1)

$$\arctan(1) = \frac{\pi}{4}$$
$$\pi = 4 * \arctan(1)$$
$$= 4 * [1 - x^2 + x^4 - x^6 + \cdots]$$
$$4 * \int [1 - x^2 + x^4 - x^6 + \cdots] dx$$
$$= 4 * \left[x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots\right]$$
$$4\left[1 - \frac{1^3}{3} + \frac{1^5}{5} - \frac{1^7}{7} + \cdots\right] \approx \pi$$

1')

$$4\left[1 - \left(\frac{1^3}{3}\right) + \left(\frac{1^5}{5}\right) - \left(\frac{1^7}{7}\right) + \left(\frac{1^9}{9}\right) - \left(\frac{1^{11}}{11}\right) + \left(\frac{1^{13}}{13}\right) - \left(\frac{1^{15}}{15}\right) + \left(\frac{1^{17}}{17}\right) - \left(\frac{1^{19}}{19}\right)\right] = 3.04183961893$$
$$3.14159265359 - 3.04183961893 = .09975303465$$

2)

$$\arctan\left(\frac{1}{2}\right) + \arctan\left(\frac{1}{3}\right) = \frac{\pi}{4}$$
$$\tan(\alpha) = \frac{1}{2}, \tan(\beta) = \frac{1}{3}$$
$$\tan(\alpha + \beta) = \frac{\tan(\alpha) + \tan(\beta)}{1 - \tan(\alpha)\tan(\beta)}$$
$$= \frac{\frac{1}{2} + \frac{1}{3}}{1 - \frac{1}{2} * \frac{1}{3}}$$
$$= \frac{\frac{5}{6}}{1 - \frac{1}{6}} = 1$$
$$\arctan(1) = \frac{\pi}{4}$$

2')

$$\pi = 4 * \arctan(1)$$
$$= 4 * [1 - x^2 + x^4 - x^6 + \cdots]$$
$$4 * \int [1 - x^2 + x^4 - x^6 + \cdots] dx$$
$$= 4 * \left[x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \cdots\right]$$
$$4\left[1 - \frac{1^3}{3} + \frac{1^5}{5} - \frac{1^7}{7} + \cdots\right]$$
$$= 2.89$$

3)

$$\frac{\pi}{4} = 4\arctan\left(\frac{1}{5}\right) - \arctan\left(\frac{1}{239}\right)$$
$$= .785$$

4)

$$13 - \left(\frac{1}{5}\right)^5 * \frac{20 * 50 + 13}{2^{10}} + \left(\frac{1 *}{2 * 4}\right)^5 * \frac{40 * 91 + 13}{2^{20}} - \left(\frac{1 * 3 * 5}{2 * 4 * 6}\right)^5 * \frac{60 * 132 + 13}{2^{30}}$$
$$\frac{128}{\pi^2} = 12.99970$$
$$\pi^2 = \frac{128}{12.99970}$$
$$= 3.13789$$
$$\pi = 3.14159265$$

the approximation with my rounding shows the first 3 digits are close when rounding