

```

program movimiento_en_campo_gravitatorio;
{C lculo en tiempo real: aceleracion centripeta y descomposicion
cartesiana}
{Primera y segunda ley de Kepler}
{Movimientos de los 4 planetas interiores}
{Mas un cometa de corto periodo y Jupiter como limite}
{tiempo aconsejable const t=500 o menor}
uses
  Crt, Graph;
const
  t=500; {constantes generales}
  pi=3.141592653598793;
  g=6.67392E-11; {6.6719199 Investig y Ciencia 6.67384E-11 wiki
6.67392 IAC}
  m=1.9891E+30;
  e1=150/2E+11; {factor de escala: hasta la rbita de marte}
  e2=150/5E+11; {factor de escala: hasta la rbita de
Jupiter}
var
  GraphDriver : integer; { The Graphics device driver }
  GraphMode : integer; { The Graphics mode value }
  MaxX, MaxY : word; { The maximum resolution of the screen }
  ErrorCode : integer; { Reports any graphics errors }
  OldExitProc : Pointer; { Saves exit procedure address }

  ame, axme, ayme, rme0, rxme0, ryme0, vxme0, vyme0, phyme0, psime:real;
{mercurio}
  a, ax, ay, r0, rx0, ry0, vx0, vy0, phy0, psi:real;
{tierra}
  av, axv, ayv, rv0, rxv0, ryv0, vxv0, vyv0, phyv0, psiv:real; {venus}
  ama, axma, ayma, rma0, rxma0, ryma0, vxma0, vyma0, phyma0, psima:real; {marte}
 aju, axju, ayju, rju0, rxju0, ryju0, vxju0, vyju0, phyju0, psiju:real;
{jupiter}
  aas, axas, ayas, ras0, rxas0, ryas0, vxas0, vyas0, phyas0, psias:real;
{asteroid1}
  aas2, axas2, ayas2, ras20, rxas20, ryas20, vxas20, vyas20, phyas20, psias2:real;
{asteroid1}
  t:integer;
  tt:real;
{$F+}
procedure MyExitProc;
begin
  ExitProc := OldExitProc; { Restore exit procedure address }
  CloseGraph; { Shut down the graphics system }
end; { MyExitProc }
{$F-}

procedure Inicia_modos_grafico;
{ Inicializa el modo grafico e informa de los errores que puedan ocurrir}
var
  InGraphicsMode : boolean; { Flags initialization of graphics mode }
  PathToDriver : string; { Stores the DOS path to *.BGI & *.CHR }
begin
  { when using Crt and graphics, turn off Crt's memory-mapped writes }
  DirectVideo := False;
  OldExitProc := ExitProc; { save previous exit proc }
  ExitProc := @MyExitProc; { insert our exit proc in chain }
}

```

```

PathToDriver := '';
repeat

{$IFDEF Use8514}                                { check for Use8514 $DEFINE }
    GraphDriver := IBM8514;
    GraphMode := IBM8514Hi;
{$ELSE}
    GraphDriver := Detect;                        { use autodetection }
{$ENDIF}

    InitGraph(GraphDriver, GraphMode, PathToDriver);
    ErrorCode := GraphResult;                    { preserve error return }
    if ErrorCode <> grOK then                     { error? }
    begin
        Writeln('Graphics error: ', GraphErrorMsg(ErrorCode));
        if ErrorCode = grFileNotFound then { Can't find driver file }
        begin
            Writeln('Enter full path to BGI driver or type <Ctrl-Break> to
quit:');
            Readln(PathToDriver);
            Writeln;
        end
        else
            Halt(1);                             { Some other error: terminate }
        end;
    until ErrorCode = grOK;
    MaxX := GetMaxX;                             { Get screen resolution values }
    MaxY := GetMaxY;
end; { Initialize }

procedure dibuja_los_ejes;
begin
    { ejes }
    SetLineStyle(DottedLn,0,NormWidth);
    SetColor(4);
    Line(MaxX div 2,MaxY div 2 +230,MaxX div 2,MaxY div 2 -230);{
vertical }
    Line(MaxX div 2 -310,MaxY div 2,MaxX div 2 +310,MaxY div 2);{
horizontal }
    { sol }
    SetLineStyle(SolidLn,0,NormWidth);setColor(14);
    Line(MaxX div 2,MaxY div 2 +6,MaxX div 2,MaxY div 2 -6);
    Line(MaxX div 2 -4,MaxY div 2,MaxX div 2 +4,MaxY div 2);
    PutPixel(MaxX div 2 +6, MaxY div 2, 15);
    PutPixel(MaxX div 2 -6, MaxY div 2, 15);
    PutPixel(MaxX div 2, MaxY div 2 +9, 15);
    PutPixel(MaxX div 2, MaxY div 2 -9, 15);
    PutPixel(MaxX div 2 +1, MaxY div 2 +1, 15);
    PutPixel(MaxX div 2 +1, MaxY div 2 -1, 15);
    PutPixel(MaxX div 2 -1, MaxY div 2 +1, 15);
    PutPixel(MaxX div 2 -1, MaxY div 2 -1, 15);
    PutPixel(MaxX div 2 +3, MaxY div 2 +3, 15);
    PutPixel(MaxX div 2 +3, MaxY div 2 -3, 15);
    PutPixel(MaxX div 2 -3, MaxY div 2 +3, 15);
    PutPixel(MaxX div 2 -3, MaxY div 2 -3, 15);
end;

procedure presentacion;

```

```

begin
  SetTextStyle(TriplexFont,0,3);SetTextJustify(CenterText,CenterText);
  SetColor(15);OutTextXY(310,70,'GRAVITY');
  OutTextXY(320,200,'Estudio del movimiento de');
  OutTextXY(320,230,'objetos celestes alrededor del sol');
  SetColor(4);
  OutTextXY(540,410,'Pulsa Enter');
  Readln;ClearViewPort;
end;
procedure DatosIniciales;
begin
  rx0:=0;ry0:=1.49598E+11;           {tierra}
  r0:=ry0;
  vx0:=-29786;vy0:=0;

  rxme0:=0;ryme0:=5.909175E+10;     {mercurio}
  rme0:=ryme0;
  vxme0:=-47872.5;vyme0:=0;

  rxv0:=0;ryv0:=1.08209E+11;        {venus}
  rv0:=ryv0;
  vxv0:=-35021;vyv0:=0;

  rxma0:=0;ryma0:=2.27936640E+11;    {marte}
  rma0:=ryma0;
  vxma0:=-24133.023;vyma0:=0; {rapido 24131 con 1s 24132.38}

  rxju0:=0;ryju0:=7.78412E+11;      {jupiter}
  rju0:=ryju0;
  vxju0:=-13069;vyju0:=0;

  rxas0:=2.27936E+11;ryas0:=0;       {asteroide1 2.27936E+11}
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
  vxas0:=0;vyas0:=19000;            {18000}

  {rxas0:=2.27936E+11;ryas0:=0;      elipse grande
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
  vxas0:=0;vyas0:=27000; }

  {rxas0:=5*2.27936E+11;ryas0:=2.27936E+11;parabolico
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
  vxas0:=-10000;vyas0:=0; }

  {rxas0:=5*2.27936E+11;ryas0:=2.27936E+11;hiperbolico
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
  vxas0:=-30000;vyas0:=0; }

  rxas20:=(5.57936E+11)/sqrt(2);ryas20:=-rxas20;{asteroide2}
  ras20:=5.57936E+11;
  vxas20:=11000/sqrt(2);vyas20:=vxas20;{-45 grados}
end;
procedure calcula_phy;{Angulo del radio vector}
begin
  if (ry0>0)and(rx0>0)then phy0:=arctan(ry0/rx0);
{tierra}
  if (ry0>0)and(rx0<0)then phy0:=arctan(ry0/rx0)+pi;
  if (ry0<0)and(rx0<0)then phy0:=arctan(ry0/rx0)+pi;
  if (ry0<0)and(rx0>0)then phy0:=arctan(ry0/rx0);

```

```

