

Anageom tutorial

by Tomas Boril (borilt@gmail.com)

Start Anageom

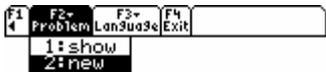
Press “diamond” and “3”.



ANAGEOM RAD AUTO FUNC 0/30

New problem

Press F8 and choose Problem, new.



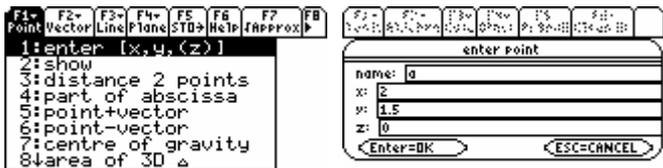
ANAGEOM RAD AUTO FUNC 0/30

Now all old variables are deleted and we can start our new problem.

We want to enter these points:

- A [2; 1.5; 0]
- B [4; 0.5; 0]
- C [0; -5; 3]
- D [2; -1; 1]

Press F1 and Enter. Then enter point A.



Press Enter.



A[2.; 1.5; 0.]

ANAGEOM RAD AUTO FUNC PAUSE

Now we are in pause mode. If the result is big, we can scroll the screen by left and right arrow. Press enter to leave the pause mode.

Ok. Now enter points B, C and D.

```

F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+
Point Vector Line Plane STD Help FApprox
A[2.;1.5;0.]
B[4.;.5;0.]
C[0.;-5.;3.]
D[2.;-1.;1.]

```

ANAGEOM RAD AUTO FUNC 0/30

If you have entered some point wrong, enter it again, it will overwrite.

What is distance between A and B?

Press F1, 3, ab, ENTER twice and once more ENTER to leave the pause mode.

<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox 1:enter [x,y,(z)] 2:show 3:distance 2 points 4:part of abscissa 5:point+vector 6:point-vector 7:centre of gravity 8:area of 3D </pre>	<pre> A[2.;1.5;0.] distance 2 points 2 points: ab <Enter=OK> <ESC=CANCEL> </pre>	<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox A[2.;1.5;0.] B[4.;.5;0.] C[0.;-5.;3.] D[2.;-1.;1.] AB = 2.23607 </pre>
ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30

The distance is 2.23. I will be more brief in next questions so just follow screenshots.

What is point just in half between A and B?

<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox 1:enter [x,y,(z)] 2:show 3:distance 2 points 4:part of abscissa 5:point+vector 6:point-vector 7:centre of gravity 8:area of 3D </pre>	<pre> A[2.;1.5;0.] part of abscissa 2 points: ab part: 1/2 <Enter=OK> <ESC=CANCEL> AB = 2.23607 </pre>	<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox A[2.;1.5;0.] B[4.;.5;0.] C[0.;-5.;3.] D[2.;-1.;1.] AB = 2.23607 1/2 AB = [3.;1.;0.] </pre>
ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30

What is point in one third between A and B?

<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox 1:enter [x,y,(z)] 2:show 3:distance 2 points 4:part of abscissa 5:point+vector 6:point-vector 7:centre of gravity 8:area of 3D </pre>	<pre> A[2.;1.5;0.] part of abscissa 2 points: ab part: 1/3 <Enter=OK> <ESC=CANCEL> AB = 2.23607 1/2 AB = [3.;1.;0.] </pre>	<pre> F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+ Point Vector Line Plane STD Help FApprox A[2.;1.5;0.] B[4.;.5;0.] C[0.;-5.;3.] D[2.;-1.;1.] AB = 2.23607 1/2 AB = [3.;1.;0.] 1/3 AB = [2.66667;1.16667;0.] </pre>
ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30	ANAGEOM RAD AUTO FUNC 0/30

We can scroll and then press ENTER.

```

F1+ F2+ F3+ F4+ F5+ F6+ F7+ F8+
Point Vector Line Plane STD Help FApprox
A[2.;1.5;0.]
B[4.;.5;0.]
C[0.;-5.;3.]
D[2.;-1.;1.]
|AB| = 2.23607
1/2 AB = [3.;1.;0.]
1/3 AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30

```

What is vector between A and B?

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

What is angle between AB and CD?

