2011 Computing

Advanced Higher

Finalised Marking Instructions

SECTION I – Software Development

Marks

1. (a) (i) Technical, economic, legal, time (accept schedule). **2 KU**
1 mark each, maximum 2.

(ii) Economic – cost-benefit analysis, do development costs outweigh potential profits, determine breakeven point etc **2 PS**
Time – time required to develop new software must be within desired completion date, identify completion date and whether it is reasonable.
Legal – the proposed software must comply with current laws eg Data Protection Act, Copyright etc since the bank must follow the DPA principles
Technical – does hardware and software exist for implementation and with acceptable performance.

Response should be in context.
Any other reasonable.

(b) Identifying subtasks (1) allows – **4 KU**
- concurrent processes to be identified,
- indication of % complete/tracking progress,
- critical path analysis,
- delegation of responsibility for subtasks

Setting timescales (1)
- people work more effectively to deadlines
- identify completion times for tasks/subtasks

Gantt/Pert (1) – award 1 mark for each technique used in Gantt/Pert
Maximum 4

Identify budget (1) with supporting reason (1).

(c) (i)
- Protects against features/functions not being present in the final software (dispute resolution). **1 KU**
- Specifies <u>exactly</u> what will be present in proposed software/delivered/made.

(ii)
- Protects against additional client demands. **1 KU**
- Additional client demands not present in ORD must be paid for by the client
- Used for validation throughout software development process.

(iii) To validate/compare/check the completed software (1) against (functional) requirements (1). **2 KU**

(d)
- Used to track the correction of bugs/errors. **2 PS**
- Assists in the identification of modules which will need to be retested/Identifies testing already completed and which will not need retested.

(e)
- (Source) code automatically created from design/models/UML etc. **1 KU**
- Automatic documentation generation.
- Generate models (UML) from source code.
- Any other valid

Marks

2. **(a)** **(i)**

- A data type created/customisable by the programmer
- consisting of a set of fields/multiple data items (1)
- which can be of different data types (1)

2 KU

1 mark each, max of 2.

(ii)

```
Question=record
        Stem:string;
        choiceA:string;
        choiceB:string;
        choiceC:string;
        choiceD:string;
        correct:string;
end type
```

3 PS

1 mark for record name with end, 1 mark for unique field names, 1 mark for all fields being strings.

(iii) Dim Quiz (20) of question.
An array with appropriate index (19 or 20) (1).
Data type matching part (ii) (1).

2 PS

(b) **(i)**

- Input past end of file.
- File does not exist.
- Pathname wrong.
- String too long for filename.
- Any other acceptable

1 PS

(ii) Inspect variables (1) – watching the values of variables change (1).
Set breakpoints (1) – stopping execution of the program at predetermined points (1).

Any other acceptable.

2 KU

(c)

```
Mark = 0
Loop 20 times
        If responses() = quiz().correct  then
                Increment mark
        End if
End loop
```

4 PS

Award 1 mark for initialisation of **mark** or similar
Award 1 mark for loop with termination eg 20 times/for all responses and the incrementing of the variable
Award 1 mark for If condition with their variable from a(iii),
Award 1 mark for correct use of their field name.

Marks

3. **(a)** **(i)**

- Compares 1 and 2, 1 and 3 and so on.
- If the second number is smaller the numbers are swapped.
- Process repeats by comparing the second item with each in turn.

3 KU

1 mark each.

(ii) 84 and 40 (Edinburgh and Crieff)
3 and 40 (Crieff and Prestwick) **2 PS**

(iii) 5 comparisons **1 PS**

(iv) 15 because 5+4+3+2+1 or 6 x 5/2 **2 PS**

Award 1 mark for adding triangular numbers eg 4+3+2+1=10 but with the wrong answer.

(b) **(i)** A=0, B=3, C=5, D=137, E=3 **5 PS**

(ii) Change the number of times it loops (1) eg **2 PS**
For counter=lower to **(upper div 2)** OR **3** OR **half the number of times** gets the second mark

Altering the loop to do once less using (UPPER-1) award 1 mark.

