A-level
Computer Science
Paper 2 Additional Questions
Mark scheme

V2.3
30/03/2017

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts: alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available from http://www.aqa.org.uk/

COMPONENT NUMBER: **Paper 2 Additional Questions**

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To Examiners:

- **When to award '0' (zero) when inputting marks on CMI+**
  A mark of 0 should be awarded where a candidate has attempted a question but failed to write anything credit worthy.

  Insert a hyphen when a candidate has not attempted a question, so that eventually the Principal Examiner will be able to distinguish between the two (not attempted / nothing credit worthy) in any statistics.

- This mark scheme contains the correct responses which we believe that candidates are most likely to give. Other valid responses are possible to some questions and should be credited. Examiners should refer responses that are not covered by the mark scheme, but which they deem creditworthy, to a Team Leader.

The following annotation is used in the mark scheme:

;	- means a single mark
//	- means alternative response
/	- means an alternative word or sub-phrase
A	- means acceptable creditworthy answer
R	- means reject answer as not creditworthy
NE	- means not enough
I	- means ignore
DPT	- in some questions a specific error made by a candidate, if repeated, could result in candidates failing to gain a mark loss of more than one mark. The **DPT** label indicates that this mistake should only result in a candidate losing one mark on the first occasion that the error is made. Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

Level of response marking instructions.

Level of response mark schemes are broken down into a number of levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are a range of marks in each level. The descriptor for the level represents a typical mid-mark performance in that level.

Before applying the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level. ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

01	1	**All marks AO1 (understanding)** **-64:** Integer, Rational, Real; **10:** Natural, Integer, Rational, Real; **5/128:** Rational, Real; **R.** answers in which additional lozenges are shaded	3

01	2	**Mark is for AO1 (knowledge)** To show order / position / rank;	1

02	1	**All marks AO2 (apply)** Correct representation of 78: 01001110; Correct representation of -23:11101001; Correct result 55: 00110111;	3

02	2	**All marks AO2 (apply)**
		
		     1 0 1 1
		* 1 0 1
		   1 0 1 1
		         0 **1 mark** (**A.** if 0 row not present **A.**
		 1 0 1 1 0 0 rows in any order)
		 1 1 0 1 1 1 **1 mark**
			2

03	1	**Mark is for AO2 (apply)** 177;	1

03	2	**Mark is for AO2 (apply)** -79;	1

03	3	**Mark is for AO2 (apply)** 22 1/8 // 22.125;	1

03	4	**Mark is for AO2 (apply)** B1;	1

03	5	**Mark is for AO1 (understanding)** Easier for people to read/understand/remember; **R.** If implication is it easier for a computer to read/understand/remember Can be displayed using fewer digits; More compact when printed/displayed; **NE.** Takes up less space	1

		NE. More compact **MAX 1**	

03	6	**All marks AO2 (apply)** Not received correctly; As contains an odd number of 1s; **A.** odd number of 0s	2

03	7	**All marks AO1 (understanding)** To enable the representation of a greater range of characters; So that more languages // all (modern) languages can be represented (in one character set); Improved portability of documents in UNICODE // each character has a unique representation in UNICODE // in ASCII, representations could vary depending upon the code page used; **MAX 2**	2

04	1	**Mark is for AO1 (understanding)** Architecture A;	1

04	2	**1 mark for AO1 (recall): Situation (MAX 1 mark):** Digital signal processing; Microprocessors / embedded devices / microcontrollers; **A.** Internal processor structure for caching **A.** other reasonable examples **2 marks for AO1 (understanding): Advantages (MAX 2 marks):** Instruction and data can be accessed simultaneously; Avoid/reduce bottleneck of single data/address bus(es) // avoid/reduce delays waiting for memory fetches; Instruction and data memory can have different word lengths; Different technologies can be used to implement instruction and data memory; Different quantities of instruction and data memory means that address lengths can differ between the two // memory address structures can differ; Avoids possibility of data being executed as code, which is one method that can be exploited by hackers;	3

