## Solutions

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

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

**2.1**

0010 1101

`0x2D`

$11 \times 16 + 7 = \mathbf{183}$

**2.2**

$20 = 0001\,0100$; flip and add 1: **1110 1100**

$246 - 256 = \mathbf{-10}$

**2.3**

yes: $150 > 127$

pattern 1001 0110

read as signed: $150 - 256 = \mathbf{-106}$

**2.4**

c, a, f take 1 byte each and é takes 2: **5** bytes

`len` counts characters: **4**

**3.1**

(a) `0100 0001 0010 0000 …` (zeros to 32 bits)

(b) sign 0, so positive; exponent field $1000\,0010 = 130$, true exponent $130 - 127 = 3$

(c) fraction `0100…`, so $1.01_2 = 1.25$

(d) $1.25 \times 2^3 = \mathbf{10.0}$

(e) about $2 \times 2^{127} \approx \mathbf{3.4} \times \mathbf{10^{38}}$

**3.2**

(a) $1920 \times 1080 \times 3 = \mathbf{6{,}220{,}800}$ bytes, about 6.2 MB

(b) 300 frames; $300 \times 6.22$ MB $\approx \mathbf{1.87}$ GB

(c) compression: frames are stored as changes from earlier frames, and detail the eye misses is dropped

**3.3**

(a) $2^{31} - 1 = 2{,}147{,}483{,}647$ counts; $/1000/86\,400 \approx \mathbf{24.9}$ days

(b) $\mathbf{-2{,}147{,}483{,}648}$

(c) $2^{32}/1000$ s $\approx \mathbf{49.7}$ days



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(d) $2^{63}/1000 \approx 9.2 \times 10^{15}$ s $\approx \mathbf{292}$ million years

(e) the 64-bit counter: it will never overflow in the device's life; the cost is 4 more bytes per counter