

NSW Independent Trial Exam
Information Processes and Technology HSC Trial Examination 2009

SUGGESTED ANSWERS AND MARKING CRITERIA

Section I - Multiple choice

1 A	2 C	3 A	4 D	5 B	6 B	7 C	8 B	9 D	10 B
11 C	12 A	13 D	14 C	15 C	16 D	17 A	18 C	19 B	20 D

Note: 14 C

As the message gets passed down through the stack moving from layer to layer in preparation for transmission, the protocols are utilised in order from the application layer first (HTML), then the communications and control layer (TCP and then IP) and finally the transmission layer (Ethernet).

Section II - Core

Question 21 (a)

Marking Criteria	Marks
Demonstrates good understanding of what is meant by both concepts, and the differences between them	2
Demonstrates limited understanding of the use of a prototype	1

A requirements prototype is a working model of the proposed system that is developed in order to allow the clients and developers to understand the requirements of the system. It is built using software that offers the functionality of screen and report generators to quickly produce appropriate interfaces which can easily be modified as feedback is incorporated.

The prototyping approach allows the developer to gradually refine the prototype through an iterative process with the client to arrive at a working solution that meets the needs well.

Question 21 (b) (i)

Marking Criteria	Marks
A good justification of an appropriate approach related to this web application	3
Provides a justification for at least one systems development approach	2
Demonstrates limited understanding of at least one system development approach	1

There are a number of approaches that are possible, with it likely that more than one approach will be utilised in the development of this particular system. As the system is a web based application, it is relevant to develop a prototype first that models what the interfaces and links will look like. As the client and developer agree on the interfaces, they can be implemented using an Agile approach, in which a working system is delivered and implemented for the client to use, in a relatively short time frame, but which is progressively updated to incorporate more functionality as the needs (in terms of legal requirements and regulations) more clearly defined.

It could also be relevant to consider a more standard waterfall approach using a phased implementation, with the initial implementation offering limited functionality, which is subsequently upgraded as each new phase is developed and installed.

Question 21 (b) (ii)

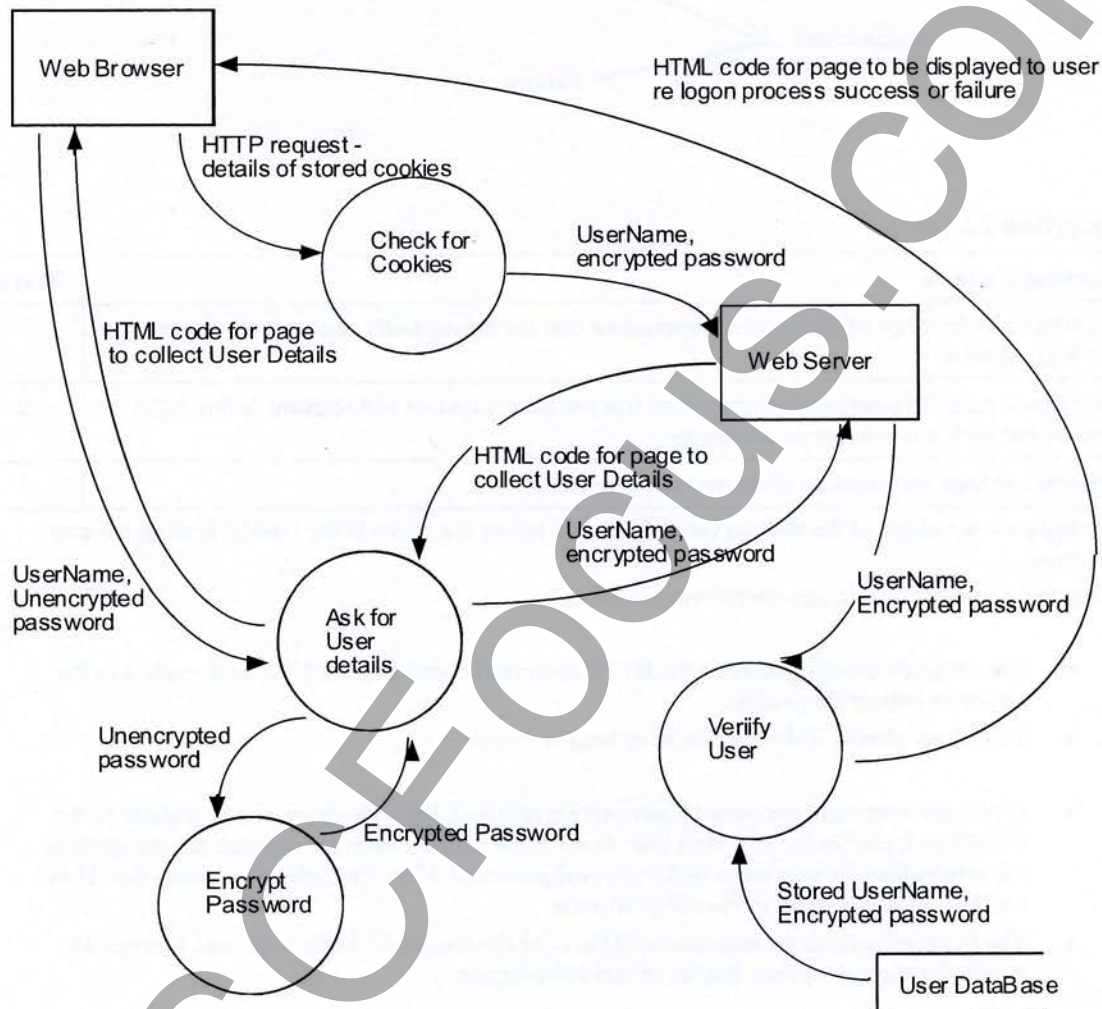
Marking Criteria	Marks
Demonstrates excellent understanding of a range of relevant project management tools and their use in effective management of the development team	3
Demonstrates a good understanding of at least two project management tools and their use in management of the development team	2
Demonstrates a limited understanding of at least two project management tools	1

There are a range of relevant project management tools that can be effective in managing the on-going development of the web application:

- Gantt charts – to allow the developer to estimate and document the time required for each subtask, and to allow ongoing monitoring of progress against this plan. The Gantt chart also allows the allocation of concurrent tasks to different team members which may reduce the overall time required to develop the system.
- Storyboard – this allows the initial look and feel of the application to be determined and documented, so that all team members can access this documentation and the prototype throughout the development process to ensure that the final application meets the requirements as expected by the client
- Journals and diaries – these allow the developers to document their progress throughout the project, allowing them to reflect on their successes as milestones are reached, and on temporary stumbling blocks and how they were eventually overcome. It allows the individual developers to refer back to how they dealt with or overcame specific issues that may again become relevant at a future time in the project
- Funding management plan – this allows management of the development team to ensure that money is available throughout the project at times which are relevant, and that the funds are spent appropriately on resources for the new system. It allows the overall budget to be managed so that the system can be developed on time and within budget, while still allowing for reallocation of funds if required because of unforeseen circumstances.
- Communications management plan – this documents all proposed meetings throughout the development process, indicating the proposed dates, who attends, matters to be discussed, and milestones that must be reached by each meeting. It allows both client and developer to understand the communication process between them, so that they are both aware of the proposed schedule of meetings and hence the facility to monitor the progress of the developing system.