        if (ryme0>0) and (rxme0>0) then phy0:=arctan(ryme0/rxme0);
{mercurio}
        if (ryme0>0) and (rxme0<0) then phy0:=arctan(ryme0/rxme0)+pi;
        if (ryme0<0) and (rxme0<0) then phy0:=arctan(ryme0/rxme0)+pi;
        if (ryme0<0) and (rxme0>0) then phy0:=arctan(ryme0/rxme0);

        if (ryv0>0) and (rxv0>0) then phyv0:=arctan(ryv0/rxv0);
{venus}
        if (ryv0>0) and (rxv0<0) then phyv0:=arctan(ryv0/rxv0)+pi;
        if (ryv0<0) and (rxv0<0) then phyv0:=arctan(ryv0/rxv0)+pi;
        if (ryv0<0) and (rxv0>0) then phyv0:=arctan(ryv0/rxv0);

        if (ryma0>0) and (rxma0>0) then phyma0:=arctan(ryma0/rxma0);
{marte}
        if (ryma0>0) and (rxma0<0) then phyma0:=arctan(ryma0/rxma0)+pi;
        if (ryma0<0) and (rxma0<0) then phyma0:=arctan(ryma0/rxma0)+pi;
        if (ryma0<0) and (rxma0>0) then phyma0:=arctan(ryma0/rxma0);

        if (ryju0>0) and (rxju0>0) then phyju0:=arctan(ryju0/rxju0);
{jupiter}
        if (ryju0>0) and (rxju0<0) then phyju0:=arctan(ryju0/rxju0)+pi;
        if (ryju0<0) and (rxju0<0) then phyju0:=arctan(ryju0/rxju0)+pi;
        if (ryju0<0) and (rxju0>0) then phyju0:=arctan(ryju0/rxju0);

        if (ryas0>0) and (rxas0>0) then phyas0:=arctan(ryas0/rxas0);
{aster1}
        if (ryas0>0) and (rxas0<0) then phyas0:=arctan(ryas0/rxas0)+pi;
        if (ryas0<0) and (rxas0<0) then phyas0:=arctan(ryas0/rxas0)+pi;
        if (ryas0<0) and (rxas0>0) then phyas0:=arctan(ryas0/rxas0);

        if (ryas20>0) and (rxas20>0) then
phyas20:=arctan(ryas20/rxas20);{ast2}
        if (ryas20>0) and (rxas20<0) then phyas20:=arctan(ryas20/rxas20)+pi;
        if (ryas20<0) and (rxas20<0) then phyas20:=arctan(ryas20/rxas20)+pi;
        if (ryas20<0) and (rxas20>0) then phyas20:=arctan(ryas20/rxas20);
    end;
procedure dibuja_planeta(x,y,c:integer);
begin
    PutPixel(MaxX div 2 +x, MaxY div 2 +y, c);
    PutPixel(MaxX div 2 +x+2, MaxY div 2 +y, c);
    PutPixel(MaxX div 2 +x, MaxY div 2 +y+2, c);
    PutPixel(MaxX div 2 +x-2, MaxY div 2 +y, c);
    PutPixel(MaxX div 2 +x, MaxY div 2 +y-2, c);
end;
procedure borra_planeta(x,y,c:integer);
begin
    PutPixel(MaxX div 2 +x, MaxY div 2 +y, c);
    PutPixel(MaxX div 2 +x+2, MaxY div 2 +y, 0);
    PutPixel(MaxX div 2 +x, MaxY div 2 +y+2, 0);
    PutPixel(MaxX div 2 +x-2, MaxY div 2 +y, 0);
    PutPixel(MaxX div 2 +x, MaxY div 2 +y-2, 0);
end;
procedure sistema;
begin
    calcula_phy;

    r0:=sqrt(rx0*rx0+ry0*ry0);
{Tierra}

```

```

a:=g*m/(r0*r0);psi:=phy0+pi;    {acel g solar en la Tierra}
if psi>2*pi then psi:=psi-2*pi;
ax:=a*cos(psi);ay:=a*sin(psi); {coord rectagulares de ac central}
borra_planeta(round(rx0*e2*0.8), -round(ry0*e2), 3);
rx0:=rx0+vx0*t+(ax*t*t)/2;ry0:=ry0+vy0*t+(ay*t*t)/2; {mrua}
vx0:=vx0+ax*t;vy0:=vy0+ay*t;
dibuja_planeta(round(rx0*e2*0.8), -round(ry0*e2), 15);

{rme0:=sqrt(rxme0*rxme0+ryme0*ryme0);} {Mercurio}
rme0:=5.909175E+10;{algo de correccion para no agrandar}
ame:=g*m/(rme0*rme0);psime:=phyme0+pi;{acel g solar en Mercurio}
