ANNEX A · BINARY

NAME _____ DATE _____

WEIGHTS	128	64	32	16	8	4	2	1	HEX	0–9	A=10	B=11	C=12	D=13	E=14	F=15

TASK 0 — Yesterday in four questions (no notes)

1. A computer is a machine that follows a _____ to _____, _____ and _____ information.
2. The three questions that decide whether something is a computer: _____
3. Is a bank card with a chip a computer? Why? _____
4. In Be the computer, program B walked off the grid. Who made the mistake? _____

TASK 1 — Binary → decimal

Add the weights under every 1. Then check each one in the terminal (**Ctrl + Alt + T**), with no spaces inside the number:

```
echo $((2#10110011))
```

`0000 0110` = _____ `0001 0001` = _____ `0100 1000` = _____

`1000 0000` = _____ `1011 0011` = _____ `1111 1111` = _____

☐ **Done when:** the terminal prints the same six numbers as you wrote.

TASK 2 — Decimal → binary

Use either method. Always write 8 bits, in two groups of four. Check by converting back with the command of task 1.

9 = _____ 25 = _____ 65 = _____

150 = _____ 200 = _____ your age = _____

Challenge: the biggest number you can write with 10 bits: _____ `0111 1111` + 1 = _____

☐ **Done when:** every answer has 8 bits and the terminal gives you back the decimal number.

TASK 3 — Secret messages

ASCII capital letters, in hex. A lower-case letter is the capital **+ 20** (hex): `A` = `41`, `a` = `61`.

A	B	C	D	E	F	G	H	I	J	K	L	M
41	42	43	44	45	46	47	48	49	4A	4B	4C	4D
N	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**	**W**	**X**	**Y**	**Z**
4E	4F	50	51	52	53	54	55	56	57	58	59	5A

- (a) Decode these four bytes: `48 6F 6C 61` → _____
- (b) Write each byte in hex, then decode: `0100 0010` _____ `0100 1001` _____ `0101 0100` _____ → _____
- (c) Make the terminal say (a). Type it exactly — every byte starts with `\x`:

```
printf '\x48\x6f\x6c\x61\n'
```

- (d) Write the first three letters of your name in hex: _____ _____ _____ Give only the bytes to your partner, who decodes them and prints them with `printf`.
- (e) The web colour `#FF6600`: red = `FF` = _____ green = `66` = _____ blue = `00` = _____ Check one with `echo $((16#66))`.

☐ **Done when:** the terminal printed the word of (a) and your partner printed your three letters.

TASK 4 Sizes and speeds

Small **b** = bit. Capital **B** = byte. 1 byte = 8 bits. 1 GB = 1,000,000,000 bytes. 1 GiB = 1,073,741,824 bytes.

- (a) A 400 Mbps connection downloads at most _____ MB/s.
- (b) Fibre at 600 Mbps. A game of 3 GB (3,000 MB). Speed: _____ MB/s. Time: _____ seconds.
- (c) A disk sold as "500 GB". Your PC counts in GiB. It shows about: _____

Working: _____

- (d) In the terminal, make a file of exactly one million bytes and measure it with both rulers:

```
head -c 1000000 /dev/zero > one.bin
ls -l one.bin
ls -lh one.bin
ls -lh --si one.bin
```

`ls -l` says: _____ `ls -lh` says: _____ `ls -lh --si` says: _____

Why are the last two different? _____

☐ **Done when:** you can explain to your neighbour why the same file is "977K" and "1.0M".

Finished early? Look at your own disk with both rulers: `df -h /` and `df -H /`. Then delete the file: `rm one.bin`.

EXIT TICKET Alone. One answer each.

1. What is `0010 1010` in decimal?

- ○ a) 21
- ○ b) 40
- ○ c) 42
- ○ d) 84

2. How many different values can one byte hold?

- ○ a) 255
- ○ b) 256
- ○ c) 8
- ○ d) 128

3. A 200 Mbps connection. What is the maximum download speed?

- ○ a) 25 MB/s
- ○ b) 200 MB/s
- ○ c) 1,600 MB/s
- ○ d) 20 MB/s

4. Why do people write bytes in hexadecimal?

- ○ a) Computers store numbers in hex
- ○ b) Hex was invented before binary
- ○ c) Hex needs less electricity
- ○ d) Each hex digit is exactly 4 bits

5. A byte holds `1111 1111` and you add 1. What does it hold now?

- ○ a) `1 0000 0000`
- ○ b) `0000 0000`
- ○ c) `1111 1111`
- ○ d) `0000 0001`

One thing I still do not understand: