Solutions

2.1

- $29 \bmod 13 = 3$; $55 \bmod 13 = 3$; $68 \bmod 13 = 3$ ✓.

2.2

- $\alpha = 12/13 \approx 0.92$ ✓.
- The average chain length equals $\alpha \approx 0.92$ ✓.

2.3

- A power-of-two modulus keeps only the low bits – keys sharing them collide wholesale ✓.
- A prime spreads the residue across all bits of the key ✓.

3.1

- Buckets: $6 \bmod 11 = 6$; $17 \bmod 11 = 6$; $28 \bmod 11 = 6$; $39 \bmod 11 = 6$; $50 \bmod 11 = 6$ ✓.
- One chain: $6 \to 17 \to 28 \to 39 \to 50$ in bucket 6 ✓.
- $\alpha = 5/11 \approx 0.45$; expected successful cost $1 + 0.45/2 \approx 1.23$ comparisons ✓.
- Worst case for 50: five comparisons – the whole chain ✓.

3.2

- Slots: $6 \to 6$; 17 probes $6, \to 7$; $28 \to 6, 7, \to 8$; $39 \to 6, 7, 8, \to 9$; $50 \to 6, 7, 8, 9, \to 10$ ✓.
- Probe counts $1, 2, 3, 4, 5$ – running total 15 ✓.
- Five distinct buckets would cost exactly 5 probes total ✓.
- The effect is clustering: the occupied run grows the probe path ✓.
- Policy: keep α under about 0.75 and resize ✓.