if psime>2*pi then psime:=psime-2*pi;
axme:=ame*cos(psime);ayme:=ame*sin(psime);{cartesianas de g}
borra_planeta(round(rxme0*e2*0.8), -round(ryme0*e2), 7);

rxme0:=rxme0+vxme0*t+(axme*t*t)/2;ryme0:=ryme0+vyme0*t+(ayme*t*t)/2;
vxme0:=vxme0+axme*t;vyme0:=vyme0+ayme*t;
dibuja_planeta(round(rxme0*e2*0.8), -round(ryme0*e2), 15);

rv0:=sqrt(r xv0*rxv0+ryv0*ryv0);    {Venus}
av:=g*m/(rv0*rv0);psiv:=phyv0+pi;{acel g solar en Venus}
if psiv>2*pi then psiv:=psiv-2*pi;
axv:=av*cos(psiv);ayv:=av*sin(psiv);{cartesianas de g}
borra_planeta(round(rxv0*e2*0.8), -round(ryv0*e2), 6);
rxv0:=rxv0+vxv0*t+(axv*t*t)/2;ryv0:=ryv0+vyv0*t+(ayv*t*t)/2;
vxv0:=vxv0+axv*t;vyv0:=vyv0+ayv*t;
dibuja_planeta(round(rxv0*e2*0.8), -round(ryv0*e2), 14);

rma0:=sqrt(rxma0*rxma0+rma0*rma0);    {Marte}
ama:=g*m/(rma0*rma0);psima:=phyma0+pi;{acel g solar en Marte}
if psima>2*pi then psima:=psima-2*pi;
axma:=ama*cos(psima);ayma:=ama*sin(psima);{cartesianas de g}
borra_planeta(round(rxma0*e2*0.8), -round(ryma0*e2), 4);

rxma0:=rxma0+vxma0*t+(axma*t*t)/2;rma0:=rma0+vyma0*t+(ayma*t*t)/2;
vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;
dibuja_planeta(round(rxma0*e2*0.8), -round(ryma0*e2), 12);

rju0:=sqrt(rxju0*rxju0+ryju0*ryju0);    {Jupiter}
aju:=g*m/(rju0*rju0);psiju:=phyju0+pi;{acel g solar en Jupiter}
if psiju>2*pi then psiju:=psiju-2*pi;
axju:=aju*cos(psiju);ayju:=aju*sin(psiju);{cartesianas de g}
borra_planeta(round(rxju0*e2*0.8), -round(ryju0*e2), 7);

rxju0:=rxju0+vxju0*t+(axju*t*t)/2;ryju0:=ryju0+vyju0*t+(ayju*t*t)/2;
vxju0:=vxju0+axju*t;vyju0:=vyju0+ayju*t;
dibuja_planeta(round(rxju0*e2*0.8), -round(ryju0*e2), 15);

ras20:=sqrt(r xas20*rxas20+ryas20*ryas20);    {asteroide2}
aas2:=g*m/(ras20*ras20);psias2:=phyas20+pi;{acel g solar en
asteroide2}
if psias2>2*pi then psias2:=psias2-2*pi;
axas2:=aas2*cos(psias2);ayas2:=aas2*sin(psias2);{cartesianas de
g}
borra_planeta(round(r xas20*rxas20*0.8), -round(ryas20*e2), 1);

```

```

rxas20:=rxas20+vxas20*t+(axas2*t*t)/2;ryas20:=ryas20+vyas20*t+(ayas2*t*t)
/2;
    vxas20:=vxas20+axas2*t;vyas20:=vyas20+ayas2*t;
    dibuja_planeta(round(rxas20*e2*0.8), -round(ryas20*e2), 14);
end;
procedure eliptica2;
var x1,x2,x3,y1,y2,y3:integer;
begin
    calcula_phy;
    rma0:=sqrt(rxma0*rxma0+ryma0*ryma0); {marte}
    ama:=g*m/(rma0*rma0);psima:=phyma0+pi; {acel solar en Marte}
    if psima>2*pi then psima:=psima-2*pi; {ang acel opuesto a v
posicion}
    axma:=ama*cos(psimas);ayma:=ama*sin(psimas);{cartesianas acel
solar}
    borra_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 4);

rxma0:=rxma0+vxma0*t+(axma*t*t)/2;ryma0:=ryma0+vyma0*t+(ayma*t*t)/2;
vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;{ecs MRUA}
dibuja_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 15);

    ras0:=sqrt(rxas0*rxas0+ryas0*ryas0); {asteroide1}
    aas:=g*m/(ras0*ras0);psias:=phyas0+pi; {acel solar en asteroide1}
    if psias>2*pi then psias:=psias-2*pi; {ang acel opuesto a v
posicion}
    axas:=aas*cos(psias);ayas:=aas*sin(psias);{cartesianas acel
