track of unique species found;*
*Award **[1 mark]** for correctly looping through the input list;*
*Award **[1 mark]** for correctly looping through the list of unique species found;*
*Award **[1 mark]** for correctly checking if the input species is already in the list of unique species;*
*Award **[1 mark]** for resetting the flag for checking the input species is not in the unique list each time;*
*Award **[1 mark]** for adding the input species to the list of unique species if it is not there;*
*Award **[1 mark]** for returning the unique species list;*
*Award **[1 mark]** for not failing if the input list is empty;*

Example:

```
public void makeSpeciesListUnique( LinkedList allSpecies )
{
     LinkedList uniqueSpecies = new LinkedList();
     boolean foundType;
     Species foundSpecies;
     Species type = (Species) allSpecies.getHead();
     while (type != null )
     {
          foundType = false;
          foundSpecies = (Species) uniqueSpecies.getHead();
          while (foundSpecies != null)
          {
               if (foundSpecies == type) foundType = true;
               foundSpecies = (Species) uniqueSpecies.getNext();
          }
          if ( !foundType ) uniqueSpecies.addHead( type );
          type = (Species) allSpecies.getNext();
     }
     allSpecies = uniqueSpecies;
}
```

[8 marks]