04	3	**All marks AO1 (recall)** **Step 1:** MAR ← [PC] / Contents of program counter transferred to MAR; **Step 2b:** MBR ← [Memory]$_{addressed}$ / Contents of addressed	3

memory location loaded into MBR / MBR ← [Memory]$_{MAR}$; (must have concept of data coming from address in memory, not just going into MBR)

Step 4: Decode instruction;
A. Contents of CIR decoded
R. Data for instruction
R. CIR decoded, CIR decodes instruction

1 mark for each correct step

For PC accept Program Counter/SCR/Sequence Control Register
For MAR accept Memory Address Register
For MBR accept Memory Buffer Register/MDR/Memory Data Register
A. Other means of indicating correct transfer e.g. [PC]→MAR or MAR:=PC
A. Missing square brackets or alternative types of brackets
A. Answers that miss out reference to "contents of"
A. [Memory] for [Memory]$_{addressed}$ / [Memory]$_{MAR}$
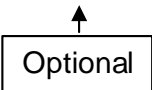
04	4	**All marks AO1 (recall)**	4
		Volatile environment / current processor state saved on stack; Source of interrupt identified; Appropriate interrupt service routine/ISR called; Volatile environment / processor state restored;	

05	1	**All marks AO1 (understanding)**	3
		Differences (2 marks): Any two points from the list below. Candidate only needs to make one side of point, the other can be implied. Do not award marks for two sides of same point.	

Public	Private
(Globally) unique.	Many computers/devices may have same address.
Allocated by a central/regional issuing authority (**A.** example).	Not allocated centrally // allocated by a home user/company/ISP.
Can be connected to directly <u>over the Internet / from outside private network</u>	Difficult/impossible to connect to <u>over Internet // from outside network</u> // must connect to Internet through router/gateway

		Owner can be looked up using WHOIS protocol	Owner cannot be looked up using WHOIS protocol	

A. private IP addresses more secure as cannot be connected to over Internet/from outside network
A. cannot identify location from a private IP address

Why combined device needs both (1 mark):

Needs public IP to connect to/be routed to via Internet and private IP to be on same subnet as computers on LAN/to be used as a gateway by computers on LAN / to connect to LAN;

05	2	**2 marks AO1 (recall): What NAT is:**	3
		Modifying network / IP addresses (and port numbers); as they pass through a router;	

1 mark AO1 (understanding): Why performed:
The private IP addresses used on the LAN are not routable, so cannot be used for routing on the Internet;
The private IP addresses used on the LAN are not unique, so cannot be used by the host to return data;
To improve the security of the LAN;
A. to convert from one address space to another;

05	3	**All marks AO1 (understanding)**	3

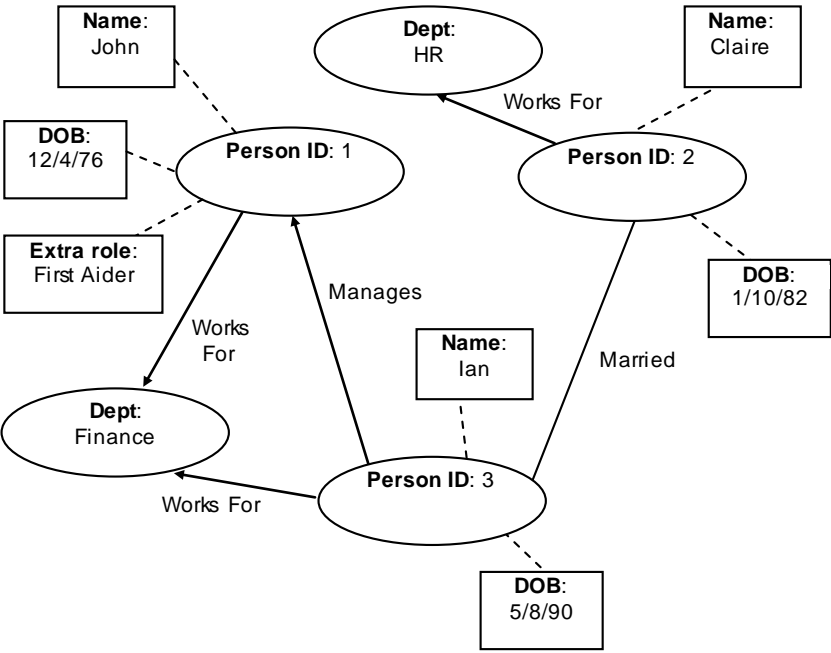| SSD	Hard Disk
Lower power consumption	Lower cost per MB/GB // greater capacity for same price **N.E.** cheaper
Faster read/write (access) times	Higher capacity drives available
No delay whilst disk spins up to speed // lower latency	Have been used for a long time so greater confidence about storing data for long term // less concern about number of write cycles that can take place
Noiseless operation **A.** quieter	
Less heat generated // No additional cooling/fan required	
Less vulnerable to damage from physical impact / magnetism	