solar}
    borra_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 6);

rxas0:=rxas0+vxas0*t+(axas*t*t)/2;ryas0:=ryas0+vyas0*t+(ayas*t*t)/2;
vxas0:=vxas0+axas*t;vyas0:=vyas0+ayas*t;{ecs MRUA}
{0.85 en x correccion ovalo} {Graficos descomposicion
acel}
    x1:=round(rxas0*e1*0.8);y1:=round(ryas0*e1);
    x2:=round(rxas0*e1*0.8+axas*4500);y2:=round(ryas0*e1+ayas*4500);

x3:=round(rxas0*e1*0.8+vxas0/1500);y3:=round(ryas0*e1+vyas0/1500);
    SetColor(14);SetLineStyle(DottedLn,0,NormWidth);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y1);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x1,MaxY div 2-y2);
    SetColor(1);
    line(MaxX div 2+x1,MaxY div 2-y2,MaxX div 2+x2,MaxY div 2-y2);
    line(MaxX div 2+x2,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
    SetColor(15);SetLineStyle(SolidLn,0,NormWidth);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x3,MaxY div 2-y3);
    TextColor(7);
    gotoxy(53,2);Write('R orb:',ras0,' m');
    gotoxy(53,5);Write('V orb:',sqrt(vxas0*vxas0+vyas0*vyas0),'
m/s');
    gotoxy(1,2);Write('g solar: ',aas:3:5,' m/s2');
    TextColor(12);
    gotoxy(56,3);Write('Rx:',rxas0,' m');
    gotoxy(56,4);Write('Ry:',ryas0,' m');
    TextColor(14);
    if axas>0 then
        begin

```

```

        gotoxy(9,3);Write('gx: ',axas:3:5,' m/s2');
    end
    else
    begin
        gotoxy(9,3);Write('gx:',axas:3:5,' m/s2');
    end;
    if ayas>0 then
    begin
        gotoxy(9,4);Write('gy: ',ayas:3:5,' m/s2');
    end
    else
    begin
        gotoxy(9,4);Write('gy:',ayas:3:5,' m/s2');
    end;
    gotoxy(56,6);Write('Vx:',vxas0,' m/s');
    gotoxy(56,7);Write('Vy:',vyas0,' m/s');
    SetColor(0);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y1);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x1,MaxY div 2-y2);
    line(MaxX div 2+x1,MaxY div 2-y2,MaxX div 2+x2,MaxY div 2-y2);
    line(MaxX div 2+x2,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
    line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x3,MaxY div 2-y3);
    dibuja_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 14);
end;
procedure eliptical;
var x1,x2,x3,y1,y2,y3:integer;
begin
    calcula_phy;
    rma0:=sqrt(rxma0*rxma0+ryma0*ryma0); {marte}
    ama:=g*m/(rma0*rma0);psima:=phyma0+pi; {acel g solar en Marte}
    if psima>2*pi then psima:=psima-2*pi; {opuesta al vec posicion}
    axma:=ama*cos(psima);ayma:=ama*sin(psima);{cartesianas de g en
Marte}
    borra_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 4);

    rxma0:=rxma0+vxma0*t+(axma*t*t)/2;ryma0:=ryma0+vyma0*t+(ayma*t*t)/2;
    vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;{esc MRUA}
    dibuja_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 15);

    ras0:=sqrt(rxas0*rxas0+ryas0*ryas0); {asteroide1}
    aas:=g*m/(ras0*ras0);psias:=phyas0+pi; {acel g solar en
asteroide}
    if psias>2*pi then psias:=psias-2*pi; {opuesta al vec posicion}
    axas:=aas*cos(psias);ayas:=aas*sin(psias);{cartesianas de g en
asteroide}
