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**STEM LAB AS.no.1**

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**Task (I):**

1-

%The column descending from the head to the base justifies the %rule.

%F to R equals 2 because F to D equals 4 so when we justify %the rule by descending the column from the head to the rule, %F to R will be 2 and of course R to D is 2 also.

%After descending the column:

%The right angle of the triangle will be 90 degree.

%So we use Pythagoras to find out the rib ED & EF.

>> ED=sqrt(5.^2+2.2)

ED = 5.3825

>>EF= sqrt(5.^2+2.2)

EF = 5.3825

>>FD = 4 %From the figure.

2- %We use atand(β)& atand(α) to find the angles β & α by %putting them in a random variables a, b and b1.

%we use a and d in sin,cos…etc. for example: asind(a) a=inv %for sin d=in degree

>> b1=atand(β) % the tan inv of angle β is 2/5

b=2\*21.801 = 43.603 %because we found out the half of the %angle β so we multiply β with 2.

β= 43.603

>>a=atand(α) % the tan inv of angle β is 5/2.

a=68.199

α=68.199

%We use a and b to find out the sin,cos…etc.

%Sin(x) = opposite/hypotenuse

%Cos(x) = adjacent/hypotenuse

%Tan(x) = opposite/adjacent

%Sec(x) = 1/Cos = hypotenuse/adjacent

%Csc(x) = 1/Sin = hypotenuse/opposite

%Cot(x) = 1/tan = adjacent/opposite

>> asind(b)

ans = 90.000 – 256.005i

>> acosd(b)

ans = 0.00000 + 216.256.00542i

>>atand(b)

ans = 88.686

>>asecd(b)

ans = 88.686

>>acscd(b)

ans = 1.3142

>> acotd(b)

ans = 1.3138

3-

>>asind(a)

ans = 90.000 - 281.638i

>>acosd(a)

ans = 0.00000 + 281.63840i

>>atand(a)

ans = 89.160

>>asecd(a)

ans = 89.160

>>acscd(a)

ans = 0.84016

>>acotd(a)

ans = 0.84007

4-

>>asin(b)

ans = 1.5708 – 4.4681i

>>acos(b)

ans = 0.00000 + 4.46814i

>>atan(b)

ans = 1.5479

>>asec(b)

ans = 1.5479

>>acsc(b)

ans = 0.022936

>>acot(b)

ans = 0.022930

5-

>>asin(a)

ans = 1.5708 - 4.9155i

>>acos(a)

ans = 0.00000 + 4.91552i

>>atan(a)

ans = 1.5561

>>asec(a)

ans = 1.5561

>>acsc(a)

ans = 0.014664

>>acot(a)

ans = 0.014662

6-

>>sind(b)

ans = 0.68966

>>cosd(b)

ans = 0.72414

>>tand(b)

ans = 0.95238

>>secd(b)

ans = 1.3810

>>cscd(b)

ans = 1.4500

>>cotd(b)

ans = 1.0500

7-

>>sind(a)

ans = 0.92848

>>cosd(a)

ans = 0.37139

>>tand(a)

ans = 2.5000

>>secd(a)

ans = 2.6926

>>cscd(a)

ans = 1.0770

>>cotd(a)

ans = 0.40000

8-

%We use the equation “x\*(pi/180)” to convert β &α from degree %to radians.

>> rad = α\*(pi/180)

rad = 1.1903

>>rad = β\*(pi/180)

rad = 0.76101

9-

%we use the build-in function deg2rad to convert β &α from %degree to radians.

>>deg2rad(a)

ans = 1.1903

>>deg2rad(b)

ans = 0.76101

10-

%we should convert b to radians to find sin,cos..etc

%we use deg2rad to convert b

>>sin(b)

ans = 0.68966

>>cos(b)

ans = 0.72414

>>tan(b)

ans = 0.95238

>>sec(b)

ans = 1.3810

>>csc(b)

ans = 1.4500

>>cot(b)

ans = 1.0500

11-

%we should convert a radians to find sin,cos..etc

%we use deg2rad to convert a

>>sin(a)

ans = 0.92848

>>cos(a)

ans = 0.37139

>>tan(a)

ans = 2.5000

>>sec(a)

ans = 2.6926

>>csc(a)

ans = 1.0770

>>cot(a)

ans = 0.40000

**Task (II):**

1-

%To have a 50-by-30(rows-by-columns) matrix and all the %elements in it are sin(pi/6) we should use the function %ones(50,30)

