```
> restart:with(plots):with(linalg);
```

```
Warning, the name changecoords has been redefined

Warning, the protected names norm and trace have been redefined and unprotected
```

[*BlockDiagonal*, *GramSchmidt*, *JordanBlock*, *LUdecomp*, *QRdecomp*, *Wronskian*, *addcol*, *addrow*, *adj*, *adjoint*, *angle*, *augment*, *backsub*, *band*, *basis*, *bezout*, *blockmatrix*, *charmat*, *charpoly*, *cholesky*, *col*, *coldim*, *colspace*, *colspan*, *companion*, *concat*, *cond*, *copyinto*, *crossprod*, *curl*, *definite*, *delcols*, *delrows*, *det*, *diag*, *diverge*, *dotprod*, *eigenvals*, *eigenvalues*, *eigenvectors*, *eigenvects*, *entermatrix*, *equal*, *exponential*, *extend*, *ffgausselim*, *fibonacci*, *forwardsub*, *frobenius*, *gausselim*, *gaussjord*, *geneqns*, *genmatrix*, *grad*, *hadamard*, *hermite*, *hessian*, *hilbert*, *htranspose*, *ihermite*, *indexfunc*, *innerprod*, *intbasis*, *inverse*, *ismith*, *issimilar*, *iszero*, *jacobian*, *jordan*, *kernel*, *laplacian*, *leastsqrs*, *linsolve*, *matadd*, *matrix*, *minor*, *minpoly*, *mulcol*, *mulrow*, *multiply*, *norm*, *normalize*, *nullspace*, *orthog*, *permanent*, *pivot*, *potential*, *randmatrix*, *randvector*, *rank*, *ratform*, *row*, *rowdim*, *rowspace*, *rowspan*, *rref*, *scalarmul*, *singularvals*, *smith*, *stackmatrix*, *submatrix*, *subvector*, *sumbasis*, *swapcol*, *swaprow*, *sylvester*, *toeplitz*, *trace*, *transpose*, *vandermonde*, *vecpotent*, *vectdim*, *vector*, *wronskian*]

First Test, Calculus 2673, 9/20/2006

1.

```
> a:=[1,2,-3]:b:=[-1,3,4]:
```

i.

```
> b1 := dotprod(a,b)/(norm(a,2))^2*a;b2:=b-b1;
```

$$b1 := \left[\frac{-1}{2}, -1, \frac{3}{2}\right]$$

$$b2 := \left[\frac{-1}{2}, 4, \frac{5}{2}\right]$$

```
> dotprod(b1,b2); # check it
```

ii Find the lengt of a+b

```
> norm(a+b,2);
```

$$\begin{matrix} 0 \\ \sqrt{26} \end{matrix}$$

iii. find angle between b and a

```
> arccos(dotprod(a,b)/(norm(a,2)*norm(b,2)));evalf(%);
>
```

$$\pi - \arccos\left(\frac{\sqrt{14}\,\sqrt{26}}{52}\right)$$

$$1.946470418$$

```
> crossprod(a,b); # 4
```

problem II

$$[17, -1, 5]$$

```
> A:=[ 1,1,1];B:=[3,2,1]; C:=[1,2,3];
```

$$A := [1, 1, 1]$$

$$B := [3, 2, 1]$$

$$C := [1, 2, 3]$$

```
> BA:= B-A; CA:= C- A; n:= crossprod(BA,CA);
```

$$BA := [2, 1, 0]$$

$$CA := [0, 1, 2]$$

$$n := [2, -4, 2]$$

Find the equation of the plane .

```
> R:=vector([x,y,z]);
```

$$R := [x, y, z]$$

```
> u:=dotprod(R,n);k :=(dotprod(n,A)); # direction and konstant
```