(iii) It does half the number of loops (1) simple sort would do (n-1) (1) **2 PS**
It only ever performs one swap on each pass (1) simple sort would often do multiple swaps (1)
A simple sort would do 15 comparisons (1), the other algorithm does 0 (1).

Be careful to check their answer against the one for part (ii).

4. M on the second level (1) **3 PS**
C, E on the left branch (1)
L, T on the right branch (1)

5 **(a)**

- Programmer creates classes which are blueprints for objects
- by defining variables describing the state
- methods to alter the state.
- Objects/instances of the class are instantiated.
- Subclasses can inherit from superclass.
- Inheritance – child class inherits all characteristics of the parent class reducing the coding requirements.
- Polymorphism – creating factions that can handle different data types reducing the need for different functions performing the same action on a different data type.

3 KU

Any three descriptions – 1 mark each. Names only eg inheritance – no marks.

(b) **(i)**

- An array to hold the values.
- A variable to hold the number of items in the stack/next available location in the stack.

2 PS

(ii)

- Pop – removal of an item.
- Push – adding an item.
- Is empty – to find if the stack has no values contained in it.
- Is full – to find if the stack is full.

2 KU

1 mark each, max of 2

(c)

- In OOP the programmer can create as many instances from the stack class as required (1) reducing development time (1) compared to redefining much of the code for a new stack in a procedural language.

- In OOP the instances of a stack class would be error free/or all contain the same error (1) making debugging code/locating errors easier (1) than in a procedural language.

- Creation of a subclass of stacks that inherits code from a superclass means only additional states and methods need be defined (1) reducing the additional coding/development time (1) compared to procedural languages.

- Sub and superclasses means that the location of errors can be traced by their presence in all objects or just those of a subclass (1) reducing debugging/testing/maintenance activities (1).

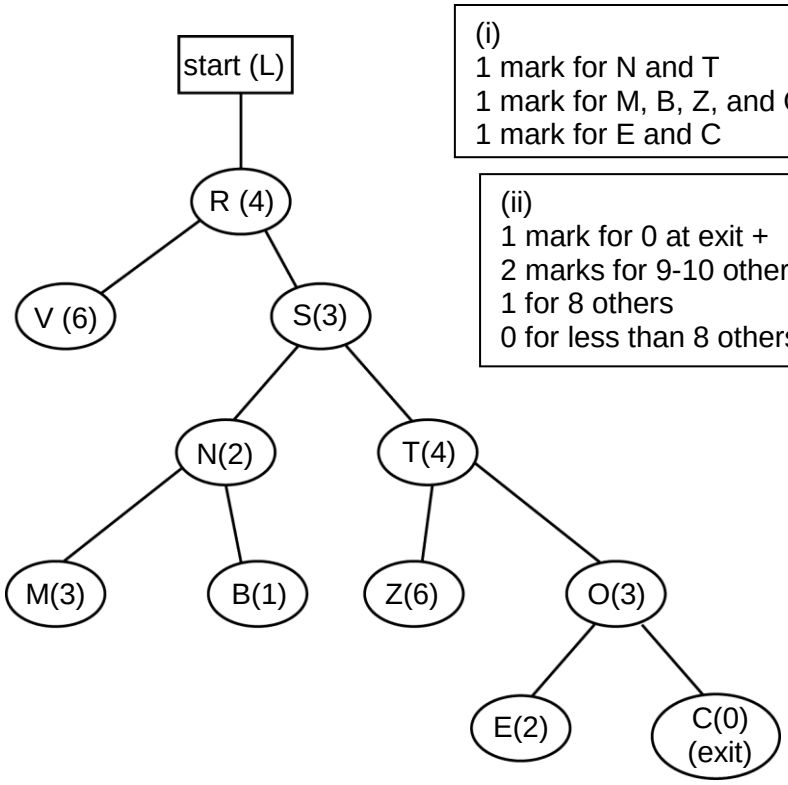
- Any other valid.

