1. A circular parabolic dish has an efficiency of 91%, a radius of 1 m, and Gain of 300. What frequency is the antenna designed for?

   Dish row, $G_{dish} = (2\pi r_{dish}/\lambda)^2\,\eta$, solved for the wavelength:
   $\lambda = 2\pi r_{dish}\sqrt{\eta/G_{dish}} = 2\pi(1\text{ m})\sqrt{0.91/300} = (6.283)(0.05508) = 0.3461\text{ m}$
   $f = c/\lambda = (3\times10^8\text{ m/s})/(0.3461\text{ m}) = 8.669\times10^8\text{ Hz} = 867\text{ MHz}$

   $f =$ 867 MHz

2. A circular parabolic dish with a diameter of 600 mm is used receive a satellite TV signal at 18 GHz. The dish has an efficiency of 90%. What is the dish's gain?

   A dish uses the radius: $r_{dish} = D/2 = 0.300$ m. $\lambda = c/f = (3\times10^8)/(18\times10^9) = 1/60 = 0.016667$ m
   $G_{dish} = \left(\frac{2\pi r_{dish}}{\lambda}\right)^2\eta = \left(\frac{2\pi(0.300)}{1/60}\right)^2(0.90) = (113.10)^2(0.90) = 11{,}512$
   (The diameter in place of the radius gives 46,048, four times too large.)

   Gain = 11512

3. A TACAMO aircraft is used to send messages to a submarine using a carrier frequency of 30 KHz. How long of an antenna must the aircraft use to send the signal (assume a dipole antenna is used)?

   $\lambda = c/f = (3\times10^8)/(30\times10^3) = 10{,}000\text{ m} = 10\text{ km}$
   Ideal Dipole row: Length $= \lambda/2 = 5{,}000\text{ m} = 5\text{ km}$

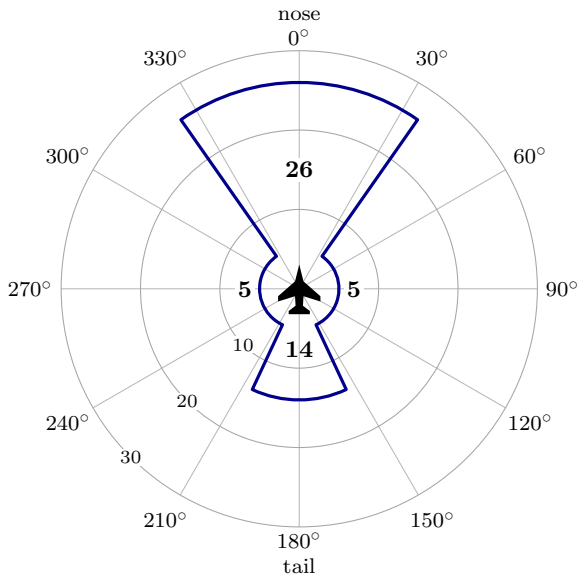
   Length = 5km

4. A circular dish antenna is to be used to communicate with a satellite communication system, using a frequency of 4.6 GHz. The dish has a diameter of 300 mm and an efficiency of 86%. What is the gain of the antenna?

   $r_{dish} = D/2 = 0.150$ m. $\lambda = c/f = (3\times10^8)/(4.6\times10^9) = 0.06522$ m
   $G_{dish} = \left(\frac{2\pi r_{dish}}{\lambda}\right)^2\eta = \left(\frac{2\pi(0.150)}{0.06522}\right)^2(0.86) = (14.45)^2(0.86) = 179.6$

   Gain = 179.6

5. The plot below is the gain pattern of the datalink antenna on a fighter, seen from above. The angle is the direction you look from the aircraft: 0° is the nose, and the angle increases clockwise, so 90° is directly off the right wing. The distance from the center is the antenna's gain in that direction, a linear ratio (not dB), read against the labeled rings. The bold number on each lobe is that lobe's gain.



Top view. The rings mark a gain of 10, 20 and 30. 0° is the nose, and the angle increases clockwise.

(a) What is the antenna's gain toward a tanker directly behind the fighter?

$G =$ 14

Directly behind is the tail, 180°. That is inside the tail lobe (155° to 205°), whose bold number is 14: $G = 14$

(b) What is the antenna's gain toward a wingman directly off the fighter's left wing?

$G =$ 5

The angle increases clockwise from the nose, so the left wing is at 270°. No lobe points there, and the pattern sits at its low level: $G = 5$, not the 26 on the nose

6. A weather RADAR operates at 5.6 GHz. Its circular parabolic dish must have a gain of 12,000, and the dish has an efficiency of 55%. What diameter must the dish have?

$\lambda = c/f = (3 \times 10^8)/(5.6 \times 10^9) = 0.05357$ m

Dish row solved for the radius: $r_{dish} = \dfrac{\lambda}{2\pi}\sqrt{\dfrac{G_{dish}}{\eta}} = \dfrac{0.05357}{2\pi}\sqrt{\dfrac{12{,}000}{0.55}} = (0.008526)(147.7) = 1.2594$ m

The row gives the radius, so $D = 2\,r_{dish} = 2(1.2594) = 2.519$ m ≈ 2.52 m

Check: $\left(\dfrac{2\pi(1.2594)}{0.05357}\right)^2 (0.55) = 12{,}000$

Diameter = 2.52 m