1. Integrate.

(a) \( \int (x + 3) \sin 2x \, dx \)  
(b) \( \int \sin x \cos^7 x \, dx \)  
(c) \( \int \sqrt{9 - x^2} \, dx \)  
(d) \( \int \frac{7x + 6}{(2x + 1)(x + 3)} \, dx \)  
(e) \( \int x^2 e^{-4x} \, dx \)  
(f) \( \int \sec^4 4\theta \tan^4 4\theta \, d\theta \)  
(g) \( \int \frac{dt}{t^4 + 2t^2 + 1} \)  
(h) \( \int \frac{4x^2 + 3x + 2}{x^3 + x^2} \, dx \)  
(i) \( \int \frac{t \ln t \, dt}{1} \)  
(j) \( \int \sin^2 \pi x \cos^2 \pi x \, dx \)  
(k) \( \int \frac{\sqrt{4x^2 - 9}}{x} \, dx \)  
(l) \( \int \frac{5x + 6}{(x - 2)(x^2 + 4)} \, dx \)

(m) \( \int (x + \sin x)^2 \, dx \)  
(n) \( \int \frac{x^2}{x^2 + 4x + 13} \, dx \)  
(o) \( \int \sin 2\theta e^{\sin \theta} \, d\theta \)  
(p) \( \int \sec^2 x \sec^3 (\tan x) \tan^3 (\tan x) \, dx \)  
(q) \( \int e^{2x} + 5e^x + 6 \, dx \)  
(r) \( \int_0^{\pi/2} \cos x \sqrt{1 + 3 \sin^2 x} \, dx \)

2. Eliminate the parameter to express each of the parametric curves in the form \( y = f(x) \).

(a) \( x(t) = t + 1, \ y(t) = t^3 + 1 \)  
(b) \( c(t) = (e^{2t} + 1, e^{6t} + 1) \)  
(c) \( x(t) = \frac{2 + t}{1 + t}, \ y(t) = \frac{1}{(1 + t)^3} + 1 \)  
(d) \( c(t) = (5 \cos t, 5 \sin t) \) for \( t \in [\pi, 2\pi] \)

3. Find the length of the following parametric curves over the given interval.

(a) \( x(t) = 4t + 1, \ y(t) = 3t - 1, \ 0 \leq t \leq 2 \)  
(b) \( x(t) = 3t^2 + 3, \ y(t) = t^3 - 2, \ 0 \leq t \leq \sqrt{5} \)  
(c) \( c(t) = (e^{2t} \cos t, e^{2t} \sin t), \ t \in [0, \pi] \)  
(d) \( c(t) = (t - \sin t, 1 - \cos t), \ t \in [0, 2\pi] \)

4. Find the slope, \( \frac{dy}{dx} \), and the speed, \( \frac{ds}{dt} \), of a particle traveling along each curve.

(a) \( x(t) = 2 \sin t, \ y(t) = t, \ t = \pi/6 \)  
(b) \( x(t) = \frac{t + 2}{4}, \ y(t) = \frac{t - 3}{3}, \ t = \frac{-\pi^3}{e^{3t}} \)  
(c) \( c(t) = (2 \cos 2t, \sin 2t), \ t = 3\pi/8 \)  
(d) \( c(t) = \left( \frac{t}{t + 1}, t^2 \right), \ t = 1 \)

5. Convert the following polar equations into rectangular coordinates.

(a) \( r = 2 \)  
(b) \( r = \frac{3}{\cos \theta} \)  
(c) \( r = 2 \csc \theta \)  
(d) \( r = \frac{6}{2 \cos \theta - 3 \sin \theta} \)  
(e) \( r = -2 \sin \theta \)  
(f) \( \theta = \frac{\pi}{4} \)

6. Sketch the following polar curves.

(a) \( r = 3 \)  
(b) \( r = 2 \cos \theta \)  
(c) \( r = \sin 2\theta \)  
(d) \( r = 1 - 2 \sin \theta \)

