2. Evaluate

$$\int \frac{\sin\theta}{\sqrt{2-\cos^2\theta}}\,d\theta$$

(10)

3. Evaluate

$$\int_0^\infty \frac{e^t}{e^{2t}+3e^t+2}\,dt$$

(10)

3. (10 points) Consider the improper integral $\displaystyle\int_1^\infty \frac{\tan^{-1}(x)}{x^2}\,dx$.

   Evaluate the integral (if it converges) or explain carefully why it does not converge.

   If it converges, give your answer in exact form.

4. (8 points) Determine whether the following improper integral is convergent or divergent. Evaluate it if it is convergent.

$$\int_0^\infty x^3 e^{-x^2}\, dx$$

6. (10 total points) Consider the *improper* integral

$$\int_0^1 x^k \ln x \, dx,$$

where k is a constant.

(a) (4 points) Does this improper integral converge when $k = -1$? Justify your answer.

(b) (6 points) Determine the values of $k \neq -1$ for which the improper integral above converges. Justify your answer.

3. (8 points) Evaluate the improper integral

$$\int_0^\infty \frac{1}{\sqrt{x}(1+x)}\,dx.$$

Be sure to indicate the limit(s) you are taking to evaluate the integral because it is an improper integral.

2. Evaluate

$$\int \frac{\sin\theta}{\sqrt{2-\cos^2\theta}}\,d\theta$$

(10)

3. Evaluate

$$\int_0^\infty \frac{e^t}{e^{2t}+3e^t+2}\,dt$$

(10)