1. In polar coordinates, the surface has equation r^4. So we need to compute

$$\int_0^{\frac{\pi}{2}} \int_0^1 r^5 \, dr \, d\theta = \int_0^{\frac{\pi}{2}} \frac{1}{6} \, d\theta = \frac{\pi}{12}.$$

2. The integral we are looking for is

$$\int_{\frac{\pi}{4}}^{\pi} \int_5^9 r \, dr \, d\theta = \int_{\frac{\pi}{4}}^{\pi} \left(\frac{81}{2} - \frac{25}{2} \right) d\theta = 21\pi.$$

3. (a) We calculate $f(1) = 3$ and $f'(1) = 5$, so $T_1(x) = 3 + 5(x-1)$.

   (b) Since $f''(x) = 2$, the error is less than or equal to $\frac{2}{2}|x-1|^2 = |x-1|^2$. On the interval $[0.5, 1.5]$, $|x-1| \leq 0.5$, so the error is less than or equal to $(0.5)^2 = 0.25$.

   (c) We need $|x-1|^2 \leq 0.01$, so we need $|x-1| \leq \sqrt{0.01} = 0.1$. So the interval we are looking for is $[0.9, 1.1]$. (Any interval smaller than this would work also.)