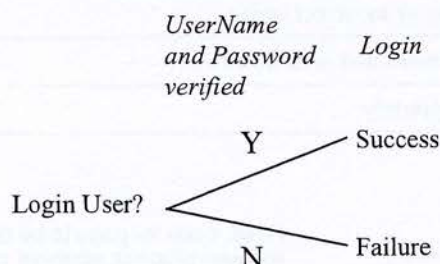
Question 22 (a)

Marking Criteria	Marks
A substantially correct DFD that includes web browser and server as external entities, processes that include check for cookies, ask for user details, verify user and encrypt entered password as processes, and storage with the user details. All data flows labelled appropriately.	4
An almost correct DFD but with some missing or incorrect items	3
A DFD that includes at least two correct processes and data flows	2
A DFD with at least two symbols used appropriately	1



Question 22 (b)

Marking Criteria	Marks
Provides a correct decision tree	2
Provides a decision tree for this part of the system with some minor errors	1

**Question 22 (c)**

Marking Criteria	Marks
Identifies a wide range of client-server operations that are substantially correct and relevant to this login system	3
Identifies a range of client-server operations that are almost correct and relevant to this login system, but with some errors or omissions	2
Identifies at least one relevant client-server operation	1

The browser is a client to the web server and the web server is a client to the DBMS hosting the user database.

There are a number of relevant operations, including:

A:

- The client (browser) generates the HTTP command containing the URL and sends it to the server to initiate the process.
- The server checks if the cookies have been received.

B:

- If the user name and encrypted password are received, the web server acts as a client to the DBMS as it checks the user data base to see if the stored values for this user are the same as the sent values for user name and encrypted password. If so, the web server sends the HTML for the successful login to the client browser.
- The browser accepts the transmitted HTML for the successful login page, and formats the screen for the appropriate display of this information.

C:

- If the web server did not receive the 2 cookies, it transmits the HTML code for the login screen to the client browser.
- The client (browser) accepts the transmitted HTML for the new login page, and formats the screen for the appropriate display of this information.
- The client then accepts the keyed information from the user (user name and unencrypted password), and transmits this information to the web server for processing.
- The web server takes the unencrypted password and performs the encryption process.
- The process resumes from B: above

Question 22 (d)

Marking Criteria	Marks
Demonstrates an excellent evaluation of the password security in this system (both positive AND negative)	3
Demonstrates a good understanding of the password security in this system (either positive OR negative)	2
Demonstrates limited understanding of password security	1

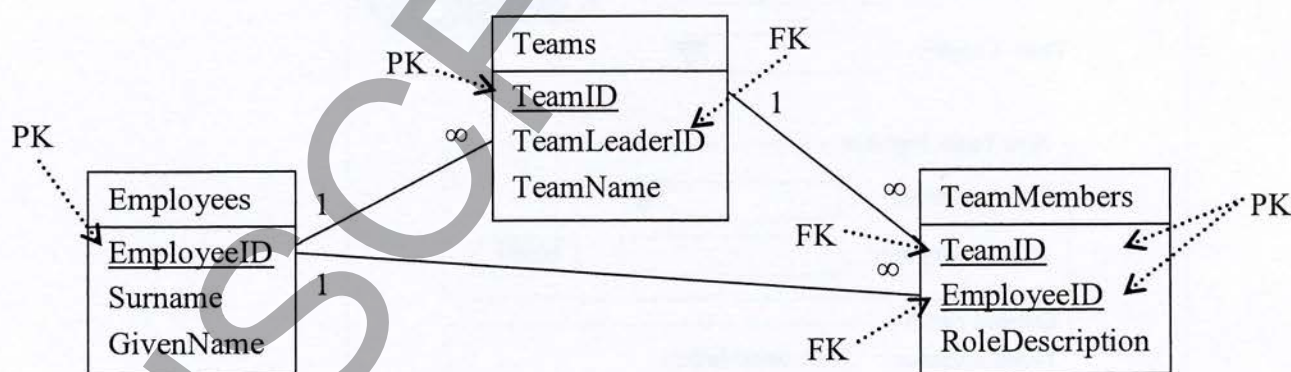
If the client computer is hacked into with a view to unethically taking and using the username and password information from the stored cookies, this means that anyone using that computer and accessing that website can login to that site, as the information will be utilised automatically from the cookies by the server software. However, if the hacker intended to then use the login username and encrypted password for entry to other sites or applications, this would not be successful as the encrypted form of the password would not be relevant for entry to other sites. It is assumed that the user would need to enter the unencrypted form of the password which would still be unknown to the hacker.

On the other hand, the system has a weakness in that it is possible for a hacker to access the unencrypted form of the password if they trap the user's keystrokes at the time that they first login to this website (before they have checked the "Remember Me" box).

If the user database is compromised then user names and encrypted passwords will be known. A clever hacker could potentially create their own cookies that make use of this information, however they will not be able to login normally as the original (unencrypted) password is not known.

Question 23 (a)

Marking Criteria	Marks
Identifies all primary and foreign keys correctly, as well as the 1 and many symbols	3
Identifies all primary and foreign keys correctly, as well as the 1 and many symbols, but with some minor omissions or errors	2
Identifies at least one key or relationship correctly	1



Note: It is not necessary to explicitly include the PK and FK labels, as long as the primary key fields are underlined (or perhaps a key drawn) and the 1 to ∞ relationships are shown correctly.

