Question 1

What will be the value of the following expression?

$$\frac{1}{\log_a abc} + \frac{1}{\log_b abc} + \frac{1}{\log_c abc}$$

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Answer 1

$$\frac{1}{\log_a abc}+\frac{1}{\log_b abc}+\frac{1}{\log_c abc}$$
$$= \log_{abc} a+\log_{abc} b+\log_{abc} c$$
$$= \log_{abc} abc$$
$$= 1$$

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 2

If $n!$ denotes the product of the integers 1 through n, what is the remainder when $(1! + 2! + 3! + 4! + 5! + 6! + \ldots + 9!)$ is divided by 9?

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Answer 2

First of all, we know that $k! \equiv 0(\bmod 9)$ for all $k \geq 6$. Thus, we only need to find $(1!+2!+3!+4!+5!)(\bmod 9)$

$$\begin{gathered}
1! \equiv 1(\bmod 9) \\
2! \equiv 2(\bmod 9) \\
3! \equiv 6(\bmod 9) \\
4! \equiv 24 \equiv 6(\bmod 9) \\
5! \equiv 5 \cdot 6 \equiv 30 \equiv 3(\bmod 9)
\end{gathered}$$

Thus,

$$(1!+2!+3!+4!+5!) \equiv 1+2+6+6+3 \equiv 18 \equiv 0(\bmod 9)$$

So, the remainder is 0.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 3

Which of the following is(are) sufficient argument(s) to show that the vectors of set S are linearly dependent?

$$S = \left\{ u = \begin{bmatrix} 1 \\ -2 \\ 7 \end{bmatrix}, v = \begin{bmatrix} -7 \\ 14 \\ -49 \end{bmatrix}, w = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \right\}$$

Treat each option independently, correct option independently should be sufficient to infer that vectors are linearly dependent.

A. $0u + 0v + 1w = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

B. $0u + 0v = w$

C. $0u + 0v + 0w = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

D. $7u + (-1)v + 1w = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

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Answer 3

As per the definition of LD, there should be a nontrivial solution to show Linear Dependence among vectors of a set. C gives the trivial solution, i.e., all 0 coefficients.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 4

Which of the following is(are) true for the following system of linear equations $\mathrm{AX} = \vec{0}$

$$\begin{bmatrix} 2 & 3 & -5 \\ -5 & -1 & 32 \\ 2 & -4 & -26 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

A. $\mathrm{X} = [-7 \quad 3 \quad 1]^\top$ is a solution to the equation $\mathrm{AX} = \vec{0}$.

B. Showing that $\mathrm{X} = [0 \quad 0 \quad 0]^\top$ is a solution to $\mathrm{AX} = \vec{0}$ is sufficient to conclude that the columns of A are Linearly Independent.

C. Showing that $\mathrm{X} = [-7 \quad 3 \quad 1]^\top$ is a solution to $\mathrm{AX} = \vec{0}$ is sufficient to conclude that the columns of A are Linearly Independent.

D. $\mathrm{X} = [0 \quad 0 \quad 0]^\top$ is a solution to the equation $\mathrm{AX} = \vec{0}$.

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Answer 4

$X = [0 \quad 0 \quad 0]^{\top}$ is a trivial solution, but there might exist other solution to the equation, $X = [-7 \quad 3 \quad 1]^{\top}$ is one such solution which in turn shows that the column vectors in A are linearly dependent. Hence, B and C are incorrect.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 5

Given a set S of vectors in $\mathbb{R}^n$, and set $\mathrm{X}(\mathrm{X} \subset \mathrm{S})$ and $\mathrm{Y}(\mathrm{S} \subset \mathrm{Y})$, mark all the statements which are always true:

A. If the vectors of S are Linearly Dependent, then the vectors of X are also Linearly Dependent.
B. If the vectors of S are Linearly Independent, then the vectors of X are also Linearly Independent.
C. If the vectors of S are Linearly Dependent, then the vectors of Y are also Linearly Dependent.
D. If the vectors of S are Linearly Independent, then the vectors of Y are also Linearly Independent.

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Answer 5

Given: a set S of vectors in R^n and a set X (X⊂S) and Y (S⊂Y).

A. False. If the vectors of S are LD then it is not necessary that vectors of X are also LD they can be LI as well and the remaining vectors (S-X) can be dependent which will make the S LD.
B. True. Since X ⊂ S and S is LI then none of the vectors of S can be represented as a Linear Combination of other vectors of S, which include X as well.
C. True. Since S ⊂ Y and S is LD then Y is also LD because Y contains S i.e. at least 1 vector of Y (from set S) can be represented as a Linear Combination of another vector in Y.
D. False. If S is LI doesn't mean Y will be LI as well because S ⊂ Y and the remaining vectors from set Y (Y-S) can be LD as well.

