Captains' fight

Captains' fight n°3 : Question

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You have **3 minutes** to answer the following question :

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What would be the linear size **in meters** of a cube made of gold of the same mass as the atmosphere ?

Captains' fight n°3 : Answer

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The atmospheric pressure corresponds to the weight of an air column of $1\,\mathrm{m}^2$, corresponding also to a 10 m-high column of water, thus $1{\cdot}10^4\,\mathrm{kg}$. Multiplying this mass by the surface of the Earth, we get

$$M_{\mathrm{atm}} \simeq 4\pi(6400 \cdot 10^3)^2 \cdot 10^4 = 5{,}1{\cdot}10^{18}\,\mathrm{kg}.$$

Gold has a density $d_{\mathrm{gold}} \simeq 20$, such that $\rho_{\mathrm{gold}} \simeq 20{\cdot}10^3\,\mathrm{kg{\cdot}m^{-3}}$. The volume of the cube is

$$V_{\mathrm{gold}} \simeq \frac{5{,}1{\cdot}10^{18}}{20{\cdot}10^3} \simeq 2{,}6{\cdot}10^{14}\,\mathrm{m}^3$$

The height of the cube is then

$$\boxed{L_{\mathrm{gold}} \simeq 4{,}0{\cdot}10^4\,\mathrm{m}} \qquad \log_{10} L = 4.6$$

(10^5 wins against 10^4)

You want more ?

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Really ?

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Quick : 1min

Question : If you manage to drive all the water of the Niagara falls inside a straw, what would be the speed (in $\mathrm{m \cdot s^{-1}}$) of the water ?

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Answer

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Really ?

Quick : 1min

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Answer

The typical flow rate of Niagara falls is $2\,800\,\mathrm{m^3{\cdot}s^{-1}}$ (*value taken from Wikipedia. This can be estimated knowing that the falls are 1 km long !*).

The surface of a straw is typically $\pi \times \frac{(10^{-2})^2}{4} = 1{\cdot}10^{-4}\,\mathrm{m^2}$.

The velocity is thus :

$$v = \frac{2800}{10^{-4}} = \boxed{2{,}8{\cdot}10^{7}\,\mathrm{m{\cdot}s^{-1}}} \qquad \log_{10} v = 7{,}4$$

(10^7 wins agains 10^8)