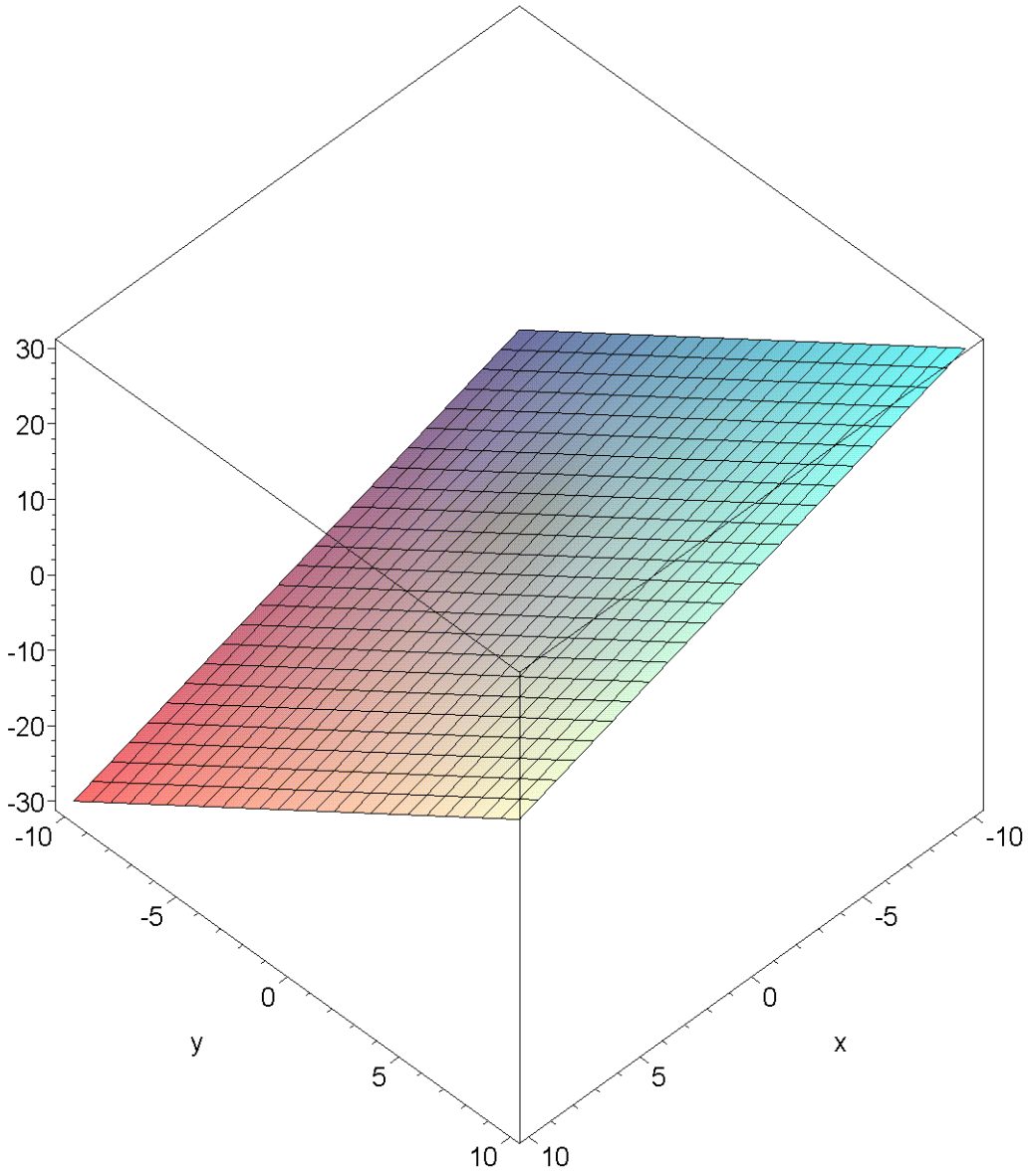
$$u := 2x - 4y + 2z$$

$$k := 0$$

```
> u = k; # equation of the  plane
```

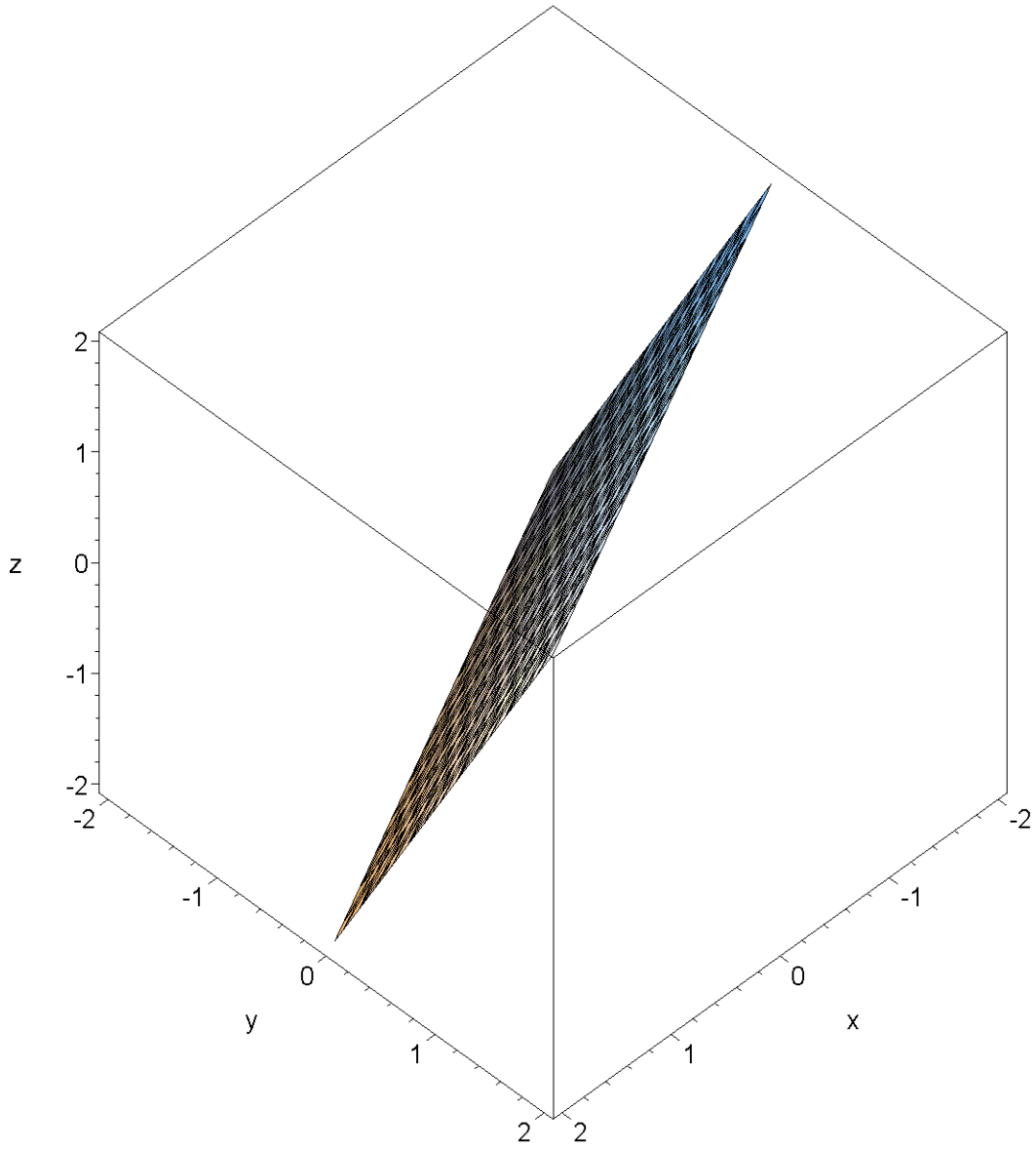
$$2x - 4y + 2z = 0$$

```
> plot3d(2*y-x,x=-10..10,y=-10..10,axes = boxed);# plot it
```




```
> Warning, the protected names norm and trace have been redefined and unprotected
```

```
> implicitplot3d(2*x-4*y+2*z=0, x=-2..2, y=-2..2, z=-2..2,
  axes=boxed);
```



2. a plane through (1,1,2) and perpendicular to the line

```
> n:=[1,1/2,1/3]; # normal vector of plane
```

$$n := \left[1, \frac{1}{2}, \frac{1}{3}\right]$$

```
> P:=[1,1,2];R:=vector([x,y,z]):#P is the point
```

