**Question 1:**

**1) 2% - Choose a 𝑞 value which gives no solution.**

**2) 2% - Choose a 𝑞 value which gives infinitely many solutions.**

**3𝑥 + 6𝑦 = 1**

**6𝑥 + 12𝑦 = 𝑞**

**Ans1.**

The matrix form of the system of equations is as follows (Based on **Ax = b**):

Since the determinant of matrix A is zero (3\*12 – 6\*6 = 0), we can say that it’s a singular matrix having no inverse, so either the system of equations will have no solutions or it’ll have infinite solutions.

1. The value of q which has no solutions will result in parallel lines in geometric 2-D space. Line 1 🡺 3x + 6y = 1

Line 2 🡺 2(3x + 6y) = q 🡺 3x + 6y = q/2

To get parallel lines, we can take any real number for q/2 which is not equal to 1

Therefore, a possible value for q/2 = 10 🡺 q = 20

Thus, a value of 4 for the variable q will lead to no solutions for the above system of equations.

1. The value of q which has infinite solutions will result in same lines in geometric 2-D space.

Line 1 🡺 3x + 6y = 1

Line 2 🡺 2(3x + 6y) = q 🡺 3x + 6y = q/2

To get same line, we can equate q/2 = 1

Therefore, the value of q = 2

Thus, a value of 2 for the variable q will lead to infinite solutions for the above system of equations.

**Question 2:**

**1) 5% - Solve the following system of equations using Gaussian Elimination.**

**2𝑥 + 3𝑦 + 𝑧 = 12**

**−2𝑥 + 3𝑦 − 2𝑧 = 1**

**𝑥 − 𝑦 + 4𝑧 = 16**

**2) 2% Validate your answer using Python.**

**Ans2.**

**Row 2 => Row2 + Row1**

**Row 1 => Row1/2**

**Row 3 => Row3 – Row1**

**Row1 => Row2/6**

**Row3 => Row3 + 2.5\*Row2**

**Row3 => Row3/3.083333**

* **Upper triangular Matrix**

Now using back substitution, we can see that the value of z = 5

For y

y – 5\*(-0.16667) = 2.16667 => y = 3

For x

x + 1.5\*3 + 0.5\*5 = 6 => x = -1

**Question 3:**

Find the rank of each of the following matrices. Verify your rank calculation using Python.

**Ans3.**

1. [[1,3,1,2,0],

[0,0,2,1,3],

[0,0,0,3,2],

[0,0,0,3,-1]]

After converting to upper triangular form, we get 4 pivots, and we see that column 2 is dependent on column1

Thus, the rank of matrix is 4

1. [[-1, 1, 0, -1],

[-2, 2, 1, -4],

[-1, 1, -2, 3]]

After converting to upper triangular form, we get 2 pivots, and we see that column 2 is dependent on column1 and column4 is dependent on the columns 1 and 3 (col4 = col1 – 2\*col3)

Thus, the rank of matrix is 2