Example Candidate Responses

Cambridge International AS & A Level

Cambridge International AS & A Level Computer Science

9608

Paper 1

Cambridge Advanced

CAMBRIDGE International Examinations

Version 1

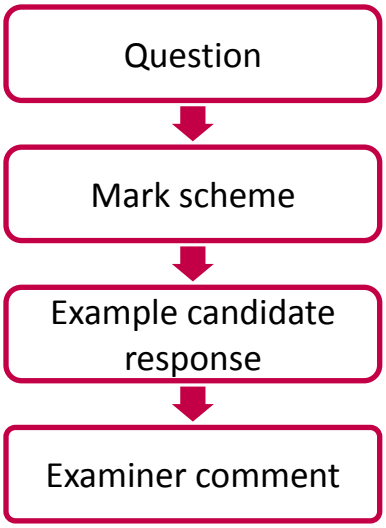
Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS & A Level Computer Science (9608), and to show how different levels of candidates' performance relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen to exemplify a range of answers. Each response is accompanied by a brief commentary explaining the strengths and weaknesses of the answers.

For ease of reference the following format for each component has been adopted:



Each question is followed by an extract of the mark scheme used by examiners. This, in turn, is followed by examples of marked candidate responses, each with an examiner comment on performance. Comments are given to indicate where and why marks were awarded, and how additional marks could have been obtained. In this way, it is possible to understand what candidates have done to gain their marks and what they still have to do to improve their marks.

This document illustrates the standard of candidate work for those parts of the assessment which help teachers assess what is required to achieve marks beyond what should be clear from the mark scheme. Some question types where the answer is clear from the mark scheme, such as short answers and multiple choice, have therefore been omitted.

Past papers, Examiner Reports and other teacher support materials are available on Teacher Support at https://teachers.cie.org.uk

Assessment at a glance

For Cambridge International AS and A Level Computer Science, candidates may choose:

- to take Papers 1, 2, 3 and 4 in the same examination series, leading to the full Cambridge International A Level
- to follow a **staged** assessment route by taking Papers 1 and 2 (for the AS Level qualification) in one series, then Papers 3 and 4 (for the full Cambridge International A Level) in a later series
- to take Papers 1 and 2 only (for the AS Level qualification).

Components All candidates take	Weighting (%)	
	AS	A
Paper 1 Theory Fundamentals This written paper contains short-answer and structured questions. There is no choice of questions. 75 marks Externally assessed 1 hour 30 minutes	50	25
Paper 2 Fundamental Problem-solving and Programming Skills This written paper contains short-answer and structured questions. There is no choice of questions. Topics will include those given in the pre-release material.[1] 75 marks Externally assessed 2 hours	50	25
Paper 3 Advanced Theory This written paper contains short-answer and structured questions. There is no choice of questions. 75 marks Externally assessed 1 hour 30 minutes	–	25
Paper 4 Further Problem-solving and Programming Skills This written paper contains short-answer and structured questions. There is no choice of questions. Topics will include those given in the pre-release material.[1] 75 marks Externally assessed 2 hours	–	25

Advanced Subsidiary (AS) forms 50% of the assessment weighting of the full Advanced (A) Level.

Teachers are reminded that the latest syllabus is available on our public website at **www.cie.org.uk** and Teacher Support at **https://teachers.cie.org.uk**

Paper 1 – Theory Fundamentals

Question 1

1 **(i)** Convert the following binary number into hexadecimal.

1 0 1 1 1 0 0 0

.....[1]

(ii) Convert the following denary number into BCD format.

9 7

.....[1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

114								
- 93								

[2]

Mark scheme

1 **(i)** B 8 **[1]**

(ii) 1 0 0 1 0 1 1 1 **[1]**

(iii)

114	**0**	**1**	**1**	**1**	**0**	**0**	**1**	**0**
– 93	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**

[2]

Example candidate response – high

1 (i) Convert the following binary number into hexadecimal.

10111000

B8 .....[1]

(ii) Convert the following denary number into BCD format.

97

1001 0111 .....[1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

128 64 32 16 8 4 2 1

114 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 |

-93 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |

[2]

Examiner comment – high

In part (i) the candidate has correctly converted the given binary number to hexadecimal format. The answer would have been more complete if the subscript 16 was added to indicate the base, i.e. $B8_{16}$.

In part (ii) the candidate has correctly converted the denary number into Binary Coded Decimal (BCD) format and has neatly written the answer as two groups of four binary digits.

In part (iii) the candidate has correctly converted both the positive and negative denary numbers into two's complement binary format.

Marks awarded for part (i) = 1/1
Marks awarded for part (ii) = 1/1
Marks awarded for part (iii) = 2/2

Total marks awarded = 4 out of 4

Example candidate response – middle

1 (i) Convert the following binary number into hexadecimal.

10111000

184 [1]

(ii) Convert the following denary number into BCD format.

97

1001 0111 [1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

114	0	1	1	1	0	0	1	0
-93	1	0	1	0	0	0	1	1

[2]

Examiner comment – middle

In part (i) the candidate has converted the binary number into denary, instead of hexadecimal. To be awarded the mark this denary value needs to be converted to hexadecimal.

In part (ii) the candidate has correctly converted the denary number into Binary Coded Decimal (BCD) format and has neatly written the answer as two groups of four binary digits.

In part (iii) the candidate has correctly converted both the positive and negative denary numbers into two's complement binary format.

Marks awarded for part (i) = 0/1
Marks awarded for part (ii) = 1/1
Marks awarded for part (iii) = 2/2

Total marks awarded = 3 out of 4

Example candidate response – low

1 (i) Convert the following binary number into hexadecimal.

10111000

B8 ..... [1]

(ii) Convert the following denary number into BCD format.

97

01100001 ..... [1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

	-128	64	32	16	8	4	2	1
114	0	1	1	1	0	0	1	0
-93	0	0	1	0	0	0	1	1

[2]

Examiner comment – low

In part (i) the candidate has correctly converted the given binary number to hexadecimal format. The answer would have been more complete if the subscript 16 been added to indicate the base, i.e. $B8_{16}$.

In part (ii) the candidate has confused Binary Coded Decimal (BCD) format with pure binary and has converted the denary number into an eight bit binary number instead of converting each individual denary digit into a four bit binary integer.

In part (iii) the candidate has correctly identified the weightings for each of the bits in the registers given on the examination paper and the conversion of the positive denary number has been completed correctly. When converting the negative value the candidate has correctly calculated that the difference between 128 and 93 is 35 and has converted that value to binary but has omitted to include the 1 in the leftmost bit to show that −93 = −128 + 35. This was a common error in this part of the question.

Marks awarded for part (i) = 1/1
Marks awarded for part (ii) = 0/1
Marks awarded for part (iii) = 1/2

Total marks awarded = 2 out of 4

Question 2

2 (a) Sound can be represented in a computer in a digital format.

(i) Give the definition of the term sampling.

.....

.....

.....[1]

(ii) Give **one** reason why 16-bit sampling is used in an audio compact disc (CD).

.....

.....[1]

(iii) Explain what is meant by the term sampling resolution.

.....

.....

.....

.....[2]

(iv) Give **one** benefit and **one** drawback of using a higher sampling resolution.

Benefit .....

.....

Drawback .....

.....[2]

(b) Describe **two** typical features found in software for editing sound files.

1 .....

.....

2 .....

.....[2]

Question 2, continued

(c) Explain the difference between *lossless* and *lossy* data compression techniques.

.....

.....

.....

.....

.....

.....[3]

Mark scheme

2 (a) (i) Any **one** from:

- amplitude of sound wave taken at different points in time
- measurement of value of analogue signal at regular time intervals/a point in time **[1]**

(ii) Any **one** from:

- bit depth/sampling resolution sufficient for good quality sound
- higher bit depth/sampling resolution would mean bigger files
- ...hence less (music) content on each CD
- can represent dynamic range of about 90 dB
- 90 dB is basically the maximum dynamic range of human hearing
- compromise between quality and reasonable file size **[1]**

(iii) Any **two** from:

- resolution is the number of distinct values available to encode/represent each sample
- specified by the number of bits used to store/record each sample
- sometimes referred to as bit depth
- the higher the sampling resolution, the smaller the quantization error
- a higher sampling resolution results in less distortion of the sound
- usually 8 bit, 16 bit, 24 bit or 32 bit **[2]**

(iv) **1 mark** for benefit and **1 mark** for drawback.

benefit

- allows for larger dynamic ranges
- ...as dynamic range is approximately six times the bit depth
- more accurate representation/crisper sound quality

drawback

- bigger files/occupies more memory/storage
- longer to transmit data/download music
- greater processing power needed **[2]**

Mark scheme, continued

(b) Any **two** from:

- edit start time, stop time and duration of any sound/timeline
- extract/delete/save part of a clip
- frequency, amplitude, pitch alteration
- fade in/out of a clip
- mix/merge multiple sound sources/tracks
- combine different sources at various volume levels
- pan between tracks/channels
- use of filters
- playback to speakers, processors or recording medium
- conversion between different audio file formats
- etc...

[2]

(c) Any **three** from:
For full marks both techniques must be mentioned.

- lossless designed to lose none of the original detail/lossless allows original file to be recreated exactly
- lossless technique based on some form of replacement
- mention of type of replacement, for example RLE, FLAC etc.
- by example: e.g. 000–1111–222222–333 = 3–0, 4–1, 6–2, 3–3 etc.
- maximum compression about 50%
- lossy may result in loss of detail compared to original file/lossy does not allow original file to be re-created exactly
- lossy techniques make decision about what parts of sound/sound file are important and discards other information
- only keeps sounds human ear can process/discards sounds most people cannot hear
- ... then applies lossless technique, for further reduction
- lossy compression can reduce to about 10%
- an example of jpeg, mp3 or other correct examples of compressed formats.

No double credit to opposite answers, e.g. lossless maintains detail, but lossy loses detail just one mark.

[3]

Example candidate response – high

2 (a) Sound can be represented in a computer in a digital format.

(i) Give the definition of the term sampling.

It refers to regularly inputting the value of a sound to get a digital representation of the analogue sound. The more samples taken, the more accurately the digital representation is. [1]

(ii) Give **one** reason why 16-bit sampling is used in an audio compact disc (CD).

Because 8 samples are taken per second (sampling rate is 8) and due to Nyquist theorem, the sampling resolution must be twice this value, so 16-bit. [1]

(iii) Explain what is meant by the term sampling resolution.

Sampling resolution is the number of bits assigned to each sample of the sound which is taken. A higher sampling resolution will lead to the sound the resulting sound having a better quality. [2]

(iv) Give **one** benefit and **one** drawback of using a higher sampling resolution.

Benefit Digital Sound will have a higher quality and be more similar to the original sound

Drawback It will increase the file size of the sound, so it will take up more storage space. [2]

(b) Describe **two** typical features found in software for editing sound files.

1 The option to change the frequency (pitch) of the sound

2 The option to crop parts of the sound which has been input (remove parts of the sound). [2]

Example candidate response – high, continued

(c) Explain the difference between *lossless* and *lossy* data compression techniques.

Lossless techniques result in no data being lost (file doesn't lose accuracy, can be decompressed back to a copy of original), whereas lossy techniques result in data being lost (can't be decompressed back to original). However, lossy techniques result in greater compression and reduction of file size than lossless techniques (only up to about half the original file size). [3]

Lossless techniques include ~~run~~ run-length-encoding (repeating patterns in data), whereas lossy techniques includes perceptual coding (removes less significant data).

Examiner comment – high

It should be noted here that part (a)(i)–(iv) are all one sub-question and the rubric at the beginning of part (a) refers to sound. Candidates who refer to, for example, images, in their answers or candidates who give image examples in their answers will therefore not be awarded any marks.

