

# Answer Keys & Grading Notes

Worked solutions, full-credit exemplars, and the mistakes to watch for. **Do not distribute to students.**

## A · Binary & Number Systems worksheet (20 pts)

2 pts each. Give 1 pt for correct method with an arithmetic slip.

### Decimal → Binary (8-bit)

Decimal	Binary (8-bit)	Work (place values 128 64 32 16 8 4 2 1)
13	0000 1101	8+4+1
42	0010 1010	32+8+2
100	0110 0100	64+32+4
200	1100 1000	128+64+8
255	1111 1111	all bits on = max 8-bit value

### Binary → Decimal

Binary	Decimal	Work
0000 1001	9	8+1
0011 0000	48	32+16
0101 0101	85	64+16+4+1
1000 0001	129	128+1

**Concept answers.** How many values can  $N$  bits store? →  $2^N$ . (4 bits → 16, 8 bits → 256.) Largest value in 8 bits? → 255 ( $= 2^8 - 1$ ). Why is it 255, not 256? → counting starts at 0, so 256 distinct values run 0–255.

**Common mistakes:** (1) writing  $2^N$  as the *largest value* instead of the *count of values* — largest is  $2^N - 1$ . (2) Dropping leading zeros so the answer isn't 8 bits (dock only if the assignment specified 8-bit width). (3) Reversing bit order (reading right-to-left). (4) Confusing "bit" and "byte" (1 byte = 8 bits).

## B · Encoding by hand (20 pts)

### Text via ASCII (8 pts)

Reference: A=65 , a=97 , 0(char)=48 , space =32 . Each letter's value = base + offset in the alphabet.

Character	Decimal (ASCII)	Binary (8-bit)
C	67	0100 0011
S	83	0101 0011
P	80	0101 0000
a	97	0110 0001

### Black-&-white image (6 pts)

1 bit per pixel (1 = black, 0 = white, per Code.org convention). A 5×5 grid needs **25 bits**. Full credit if their bit string matches their shaded grid *and* they state the correct total bit count. The exact picture varies by student — grade the mapping, not the art.

### Color image (6 pts)

Each pixel = 3 channels (Red, Green, Blue). At 8 bits/channel that's **24 bits (3 bytes) per pixel**, and each channel ranges **0–255**. Pure red = 255,0,0 = 1111 1111 0000 0000 0000 0000 . White = 255,255,255 ; black = 0,0,0 .

**Common mistakes:** saying 8 bits per *pixel* for color (it's 8 bits per *channel*, 24 per pixel); channel range 1–256 instead of 0–255; forgetting that more bits/channel → more colors (bit depth ↔ number of representable colors).

## C · Compression: lossless vs. lossy (15 pts)

	Lossless	Lossy
<b>Definition</b>	Reduces size with <i>no</i> loss of data; original is perfectly recoverable.	Reduces size by <i>permanently discarding</i> some data; original cannot be fully recovered.
<b>Example use</b>	Text, ZIP, PNG, program files — anywhere every bit matters.	JPEG photos, MP3 audio, streaming video — where small quality loss is acceptable.
<b>Trade-off</b>	Larger files than lossy, but perfect fidelity.	Much smaller files, but quality degrades and can't be restored.

**Exemplar full-credit answer** ("When would you require lossless?"): *"For anything where losing data changes the meaning — a legal document, source code, or a bank record. If a lossy method dropped bits, a word or number could change, so the trade-off of a bigger file is worth perfect accuracy."*

**Common mistakes:** claiming lossless "loses a little" (it loses nothing); saying lossy is "always worse" (it's a

deliberate trade-off for size); no concrete example (an answer with no example is capped at half credit).

## D · Overflow & round-off short response (10 pts)

**Overflow (5 pts):** occurs when a value is too large for the fixed number of bits available, so it "wraps" or produces a wrong result. Example: an 8-bit counter at 255 ( 1111 1111 ) plus 1 rolls over to 0.

**Round-off (5 pts):** occurs because some numbers (e.g., 0.1, or 1/3) can't be represented exactly in a fixed number of bits, so the stored value is slightly off; errors can accumulate over many calculations.

**Common mistakes:** confusing overflow (too big) with round-off (not exact); no example given; saying "the computer breaks" instead of describing wrap-around / approximation.

## E · Unit 1 concept quiz — key (25 pts, 1 each)

AP-style. Letters assume the standard Unit 1 item bank ordering; adjust to your quiz. The reasoning column is what matters for re-teaching.

#	Ans	Why / re-teach note
1	B	A bit is a single binary digit (0 or 1).
2	C	8 bits = 1 byte.
3	D	N bits represent $2^N$ distinct values.
4	A	Analog is continuous; digital is discrete (sampled).
5	C	Largest 8-bit value = $255 = 2^8 - 1$ .
6	B	Overflow = value exceeds available bits.
7	D	Round-off = number can't be stored exactly.
8	A	Lossless = fully recoverable.
9	C	Lossy = smaller file, permanent data loss (JPEG/MP3).
10	B	RGB color = 24 bits/pixel at 8 bits/channel.
11– 25	—	Enter your quiz's remaining keys here; keep the "why" note so weak items point to a re-teach.

**Use the tally:** after entering scores, any question >40% of the class missed is a re-teach flag. Cross-reference the "why" note to the objective (folder 01) and reteach that objective, not just the question.