2010 – 2011 Log1 Contest Round 2
Theta Matrices

Name: _____

4 points each		
1	Evaluate: $\begin{bmatrix} 24 & 4 \\ -11 & 37 \end{bmatrix} - \begin{bmatrix} 20 & -7 \\ -9 & 50 \end{bmatrix}$	
2	Matrix **A** has 4 rows and 6 columns and matrix **C** has 4 rows and 6 columns. If matrix **B** is such that **AB** = **C**, how many rows and columns does B have? Answer in the form (row,col).	
3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	
4	If **A** = $\begin{bmatrix} 3 & 0 & -21 \\ 9 & 12 & 10 \\ 21 & 24 & -3 \end{bmatrix}$ and $a_{i,j}$ represents the elements of **A**, what is the sum $a_{2,1} + a_{3,2}$?	
5	Find the determinant of $\begin{bmatrix} 5 & -3 \\ 2 & 12 \end{bmatrix}$	

5 points each		
6	Let **A**= $\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and **B**= $\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is 3**B** – 2**A?**	
7	If both **A** and **B** are both n x n matrices, is the following necessarily true? Answer Yes or No. $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + 2\mathbf{AB} + \mathbf{B}^2$	
8	Find the inverse matrix of $\begin{bmatrix} 2 & -1 \\ -3 & 0 \end{bmatrix}$	
9	Find the transpose of $\begin{bmatrix} 2 & -1 & 5 \\ 6 & 3 & 0 \end{bmatrix}$.	
10	If $\begin{vmatrix} 6 & 3 \\ x & 2 \end{vmatrix} = \begin{vmatrix} 5 & 2x \\ -3 & 6 \end{vmatrix}$, then what is x?	

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	
14	Find the sum of the entries of **A**. $\mathbf{A} = \begin{bmatrix} 3 & 1 & 1 \\ 0 & 4 & -3 \\ 2 & 0 & 1 \end{bmatrix}^2$	
15	What is the cofactor of 0 in matrix **A**? $\mathbf{A} = \begin{bmatrix} 1 & -4 & 6 \\ 8 & -7 & -2 \\ 3 & 0 & 5 \end{bmatrix}$	

2010 – 2011 Log1 Contest Round 2
Alpha Matrices

Name: _____

4 points each		
1	Evaluate: $\begin{bmatrix} 24 & 4 \\ -11 & 37 \end{bmatrix} - \begin{bmatrix} 20 & -7 \\ -9 & 50 \end{bmatrix}$	
2	Matrix **A** has 4 rows and 6 columns and matrix **C** has 4 rows and 6 columns. If matrix **B** is such that **AB** = **C**, how many rows and columns does B have? Answer in the form (row,col).	
3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	
4	Calculate the magnitude of the vector **u** = <5, 2, -5>.	
5	Find the determinant of $\begin{bmatrix} 5 & -3 \\ 2 & 12 \end{bmatrix}$	

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6	Let **A**= $\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and **B**= $\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is 3**B** – 2**A?**	
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9	Evaluate: $\begin{vmatrix} 1 & 4 & 3 & 1 \\ 0 & 1 & 5 & 6 \\ 3 & 12 & 9 & 3 \\ 2 & 4 & 6 & 2 \end{vmatrix}$	
10	If $\begin{vmatrix} 6 & 3 \\ x & 2 \end{vmatrix} = \begin{vmatrix} 5 & 2x \\ -3 & 6 \end{vmatrix}$, then what is x?	

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	
14	What is the cosine of the acute angle between vectors **u** and **v**, where **u** = <0, -2, 4> and **v** = <5, -2, 1>?	
15	What is the cofactor of 0 in matrix **A**? $\mathbf{A} = \begin{bmatrix} 1 & -4 & 6 \\ 8 & -7 & -2 \\ 3 & 0 & 5 \end{bmatrix}$	

