Calculator and mobile phones are NOT allowed.
Answer the following questions. Each sub(question) is worth 4 points

Q1. Show that $f(x)=\sqrt{1+\ln(x^2+1)}$, $x \geq 0$ is one-to-one. Find $f^{-1}(x)$ and state its domain.

Q2. Evaluate $\lim_{x\to 0^+}\left(\frac{1}{\tan x}-\frac{1}{x}\right)$

Q3. Evaluate the following integrals:

(a) $\int (\ln x)^2\, dx$

(b) $\int \frac{e^{2x}}{\sqrt{e^{4x}+2e^{2x}+2}}dx$

(c) $\int \frac{(2\sin x-3)\cos x}{\sin^2 x+3\sin x+2}dx$

Q4 Determine whether the integral $\int_{-\infty}^{\infty} \frac{1}{e^x+e^{-x}}dx$ converges or diverges, if it converges, find its value.

Q5. Find the length of the curve C given by

$$x=t^2\cos t,\quad y=t^2\sin t\quad ;\quad 0\leq t\leq 2\pi.$$

Q6. Find the area of the region that is inside the circle $r=9\cos\theta$ and outside the cardioid $r=3+3\cos\theta$.

Q7. If θ is the angle between nonzero vectors **a** and **b**, then prove that

$$\mathbf{a}\cdot\mathbf{b}=\|\mathbf{a}\|\,\|\mathbf{b}\|\cos\theta$$

Q8. Find the equation of the plane through the point $P(6, 2, -1)$ and perpendicular to the line of intersection of the planes $4x-3y+2z+5=0$ and $3x+2y-z+11=0$.