Abbreviations: LD – Linearly Dependent, LI – Linearly Independent

answered Mar 15, 2023

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Sankalps

Question 6

Which of the following is/are CORRECT?
$u, v, \text{ and } w$ are vectors in $\mathbb{R}^n$.

A. A set $\{u, v, w\}$ is linearly independent if u can not be written as linear combination of v and w.
B. A set $\{u, v, w\}$ is linearly dependent if u is a linear combination of v and w.
C. If a set $\{u, v, w\}$ is linearly dependent then u is a linear combination of v and w.
D. For three vectors $\mathbf{u}, \mathbf{v}, \mathbf{w}$, if $\{\mathbf{u}, \mathbf{v}\}$ is linearly independent, and $\{\mathbf{v}, \mathbf{w}\}$ is linearly independent; then $\{\mathbf{u}, \mathbf{v}, \mathbf{w}\}$ is linearly independent.

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Answer 6

Option A— False

A given set of vectors is linearly independent if and only if none of the vectors can be expressed as linear combination of other vectors.

Option B – True

This follows the definition of Linear Dependence
A set of vectors are linearly dependent if atleast one vector can be expressed as the linear combination of other vectors

Option C – False

Counter example u = [0,1]; v=[1,0]; w= [2,3]
Here u cannot be expressed as linear combination of v,w. Only w can be w=2v+3u

Option D – False

Counter example: u = [0,1]; v=[1,0]; w= [2,3]
{u,v} and {v,w} are linearly dependent but not {u,v,w} as w can be expressed as w=2v+3u

answered Mar 15, 2023

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Vineeth Rambhiya

Question 7

- $\mathbb{S}1$: A set of two vectors in $\mathbb{R}^n$ is Linealy dependent if at least one vector is a multiple of the other.
- $\mathbb{S}2$: A set of n vectors in $\mathbb{R}^n$ is Linealy independent if and only if none of the vectors are a multiple of any other vector.

A. $\mathbb{S}1$ and $\mathbb{S}2$ both are correct
B. $\mathbb{S}1$ is correct and $\mathbb{S}2$ is incorrect
C. $\mathbb{S}2$ is correct and $\mathbb{S}1$ is incorrect
D. $\mathbb{S}1$ and $\mathbb{S}2$ both are incorrect

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Answer 7

The rigorous definition of LI and LD among vectors is in terms of the Linear combination of vectors and not multiples of each other.

For a set of two vectors. Linear combinations and multiples of each other are equivalent, hence, $\mathrm{S1}$ is correct.

For > 2 vectors, Even if no vector is a multiple of any other vector, still that set can be LD if one vector is a linear combination of others. Hence, $\mathrm{S2}$ is incorrect (B) is correct.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 8

What will be value of x satisfying the below equation?

$$\sqrt{\log_2 x^4} + 4\log_4 \sqrt{\frac{2}{x}} = 2$$

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Answer 8

$$\sqrt{4\log_2 x + 4\log_4\left(\frac{2}{x}\right)^{1/2}} = 2$$

$$2\sqrt{\log_2 x + \frac{4}{2}\log\left(\frac{2}{x}\right)} = 2$$

$$2\sqrt{\log_2 x + 2\log\left(\frac{2}{x}\right)} = 2$$

$$\sqrt{\log_2 x + \log_4 2 - \log_4 x} = 1$$

$$\sqrt{\log_2 x + \frac{\log 2}{\log 4} - \frac{\log x}{\log 4}} = 1$$

$$\sqrt{\log_2 x + \frac{\log 2}{\log 2^2} - \frac{\log x}{\log 2^2}} = 1$$

$$\sqrt{\log_2 x + \frac{\log 2}{2\log 2} - \frac{\log x}{2\log 2}} = 1$$

$$\sqrt{\log x + \frac{1}{2} - \frac{1}{2}\log x} = 1$$

$$\sqrt{\log_2 x - \frac{1}{2}\log_2 x} = \frac{1}{2}$$

$$\text{Assume } \log_2 x = m$$

$$\sqrt{m - \tfrac{1}{2}m} = \tfrac{1}{2}$$

$$\text{SQUARING}$$

$$4m = 1 + 2m + m^2$$

$$m^2 - 2m + 1 = 0$$

$$(m-1)^2 = 0$$

$$m - 1 = 0$$

$$m = 1$$

$$\log_2 x = 1$$

$$\boxed{x = 2}$$

answered Mar 14, 2023 • edited Mar 13, 2024 by **Shadymademe**

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Question 9

Let us consider the following three vectors v_1, v_2, and v_3 in $\mathbb{R}^3$.

