Write clearly and justify every step as if this were an exam.

Consider the following matrices:

\[
A = \begin{pmatrix} 1 & 1 & 2 \\ 1 & 2 & 3 \end{pmatrix} \quad B = \begin{pmatrix} 1 & 0 \\ 1 & 2 \\ 5 & 2 \end{pmatrix} \quad C = \begin{pmatrix} 1 & -1 \\ 1 & 1 \\ 2 \end{pmatrix} \quad D = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 1 \end{pmatrix} \quad E = \begin{pmatrix} 1 & 0 & 2 \\ 1 & 2 & -1 \\ 0 & 0 & 4 \end{pmatrix}
\]

\[
F = \begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix}
\]

For each of the following evaluate the following or explain why they cannot be evaluated.

1. \(AB\)
2. \(BA\)
3. \(A^2B\)
4. \(D^2B\)
5. \(DE\)
6. \(ABC\)
7. \(A + 2B\)
8. \(D + 3E\)
9. \(A^T + 2B\)
10. \(B^T D\)

Check your understanding.

1. What must matrices \(Q\) and \(R\) satisfy for you to be able to add them?

2. What must matrices \(Q\) and \(R\) satisfy for you to be able to multiply them?