Calculators, mobile phones and pagers are not allowed
Answer all of the following questions. Each (sub)question is worth 4 points

1. Let $f(x) = \tan^{-1}\left(e^{2x} + 1\right)$. Find the domain of f and show that f is one-to-one. Also compute $f^{-1}(x)$ and state the domain and the range of f^{-1}.

2. Find the limit

$$\lim_{x \to 0^+} \frac{\ln(\arcsin x)}{\ln(\sin x)}$$

3. Evaluate the following integrals:

(a) $\displaystyle\int \frac{\ln x}{\sqrt{x}}\, dx$ (b) $\displaystyle\int \frac{\sqrt{1+t^2}}{t}\, dt$

(c) $\displaystyle\int \sin^3 x \cos\left(\frac{x}{2}\right)\, dx$ (d) $\displaystyle\int \frac{dx}{2 - \cos x}$

(e) $\displaystyle\int_0^{\ln 2} \frac{dx}{\sqrt{e^x - 1}}$ (if it exists).

4. Identify and sketch the curve whose polar equation is

$$r = \frac{5}{3 + 2\sin\theta}$$

by transforming it to rectangular coordinates.

5. Find the area of the region that is inside the circle $r = 4\cos\theta$ and outside the limacon $r = 3 - 2\cos\theta$.

6. Find parametric equations for the line passing through the point $P(1, 2, -1)$ which is parallel to the intersection of the planes $x + y + z = 5$, $x - 2y - 2z = -1$.

Total 40 points