```
> restart:with(plots):
  with(student):with(linalg):Digits := 4:
Warning, the name changecoords has been redefined
Warning, the protected names norm and trace have been redefined and unprotected
```

sample questions First Test, Calculus 2673, 9/20/2005

1. i

```
> a:= vector([1,0,1]):b:=vector([1,1,1]):
```

i.

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

$$b1 := [1, 0, 1]$$

ii

```
> b2:=evalm(b-b1);
```

$$b2 := [0, 1, 0]$$

for part iii

```
> theta:= evalf (arccos(dotprod(a,b)/(norm(a,2)*norm(b,2)))/Pi);
```

$$\theta := 0.1960$$

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

2. Find the equation of the plane that contains (1,0,-1) and is parallel to x+y+z=4.

```
> a:= vector([1,0,-1]);n:= vector([1,1,1]);# n for normalto the   plane
```

$$a := [1, 0, -1]$$

$$n := [1, 1, 1]$$

```
> R:=vector([x,y,z]);# template to pick up the varaibles
```

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

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

$$u := x + y + z$$

$$k := 0$$

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

$$x + y + z = 0$$

3. Find the equation of the line trhough (-1,-2,4) and (4,2,1) .

```
> a:= (1,0,-1);b:= (4,2,1); #  point in the  plane
```

$$a := 1, 0, -1$$

$$b := 4, 2, 1$$

```
> ba:= eval([b-a]); v:=vector(ba);
```

$$ba := [3, 2, 2]$$

$$v := [3, 2, 2]$$

```
> l:=evalm([1,0,-1]+t*v);
```

$$l := [1 + 3\,t, 2\,t, -1 + 2\,t]$$

4 1. Find the equation of the plane .

```
> a:=[0,0,0];b:=[1,1,1]; c:=[1,2,3];#  points in the  plane
```

$$a := [0, 0, 0]$$

$$b := [1, 1, 1]$$

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

```
> ba := b-a; bc:= b-c;  n:=crossprod(ba,bc); # normal of 2 vectors in the
  plane
```