We can do this in two ways – by vectors or by lines.

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
B14: 2:enter (2 points)
C10: 3:show
D12: 4:size
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

If we do not like result in radians, we can exit Anageom and set degree mode and run Anageom again – it remembers all variables. To access Exit menu, press F8.

```

F1- F2- F3- F4-
Problem Language Exit
D12: 1:enter (x,y,(z))
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM RAD AUTO FUNC 0/30
  
```

Press MODE and set degrees mode.

```

MODE
F1- F2- F3-
Page 1 Page 2 Page 3
Graph..... FUNCTION →
Current Folder..... main →
Display Digits..... FLOAT 6 →
Angle..... 1: RADIAN
Exponential Format..... 2: DEGREE
Complex Format.....
Vector Format..... RECTANGULAR →
Pretty Print..... ON →
Enter=SAVE ESC=CANCEL
TYPE OR USE ←→+ + [ENTER] OR [ESC]
  
```

Run Anageom again – press “diamond” and “3”.

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help FApprox FB
D12: 1:enter (x,y,(z))
IAB: 5:vector+vector
1/2: 6:vector-vector
AB: 7:vector*vector (sc)
1/2: 8:vector*vector
AB = [2.66667;1.16667;0.]
ANAGEOM DEG AUTO FUNC 0/30
  
```

Now we calculate angle again, exactly same way as before.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 5:vector+vector
1AB 6:vector-vector
1/2 7:vector*vector (sc)
1/3 8:vector*vector
1/3 9:vector*number
A:vector+size
→AB B:variance
→AB C:rotation
↔AB ↔ ↔CD = 1.5708°
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/3 2:enter (2 points)
1/3 3:show
1/3 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
↔AB ↔ ↔CD = 1.5708°
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/3 2:enter (2 points)
1/3 3:show
1/3 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
↔AB ↔ ↔CD = 1.5708°
ANAGEDM DEGAUTO FUNC 0/30
  
```

Nice. It seems that both lines are perpendicular.

Calculate scalar product of AB and CD.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/2 2:enter (2 points)
1/3 3:show
1/3 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
↔AB ↔ ↔CD = 90.°
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/3 2:enter (2 points)
1/3 3:show
1/3 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
↔AB ↔ ↔CD = 90.°
ANAGEDM DEGAUTO FUNC 0/30
  
```

It is 0. So they are perpendicular.

Calculate vector product between AB and CD and store it as vector c.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/3 2:enter (2 points)
→AB 3:show
→AB 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
→AB 8:vector*vector
→AB *(sc) →CD = 0.
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/2 1:enter (x,y,z)
1/3 2:enter (2 points)
→AB 3:show
→AB 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
→AB 8:vector*vector
→AB *(sc) →CD = 0.
ANAGEDM DEGAUTO FUNC 0/30
  
```

Press F5.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/3 1:enter (x,y,z)
1/3 2:enter (2 points)
→AB 3:show
→AB 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
→AB 8:vector*vector
→AB *(sc) →CD = 0.
→AB × →CD = (2.;4.;10.)
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1/3 1:enter (x,y,z)
1/3 2:enter (2 points)
→AB 3:show
→AB 4:size
→AB 5:vector+vector
→AB 6:vector-vector
→AB 7:vector*vector (sc)
→AB 8:vector*vector
→AB *(sc) →CD = 0.
→AB × →CD = (2.;4.;10.)
ANAGEDM DEGAUTO FUNC 0/30
  
```

What is area of triangle ABC?

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1:enter (x,y,(z))
2:show
3:distance 2 points
4:part of abscissa
5:point+vector
6:point-vector
7:centre of gravity
8:area of 3D Δ
↔c(2.;4.;10.)
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help FApprox
1:enter (x,y,(z))
2:show
3:distance 2 points
4:part of abscissa
5:point+vector
6:point-vector
7:centre of gravity
8:area of 3D Δ
↔c(2.;4.;10.)
ANAGEDM DEGAUTO FUNC 0/30
  
```

And what formula have you used to calculate it!?