%to have a (50,30) matrix filled with sin(pi/6), we use %ones(50,30)and multiply it the matrix sin(pi/6)

>>ones(50,30)\*sin(pi/6);

2-%To have a 50-by-30(rows-by-columns) matrix and all the %elements in it are zeros we use the function zeros(50,30)

>>zeros(50,30);

3-%To have a 50-by-30(rows-by-columns) matrix and all the %elements in it are threes we use the function ones(50,30)

&and we multiply the matrix with 3

>>ones(50,30)\*3;

**Task (III):**

%Firstly, we define the equations in two matrixes, first one

%with A and the second one with B.

%Then the matrix A will have the factors of unknowns

%and the matrix B will be defined with the constants.

>> A=[1 0 3; 2 3 4; 0 1 1] %because in the first equation

**%x**2 was missing so we replace the missing factor with 0

>>B[4; -5; 2] %we move the constants to the other side %and define B with them

>>inv(a)\*b %to let all the rows and columns in the matrix A %to multiply with matrix B in the order to have the factors of %unknowns

ans =

-7.4000

-1.8000

3.8000

**Task (IV):**

%Firstly, we need to use the straight-line equation that is:

%y - y1 = m(x – x1)

%Then we use this equation to find the paths that both cars %will take

%H1 is the car which the person A is driving so we should find %the inclination of the path that H1 is taking.

%H2 is the car which the person B is driving so we should find %the inclination of the path that H2 is taking.

1-

>>y-y1 = m(x-x1)

>>H1 : %By taking two points from the figure (H1 path) and %find the inclination for it.

>>m = (4-0)/(0-4) %(0,4) and (4,0)

m =

-1

%We write the equation then we make it up.

>>y – 4 = -1(x – 0)

y – 4 = -x

H2 : %%By taking two points from the figure (H2 path) and %find the inclination for it.

>>m = (1-0)/(3-1)

m =

0.5000

%We write the equation then we make it up.

>>y – 1 = 0.5(x – 3)

y -1 = 0.5x – 1.5

2-

%Writing the equation in form of requested in the question %by moving the transaction coefficients to one side and the %constants to one side.

>>H1 : %a1 \* y + b1 \* x = c1

y + x = 4

>>H2 : %a2 \* y + b2 \* x = c2

y - 0.5x = -0.5

3-

%The coefficient matrix A is the coefficient of the %transactions x and y in both equations in part 2.

>> A =[1 1; 1 -0.5]

A =

1.00000 1.00000

1.00000 -0.50000

4-

%The constant matrix B is the constants from the equations %in part 2.

>> B = [4; -0.5]

B =

4.00000

-0.50000

5-

%Determinant of this example:

%A = 4 5

% 2 6

%det (A) = 4 \* 6 – 2 \* 5 = 24 – 10 = 14

>>det(A)

ans =

-1.5000

6 –

%The inverse of matrix A is A^-1 of the matrix A

>>inv(A) =

0.33333 0.66667

0.66667 -0.66667

7-

%To find the coordinates of point b we should multiply the %inverse of matrix A with B, because the point b is the %collision point between the two paths.

>>b = inv(A)\*B

>> b =

1.0000

3.0000

|  |
| --- |
| **Critical analysis:** Firstly, we should find the straight-line equation of the two cars H1, H2. But we should find the inclination of the two equations, after having the two equations, we will have found the path of H1, H2, then we find the collision point (b) (that H1 will collide with H2) by multiplying the inverse of A (the coefficient of the transactions x and y in both equations) with B (the constants from the equations).But the point b we can see from the figure its (3,1) so we can find the path of H1, H2 without multiplying the inverse of A with B |

**Task (V):**

1-

%First of all, We define the matrix A as follows in the %question by using the function A=[……].

%magic(9) is a MATLAB function that gives (9X9) matrix

%(9 rows \* 9 columns) and the sum of every column equals the %next column.

