

## Problem 14

Find the order of magnitude of the following physical quantities. (a) The mass of Earth's atmosphere:  $5.1 \times 10^{18}$  kg (b) The mass of the Moon's atmosphere: 25,000 kg; (c) The mass of Earth's hydrosphere:  $1.4 \times 10^{21}$  kg (d) The mass of Earth:  $5.97 \times 10^{24}$  kg (e) The mass of the Moon:  $7.34 \times 10^{22}$  kg (f) The Earth–Moon distance (semimajor axis):  $3.84 \times 10^8$  m (g) The mean Earth–Sun distance:  $1.5 \times 10^{11}$  m (h) The equatorial radius of Earth:  $6.38 \times 10^6$  m (i) The mass of an electron:  $9.11 \times 10^{-31}$  kg (j) The mass of a proton:  $1.67 \times 10^{-27}$  kg (k) The mass of the Sun:  $1.99 \times 10^{30}$  kg.

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### Solution

Write each of the numbers in scientific notation and then round the leading number. If it's 5 or higher, round it up to 10, and if it's lower than 5, round it down to 1.

- (a)  $5.1 \times 10^{18} \text{ kg} \approx 10 \times 10^{18} \text{ kg} = 10^{19} \text{ kg}$
- (b)  $25,000 \text{ kg} = 2.5 \times 10^4 \text{ kg} \approx 1 \times 10^4 \text{ kg} = 10^4 \text{ kg}$
- (c)  $1.4 \times 10^{21} \text{ kg} \approx 1 \times 10^{21} \text{ kg} = 10^{21} \text{ kg}$
- (d)  $5.97 \times 10^{24} \text{ kg} \approx 10 \times 10^{24} \text{ kg} = 10^{25} \text{ kg}$
- (e)  $7.34 \times 10^{22} \text{ kg} \approx 10 \times 10^{22} \text{ kg} = 10^{23} \text{ kg}$
- (f)  $3.84 \times 10^8 \text{ m} \approx 1 \times 10^8 \text{ m} = 10^8 \text{ m}$
- (g)  $1.5 \times 10^{11} \text{ m} \approx 1 \times 10^{11} \text{ m} = 10^{11} \text{ m}$
- (h)  $6.38 \times 10^6 \text{ m} \approx 10 \times 10^6 \text{ m} = 10^7 \text{ m}$
- (i)  $9.11 \times 10^{-31} \text{ kg} \approx 10 \times 10^{-31} \text{ kg} = 10^{-30} \text{ kg}$
- (j)  $1.67 \times 10^{-27} \text{ kg} \approx 1 \times 10^{-27} \text{ kg} = 10^{-27} \text{ kg}$
- (k)  $1.99 \times 10^{30} \text{ kg} \approx 1 \times 10^{30} \text{ kg} = 10^{30} \text{ kg}$