2010 – 2011 Log1 Contest Round 2
Mu Matrices

Name: _____

	4 points each	
1	Evaluate: $\begin{bmatrix} 24 & 4 \\ -11 & 37 \end{bmatrix} - \begin{bmatrix} 20 & -7 \\ -9 & 50 \end{bmatrix}$	
2	Matrix **A** has 4 rows and 6 columns and matrix **C** has 4 rows and 6 columns. If matrix **B** is such that **AB** = **C**, how many rows and columns does B have? Answer in the form (row,col).	
3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	
4	Calculate the magnitude of the vector **u** = <5, 2, -5>.	
5	What value of x makes **A** singular? $\mathbf{A} = \begin{bmatrix} 7x & 1/4 \\ 6 & 3 \end{bmatrix}$	

	5 points each	
6	Let $\mathbf{A}=\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and $\mathbf{B}=\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is $3\mathbf{B} - 2\mathbf{A}$?	
7	If both **A** and **B** are both n x n matrices, is the following necessarily true? Answer Yes or No. $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + 2\mathbf{AB} + \mathbf{B}^2$	
8	Find the inverse matrix of $\begin{bmatrix} 2 & -1 \\ -3 & 0 \end{bmatrix}$	
9	Evaluate: $\begin{vmatrix} 1 & 4 & 3 & 1 \\ 0 & 1 & 5 & 6 \\ 3 & 12 & 9 & 3 \\ 2 & 4 & 6 & 2 \end{vmatrix}$	
10	Find the sum of the eigenvalues of the matrix $\begin{bmatrix} 11 & 4 \\ 3 & 11 \end{bmatrix}$.	

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	
14	What is the cosine of the acute angle between vectors **u** and **v**, where **u** = <0, -2, 4> and **v** = <5, -2, 1>?	
15	Let **u** = <2, 5, 1> and **v** = <-1, 3, 0>. Find $\|\mathbf{v} \times \mathbf{u}\|$.	

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Theta Matrices

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4 points each		
1	Evaluate: $\begin{bmatrix} 24 & 4 \\ -11 & 37 \end{bmatrix} - \begin{bmatrix} 20 & -7 \\ -9 & 50 \end{bmatrix}$	$\begin{bmatrix} 4 & 11 \\ -2 & -13 \end{bmatrix}$
2	Matrix **A** has 4 rows and 6 columns and matrix **C** has 4 rows and 6 columns. If matrix **B** is such that **AB** = **C**, how many rows and columns does B have? Answer in the form (row,col).	(6,6)
3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	$\begin{bmatrix} 7 & -10 \\ -1 & -25 \end{bmatrix}$
4	If **A** = $\begin{bmatrix} 3 & 0 & -21 \\ 9 & 12 & 10 \\ 21 & 24 & -3 \end{bmatrix}$ and $a_{i,j}$ represents the elements of **A**, what is the sum $a_{2,1} + a_{3,2}$?	33
5	Find the determinant of $\begin{bmatrix} 5 & -3 \\ 2 & 12 \end{bmatrix}$	66

5 points each		
6	Let **A**= $\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and **B**= $\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is 3**B** – 2**A?**	$\begin{bmatrix} 15 & -5 \\ 4 & -5 \end{bmatrix}$
7	If both **A** and **B** are both n x n matrices, is the following necessarily true? Answer Yes or No. $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + 2\mathbf{AB} + \mathbf{B}^2$	No
8	Find the inverse matrix of $\begin{bmatrix} 2 & -1 \\ -3 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & -1/3 \\ -1 & -2/3 \end{bmatrix}$
9	Find the transpose of $\begin{bmatrix} 2 & -1 & 5 \\ 6 & 3 & 0 \end{bmatrix}$.	$\begin{bmatrix} 2 & 6 \\ -1 & 3 \\ 5 & 0 \end{bmatrix}$
10	If $\begin{vmatrix} 6 & 3 \\ x & 2 \end{vmatrix} = \begin{vmatrix} 5 & 2x \\ -3 & 6 \end{vmatrix}$, then what is x?	[x=] -2

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	$-\frac{15}{2}$
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	1/2
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	5x+5
14	Find the sum of the entries of **A**. $\mathbf{A} = \begin{bmatrix} 3 & 1 & 1 \\ 0 & 4 & -3 \\ 2 & 0 & 1 \end{bmatrix}^2$	27
15	What is the cofactor of 0 in matrix **A**? $\mathbf{A} = \begin{bmatrix} 1 & -4 & 6 \\ 8 & -7 & -2 \\ 3 & 0 & 5 \end{bmatrix}$	50

