(i) If $C \neq 0$, then the equation becomes

$$B\left(y+\frac{D}{2B}\right)^2 = -C\left(x-\frac{E}{C}+\frac{D^2}{4BC}\right),$$

which is a parabola.

(ii) If $C = 0$, then the equation is

$$\left(y+\frac{D}{2B}\right)^2 = N,$$

where $N = \frac{-E}{B} + \frac{D^2}{4B^2}$.

(a) If N is positive, the graph is two lines.

(b) If N is zero, the graph is a point.

(c) If N is negative, there is no graph.

(3) ($A \neq 0$ and $B = 0$) This is similar to case (2) and we leave the analysis as an exercise.

(4) ($A = 0$ and $B = 0$) Equation (4.1) in this case reduces to

$$Cx + Dy + E = 0,$$

which is a line or all of $\mathbb{R}^2$.

The code for this procedure then would be the following:

Code for Classifying Conic Sections

```
conics:=proc(A,B,C,D,E)
  local N,M,ans;
  if A<>0 and B<>0 then
       M:=evalf((B*C^2+A*D^2-4*E*A*B)/(4*A*B));
       if M=0 then
            if A*B>0 then ans:= "point"
            else ans:="two lines"
            end if;
       elif M<>0 then
         if (M/A)>0 and (M/B)>0 then  ans:="ellipse"
         elif (M/A)<0 and (M/B)<0 then ans:="no graph"
         else ans:="hyperbola"
```