$$P := [1, 1, 2]$$

```
> u:=dotprod(R,n);k :=dotprod(n,P);
```

$$u := x + \frac{y}{2} + \frac{z}{3}$$

$$k := \frac{13}{6}$$

```
> u=k; # equation of  plane
```

$$x + \frac{y}{2} + \frac{z}{3} = \frac{13}{6}$$

3 find the point of intersection

```
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```

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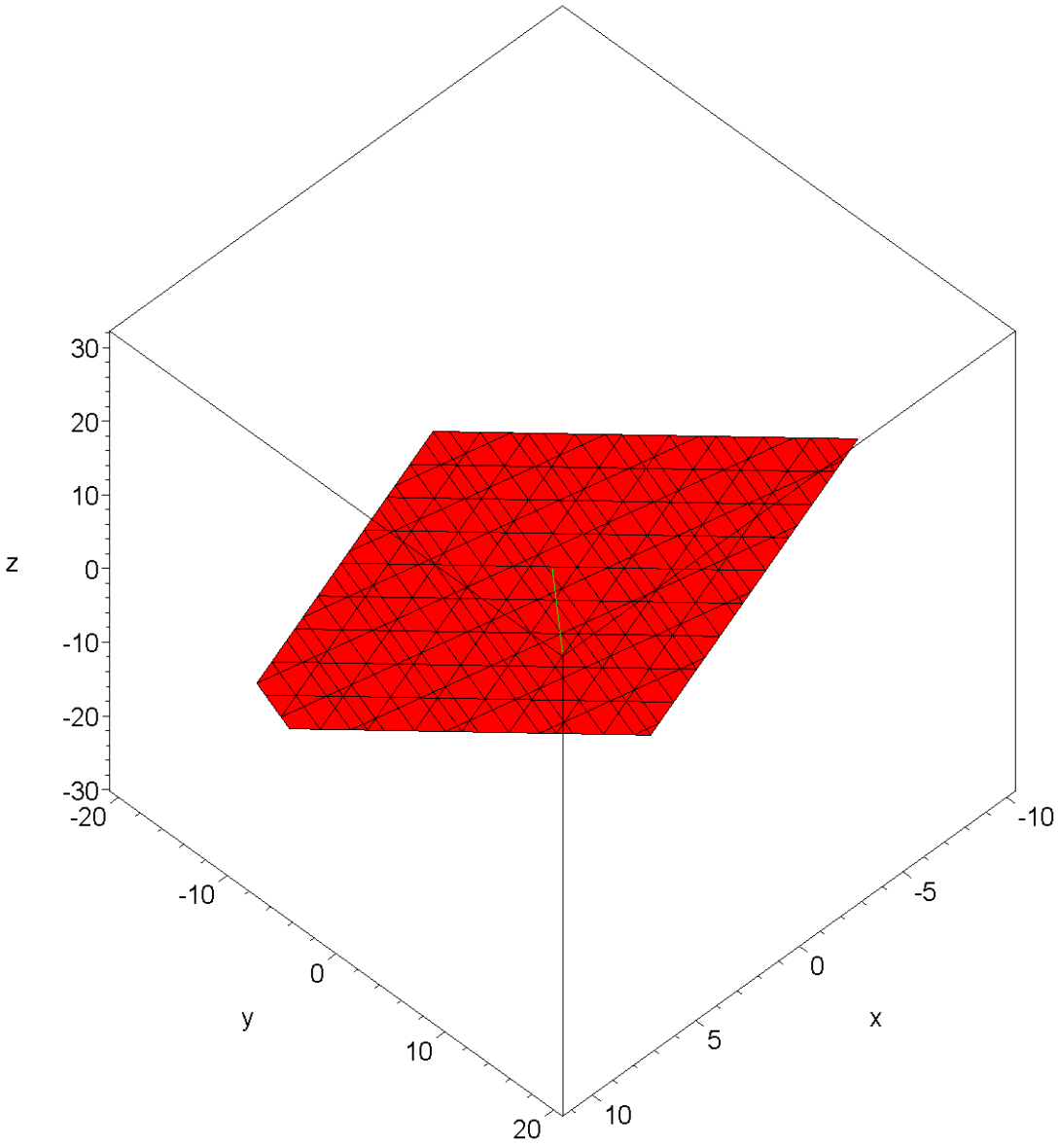
```

$$7\,t + 3 = 3$$

```
> plot1 :=implicitplot3d( 2*x + y + z=3, x= -10..10, y= -10..10,z=
  -10..10,color = red,axes = boxed):
 > line1:=spacecurve([t+1,2*t,3*t+1],t=-10..10,color=green,axes=box):
```

```
> display3d(plot1,line1); # ok now the point
```




```
> subs( x=t+1,y=2*t,z=3*t+1, 2*x+y+z=3);solve(%,t);
```

$$7\,t + 3 = 3$$

$$0$$

4. Find the parametric equation of the line through (-1,2,4) and (1,2,1)

```
> p:=[-1,2,4]:q:=[1,2,1]:
> lvex:=t*(p-q) + p;
```

