Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

$\dfrac{48 \times 10^{6} \times 10^{-3}}{5} = \mathbf{9600}$ passes; 2 ms: **19 200**; $19\,200 < 65\,535$, so yes

2.2

$I = \dfrac{3.3}{10\,000} = \mathbf{0.33\ mA}$; open: $3.3 - 10^{-6} \times 10^{4} = \mathbf{3.29\ V}$; logic **1**

2.3

$R = \dfrac{3.3 - 1.8}{0.010} = \mathbf{150}\ \Omega$; 8 mA needs $R \geq 187.5\ \Omega$, so 220 Ω; $I = \dfrac{1.5}{220} = \mathbf{6.8\ mA}$

2.4

ODR at `0x4002_0000` + `0x14` = **`0x4002_0014`**; clear the field with `~(3u << 12)`; `MODER = (MODER & ~(3u << 12)) | (1u << 12);`

3.1

$64 \times 8 = 512$ bits at 8 MHz: **64 µs**

A: the CPU is busy for all 64 µs, 5376 cycles; every ms that is **6.4**% of the CPU

B: 90 cycles = 1.1 µs, which is **0.11**%

for a few bytes, when the DMA setup costs about as much as moving them, or when no DMA channel is free

3.2

```
if ((IDR & (1u << 6)) == 0)
```

one press can look like several presses and releases, so the counter goes up by more than one

accept a new state only when two polls in a row agree; bouncing lasts less than one poll period, so the worst delay is about **20 ms**

a press shorter than 10 ms can fall between two polls; an edge interrupt would catch it

3.3

(a) awake 6 mA $\times \dfrac{2}{1000} = 12$ µA; LED 5 mA $\times \dfrac{50}{10\,000} = 25$ µA; sleep 2 µA; pull-up $\dfrac{3.3}{10\,000} = 330$ µA; total **369 µA**

(b) $\dfrac{220}{0.369} = 596$ h = **25 days**

(c) the pull-up, which is 90% of the total: change the logic so the line rests high, or enable the pull-up only while reading; total 39 µA gives **235 days**

(d) parts the budget misses, such as a floating input or a peripheral left on, can draw more than the whole budget

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