Question 23 (b)

Marking Criteria	Marks
Substantially correct SQL statement	2
Recognisable SQL statement but with some errors or omissions	1

Using syllabus SQL:

```
SELECT Teams.TeamName, Employees.Surname, Employees.GivenName
FROM Teams, Employees
WHERE Teams.TeamLeaderID = Employees.EmployeeID
ORDER BY Teams.TeamName
```

Using INNER JOIN:

```
SELECT Teams.TeamName, Employees.Surname, Employees.GivenName
FROM Employees INNER JOIN Teams ON Employees.EmployeeID = Teams.TeamLeaderID
ORDER BY Teams.TeamName
```

Question 23 (c)

Marking Criteria	Marks
Appropriate design that includes good design principles, relevant design elements (such as drop down lists, scroll bars, etc. Relevant to the design) and all required data fields, demonstrating excellent understanding of the system	3
Appropriate design that includes good design principles, with some relevant design elements (such as drop down lists or scroll bars) OR most required data fields	2
Design that shows some understanding of the system	1

Define New Team



Team Name:

Team Leader:

Add Team Member

Team member:

Role description:

Current Team

Team member	Role description
John Smith	Analyst
Chris Brown	Network Admin
Mary Green	Programmer
Robin White	Engineer

To delete a team member, highlight and press the delete key

Or, one created using Microsoft Access:

Question 23 (d)

Marking Criteria	Marks
Demonstrates excellent understanding of team building strategies AND advantages of teams that function well	4
Demonstrates a substantial understanding of at least 2 team building strategies AND at least 2 advantages of teams that function well	3
Demonstrates a good understanding of EITHER 2 team building strategies OR 2 advantages of a team that functions well	2
Demonstrates limited understanding of the use of a team	1

Team building strategies could include:

- Initial introduction of team members to each other so they begin to understand each others' strengths and can relate well to each other
- Recognition of each team member's strengths and weaknesses so that tasks are allocated by the team leader appropriately to a relevant team member
- Appropriate professional development opportunities and mentoring offered to inexperienced team members or to those whose particular skills need developing
- Encouraging all team members to understand the overall project (not just their particular task) and the role played by their individual task
- If conflict arises in the team (as is inevitable) appropriate management of this conflict using techniques such as
 - Active listening as other team members express their views
 - Negotiation so that no team member feels undervalued or disempowered
 - Conflict resolution by the team leader if required
 - Reminding that their primary goal and focus should be on building a quality product that they will each be proud of

The advantages of the team working well together include

- Increased job satisfaction for each member of the team - due to less conflict within the team. Throughout the course of the project, team members should be able to see the result of their skills, and they should experience the satisfaction of being part of a good system
- Better productivity - as all team members are focussed on their particular task, understand the bigger picture of the system as a whole, take pride in their work, and are not distracted by having to deal with "issues"
- Development of a good quality system delivered to the client - as communication between team members is productive, and they are all focussed on the product that is clearly understood by all members

Question 24 (a)

Marking Criteria	Marks
Demonstrates good understanding of netiquette with respect to Sue's e-mail	2
Demonstrates understanding of netiquette in general	1

Netiquette is a set of accepted ethical rules governing electronic communication, particularly relevant to e-mail messages.

Some of the relevant rules include:

1. Always use a relevant subject heading (so as not to mislead the receiver)
2. never type in CAPITAL letters, as this can appear as SHOUTING or very aggressive
3. Use appropriate language for the recipient
4. Never be abusive (no flaming) as there is a record of this communication
5. ensure that attachments are not too large, and not in an unusual file format that may not be able to be opened by the recipient

All of these are relevant to Sue, as she is in a business relationship with John. She should put in a subject heading such as "Questions on attached draft database" rather than "Hi from Sue".

There has been some disagreement so far, so Sue should be careful not to appear aggressive by using capital letters inappropriately to emphasise her point of view. (I REALLY think that it should LOOK LIKE THIS!)

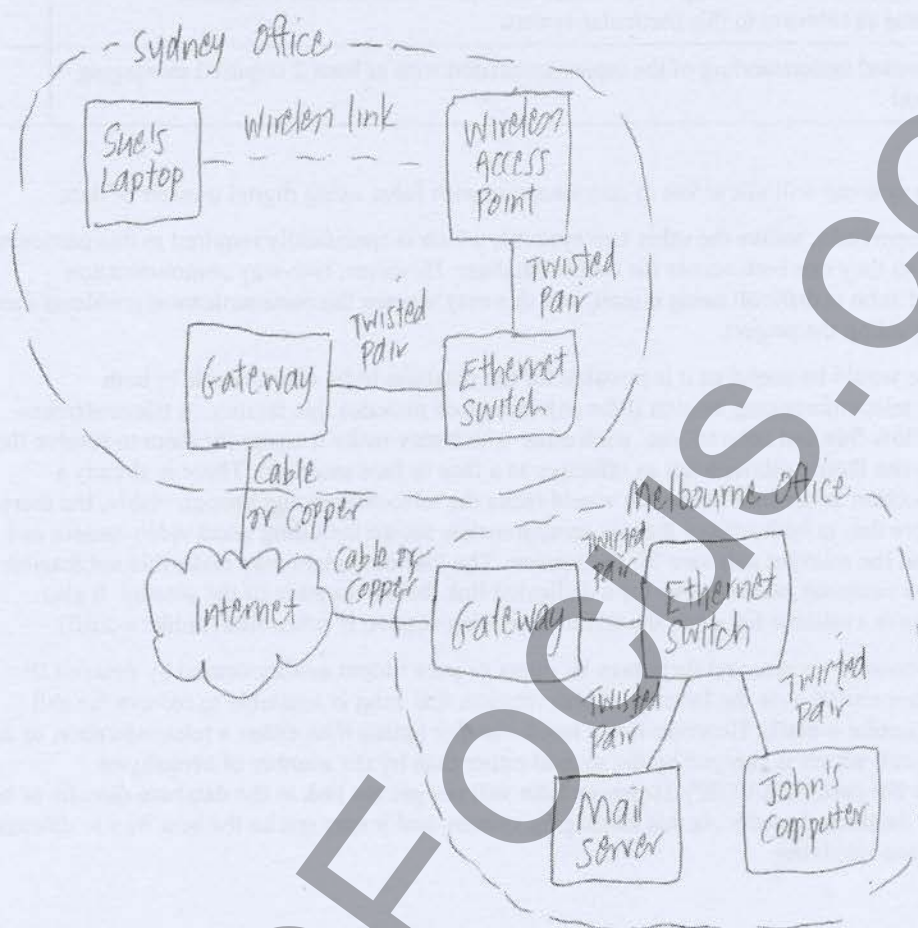
Sue should remember that this e-mail is related to work, and so the language should be formal and professional and not include informal acronyms such as gtg or cya.

No matter how frustrated Sue might be with the lack of progress on this project, she should not let this influence her choice of language in the e-mail (so she should not say "You are always unable to see my point of view and do not deserve to be on the project...")

Sue should ensure before she includes a link to the online database and that John has the required software to open and use the database as intended.