$$ba := [1, 1, 1]$$

$$bc := [0, -1, -2]$$

$$n := [-1, 2, -1]$$

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

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

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

$$u := -x + 2\,y - z$$

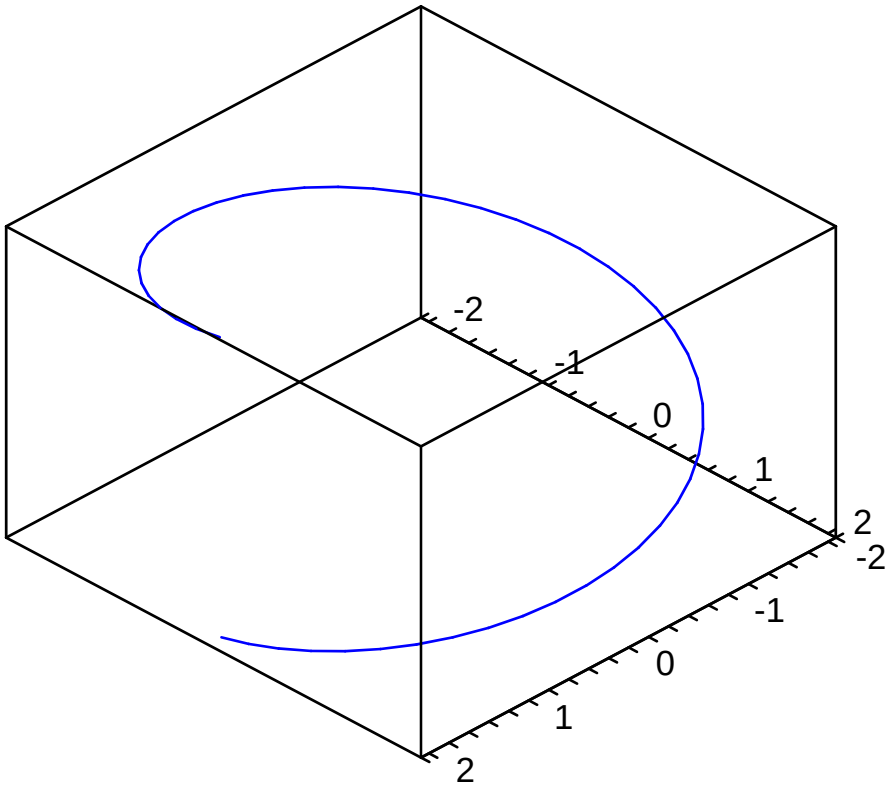
$$k := 0$$

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

$$-x + 2\,y - z = 0$$

Ex 5

```
> spacecurve( [2*cos(t),2*sin(t),t],t = 0 .. 2*Pi,color=blue,axes=boxed);
```




```
> r := t -> vector([2*cos(t),2*sin(t),t]);
  rt:=  t ->  vector([-2*sin(t),2*cos(t),1]);rtt:= t ->
  vector([-2*cos(t),-2*sin(t),0]);
```

$$r := t \to [2\cos(t), 2\sin(t), t]$$

$$rt := t \to [-2\sin(t), 2\cos(t), 1]$$

$$rtt := t \to [-2\cos(t), -2\sin(t), 0]$$

```
> vt:= t -> (sqrt((-2*sin(t))^2+(2*cos(t))^2 +1)); # sqrt(5)
```