4 PS

Marks

6. (a) (i) **3 PS**

(ii) **3 PS**



(iii) Start or L– R – S – N – B (dead end). **2 PS**
If no start or L then R – S – N – B give 1 mark
If Start or L – R – S – N – B & more give 1 mark

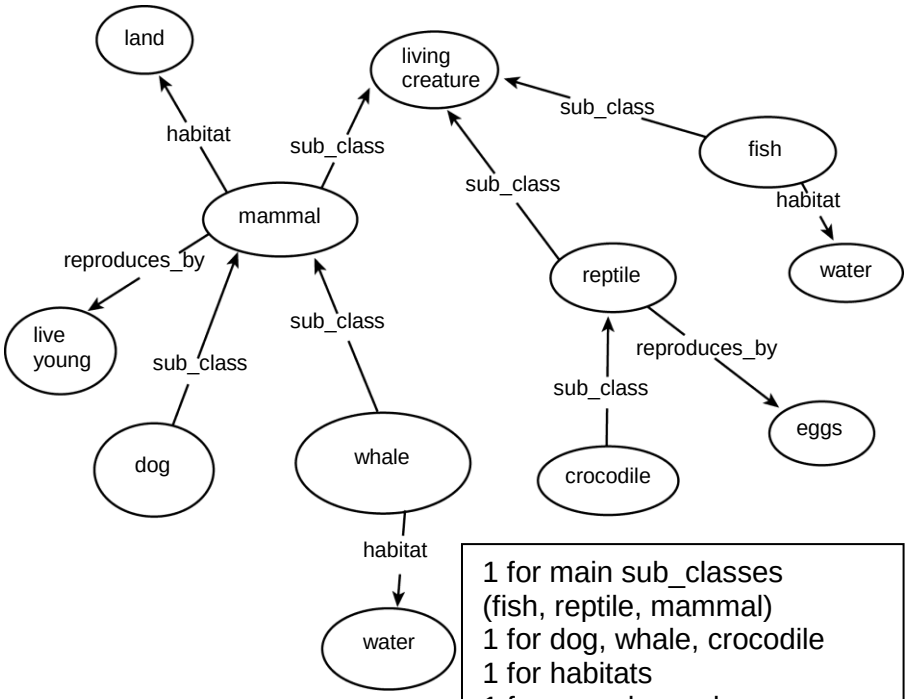
(iv) Best first (1); would not get stuck at a dead end/can **1 KU**
back-track/has kept other possibilities in memory/complete (1) **1 PS**

(b) (i) Idea of combinatorial explosion (1); needs heuristic to reduce search space to a manageable size/would reach goal state quicker than an exhaustive search etc (1). **2 PS**

(ii) Searching backward from the exit at the same time (or other valid). **1 KU**

Marks

7. (a) **4 PS**



1 for main sub_classes (fish, reptile, mammal)
1 for dog, whale, crocodile
1 for habitats
1 for reproduces_by

(b) A value inherited by subclasses (1), unless other information is provided (1). **2 KU**
If explained by using an example from the semantic net give (1).

(c) **(i)** **3 PS**

```
sub_class(mammal, living_creature).
sub_class(reptile, living_creature).
sub_class(fish, living_creature).
sub_class(dog, mammal).
sub_class(whale, mammal).
sub_class(crocodile, reptile).
habitat(mammal, land).
habitat(fish, water).
habitat(whale, water).
reproduces_by(mammal, live_young).
reproduces_by(reptile, eggs).
```

1 for sub_classes
1 for habitats
1 for reproduces_by

(ii) There is no clause which matches. **1 PS**
There is no rule that takes inheritance into account.