Question 24 (b)

Marking Criteria	Marks
Substantially correct diagram with most hardware and data links appropriately labelled	3
Recognisable diagram with many hardware and data links appropriately labelled	2
At least 3 relevant recognisable items or data links	1



Question 24 (c)

Marking Criteria	Marks
Demonstrates excellent understanding of the issues associated with the 3 required messaging systems as relevant to this particular system (budget requirements, potential conflict to be avoided, no need for receiver to be present, file to be attached)	3
Demonstrates good understanding of the issues associated with 3 required messaging systems in general, OR Demonstrates excellent understanding of the issues associated with at least 2 required messaging systems as relevant to this particular system	2
Demonstrates limited understanding of the issues associated with at least 2 required messaging systems in general	1

All 3 messaging systems will allow Sue to communicate with John, using digital transfer of data.

E-Mail allows hyperlinks, unlike the other two systems, which is specifically required in this particular communication so they can both access the online database. However, two-way communication between Sue and John is difficult using e-mail, and this may worsen the communication problems they already have regarding the project.

A teleconference would be useful as it is possible for the database to be made visible to both participants in a teleconferencing session if the software used includes this facility. A teleconference session would allow Sue and John to 'see' each other which may make it easier for them to resolve the differences between them (although not as effective as a face to face meeting). There is already a broadband connection to the Internet which would make the teleconferencing session viable, but there is a need to ensure that in both offices there is an appropriate set-up including good video camera and microphones, and the relevant software for the session. The limited budget may make this not feasible particularly if the company needs to pay for a dedicated link for the duration of the session. It also requires that John is available for when the teleconferencing session is scheduled (unlike e-mail).

VOIP is not necessarily secure, and there may be jitters or poor output quality caused by delayed IP packets as they are routed over the Internet. It also requires that John is available to receive the call when it arrives (unlike e-mail). However it is a much cheaper option than either a teleconference, or an interstate phone call which is charged by the second rather than by the number of Megabytes transferred (as is the case with VOIP). However John will not get the link to the database directly or be able to view the database directly via this messaging system, and it may not be the best way to discuss the issues that need resolving.

Section III - Options**Question 25 – Transaction Processing Systems****Question 25 (a) (i)**

Marking Criteria	Marks
Demonstrates excellent understanding of how an RFID tag works with respect to product identification in a warehouse	3
Demonstrates good understanding of how an RFID tag works	2
Demonstrates a limited understanding of an RFID tag	1

An RFID tag emits electromagnetic radiation (radio waves) of a specific frequency that can be picked up by a nearby RFID access point and uniquely identified. The tag can be an active tag, which is powered by its own power source through a small battery, and which can transmit continuously, or it can be a passive tag that requires an external source to provoke the signal transmission. In the case of the warehousing system, it will most likely utilise a passive tag which emits its own identifying frequency as the forklift passes by. If the product is then moved to the end of the aisle, an RFID access point at that position can identify the fact that that particular product is being moved off the shelving in the warehouse to another location.

Question 25 (a) (ii)

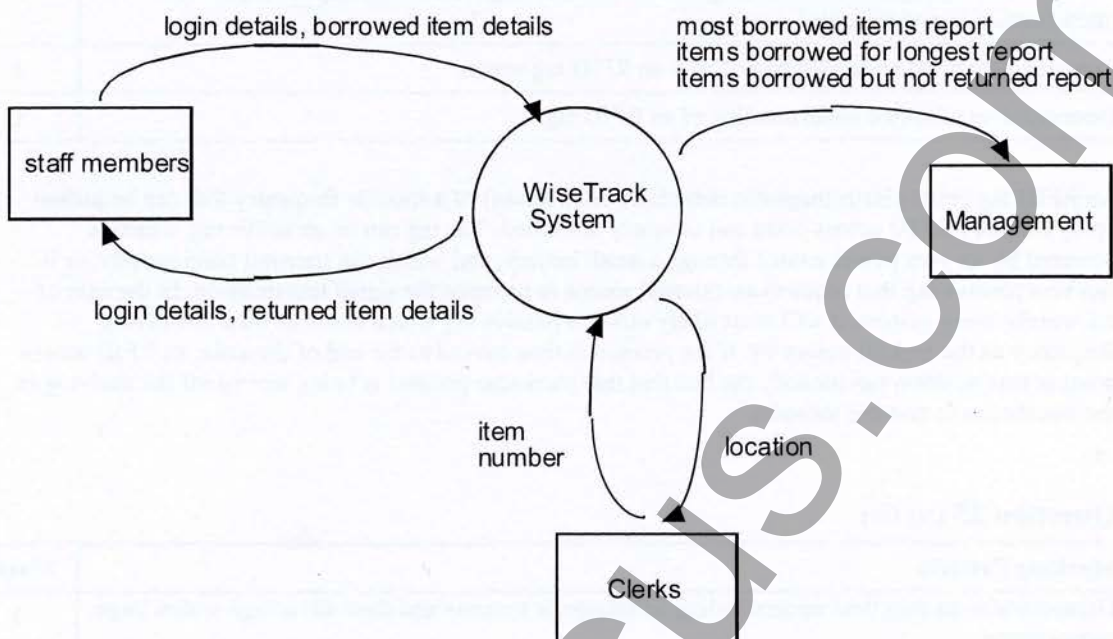
Marking Criteria	Marks
Demonstrates an excellent understanding of enterprise systems and their advantage within large corporations	3
Demonstrates good understanding of an enterprise system	2
Demonstrates a limited understanding of an enterprise system	1

An enterprise system is a large-scale integrated system where a number of critical applications are integrated and all share the same data, to support all of the processes, information flows, reporting and data analysis within the company. It is common for a single software product to offer the necessary integrated applications. The advantage to a large company is that the data is integrated across all of the required applications, and queries and reports across the various applications can be performed seamlessly without the need to export data into a different format to be accessible by a different application or department. Such systems are usually expensive and take time to implement and require significant training, but they support greatly improved decision making within the company through the use of such a highly integrated system.

As transactions are collected and processed as part of the transaction processing system, the resultant data can be directly input into the larger enterprise system for use in various other management oriented component sub-systems.

