Unit 2 · Data in Depth

WORKSHEET

Full marks 34

Name _____ Class _____ Roll no. ____ Date _____ Marks _____ / 34

1 Key words [4]

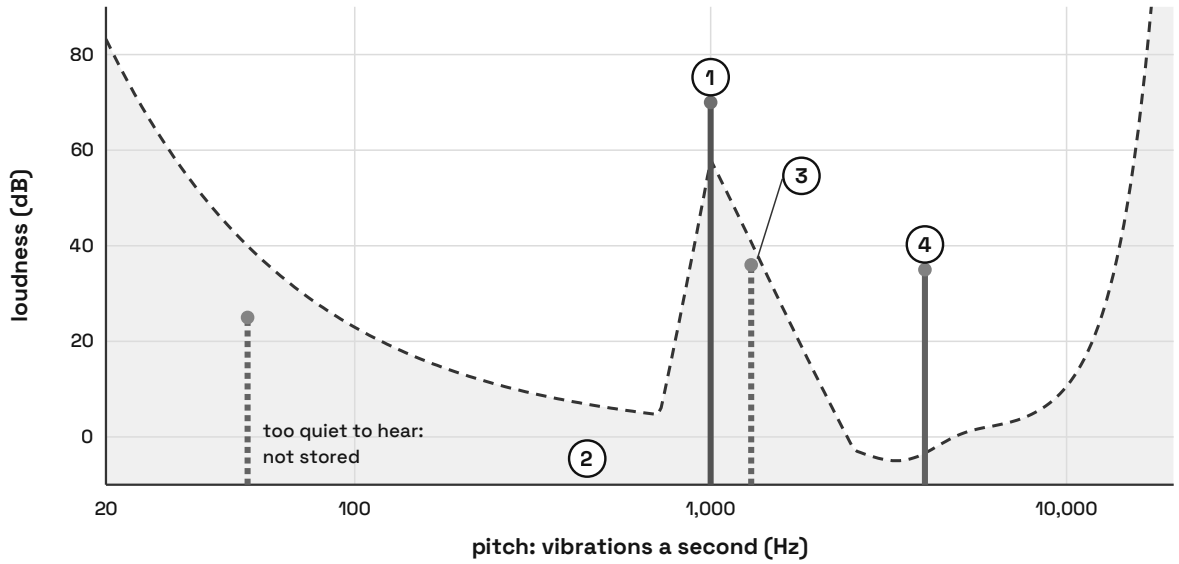
Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

base	bit rate	code point	color depth	hexadecimal	lossless	lossy	octal
run-length encoding	two's complement						

The number of different digits a number system uses is its _____. The base-16 system, with the digits 0 to 9 and A to F, is _____. Most computers store negative numbers in _____, where the left bit of a byte is worth −128. Every character has a number in Unicode, its _____. The number of bits used for each pixel of a picture is its _____. Storing WWWWBB as 4W 2B is _____. A ZIP file uses _____ compression, which keeps every bit, while an MP3 uses _____ compression, which throws away what the ear misses.

2 Label the diagram [2]

The diagram shows what an MP3 encoder works out for one short moment of sound. Write what belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ 2. _____

3. _____ 4. _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. What is $(1110)_2 + (1011)_2$? [1]

a. $(11001)_2$ **b.** $(10101)_2$
c. $(11101)_2$ **d.** $(11010)_2$

ii. What is the binary equivalent of $(53)_8$? [1]

a. $(101011)_2$ **b.** $(110101)_2$
c. $(10111)_2$ **d.** $(100011)_2$

iii. Which 8-bit two's complement number is −2? [1]

a. 10000010 **b.** 11111110
c. 11111101 **d.** 00000010

iv. A text holds the word **ज्ञान** (ज ् ञ া ন). How many bytes does it take in UTF-8? [1]

a. 3 **b.** 5
c. 10 **d.** 15

v. A picture is 100 × 100 pixels with a color depth of 1 bit. How many bytes? [1]

a. 100 **b.** 1,250
c. 10,000 **d.** 30,000

4 Trace the program [4]

Fill in the trace table: one row for each time round the loop, then what the program prints. The first row shows the values before the loop.

```
digits = "0123456789ABCDEF"
n = 725
base = 8
answer = ""
while n > 0:
    r = n % base
    answer = digits[r] + answer
    n = n // base
print(answer)
```

r	answer	n	Output
(before)	""	725	

5 Short answers [9]

Write short answers to the following questions.

a. i. Work out $(101100)_2 - (10111)_2$. [2]
ii. Work out $(1101)_2 \times (101)_2$.

b. i. Write −45 in 8-bit two's complement, showing your steps. [3]
ii. What number does the 8-bit two's complement 11010110 stand for?
iii. Work out 70 − 45 by adding 70 and −45 in 8-bit two's complement.

c. Explain why the one Nepali syllable **स्त्री** takes 18 bytes in UTF-8, while the English word **stree** takes 5. [2]

d. i. Encode `BBBBBBBBWWWWBBBBBBBBBBB` with run-length encoding. Counting each pixel as 1 byte and each run as 2 bytes, what is the compression ratio? [2]
ii. Decode `3W 2B 5W`.

6 Numerical problems [5]

Solve the following problems. Show your working.

a. A logo is 800 × 600 pixels and uses only 256 colors. How big are its pixels, in KB? (1 KB = 1,024 bytes.) [2]

Answer: _____

b. A two-minute interview is recorded at 48,000 samples a second, 16 bits a sample, in stereo. **[3]**

i. How big is it uncompressed, in MB? (1 MB = 1,024 × 1,024 bytes.)

ii. Saved as an MP3 at 192 kbps (1 kilobit = 1,000 bits), how big is it in MB?

iii. What is the compression ratio?

Answer: _____

7 True or false **[3]**

Write True or False after each sentence.

i. Decompressing a ZIP file gives back exactly the original files. ☐

ii. Saving a blurry low-quality JPEG again at quality 100 brings back the lost detail. ☐

iii. Run-length encoding can make a file bigger. ☐

iv. A Python program can be saved with lossy compression, since one character hardly matters. ☐

v. An MP3 doesn't store a quiet sound that a louder sound near it in pitch would hide. ☐

vi. A JPEG keeps a color for every pixel, but rounds off its brightness. ☐

8 Think **[2]**

Think, then answer.

Ramesh zips a folder, and it shrinks from 30 MB to 10 MB. He zips the ZIP file again, hoping for 3 MB. What happens, and why?

_____

_____

_____

_____

9 Activity: Squeeze the same photo (not marked)

Use **Throwing detail away** on the unit's page, or a photo app. Save one photo at each quality; zoom in on a sharp edge and mark it from 1 (awful) to 5 (as good as the original).

Format and quality	Size in KB	Ratio: PNG size ÷ this size	My mark, 1 to 5
PNG		1 : 1	
JPEG 80			
JPEG 40			
JPEG 5			