(iii) Inheritance is where an instance or sub_class automatically takes the properties of the class to which it belongs. **1 KU**

(iv) reproduces_by(X,Z):- sub_class(X,Y), reproduces_by(Y,Z). **2 PS**

1 mark for each sub goal – order doesn't matter

(d) Independent test group/after implementation is complete. **2 PS**
End users testing software (1) in its home environment(on-site) (1) and providing feedback (1)
Need two points

Marks

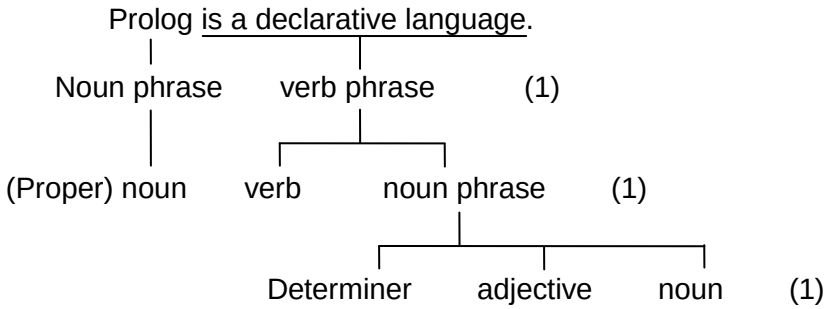
8. **(a)** **(i)** X is a member of the list (1), if X is the head of the list (1). **2 KU**

(ii) member_of(X,[Head | Tail]):-member_of(X,Tail). **2 KU**

Tail can be any variable
Can actually use anonymous variable
Award (1) if no square brackets
Award (1) for recursive rule with incorrect arguments

(iii) Using 1st rule: is green the head of the list; fails (1). **3 PS**
Using 2nd rule: is green in the tail of the list; to solve this, recursively calls 1st rule with the Tail [green, blue…] as the new list (1).
Using 1st rule: is **green** the head of this list; yes, so query succeeds (1).

(b) **3 PS**



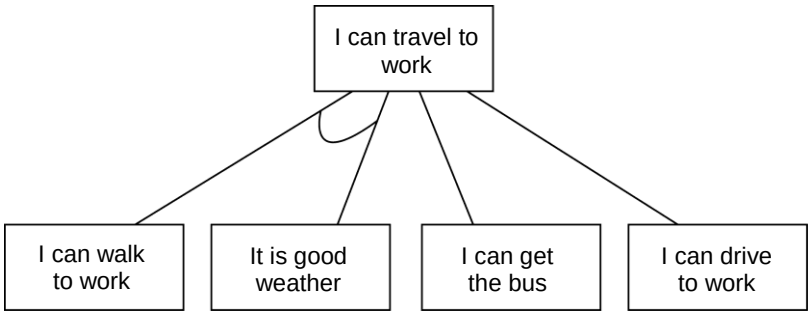
1 mark for each as shown
Can accept article instead of determiner

(c) **(i)** To check that a word was (eg) a verb or a noun; if not, the grammar might be incorrect. **2 PS**

Accept 1 mark for definition/1 mark for example

(ii) To check that a word made sense in the sentence, eg travel instructions might say “go north” (or some other direction); to make sense, the 2nd word must be a direction, so could check in a list of direction words; a word like “blue” would be grammatically correct, but would fail on semantic analysis. **2 PS**
Accept 1 mark for definition/1 mark for example.

9. **(a)** **(i)** **2 PS**



1 mark for the AND sign
1 mark for having all 4 options

(ii) Means the same (semantics), but different structure (syntax). **2 PS**

(b) **(i)** The group of rules (1) which can be "fired" at a particular time (1). **2 KU**

(ii) Any valid example – eg most recent, most complex, first come first served, most specific, avoid repetition, setting priorities etc. **1 KU**

(c) **(i)** Associates 40 as CF of a condition (1); **1 KU**
uses it to calculate CFs for conclusions (1). **1 PS**

(ii) Either choice – but justified in terms of use of resources, robustness etc. **1 PS**

10. **(a)** **(i)**
- Labels all external lines with arrows; **2 KU**
- compares each vertex in turn with its list of all possible vertices;
- assign – or + (concave or convex) to each edge -only need any 2 points from 3

(ii) Interpreting 2-D line drawings (1) as 3-D objects.(1) **2 KU**
OR
Used to pick out/recognise/identify trihedral shapes or objects (1) from image/photo/digitisation/2-D image (1)

