Physics 108 Homework 10

1. The water hole is a narrow range of frequencies in the radio spectrum where background noise is lowest, and thus the chances are highest for detecting a signal from some other civilization. The water hole extends from about 1 GHz to 10 GHz

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2. a) Much of the galaxy was obscured from view by dust in the galactic plane and galactic bulge

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b) The dust does not block radio signals or infrared light, so the development of radio telescopes and infrared telescopes made it possible to see through the dust and figure out the structure of the Milky Way

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3. The number of orbits is simply the total time divided by the time per orbit

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$$N = \frac{6 \times 10^9 \text{ yr}}{230 \times 10^6 \text{ yr}} = \frac{6000}{230} = 26 \text{ times}$$

4. For wheel-like rotation the speed goes up for points farther from the center, as it does for a point at the edge of a merry-go-round (see Fig 22.29A)

+5 For planet-like rotation the speed goes down for points (eg planets) farther away from the center (as in Fig 22.29B).

A flat rotation curve does neither, so both are ruled out.

5. The total mass of the Milky Way is estimated to be $6 \times 10^{11}\ M_\odot$ (pg 538).

The mass of the black hole in the center of the Milky Way has a mass of about $2.6 \times 10^{6}\ M_\odot$ (pg 545). Then

+5 $$\frac{2.6 \times 10^{6} M_\odot}{6 \times 10^{11} M_\odot} \times 100\% = 4.3 \times 10^{-4}\% = 0.00043\ \%$$

30 You might use slightly different values, but in any case the black hole in the center is small compared to the overall mass of the galaxy.