>>A=magic(9)

A=

47 58 69 80 1 12 23 34 45

57 68 79 9 11 22 33 44 46

67 78 8 10 21 32 43 54 56

77 7 18 20 31 42 53 55 66

6 17 19 30 41 52 63 65 76

16 27 29 40 51 62 64 75 5

26 28 39 50 61 72 74 4 15

36 38 49 60 71 73 3 14 25

37 48 59 70 81 2 13 24 35

2-

%Then we put the matrix in the right order as requested as the %question(Transform Matrix A into the following matrix in the %question)

%We define the other matrix as B

>>B = A (:,[5 6 7 8 9 1 2 3 4]) %The function ‘:,’ is used to %reorder the matrix as the following columns as written.

B =

1 12 23 34 45 47 58 69 80

11 22 33 44 46 57 68 79 9

21 32 43 54 56 67 78 8 10

31 42 53 55 66 77 7 18 20

41 52 63 65 76 6 17 19 30

51 62 64 75 5 16 27 29 40

61 72 74 4 15 26 28 39 50

71 73 3 14 25 36 38 49 60

81 2 13 24 35 37 48 59 70

%Then we use the function eye(x), to leave the main diagonal %the same and zeros everywhere.

%We use any named variable to define it with eye(x).

>>C = B.\*eye(9) %We use ‘.’ To let all the rows and %columns %(except the main diagonal) to multiply with %eye(9),and when we say except the main diagonal its because %the eye(9) function.

C =

1 0 0 0 0 0 0 0 0

0 22 0 0 0 0 0 0 0

0 0 43 0 0 0 0 0 0

0 0 0 55 0 0 0 0 0

0 0 0 0 76 0 0 0 0

0 0 0 0 0 16 0 0 0

0 0 0 0 0 0 28 0 0

0 0 0 0 0 0 0 49 0

0 0 0 0 0 0 0 0 70

%After that, we should re order the matrix as requested as the %question, and we should move the columns to the right order %by using for example X = Y(:,[……;…….]) to change the %columns %as wanted.

%And we use any named variable to define C in it.

>> D = C(:,[1 3 2 5 4 7 6 9 8])

D =

1 0 0 0 0 0 0 0 0

0 0 22 0 0 0 0 0 0

0 43 0 0 0 0 0 0 0

0 0 0 0 55 0 0 0 0

0 0 0 76 0 0 0 0 0

0 0 0 0 0 0 16 0 0

0 0 0 0 0 28 0 0 0

0 0 0 0 0 0 0 0 49

0 0 0 0 0 0 0 70 0

%But, the element (9,9) is zero, it should be changed to one %as requested in the question, so we use the function by its %name and we detect the raw and the column that is wanted to %change is and we equal it to the wanted number.

>>D(9,9)=1

D =

1 0 0 0 0 0 0 0 0

0 0 22 0 0 0 0 0 0

0 43 0 0 0 0 0 0 0

0 0 0 0 55 0 0 0 0

0 0 0 76 0 0 0 0 0

0 0 0 0 0 0 16 0 0

0 0 0 0 0 28 0 0 0

0 0 0 0 0 0 0 0 49

0 0 0 0 0 0 0 70 1

3-

%To have the sum of the elements of transformed matrix are not %equal zero, we should detect the raw and column manually(that %aren’t equals zero) and use ‘+’ to find the sum.

%And of course, D(x,y) x = rows , y = columns.

>> D(1,1)+D(2,3)+D(3,2)+D(5,4)+D(4,5)+D(7,6)+D(6,7)+D(9,8)+D(8,9)+D(9,9)

ans =

361

4-

%Determinant of this example:

%A = 4 5

% 2 6

%det (A) = 4 \* 6 – 2 \* 5 = 24 – 10 = 14

>> det (D) =

6.0763e+12

**Task (VI):**

%Firstly, to check that the paths the aircrafts are taking are %incorrect, we should analyze every aircraft and determine the %path of it so we have the straight line equation of every %plane.

%We should take every two aircrafts together and by using the %trajectory of every aircraft we’ll find the path and we’ll %find if the two planes will collide with each other.

