Measuring antenna temperature in point sources.
Recall that in the lecture on antenna fundamentals you noted that the power collected by a telescope from a source corresponded to an antenna temperature:

$$P_\nu = \frac{A_e S_\nu}{2} = kT_A \ ,$$

where antenna temperature represents the equivalent resistor temperature to match the response of the telescope to the P_ν coming in from the source. Generally instead of quoting A_e for a telescope, you will instead find a quote for the aperture efficiency η_A, such that we can write:

$$P_\nu = \frac{\eta_A A_{geom} S_\nu}{2} = kT_A.$$

thus requiring only knowledge of the quoted aperture efficiency and the geometric area. Many telescopes have efficiencies that are pretty poor, and for most systems, $\eta_A < 0.7$ is typical.

OK, now consider the following: You're observing a compact point source of angular size $\Omega_s = 10^{-10}$ sr at a frequency of $\nu = 1$ GHz. Its brightness temperature is $T_B = 10^{12}$ K.

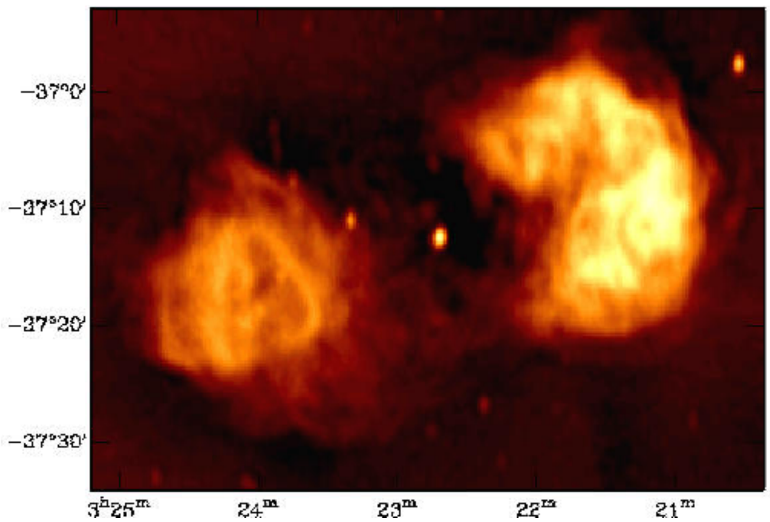
Note, I really suggest you work symbolically until you come up with expressions you think will be useful here before plugging in numbers!

- Assuming $\eta_A = 1.0$, what effect does the dish size have on the antenna temperature you'll measure for your target
  (try 10m, 100m diameter telescopes)?
- Assuming a fixed dish size, what effect does the aperture efficiency have on the antenna temperature you'll measure
  (try 50%; 100% efficiency)?

[Second note; the equations above may serve to distract you, but I hope should push to help your understanding of how various concepts we've seen interrelate!]

Measuring antenna temperature in Fornax A.

Read the lead-in to the previous question (up until "$\eta_A < 0.7$ is typical"). You're observing the extended western lobe of the elegant Fornax A radio galaxy, pictured below as observed by the SUMSS survey at 843 MHz:



In this image, Right Ascension is given on the x-axis (in hours/minutes) and Declination is given on the y-axis (in degrees/arcminutes). Consider the western lobe—the one on the right—as an extended region of constant surface brightness of 10^{-7} Jy/sr (ignore variations across the lobe). You're observing at a center frequency of 1 GHz.

Note, I really suggest you work symbolically until you come up with expressions you think will be useful here before plugging in numbers!

- Assuming $\eta_A = 1.0$, what is the antenna temperature you'll measure for your target with Arecibo telescope (D=300m)? What about FAST telescope (D=500m)?
- What effect does an aperture efficiency of $\eta_A = 0.5$ have on the antenna temperature you'll measure with Arecibo?

Climbing telescopes.
A typical aperture efficiency for the Karl G. Jansky Very Large Array (VLA) at 43 GHz is 35%. (a) Assuming the entirety of aperture efficiency losses come from dish surface imperfections, what is the rms surface error in mm on a VLA dish? (b) A popular activity of VLA visitors is to walk on the surface of the dishes. If the indentation left by someone walking on the surface of the dish can be as large as 0.5 mm, is it a good idea to let people on the surface?