

# hw1

August 22, 2018

## 1 Homework 1: Math Review

### 1.1 Complex Numbers

Suggested reading: McQuarrie MathChapter A

1. Find the real and imaginary parts of the following quantities:

- a.  $(2 - i)^3$
- b.  $e^{\pi i/2}$
- c.  $e^{-2+i\pi/2}$
- d.  $(\sqrt{2} + 2i)e^{-i\pi/2}$

2. Find the three distinct roots of  $x^3 = 8$ .

### 1.2 Vectors and Matrices

Suggested reading: McQuarrie MathChapter C and G

3. For the following two vectors,  $\mathbf{v} = 2\mathbf{i} - \mathbf{j} + 3\mathbf{k}$  and  $\mathbf{u} = \mathbf{i} + 4\mathbf{j} - \mathbf{k}$ , compute the following:

- a.  $|\mathbf{u}|$
- b.  $|\mathbf{v}|$
- c.  $\mathbf{u} \cdot \mathbf{v}$
- d.  $\mathbf{u} \times \mathbf{v}$
- d.  $\mathbf{v} \times \mathbf{u}$

4. Given the two matrices  $\mathbf{A} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$  and  $\mathbf{B} = \begin{bmatrix} -2 & -6 & 1 \\ -3 & 4 & -1 \end{bmatrix}$  compute the following:

- a.  $\mathbf{A} - \mathbf{B}$
- b.  $\mathbf{A} \cdot \mathbf{B}^T$
- c.  $\mathbf{A}^T \cdot \mathbf{B}$

### 1.3 Eigenvalue Problems

Suggested reading: McQuarrie MathChapter H

5. Show that the matrix  $\mathbf{A} = \begin{bmatrix} 1 & i & 1-i \\ -i & 0 & -1+i \\ 1+i & -1-i & 3 \end{bmatrix}$  is Hermitian

6. Compute the eigenvalues and eigenvectors of the matrix  $\mathbf{A} = \begin{bmatrix} 1 & 0 & -1 \\ 0 & 1 & 0 \\ -1 & 0 & 1 \end{bmatrix}$ .

7. (BONUS) Compute the eigenvalues and eigenvectors of the matrix  $\mathbf{A} = \begin{bmatrix} 2 & 0 & 2 & 0 & 2 \\ 0 & 3 & 0 & 3 & 0 \\ 2 & 0 & 2 & 0 & 2 \\ 0 & 3 & 0 & 3 & 0 \\ 2 & 0 & 2 & 0 & 2 \end{bmatrix}$ .

## 1.4 Integration and Differentiation

8. Perform the following integration:

a.  $\int x e^{6x} dx$

b.  $\int_1^4 x^2 e^{3x} dx$

9. Compute  $\frac{df}{dx}$  for the following functions

a.  $f(x) = x^2 \ln(x)$

b.  $f(x) = \frac{e^{2x}}{x^3}$