Question 25 (b) (i)

Marking Criteria	Marks
Substantially correct context diagram showing one process, 3 external entities and most data transferred	2
Almost correct context diagram, but with minor errors or omissions	1

**Question 25 (b) (ii)**

Marking Criteria	Marks
Demonstrates excellent understanding of the change in nature of work for all three groups of participants in this system (staff members, clerks AND management)	4
Demonstrates excellent understanding of the change in nature of work for at least 2 of the groups of participants in this system (staff members, clerks, management)	3
Demonstrates limited understanding of nature of work changes to at least 2 groups of participants OR Demonstrates excellent understanding of nature of work changes to one of the groups of participants (staff members, clerks, OR management)	2
Demonstrates limited understanding of nature of work changes in general	1

There are a number of areas in which the nature of work of the various participant groups have changed:

- Staff members who borrow items
 - As they borrow an item, they now have to login and register the borrowing of the item. This means an extra task for them, and the need to access and utilise technology where before they did not have to. They will need to be trained to use the technology and will experience the frustration associated with the failure of Internet based systems if the network or Internet is temporarily unavailable
 - They now are aware that their borrowing details are stored in the system. If they are chronically late returners of borrowed items, or tend to lose them, they now experience the stress of knowing that the system will have their details available to management at the press of a button
 - As an improvement on the previous system, it is now an easy matter for staff who cannot remember when their borrowed item is due back, or who wish to borrow an item that is currently unavailable, to quickly logon to see these details on their screen

- Clerks who used to track, locate and monitor borrowed items
 - Before the implementation and use of this system, clerks had to manually go and look for borrowed items, and presumably spent time on the phone chasing up people to return items so that others could borrow them. With this asset tracking system, this part of their job has now become automated. This has released them from the tedious workload, but hopefully they are still gainfully employed at a level that is suited to their abilities
 - Clerks now have the ability to query the asset tracking system to allow them to locate specific items, or to determine who has borrowed a particular item. With appropriate training and access to relevant technology, this should make this part of their job much more productive and interesting
- Management
 - Previously, management had no way of determining quantitative information about the movement of their assets due to borrowing by other members of staff. Any decisions they would make regarding the placement of these items, or the purchase of more of these items to reduce the amount of borrowing would have been based on little more than hearsay or a feel for how large a problem it was to the business. Now with the use of this asset tracking system, management now have easy real time access to accurate information in an easy to interpret analysed form. Reports listing products that are continually being borrowed can be used to determine which extra products need to be purchased to improve productivity.
 - The implementation of this system comes at a cost to acquire, install and maintain the technology, and because the system is web-based there are now potential security concerns for the asset - related data. This will add to the stress and workload of management.

Question 25 (b) (iii)

Marking Criteria	Marks
Demonstrates an excellent understanding of quality of data as relevant to this asset tracking system	3
Demonstrates a good understanding of quality of data with some attempt to relate it to this asset tracking system	2
Demonstrates a limited understanding of quality of data in general terms	1

Data quality relies on the

- Accuracy
- Timeliness
- and Accessibility

of the data stored and used as part of a system.

In this particular asset tracking system, it is critical that the assets stored are current (with duplicate, missing, damaged or sold items deleted from the files on a regular basis). As staff members borrow items, there should be sufficient validation on the web-based forms to prevent inappropriate item number, staff id, date, location from being entered. The use of drop down lists (rather than simple text entry boxes) will help in this regard. Training of staff members in the process of verification (where they scan the screen for errors before pressing the 'submit' button, particularly the displayed item description from the entered asset number) will also help to prevent wrong information (such as the wrong item number) being entered. If the system were to be upgraded, it would be relevant to include automatic entry of the staff number and item number either by scanning a barcode, or by equipping the item and staff id card with a unique RFID tag rather than asking the staff member to enter their staff number and item number manually.

To ensure that the stored data remains accurate once stored correctly, it is important to ensure that there is adequate security so that disgruntled or malicious employees (or others) do not change the stored data for their own malicious purposes (such as to delete a borrowing transaction if they have lost or broken their borrowed asset). There should also be adequate backup so that in the event of an accidental loss of data, it can quickly be restored to its previous accurate state.

Staff members should be trained to enter their borrowing details immediately before borrowing the item, so that their transaction is recorded into the system as soon as the item is borrowed. This prevents staff forgetting to enter the transaction until some time after the borrowing has occurred, meaning that some items may appear to still be available when in fact they have actually been borrowed. It is also important that there is technology available in the immediate vicinity of the item to be borrowed (wireless or otherwise) so that the staff member does not have to walk far to look for a terminal to access the system. This could lead again to a time delay between the actual borrowing and the recording of that transaction into the system, meaning that the quality of the data would be compromised.

As the system is a web-based system, this goes a long way to ensuring accessibility to the data from this system. If the staff members and management have wireless access through laptops, it means that they can access the system easily for borrowing and returns, queries and reports from anywhere that has access to an access point and subsequently to the server, thus enhancing the usefulness of the software application.

Question 25 (c) (i)

Marking Criteria	Marks
Proposes a valid relevant manual procedure that demonstrates excellent understanding of the requirements	3
Proposes a valid relevant manual procedure	2
Proposes a manual procedure that has some relevance	1

There are a number of valid possible procedures.

One procedure might be as follows:

There should be a set of manual forms stored adjacent to the normal location of each borrowable item. The form should have room for the borrower to fill in their name, item number, item description, date and time, number of days borrowed for, new location while borrowed.

This form is to be filled out whenever the item is borrowed, and a copy lodged with a nominated clerk (whose usual job is to monitor borrowed items, so they would be familiar with the system). The original form is to be kept by the borrowing staff member. The clerk is to accumulate all of these copied forms for every item borrowed whilst the system is unavailable, and they are to be sorted into item number sequence.

If a staff member needs to query at any stage the location of borrowed items, or to check if an item has been borrowed, the clerk is to be contacted, and they can search through their manually completed forms to find the form for the relevant item, and respond to the query.

As borrowed items are returned, the borrowing staff member takes their original copy of the borrowing form, ticks the 'returned' box and fills in the date and time returned and again lodges this form with the clerk. (It might be appropriate to get someone from the item's department to also sign the form to confirm that the item has in fact been returned). The clerk takes this form and attaches it to the 'borrowed' form in their pile, so that if they get a subsequent query for this item, they will see that the item has been returned.

When the system comes back on line again, the clerk is to take all of the forms (both borrowed and returned) and they are to key the details from those forms into the assets system in batch mode so that the system will have stored an ongoing record of ALL transactions on their database (whether completed on-line or through this temporary replacement manual process). Subsequent reports will therefore contain details of all borrowings, regardless of whether or not they occurred during a time when the system was temporarily unavailable.

Question 25 (c) (ii)

Marking Criteria	Marks
Demonstrates a good understanding of BOTH how and why such manual systems need to be periodically tested	2
Demonstrates an understanding of EITHER how OR why such manual systems need to be periodically tested	1

It is very important that if there is a well defined and documented alternate manual procedure that is to be used in case of failure of the on-line system, that it is periodically tested. This ensures that when there is a systems failure of the electronic assets tracking system (which is a not an unlikely event, caused through failure of the local network, server, internet connection, or loss of electrical power) that staff members and the clerk involved in managing the manual forms do not get frustrated or panicked by the loss of the system, or feel that they simply will not be able to borrow items until the system becomes available again. If they have practised the alternate manual system they will feel comfortable with how to use the alternate system and will do so with minimal fuss (just like fire or evacuation drills at school). The other advantage is that if the electronic system has had minor updates made to it and the replacement manual system also need to have its forms redesigned to include newly required data, this will become apparent at the first testing session of the manual system (or when the first reports / queries are produced) after the changes to the electronic system have been made. It is better to find the changes required to the manual system and then to test the redesigned manual system as soon as possible, rather than waiting for the electronic system to fail and then realising that the manual system is not fully compatible with the current version of the electronic system meaning that valuable data may be lost.