Do not panic, we have got help ☺

Press F6.

```

F1- F2- F3- F4- F5-
Point Vector Line Plane Back
1:distance 2 points
2:part of abscissa
3:centre of gravity
4:area of 3D Δ
5:area of 2D polygon
→AB × →CD = (2.;4.;10.)
↔c(2.;4.;10.)
area ABC = 8.21584
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5-
Point Vector Line Plane Back
1:distance 2 points
2:part of abscissa
3:centre of gravity
4:area of 3D Δ
5:area of 2D polygon
→AB × →CD = (2.;4.;10.)
↔c(2.;4.;10.)
area ABC = 8.21584
ANAGEDM DEGAUTO FUNC 0/30
  
```

And press F5.

```

F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+
Vector Line Plane STD Help (Approx)
7:AB * ->CD = (2.;4.;10.)
->AB * ->CD = (2.;4.;10.)
->c(2.;4.;10.)
area ABC = 8.21584
-----
ΔABC
area = 1/2 |->AB * ->BC|
ANAGEDM DEGAUTO FUNC 0/30
  
```

What is a centre of gravity of triangle ABC?

<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) 1:enter [x,y,(z)] 2:show 3:distance 2 points 4:part of abscissa 5:point+vector 6:point-vector 7:centre of gravity 8:area of 3D Δ ----- area = 1/2 ->AB * ->BC ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ->AB * ->CD = (2.;4.;10.) centre of gravity Min 2 points: labc Enter=OK ESC=CANCEL ----- ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ->AB * ->CD = (2.;4.;10.) ->c(2.;4.;10.) area ABC = 8.21584 ----- ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ANAGEDM DEGAUTO FUNC 0/30 </pre>
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We could scroll the result or save the result if we wanted.

Make line p from points A and B

<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) 1:enter (2 points) 2:enter (point,vec.) 3:enter(universal)2D 4:enter(direction)2D 5:show 6:intersection 7:variance 8:line+vector ----- centre of gr. ABC = [2.;-] ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) enter line - 2 points name: p 2 points: lab Enter=OK ESC=CANCEL ----- area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ->AB * ->CD = (2.;4.;10.) area ABC = 8.21584 ----- ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ->p = ->AB = (12.;1.5;0.) ANAGEDM DEGAUTO FUNC 0/30 </pre>
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What is distance between line p and point C?

<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) 4:enter(direction)2D 5:show 6:intersection 7:variance 8:line+vector 9:point_line Hx -> point By -> point ----- ->p = ->AB = (12.;1.5;0.) ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) point line Point: c Line: p Enter=OK ESC=CANCEL ----- centre of gr. ABC = [2.;-] ->p = ->AB = (12.;1.5;0.) ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ->AB * ->CD = (2.;4.;10.) area ABC = 8.21584 ----- ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ->p = ->AB = (12.;1.5;0.) IC ->p = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>
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You can also try to calculate distance between line AB and point C, it is the same.

<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) 3:enter(universal)2D 4:enter(direction)2D 5:show 6:intersection 7:variance 8:line+vector 9:point_line Hx -> point ----- IC ->p = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) area ABC = 8.21584 point line Point: c Line: ab Enter=OK ESC=CANCEL ----- ->p = ->AB = (12.;1.5;0.) IC ->p = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ->p = ->AB = (12.;1.5;0.) IC ->p = 7.34847 IC ->AB = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>
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Calculate intersection of line p and line CD and store this point as X.

<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) 1:enter (2 points) 2:enter (point,vec.) 3:enter(universal)2D 4:enter(direction)2D 5:show 6:intersection 7:variance 8:line+vector ----- IC ->AB = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) intersection of lines Line: p Line: cd Enter=OK ESC=CANCEL ----- IC ->p = 7.34847 IC ->AB = 7.34847 ANAGEDM DEGAUTO FUNC 0/30 </pre>	<pre> F1+ Point Vector F2+ F3+ F4+ F5+ F6+ F7+ F8+ Vector Line Plane STD Help (Approx) ΔABC area = 1/2 ->AB * ->BC centre of gr. ABC = [2.;-] ->p = ->AB = (12.;1.5;0.) IC ->p = 7.34847 IC ->AB = 7.34847 ->p ->CD = [3.;1.;0.] ANAGEDM DEGAUTO FUNC 0/30 </pre>
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Press F5.