7. Find the length of the following polar curves.

(a) \( r = 3 \)  
(b) \( r = \theta, \ \theta \in [0, \pi] \)  
(c) \( r = \theta^2, \ \theta \in [0, \pi] \)  
(d) \( r = \theta^2 - 1, \ 0 \leq \theta \leq \pi \)  
(e) \( r = e^{2\theta}, \ 0 \leq \theta \leq \pi \)  
(f) \( r = \cos^2 \theta \)
8. The figure below shows a graph of $r$ as a function of $\theta$ in Cartesian coordinates. Use it to sketch the corresponding polar curve.

![Graph of $r$ vs $\theta$](image)

9. Sketch the polar region described and then find the area.

   (a) Inside $r = 2 + \cos \theta$.
   
   (b) The line $r = 3 \sec \theta$ cuts the area inside $r = 4 \cos \theta$ into two pieces. Find the area of the smaller of the two.

10. Find the polar areas described below and shaded in the figures.

    (a) Inside $r = 2 \cos 3\theta$ and outside $r = \sqrt{3}$.
    
    (b) Inside $r = 3$ and outside $r = 2 - 2 \cos \theta$.
    
    (c) Inside the inner loop of $r = 1 + 2 \sin \theta$.
    
    (d) Inside $r = 3 \sin \theta$ and outside $r = 1 + \sin \theta$. 
1. Integrate.

(a) \( \int \sin^3 2x \cos^2 2x \, dx \)

(b) \( \int_1^2 x^2 \ln 3x \, dx \)

(c) \( \int \frac{4x}{x^2 - 1} \, dx \)

(d) \( \int \frac{dt}{t^2 \sqrt{4 - t^2}} \)

2. Express \( \left( \frac{1}{\sqrt{t+1}}, \frac{t}{t+1} \right) \) in the form \( y = f(x) \).

3. Find the length of the path \((3t^2, t^3 + 1)\) over \(0 \leq t \leq \sqrt{5}\).

4. Find the speed of a particle traveling along the curve \((\tan t, 2t)\) at \(t = \pi/4\).

5. Find the direction, \( \frac{dy}{dx} \), of a particle traveling along the curve \((\tan t, 2t)\) at \(t = \pi/4\).

6. Convert to an equation in rectangular coordinates. \( r = 2 \sin \theta \)

7. Carefully sketch the curve \( r = 1 + 2 \sin \theta \) on the provided polar grid.

8. Find the length of the path \( r = \theta \) for \( 0 \leq \theta \leq \sqrt{3} \).

9. Find the area inside both \( r = \sin 2\theta \) and \( r = \cos 2\theta \). See the figure.
Practice Final A+

1. Integrate.
   (a) \[ \int x^2 e^{2x} \, dx \]
   (b) \[ \int_0^1 \frac{dx}{(1 + x^2)^2} \]
   (c) \[ \int \tan^2 \theta \sec^4 \theta \, d\theta \]
   (d) \[ \int \frac{2x}{(x + 1)(x^2 + 1)} \, dx \]

2. Express \((t + 1, t^2 - 3)\) in the form \(y = f(x)\).

3. Find the length of the path \((2 \arcsin t, \ln (1 - t^2))\) over \(0 \leq t \leq \frac{1}{2}\).

4. Find the speed of a particle traveling along the curve \((3t, e^{2t})\) at \(t = \ln \sqrt{2}\).

5. Find the direction \(\frac{dy}{dx}\) of a particle traveling along the curve \((3t, e^{2t})\) at \(t = \ln \sqrt{2}\).

6. Convert to an equation in rectangular coordinates. \(r = 2 \sec \theta\)

7. Carefully sketch the curve \(r = 3 \sin 3\theta\) on the provided polar grid.

8. Find the length of the path \(r = e^\theta\) for \(-\infty < \theta \leq 0\).

9. Find the area between the inner and outer loops of the limacon \(r = 1 - 2 \sin \theta\). See the figure.