To test the replacement manual system, management needs to schedule a day a month (for example) where all staff are directed to use the manual system rather than using the on-line system to enter borrowing details or queries. They should also organise overtime (or an extra casual) to key in the manually collected data at the end of that day into the electronic system to ensure that queries subsequently made for items borrowed on that day return the correct results in all respects, from data entered from both previous on-line entry and the day's manually collected data.

Question 26 – Decision Support Systems

Question 26 (a) (i)

Marking Criteria	Marks
Demonstrates an excellent understanding of GIS systems, and how they can be used as a DSS	3
Demonstrates an excellent understanding of GIS systems OR how they can be used as a DSS	2
Demonstrates limited understanding of GIS systems	1

A GIS (Geographic Information System) is an information system that allows users to collect, store, manage, analyse and display a large volume of spatially referenced information relevant to a defined area. Data could include such attributes as roads, water pipes, demographic data, soil types and the like – in fact, any feature that can be mapped on the ground. GIS allows the display of selected data in the form of maps with the features shown in different colours. An example of its use as a DSS could be to create a map showing population density, urbanisation and mobile phone coverage to determine where to place a new mobile phone tower, for example.

Question 26 (a) (ii)

Marking Criteria	Marks
Demonstrates an excellent understanding of OLAP systems, and how the drill down process offers selected views of the data	3
Demonstrates a good understanding of OLAP systems OR how the drill down process offers selected views of the data	2
Demonstrates a limited understanding of OLAP systems	1

An OLAP system allows corporate data to be stored in a multidimensional data base, with each attribute stored as a separate dimension. This allows the data to be selectively extracted and viewed from different perspectives. Such systems (and their specially designed software) allow decision makers to analyse large data stores visually, online and in a very short time frame.

The drill down process allows a user to select one attribute and then explore the characteristics of a second attribute related to the one just selected. This allows the user to progressively focus in on more and more detailed information.

So for example, a graph could be requested showing details of all swimwear sold in the month of July, followed by a second graph showing sales of those same products in the month of September, followed perhaps by a comparison of sales of all related products in Bondi for that month.

The process of 'slicing and dicing' allows the filter criteria to be changed with each selection of data to be displayed, allowing unrestricted exploration of the data and the patterns within it.

Question 26 (b) (i)

Marking Criteria	Marks
Identifies a range of relevant input devices	2
Identifies at least 1 relevant input device	1

The sources of data could include such devices as:

- CD with stored digital sound patterns or files
- MIDI device such as a digital keyboard
- Microphone to input spoken commands or other noises
- Software that generates specific sounds (could include speciality websites with copyright free sounds).

Question 26 (b) (ii)

Marking Criteria	Marks
Demonstrates excellent understanding of the role of training in this particular neural network	3
Demonstrates a good understanding of the role of training in neural networks in general	2
Demonstrates a limited understanding of the role of training in neural networks in general	1

For this neural network to function as expected, it is necessary to expose it to a series of input sounds that are similar to those expected to be input when the system begins to operate under live conditions. Thus, if the system is to recognise a series of commands, each command must be spoken into a microphone connected to the system (for example) a number of times by a number of people with different voices and accents. For each such inputted command, it is necessary to then input the equivalent command (such as 1. 'open door', 2. 'turn off light', 3. 'turn on radio')

As this process occurs, the neural network through its pattern matching capabilities sets its internal weightings and threshold values for each of its tiny individual neurones to values which will cause it to consistently output the same signal for each of the inputted values for the same command. The more occurrences of each command that are used as input in this training stage, the more correct the signal output by the system will be once it moves into its execution (operational) usage.

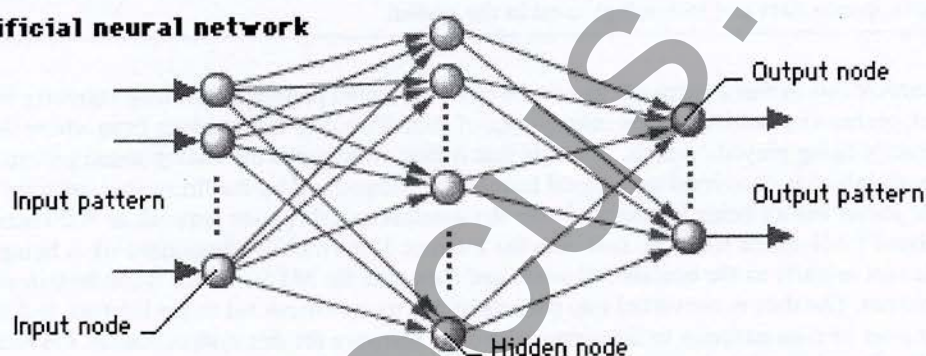
Question 26 (b) (iii)

Marking Criteria	Marks
Demonstrates excellent understanding of the role of the hidden layer in this particular neural network	3
Demonstrates a good understanding of the hidden layer in neural networks in general	2
Demonstrates a limited understanding of how a neural networks functions	1

Artificial neural networks consist of 3 distinct layers –

- Input layer – where the input signals are collected from the input device(s) (in this case the microphone connected to the system)
- Hidden (or middle) layer – consisting of a complex network of interconnected neurones each taking their input either from the input layer, or from other neurone(s) in the hidden layer
- Output layer – where the input signals are taken from the neurones in the hidden layer, and which then output relevant data to the output device(s) used in this particular neural network system (such as the display of the command on the screen, or the activation of an electrical signal or software routine to put the command into effect)

Artificial neural network



(image taken from Microsoft Encarta)

The role of the hidden layer is to effect the pattern matching process by causing the output from this layer to be consistently correct for the appropriate input(s) received from the input layer. Each node in the hidden layer performs a calculation on the signals reaching it to determine the corresponding signal to output to further nodes. If the weightings and threshold values set in the training cycle for each node in the hidden layer are correct, then the output signal generated by this process will be consistent with the values used in the training cycle.

Question 26 (c) (i)

Marking Criteria	Marks
Effectively distinguishes between the processes required and performed by a neural network compared to those required and performed by an expert system	3
Describes well the processes required and performed by an expert system OR the processes required and performed by a neural network in solving this sound recognition problem	2
Demonstrates a limited understanding of either an expert system or a neural network in general terms	1

The neural network system requires that it be initially trained and used as described in the answers to questions b (ii) and (iii) above. There is no need for an 'expert' to understand what comprises the different sound patterns for each of the inputted commands, nor to determine what is common to these sound patterns when spoken by different people. When the system outputs its response (after it has undergone sufficient relevant training), the user must simply accept the output produced. It is not possible to ask for an explanation or reason why the output is what it is for the given input.

