

Homework No. 01 (2019 Fall)

PHYS 301: Theoretical Methods in Physics

Due date: Monday, 2019 Aug 26, 10:00 AM, in class

1. **(10 points.)** Find the real and imaginary part of

$$z = \frac{(a + ib)}{(c + id)}. \quad (1)$$

Thus, express z in the form $z = u + iv$. Assume a , b , c , and d are real.

2. **(10 points.)** (Refer Arfken) The complex quantities

$$a = u + iv, \quad (2a)$$

$$b = x + iy \quad (2b)$$

may also be represented as two-dimensional vectors

$$\mathbf{a} = \hat{\mathbf{x}}u + \hat{\mathbf{y}}v, \quad (3a)$$

$$\mathbf{b} = \hat{\mathbf{x}}x + \hat{\mathbf{y}}y. \quad (3b)$$

Show that

$$(a^*)b = \mathbf{a} \cdot \mathbf{b} + i\hat{\mathbf{z}} \cdot \mathbf{a} \times \mathbf{b}. \quad (4)$$

3. **(30 points.)** Find the fifth roots of unity by solving the equation

$$z^5 = 1. \quad (5)$$

Mark the the points corresponding to the five roots on the complex plane. Find the five roots of the equation

$$z^5 = -1. \quad (6)$$

Mark the roots on the complex plane. Next, find the roots of the equation

$$z^5 = i \quad (7)$$

and mark the roots on the complex plane. Repeat the exercise for $z^5 = -i$. How do these roots match with the fifth roots of unity?