

1) Reduce each expression to  $a+bi$  form and plot the corresponding point(s) in the complex plane:  $\frac{(2+3i)^2}{5-i}$ ,  $e^{2+3i}$ ,  $\text{Log}(5+12i)$ ,  $\log(-1+i)$ . (Recall  $\text{Log}(z)$  is the single principal value of logarithm, while  $\log(z)$  is the set of all possible values.)

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2) Let  $f(x+iy) = (x^2 + y^2 + 3x + 4y) + i(-x^2 + 5y^2)$ . Find the single point of  $\mathbb{C}$  at which the Cauchy-Riemann equations hold. Is  $f$  differentiable at this point? Is  $f$  analytic at this point? Fully justify your answers.

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3) Suppose  $z_1$  and  $z_2$  are non-zero complex numbers. Explain the geometric relationship between the positions of  $z_1$ ,  $z_2$ , and  $z_1z_2$  in the complex plane.

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4) Explain the difference between an open set and a domain. Give an examples of a set which is: (a) not open; (b) open but not connected; and (c) a domain.

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5) Explain the difference between “differentiable” and “analytic”.

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6) Find all solutions to  $z^9 = 2 + 4i$ . Find all solutions to  $e^{3z} = 8i$ .

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