		Award **1 mark per valid point made** from the table above about each type of storage device. To award the mark, the point **must be explicitly related to the application** eg "lower power consumption" by itself would not be worth a mark, but "lower power consumption which is important as the NAS will probably be switched on all day" would be. Points can be awarded for both devices, but **MAX 2 if only one type of device is referred to**.	
05	**4**	**All marks AO1 (recall)** (Most commonly) uses NAND flash memory; Data stored using floating gate transistors; This is a type of transistor that can trap and store charge // does not lose state when power no longer applied; (In most implementations) cannot read/write individual bits // data must be read in pages and written/erased in blocks; Can use single-level cells (that store one bit) or multi-level cells (that store two bits); **A.** use of "pages" when "blocks" is meant and vice-versa. **MAX 4**	4
06	**1**	**All marks AO3 (programming)** MemberID INT PRIMARY KEY NOT NULL // MemberID INT PRIMARY KEY(MemberID) ⬆ [Optional] Forename VARCHAR(20) Surname VARCHAR(20) MaxBooks INT DateOfBirth Date **1 mark** for MemberID, with sensible data type and identified as primary key **1 mark** for two other fields with sensible data types and lengths *OR* **2 marks** for all four other fields with sensible data types and lengths **A.** any sensible types. Lengths do not need to be specified. **Valid alternative SQL types are:** • Alternative types For *MemberID*: smallint, mediumint, integer, any text type (see below)	3

		• Alternative types for *text fields (Surname, Forename)*: char, varchar, nchar, nvarchar, ntext, longvarchar, varchar2, nvarchar2, text, tinytext, mediumtext, longtext • Alternative types for *MaxBooks*: smallint, mediumint, integer • Alternative types for *DateOfBirth*: datetime, datetime2, date/time, smalldatetime Allow lengths after numeric types eg INT(11) as these are allowed in MySQL. **Answers using a syntax that is clearly not SQL should be awarded zero marks. But:** • **ignore punctuation errors eg unnecessary colons or commas.** • **answers in SQL style syntax but using non-SQL data types can be credited but MAX 1 of 2 for data types if any non-SQL types used.**	

06	2	**2 marks for AO2 (analyse) and 2 marks for AO3 (programming)** Mark Scheme **AO2 (analyse) – 2 marks:** **1 mark** for correctly understanding the data model and identifying the table that data needs to be extracted from and the fields that need to be extracted, and including these and no other tables or fields in the query **1 mark** for identifying the correct conditions to use within the model for the Author and Price fields to retrieve the required data and for using the correct logical operator (AND) between the conditions **Note:** The AO2 marks for understanding the data model should be awarded regardless of whether correct SQL syntax is used or not as they are for data modelling, not syntactically correct SQL programming **AO3 (programming) – 2 marks:** **1 mark** for correct SQL syntax in two of the four clauses (SELECT, FROM, WHERE, ORDER BY) **OR** **2 marks** for correct SQL syntax in all four clauses – to get two marks, there must be fully correct SQL syntax and all four	4

clauses must be present, but there could be mistakes in the marks awarded for AO2 e.g. an incorrect or missing condition