Calculator interface showing the 'intersection of lines' menu. The user has entered line 'p' and line 'q'. The calculator displays the intersection point as E(5.;0.;0.).

Calculate intersection of lines p and q.

Calculator interface showing the 'intersection of lines' menu. The user has entered line 'p' and line 'q'. The calculator displays the intersection point as E(5.;0.;0.).

You can see that the intersection does not exist.

Calculate point Z which is point A moved in direction of vector c.

Three screenshots of the calculator interface. The first shows the 'point+vector' menu with point 'a' and vector 'c'. The second shows the calculation of point Z as $A + c = [4.;5.5;10.]$. The third shows the calculation of the distance between line r and point E as 8.4113.

Press F5.

Calculator interface showing the 'point+vector' menu. The user has entered point 'a' and vector 'c'. The calculator displays the resulting point Z as $[4.;5.5;10.]$.

Enter line r, which has direction of vector b and and goes through point Z.

Three screenshots of the calculator interface. The first shows the 'enter line - point and vector' menu with point 'z' and vector 'b'. The second shows the calculation of line r as $Z + k*b = [4.;5.5;]$. The third shows the calculation of the distance between line r and point E as 8.4113.

What is distance between line r and point E?

Three screenshots of the calculator interface. The first shows the 'point+line' menu with point 'e' and line 'r'. The second shows the calculation of the distance between line r and point E as 8.4113.

Enter 2D lines, s: $5x - 3y + 1 = 0$ and t: $2x + 2y - 6 = 0$

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
1:enter (2 points)
2:enter (point,vec.)
3:enter (universal)2D
4:enter (direction)2D
5:show
6:intersection
7:variance
8:line+vector
IE ↔r| = 8.4113
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
enter line - universal 2D
ax+by+c=0
name: s
a: 5
b: -3
c: 1
Enter=DK ESC=CANCEL
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
↔p n ↔q = 0.
A + ↗c = [4.:5.5:10.]
Z[4.:5.5:10.]
↔r = (Z+k*↗b) = ([4.:5.5:
IE ↔r| = 8.4113
↔s = (5.x+-3.y+1.=0)
  
```

And in the same way line t.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
↔p n ↔q = 0.
A + ↗c = [4.:5.5:10.]
Z[4.:5.5:10.]
↔r = (Z+k*↗b) = ([4.:5.5:
IE ↔r| = 8.4113
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
ANAGEDM DEGAUTO FUNC 0/30
  
```

What is angle between lines s and t?

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
1:enter (2 points)
2:enter (point,vec.)
3:enter (universal)2D
4:enter (direction)2D
5:show
6:intersection
7:variance
8:line+vector
IE ↔r = (Z+k*↗b) = ([4.:5.5:
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
↔s ∠ ↔t = 75.9638°
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
↔p n ↔q = 0.
A + ↗c = [4.:5.5:10.]
Z[4.:5.5:10.]
↔r = (Z+k*↗b) = ([4.:5.5:
IE ↔r| = 8.4113
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
↔s ∠ ↔t = 75.9638°
  
```

Enter 2D vectors, e (3; 0), f (3; 3*√3) and g (8; 8)

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
1:enter (x,y,(z))
2:enter (2 points)
3:show
4:size
5:vector+vector
6:vector-vector
7:vector*vector (sc)
8:vector*vector
↔s ∠ ↔t = 75.9638°
TYPE OR USE ↔t+ (ENTER) OR (ESC)
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
enter vector
name: e
x: 3
y: 0
z:
Enter=DK ESC=CANCEL
↔s ∠ ↔t = 75.9638°
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
Z[4.:5.5:10.]
↔r = (Z+k*↗b) = ([4.:5.5:
IE ↔r| = 8.4113
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
↔s ∠ ↔t = 75.9638°
↗e(3.:0.)
  
