**1.12** In single precision (IEEE-754 standard), 8 bits are used for storing the exponent (the bias is 127), and 23 bits are used for storing the mantissa.
(*a*) What are the smallest and the largest positive numbers that can be stored in single precision?
(*b*) What is the smallest value of the mantissa that can be stored?

**Solution**

(a) The largest binary form of the exponent plus bias that can be stored in single precision is 11111111 or $2^7+2^6+2^5+2^4+2^3+2^2+2^1+2^0=255$. Therefore the largest exponent that can be stored is 255-127=128. The smallest exponent is 00000000 or 0-127=-127. The largest binary mantissa is:
11111111111111111111111 or in decimal form,
$2^{-1}+2^{-2}+...+2^0=0.9999998807907105$
Thus, the largest number that can be stored is $1.9999998807907105 \times 2^{128}$.

Similarly, the smallest binary mantissa is 00…0, or in decimal form 0. Thus, the smallest number that can be stored is $1.0 \times 2^{-127}$.
(b) From part(a) above, the smallest value of the mantissa that can be stored is 0.