Answer the following questions. Calculators and mobile telephones are not allowed.

Evaluate the following integrals:

1. $\int \tan^{-1} 3x\,dx$ (7 points)

2. $\int \sin^3 x\sqrt{\sec x}\,dx$ (7 points)

3. $\int \dfrac{dx}{x^4\sqrt{16-x^2}}$ (7 points)

4. $\int \dfrac{3x^2+5x+10}{(x+2)(x^2-2x+4)}$ (7 points)

5. Determine whether the integral converges or diverges, and if it converges, find its value.

$$\int_0^{\frac{\pi}{2}} \frac{dx}{1-\sin x}$$ (7 points)

6. Find the arc length of the curve $x = \sec t$, $y = \ln(\sec t + \tan t)$, $0 \le t \le \frac{\pi}{4}$ (7 points)

7. Find the area of the region inside the cardioid $r = 4 - 4\cos\theta$ and outside the circle $r = 2$. (8 points)