$$lvex := t\,[-2, 0, 3] + [-1, 2, 4]$$

III Sketch

$$n := [3, 6, 2]$$

```
> restart:with(plots):with(linalg):
```

```
implicitplot3d(x^2+y^2+z^2
-4*x-4*z=0,x=-6..6,y=-6..6,z=-6..6,color = red,axes = boxed);
```

```
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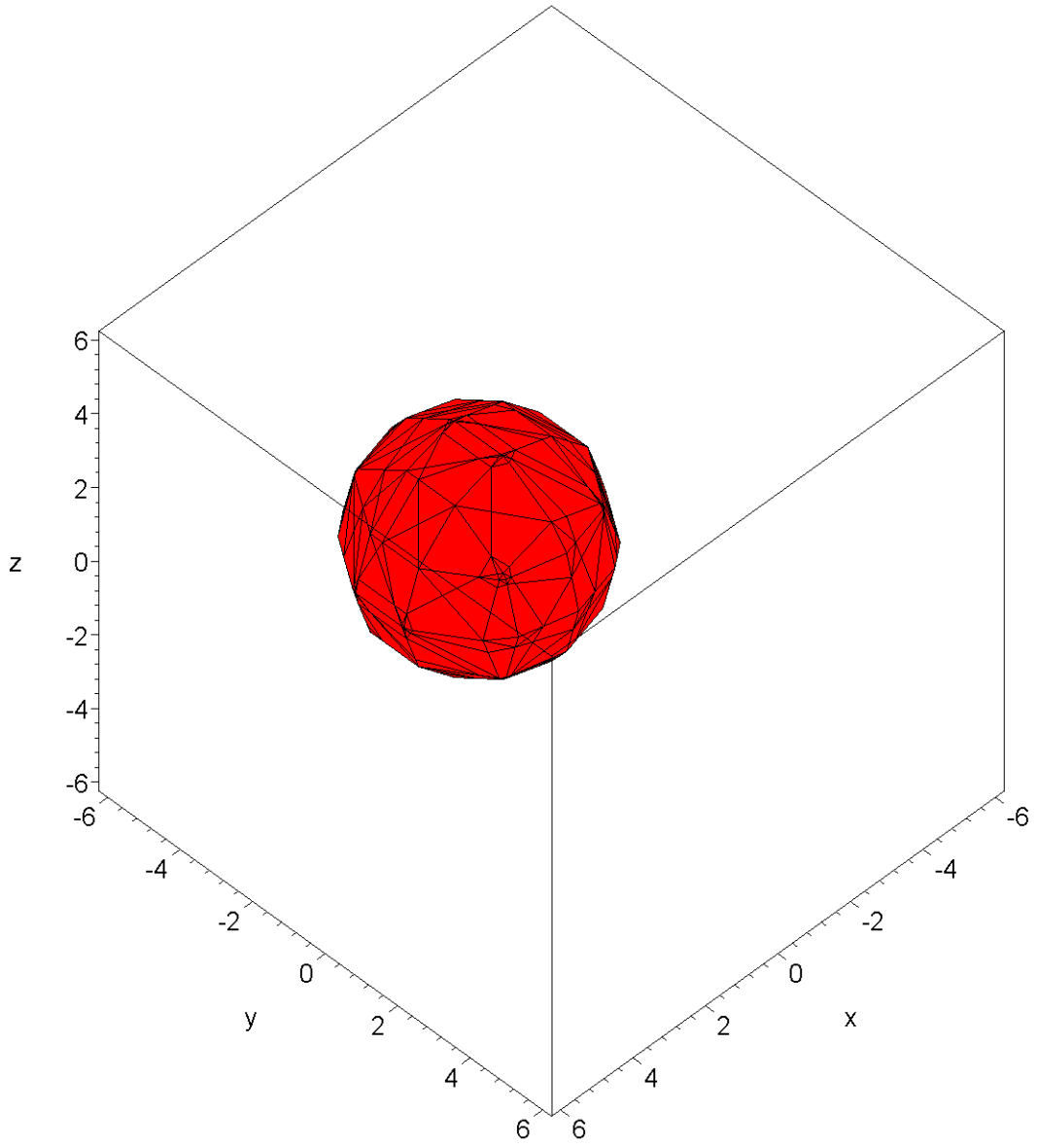
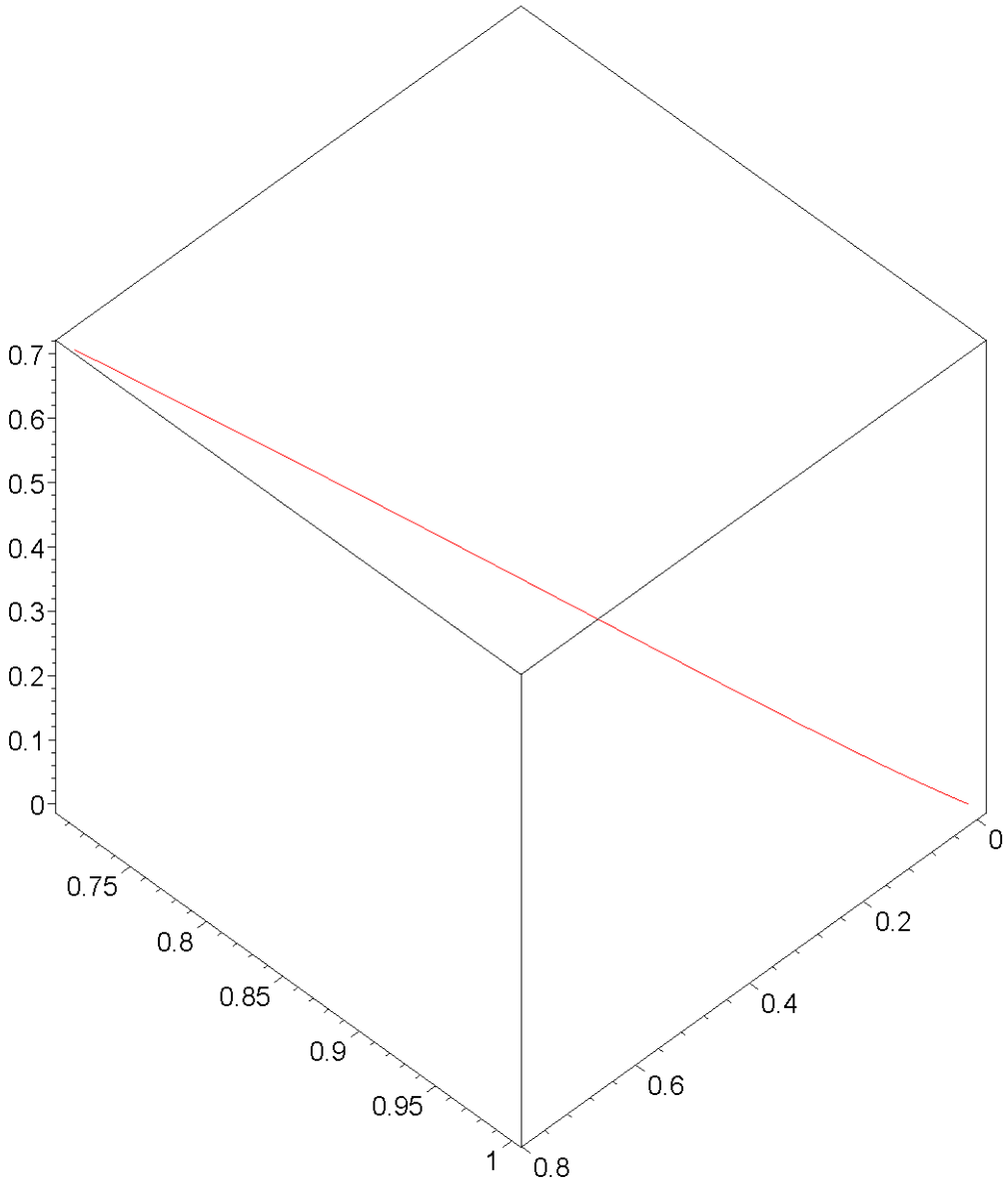
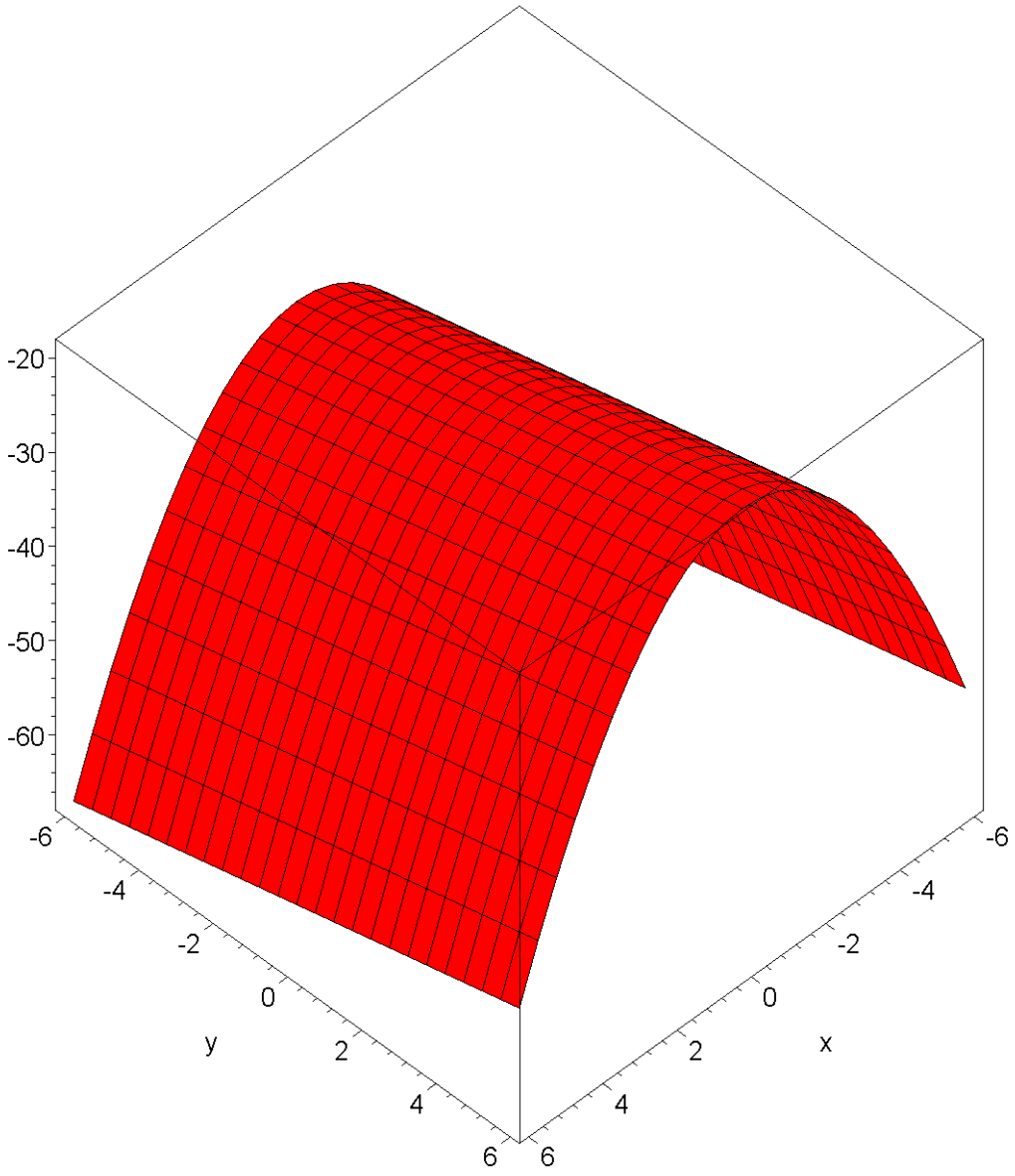
```