In part (a)(i) the candidate has correctly explained that sampling is the capturing of the value of the sound wave at regular intervals and has been awarded the mark. The definition given could be improved if *inputting* had been replaced with a different word, for example, measuring, but it is clear what the candidate means. The expansion statement is also correct, although not required as there is just one mark for this part question.

In part (a)(ii) there needs to be an awareness that an audio CD has a fixed amount of storage space, and so in order to accommodate a reasonable number of tracks on the CD there needs to be a compromise between the accuracy of the digital representation of the audio so that the resulting sound is acceptable to listeners and the size of the files created. 16-bit sampling best satisfies both of these conditions.

In part (a)(iii) the candidate has correctly stated that sampling resolution is the number of bits assigned to each sample and has been awarded one mark. However, the statement that a higher sampling resolution leads to better sound quality is not precise enough to be awarded the second mark. It is the accuracy (or precision) of the sampled sound that is improved. If the original (analogue) audio is of poor quality it does not matter what sampling resolution is used the result will still be a poor quality sound.

In part (a)(iv) the candidate has given two very good answers, explaining that the sampled sound will be more similar to the original and that the higher sampling resolution will result in a greater file size hence requiring more storage space. Both marks have been awarded.

In part (b) the candidate was awarded both marks for correctly identifying features found in software for editing sound files.

In part (c) the candidate has given an excellent answer. The statement that lossless compression means that the file can be decompressed to an exact copy of the original is awarded a mark; the next statement about lossy compression is the reverse argument and so is not awarded a second mark. The candidate has then explained about the difference in compression ratios which is awarded the second mark and has named two compression techniques, any one of which would be awarded the third mark.

Marks awarded for part (a) = (i) 1/1, (ii) 0/1, (iii) 1/2, (iv) 2/2
Marks awarded for part (b) = 2/2
Marks awarded for part (c) = 3/3

Total marks awarded = 9 out of 11

Example candidate response – middle

2 (a) Sound can be represented in a computer in a digital format.

(i) Give the definition of the term sampling.

Is the use of samples to record analogue data such as sound

[1]

(ii) Give **one** reason why 16-bit sampling is used in an audio compact disc (CD).

It is enough sampling to store songs

[1]

(iii) Explain what is meant by the term sampling resolution.

The amount of samples that are recorded in one second. It is measured in Hertz. The amount of bits that are used in each sample. This determines the precision of the sound

[2]

(iv) Give **one** benefit and **one** drawback of using a higher sampling resolution.

Benefit The quality of the sound is really good and precise

Drawback It takes up a lot of file size

[2]

(b) Describe **two** typical features found in software for editing sound files.

1 DAC, digital analogue converter

2 ADC, analogue digital converter

[2]

Example candidate response – middle, continued

(c) Explain the difference between *lossless* and *lossy* data compression techniques.

lossless compression is a compression where the data doesn't lose any accuracy when it is decompressed because when it is decompressed it is identical to the original data. an example would be a GIF file lossy compression does lose some accuracy because temporal and spatial redundancy are applied to the compression file, an exam ple would be a JPEG file [3]

Examiner comment – middle

The responses to parts (a)(i) and (a)(ii) are not precise enough to be awarded any marks. In part (a)(i) the candidate needs to define what is meant by a sample, and in (a)(ii) there needs to be an explanation of why 16-bit sampling is enough to store songs.

In part (a)(iii) the candidate has correctly explained what sampling resolution is and is awarded one mark. There is also an expansion statement that refers to the precision of the sound, which is good enough to be awarded the second mark.

The responses to part (a)(iv) are just good enough to be awarded both marks. The candidate has qualified the first statement by saying that the quality is precise, which has been accepted as equivalent to accurate and *a lot of file size*, though worded poorly, is enough to show that there is understanding that the file size is increased.

In part (b) the response is not precise enough to gain any marks. The second feature is just the opposite of the first and so is not worthy of a second mark. Sound editing software might very well include a feature to convert analogue sound to digital, but this answer is not in any context and needs expansion. It is too generalised a statement to be awarded a mark.

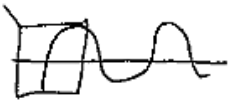
In part (c) the response is awarded all three marks. The candidate has also stated that lossless compression allows decompression to the original, which is awarded one mark. There is a correct example of a compressed file type, which has been awarded the second mark and a method of compression has been identified for the third mark.

Marks awarded for part (a) = (i) 0/1, (ii) 0/1, (iii) 2/2, (iv) 2/2
Marks awarded for part (b) = 0/2
Marks awarded for part (c) = 3/3

Total marks awarded = 7 out of 11

Example candidate response – low

2 **(a)** Sound can be represented in a computer in a digital format.



(i) Give the definition of the term sampling.

The ~~section~~ section of sound/wave that you're focusing on.

[1]

(ii) Give **one** reason why 16-bit sampling is used in an audio compact disc (CD).

It's the most efficient way.

[1]

(iii) Explain what is meant by the term sampling resolution.

The quality of the sound. The higher the resolution, the better the quality.

[2]

(iv) Give **one** benefit and **one** drawback of using a higher sampling resolution.

Benefit Better quality

Drawback ~~Hi~~ File size increases

[2]

(b) Describe **two** typical features found in software for editing sound files.

1 ~~Adding more sound files~~ Increase/decrease pitch/volume of the sound file

2 Deleting one or more or parts of a sound file.

[2]

Example candidate response – low, continued

(c) Explain the difference between *lossless* and *lossy* data compression techniques.

In lossless compression when the file is compressed, ~~its~~ the result is an identical copy of the orignal where as in lossy redundant parts are lost but this changes / decreases the file quality / size. [3]

Examiner comment – low

The responses to parts (a)(i) and (a)(ii) are not precise enough to be awarded any marks. In part (a)(i) the definition refers to a *section* of the sound and the diagram is actually incorrect as it also suggests that it is a whole section of the sound wave that is being examined rather than a single point on the curve. In (a)(ii) there needs to be an explanation of why 16-bit sampling is used, the candidate's response is far too general to be awarded a mark at this level.

In part (a)(iii) the candidate should have first explained what was meant by sampling resolution and then explained the effect of changing the resolution. This explanation alone is not precise enough to be awarded a mark. Similarly, in part (a)(iv) 'better quality' is too imprecise for the mark, it needs reference to accuracy of representation, whilst the answer given for the drawback is just good enough to be awarded a mark.

In part (b) the candidate has described two correct features of sound editing software and is awarded both marks.

In part (c) the candidate has stated that lossless compression allows decompression to the original, which is awarded one mark. The second statement referring to lost data reducing the file size is also awarded a mark, but there needs to be an additional correct statement for the award of a third mark.

Marks awarded for part (a) = (i) 0/1, (ii) 0/1, (iii) 0/2, (iv) 1/2
Marks awarded for part (b) = 2/2
Marks awarded for part (c) = 2/3

Total marks awarded = 5 out of 11

Question 3

3 Five modes of addressing and five descriptions are shown below.

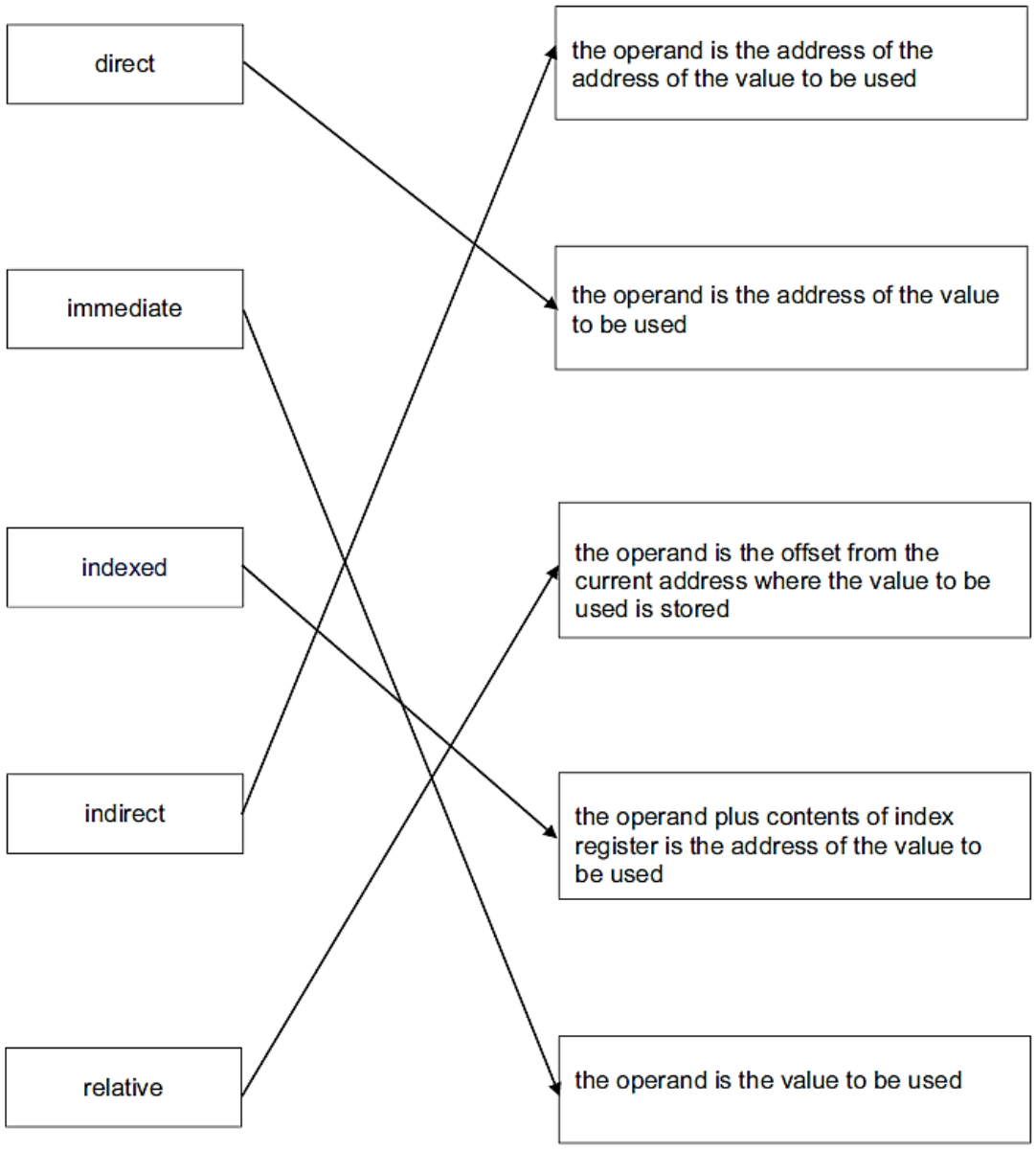
Draw a line to connect **each** mode of addressing to its correct description.