Example Solution

```
SELECT BookID, Title, Author, Price,
       Category
FROM Book
WHERE Author = "David Ferguson"
      AND Price < 25
ORDER BY Price DESC
```

Additional Guidance

AO2 marks:

Mark(s) can be awarded for the correct logical conditions even if the required table is not identified as being used by the query

AO3 marks:

Accept table names before fieldnames.
Accept use of `Alias`/`AS` command eg `FROM Book AS B` or `FROM Book B` then use of `B` as table name.
Accept `INNER JOIN` written as one word i.e. `INNERJOIN`
Accept `ORDER BY` written as one word i.e. `ORDERBY`.
Accept insertion of spaces into fieldnames.
Accept use of currency formatting for the `25` value.
Ignore unnecessary brackets.
DPT. for unnecessary punctuation – allow one semicolon at the very end of the statement, but not at the end of each clause.
DPT. for fieldname before table name.

06	3	**Mark is for AO1 (knowledge)**	1
		Read; **A.** Retrieve	

06	4	**Mark is for AO1 (understanding)**	1
		Representation 1; **R.** if both lozenges shaded	

06	5	**Marks are for AO1 (understanding)**	2
		More compact; Structure understood directly in some languages (eg Javascript, Python); Easier for computers to parse // quicker to parse; Easier to create; **MAX 2**	

07	1	**Marks are for AO1 (knowledge)** The velocity/speed at which the data is generated/received; The variety/range of data types in the data set (**A.** examples) // unstructured nature of data; **N.E.** Just the words "velocity" or "variety"/"range"	2

07	2	**Marks are for AO1 (understanding)** Data in a functional language is immutable // there are no side-effects of computations // one part of a functional program cannot change data and thus affect another part; Map/reduce operations can be easily parallelised // functional programming operations are often collection oriented (so can be easily parallelised); Order of execution less rigidly defined in a functional language than for procedural/object-oriented/other paradigms; **MAX 2**	2

07	3	**Marks are for AO2 (analysis)**	3

1 mark for Extra role property added correctly to schema
1 mark for correctly placed directed edge labelled Manages and undirected edge labelled Married
1 mark for adding departments correctly with appropriate directed edges, all labelled Works For
A. variation on edge labels so long as meaning is clear.

08	1	**Mark is for AO2 (apply)**	
		$\mathbb{N}$ // { z | z $\in \mathbb{N}$ and z<y }; **A.** Natural numbers **A.** { z | z $\in \mathbb{N}$ and z>=0 and z<y }	1

08	2	**Mark is for AO2 (apply)**	
		36;	1

08	3	**Marks are for AO1 (understanding)**	
		Reduces a list of values to a single value; By applying a combining function;	2

09		**Marks are all AO2 (analysis)** **Levels**		9

Level	Description	Mark Range
3	A line of reasoning has been followed to produce a coherent, relevant, substantiated and logically structured response. The response covers at least three areas indicated in the guidance below and in at least three of these areas there is sufficient detail to show that the student has a good level of understanding of the issues involved. A good level of understanding would be indicated by two or three substantiated points being made per area.	7-9
2	A line of reasoning has been followed to produce a mostly coherent, relevant, substantiated and logically structured response that covers at least two of the areas in the guidance. In each of these areas, at least two valid points must have been made.	4-6
1	A few relevant points have been made but there is no evidence that a line of reasoning has been followed. The points may only relate to one of the areas of the guidance.	1-3

Guidance

Underlying issue:

- Control over data access moves from users to third party cloud storage company
- Company has a responsibility to decide in a fair way how the data can be used

Ethical issues:

- Who will own the data when it is stored on the service?
- What rules should the company develop about acceptable use of its service?
- Need to have transparent policies to gain trust of users
- Need to consider what harmful purposes users might use service for
- What security measures should the developers put in place to protect files? (Accept examples, such as encryption, two-factor authentication)