2010 – 2011 Log1 Contest Round 2
Alpha Matrices

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4 points each		
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3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	$\begin{bmatrix} 7 & -10 \\ -1 & -25 \end{bmatrix}$
4	Calculate the magnitude of the vector **u** = <5, 2, -5>.	$3\sqrt{6}$
5	Find the determinant of $\begin{bmatrix} 5 & -3 \\ 2 & 12 \end{bmatrix}$	66

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6	Let **A**= $\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and **B**= $\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is 3**B** – 2**A?**	$\begin{bmatrix} 15 & -5 \\ 4 & -5 \end{bmatrix}$
7	If both **A** and **B** are both n x n matrices, is the following necessarily true? Answer Yes or No. $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + 2\mathbf{AB} + \mathbf{B}^2$	No
8	Find the inverse matrix of $\begin{bmatrix} 2 & -1 \\ -3 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & -1/3 \\ -1 & -2/3 \end{bmatrix}$
9	Evaluate: $\begin{vmatrix} 1 & 4 & 3 & 1 \\ 0 & 1 & 5 & 6 \\ 3 & 12 & 9 & 3 \\ 2 & 4 & 6 & 2 \end{vmatrix}$	0
10	If $\begin{vmatrix} 6 & 3 \\ x & 2 \end{vmatrix} = \begin{vmatrix} 5 & 2x \\ -3 & 6 \end{vmatrix}$, then what is x?	[x=] -2

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	$-\frac{15}{2}$
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	1/2
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	5x+5
14	What is the cosine of the acute angle between vectors **u** and **v**, where **u** = <0, -2, 4> and **v** = <5, -2, 1>?	$\frac{2\sqrt{6}}{15}$ or $\frac{4}{5\sqrt{6}}$
15	What is the cofactor of 0 in matrix **A**? $\mathbf{A} = \begin{bmatrix} 1 & -4 & 6 \\ 8 & -7 & -2 \\ 3 & 0 & 5 \end{bmatrix}$	50

2010 – 2011 Log1 Contest Round 2
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3	What is $\begin{bmatrix} 3 & 2 \\ -11 & 5 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ 2 & -5 \end{bmatrix}$?	$\begin{bmatrix} 7 & -10 \\ -1 & -25 \end{bmatrix}$
4	Calculate the magnitude of the vector **u** = <5, 2, -5>.	$3\sqrt{6}$
5	What value of x makes **A** singular? **A** = $\begin{bmatrix} 7x & 1/4 \\ 6 & 3 \end{bmatrix}$	$\frac{1}{14}$

	5 points each	
6	Let **A**= $\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix}$ and **B**= $\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix}$ What is 3**B** – 2**A?**	$\begin{bmatrix} 15 & -5 \\ 4 & -5 \end{bmatrix}$
7	If both **A** and **B** are both n x n matrices, is the following necessarily true? Answer Yes or No. $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + 2\mathbf{AB} + \mathbf{B}^2$	No
8	Find the inverse matrix of $\begin{bmatrix} 2 & -1 \\ -3 & 0 \end{bmatrix}$	$\begin{bmatrix} 0 & -1/3 \\ -1 & -2/3 \end{bmatrix}$
9	Evaluate: $\begin{vmatrix} 1 & 4 & 3 & 1 \\ 0 & 1 & 5 & 6 \\ 3 & 12 & 9 & 3 \\ 2 & 4 & 6 & 2 \end{vmatrix}$	0
10	Find the sum of the eigenvalues of the matrix $\begin{bmatrix} 11 & 4 \\ 3 & 11 \end{bmatrix}$.	22