Mode of addressing	Description
direct	the operand is the address of the address of the value to be used
immediate	the operand is the address of the value to be used
indexed	the operand is the offset from the current address where the value to be used is stored
indirect	the operand plus the contents of the index register is the address of the value to be used
relative	the operand is the value to be used

[4]

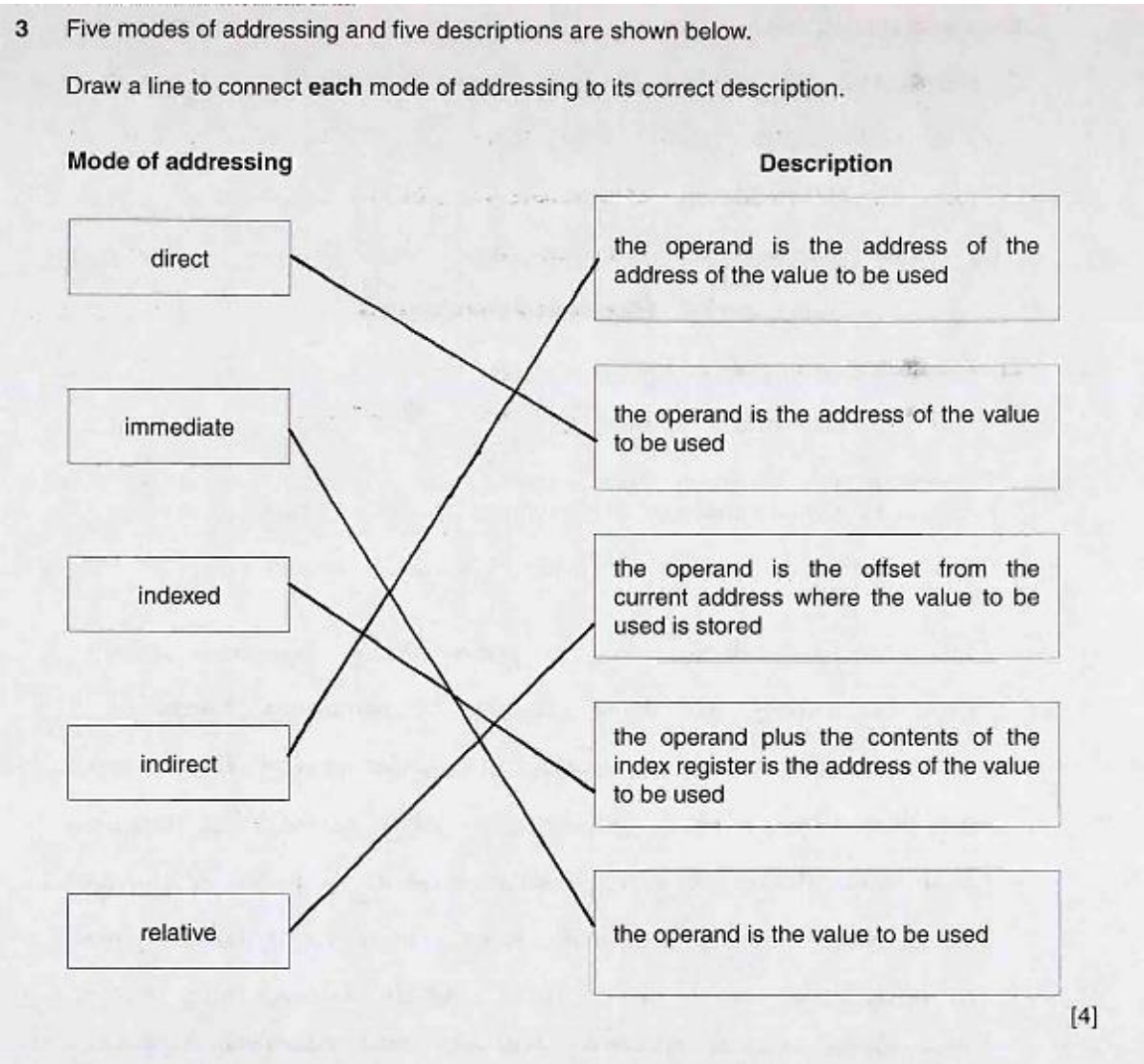
Mark scheme

3



[4]

Example candidate response – high

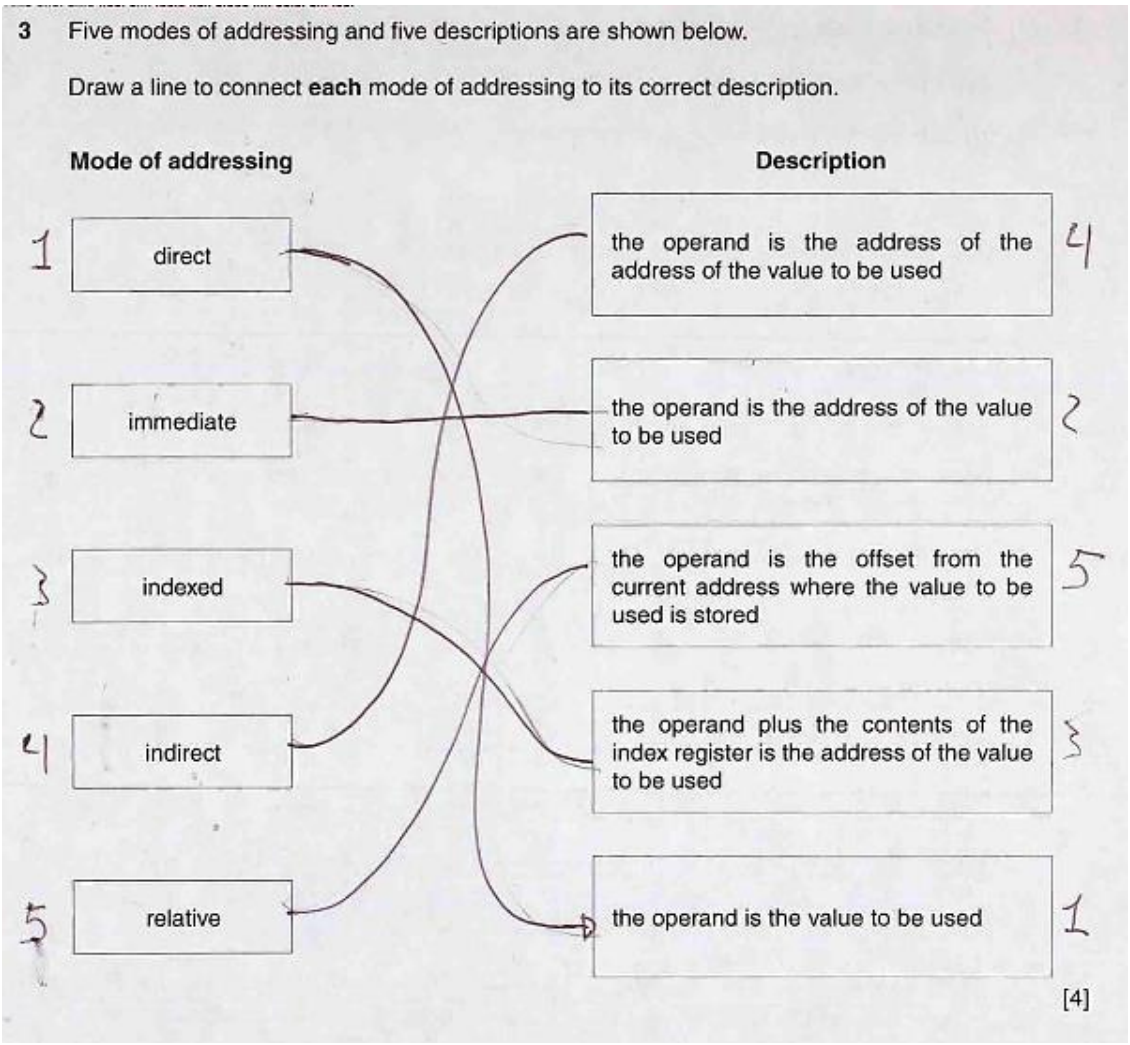


Examiner comment – high

The candidate has correctly connected each mode of addressing with the corresponding description. There are no incorrect connections, so four marks are awarded.

Total marks awarded = 4 out of 4

Example candidate response – middle



3 Five modes of addressing and five descriptions are shown below.

Draw a line to connect **each** mode of addressing to its correct description.

Mode of addressing		Description	
1	direct	the operand is the address of the address of the value to be used	4
2	immediate	the operand is the address of the value to be used	2
3	indexed	the operand is the offset from the current address where the value to be used is stored	5
4	indirect	the operand plus the contents of the index register is the address of the value to be used	3
5	relative	the operand is the value to be used	1

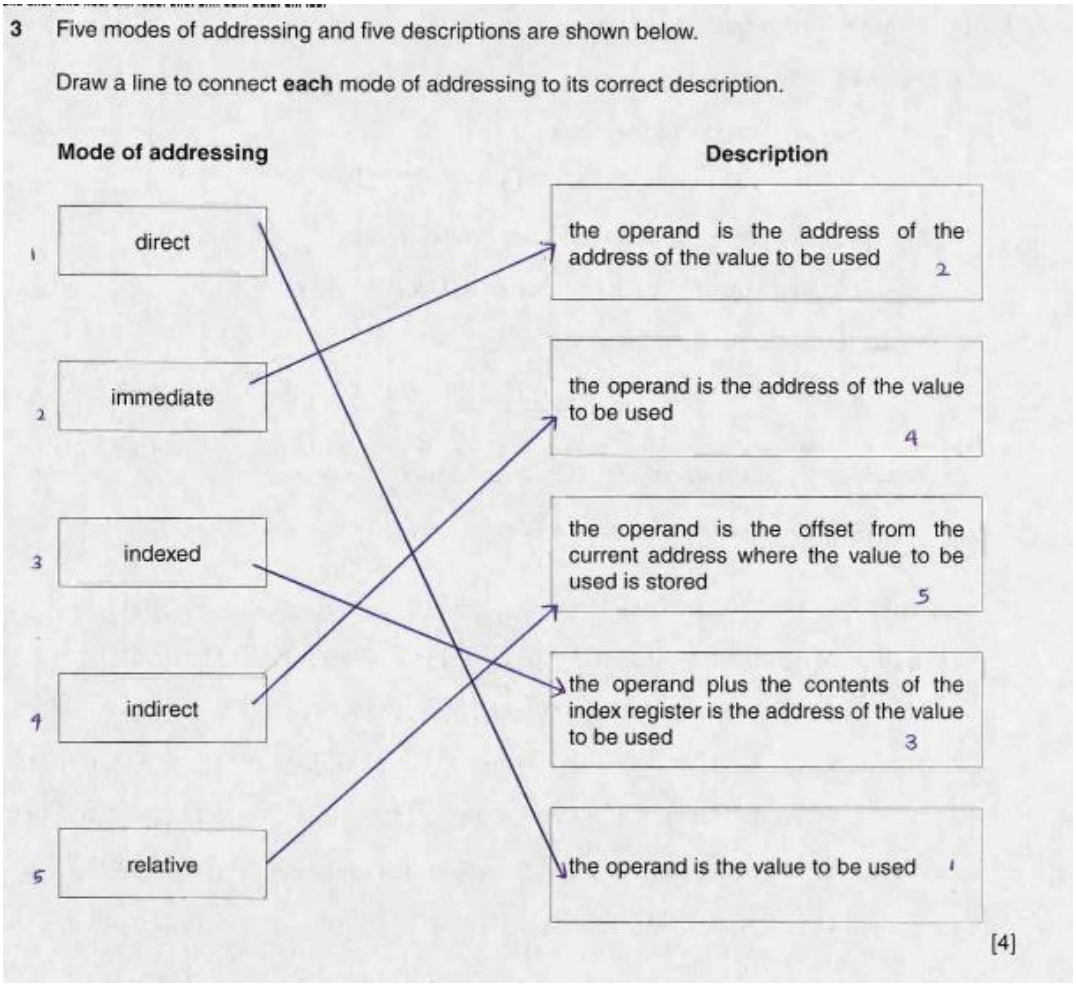
[4]

Examiner comment – middle

This candidate has confused direct addressing and immediate addressing and has thus made two incorrect connections, so is awarded two of the four marks.

Total marks awarded = 2 out of 4

Example candidate response – low



3 Five modes of addressing and five descriptions are shown below.

Draw a line to connect **each** mode of addressing to its correct description.