- Possible tension between security for individual users and security/safety of country / others
- If data is encrypted, should the company know the key to decrypt it or only the user?
- Should the company offer "backdoor" access to security services?
- If company shown to cooperate too much with security services, may lose trust of users / not be commercially viable
- Should the company analyse data stored itself so that it can alert law enforcement agencies if it suspects illegal behaviour?
- Should employees of the company be able to access users files?
- Could the company exploit the data that is stored itself eg analyse files stored to target adverts at users?
- Should other data be gathered by the company, eg who is accessing what files?
- What steps should company take to ensure that user data is not lost / damaged?
- How to deal with copyright material / intellectual property that is uploaded to service?

Legal issues:

- Need to comply with legislation
- Worldwide service so need to deal with different laws in different countries
- Where to base service may be influenced by laws that apply in country
- May be conflict between how users expect company to treat data and legal requirements
- May be obliged to comply with legal notices/rulings which company must keep secret // cannot notify users about
- Privacy / data protection legislation will (probably apply)
- Copyright legislation may be breached if copyright material uploaded

Cultural issues:

- Different values associated with / interpretations placed on privacy in different cultures
- Risk of pushing western values onto other cultures

10	1	**Mark is for AO2 (apply)** ELEPHANT; **A.** letters in uppercase or lowercase or mixed	1

10	2	**Marks are all AO2 (apply)** **1 mark**: "RUN" correctly encoded in ASCII as: 01010010 01010101 01001110 **1 mark**: Student has recognised that bitwise XOR operation should be used by either stating this or demonstrating it by correctly XORing at least one character with the key; **1 mark**: Fully correct encrypted ciphertext: 11101011 00011000 00001111 Award the second and third marks if the student has incorrectly encoded RUN into ASCII, but has performed the XOR operation on this incorrect encoding correctly.	3

10	3	**Marks are all AO1 (understanding)** **Why Caesar cipher insecure (MAX 3):** Each plaintext letter is always converted to the same ciphertext letter // it is a monoalphabetic cipher; Frequencies of usage of letters in writing in English well known; Use of frequency analysis of letters in ciphertext can easily reveal which plaintext letters they correspond to; As this is a shift cipher, only need to map one (or a small number) of letters back from ciphertext to plaintext to correctly deduce the mapping used for all letters; There are only 25 / 26 possible mappings from plaintext to ciphertext; Trivial to use brute force // try out all possible mappings from ciphertext to plaintext; **Why Vernam cipher perfectly secure (MAX 3):** Ciphertext contains no useful information about plaintext; Mapping from plaintext to ciphertext (or vice-versa) is different for each letter position in the plaintext/ciphertext; Brute force // trying every possible key/mapping cannot reveal plaintext // will reveal every possible plaintext // too many possible keys to use brute force; Frequency analysis does not help as different plaintext letters can map onto the same ciphertext letter (depending upon position) // as ciphertext letters have uniform/equal probability; **MAX 4**	4

11	1	**All marks AO1 (recall)** Object type; Fill colour; Edge colour; Line/edge width/thickness; Line/edge pattern/style; Fill pattern/style; **NE** colour, co-ordinates **MAX 2**	2

11	2	**All marks AO1 (understanding)** **Advantages of vector graphics (MAX 2):** (For geometric images) less storage space/memory likely to be needed; **NE.** less space (For geometric images) will load faster from secondary storage; (For geometric images) will download faster; Can be scaled/resized without distortion; A. zoom Image can be (more easily) searched for particular objects; Can (more easily) manipulate individual objects in an image; **Limitations of vector graphics (MAX 2):** Only appropriate for images made of geometric shapes // where it is known what objects an image is composed of; Unsuitable if colour of each pixel is likely to vary // example of a situation in which this is the case eg a digital photograph; Some drawing tools are unlikely to be/won't be available when using vector graphics (eg spray paint, blurring); Can take longer to render an image (for complex images);	3