```

And in the same way vectors f and g.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
enter vector
name: f
x: 3
y: 3*√(3)
z:
Enter=DK ESC=CANCEL
↔e(3.:0.)
↗f(3.:5.19615)
↗g(8.:8.)
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
↔s ∠ ↔t = 75.9638°
↗e(3.:0.)
↗f(3.:5.19615)
↗g(8.:8.)
  
```

But the vector f is 5.19615. We wanted $3\sqrt{3}$. What is wrong? Nothing, just turn off approx display mode by pressing F7.

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
1:enter (x,y,(z))
2:enter (2 points)
3:show
4:size
5:vector+vector
6:vector-vector
7:vector*vector (sc)
8:vector*vector
↗q(8:8)
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
vector - show
name: f
Enter=DK ESC=CANCEL
↗f(3.:5.19615)
↗q(8.:8.)
↗q(8:8)
  
```

```

F1- F2- F3- F4- F5- F6- F7- FB
Point Vector Line Plane STD Help fApprox
↔s = (5.x+-3.y+1.=0)
↔t = (2.x+2.y+-6.=0)
↔s ∠ ↔t = 75.9638°
↗e(3.:0.)
↗f(3.:5.19615)
↗q(8.:8.)
↗q(8:8)
↗f = (3:3*√(3))
ANAGEDM DEGAUTO FUNC 0/30
  
```

Ok. It is all right. It was stored correctly. It was only because of approx display mode.

Are vectors e and f linear independent?

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
7:vector*vector (sc)
←s
8:vector*vector
→e(
9:vector*number
→f(
A:vector+|size|
→f(
B:variance
→q(
C:rotation
→q(
D: ? lin. dependent.
→e(
E: v. depend. on 2 v.
→f = (3;3*√(3))
ANAGEDM DEGAUTO FUNC 0/30
  
```

linearly dependent vectors?

vector: e

vector: f

<Enter=OK >ESC=CANCEL

```

→e(3.;0.)
→f(3.;5.19615)
→q(8.;8.)
→q(8;8)
→f = (3;3*√(3))
→e ?1d →f = false
ANAGEDM DEGAUTO FUNC 0/30
  
```

No, they are not. So they can be understood as coordinates.

How you can express vector g by sum of vectors e and f?

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
7:vector*vector (sc)
←s
8:vector*vector
→e(
9:vector*number
→f(
A:vector+|size|
→f(
B:variance
→q(
C:rotation
→q(
D: ? lin. dependent.
→e(
E: v. depend. on 2 v.
→e ?1d →f = false
TYPE OR USE ←→+ (ENTER) OR (ESC)
ANAGEDM DEGAUTO FUNC 0/30
  
```

vector dependent on 2 vectors

target vector: g

1. vector: e

2. vector: f

<Enter=OK >ESC=CANCEL

```

→e(3.;0.)
→f(3.;5.19615)
→q(8.;8.)
→q(8;8)
→f = (3;3*√(3))
→e ?1d →f = false
→g = k1*→e + k2*→f k1,k2=?
ANAGEDM DEGAUTO FUNC 0/30
  
```

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
→e(3.;0.)
→f(3.;5.19615)
→q(8.;8.)
→q(8;8)
→f = (3;3*√(3))
→e ?1d →f = false
→2=(8*√(3)/9-8/3; -8*√(3)/9)
ANAGEDM DEGAUTO FUNC 0/30
  
```

These numbers are coordinates of vector g in the base of vectors e and f. We can turn on approx display mode by pressing F7.

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
→f(3.;5.19615)
→q(8.;8.)
→q(8;8)
→f = (3;3*√(3))
→e ?1d →f = false
→2=(8*√(3)/9-8/3; -8*√(3)/9)
→ k1,k2=C-1.12707; -1.5396)
ANAGEDM DEGAUTO FUNC 0/30
  
```

Rotate vector e so vectors e and f will be linearly dependent.

Ok. But we do not know the angle at this time.

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
7:vector*vector (sc)
←s
8:vector*vector
→e(
9:vector*number
→f(
A:vector+|size|
→e(
B:variance
→q(
C:rotation
→q(
D: ? lin. dependent.
→ k1,k2=C-1.12707; -1.5396)
ANAGEDM DEGAUTO FUNC 0/30
  
```

vector z vector

vector: e

vector: f

<Enter=OK >ESC=CANCEL

```

→e(3.;0.)
→f(3.;5.19615)
→q(8.;8.)
→f = (3;3*√(3))
→e ?1d →f = false
→2=(8*√(3)/9-8/3; -8*√(3)/9)
→ k1,k2=C-1.12707; -1.5396)
→e ∠ →f = 60.°
ANAGEDM DEGAUTO FUNC 0/30
  
```

Ok, it is 60 degrees.