Mode of addressing	Description
direct	the operand is the address of the address of the value to be used
immediate	the operand is the address of the value to be used
indexed	the operand is the offset from the current address where the value to be used is stored
indirect	the operand plus the contents of the index register is the address of the value to be used
relative	the operand is the value to be used

[4]

Examiner comment – low

This candidate has correctly identified the descriptions of indexed and relative addressing; however, the descriptions of direct addressing, immediate addressing and indirect addressing have been confused and there are thus three incorrect connections, so the candidate is awarded one mark.

Total marks awarded = 1 out of 4

Question 4

4 (a) Sensors are one type of input device.

For each of the following situations, name a **different** sensor that could be used.

(i) air conditioning in an office building

.....[1]

(ii) maintaining correct growing conditions in a greenhouse

.....[1]

(iii) detecting an intruder in a building

.....[1]

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data are transmitted to a central computer. This is hundreds of kilometres away.

Describe **one** way of ensuring that the integrity of the data is retained during the transmission stage.

.....

.....

.....

.....

.....

.....

.....[4]

Mark scheme

4 **(a)** answer requires a **different sensor** for **each** part, **1 mark** for each part

(i) temperature/thermistor **[1]**

(ii) moisture, humidity, light/photodiode, temperature, pH **[1]**

(iii) sound/acoustic, infrared, pressure, motion, microwave **[1]**

(b) **1 mark** for name + **3 marks** for description

parity check

- uses even or odd parity which is decided before data sent
- each byte has a parity bit
- parity bit is set to 0 or 1 to make parity for byte correct
- after transmission, parity of each byte re-checked
- if it is different, then an error is flagged
- any reference to use of parity blocks/parity byte to (identify position of incorrect bit)

checksum

- a calculation is carried out on the data to be sent (checksum)
- the result is sent, along with data to recipient
- checksum is re-calculated at receiving end
- if both sums are the same, no error has occurred
- if the sums are different, the data has been corrupted during transmission
- request is sent to re-send data

[4]

Example candidate response – high

4 (a) Sensors are one type of input device.

For each of the following situations, name a **different** sensor that could be used.

(i) air conditioning in an office building

Temperature sensor [1]

(ii) maintaining correct growing conditions in a greenhouse

Humidity sensor [1]

(iii) detecting an intruder in a building

Motion Sensor [1]

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data are transmitted to a central computer. This is hundreds of kilometres away.

Describe **one** way of ensuring that the integrity of the data is retained during the transmission stage.

Parity check could be used. The two devices (sensor and computer) ~~to~~ will agree on a parity (odd or even), the last digit will be the checking digit* ~~when the receiving device~~ After the transmission, the receiving device will check the number of 1s or 0s and if it doesn't match with the sending device, an error will be produced. [4]

* (1 for an even parity, 0 for an odd parity).

Examiner comment – high

In part (a) the candidate has correctly identified three different sensors that could be used in the given situations.

In part (b) a method of ensuring data integrity has been named, a parity check, and so a mark is awarded for the identification of the method. The candidate has stated that there will need to be agreement on the type of parity used, so a second mark is awarded. The description of odd or even parity, however, is not detailed enough to be awarded any marks because the additional statement is incorrect and *checking digit* is not sufficiently precise for a description of the parity bit. There is also insufficient precision in the description of the receiving device checking the parity as the candidate does not explain whether the ones and zeros are being checked horizontally in a byte or vertically in a column. A third mark is awarded for the error being produced if parity of received data is different.

Marks awarded for part (a) = (i) 1/1, (ii) 1/1, (iii) 1/1
Marks awarded for part (b) = 3/4

Total marks awarded = 6 out of 7

Example candidate response – middle

4 **(a)** Sensors are one type of input device.

For each of the following situations, name a **different** sensor that could be used.

(i) air conditioning in an office building

Temperature Sensor [1]

(ii) maintaining correct growing conditions in a greenhouse

light sensor [1]

(iii) detecting an intruder in a building

heat/sound motion sensor [1]

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data are transmitted to a central computer. This is hundreds of kilometres away.

Describe **one** way of ensuring that the integrity of the data is retained during the transmission stage.

One way of keeping integrity is using parity byte. This checksum (within the data) will easy tells us if any corruption has happened. [4]

Examiner comment – middle

In part (a) the candidate has correctly identified three different sensors that could be used in the given situations.

In part (b) a method of ensuring data integrity has been identified, the use of a parity byte, and so a mark is awarded. The second statement is too generalised to be awarded any marks as there is no further description of the method.

Marks awarded for part (a) = (i) 1/1, (ii) 1/1, (iii) 1/1
Marks awarded for part (b) = 1/4

Total marks awarded = 4 out of 7

Example candidate response – low

4 **(a)** Sensors are one type of input device.

For each of the following situations, name a **different** sensor that could be used.

(i) air conditioning in an office building

Temperature Sensure [1]

(ii) maintaining correct growing conditions in a greenhouse

Moisture / humidity [1]

(iii) detecting an intruder in a building

Laser Sensor [1]

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data are transmitted to a central computer. This is hundreds of kilometres away.

Describe **one** way of ensuring that the integrity of the data is retained during the transmission stage.

Using data encryption, the original text will be turned into encrypted text using a key value hence the only way to do a decryption and manipulate the data is by having the key value, ~~depending if the enc~~ the key value is only known between the sender and the receiver, so data in the original data can only be seen and manipulate it ~~between~~ by the sender and the receiver [4]

Examiner comment – low

In part (a) suitable sensors have correctly been identified for the first two situations, however *laser sensor* is not an acceptable name for a sensor to detect an intruder and so no mark is awarded for the third part question.

In part (b) the question asks for a method of ensuring data integrity during transmission. Encryption will prevent the data being understood if it is accessed by unauthorised individuals whilst being transmitted, but it is not a method of ensuring data integrity. The encrypted data could still be corrupted during transmission.

Marks awarded for part (a) = (i) 1/1, (ii) 1/1, (iii) 0/1
Marks awarded for part (b) = 0/4

Total marks awarded = 2 out of 7

Question 5

5 (a) Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		
dedicated channel used between two points for the duration of the call		
connection maintained throughout the telephone call		
encoding schemes and compression technology used		
lines remain active even during a power outage		

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

.....

.....

.....

.....

.....

.....[3]

Question 5, continued

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

.....[1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

.....[1]

(iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

.....[1]

Mark scheme

5 (a)

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		✓
dedicated channel used between two points for the duration of the call	✓	
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	

[5]

(b) **maximum** of **two marks** for Internet references and **maximum** of **two marks** for world wide web references

Internet

- massive network of networks/interconnected network of computer devices
- Internet stands for Interconnected Networks
- uses TCP/IP protocol

World Wide Web (www)

- is a collection of (multimedia) web pages/documents
- ...stored on websites
- http/protocols used to transmit data
- web pages are written in HTML
- URLs specify the location of the web pages
- web documents are accessed using browsers **[3]**

(c) (i) router **[1]**

(ii) gateway **[1]**

(iii) server **[1]**

Example candidate response – high

5 **(a)** Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted	✓	✓
dedicated channel used between two points for the duration of the call		✓
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

The difference is that the Internet is a ~~netwo~~ network collection of interconnected computers ~~network~~ available all around the world, allowing people to ~~connect~~ communicate using their computers. On the ~~ther~~ hand, the WWW is just a collection of interconnected hypertext documents that is just a small part of the Internet. [3]

Example candidate response – high, continued

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

Router [1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

Gateway [1]

(iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

Server [1]

Examiner comment – high

In part (a) the candidate has correctly matched four of the descriptions to the communication method and is therefore awarded four marks. An internet-based system does not maintain a dedicated channel between the two points for the duration of a call, but a conventional telephone using PSTN does.

In part (b) the first statement that the internet is a network of interconnected networks available around the world is awarded one mark as there is a definite statement of the scale of the network connection. The statement that the WWW is a collection of interconnected hypertext documents is also awarded one mark. Neither the internet nor the WWW has been further expanded sufficiently to award the third mark. *Allowing people to communicate using computers* is not detailed enough; communication via computers can be done without the internet and the statement that the WWW is a small part of the internet is implying that the WWW is hardware, which is incorrect.

In part (c) the candidate has correctly identified each of the hardware devices described and is therefore awarded all three marks.

Marks awarded for part (a) = 4/5
Marks awarded for part (b) = 2/3
Marks awarded for part (c) = (i) 1/1, (ii) 1/1, (iii) 1/1

Total marks awarded = 9 out of 11

Example candidate response – middle

5 **(a)** Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		✓
dedicated channel used between two points for the duration of the call	✓	
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

Internet ~~as~~ is a world wide network which connects the computers to internet service providers all around Earth

World Wide Web is used when a web page is requested through the internet service providers. Used for web page hosting. [3]

Example candidate response – middle, continued

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

Router .....[1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

Modem .....[1]

(iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

Hub .....[1]

Examiner comment – middle

In part (a) the candidate has correctly matched all five descriptions to the communication method and is awarded all five marks.

In part (b) the statement that the internet is a worldwide network is awarded a mark as there is a clear statement of the scale of the network. The statements about the WWW, however, are not a description of hypertext documents or multi-media resources. The candidate needs to understand that the WWW is the collection of documents, one of which will be the webpage requested through the ISP. The final statement also refers to the WWW in terms of hardware which is incorrect; if the candidate had made it clear that the internet was used for webpage hosting it would have been a better answer.

In part (c) the candidate has identified just one of the hardware devices being described and so is awarded just one mark.

Marks awarded for part (a) = 5/5
Marks awarded for part (b) = 1/3
Marks awarded for part (c) = (i) 1/1, (ii) 0/1, (iii) 0/1

Total marks awarded = 7 out of 11

Example candidate response – low

5 (a) Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted	✓	
dedicated channel used between two points for the duration of the call	✓	
connection maintained throughout the telephone call	✓	
encoding schemes and compression technology used		✓
lines remain active even during a power outage	✓	✓

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

World wide web is ke collection of webpages that can be accessed via ke internet, which is a group of interconnected networks.

[3]

Example candidate response – low, continued

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

DNS .....[1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

Firewall .....[1]

(iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

Router .....[1]

Examiner comment – low

In part (a) the candidate has correctly matched three of the descriptions to the communication method and is therefore awarded three marks. A conventional telephone using PSTN is connected the whole time whether the callers are speaking or not, whereas an internet-based system uses the connection only when transmitting sound. A conventional telephone using PSTN remains active during a power outage, an internet-based system does not.

In part (b) the first statement that the WWW is a collection of webpages is enough to be awarded one mark. The statement that the internet is a group of interconnected networks is not a precise enough description as the candidate needs to illustrate the scale of the network. There are three marks available for this part question and the candidate needs to understand that three correct, clear and different statements are needed if three marks are to be awarded.

In part (c) the candidate has not correctly identified any of the hardware devices being described and so is not awarded any marks.

Marks awarded for part (a) = 3/5
Marks awarded for part (b) = 1/3
Marks awarded for part (c) = (i) 0/1, (ii) 0/1, (iii) 0/1

Total marks awarded = 4 out of 11

Question 6

6 **(a)** Name the **most** suitable input or output device for each of the following uses.

Give a different device in **each** case.

Description of use	Input or output device
input of credit card number into an online form	
selection of an option at an airport information kiosk	
output of a single high-quality photograph	
output of several hundred high-quality leaflets	
input of a hard copy image into a computer	

[5]

(b) All of the uses in **part (a)** involve the input or output of data.

(i) Describe **two** methods of preventing accidental loss of data.

1 .....

.....

2 .....

.....[2]

(ii) Describe **one** way of ensuring the security of the data against malicious damage.

.....

