Exercise 1.3.1

Fig. 3.7 thru Fig. 3.9 involves zero-gravity collisions of point masses M_1=7 and M_2=1 with initial positions ($y_1^{(IN)}$=3, $y_2^{(IN)}$=1) and initial velocities ($v_1^{(IN)}$=-1, $v_2^{(IN)}$=-1).

In Fig. 3.9 the mass M_1=7 has Bang-1 off a floor at y=0 and M_2 bounces between the ceiling and M_1. After Bang-1 the floor opens so both masses are free to fall thru indefinitely.

Use attached or similar Cartesian coordinate graph-paper to plot exercise results.

(a) Continue Fig. 3.9 for three or more collisions using same ceiling *height=7.0* until a "game-over" point where the last possible M_1-M_2 collision occurs (well outside (y_1, y_2)-graph.)

(b) Plot that final $(v_1^{(FIN)}=?, v_2^{(FIN)}=?)$ vector at game-over.

(b) Where in space-space $(y_1^{(FIN)}=?, y_2^{(FIN)}=?)$ do they last collide?

(c) When?

Exercise 1.4.1

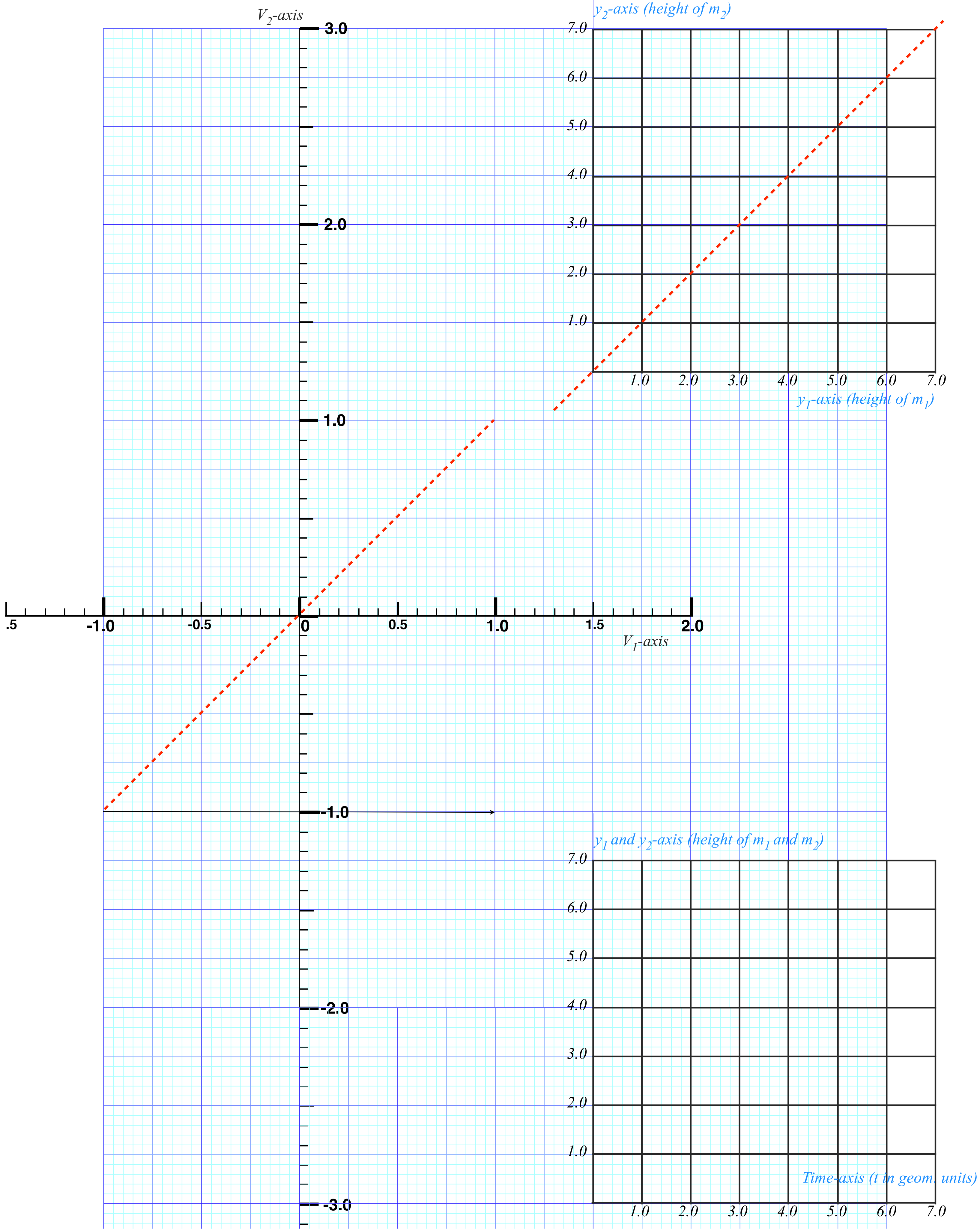
Use attached or similar Polar coordinate (V_1,V_2) Estrangian graph-paper to plot velocities of Ex. 1.3.1.

