Each problem is worth 10 points. For full credit provide good justification for your answers.

1. Evaluate $\int \sin^2 \theta \cos \theta \, d\theta$

2. Evaluate $\int x e^x \, dx$

3. Write the appropriate form for a partial fractions decomposition of the function

$$\frac{2(x^4 + 1)}{(x - 2)^2(x - 1)(x^2 + 2)^2}$$

4. Evaluate $\displaystyle\int_{e}^{e^6} \frac{dx}{x\sqrt{\ln x}}$

5. Evaluate $\displaystyle\int_3^\infty e^{-5p}\,dp$

6. Evaluate $\displaystyle\int \frac{x^3}{\sqrt{1-x^2}}\,dx$

7. Star is a calculus student at Enormous State University, and they're having some trouble. Star says "Yikes! Calc 2 is like a totally different thing than Calc 1. These problems are so long! And sometimes I wonder why they pick the things they do, like for a trig sub one, why do they do $x = \sin\theta$? Would it work if you did $x = \cos\theta$?"

Help Star out. Explain to them as clearly as possible whether their alternative works well, and why.

8. Derive Line 87 from the Table of Integrals,

$$\int \sin^{-1} u \, du = u \sin^{-1} u + \sqrt{1 - u^2} + C$$

9. Derive Line 30 from the Table of Integrals,

$$\int \sqrt{a^2 - u^2}\, du = \frac{u}{2}\sqrt{a^2 - u^2} + \frac{a^2}{2}\sin^{-1}\frac{u}{a} + C$$

10. Evaluate $\int \dfrac{1}{1 - x^3}\, dx$ [Hint: $(1 - x)^3 = (1 - x)(1 + x + x^2)$]

Extra Credit [5 points possible]: Evaluate $\displaystyle \int \frac{x^2}{\sqrt{1-x}}\, dx$