.....[1]

Mark scheme

6 (a)

Description of use	Input or output device
input of credit card number into an online form	**Keyboard/keypad/numberpad**
selection of an option at an airport information kiosk	**touch screen**
output of a singe high quality photograph	**ink jet printer**
output of several hundred high quality leaflets	**laser printer**
input of a hard copy image into a computer	**scanner**

[5]

(b) (i) Any **two** from:
- frequent (or equivalent) backup EITHER to secondary media/to 3rd party server/cloud/removable devices/continuous backup OR stored remotely
- disk-mirroring strategy/RAID
- UPS (uninterruptable power supply)/backup generator [2]

(ii) Any **one** from:
- protection of data (or equivalent) with passwords/using password and username for logging on include e.g. fingerprint scanning
- encryption
- installation and use of up to date anti-malware/anti-virus
- give different access rights to different users
- use a firewall,
- physical methods/lock doors and use secure entry devices/CCTV [1]

Example candidate response – high

6 **(a)** Name the **most** suitable input or output device for each of the following uses.

Give a different device in **each** case.

Description of use	Input or output device
input of credit card number into an online form	Keyboard
selection of an option at an airport information kiosk	Touchscreen
output of a single high-quality photograph	Inkjet printer
output of several hundred high-quality leaflets	Laser printer
input of a hard copy image into a computer	~~Scanner~~ Scanner

[5]

(b) All of the uses in **part (a)** involve the input or output of data.

(i) Describe **two** methods of preventing accidental loss of data.

1 Data backup (where a copy of the (data in the) hard drive is made to make sure information is not lost in case of an accident)

2 Disk - mirroring strategy, where data is copied simultaneously in two different locations in case one fails. [2]

(ii) Describe **one** way of ensuring the security of the data against malicious damage.

Encryption (so only people who are given the key encryption key can understand the data) [1]

Examiner comment – high

In part (a) the candidate has correctly identified a different device for all five uses and has distinguished correctly between different types of printer. This answer is awarded five marks.

In part (b)(i) the candidate has correctly identified and described disk-mirroring as a method of preventing accidental loss of data, and is awarded one mark for the second answer. The candidate should be aware that just describing disk backup is not sufficiently detailed to be awarded a mark. There needs to be an understanding that the backups need to be performed regularly and the backup media stored safely, preferably off-site.

In part (b)(ii) the candidate has given a good description of encryption as a method of preventing malicious damage to the data and is awarded a mark.

Marks awarded for part (a) = 5/5
Marks awarded for part (b) = (i) 1/2, (ii) 1/1

Total marks awarded = 7 out of 8

Example candidate response – middle

6 (a) Name the most suitable input or output device for each of the following uses.

Give a different device in each case.

Description of use	Input or output device
input of credit card number into an online form	Key pad/board
selection of an option at an airport information kiosk	Touch screen
output of a single high-quality photograph	laser printer
output of several hundred high-quality leaflets	inkjet printer
input of a hard copy image into a computer	Scanner

[5]

(b) All of the uses in part (a) involve the input or output of data.

(i) Describe two methods of preventing accidental loss of data.

1 Disk mirroring → so you have a copy of the data on an identical drive.

2 Have backup hard drives, incase one get destroyed, you have your date on another. [2]

(ii) Describe one way of ensuring the security of the data against malicious damage.

Using passwords

.....[1]

Examiner comment – middle

In part (a) the candidate has identified five different devices and has differentiated between the different types of printer. However, there has been confusion between the use of the inkjet and laser printer so there are three correct answers.

In part (b) (i) the candidate has correctly identified and described disk-mirroring as a method of preventing accidental loss of data, and is awarded one mark for the first answer. The candidate should be aware that the statement *have backup hard drives* is not precise enough to be awarded a mark. There needs to be an understanding that the backup hard drives need to be used to create frequent backups of the data and the media stored safely. It is no use having a backup hard drive if the data stored on it is out of date and the disk drive is stored in the same place as the original data.

In part (b)(ii) the candidate needs to understand that *using passwords* is not precise enough for a description of a method of preventing malicious damage to data. A more complete answer would describe either using a password on a file such as a document to protect the data stored in the file, or using a password in combination with a username to identify users when logging on.

Marks awarded for part (a) = 3/5
Marks awarded for part (b) = (i) 1/2, (ii) 0/1

Total marks awarded = 4 out of 8

Example candidate response – low

6 **(a)** Name the **most** suitable input or output device for each of the following uses.

Give a different device in **each** case.

Description of use	Input or output device
input of credit card number into an online form	Keyboard
selection of an option at an airport information kiosk	Mouse
output of a single high-quality photograph	Laser printer
output of several hundred high-quality leaflets	Printer inkjet printer
input of a hard copy image into a computer	Scanner

[5]

(b) All of the uses in **part (a)** involve the input or output of data.

(i) Describe **two** methods of preventing accidental loss of data.

1 Data packets collects during transmission ensuring the user has recieved the data.

2 Sent multple times

.....[2]

(ii) Describe **one** way of ensuring the security of the data against malicious damage.

Using some sort of encription.

.....[1]

Examiner comment – low

In part (a) the candidate has correctly identified two different devices, the keyboard and scanner. The candidate has also differentiated between the different types of printer. However, there has been confusion between the use of the inkjet and laser printer and it is very unlikely that an airport information kiosk would have a mouse for input so there are just two correct answers.

In part (b)(i) the response is not set in the context of data transmission. This candidate needs to understand the difference between accidental loss of data stored in a computer system and loss of data integrity during transmission.

The answer to part (b)(ii) is just about sufficient for the award of a mark for a description of a method of preventing malicious damage to data.

Marks awarded for part (a) = 2/5
Marks awarded for part (b) = (i) 0/2, (ii) 1/1

Total marks awarded = 3 out of 8

Question 7

7 A system is monitored using sensors. The sensors output binary values corresponding to physical conditions, as shown in the table:

Parameter	Description of parameter	Binary value	Description of condition
P	oil pressure	1	pressure >= 3 bar
		0	pressure < 3 bar
T	temperature	1	temperature >= 200°C
		0	temperature < 200°C
R	rotation	1	rotation <= 1000 revs per minute (rpm)
		0	rotation > 1000 revs per minute (rpm)

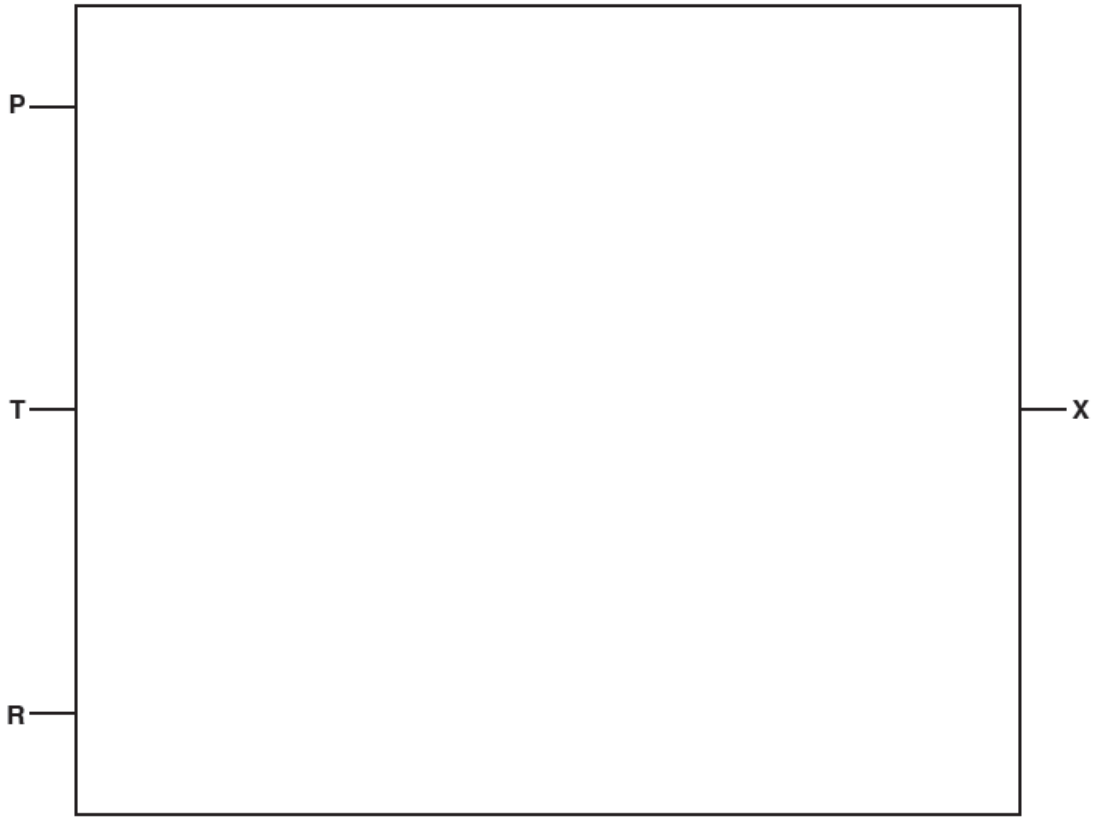
The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

either oil pressure >= 3 bar **and** temperature >= 200°C

or oil pressure < 3 bar **and** rotation > 1000 rpm

or temperature >= 200°C **and** rotation > 1000 rpm

(a) Draw a logic circuit to represent the above system.



[5]

Question 7, continued

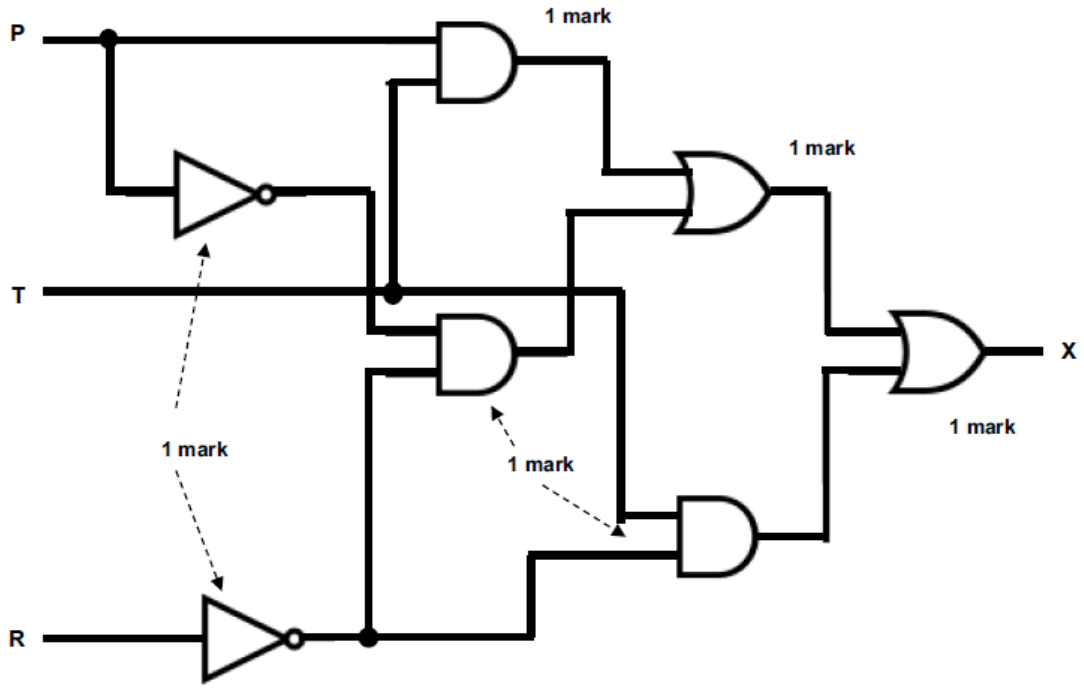
(b) Complete the truth table for this system.

