2015 Paper Model solution

NOTE: The paper itself can be obtained from the AQA exam board website, here. The official mark scheme (that the examiners themselves used when marking the paper) can be picked up from here.

1a. Binary to denary conversion.

128	64	32	16	8	4	2	1
1	0	**1**	**1**	**1**	0	**1**	0

Check: $128 + 32 + 16 + 8 + 2 = \textbf{186}_{10}$

1b. 1110_2 in hexadecimal…

Step 1: Draw a binary nibble/dec/hex conversion table (it's slow, but I personally do it this way, as I know I'll have the right answer and can use it in any other questions that crop up later for reference)

Binary	Dec	Hex
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	**14**	**E**
1111	15	F

Step 3: Look up the appropriate nibbles in the table…
1110 = **E. ANSWER: E**

Note: Another way to quickly get to the answer in this case is to remember that 1111 would be F, and that the question is only one number lower, so must be E.

1c. 4C in denary.

Method 1:
Step 1: Look up 4 and C in the nibbles table I drew previously (I did say it'd come in handy). Write the nibbles one after another.
0100 1100

4   C
Step 2: Convert the binary number into denary, just like in Q1a.

128	*64*	*32*	*16*	*8*	*4*	*2*	*1*
0	**1**	0	0	**1**	**1**	0	0

= 64 + 8 + 4 = 76
Answer: 76.

Method 2:
Step 1: Starting at the LSF (Least Significant Figure; C in this case), multiply its denary value (C = 12) by 1, and write down the result (12).

Step 2C: Take the denary value of the next digit (4 = 4) and multiply it by 16 (Answer is 64). Add this to the previous result to get the answer (12+64 = 76).

Note: If there'd been another hex digit after that one, we'd need to multiply the denary value of that digit by 16x16 (256). The next digit after that would need multiplying by 16x16x16 (4096) and so on.

1d. Storage sizes

Amount	Size in bits
15 bits	= 15
3 nibbles	= 12
2 bytes	= 16
1kB	= 1024

Answer: 3 nibbles, 15 bits, 2 bytes then 1kB.

1e. If 1100110 is worth 'f', then the next binary number in the sequence (for 'g') should be:
Answer: 1100111

1f i. The first option is wrong, as they use the white colour code for the black pixels and vice-versa. The second is wrong, as there are only three pixels shown, but 4 sets of bits. The third option is correct.

1f ii. **Method 1:** 2^2 is 4.
Note: If the question was asking about 3 bits, I'd need to do 2^3 to get the answer (8).

Method 2: With two bits, there are four different possible combinations: 00, 01, 10 and 11. Therefore, 4 different colours can be encoded.

1f iii. **Method 1:** Starting at 1, count the binary bit values until you arrive at/exceed the target number. The answer is one less than that. I.e. 1, 2, 4, 8, 16, **32** (stop after 5 bits). Answer: To encode 32 different colours, **5** bits are needed.
Note: So if I was trying to encode between 33 and 63 different colours, I'd need 6 bits.

1f iv. The resolution of the image OR the file compression method used when saving the file will both affect the quality of the image.

2a. Python: List *(you could also go for dictionaries, tuples or classes)*

2b. Advantages of using arrays over variables
Advantage 1: An array will allow the records to be accessed by referring to their index for easier iteration.
Advantage 2: The data in the array can be sorted more conveniently
Advantage 3: The code needed to access the contents of the array will be shorter than that needed to access individual variables.

+ The size of the group would need to be known with variables, so the appropriate amount could be hard-coded. This wouldn't be a problem with an array.
+ Future modification would be easier.

3a. An algorithm is a sequence of steps designed to solve a problem.
Note: This is the word-for-word official AQA definition of an algorithm, taken from their mark scheme.

3b. i. Variable i serves as a <u>counter</u> in the program to refer to a specific index in the array.

3b ii. Matched is a Boolean

3b. iii. The algorithm checks to see if 'diffie' is located inside an array.

3b iv. The second algorithm is more efficient, as it stops the WHILE loop if the value being sought is located, (potentially) requiring less iterations to complete.
Note: The process of starting with the first array element, and going through them one by one to find a value is called a 'linear search'.

4a. **Answer:** Analysis, Design, Implementation, Testing.
Notes:
In the analysis phase, the developer meets with the client and establishes what the problem is to be solved, perhaps interviewing users of the current (presumably paper-based) system and establishing precisely what the user wants their new system to do.

In design, the developer designs the data structures that will be needed, and produces mock-ups of what the eventual UI will look like to ensure the client is going to get the product they want once it is written. Use-cases are produced for different outcomes to ensure the system will work as needed.

In implementation, the code is written.

In the testing phase, the code is tested first by the development team (alpha testing), then shown to select users (beta testing) to identify and report bugs before client for sign-off.

4b. i. Spiral or agile are two other development models.