```

F1- F2+ F3+ F4+ F5 F6 F7 FB
Point Vector Line Plane STD Help Approx
5:vector+vector
→q(
6:vector-vector (sc)
→f(
7:vector*vector (sc)
→e(
8:vector*vector
→e(
9:vector*number
→2=(
A:vector+|size|
→q(
B:variance
→q(
C:rotation
→e ∠ →f = 60.°
ANAGEDM DEGAUTO FUNC 0/30
  
```

rotation

vector: e

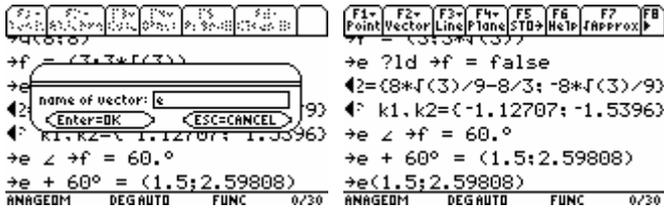
angle: 60

<Enter=OK >ESC=CANCEL

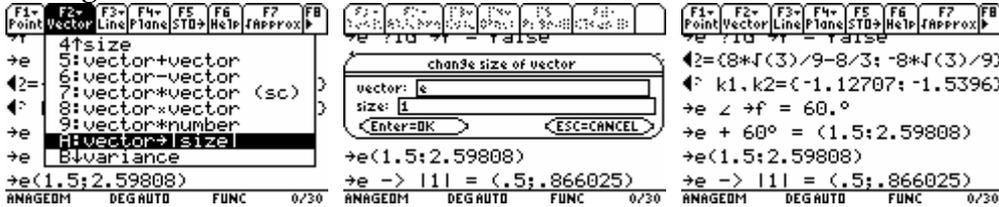
```

→f = (3;3*√(3))
→e ?1d →f = false
→2=(8*√(3)/9-8/3; -8*√(3)/9)
→ k1,k2=C-1.12707; -1.5396)
→e ∠ →f = 60.°
→e + 60° = (1.5;2.59808)
ANAGEDM DEGAUTO FUNC 0/30
  
```

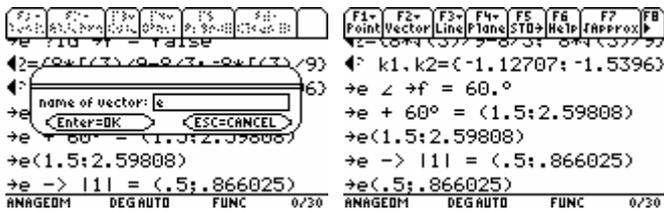
Press F5.



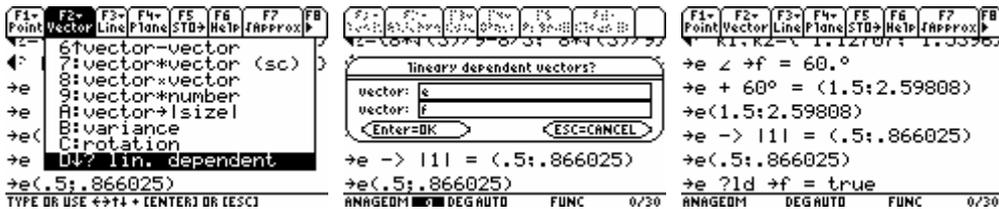
Change the size of vector e to 1.



Press F5.



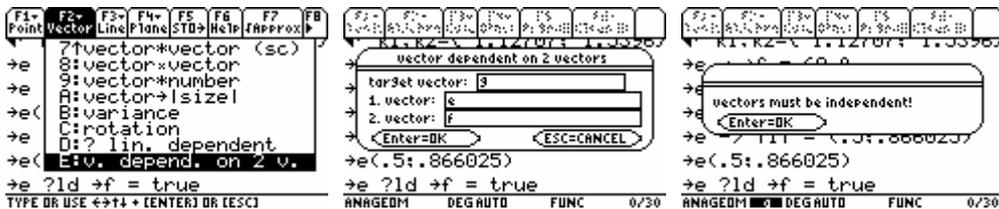
Are vectors e and f linear independent?



Yes, they are. So they cannot be understood as coordinates any more.

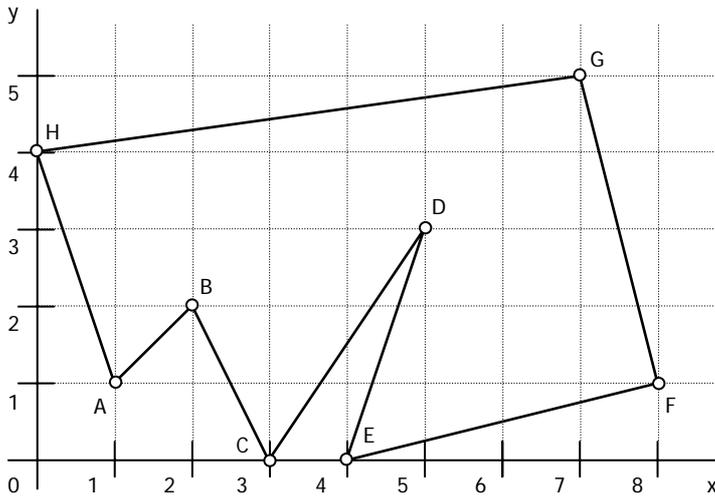
How you can express vector g by sum of vectors e and f ?

It is tricky question because e and f are not coordinates. Let's see:



Exactly as I have said. Press ENTER and ESC.

Start new problem and calculate the area and the centre of gravity of this polygon.