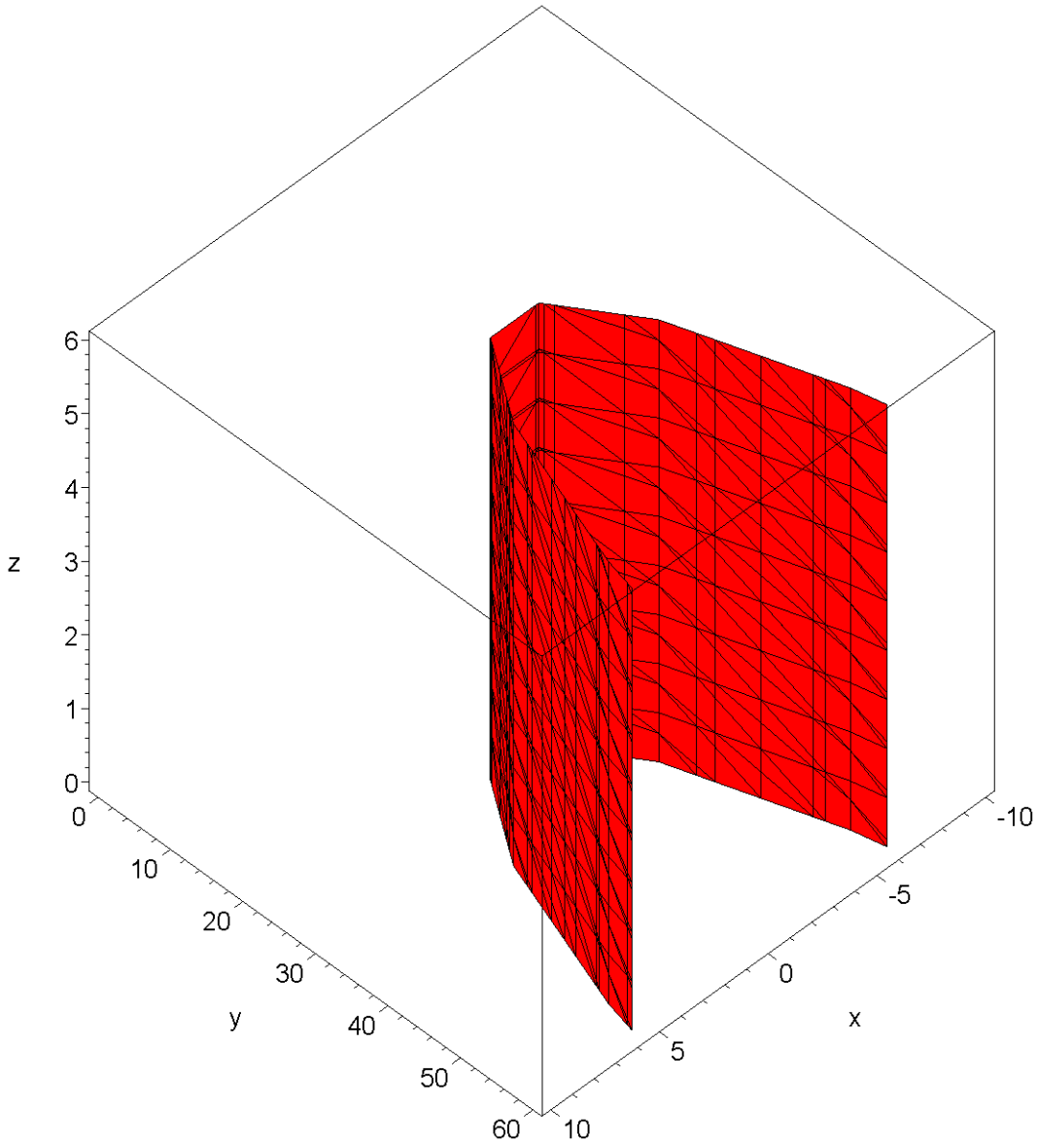

```
> spacecurve([t,cos(t),sin(t)],t=0..Pi/4,color=red,axes=box);
```




```
> plot3d(-x^2+y-25,x=-6..6,y=-6..6,color = red,axes = boxed);
```




```
> implicitplot3d(y - x^2 = 25, x= -10..10, y= 0..60, z= 0 .. 6,color
  = red,axes = boxed);
```



