

Past Papers May/June 2015 to 2018, Oct/Nov 2015 till 2017:  
Topic 1.1.1 Number representation

(9608/11/M/J/15)

Q1/- (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]

Q2 (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 .....

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

1.....  
.....  
2.....  
.....[2]

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

.....  
.....  
.....  
.....[3]



(9608/13/M/J/15)

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

124

--	--	--	--	--	--	--	--

-77

--	--	--	--	--	--	--	--

[2]

(ii) Convert the two numbers in part (a) (i) into hexadecimal.

124

.....

-77

.....

[2]

(b) Binary Coded Decimal (BCD) is another way of representing numbers.

(i) Write the number 359 in BCD form.

..... [1]

(ii) Describe a use of BCD number representation.

.....

..... [2]

(9608/11/M/J/16)

4 (a) Convert the following denary integer into 8-bit binary.

55

--	--	--	--	--	--	--	--

[1]

(b) Convert the following Binary Coded Decimal (BCD) number into denary.

10000011

..... [1]

(c) Convert the following denary integer into 8-bit two's complement.

-102

--	--	--	--	--	--	--	--

[2]

(d) Convert the following hexadecimal number into denary. 4E

..... [1]

5. A group of students broadcast a school radio station on a website. They record their sound clips (programmes) in advance and email them to the producer.

(a) Describe how sampling is used to record the sound clips.

.....  
.....  
.....  
.....  
.....  
.....  
..... [3]

(b) The students use software to compress the sound clips before emailing them.

(i) Circle your chosen method of compression and justify your choice.

Lossy / Lossless

Justification: .....  
.....  
.....  
..... [3]

Students also email images to the radio station for use on its website.

These are compressed before sending using run-length encoding (RLE).



Answers: 9608/11/M/J/15

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]

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]

(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]

(9608/13/M/J/15)

3.

(a) (i)

124	0	1	1	1	1	1	0	0
-77	1	0	1	1	0	0	1	1

[2]

(ii) 124: 7 C




-77: B 3

[2]

(b) (i) 0 0 1 1 0 1 0 1 1 0 0 1

[1]

(ii)

-  when denary numbers need to be electronically coded
-  e.g. to operate displays on a calculator where each digit is represented
-  decimal fractions can be accurately represented

[2]

(9608/11/M/J/16)

4. (a) 00110111 [1]

(b) 83 [1]






(c) 10011010 [2]

Marks allocated as follows:

1 mark for the most significant bit 1 mark for the remaining 7 bits






(d) 78 [1]

5 (a) Three from: [3]




-  The height/amplitude of the (sound) wave is determined.
-  At set (time) intervals // by example of sensible time period.
-  To get an approximation of the sound wave
-  And encoded as a sequence of binary numbers // and converted to a digital signal.
-  Increasing the sampling rate will improve the accuracy of the recording.

(b) (i) No mark awarded for identifying method. Three marks for justification. [3]







Lossy – Three points from:

-  The human ear will not notice that the decompressed stream will not be identical to the original (file) / that parts of the original data have been discarded / removed / deleted.
-  File size reduction is greater than using lossless.
-  Email has limits on file sizes (on attachments) / a smaller file will take less time to transmit.
-  The file may not need to be of high precision / accuracy.
-  The producer has requested an mp3 file.

Lossless – Three points from:

-  The file needs to be high precision / accuracy.
-  None of the original data is lost / the decompressed file will be identical to the original.
-  The producer has requested a flac file.

(ii) Three points from: [3]

-  Lossless method of compression.
-  Reduces (the physical size of) a string of adjacent, identical characters/pixels / bytes etc.
-  The repeating string (a run) is encoded into two values.
-  One value represents the number of (identical) characters in the run (the run count).
-  The other value is the code of the character / colour code of pixel etc. in the run (the run value).
-  The run value and run count combination may be preceded by a control character. • Any valid example given.



**(iii) Two marks for three correct rows, one mark for two correct rows.**

**[2]**

Row 1: 153 10 255 3 153 3

Row 2: 153 9 255 6 153 1

Row 3: 153 7 255 9

**Alternative correct answer:**

Row 1: 153 9 255 2 153 2

Row 2: 153 8 255 5 153 0

Row 3: 153 6 255 8