9. Find two different $2 \times 2$ matrices $A$, $B$ with integer entries such that $AB = O_{2 \times 2} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$.

11. Find two different $2 \times 2$ matrices $A$, $B$ such that $AB = I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

21. Find the scalar $r$ such that $AX = rX$ where $A = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 0 & 1 \\ 4 & -4 & 5 \end{bmatrix}$ and $X = \begin{bmatrix} -1/2 \\ 1/4 \\ 1 \end{bmatrix}$.

23. Find a scalar $s$ such that $A^2X = sX$ when $AX = rX$

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5. Describe all matrices that are both upper and lower triangular

7. If $AB = BA$ show that $(AB)^2 = A^2B^2$

9. Find a $2 \times 2$ matrix $B \neq O_2$ and $B \neq I_2$ such that $AB = BA$, where $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$. How many such matrices $B$ are there?

13. Show that if $A$ is a symmetric matrix, than $A^T$ is symmetric.

Answers

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9. Many possible answers:

$$\begin{bmatrix} 10 \\ 00 \end{bmatrix}, \begin{bmatrix} 00 \\ 01 \end{bmatrix}$$

11. Many possible answers:

$$\begin{bmatrix} 10 \\ 02 \end{bmatrix}, \begin{bmatrix} 20 \\ 02 \end{bmatrix}$$

21. $r = 2$. To find $r$, transform the matrix equation into a system of 3 linear equations. Use one equation (the middle equation $\frac{1}{2} = r\left(\frac{1}{2}\right)$ is the easiest) to solve for $r$.

23. $s = r^2$.

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5. Diagonal matrices.


9. Many possible answers, one is $\begin{bmatrix} 1 & 3 \\ 3 & 1 \end{bmatrix}$

13. $(A^T)^T$ (since for any $B$, $B^T = B$) = $A$ (since $A$ is symmetric) = $A^T$. 