$$v_1 = (1 \quad 0 \quad -2)$$
$$v_2 = (-1 \quad 0 \quad 2)$$
$$v_3 = (1 \quad 0 \quad 2).$$

A. The three vectors v_1, v_2, and v_3 are linearly independent.

B. Every pair of vectors $\{v_1, v_2\}, \{v_2, v_3\}$, and $\{v_1, v_3\}$ are linearly independent.

C. All pairs except the pair $\{v_1, v_2\}$ are linearly independent.

D. All pairs except the pair $\{v_1, v_3\}$ are linearly independent.

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Answer 9

Given vectors

$$v_1 = \begin{bmatrix} 1 \\ 0 \\ -2 \end{bmatrix}$$

$$v_2 = \begin{bmatrix} -1 \\ 0 \\ 2 \end{bmatrix}$$

$$v_3 = \begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}$$

The only dependent pair are $\{v_1, v_2\}$ as v_2 = (-1).v_1

As v_2 can be expressed as the linear combination of v_1 and v_3. So the given set of vectors are Linearly dependent (v_2 = (-1).v_1 + (0).v_3)

Answer is C

answered Mar 15, 2023 • edited Mar 15, 2023 by **Vineeth Rambhiya**

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Vineeth Rambhiya

Question 10

Let a, b be in $\mathbb{R}$. Consider the three vectors

$$\boldsymbol{v}_1 = \begin{bmatrix} a \\ 0 \\ 0 \end{bmatrix}, \quad \boldsymbol{v}_2 = \begin{bmatrix} 0 \\ b \\ 1 \end{bmatrix}, \quad \boldsymbol{v}_3 = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}.$$

For which values of a and b are $\boldsymbol{v}_1, \boldsymbol{v}_2, \boldsymbol{v}_3$ independent?

A. $a = 0$ and $b = 1$
B. $a \neq 0$ and $b \neq 1$
C. $a = 0$ and $b \neq 1$
D. $a \neq 0$ and $b = 1$

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Answer 10

If we take a=0 then v_1 will become zero vector which in result will make $\{v_1, v_2, v_3\}$ linearly dependent as we can then represent, v1 = 0.v2 + 0.v3 . Hence a$\neq$0.

If we take b=1 then v_2 and v_3 will become same vector. Hence b$\neq$1 for $\{v_1, v_2, v_3\}$ to be linearly independent.

$\therefore$ b is correct.

answered Mar 15, 2023

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Geekybread

Question 11

Which of the following is FALSE?

A. If $v_1, \ldots, v_4$ are in $\mathbf{R}^5$ and $\{v_1, v_2, v_3\}$ is linearly dependent then $\{v_1, v_2, v_3, v_4\}$ is linearly dependent.

B. If $v_1, \ldots, v_4$ are in $\mathbf{R}^5$ and v_1 is not a linear combination of $\{v_2, v_3, v_4\}$, then $\{v_1, v_2, v_3, v_4\}$ is linearly independent.

C. If $v_1, \ldots, v_4$ are linearly independent vectors in $\mathbf{R}^5$, then $\{v_1, v_2, v_3\}$ is also linearly independent.

D. Any set of 6 vectors in $\mathbf{R}^5$ is linearly dependent.

Answer 11

(A) True. $\{v_1, v_2, v_3\}$ linearly dependent means there exists weights a_1, a_2, and a_3 not all zero such that

$$a_1v_1 + a_2v_2 + a_3v_3 = 0$$

This means

$$a_1v_1 + a_2v_2 + a_3v_3 + a_4v_4 = 0$$

for $a_4 = 0$ and the same a_1, a_2, a_3 as above. Since not all of a_1, a_2, and a_3 are zero, that means not all of of a_1, a_2, a_3, a_4 are zero. And that means $\{v_1, v_2, v_3, v_4\}$ are linearly dependent.

(B) False. Here's a simple counterexample: choose $v_1 = e_1$ and $v_2 = v_3 = v_4 = e_2$. Then v_1 is not a linear combination of $\{v_1, v_2, v_3\}$, yet $\{v_1, v_2, v_3, v_4\}$ are linearly dependent (because, for example, $0v_1 + 0v_2 + v_3 - v_4 = 0$).