(b) **(i)** Most waste objects will not be trihedral shapes/will have curves. **1 PS**

(ii) Any correctly named (eg learning from example, inductive learning, learning by discovery, learning by analogy, learning from experience, learning by rote) (1), with description (1), related to scenario (1 PS). **2 KU** **1 PS**

[END OF SECTION II – Part A]

SECTION II – Part B – Computer Architecture

Marks

11. **(a)** **(i)** BNE -8 **1 PS**

(ii) STA 2006 **1 PS**

(b) **(i)** Implied addressing **1 PS**

(ii) Direct (or Absolute) addressing **1 PS**

12. **(a)**

- Omitron has more registers than the Alphatron = fewer accesses to main memory (1). **2 PS**
- The level 2 cache on the Omitron is located on the processor while on the Alphatron the level 2 cache is on motherboard leading to slower access time (1).
- The Omitron has SIMD capability so for many instructions, much more data is processed in a given time (1).

(b) RISC processors have an instruction set which is based on register to register operations (1). The Omitron has 128 as opposed to the Alphatron's 16 registers (1) or **2 PS**
Omitron has more registers which is a feature of RISC (1).

(c) **(i)** Because it has a PCI-X bus which is 64 bits wide and has a speed of 133MHz (1). **3 PS**
The Omitron has a PCI bus which is 32 bits wide and has a speed of 33.3MHz (1) meaning that the Alphatron can transfer twice the amount of data at 4 times the speed = 8 x the transfer rate of the Omitron (1).
PCI-X has a higher bandwidth than PCI (1). 2 marks with some reference to numbers.

(ii) A DMA controller could be attached to the system bus (1). **3 PS**
When the processor requires to make a block data transfer, it sends a command to the DMA controller.
The DMA controller (DMAC) then takes over and transfers data between main memory and the I/O module releasing the processor for other tasks (2).

(d) **(i)** The processor loads data into each of the 32 128 bit registers (1) then executes the instruction on each of the banks <u>simultaneously</u> (1). **2 PS**
1 for general explanation of SIMD (but 0 just for an expansion of the acronym). 1 for reference to Omitron.

(ii) number of registers x capacity of each register **2 PS**
= 32 x 128 bits (1) = 512 bytes (1).

(iii) The data on the background colour of each frame in the video clip will be loaded into the 32 SIMD registers (1). The instruction to change the background colour will be loaded and executed on the data in each of the registers simultaneously avoiding the need to repeatedly load and execute the instruction to change the background colour for each of the 32 registers individually (1). **2 PS**

				Marks
13.	**(a)**	**(i)**	The IA-64 Superscalar processor has multiple pipelines (1) enabling it to process two or more instructions at the same time (1).	**2 KU**
		(ii)	To avoid delays in the flow of instructions through pipelines (1) caused when the processing of one instruction depends on the results of another instruction: data dependency (1).	**2 KU**
		(iii)	The assembler (allow processor) analyses the instructions for any dependency (1), then re-orders instructions (1).	**2 KU**
	(b)	**(i)**	When the program reaches the instruction (1), the data is retrieved from registers rather than main memory (1) thus reducing delays in running the program caused by fetching data from main memory (1).	**3 PS**
		(ii)	Speculative loading of data.	**1 KU**
	(c)	**(i)**	The branch instructions BNE and BMI can cause pipelines to be flushed and refilled (1) causing delays in processing (1).	**2 PS**
		(ii)	Because the IA-64 uses predication (1) which executes instructions from the two possible branches in different pipelines (1). Once the processor knows which branch is to be taken, it discards the results of the "not taken" branch, and proceeds with the "taken" branch (1).	**3 PS**
	(d)		To do this the processor must have a 128 data bus and 128 bit registers (1) and the 80386 series had 32 bit registers and a 32 bit data bus (1). The IA64 has a wider data bus (1).	**2 PS**
14.	**(a)**		Data pathways (buses) connecting clusters of processors. Packet switching: each packet is assigned the address of the receiving processor and is forwarded through the network of connections till it reaches its destination. (1 for brief description) Circuit Switching (0). Names with no descriptions (0).	**2 KU**
	(b)		Each processor has its own dedicated memory bank (1) as well as access to common shared memory area (1). Allow registers or cache for local memory. Hard drive or backing store (0).	**2 KU**
	(c)		Meteorological, financial, scientific applications or any suitable context (1) with description (1).	**2 PS**

