1. $||\gamma'|| = 5$. Consider the reparametrization $\tilde{\gamma}(t) = (3 \sin \frac{t}{5}, 3 \cos \frac{t}{5}, \frac{4t}{5})$. By standard calculation, $k = \frac{3}{25}$, $\tau = -\frac{4}{25}$.

2. See the textbook.

3. (a) True. They are locally isometric to the plane. (b) True. Consider $\gamma(t) = (e^{-\frac{1}{2}t}, e^{-\frac{1}{2}t}t, 0)$. Define $e^{-\frac{1}{2}t} = 0$ if $t = 0$. Then the image of $\gamma$ is given by the set in (b). Check that $\gamma$ is smooth, but not regular. (c) False. The initial tangent is not decided. (d) False. Consider Mobius band.

4. $\sigma_u = (\cos v, \sin v, 0); \sigma_v = (-u \sin v, u \cos v, 0)$. Thus the first fundamental form is $du^2 + u^2 dv^2$. $f(x,y) = f(u \cos v, u \sin v, 0) = F(u, v) = (\cos v, \sin v, g(u))$. $F_u = (0, 0, g')$; $F_v = (-\sin v, \cos v, 0)$. Then the first fundamental form induced by $F$ is $g'^2 du^2 + dv^2$. Since $f$ is conformal, $g'^2 u^2 = 1$. Then $g' = \frac{1}{u}$ or $-\frac{1}{u}$. Therefore $g(u) = \ln u + C$ or $-\ln u + C$. 