P	T	R	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

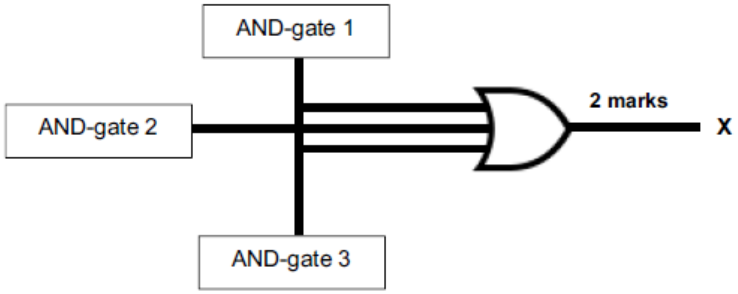
Mark scheme

7 (a) Since it is possible to simplify the original conditions, at least 3 possible answers exist for the logic circuit.



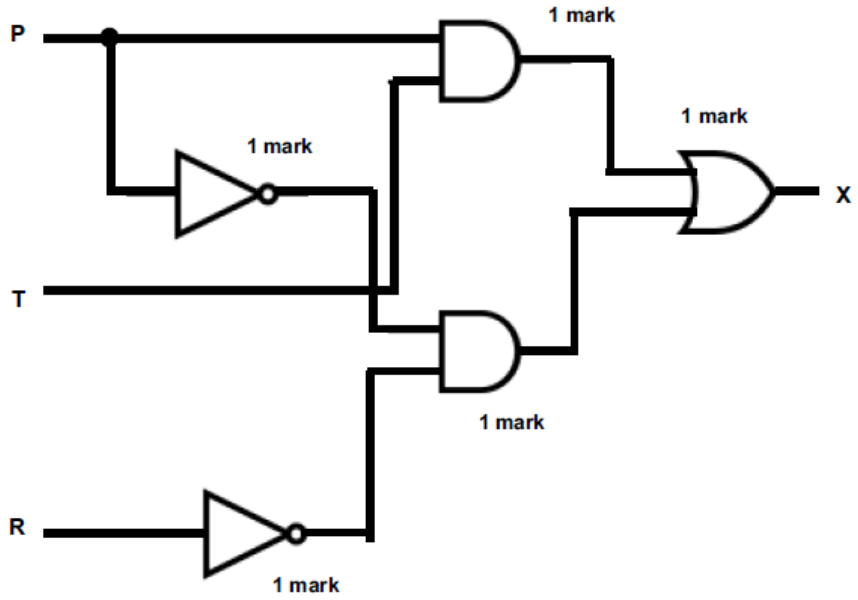
Note: input T has 2 cross overs that should not be connections

Note: it is possible to use a 3-input OR gate rather than the two 2-input OR gates on the top right:

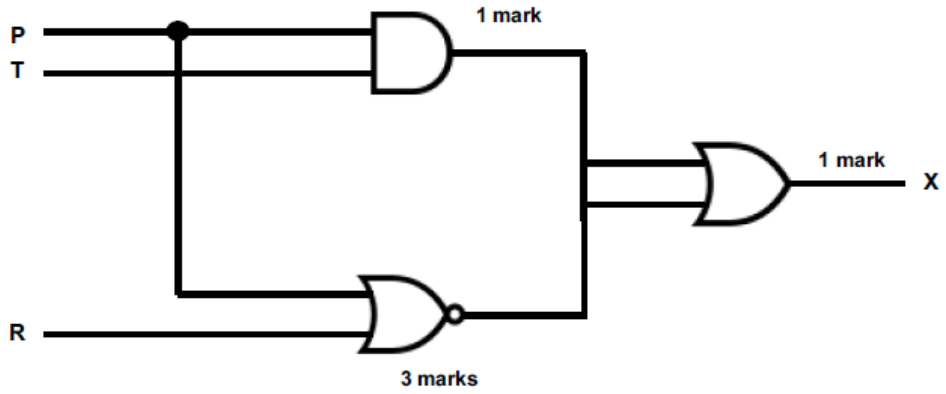


Mark scheme, continued

Alternative solution 1:



Alternative solution 2:



[5]

Note: other solutions may be possible depending on how simplification of the original statement is done

Mark scheme, continued

(b)

P	T	R	Workspace	X	
0	0	0		1	} 1 mark
0	0	1		0	
0	1	0		1	} 1 mark
0	1	1		0	
1	0	0		0	} 1 mark
1	0	1		0	
1	1	0		1	} 1 mark
1	1	1		1	

[4]

Example candidate response – high

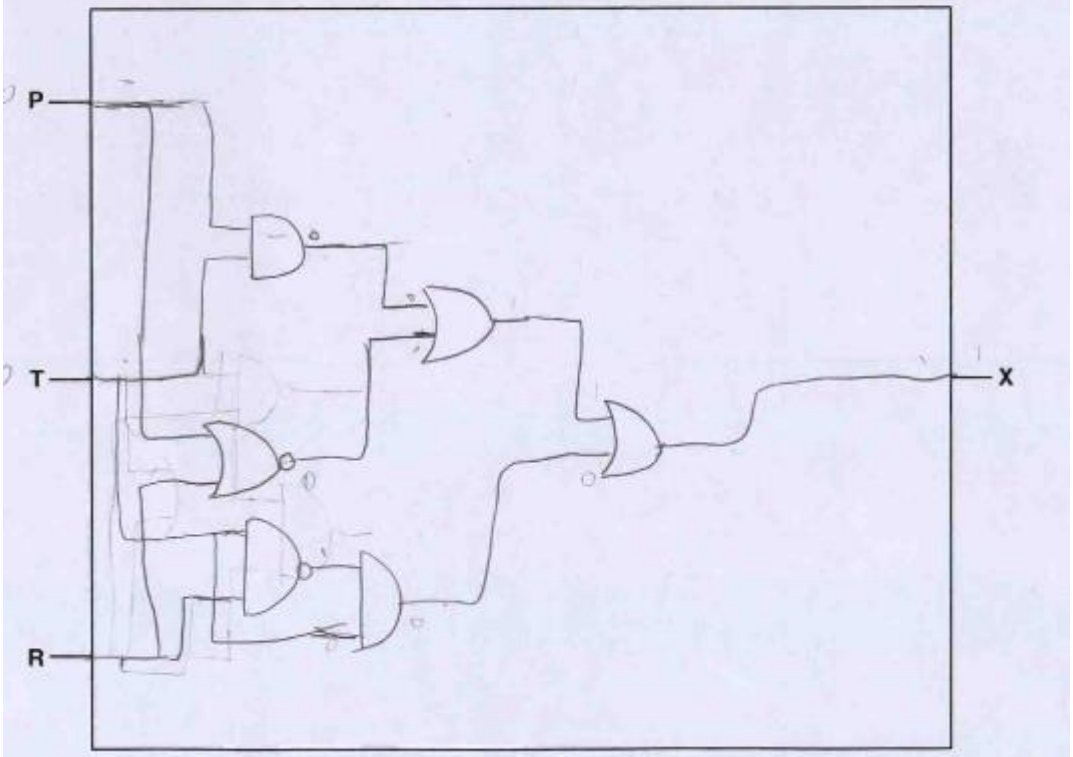
The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

either oil pressure >= 3 bar **and** temperature >= 200°C
P 1 T 1

or oil pressure < 3 bar **and** rotation > 1000 rpm
P 0 R 0

or temperature >= 200°C **and** rotation > 1000 rpm
T 1 R 0

(a) Draw a logic circuit to represent the above system.



[5]

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Example candidate response – high, continued

(b) Complete the truth table for this system.

P	T	R	Workspace	X
0	0	0		1
0	0	1		0
0	1	0		1
0	1	1		0
1	0	0		0
1	0	1		0
1	1	0		1
1	1	1		1

[4]

Examiner comment – high

The Boolean expression for the given system is:
(P AND T) OR (NOT P AND NOT R) OR (T AND NOT R)

In part (a) this candidate is awarded one mark for the AND gate with inputs P and T. The candidate has realised that the middle bracket, (NOT P AND NOT R), can be replaced by a single NOR gate with inputs P and R and so is awarded one mark for the NOR gate. The final expression, (T AND NOT R) has been incorrectly interpreted using the NAND gate and AND gate together and so no mark is awarded for this. The outputs from the top two gates are correctly input into an OR gate, so a third mark is awarded for this, and so that the candidate is not penalised twice for a single mistake the output from the candidate's (incorrect) third expression is input to another OR gate with the output of the first OR gate so a fourth mark is given here.

In part (b) the candidate has correctly interpreted the information given in the question as can be seen by the values written below the text in the question. The truth table can be completed from the information in the question, without reference to the logic circuit. This candidate has used the information given and has correctly completed each line of the truth table, so all four marks are awarded. It was a common mistake for candidates to use their logic circuit to complete the truth table, and if the circuit was incorrect it meant that the truth table was often also incorrect.

Marks awarded for part (a) = 4/5
Marks awarded for part (b) = 4/4

Total marks awarded = 8 out of 9

Example candidate response – middle

The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

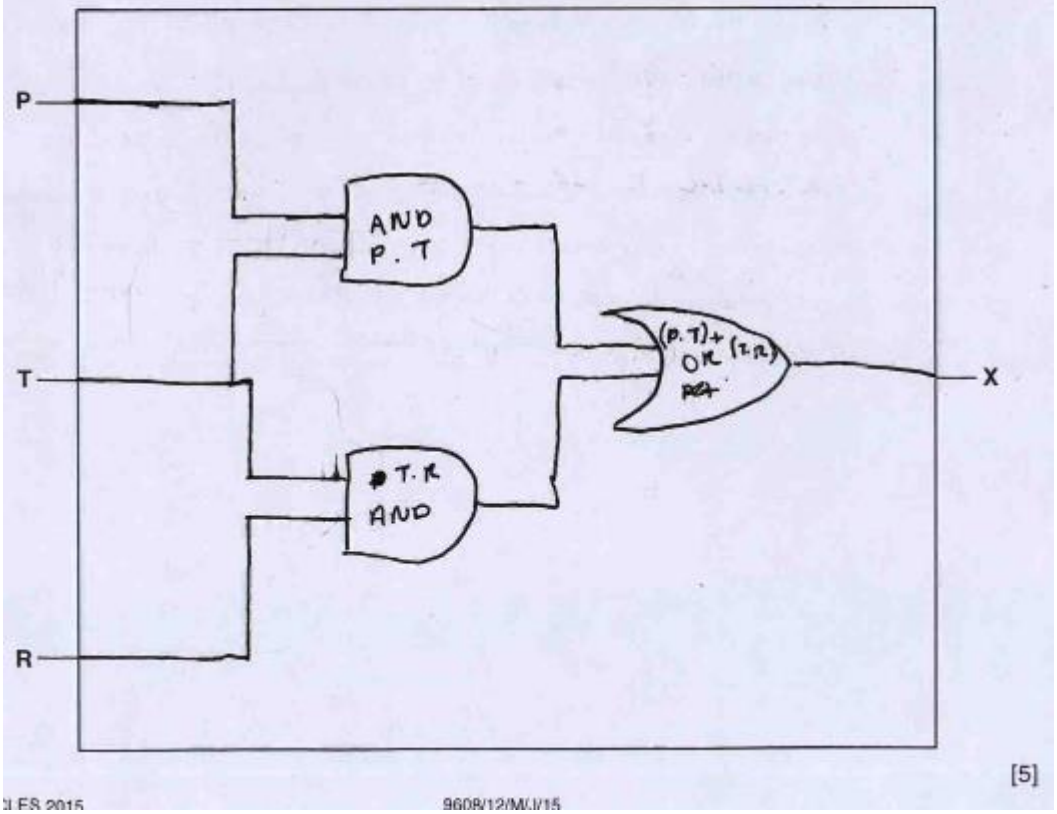
either 1 oil pressure >= 3 bar **and** temperature >= 200°C 1 and P=1 T=1

or 0 oil pressure < 3 bar **and** rotation > 1000 rpm 1 or P=0 T=1

or 1 temperature >= 200°C **and** rotation > 1000 rpm 1 and

either P or T = 1 ∴ X = 1
either T and R = 1 ∴ X = 1

(a) Draw a logic circuit to represent the above system.



