# 12.238

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**Question**:

The inverse of the matrix $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ is (CH 2010)

**Solution**:

Let

$$\mathbf{A} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \tag{1}$$

The augmented matrix is

$$\left( \mathbf{A} \mid \mathbf{I} \right) \implies \left( \begin{array}{cc|cc} 1 & 2 & 1 & 0 \\ 3 & 4 & 0 & 1 \end{array} \right) \xleftrightarrow{R_2 \to R_2 - 3R_1} \left( \begin{array}{cc|cc} 1 & 2 & 1 & 0 \\ 0 & -2 & -3 & 1 \end{array} \right) \tag{2}$$

$$\xleftrightarrow{R_1 \to R_1 + R_2} \left( \begin{array}{cc|cc} 1 & 0 & -2 & 1 \\ 0 & -2 & -3 & 1 \end{array} \right) \tag{3}$$

$$\xleftrightarrow{R_2 \to \frac{-1}{2} \times R_2} \left( \begin{array}{cc|cc} 1 & 0 & -2 & 1 \\ 0 & 1 & \frac{3}{2} & \frac{-1}{2} \end{array} \right) \tag{4}$$

As the left block of the Augmented matrix is $\mathbf{I}$ the right block is $\mathbf{A^{-1}}$.

$$\mathbf{A^{-1}} = \begin{pmatrix} -2 & 1 \\ \frac{3}{2} & \frac{-1}{2} \end{pmatrix} \tag{5}$$