(C) True. To show that $\{v_1, v_2, v_3\}$ is linearly independent, we must show that if $a_1v_1 + a_2v_2 + a_3v_3 = 0$, then $a_1 = a_2 = a_3 = 0$ (“only the trivial solution...”).

So, assume $a_1v_1 + a_2v_2 + a_3v_3 = 0$. Then $a_1v_1 + a_2v_2 + a_3v_3 + 0v_4 = 0$ must also be true (we simply added 0 to the left-hand side). But because $\{v_1, v_2, v_3, v_4\}$ are linearly independent, that means all the weights in this expression must be zero.

In particular, $a_1 = a_2 = a_3 = 0$. Which is what we wanted.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 12

Consider a set of n linearly independent vectors $\{\vec{w}_1, \ldots, \vec{w}_n\} \in \mathbb{R}^n$. A vector $\vec{u} \in \mathbb{R}^n$ will:

- Option 1. Always be a linear combination of $\{\vec{w}_1, \ldots, \vec{w}_n\}$
- Option 2. Never be a linear combination of $\{\vec{w}_1, \ldots, \vec{w}_n\}$

Enter the correct option as the numeric number. That is if option 2 is correct then enter "2".

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Answer 12

In a vector space R^n, any set of ***n*** linearly independent vectors forms the basis vectors.

i.e A set of n linearly independent vectors belonging to the vector space R^n can span the entire space of R^n.

So a vector $\overrightarrow{u} \epsilon R^n$ can always be expressed as the linear combination

of n linearly independent vectors $\{\overrightarrow{w_1}, \ldots, \overrightarrow{w_n}\} \epsilon R^n$.

Option1 is correct

answered Mar 15, 2023

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Vineeth Rambhiya

Question 13

Which of the following set is/are linearly independent?

A. $\left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \end{bmatrix} \right\}$

B. $\left\{ \begin{bmatrix} 1 \\ -1 \end{bmatrix} \right\}$

C. $\left\{ \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \right\}$

D. $\left\{ \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \right\}$

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Answer 13

Let's see option by option …

A. $\left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \end{bmatrix} \right\}$

These two vectors are not multiple of each other so, they are Linearly Independent .

B. $\left\{ \begin{bmatrix} 1 \\ -1 \end{bmatrix} \right\}$

These is a single vector which is not any multiple of other vector in the set and also there are not any zero vector which can lead the set to LD. Hence these single set of vector also linearly Independent.

C. $\left\{ \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix}, \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} \right\}$

These set is in R^3, So, here we can see that we have more than 3 vectors in the set which is leading to Linearly Dependent condition,

Also, we can see that $0 \times \begin{bmatrix} 1 \\ 2 \\ 1 \end{bmatrix} + 2 \times \begin{bmatrix} 1 \\ -1 \\ 2 \end{bmatrix} + 5 \times \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 2 \\ 3 \\ 4 \end{bmatrix}$

So we can represent also 1 vector as a linear combination of other 3 vectors. So it is clear that these set is LD.

D. $\left\{ \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} \right\}$

The set is already consisting a zero vector that means this set is Linearly Dependent.

Question is asking for LI set,

***So,* ANS is: A;B**

answered Mar 15, 2023 • edited Apr 4, 2023 by **Akash 15**

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Akash 15

Question 14

$$a\begin{bmatrix}1\\2\\3\\4\\5\end{bmatrix}+b\begin{bmatrix}-1\\2\\-3\\4\\-5\end{bmatrix}=\begin{bmatrix}0\\0\\0\\0\\0\end{bmatrix}$$

How many number of pairs (a, b) are there, that satisfy the above equation?

A. 0
B. 1
C. Infinite
D. 2

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Answer 14

Linear combination of LI vectors can be 0 vector, only if, all coefficients are 0 s. Hence, only 1 pair $(0,0)$ exists for (a,b) Option B is correct.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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Question 15

Given a set of vectors $S(|S| \geq n)$, with all vectors in $\mathbb{R}^n$, which of the following is a necessary and sufficient condition for the vectors of S to be Linearly Dependent?

A. Exactly n vectors can be represented as a linear combination of other vectors of the set S.
B. At least n vectors can be represented as a linear combination of other vectors of the set S.
C. At least one vector u can be represented as a linear combination of any vector(s) of the set S.
D. At least one vector u can be represented as a linear combination of vectors (other than u) of the set S.

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Answer 15

This follows directly from the definition of Linear Independence. C can't be the answer because it says "any vector(s)", which would include the vector u itself. A & B are sufficient, but not necessary.

answered Mar 14, 2023 • edited Mar 14, 2023 by **Lakshman Bhaiya**

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