Instructions: Show all work. Answers without work required to obtain the solution will not receive full credit. Some questions may contain multiple parts: be sure to answer all of them. Give exact answers unless specifically asked to estimate.

1. Perform the indicated operation, given:

$$A = \begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}, B = \begin{bmatrix} -1 & 1 \\ 0 & 9 \end{bmatrix}, \vec{u} = \begin{bmatrix} 1 \\ 4 \end{bmatrix}, \vec{v} = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$$

a. $A\vec{u}$

$$\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}\begin{bmatrix} 1 \\ 4 \end{bmatrix} = \begin{bmatrix} 3+4 \\ 1+8 \end{bmatrix} = \begin{bmatrix} 7 \\ 9 \end{bmatrix}$$

b. AB

$$\begin{bmatrix} 3 & 1 \\ 1 & 2 \end{bmatrix}\begin{bmatrix} -1 & 1 \\ 0 & 9 \end{bmatrix} = \begin{bmatrix} -3+0 & 3+9 \\ -1+0 & 1+18 \end{bmatrix} = \begin{bmatrix} -3 & 12 \\ -1 & 19 \end{bmatrix}$$

c. B^T

$$\begin{bmatrix} -1 & 0 \\ 1 & 9 \end{bmatrix}$$

d. $(B + iA)^2$

$$\begin{bmatrix} -1+3i & i+i \\ i & 9+2i \end{bmatrix}\begin{bmatrix} -1+3i & i+i \\ i & 9+2i \end{bmatrix} = \begin{bmatrix} 1-6i-9+i-1 & -1 & -i+3i-3 & +9+2i+9i-2 \\ -i-3+9i-2 & i-1+81+ & 36i-4 \end{bmatrix}$$

$$\begin{bmatrix} -9-5i & 3+13i \\ -5+8i & 76+35i \end{bmatrix}$$

2. Solve the second order ODE $6y'' - 7y' - 20y = 0$, but assuming $y = e^{rt}$.

$$6r^2 - 7r - 20 = 0$$

$$6r^2 - 15r + 8r - 20 = 0$$

$$3r(2r-5) + 4(2r-5) = 0$$

$$(2r-5)(3r+4) = 0$$

$$r = \tfrac{5}{2}$$
$$r = -\tfrac{4}{3}$$

$$120$$
$$8\,115$$

$$y(t) = c_1 e^{5/2 t} + c_2 e^{-4/3 t}$$