4b ii. Prototyping is the process of producing a simplified version of the proposed solution as a demonstration/proof of concept for how the end product will work.

Advantages of this are that it provides the user with an opportunity to determine whether or not the program is as the client envisages. Experimenting with a prototype may also provide inspiration for other features that can be worked into the final product. Any

features that aren't as per the client's needs can be removed or re-worked before building the finished solution.

The disadvantages are that developers can become attached to prototypes and convert them into the client's final product. This can be unwise, as prototypes are often lazily coded in order to produce a demonstrable product and it may make the eventual solution less robust and efficient than it may have been if re-written.

5a i. CountryName

5a ii. 6.

5a iii. The relationship created by having the primary key of the country table used as a foreign key in the airport table.

5b. Option 1 is wrong, because PUT isn't the SQL syntax for inserting a record.
Option 2 is wrong, because UPDATE is used for editing existing records.
So the answer is option **3**.

5c. The first line tells the database to only output two columns.
The FROM line tells SQL which database tables we're going to use.
WHERE sets out our query criteria
ORDER BY tells the database engine how to sort the resulting data.
Answer:
FCO, 4
FRA, 2
HAM, 2

6a. A computer system is a combination of hardware and software.
Note: AQA official definition.

6b. Instructions are processed as follows:

The instructions are held in memory,
Loads instructions from secondary storage to memory,
Instructions are stored in a contiguous format,
The processor fetches an instruction from memory,
The processor decodes the instruction,
The processor executes the instruction,
The result may be stored back into memory,
The process is repeated continuously

6c. A dual-core CPU may be faster at completing certain tasks because it can process two instructions at the same time.

6d. Optical media uses a laser to read data.
ROM contents can't be changed.
Cache memory is small, fast storage found close to the CPU.

6e. Virtual memory (Hard drive space that the computer treats as if it were RAM) may be used when all the computer's main memory is used up but more is needed.
Note: As RAM tends to operate in nano-second access times and hard drives work in milli-seconds, a computer using virtual memory will run noticeably more slowly. This is one of the reasons that installing more RAM in a PC will make it run more quickly.

7a. It has a RETURN command at the end of it.

7b. It's a 'real' value. We can tell, as it is assigned a number with a floating point.

7c. Answer:

Cost
0
2000
1000
500

7d. Advantages of using functions when coding are:
Commonly accessed code only needs writing once, then can be called repeatedly (using parameters if needed)
Maintenance becomes easier, as developers can focus on individual functions.
Teams can work on the code, by assigning functions to individuals/teams and agreeing parameters and return values.
+ the code will be easier to read, as bulky portions of code can be stored in functions.

8. A network is a set of devices connected together to allow them to exchange data. One advantage of networking computers is that it enables hardware resources such as printers and scanners (or an Internet connection) to be shared between computers. It also allows users to have centralised file storage so that files can be shared among those on the same network. Administrative tasks such as performing backups can also be performed over the network, making the IT system in question more robust.

Disadvantages of networks are that they require the initial purchase of NIC (Network Interface Cards) or WiFi cards for the client computers, then either switches or WiFi hotspots to set them up initially. A network will also require configuration, and in large organisations will require a dedicated network manager (and possibly IT support team) to ensure the network stays online. Some virii are also able to traverse the nodes of a network, so that once a single machine is infected, the other machines can be too. This necessitates good security practices and up-to-date anti-virus software to provide protection.

9. **Answer:**
```
pages ← USERINPUT
seconds ← 0
WHILE pages > 0
        diff ← USERINPUT

        IF diff = 'easy' THEN
                seconds ← seconds + 40
        ENDIF
```

```
        IF diff = 'difficult' THEN
                seconds ← seconds + 100
        ENDIF pages ← pages − 1
ENDWHILE

OUTPUT seconds
```

Note: Try to ensure you indent nicely, to make things clearer for the examiner to read. I'd be inclined with something like this (unless I was running out of time) to draft my answer on rough paper, check it (twice) then write it up in the answer book.

10. a. i. **Answer:** 'o'
Note: For some reason, AQA often start their indices at 1 for the first character, whereas most languages start at 0 for the first character. Whenever a question refers to an index, look closely to establish where they start. Sometimes, the question text will implicitly state it starts at 1, and other times (like here) you can work it out by looking at provided examples.

10. a. ii. **Answer:** 'd'
Note: As the answer is a character, it's better to wrap it in quotes. The same applies for strings too.

10. b. **Answer:**

strIn	isPalindrome	iUp	iDown
abcaba	true	1	6
		2	5
		3	4
	false	4	3

Practice answering trace table questions. There are lots over at www.BourneToCode.com

10. c. i. Typing WHIKE instead of WHILE is a **syntax** error.

10. c. ii. Writing a > when you meant to put < means the program will still run, but you'll get the wrong result. This is an example of a **logical** error.