%The trajectory of the Aircraft (Boeing 737) is:

%y = x + 10

%The trajectory of the Aircraft (Boeing 747) is:

%2y = 2x + 10

%The trajectory of the Aircraft (Boeing 720) is:

%y = 3x + 2

%We will start by taking the Boeing 737 with Boeing 747:  
%Before that, we should move the transaction coefficients to %one side of the equation and the constants to the other side %of the equation too. (We will do this step for every two %aircrafts taken together).

%The trajectory of the Aircraft (Boeing 737) will be:

%y - x = 10

%The trajectory of the Aircraft (Boeing 747) will be:

%2y – 2x = 10

%The trajectory of the Aircraft (Boeing 720) will be:

%y – 3x = 2

% Boeing 737 with Boeing 747(with random different named %variables)

>>A = [ 1 -1; 2 -2]

A =

1 -1

2 -2

%(1 and -1 is for transactions of 737),(2 -2 is for %transactions of 747)

>>B = [10; 10]

B =

10

10

%10 and 10 is for the constants for 737 and 747.

%Then we should multiply the inverse of A with B to multiply %every element with each other to check if they will collide.

>>X1= inv(A)\*B

X1 =

Inf

Inf

%The answer will be infinite because 737 wont collide with 747

%Warning matrix singular to machine precision

%Then we take 747 with 720(with random different named %variables)

>>C = [2 -2; 1 -3]

C =

2 -2

1 -3

%(2 and -2 is for transactions of 747),(1 -3 is for %transactions of 720)

>>D = [10; -2]

D =

10

-2

%10 and -2 is for the constants for 747 720.

%Then we should multiply the inverse of C with D to multiply %every element with each other to check if they will collide.

>>X2 = inv(C)\*D

X2 =

8.5000

3.5000

%The aircraft 747 and 720 will collide.

%Then we take 737 with 720(with random different named %variables)

>>E = [1 -1; 1 -3]

E =

1 -1

1 -3

%(1 and -1 is for transactions of 737),(1 -3 is for %transactions of 720)

>>>>F = [10; -2]

F =

10

-2

%10 and -2 is for the constants for 737 and 720.

%Then we should multiply the inverse of E with F to multiply %every element with each other to check if they will collide.

>>X3 = inv(E)\*F

X3 =

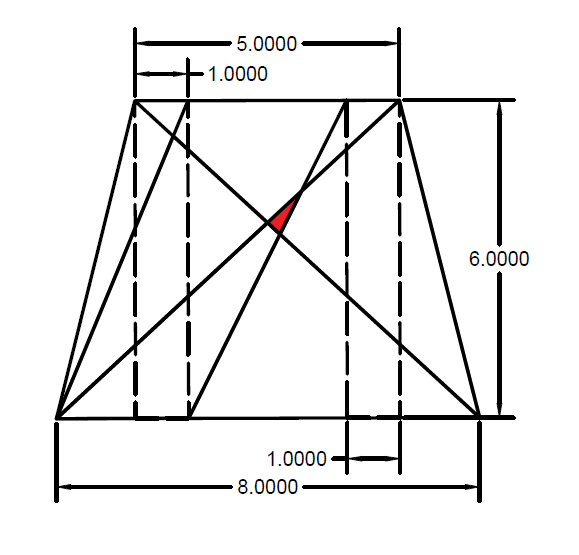
16

6

%The aircraft 747 and 720 will collide.

|  |
| --- |
| **Critical analysis:** Firstly, we have the straight- line equations of every aircraft, we put the transaction coefficients in one side and the constants in one side in order to define them into different matrixes.  Then we take every two aircrafts together and we multiply the inverse of the transaction coefficients with the constants to find out if they will collide, if the multiplication of the inverse of the transaction coefficients with the constants isn’t infinite, they will collide, if the multiplication of the inverse of the transaction coefficients with the constants is infinite as it shows, the two aircrafts will keep their path straightly without colliding each other, but if we have the start time and the end of every aircraft, we can find the path of every aircraft without checking every two aircrafts together.  So:  X1 is for Boeing 737 with Boeing 747, the answer was infinite, so they won’t collide.  X2 is for Boeing 747 with Boeing 720, the answer wasn’t infinite, so they will collide.  X3 is for Boeing 737 with Boeing 720, the answer wasn’t infinite, so they will collide |

**Task (VII):**



%Firstly, to find the requested angles, we should start to %find the missing lengths, the bottom one is 8.0000 and we %decrease 2 from it (from the figure, each one is 1), then we %will have 6 missing.

