Directions: Show your work, organize, and write clearly.

1. Determine the first three nonzero terms of the Maclaurin series for the function \( f(x) \).

Organize, show, and write your work clearly. Use correct syntax.

(a) \( f(x) = -2x^2 + 3x - 4 \)  
(b) \( f(x) = 5x^3 + 4x^2 - 3x - 2 \)  
(c) \( f(x) = \sqrt{1+x} \)  
(d) \( f(x) = \frac{1}{\sqrt{1-x}} \)  
(e) \( f(x) = \cos(\sqrt{x}) \)  
(f) \( f(x) = e^{-x^2} \)  
(g) \( f(x) = \tan(x) \)  
(h) \( f(x) = x \sin(x) \)  
(i) \( f(x) = x \cos(x) \)

Answer: \( -2x^2 + 3x - 4 \)  
Answer: \( 4x^2 - 3x - 2 \)  
Answer: \( 1 + \frac{x}{3} - \frac{x^2}{9} \)  
Answer: \( 1 - \frac{x}{2} + \frac{3x^2}{8} \)  
Answer: \( 1 + \frac{x^2}{2} + \frac{3x^4}{8} \)  
Answer: \( 1 - \frac{x^2}{2} + \frac{3x^4}{8} \)  
Answer: \( 1 - x^2 + \frac{x^4}{2} \)  
Answer: \( x + \frac{x^3}{3} + \frac{2x^5}{15} \)  
Answer: \( x^2 - \frac{x^4}{6} + \frac{x^6}{120} \)

2. Determine Maclaurin series for \( f(x) \). Express the series using the sigma notation.

Also, evaluate the interval of convergence.

(a) \( f(x) = \ln(1 + x) \)  
(b) \( f(x) = \sin(2x) \)  
(c) \( f(x) = \cos(3x) \)  
(d) \( f(x) = xe^{x/2} \)

Answer: \( \sum_{n=0}^{\infty} \frac{(-1)^n}{n+1} x^{n+1}, -1 < x \leq 1 \)  
Answer: \( \sum_{n=0}^{\infty} \frac{2(-1)^n(4^n)}{(2n+1)!} x^{2n+1}, -\infty < x < \infty \)  
Answer: \( \sum_{n=0}^{\infty} \frac{(-1)^n 3^n}{(2n)!} x^{2n}, -\infty < x < \infty \)  
Answer: \( \sum_{n=0}^{\infty} \frac{x^{n+1}}{2n+1}, -\infty < x < \infty \)

3. Sketch the graph of the parametric equation. Indicate the initial and terminal points, and label the corresponding values of \( t \). Then find an equation of the graph by eliminating the parameter \( t \).

(a) \( x = \sec(t), \quad y = \tan(t), \quad 0 \leq t \leq \frac{\pi}{4} \)  
(b) \( x = \ln(t), \quad y = (\ln(t))^2, \quad 0 \leq t \leq e \)  
(c) \( x = \sqrt{t-1}, \quad y = -\sqrt{t}, \quad 1 \leq t \leq 4 \)  
(d) \( x = 4 \cos(t), \quad y = 5 \sin(t), \quad \frac{\pi}{2} \leq t \leq \pi \)

Answer: \( y = \sqrt{x^2 - 1}, \quad 1 \leq x \leq 2 \)  
Answer: \( y = x^2, \quad 0 \leq x \leq 1 \)  
Answer: \( y = \sqrt{1 + x^2}, \quad 0 \leq x \leq \sqrt{3} \)  
Answer: \( y = \frac{5}{8} \sqrt{16 - x^2}, -4 \leq x \leq 0 \)

4. Determine the slope-intercept form of the tangent line at the indicated value of \( t_0 \) to the graph of the parametric equations.

(a) \( x = 2 \cot(t), \quad y = 2 \sin^2(t), \quad t_0 = \frac{\pi}{6} \)  
(b) \( x = \sqrt{25 - t^2}, \quad y = t^2 \sqrt{7}, \quad t_0 = 4 \)

Answer: \( y = -\frac{\sqrt{3}}{8} x + \frac{5}{4} \)  
Answer: \( y = -15x + 77 \)

5. Evaluate the length of the curved segment.

(a) \( x = t^2, \quad y = t^3, \quad 0 \leq t \leq 2 \)  
(b) \( x = 3 + 4t, \quad y = 3t + 1, \quad 1 \leq t \leq 2 \)  
(c) \( x = t^2, \quad y = t, \quad 0 \leq t \leq \frac{\sqrt{3}}{2} \)

Answer: \( \frac{8}{27} (10\sqrt{10} - 1) \)  
Answer: 5  
Answer: \( \frac{1}{4} (2\sqrt{3} + \ln(2 + \sqrt{3})) \)
6. Sketch and shade the region enclosed by the graph of \( r = f(\theta) \), an equation in polar coordinates. Then find the area of the region.

(a) \( r = 2 + \cos(\theta) \)  
    answer: \( \frac{9\pi}{2} \)

(b) \( r = 3 - 2\sin(\theta) \)  
    answer: \( 11\pi \)

7. Evaluate the length of the graph of the equation that is given in polar coordinates. Include a sketch of the graph. Label the coordinate axes.

(a) \( r = 2 + 2\cos(\theta) \).  
    answer: 16

(b) \( r = 2\theta \) where \( 0 \leq \theta \leq \frac{\pi}{2} \)  
    answer: \( \frac{\pi}{4}\sqrt{4 + \pi^2 + \ln(\frac{\sqrt{4+\pi^2}+\pi}{2})} \)

8. Evaluate the integral

(a) \( \int_{\pi/6}^\pi \sec^3(2x)\,dx \)  
    answer: \( \frac{1}{4} \left(2\sqrt{3} + \ln(2 + \sqrt{3})\right) \)

(b) \( \int_{\pi/6}^{\pi/3} e^x \cos(x)\,dx \)  
    answer: \( \frac{1}{4} \left((1 + \sqrt{3}) e^{\pi/3} - 2\right) \)

(c) \( \int_{\pi}^{\pi/2} 6e^{3x} \sin(3x)\,dx \)  
    answer: \( \frac{1}{6} \left(1 + e^{\pi/2}\right) \)

(d) \( \int_{\pi/3}^{\pi/2} \csc^3(x)\,dx \)  
    answer: \( \frac{1}{3} + \frac{\ln(3)}{4} \)