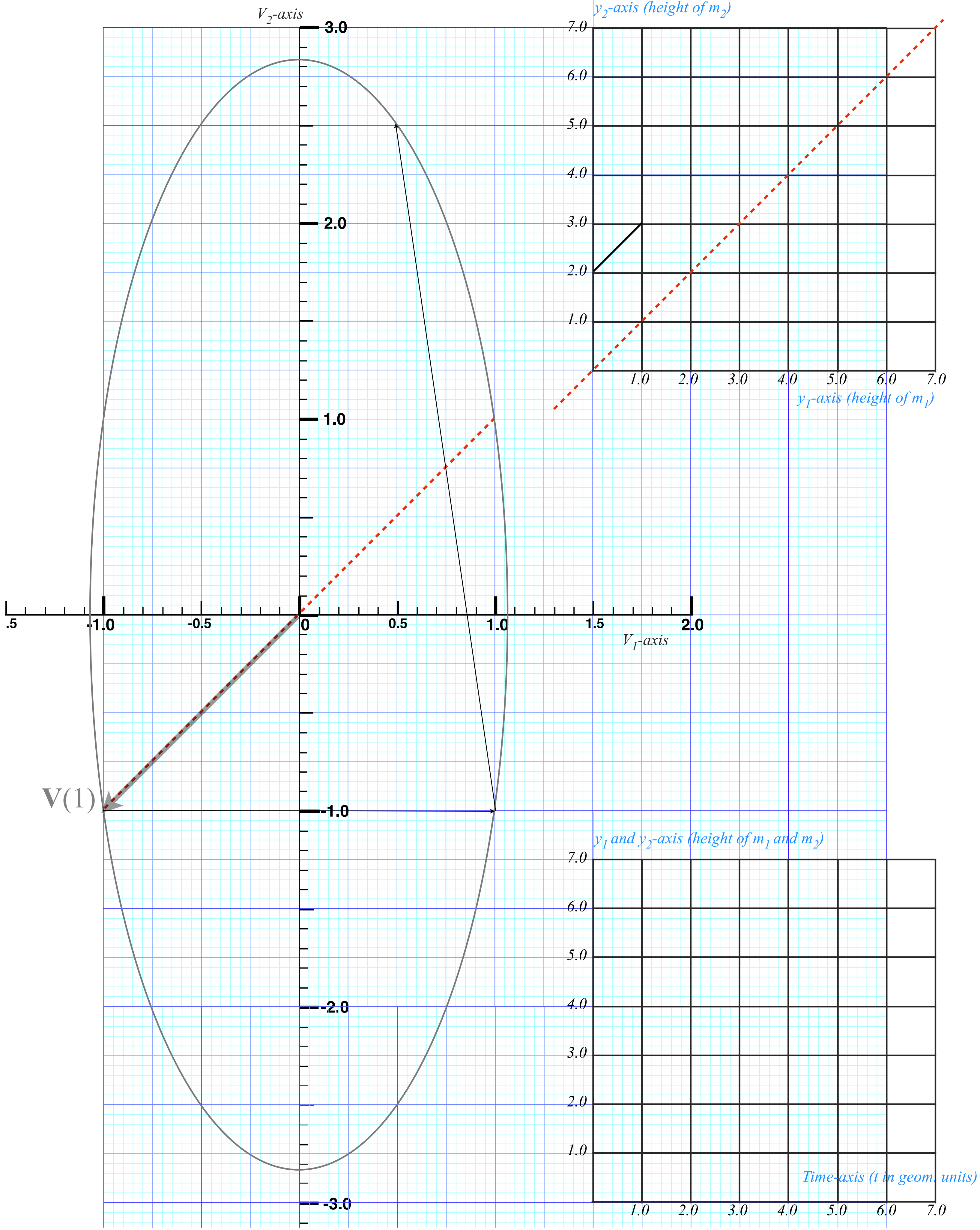
(a) Use the matrix techniques detailed in equations (4.1) thru (4.5) to calculate velocities of Ex. 1.3.1.