Marks

15. **(a)** **(i)** Demand on memory: storing graphical objects for the GUI display eg icons, menus (1).
Processor: any two of: tracking pointer position, interpreting mouse clicks, loading and displaying graphical objects (2). **3 PS**

(ii) Jean would merely have to enter the command correctly (1). Using the GUI involves operating a series of windows, dialogue boxes and selecting operations from menu: a more complicated and time consuming task (1). **2 PS**

(b) The syntax is the structure of the command being entered (1), in this case: **3 PS**

- the action being carried out: **attrib-h**
- the path **C:**, and
- the name of the file **accounts**.

Semantics is the operation carried out by the correct entry of the command, in this case showing the hidden file (1).

1 mark each for a general explanation of syntax and semantics and 1 mark for direct reference to the specified command.

(c) **(i)** The Operating System maintains a library of routines (API) that any application can call on to perform these tasks.
OR the OS uses drivers that provide a standard interface to peripherals. **1 KU**

(ii) She does not have to design, code (1) and test modules (1) to perform common tasks such as read in data entered at keyboard or display output to a screen because they are provided by the Operating System. **2 PS**

(iii) It will lead to commonality of the HCI or other relevant answer. (0 for 'user friendly' without justification). **1 PS**

(d) Legal: possible infringement of computer misuse act (1) because she is making unauthorised access to computer system details (1). **4 PS**

Ethical: she could be judged to be doing wrong (1) by stealing private information and accessing data without their owners consent (1).
OR
She could be seen to be perfectly within her rights (1) in protecting her intellectual property right and preventing illegal copying of her software (1).
OR other relevant answer – implication (1) and description/ justification (1).

(e) Each process is allocated the amount of memory that it requires in order to function correctly. **1 KU**

[END OF SECTION II − Part B]

SECTION II – Part C – Computer Networking

Marks

16. **(a)** Fibre is capable of delivering anything from 100 Mbps up to several Gbps (1). Coaxial cable was originally used in LANs at 10 Mbps but more modern coaxial can carry around 50Mbps (1). **2 KU**

(b) The fibre optic cable will be used to carry the data from central data distribution points to local communities (1).
The coaxial cable will then be used to branch out from a local distribution point to groups of individual houses (1). **2 PS**

(c) 802.11g (1) at 54 Mbps (1) **2 KU**

or

802.11n (1) at around 150 Mbps (1)

(d) **(i)** The network manager enters the MAC address of all the devices he wishes to allow access to the network into the WAP (1).
Each device has a unique MAC address (1).
Each device that attempts to join then has its MAC code checked against this allowed list (1).
any two points **2 PS**

(ii) Data interception can still occur as any computer with a wireless network interface card can listen into the wireless signal without joining the network (1) and therefore all data should be encrypted before being transmitted (1). **2 PS**

(e) **(i)**
- An unauthorised user or computer may access a device on the network.
- An application that might allow a connection to be made from outside the firewall.

1 PS

(ii)
- A specific IP address (or addresses) may be allowed access to the LAN.
- A specific port (relating to a service, eg ftp port 20 or 21) could be blocked.

1 PS

(f) PPTP allows a VPN (1) to be created between a remote user and a corporate network so that data can be transferred securely (1).
Accept correct description of tunnelling one protocol within another (1). **2 KU**

Marks

17. **(a)** **(i)**

- They will have a wide choice of hardware to pick from when updating systems.
- There will be a wide range of sources for support.
- They will be able to transfer data to and from many other systems.

