- The dependence of the surface area on the length is a power law. What is the exponent?
  2
- The dependence of the volume on the length is a power law. What is the exponent?
  3

- What is your BMI?
  I don't know your BMI. Mine is roughly between 15 and 16.
- Find the different ranges of BMI, thin, normal, fat, etc.
  The ranges are not very strict. The following are some typical values.
  underweight: below 18.5
  normal: between 18.5 and 25
  obese: above 30 overweight: between 25 and 30

- Check this relation for human, elephant, and blue whale. Find the data (average mass and average life span) you need.
  the values for mass and age, are of course not exact. A large elephant can weigh up to 5 tons and live up to 50 years. The corresponding values for a blue whale could be 100 tons and 100 years. So the ratios of the life span and the mass, are about 2 and 20. That results in α approximately 0.23. But if one use this α for the blue whale and human, even with a mass of 100 k g for a human being (I know this is a little high), the ratio of masses becomes 10^{-3}, and one expects the life-span ratio to be $(10^{-3})^{\alpha}$, which is about 0.2. So the expected life span for human would be about 20 years.
- Does human seem to be an anomaly?
  Yes. It seems that humans live a life much longer that expected regarding their mass.

- To determine the parameters τ and ℓ, some data is needed. Suppose that the average speeds at t_1 and t_2 are equal to the same value V. Find ℓ and τ.
  $\tau = \sqrt{t_1\, t_2}, \quad \ell = V\,(t_1 + t_2)$.
- As a numerical example, consider the case of running competitions for short distances. The (approximate) world records for the 100 m and 200 m races are 10 s and 20 s, respectively. What are τ and ℓ? What are the maximum values of the instantaneous and average speeds?
  $\tau = 14.1\,\mathrm{s}, \quad \ell = 300\,\mathrm{m}, \quad v_{\max} = 13.8\,\mathrm{m\,s^{-1}}, \quad \bar{v}_{\max} = 10.6\,\mathrm{m\,s^{-1}}$.

- Suppose that the temperature of the oceans increases by just 1°C. And assume that the average depth of the oceans is several kilometers. By how much does this rise the surface of the oceans?

The volumetric thermal expansion coefficient of water is about $10^{-4}\,\mathrm{K}^{-1}$. So the level-rising relative to the depth is about 10^{-4}, making the level-rising to be a few decimeters.

- If the inside temperature is kept constant by burning some fuel (directly, or indirectly), what is rate of fuel consumption corresponding the above current, assuming that the fuel is natural gas?
  The energy released by burning natural gas, is about $50\,\mathrm{M\,J\,(k\,g)}^{-1}$. So the rate of burning the fuel (to produce $20\,\mathrm{k\,W}$, should be $0.4\,\mathrm{g\,s}^{-1}$.

- Find the latent heat per volume and the surface tension, say for water, and estimate ℓ.
  For water, the latent heat per volume is about $2 \times 10^9\,\mathrm{J\,m}^{-3}$, and the surface tension is about $0.07\,\mathrm{N\,m}^{-1}$. So ℓ is about $0.3 \times 10^{-10}\,\mathrm{m}$, that is $0.3\,\text{Å}$.