    borra_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 9);

    rxas0:=rxas0+vxas0*t+(axas*t*t)/2;ryas0:=ryas0+vyas0*t+(ayas*t*t)/2;
    vxas0:=vxas0+axas*t;vyas0:=vyas0+ayas*t;{ecs MRUA}
    dibuja_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 14);
    gotoxy(1,2);Write('R orbital: ',ras0,' m');
    gotoxy(1,3);Write('V orbital: ',sqrt(vxas0*vxas0+vyas0*vyas0),'
m/s');
end;
procedure areas;
var x1,x2,x3,y1,y2,y3:integer;
begin

```

```

calcula_phy;
rma0:=sqrt(rxma0*rxma0+ryma0*ryma0);    {marte}
ama:=g*m/(rma0*rma0);psima:=phyma0+pi;
if psima>2*pi then psima:=psima-2*pi;
axma:=ama*cos(psima);ayma:=ama*sin(psima);
borra_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 4);

rxma0:=rxma0+vxma0*t+(axma*t*t)/2;ryma0:=ryma0+vyma0*t+(ayma*t*t)/2;
vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;
dibuja_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 15);

ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);    {asteroide1}
aas:=g*m/(ras0*ras0);psias:=phyas0+pi;
if psias>2*pi then psias:=psias-2*pi;
axas:=aas*cos(psias);ayas:=aas*sin(psias);
borra_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 6);

rxas0:=rxas0+vxas0*t+(axas*t*t)/2;ryas0:=ryas0+vyas0*t+(ayas*t*t)/2;
vxas0:=vxas0+axas*t;vyas0:=vyas0+ayas*t;
dibuja_planeta(round(rxas0*e1*0.8), -round(ryas0*e1), 14);
{Graficos ley de las areas por intervalos iguales}
tt:=tt+t;SetColor(1);SetLineStyle(DottedLn,0,NormWidth);
if (tt>4E+6)and(tt<6E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>10.7E+6)and(tt<12.7E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>17.4E+6)and(tt<19.4E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>23.9E+6)and(tt<25.9E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>30.1E+6)and(tt<32.1E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>35.6E+6)and(tt<37.6E+6) then line(MaxX div 2, MaxY div 2,MaxX div
2+round(rxas0*e1*0.8),MaxY div 2-round(ryas0*e1));
if (tt>37.6E+6)and(tt<37.7E+6) then
begin
    TextColor(3);gotoxy(60,5);Write('Ley de las areas');
end;
end;
procedure martel;
var x1,y1,x2,y2,x3,y3:integer;
begin
    calcula_phy;
    rma0:=sqrt(rxma0*rxma0+ryma0*ryma0);    {marte}
    ama:=g*m/(rma0*rma0);psima:=phyma0+pi; {acel g solar en Marte}
    if psima>2*pi then psima:=psima-2*pi; {opuesta a radio vector}
    axma:=ama*cos(psima);ayma:=ama*sin(psima);{cartesianas de g}
    borra_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 4);

    rxma0:=rxma0+vxma0*t+(axma*t*t)/2;ryma0:=ryma0+vyma0*t+(ayma*t*t)/2;
    vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;{ecs MRUA}
    dibuja_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 15);
    {if (phyma0>pi)and(phyma0<pi+0.01)then begin
gotoxy(1,6);write(rma0);end;
    if (phyma0>-pi/2+0.01)and(phyma0<-pi/2+0.02)then begin
gotoxy(1,6);write(rma0);end;}
end;
procedure marte2;

```



```

var x1,y1,x2,y2,x3,y3:integer;
begin
  calcula_phy;
  rma0:=sqrt(rxma0*rxma0+ryma0*ryma0);    {marte}
  ama:=g*m/(rma0*rma0);psima:=phyma0+pi; {acel g solar en Marte}