6 points each		
11	Find the product of x and y. $\begin{bmatrix} 2x & 2 & 4 \\ 1 & 0 & -4x \end{bmatrix} + \begin{bmatrix} 3y & 5 & -4 \\ 3 & 7 & 4y \end{bmatrix} = \begin{bmatrix} 12 & 7 & 0 \\ 4 & 7 & 26 \end{bmatrix}$	$-\frac{15}{2}$
12	Find the area of a triangle with vertices at (3, 2), (6, 1), and (4, 2).	1/2
13	Calculate the trace of the following matrix: $\begin{bmatrix} 3x+4 & 20 & 5x-3 \\ 0 & 6x-4 & 7-2x \\ \frac{x}{2}+4 & 10x & 5-4x \end{bmatrix}$	5x+5
14	What is the cosine of the acute angle between vectors **u** and **v**, where **u** = <0, -2, 4> and **v** = <5, -2, 1>?	$\frac{2\sqrt{6}}{15}$ or $\frac{4}{5\sqrt{6}}$
15	Let **u** = <2, 5, 1> and **v** = <-1, 3, 0>. Find $\lvert \mathbf{v} \times \mathbf{u} \rvert$.	$\sqrt{131}$

2010 – 2011 Log1 Contest Round 2
Matrices Solutions

Mu	Al	Th	Solution
1	1	1	$\begin{bmatrix} 24-20 & 4-(-7) \\ -11-(-9) & 37-50 \end{bmatrix} = \begin{bmatrix} 4 & 11 \\ -2 & -13 \end{bmatrix}$
2	2	2	**B** must have 6 rows in order to be pre-multiplied by **A** which has 8 columns. Since **C** has 6 columns, so must **B**.
3	3	3	$\begin{bmatrix} (3)(1)+(2)(2) & (3)(0)+(2)(-5) \\ (-11)(1)+(5)(2) & (-11)(0)+(5)(-5) \end{bmatrix} =$ $\begin{bmatrix} 3+4 & 0+(-10) \\ -11+10 & 0+(-25) \end{bmatrix} = \begin{bmatrix} 7 & -10 \\ -1 & -25 \end{bmatrix}$
4	4		$\sqrt{5^2+2^2+(-5)^2} = \sqrt{25+4+25} = \sqrt{54} = 3\sqrt{6}$
		4	$a_{3,2}$ represents the number in the third row and second column of the matrix. So the sum is just 9+24=33.
5			A singular matrix means there is no inverse. Thus, the determinant must equal 0. (7x)(3) - (1/4)(6) = 0 21x - 1.5 = 0 x = 1/14
	5	5	(5)(12)-(-3)(2) = 66
6	6	6	$3\begin{bmatrix} 7 & 1 \\ 0 & -1 \end{bmatrix} - 2\begin{bmatrix} 3 & 4 \\ -2 & 1 \end{bmatrix} =$ $\begin{bmatrix} 21 & 3 \\ 0 & -3 \end{bmatrix} - \begin{bmatrix} 6 & 8 \\ -4 & 2 \end{bmatrix} = \begin{bmatrix} 15 & -5 \\ 4 & -5 \end{bmatrix}$
7	7	7	Matrix multiplication is not commutative so the true statement is: $(\mathbf{A}+\mathbf{B})^2 = \mathbf{A}^2 + \mathbf{AB} + \mathbf{BA} + \mathbf{B}^2$
8	8	8	Det = (2)(0) - (-1)(-3) = -3 Inverse = $-\frac{1}{3}\begin{bmatrix} 0 & 1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 0 & -1/3 \\ -1 & -2/3 \end{bmatrix}$
9	9		A property of determinants states that if one or more columns, or rows, are a scalar multiple of another, then the determinant is equal to zero.
		9	The transpose is found by switching the values in the columns with the values in the rows. Thus, yielding the matrix $\begin{bmatrix} 2 & 6 \\ -1 & 3 \\ 5 & 0 \end{bmatrix}$.
10			$\lvert A-\lambda I\rvert = 0$, where **A** is the matrix, λ are the eigenvalues, and **I** is the identity matrix. $\left\lvert \begin{bmatrix} 11-\lambda & 4 \\ 3 & 11-\lambda \end{bmatrix} \right\rvert = (11-\lambda)(11-\lambda)-(4)(3) = 0$ $121-22\lambda+\lambda^2-12 = 0$ Sum of roots is $-\frac{b}{a}$, so sum of eigenvalues is 22.