2 PS

(ii) It may be easier for hackers to break into their network as security issues are widely reported. **1 PS**

(b) Data protection act: they will have had to protect their customer data files to ensure that details cannot be accessed by others (or similar). **2 PS**

(c)

- Every record/transaction is potentially very important.
- Transactions occur very regularly.
- Transactions may occur 24 hours a day, 7 days a week.
- Incremental backups take less time than full or differential backups and therefore can be taken more often.
- Incremental backups only copy the new data since the last copy was made.

3 PS

Any 3 of the points listed above used in a coherent statement.

(d) **(i)**

- Configure routes or firewalls to block ICMP echo replies.
- Configure routers not to forward directed broadcasts onto network.
- Configure servers not to respond to a directed broadcast request.

1 KU

Any 1 of the above.

(ii) Clients testing the software on their own systems (1). Feedback taken and used to correct issues found (1). **2 KU**

(iii)

- Easily accessible online help.
- Breadcrumbs to record position in system.
- Selection of screen set aside for links always to be available.
- Multiple user levels?

2 PS

1 mark each for any 2.

Accept any valid answer

Marks

18. **(a)** Date and time, sender address, mime type. **2 PS**

(b) **(i)**
- Validation of sender, or authentication of user
- Transfer of the mail.
- Connection termination.

2 KU

1 mark for each (or similar)

(ii) Syntax refers to the rules governing how the response is stated, in this case the first word must be HELO. (1 mark for explanation of meaning with reference to the HELO command.)
Semantics refers to the meaning of the statement, in this case it is an acknowledgement of receiving the servers domain name and sending the clients domain name.
(1 mark for explanation of meaning with reference to the HELO command.) **2 PS**

(c)
- The sender needs (to purchase) encryption software that will allow him to create a public and private key (1) OR the sender can use a digital signature (1) that can be created using public key (or asymmetric) encryption (1).
- The sender gives a copy of the public key to the intended recipient. The sender creates a message digest that is based on the message content (1).
- The sender then encrypts the message digest using his own private key (1).
- The receiver uses the public key to decrypt the message digest (1).
- The recipient also creates a message digest and compares it with the one sent (1).

4 PS

Any 4 of the above for a maximum of 4 marks.

(d) **(i)** Allow interactive video/animation. **1 KU**

(ii) It will download the object (1) check for a suitable plugin (1) and if present use the plugin to display to data (1). **2 PS**

(iii) Understanding Flash Objectsuse of <a> tag (1), use of href (1). All syntax correct (1). **3 PS**

(e) Gateway: **2 KU**
- Protocol conversion from the network to the Internet.
- Enhance security by having a firewall that restricts external access to the internal network.

1 mark each.

(f)

- ActiveX has access to the hard drive of a system and therefore offers more of a security risk than Java applets which run in a sandbox and therefore cannot affect the local hard disk.
- ActiveX can only run on Windows based machines therefore in a cross platform situation Java is the best solution.

2 PS

				Marks
19.	**(a)**	**(i)**	Internet	**1 KU**
		(ii)	PPP, ethernet, PPPoE, PPPoA	**1 KU**
	(b)	**(i)**	Both techniques remove the restrictions of the network identifier in IPv4 to be fixed at 8, 16 or 24 bits.	**1 PS**
		(ii)	CIDR allows multiple class C networks to be grouped together (1) and referred to by a single network ID (1) whilst subnetting allows the division of existing A, B or C networks (1) into separate networks at a local level (1). Any 3 of above.	**3 PS**
		(iii)	To identify 64 different values requires 6 bits (2^6 = 64) therefore 11111111.11111111.11111111.11000000 therefore 255.255.255.192.	**3 PS**
	(c)	• Traceroute sends a UDP packet with a short TTL (time to live) to the destination address. • The first host to receive the packet will send a “time to live exceeded” message back along with its own IP address. • Another packet is then sent with an increased TTL which will get as far as the second host which will then return a “time to live exceeded” message back along with its own IP address. • This is repeated and displayed in a table of IP addresses and/or domain names along with a time in milliseconds of how long each hop took.		**4 KU**

[END OF SECTION II – Part C]

[END OF MARKING INSTRUCTIONS]