[5]

Example candidate response – middle, continued

(b) Complete the truth table for this system.

P	T	R	Workspace P . T	Workspace T . R	Workspace (P . T) + (T . R)	X
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	1	1	1
1	0	0	0	0	0	0
1	0	1	0	0	0	0
1	1	0	1	0	1	1
1	1	1	1	1	1	1

[4]

Examiner comment – middle

In the text above part (a) of the question, the candidate has correctly identified the values of P and T in each case, but has incorrectly identified the value of R.

In part (a) the candidate is awarded one mark for the AND gate with inputs P and T, and one mark for the OR gate with the output of the other gates as input. The second AND gate has been incorrectly identified because of the incorrect identification of the value for R and there is no representation for the third condition. To gain more marks all three conditions need firstly to be correctly represented and then the outputs need to be fed into two OR gates, or one three-input OR gate.

In part (b) it is clear from the headings in the workspace that the candidate has used the same expressions for the truth table and the logic circuit. This means that although the values tabulated are correct for the candidate's expressions only the last two pairs of lines in the truth table are correct for the situation given in the question.

Marks awarded for part (a) = 2/5
Marks awarded for part (b) = 2/4

Total marks awarded = 4 out of 9

Example candidate response – low

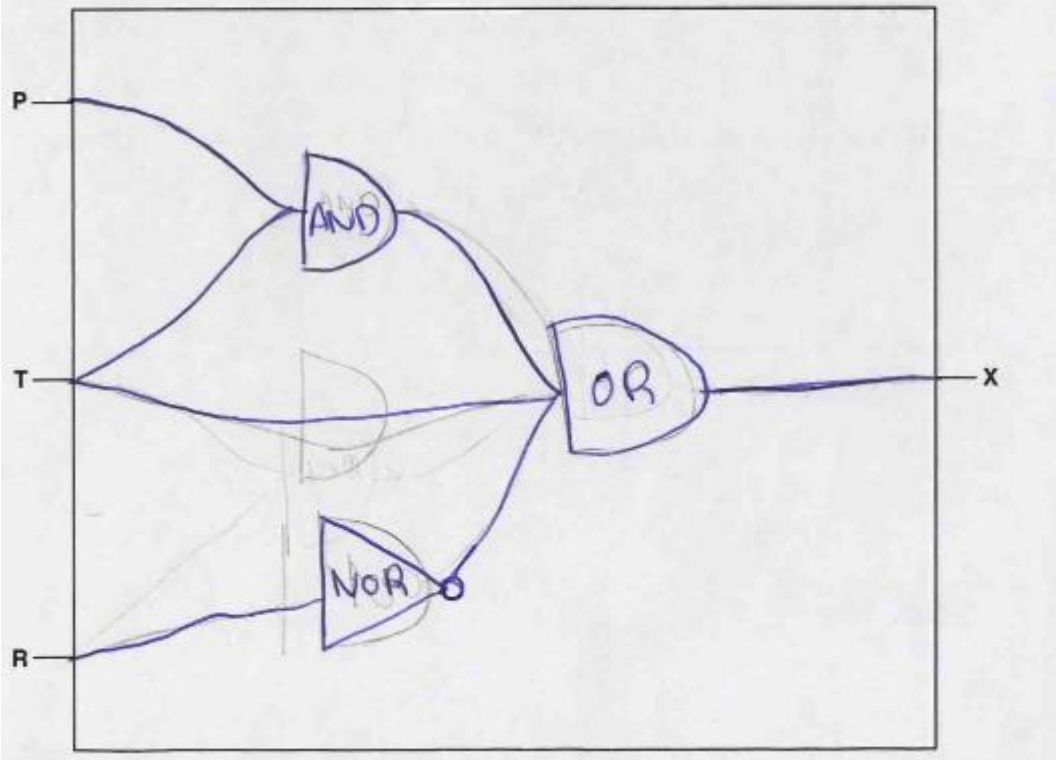
The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

either oil pressure >= 3 bar **and** temperature >= 200°C

or oil pressure < 3 bar **and** rotation > 1000 rpm

or temperature >= 200°C **and** rotation > 1000 rpm

(a) Draw a logic circuit to represent the above system.



[5]

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Example candidate response – low, continued

(b) Complete the truth table for this system.

P	T	R	Workspace	X
0	0	0		1
0	0	1		0
0	1	0		1
0	1	1		1
1	0	0		0
1	0	1		0
1	1	0		1
1	1	1		1

[4]

Examiner comment – low

In part (a) this candidate is awarded no marks, because even though there is an AND gate with inputs P and T the two inputs are combined into a single line before the gate. The OR gate has incorrect inputs and again the three inputs have been combined into a single line before the gate. The NOR gate has just a single input from R. The only gate which should have a single input is a NOT gate, it is a frequent error that candidates combine several inputs into a single line before other gates.

In part (b) the candidate has correctly interpreted most of the information given in the question, and has not relied on the logic circuit, but has also included an output of 1 at X when the temperature >=200^{o}C and the rotation <= 1000 revs per minute (rpm). The second pair of lines is thus incorrect, however the first, third and fourth pairs of lines are correct and are each awarded one mark.

Marks awarded for part (a) = 0/5
Marks awarded for part (b) = 3/4

Total marks awarded = 3 out of 9

Question 8

8 (a) Explain how the width of the data bus and system clock speed affect the performance of a computer system.

Width of the data bus .....

.....

.....

.....

Clock speed .....

.....

.....

.....[3]

(b) Most computers use Universal Serial Bus (USB) ports to allow the attachment of devices.

Describe **two** benefits of using USB ports.

1 .....

.....

2 .....

.....[2]

(c) The table shows six stages in the von Neumann fetch-execute cycle.

Put the stages into the correct sequence by writing the numbers 1 to 6 in the right hand column.

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	
the instruction is executed	
the instruction is decoded	
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched	
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	

[6]

Mark scheme

8 (a) **maximum** of **2 marks** for data bus width and **maximum** of **2 marks** for clock speed

data bus width

- the width of the data bus determines the number of bits that can be simultaneously transferred
- increasing the width of the data bus increases the number of bits/amount of data that can be moved at one time (or equivalent)
- …hence improving processing speed as fewer transfers are needed
- By example: e.g. double the width of the data bus moves 2x data per clock pulse

clock speed

- determines the number of cycles the CPU can execute per second
- increasing clock speed increases the number of operations/number of fetch-execute cycles that can be carried out per unit of time
- ...however, there is a limit on clock speed because the heat generated by higher clock speeds cannot be removed fast enough **[3]**

(b) Any **two** from:

- devices automatically detected and configured when first attached/plug and play
- it is nearly impossible to wrongly connect a device
- USB has become an industrial standard
- supported by many operating systems
- USB 3.0 allows full duplex data transfer
- later versions are backwards compatible with earlier USB systems
- allows power to be drawn to charge portable devices **[2]**

Mark scheme, continued

(c)

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	3
the instruction is executed	6
the instruction is decoded	5
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	1
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched	4
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	2

[6]

Example candidate response – high

8 (a) Explain how the width of the data bus and system clock speed affect the performance of a computer system.

Width of the data bus ..... The width of the data bus determines the number of bits the data bus can carry simultaneously. The greater the width of the data bus, the more data the data bus can carry at one time (as there more wires that carry 1 bit each).

Clock speed ..... It determines the number of cycles the CPU can do per second. If the clock speed increases, the number of instructions the CPU can process and execute will increase (so overall, it will make the CPU work faster). [3]

(b) Most computers use Universal Serial Bus (USB) ports to allow the attachment of devices.

Describe **two** benefits of using USB ports.

1 ~~They are serial, so they can transfer more that one bit of data (many bits) simultaneously~~ (available all around the world, so can be used to transfer data everywhere.)

2 As they are serial, no handshaking (synchronisation) is required when transmitting data to/from a computer, so faster data access. [2]

(c) The table shows six stages in the von Neumann fetch-execute cycle.

Put the stages into the correct sequence by writing the numbers 1 to 6 in the right hand column.

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	4
the instruction is executed	6
the instruction is decoded	5
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	1
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched.	2
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	3

[6]

Examiner comment – high

In part (a) the candidate has made a correct statement about what is determined by the width of the data bus, the number of bits *simultaneously* carried, and so is awarded one mark. There is also a correct expansion of the initial statement that increasing the width of the data bus means that more data can be carried *at one time*, so a second mark is awarded and the candidate has achieved the maximum number of marks allowed for explaining the effect of changing the width of the data bus.

The candidate has also made a correct statement regarding the clock speed, it determines the number of cycles *per second*, and is awarded a third mark. The candidate has achieved the maximum marks for this part question. Had there been four marks for this part question, the expansion point for clock speed would not have been awarded a mark however, as it is not precise enough as the candidate needs to realise that the number of instructions processed *per second* would increase.

This is an excellent answer to this part question

In part (b) the question asks about USB ports, so candidates needed to realise that it is the benefits of USB ports that are required not of USB devices. Giving the benefits of USB devices was a common mistake. This candidate needs to be aware that these statements are not precise or detailed enough to be accepted as equivalent to those on the mark scheme.

In part (c), in common with the vast majority of candidates, this candidate has correctly identified the sequence of stages of the von Neumann fetch-execute cycle.

Marks awarded in part (a) = 3/3
Marks awarded in part (b) = 0/2
Marks awarded in part (c) = 6/6

Total marks awarded = 9 out of 11

Example candidate response – middle

8 (a) Explain how the width of the data bus and system clock speed affect the performance of a computer system.

Width of the data bus if the width of the data bus is great then it can carry more data at one time. This means it can send more data = faster meaning a fetch - execute cycle can be completed faster thus speeding up the computer's performance - makes it better.

Clock speed the clock speed if the clock speed is fast then the data bus will move faster thus also increasing the amount of data transferred per second thus speeding and bettering the performance of the computer system [3]

(b) Most computers use Universal Serial Bus (USB) ports to allow the attachment of devices.

Describe two benefits of using USB ports.

1 allows use of USB which USB is a portable flash memory device thus allowing the transfer of data from computer to computer safely

2 USB ports now connect much more than just USBs such that they can charge devices no matter the country [2]

No image of the answer for part (c) has been included as it is identical to that of the A grade response.

Examiner comment – middle

In part (a) the candidate has made a correct statement about what is determined by the width of the data bus, the number of bits carried *at one time*, and so is awarded one mark. The expansion statement however needs to be more precise, just 'sending more data faster' is not equivalent to increasing the amount of data that can be moved at one time. The explanation of clock speed also needs to be more precise. Increasing the clock speed does not only affect the operation of the data bus.

In part (b) the candidate's first statement is referring to USB devices, not the benefit of a USB port. This candidate has explained that the USB is a portable device but a common mistake amongst candidates is to refer to a USB device as simply a USB, this is too imprecise to be awarded any marks. The second statement correctly identifies that USB ports can also be used to draw power and charge devices and so is awarded a mark.

In part (c) the candidate has correctly identified the sequence of stages of the von Neumann fetch-execute cycle.

Marks awarded for part (a) = 1/3
Marks awarded for part (b) = 1/2
Marks awarded for part (c) = 6/6

Total marks awarded = 8 out of 11

Example candidate response – low

8 **(a)** Explain how the width of the data bus and system clock speed affect the performance of a computer system.

Width of the data bus ...If the width of the data bus increase more data is allow to travel though it which did more data will read increase the rate of data transmission.

Clock speed ...If the clock speed increase the more instruction per second increase aswell, therefore the the computer can do more things at a given time.[3]

(b) Most computers use Universal Serial Bus (USB) ports to allow the attachment of devices.

