In your tutorial, your tutor will work through the unstarred problems, and you will be expected to work on the starred problems yourself. The participation mark will be awarded only if you make a serious attempt at the starred problems.

1. This question is based on material from Maths I. You should attempt it before your tutorial. Your tutor will not work through this question.
   
   (i) Let $z_1 = 2 - 5i$ and $z_2 = -3 - i$.
   Find $z_1, z_2, |z_1|, |z_2|, \text{Arg } z_1, \text{Arg } z_2, z_1 + z_2, z_1 - z_2, z_1 z_2, \text{ and } z_1/z_2$.
   
   (ii) Write the following complex numbers in mod-arg form:
   $-5i, -1 + i, 3 - 3i, 1 + \sqrt{3}i$.
   
   (iii) Write the following complex numbers in the form $a + ib$, where $a$ and $b$ are real:
   $e^{\pi i}, 2e^{\pi i}, 3e^{-\pi i}, e^{2\pi i}$.

2. Consider the function $f(z) = \frac{2xy}{x^2 + y^2} - \frac{y^2}{x^2}i$.

   Find the limit of $f(z)$ as $z \to 0$ along the lines (a) $y = x$; and (b) $y = 2x$.

   What can you conclude about the limit of $f(z)$ as $z \to 0$? Justify your answer.

3. Consider the function $f(z) = \frac{\text{Arg } z}{z}$.

   Find the limit of $f(z)$ as $z \to 0$ along the line $x = 0$.

   What can you conclude about the limit of $f(z)$ as $z \to 0$? Justify your answer.

4. Find any points in $\mathbb{C}$ at which the function $f(z) = \frac{z^2}{z^2 - 3 - 4i}$ is discontinuous.

5. Determine whether or not the following functions are analytic. Find the derivative for those which are analytic.
   
   (i) $x + y + i2xy$  
   (ii) $x^2 - y^2 - x + i(1 - y + 2xy)$

6. Repeat Question 5 for the following functions.
   
   (i) $\frac{x}{x^2 + y^2} - i \frac{y}{x^2 + y^2}$  
   (ii) $x - 3y + i(x + 3y)$
   
   (iii) $e^x \sin y + i e^x \cos y$
   
   (iv) $x^2 - y^2 + y + 2 + i(2xy - x + 3)$