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Problem

At 45° latitude, the gravitational acceleration as a function of elevation z above sea level is given by $g = a - bz$, where $a = 9.807 \text{ m/s}^2$ and $b = 3.32 \times 10^{-6} \text{ s}^{-2}$. Determine the height above sea level where the weight of an object will decrease by 0.5 percent.

Step-by-step solution

Step 1 of 3

Write the expression for gravitational acceleration as function of elevation z above the sea level.

$$g = a - bz$$

Here, the parameters are a and b .

Substitute 9.807 m/s^2 for a and $3.32 \times 10^{-6} \text{ s}^{-2}$ for b .

$$g = 9.807 - 3.32 \times 10^{-6} z$$

Percentage of weight of the object decreased 0.5%

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Step 2 of 3

Write the expression for weight.

$$W = mg$$

Here, the mass is m and the acceleration due to gravity is g .

Substitute $(9.807 - 3.32 \times 10^{-6} z)$ for g .

$$W = m(9.807 - 3.32 \times 10^{-6} z)$$

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Step 3 of 3

Calculate the weight of the object will decrease by 0.5 percent.

$$W = \left(1 - \frac{0.5}{100}\right) W_s$$

$$= 0.995 \times mg_s$$

Here, the acceleration due to gravity at sea level.

Substitute $m(9.807 - 3.32 \times 10^{-6} z)$ for W and 9.807 m/s^2 for g_s .

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$$-3.32 \times 10^{-7}$$

$$= 14769.5 \text{ m}$$

Therefore, the height above the sea-level is .

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