```

F1- F2- F3- F4-
4- Problem Lon3u3e Exit
1:show 1:1270r 1.3396
2:new 30.0
e + 60° = (1.5;2.59808)
e(1.5;2.59808)
e -> |l| = (.5;.866025)
e(.5;.866025)
e ?ld +f = true
ANAGEDM DEGAUTO FUNC 0/30 ANAGEDM DEGAUTO FUNC 0/30
    
```

Enter all points A through H.

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help fApprox
enter point
name: a
x: 1
y: 1
z:
Enter=DK ESC=CANCEL
A[1.;1.]
B[2.;2.]
C[3.;0.]
D[5.;3.]
E[4.;0.]
F[8.;1.]
ANAGEDM DEGAUTO FUNC 0/30 ANAGEDM DEGAUTO FUNC 0/30 ANAGEDM DEGAUTO FUNC 0/30
    
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help fApprox
C[3.;0.]
D[5.;3.]
E[4.;0.]
F[8.;1.]
G[7.;5.]
H[0.;4.]
ANAGEDM DEGAUTO FUNC 0/30
    
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help fApprox
2:show
3:distance 2 points
4:part of abscissa
5:point+vector
6:point-vector
7:centre of gravity
8:area of 3D Δ
9:area of 2D polygon
H[0.;4.]
area ABCDEFGH = 26.
ANAGEDM DEGAUTO FUNC 0/30 ANAGEDM DEGAUTO FUNC 1/30
    
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help fApprox
1:enter [x,y,(z)]
2:show
3:distance 2 points
4:part of abscissa
5:point+vector
6:point-vector
7:centre of gravity
8:area of 3D Δ
area ABCDEFGH = 26.
ANAGEDM DEGAUTO FUNC 1/30
1:enter [x,y,(z)]
2:show
3:distance 2 points
4:part of abscissa
5:point+vector
6:point-vector
7:centre of gravity
8:area of 3D Δ
area ABCDEFGH = 26.
centre of gr. ABCDEFGH = [3.75;2.]
ANAGEDM DEGAUTO FUNC 1/30 ANAGEDM DEGAUTO FUNC 1/30
    
```

```

F1- F2- F3- F4- F5- F6- F7- F8-
Point Vector Line Plane STD Help fApprox
D[5.;3.]
E[4.;0.]
F[8.;1.]
G[7.;5.]
H[0.;4.]
area ABCDEFGH = 26.
gr. ABCDEFGH = [3.75;2.]
ANAGEDM DEGAUTO FUNC 1/30
    
```

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