1) (b) \( \lim_{x \to 0} x \cot x = \lim_{x \to 0} \frac{x}{\sin x} = 1 \times 1 = 1 \)

1) (c) \( \lim_{x \to 1} \frac{x}{|x-1|} \). Note that the denominator stays positive but approaches zero, so the quotient approaches infinity as \( x \to 1^- \).

3) Let \( a \) be a value of \( x \) where \((a,a^2)\) is on the curve and the tangent line passes through \((-2,3)\). \( f(x) = x^2 \), \( f'(x) = 2x \), so \( m = \) the slope of the tangent line = 2a.. The line with slope 2a passes through \((a,a^2)\) and \((-2,3)\), so we have \( \frac{a^2 - 3}{a - (-2)} = 2a. \) Solve for \( a \): \( a^2 - 3 = 2a(a+2) \), \( 0 = a^2 + 4a + 3 = (a+3)(a+1) \). So \( a = -1 \) or \( a = -3 \). Thus we want the two lines through \((-2,3)\) with slopes \(-2\) and \(-6\). The two lines are \( y - 3 = -2(x + 2) = -6 \).

4) Let \( f(x) = \cos x - x^2 \). Then \( f(0) = 1 \) and \( f(\pi/2)) = -(\pi/2)^2 \). Since \( -(\pi/2)^2 < 0 < 1 \), by the Intermediate Value Property there is a point \( c \) between 0 and \( \pi/2 \) with \( f(c) = 0 \).

6) c) \( f'(x) = \frac{1}{3} x^{-2/3} - \frac{1}{(x-2)^2} \) is defined for all \( x \) except \( x = 0 \) or \( x = 2 \).

7) a) There is a vertical asymptote at \( x = 1 \). Note that as \( x \to \infty \) or \( x \to -\infty \) that \( f(x) \to 1 \) so that \( y = 1 \) is a horizontal asymptote.

9) c) See the textbook for more examples. \( x^3 y' + 3x^2 y + x3y^2 y' + y^3 = 0 \). Substitute \( x = 1 \), \( y = 1 \), and get \( y' + 3 + 3y' + 1 = 0 \). So \( 4y' = -1 \), \( y' = -1 \). So \(-1\) is the slope of the tangent line at \((1,1)\), so the equation of the tangent line is \( \frac{y - 1}{x - 1} = -1 \).

11)a) \( y^{-2} y' = x + 1 \). Integrate and get

\[ -y^{-1} = x^2 + x + C \]

\[ \frac{-1}{y} = x^2 + x + C. \]

When \( x = 0 \), \( y = 1 \). Therefore \( C = -1 \). So

\[ \frac{-1}{y} = x^2 + x - 1, \]

so

\[ y = \frac{-1}{x^2 + x - 1} \]

14) When \( x=0 \), \( f(x)=-30 \), when \( x=1 \), \( f(x)=-17 \), and when \( x=2 \), \( f(x)=2 \), so there is a root slightly less than 2.
$x_0 = 2$ would be a reasonable initial guess to start the process of Newton’s Method. Since we do not use calculators on the final, you would not be required to simplify the result for $x_2$.

20) You need to sketch both functions and see which is above which on the interval $[0, 2\pi]$.

$$
\int_0^{2\pi} |\cos x - \sin x| \, dx = \int_0^{\pi/4} (\cos x - \sin x) \, dx + \int_{\pi/4}^{5\pi/4} (\sin x - \cos x) \, dx + \int_{5\pi/4}^{2\pi} (\cos x - \sin x) \, dx
$$