(b) Use the matrix techniques detailed in equations (4.9) thru (4.13) to calculate Estrangian velocities.

(c) Redraw collisions of Ex. 1.3.1 as Estrangian (V_1, V_2) plots of Fig. 4.2(b) up to "game-over" point.

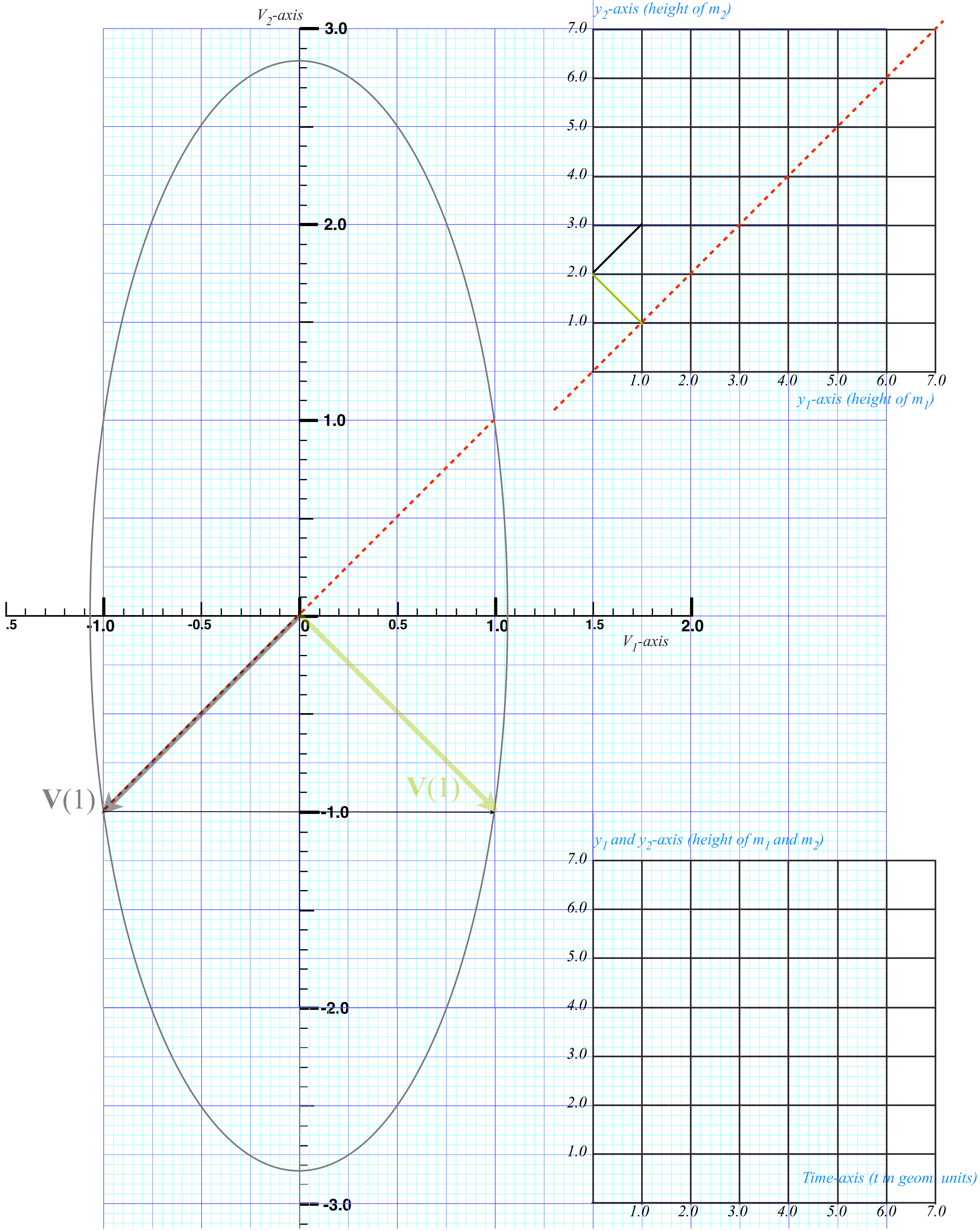
(d Open-ended question) Is it possible to plot spatial position using Estrangian techniques?