	10	10	(6)(2) – (3)(x) = (5)(6) – (2x)(-3) 12 – 3x = 30 + 6x -18 = 9x -2 = x
11	11	11	By matrix addition: $\begin{cases} 2x+3y=12 \\ -4x+4y=26 \end{cases}$ Solve system of equations: $\begin{cases} 2(2x+3y)=2(12) \\ -4x+4y=26 \end{cases} \Rightarrow \begin{cases} 4x+6y=24 \\ -4x+4y=26 \end{cases}$ $10y=50 \Rightarrow y=5$ $x=-\frac{3}{2}$ $x*y=-\frac{15}{2}$
12	12	12	There are several ways to solve this problem. First, it could easily be done by plotting the points; secondly, the "shoelace" method could be used. The matrix is solution is: $A=\frac{1}{2}\begin{vmatrix} 3 & 2 & 1 \\ 6 & 1 & 1 \\ 4 & 2 & 1 \end{vmatrix}=\frac{1}{2}\left(3\begin{vmatrix} 1 & 1 \\ 2 & 1 \end{vmatrix}-2\begin{vmatrix} 6 & 1 \\ 4 & 1 \end{vmatrix}+1\begin{vmatrix} 6 & 1 \\ 4 & 2 \end{vmatrix}\right)$ $=\frac{1}{2}[3(1-2)-2(6-4)+1(12-4)]$ $=\frac{1}{2}(-3-4+8)=\frac{1}{2}$
13	13	13	The trace is found by adding all the entries along the main diagonal: 3x + 4 + 6x – 4 + 5 – 4x = 5x + 5
14	14		$\cos\theta=\frac{u\bullet v}{\|u\|\|v\|}=$ $\frac{(0)(5)+(-2)(-2)+(4)(1)}{\sqrt{0^2+(-2)^2+4^2}\sqrt{5^2+(-2)^2+1^2}}=$ $\frac{4+4}{\sqrt{20}\sqrt{30}}=\frac{8}{10\sqrt{6}}=\frac{2\sqrt{6}}{15}$
		14	$\begin{bmatrix} 3 & 1 & 1 \\ 0 & 4 & -3 \\ 2 & 0 & 1 \end{bmatrix}\begin{bmatrix} 3 & 1 & 1 \\ 0 & 4 & -3 \\ 2 & 0 & 1 \end{bmatrix}=$ $\begin{bmatrix} 9+0+2 & 3+4+0 & 3+(-3)+1 \\ 0+0+(-6) & 0+16+0 & 0+(-12)+(-3) \\ 6+0+2 & 2+0+0 & 2+0+1 \end{bmatrix}=$ $\begin{bmatrix} 11 & 7 & 1 \\ -6 & 16 & -15 \\ 8 & 2 & 3 \end{bmatrix}$ Sum of entries = $11+7+1+(-6)+16+(-15)+8+2+3=27$

15			$\mathbf{v} \times \mathbf{u} = \begin{bmatrix} \vec{i} & \vec{j} & \vec{k} \\ -1 & 3 & 0 \\ 2 & 5 & 1 \end{bmatrix} =$ $\vec{i}\begin{vmatrix} 3 & 0 \\ 5 & 1 \end{vmatrix} - \vec{j}\begin{vmatrix} -1 & 0 \\ 2 & 1 \end{vmatrix} + \vec{k}\begin{vmatrix} -1 & 3 \\ 2 & 5 \end{vmatrix} = 3\vec{i} + \vec{j} - 11\vec{k}$ $\lvert\mathbf{v} \times \mathbf{u}\rvert = \sqrt{3^2 + 1^2 + (-11)^2} = \sqrt{131}$
	15	15	To find the cofactor of 0, cross out the row and column containing the element 0 and find the determinant of the remaining elements. However, the sign is opposite because it is a determinant and in C_{ij}, i + j is an odd number. $C_{32} = -1\begin{vmatrix} 1 & 6 \\ 8 & -2 \end{vmatrix} = -1(-2 - 48) = 50$