  if psima>2*pi then psima:=psima-2*pi; {opuesta a radio vector}
  axma:=ama*cos(psimas);ayma:=ama*sin(psimas);{cartesianas de g}
  borra_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 4);

rxma0:=rxma0+vxma0*t+(axma*t*t)/2;ryma0:=ryma0+vyma0*t+(ayma*t*t)/2;
  vxma0:=vxma0+axma*t;vyma0:=vyma0+ayma*t;{ecs MRUA}
  {Graficos descomposicion de aceleraciones}
  SetColor(14);SetLineStyle(DottedLn,0,NormWidth);
  x1:=round(rxma0*e1*0.8);y1:=round(ryma0*e1);

x2:=round(rxma0*e1*0.8+axma*20000);y2:=round(ryma0*e1+ayma*20000);

x3:=round(rxma0*e1*0.8+vxma0/1500);y3:=round(ryma0*e1+vyma0/1500);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y1);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x1,MaxY div 2-y2);
  SetColor(1);
  line(MaxX div 2+x1,MaxY div 2-y2,MaxX div 2+x2,MaxY div 2-y2);
  line(MaxX div 2+x2,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
  SetColor(15);SetLineStyle(SolidLn,0,NormWidth);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
  {{line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x3,MaxY div 2-y3);}}
  TextColor(12);
  gotoxy(55,3);Write('Rx: ',rxma0,' m');
  gotoxy(55,4);Write('Ry: ',ryma0,' m');
  TextColor(14);
  if axma>0 then
    begin
      gotoxy(6,3);Write('gx: ',axma:3:5,' m/s2');
    end
    else
    begin
      gotoxy(6,3);Write('gx: ',axma:3:5,' m/s2');
    end;
  if ayma>0 then
    begin
      gotoxy(6,4);Write('gy: ',ayma:3:5,' m/s2');
    end
    else
    begin
      gotoxy(6,4);Write('gy: ',ayma:3:5,' m/s2');
    end;
  TextColor(3);
  gotoxy(55,6);Write('Vx: ',vxma0,' m/s');
  gotoxy(55,7);Write('Vy: ',vyma0,' m/s');

  SetColor(0);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y1);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x1,MaxY div 2-y2);
  line(MaxX div 2+x1,MaxY div 2-y2,MaxX div 2+x2,MaxY div 2-y2);
  line(MaxX div 2+x2,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
  line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x2,MaxY div 2-y2);
  {line(MaxX div 2+x1,MaxY div 2-y1,MaxX div 2+x3,MaxY div 2-y3);}
  dibuja_planeta(round(rxma0*e1*0.8), -round(ryma0*e1), 15);

```

```

end;
begin
  Inicia_modos_grafico;Presentacion;
  {Parte 1: Marte}
  dibuja_los_ejes;
  TextColor(12);gotoxy(1,1);Write('Marte');TextColor(7);
  gotoxy(1,2);Write('R orbital: 227.936.640 Km');
  gotoxy(1,3);Write('V orbital:      24.133 m/s');
  DatosIniciales;t:=1500;
  repeat martel until keypressed;
  {textcolor(14);gotoxy(1,6);write(rma0);}
  ReadLn;
  ClearViewport;
  {Parte 2: Marte y descomposicion de aceleracion}
  dibuja_los_ejes;
  TextColor(12);gotoxy(1,1);Write('Marte');TextColor(7);
  gotoxy(55,2);Write('R orbital: 2.27936E+11 m');
  gotoxy(55,5);Write('V orbital: 2.41310E+04 m/s');
  gotoxy(1,2);Write('g solar:      ',ama:3:5,' m/s2');
  DatosIniciales;t:=1500;
  repeat marte2 until keypressed;
  ReadLn;
  ClearViewport;
  {Parte 3: Marte y planeta con orbita eliptica}
  dibuja_los_ejes;
  TextColor(12);gotoxy(1,21);Write('Marte');TextColor(8);