$$vt := t \to \sqrt{4\sin(t)^2 + 4\cos(t)^2 + 1}$$

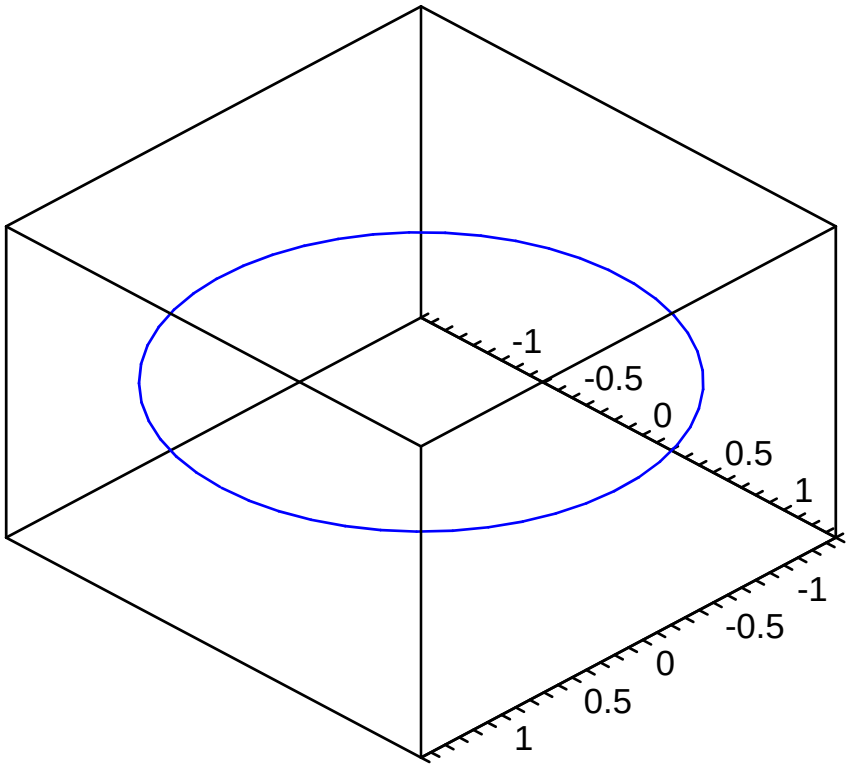
```
> T := t -> rt(t)/sqrt(5);
```

$$T := t \to \frac{rt(t)}{\sqrt{5}}$$

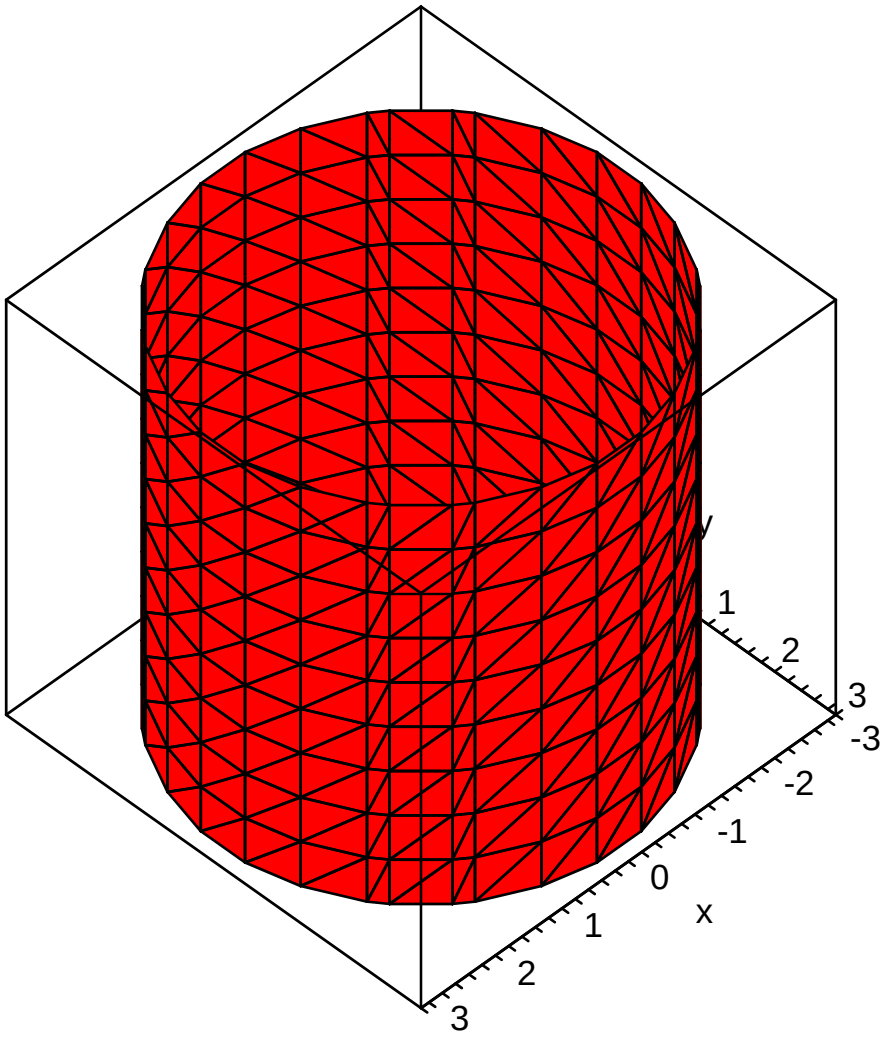
```
>
```

$$Tt := t \to eval(d(eval(T(t))))$$

```
> #Ex 11
> spacecurve( [sqrt(2)*cos(t),sqrt(2)*sin(t),0],t = 0 ..
  2*Pi,color=blue,axes=boxed);
```




```
> implicitplot3d( x^2+y^2-9=0, x= -3 .. 3,y=-3 .. 3, z=-3 ..3,color = red,
  axes = boxed); #ex 12
```




```
> #13
> x:=t +1;y:=2*t;z:=3*t; L: t -> [x,y,z];
```

$$x := t + 1$$

$$y := 2\,t$$

$$z := 3\,t$$

$$t \to [x, y, z]$$

```
> eq := x+y+z=1;
> solve(eq,t); # answer in t
```

$$eq := 6\,t + 1 = 1$$

$$0$$

```
> # so the point is (1,0,0)
> #14
```

idea is to find the line perp to the plane through the origin, get it's intersection P in the plane then measure that distance d(O,P) to the origin

```
> n:=[1,2,2]; OO:=[0,0,0]; L:= t -> t*n;
```

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

$$OO := [0, 0, 0]$$

$$L := t \to t\, n$$

```
> x:=1*t;y:=2*t;z:=3*t; # line through origin
```

$$x := t$$

$$y := 2\, t$$

$$z := 3\, t$$

```
> eq := x+2*y+2*z=6;solve(eq,t); # find interesction with plane
```

$$eq := 11\, t = 6$$

$$\frac{6}{11}$$

```
> L(%); # the point  of intersection
```

$$\left[\frac{6}{11}, \frac{12}{11}, \frac{12}{11}\right]$$

```
> norm(%,2); # the answer
```

$$\frac{18}{11}$$