On the other hand, for this problem to be solved using an expert system, it is first necessary for a human expert to determine the relevant facts and rules governing the determination of the appropriate command from the input provided. Once this has been determined (which may prove to be very difficult for this particular system) it is then up to the Knowledge Engineer to take these facts and rules, remove any inconsistencies and omissions, and encode them using the appropriate syntax into an appropriate Expert System Shell. The resulting system should be extensively tested to ensure that the output produced is reasonable and consistent for the full range of inputted commands.

With this expert system, it is then appropriate to ask for an explanation, as the software can list the set of 'fired' rules for the current session, providing an insight into which rules were applied to solve for this particular input.

Question 26 (c) (ii)

Marking Criteria	Marks
Demonstrates a comprehensive understanding of this system by providing the characteristics and features of and the relationships between the participants, data and technology used in the system	3
Demonstrates a clear understanding of this system by providing the characteristics and features of the participants, data and technology used in the system	2
Demonstrates a limited understanding of this system by providing the characteristics of some of the participants, data and technology used in the system	1

The participants in this system are those who enter the sound pattern of the song currently being played, perhaps by holding up the microphone of their iPhone to the speakers from where the sound file is currently being played / output. The data that is then collected is the analog sound pattern of the song fragment, which is converted into digital format and compressed by the firmware / software of the mobile phone before being transmitted over the wireless mobile phone network or WiFi network to the associated LAN where it will be sent onto the Internet. If the mobile phone network is being used, the data is sent initially to the nearest cell tower and then onto the MTSO where it can be transmitted over the Internet. The data is converted into packets by the router connected to the Internet, and each packet is sent over its own pathway to the server where the software for this system resides. On receipt of the complete sound file, it is input into the neural network system which uses pattern matching to determine the equivalent output. During this training cycle, the threshold and weighting values for each of the neurones in the hidden layer will have been set to values which cause the correct answer to be consistently output for any song fragment entered as input.

Once the correct song title has been determined (or a 'not recognised' output is produced), the song database on the server can be queried to retrieve the artist, distributing company, and CD image for this song title. This data will then be transmitted back over the Internet or mobile phone network to be eventually displayed on the LCD of the iPhone, where the person using that iPhone as the client node, (where the original query originated) can view the results.

Question 27 – Automated Manufacturing Systems

Question 27 (a) (i)

Marking Criteria	Marks
Identifies a sensor with an accurate description of its operation.	3
Identifies a sensor with a limited description of its operation.	2
Identifies a sensor	1

Sensors described could include temperature, pressure, motion, flow or light sensors.

Light Sensor

- Contain a phototransistor that when exposed to light, current is allowed to flow.
- The amount of current flowing indicates the amount of light hitting the phototransistor.
- The different levels of current are then represented as different binary numbers.

Flow sensor:

- Measures the volume of a liquid or gas moving through a media over time.

- Most flow sensors include a turbine that spins as liquid or gas passes through.
- A generator is attached to the turbine's spindle.
- The generator produces a varying electrical current corresponding to the flow rate of the liquid or gas.

Motion sensor:

- Detects the speed of an object.
- Can be attached to the object or used to detect movement in a remote object.
- Mechanical versions are used within some mice. A wheel rotates as the mouse is moved. The wheel contains equally spaced holes through which light is emitted. The number of light pulses received by the detector on the opposite side of the wheel corresponds to the speed of movement.
- Speed radar transmits waves that bounce off the moving vehicle. Some of these waves reflect back to the radar guns detector. The frequency change between the transmitted and received waves corresponds to the speed of the vehicle.

Similarly, answers could describe the operation of temperature or pressure sensors.

Question 27 (a) (ii)

Marking Criteria	Marks
Clearly distinguishes between human and machine centred systems.	3
Shows some understanding of the difference between human and machine centred systems.	2
Limited understanding of the difference between human and machine centred systems.	1

Human-centred automated manufacturing systems are controlled by humans whereas machine-centred systems include the humans as just another component part of the system. In a machine-centred system the human tasks are often repetitive and the human is forced to complete tasks at a speed determined by the machines, such as packing goods as they arrive at the end of a conveyor, for example. A human centred system uses the skills of the operator in a meaningful way so that the human has input into the quality and timing of their actions. For instance when using a CNC lathe the operator first makes adjustments to the CAD file, loads the stock and then monitors the machining.

Question 27 (b) (i)

Marking Criteria	Marks
Proposes and justifies a suitable actuator	2
Proposes a possible but not entirely suitable actuator	1

A hydraulic pump would be suitable. The pressure in the hydraulic fluid is altered to accurately lift and lower the torque heads. In addition, the speed at which the cap is lowered must accurately reflect the lowering of the cap as it is screwed onto the bottle, such accuracy is possible with hydraulics.

Question 27 (b) (ii)

Marking Criteria	Marks
Proposes and justifies a suitable actuator	2
Proposes a possible but not entirely suitable actuator	1

An electric motor would be suitable. In this case the torque head is spun at an appropriate speed and is then lowered onto the bottle to screw on the cap. The motor can be switched off just prior to the cap being tight enough. The remaining potential energy will then tighten the cap to the required torque.

Question 27 (b) (iii)

Marking Criteria	Marks
Proposes and justifies a suitable actuator	2
Proposes a possible but not entirely suitable actuator	1

A stepping motor is appropriate. The circular tray needs to be rotated through a very precise angle so that the next bottle is aligned correctly under the torque head. Stepping motors are designed for this particular task. They are programmed to rotate through a very precise particular angle and then stop.

Question 27 (c)

Marking Criteria	Marks
Describes TWO areas where feedback is appropriate including describing how the machine's operation is improved based on this feedback.	4
Describes TWO areas where feedback is appropriate with a limited description of the improved operation.	3
Describes TWO areas where feedback may be generated	2
Limited understanding of the use of feedback from sensors	1

Some possible feedback areas may include:

- A light sensor could be used to detect the alignment of caps as they are delivered via the vibrating cap feeder. The machine will be able to react to misaligned caps by adjusting the positioning of the torque head so that the machine does not need to stop for operator assistance.
- As each bottle reaches its final capping position a light sensor could be tripped. If the sensor is not tripped at precisely the right moment then small adjustments to the stepping motor rotation are made to realign the bottle. All systems experience wear, noise and other factors that result in alignment issues, such a feedback system allows the machine to continue to operate for longer periods of time without the need for readjustment.
- The jaws within the torque head must not deform each cap, however they must grip tightly enough that the cap is able to be screwed on without slipping. A pressure sensor could be installed within the head to provide feedback to the controller so that the pressure applied by the jaws can be altered automatically in response to different caps or in response to component wear.