  gotoxy(1,22);Write('R orbital: 2.27936E+11 m');
  gotoxy(1,23);Write('V orbital: 2.41310E+04 m/s');
  gotoxy(1,24);Write('g solar:      ',ama:3:5,' m/s2');
  TextColor(6);gotoxy(1,1);Write('Orbita eliptica');TextColor(7);
  DatosIniciales;t:=1500;
  repeat eliptical until keypressed;
  ReadLn;
  ClearViewport;
  {Parte 4: Marte y planeta con orbita eliptica grande}
  dibuja_los_ejes;
  TextColor(12);gotoxy(1,21);Write('Marte');TextColor(8);
  gotoxy(1,22);Write('R orbital: 2.27936E+11 m');
  gotoxy(1,23);Write('V orbital: 2.41310E+04 m/s');
  gotoxy(1,24);Write('g solar:      ',ama:3:5,' m/s2');
  TextColor(6);gotoxy(1,1);Write('Orbita eliptica');TextColor(7);
  DatosIniciales;t:=1500;
  rxas0:=2.27936E+11;ryas0:=0;           {elipse grande}
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
  vxas0:=0;vyas0:=27000;
  repeat eliptical until keypressed;
  ReadLn;
  ClearViewport;
  {Parte 5: Marte y planeta con orbita hiperbolica}
  dibuja_los_ejes;
  TextColor(12);gotoxy(1,21);Write('Marte');TextColor(8);
  gotoxy(1,22);Write('R orbital: 2.27936E+11 m');
  gotoxy(1,23);Write('V orbital: 2.41310E+04 m/s');
  gotoxy(1,24);Write('g solar:      ',ama:3:5,' m/s2');
  TextColor(6);gotoxy(1,1);Write('Orbita eliptica');TextColor(7);
  DatosIniciales;t:=1500;
  rxas0:=5*2.27936E+11;ryas0:=2.27936E+11;{hiperbolico}
  ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);

```

```

vxas0:=-30000;vyas0:=0;
repeat elliptical until keypressed;
ReadLn;
ClearViewPort;
{Parte 6: Marte y planeta con orbita parabolica}
dibuja_los_ejes;
TextColor(12);gotoxy(1,21);Write('Marte');TextColor(8);
gotoxy(1,22);Write('R orbital: 2.27936E+11 m');
gotoxy(1,23);Write('V orbital: 2.41310E+04 m/s');
gotoxy(1,24);Write('g solar:    ',ama:3:5,' m/s2');
TextColor(6);gotoxy(1,1);Write('Orbita eliptica');TextColor(7);
DatosIniciales;t:=1500;
rxas0:=-5*2.27936E+11;ryas0:=2.27936E+11;{parabolico}
ras0:=sqrt(rxas0*rxas0+ryas0*ryas0);
vxas0:=10000;vyas0:=0;
repeat elliptical until keypressed;
ReadLn;
ClearViewPort;
{Parte 7: Descomposicion de aceleracion en planeta orbita eliptica}
dibuja_los_ejes;
TextColor(12);gotoxy(1,21);Write('Marte');TextColor(8);
gotoxy(1,22);Write('R orbital: 2.27936E+11 m');
gotoxy(1,23);Write('V orbital: 2.41310E+04 m/s');
gotoxy(1,24);Write('g solar:    ',ama:3:5,' m/s2');
TextColor(6);gotoxy(1,1);Write('Orbita eliptica');TextColor(7);
DatosIniciales;t:=2000;
repeat eliptica2 until keypressed;
ReadLn;
ClearViewPort;
{Parte 8: Segunda ley de Kepler}
dibuja_los_ejes;
DatosIniciales;tt:=0;t:=500;
repeat areas until keypressed;
readLn;
ClearViewPort;
{Parte 9: Sistema solar}
dibuja_los_ejes;
DatosIniciales;t:=2000;
TextColor(7);gotoxy(23,15);Write('Mercurio');
TextColor(6);gotoxy(23,14);Write('Venus');
TextColor(3);gotoxy(23,13);Write('Tierra');
TextColor(4);gotoxy(23,11);Write('Marte');
TextColor(7);gotoxy(15,2);Write('Jupiter');
TextColor(1);gotoxy(57,21);Write('Vesta');
repeat sistema until keypressed;
end.

```