IV

```
> r:= t -> [4*cos(t),4*sin(t),t];
```

$$r := t \to [4\cos(t), 4\sin(t), t]$$

```
> v:=  map((diff,r(t),t));
```

$$v := [-4\sin(t), 4\cos(t), 1]$$

```
> a:= map(diff,v,t);
>
```

$$a := [-4\cos(t), -4\sin(t), 0]$$

```
> T:= v/17;
```

$$T := \left[-\frac{4}{17}\sin(t), \frac{4}{17}\cos(t), \frac{1}{17} \right]$$

```
> N:= map(diff,T,t);
```

$$N := \left[-\frac{4}{17}\cos(t), -\frac{4}{17}\sin(t), 0 \right]$$

```
> point0:=r(Pi/4); # last problem
```

$$point0 := \left[2\sqrt{2}, 2\sqrt{2}, \frac{\pi}{4} \right]$$

```
> vector0:= subs(t=Pi/4,T);
```

$$vector0 := \left[-\frac{4}{17}\sin\left(\frac{\pi}{4}\right), \frac{4}{17}\cos\left(\frac{\pi}{4}\right), \frac{1}{17} \right]$$

```
> answer:= vector0*t + point0;
```

$$answer := \left[-\frac{2\sqrt{2}}{17}, \frac{2\sqrt{2}}{17}, \frac{1}{17} \right] t + \left[2\sqrt{2}, 2\sqrt{2}, \frac{\pi}{4} \right]$$

```
>
>
>
```