%but the length of the right angle and the left angle of the %big right triangle is the same so we will name each one ‘x’

%so, 2x + 5 = 8 >> 2x = 3 >> x = 1.5

%so, the length of the middle triangle is 3 because 1.5 + 1.5 %+ 1 + 1 = 5 >> 8 – 5 = 3

%Then, we take the big right triangle to find the hypotenuse %of it.

%we use Pythagoras. But the length of the big right triangle %is 6.5 because 1 + 1.5 + 3 = 6.5

%By Pythagoras, 6.5.^2 + 6.^2 = hypotenuse^2

>>sqrt(6.5.^2+6.^2)= hypotenuse

hypotenuse = 8.8459

%Then we use tan inverse to find the left angle of the big %right triangle

>>atand(6/6.5) =

42.709

%Then we have the right angle of the big triangle is 90 %because it’s an isosceles trapezium and from the figure we %will find out that the angle is 90

%Then, we decrease the sum of the two angles of the big right %triangle from 180. 180 – (42.709+90.000) = 180 – 132.71 = %47.291. It’s the above angle of the big right triangle

%After that we have that the angle and the corresponding to it %in the letter Z are the same, so, the angle of corresponding %to the above angle of the big right triangle in the letter Z %is 47.291, then we have that angle and the complementary %angle for it so 180 – 47.291 = 132.71

%After that, we take the middle triangle to find the above %angle of it. We use Pythagoras to find firstly the bottom %left angle. 3.^2 + 6.^2 = hypotenuse^2

>>sqrt(3.^2+6.^2) = hypotenuse

hypotenuse = 6.7082

%Then we use tan inverse to find the left angle of the middle %triangle

>>atand(6/3) =

63.435

%then from the middle triangle, we have the right angle of it %is 90 because it’s an isosceles trapezium and from the %figure.

%Then, we decrease the sum of the two angles of the middle %triangle from 180. 180 – (63.435+90.000) = 180 – 153.44 = %26.565.It’s the above angle of the middle triangle.

%We have the complementary angle for the straight line(180) is %132.71 so we decrease (26.565 + 132.7) from 180. 180 – 159.26 %= 20.735

Angle 1 = 20.735

%Then we have the angles of the big left triangle is the same %as the angles of the big right triangle because it’s an %isosceles trapezium so the angles and the hypotenuse of the %triangles of it are the same

%Then we have the big left triangle, the above left angle of %it is 47.291 because it’s the same angle of the above right %angle of the big right triangle and from the triangle %similarity we have a small triangle in the big left triangle %so the angle of the smaller triangle in the big left triangle %is 47.291. Then we have the small triangle to the right that %its part of the big left triangle is isosceles so the angle %47.291 is the same of the bottom angle of this triangle so we %decrease the sum of this angles from 180. 180-(47+291+47.291) %= 85.418

%from meeting the head 85.418

Angle 2 = 85.418

Angle 3 = 180 – (85.418+20.735) = 73.847

|  |
| --- |
| **Critical analysis:** We have the lengths of the isosceles trapezium, but some lengths are missing so we find them using the lengths we have then we use tan (opposite/adjacent) inverse to find the angles to the both of big triangles, the trapezium is isosceles so we can take that advantage to know that we have the same angles of the same hypotenuse of the isosceles trapezium, then, when we have the angles of the big triangles, we will have some missing angles so we use the corresponding of an angle that above an another angel with letter Z, also, when we have 2 angles on the same straight line we can use the complementary of an angel and we decrease it from 180, and we also use the similarity of the big triangle and the smaller one to find out they have the same above angel, then after founding the angles we use meeting the head to find out the requested angles of the small red triangles (from meeting the head : every two angles meet at one  head have the same angle. |

The END