Describe **two** benefits of using USB ports.

1 ...they are Nearly every device can connect via USB so is big variety.

2 ...Not easy break while will the pins in the ports.[2]

No image of the answer for part (c) has been included as it is identical to that of the A grade response.

Examiner comment – low

In part (a) the candidate's response needs to be more precise for credit at this level. There is a need to identify what is determined by the width of the data bus and the effect of increasing the width.

The candidate has correctly identified that increasing the clock speed increases the number of instructions *per second* that can be executed, and is awarded a mark. The expansion statement however, needs to be more precise, 'more things' is too general.

In part (b) the first statement is not precise enough to be equivalent to industry standard, and the second statement is also not precise enough to be equivalent to almost impossible to connect incorrectly.

In part (c) the candidate has correctly identified the sequence of stages of the von Neumann fetch-execute cycle.

Marks awarded for part (a) = 1/3
Marks awarded for part (b) = 0/2
Marks awarded for part (c) = 6/6

Total marks awarded = 7 out of 11

Question 9

9 A database has been designed to store data about salespersons and the products they have sold.

The following facts help to define the structure of the database:

- each salesperson works in a particular shop
- each salesperson has a unique first name
- each shop has one or more salespersons
- each product which is sold is manufactured by one company only
- each salesperson can sell any of the products
- the number of products that each salesperson has sold is recorded

The table `ShopSales` was the first attempt at designing the database.

FirstName	Shop	ProductName	NoOfProducts	Manufacturer
Nick	TX	television set refrigerator digital camera	3 2 6	SKC WP HKC
Sean	BH	hair dryer electric shaver	1 8	WG BG
John	TX	television set mobile phone digital camera toaster	2 8 4 3	SKC ARC HKC GK

(a) State why the table is **not** in First Normal Form (1NF).

.....

.....[1]

(b) The database design is changed to:

`SalesPerson (FirstName, Shop)`

`SalesProducts (FirstName, ProductName, NoOfProducts, Manufacturer)`

Using the data given in the first attempt table (`ShopSales`), show how these data are now stored in the revised table designs.

Table: `SalesPerson`

FirstName	Shop

Question 9, continued

Table: SalesProducts

FirstName	ProductName	NoOfProducts	Manufacturer

[3]

Question 9, continued

(c) (i) A relationship between the two tables has been implemented.

Explain how this has been done.

.....

.....

.....

.....

.....[2]

(ii) Explain why the `SalesProducts` table is **not** in Third Normal Form (3NF).

.....

.....

.....

.....[2]

(iii) Write the table definitions to give the database in 3NF.

.....

.....

.....

.....[2]

Mark scheme

9 (a) Any **one** from:

- (ShopSales) table has repeated group (of attributes)
- each sales person has a number of products
- FirstName, Shop would need to be repeated for each record **[1]**

(b) **One mark** for `SalesPerson` table

table: `SalesPerson`

FirstName	Shop
Nick	TX
Sean	BH
John	TX

Mark scheme, continued

table: `SalesProducts`

FirstName	ProductName	NoOfProducts	Manufacturer
Nick	television set	3	SKC
Nick	refrigerator	2	WP
Nick	digital camera	6	HKC
Sean	hair dryer	1	WG
Sean	electric shaver	8	BG
John	television set	2	SKC
John	mobile phone	8	ARC
John	digital camera	4	HKC
John	toaster	3	GK

(**1 mark** for `FirstName` column + **1 mark** for remainder of table)

[3]

Mark scheme, continued

(c) (i) Any **two** from:

- primary key of SalesPerson table is FirstName
- links to FirstName in SalesProducts table
- FirstName in SalesProductsS table is foreign key **[2]**

(ii)
- There is a non-key dependency
- Manufacturer is dependent on ProductName, (which is not the primary key of the SalesProducts table) **[2]**

(iii)
```
SalesPerson (FirstName, Shop)
-SalesProducts (FirstName, ProductName, NoOfProducts) OR
  SalesProducts(SalesID, FirstName, ProductName, NoOfProducts)

-Product (ProductName, Manufacturer)
```

1 mark for correct attributes in `SalesProducts` and `Product` tables and **1 mark** for correct identification of both primary keys **[2]**

Example candidate response – high

(a) State why the table is **not** in First Normal Form (1NF).

There are repeating groups of data like for each First name and shop [1]

Table: SalesPerson

FirstName	Shop
Nick	TX
Sean	BH
John	TX

Table: SalesProducts

FirstName	ProductName	NoOfProducts	Manufacturer
Nick	television set	3	SKC
Nick	refrigerator	2	WP
Nick	digital camera	6	HKC
Sean	hair dryer	1	WG
Sbean	electric shaver	8	BG
John	television set	2	SKC
John	mobile phone	8	ARC
John	digital camera.	4	HKC
John	toaster	3	GK

[3]

(c) (i) A relationship between the two tables has been implemented.

Explain how this has been done.

The First name acts as the primary key in the salesperson table, it links the table to the sales products table by acting as a foreign key in SALES PRODUCTS Table.

.....[2]

(ii) Explain why the `SalesProducts` table is **not** in Third Normal Form (3NF).

there are partial dependancies, for example manufacturer ondepends on the product, there are non-key attributes that do not have complete links with the primary key.

.....[2]

(iii) Write the table definitions to give the database in 3NF.

Sales Products(First name, Product Name, quantity NoofProducts)

Manufacturer details(Product name, manufacturer)

Product name is the foreign key in SalesProduct table [2]

Examiner comment – high

In part (a) many candidates were able to describe why the table was not in First Normal Form in terms of the data given, although very few used the correct terminology.

This candidate has fortunately crossed out the word 'for' and has thus correctly identified the repeating data and has been awarded the mark

In part (b) the vast majority of candidates correctly completed the two tables and were awarded all three marks. A very few candidates left blanks in the `FirstName` column of the `SalesProducts` table and so were awarded only the one mark for the `SalesPerson` table.

In part (c)(i) the candidate has correctly identified the attribute forming the link between the tables, (`FirstName`) and is awarded one mark. This attribute has also correctly been identified as the primary key in the `SalesPerson` table and the foreign key in the `SalesProducts` table and so is awarded a second mark.

The candidate has correctly described a non-key dependency in part (c)(ii) and is awarded one mark. The candidate has then also identified that non-key dependence and is awarded the second mark. The response would have been improved if the non-key dependence had been identified as `Manufacturer` dependent on `ProductName`, rather than *the product*.

In part (c)(iii) the two table definitions have been written according to convention and each table has the correct attributes so the first mark is awarded. The primary keys of each table have also been correctly identified so the second mark is awarded. This answer would have been more complete if the `SalesPerson` table had also been included in the answer showing the complete database in 3NF.

Marks awarded for part (a) = 1/1
Marks awarded for part (b) = 3/3
Marks awarded for part (c) = (i) 2/2, (ii) 2/2, (iii) 2/2

Total marks awarded = 10 out of 10

Example candidate response – middle

(a) State why the table is **not** in First Normal Form (1NF).

There are no single rows ~~in~~ the ProductName has three pieces of data [1]

No image of the answer for part (b) has been included as it is identical to that of the A grade response.

(c) (i) A relationship between the two tables has been implemented.

Explain how this has been done.

Using a primary key, which is a field which contains unique data, or a composite key and a foreign key. In the table before there is a relationship between these two tables is by the primary key in SalesPerson(FirstName) with the foreign key in SalesProduct(FirstName) [2]

(ii) Explain why the `SalesProducts` table is **not** in Third Normal Form (3NF).

Because it is in Second normal form as the non-key attributes are dependent on the primary key

[2]

(iii) Write the table definitions to give the database in 3NF.

~~SalesPerson(FirstName, Shop)~~

SalesPerson(FirstName, Shop)

SalesProduct(FirstName, ProductName, NoOfProducts)

ProductManufacturer(ProductName, Manufacturer) [2]

Examiner comment – middle

In part (a) this candidate has not correctly identified the repeating data, and has not described in sufficient detail what is meant by a repeated group of attributes, so no mark is awarded.

In part (b) the candidate has correctly completed both tables and is awarded all three marks.

In part (c)(i) the candidate has correctly identified the attribute forming the link between the tables, (`FirstName`) and is awarded one mark. This attribute has also correctly been identified as the primary key in the `SalesPerson` table and the foreign key in the `SalesProducts` table and so is awarded a second mark.

The response to part (c)(ii) is confused. The answer would be improved by changing *dependent to not dependent*, however there would still need to be some identification of the attributes in order for both marks to be given.

In part (c)(iii) all three table definitions have been written according to convention showing the complete database in 3NF. The candidate has correctly identified the attributes in the `SalesProducts` and `Product` tables and is awarded one mark. The primary keys of both tables have also been correctly identified, so the second mark is also awarded. This is an excellent answer to this part of the question.

Marks awarded for part (a) = 0/1
Marks awarded for part (b) = 3/3
Marks awarded for part (c) = (i) 2/2, (ii) 0/2, (iii) 2/2

Total marks awarded = 7 out of 10

Example candidate response – pass

(a) State why the table is **not** in First Normal Form (1NF).

It is not in First Normal Form because it has no repeated group of attributes [1]

Table: SalesPerson

FirstName	Shop
Nick	Tx
Sean	BH
John	Tx

Table: SalesProducts

FirstName	ProductName	NoOfProducts	Manufacturer
Nick	television set refrigerator digital camera	3 2 6	SkC WP HKC
Sean	hair dryer electric shaver	1 8	WC BC
John	television set mobile phone digital camera toaster	2 4 3 1	SkC ARC HKC GK

[3]

(c) (i) A relationship between the two tables has been implemented.

Explain how this has been done.

1) Link table has been formed
2) primary key in one table is used as a foreign key in other table
3) 2* ~~need~~ many to many relationships broken to form one to many from both tables by a bridge entity. [2]

(ii) Explain why the SalesProducts table is **not** in Third Normal Form (3NF).

~~All non key attributes are fk~~
1) It has partial dependencies
2) All non key attributes dependent on one foreign key.
3) First Name depends on ProductName [2]

(iii) Write the table definitions to give the database in 3NF.

SalesPerson (FirstName, Shop)
SalesProducts (FirstName, ProductName, NoOfProducts)
~~ManufacturerDetails (ProductName, Manufacturer)~~
ManufacturerDetails (Manufacturer, ProductName) [2]

Examiner comment – pass

In part (a) the candidate has stated that there is no repeated group of attributes. The terminology has been used correctly, but the answer is the opposite of the correct one so no mark was awarded.

In part (b) the candidate has correctly completed the `SalesPerson` table and so is awarded the mark. For the `SalesProducts` table however, the candidate has copied the table given in the stem of the question into the first three rows of the answer space and has not implemented the revised design given in the rubric for this part of the question. No marks were awarded for this table as neither the `FirstName` column nor the remainder of the table was correct.

In part (c)(i) the candidate has correctly stated that the primary key in one table has been used as a foreign key in the other to form a link between the tables, so is awarded one mark. There is a need though, to identify at least one of the keys in order to gain the second mark.

The candidate has correctly identified that there is a non-key dependency in part (c)(ii) and is awarded one mark. The identification of the non-key dependency needs to be correct if the second mark is to be awarded. In this case that is not so.

In part (c)(iii) the table definitions have been written according to convention and each table has the correct attributes so the first mark is awarded. A primary key has been identified for each table, but that shown for the `ManufacturerDetails` table is incorrect so the second mark has not been awarded.

Marks awarded for part (a) = 0/1
Marks awarded for part (b) = 1/3
Marks awarded for part (c) = (i) 1/2 (ii) 1/2 (iii) 1/2

Total marks awarded = 4 out of 10

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