Question 27 (d)

Marking Criteria	Marks
Excellent description with multiple reasons for automating a bottle capping operation.	4
Good description with at least two reasons for automating a bottle capping operation.	3
Satisfactory description with at least two reasons for automating a bottle capping operation.	2
Limited description OR lists some of the syllabus reasons without reference to the bottle capping operation.	1

The syllabus includes the following reasons for automation that are relevant to this scenario:

- repetitive tasks
- faster decision-making
- safety
- cost reduction
- customisation
- quality control
- precision and acceptable tolerance range
- productivity gains

Clearly students must relate their answers to the bottle capping machine.

Question 28 – Multimedia Systems**Question 28 (a) (i)**

Marking Criteria	Marks
Clear description of JPEG compression	3
Satisfactory description of JPEG compression	2
Limited understanding of JPEG compression	1

The JPEG format is designed to hold photographic type images. Therefore the compression used aims to minimise the perceived image quality whilst maximising the reduction in storage size. The human eye is good at detecting changes in brightness but is less able to recognise colour changes. This is particular true for blues and reds, whilst changes in greens are more noticeable. The compression used first converts the pixels into the YCbCr system. The Y component represents much of the brightness and green information and hence is only compressed using lossless techniques. The Cb and Cr components are further analysed to determine change throughout the image. Depending on the amount of compression required these Cb and Cr are compressed using a combination of both lossy and lossless compression.

Question 28 (a) (ii)

Marking Criteria	Marks
Accurate explanation of how plasma screens work.	3
Satisfactory explanation of how plasma screens work.	2
Limited or trivial understanding of how plasma screens work.	1

Plasma screens include a 2D grid of cells between sheets of glass. Each screen pixel is composed of three tiny cells - a red, a green and a blue cell. Each cell is coated in the appropriate coloured phosphor. Within each cell is a tiny amount of neon and xenon gas. When power is applied to a cell, via a grid of address wires, the gas heats and forms plasma. Plasma emits UV light. The UV light excites the phosphor which causes the phosphor coating to emit visible light (either red, green or blue).

Switching on and off individual cells for differing amounts of time creates different intensities of colour. When this occurs for all cells in all pixels on the whole screen an image is produced. The human eye does not detect the individual cells rather it merges all the emitted light to form a complete image.

Question 28 (b) (i)

Marking Criteria	Marks
Clear explanation of the relationship between browser, HTML file, flash player and flash file.	2
Limited understanding of the relationship between browser, HTML file, flash player and flash file.	1

The interaction with the web server does not occur through the HTML file, rather this interaction takes place from within the flash player running within the browser. The flash file includes the code needed to cause the flash player to react to user inputs and to display the content. Therefore, the HTML file specified by the URL need only contain sufficient information so that the browser can download the flash file and commence playing it within the flash player application.

Question 28 (b) (ii)

Marking Criteria	Marks
Excellent understanding of the difference between MPG and SWF, including justification for using SWF for this system.	4
Good discussion of the difference between MPG and SWF, including some justification for using SWF for this system.	3
Satisfactory discussion of the difference between MPG and SWF	2
Limited response showing some understanding of the difference between SWF and MPG	1

MPG files are essentially a compressed sequence of frames combined with a sampled audio track. Each frame is much like a bitmapped image where the shapes are defined. In contrast animation within an SWF file is stored much like vector graphics where the shapes (including fonts) together with the movement of the shape across the background is stored. In this case a sampled audio track is also stored along with the animation.

As a result, and in terms of storage an MPG format will require vastly greater storage for the animation component compared to the SWF animation. The entire detail of many frames is stored, even though most frames show little or no change from the previous frame. For instance, an equal sign appears and then a few frames later the first character in the answer appears, and so on. As the MPG would be much larger then it follows that the time taken to transfer the file from the web server to the browser will take significantly longer. This includes a longer wait for users while sufficient frames are buffered prior to playback commencing and also much more time taken to download the entire MPG file. The SWF format is a more suitable choice for this application as the images are produced using the computer and are largely composed of a static background with shapes in the form of mathematical symbols and other simple geometric shapes.

Question 28 (c) (i)

Marking Criteria	Marks
Describes a broad range of applications of relevance to the development of this system.	4
Describes a range of applications of relevance to the development of this system, but omits to address applications to develop some of the content..	3
Describes a limited range of applications of relevance to the development of this system	2
Lists applications of some relevance without relating them to the Maths Online system.	1

A variety of software applications could be used, including:

- Presentation software could be used to create the animations. Popular examples include the ability to progressively display text together with the addition of highlighting and other formatting features. The presentation can then be exported to a format suitable for use within flash files.
- An audio recording application could be used to record the presenters voice as they view the animation of each lesson.
- An authoring package that produces the menu system together with the links to lessons, worksheets, solution sheets, etc. Many such specialist packages are available that also create the final SWF flash files.
- A word processor could be used to create each of the worksheets and solution sheets. If these documents are then converted to Adobe's PDF format they can be integrated into the flash files.
- A DBMS could also be used to maintain a database of user details, such as user names, passwords, completed lessons, etc.

Question 28 (c) (ii)

Marking Criteria	Marks
Excellent discussion of similarities and difference between Maths Online on traditional maths lessons.	4
Sound discussion of similarities and difference between Maths Online on traditional maths lessons.	3
Limited discussion of similarities and difference between Maths Online on traditional maths lessons.	2
Limited or trivial discussion of similarities or differences with some merit..	1

In many ways the Maths Online system is a computer-based simulation of a traditional maths lesson. The teacher presents the new concept using a series of examples. The students then complete questions to reinforce the new concept and finally the questions are marked.

However, there are significant differences. The Maths Online system can be used from home (or anywhere with an Internet connection). This allows students to revise the teacher's presentation at home and at their own pace. Furthermore students can listen and view the teacher's explanation many times if they are experiencing difficulty, which cannot happen individually in a real classroom unless many students are experiencing the same difficulties.

Often students will go over the worked examples within their maths textbook to try to understand how to work problems. By using animation within the lessons allows the student to see the detailed thought processes that are involved in each step of the solution. For instance, how to get from one line of the solution to the next, how $3x^2/12x$ suddenly became $x/4$ for example.

This Trial HSC Examination, marking guidelines/suggested answers and mapping grid have been produced to help prepare students for the HSC to the best of our ability. Individual teachers/schools may alter parts of this product to suit their own requirements.