V_2-axis
3.0
2.0
1.0
-1.0
-2.0
-3.0
.5
-1.0
-0.5
0
0.5
1.0
1.5
2.0
V_1-axis
y_2-axis (height of m_2)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
1.0 2.0 3.0 4.0 5.0 6.0 7.0
y_1-axis (height of m_1)
y_1 and y_2-axis (height of m_1 and m_2)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
Time-axis (t in geom. units)
1.0 2.0 3.0 4.0 5.0 6.0 7.0



Ellipse radius 1	*Ellipse radius 2*
$a_1 = \sqrt{2KE/M_1}$	$a_2 = \sqrt{2KE/M_1}$
$= \sqrt{2KE/7}$	$= \sqrt{2KE/1}$
$= \sqrt{8/7}$	$= \sqrt{8/1}$
$= 1.07$	$= 2.83$

Collisions for mass ratio m_1:m_2= 7:1



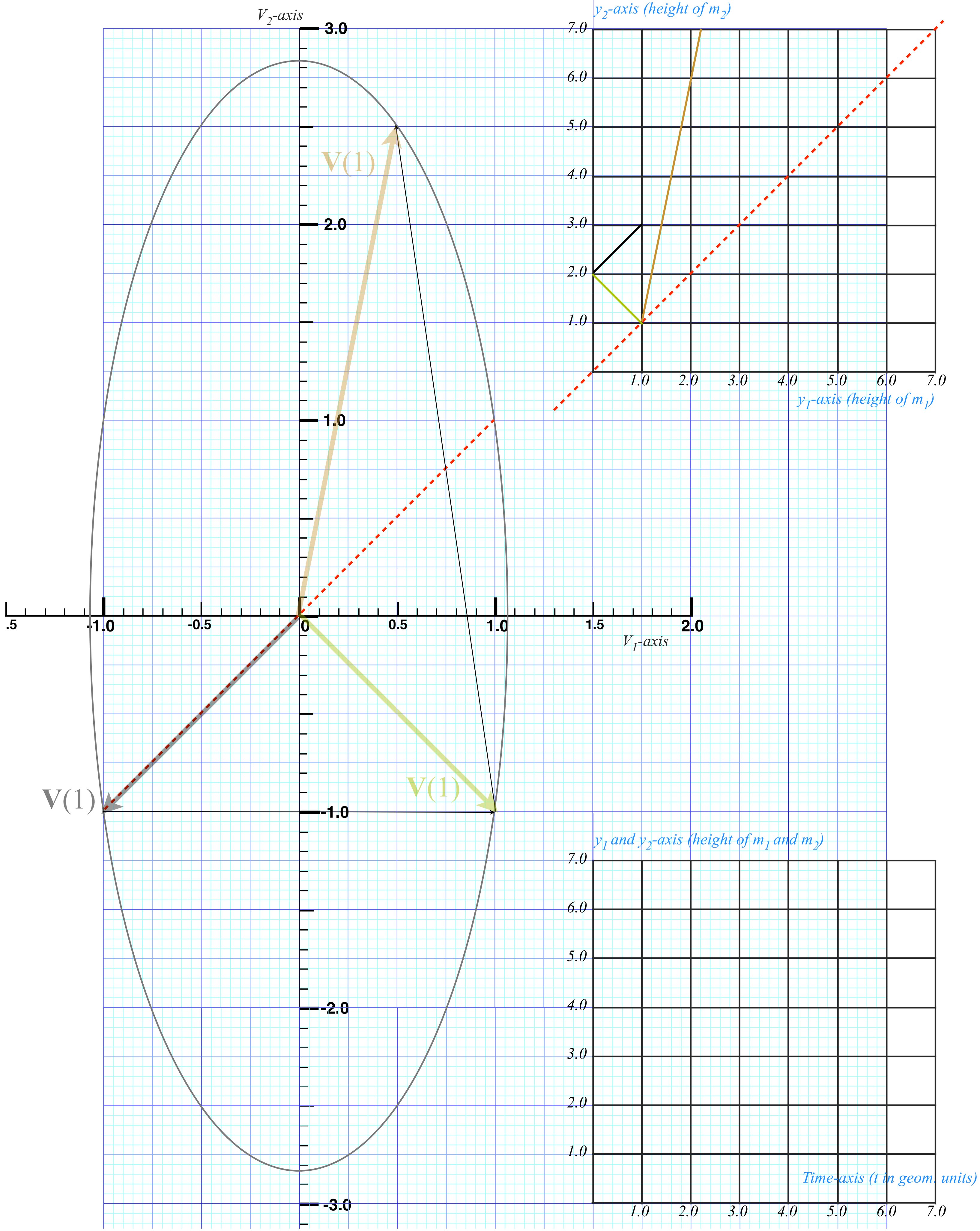
Ellipse radius 1

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

Ellipse radius 2

$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



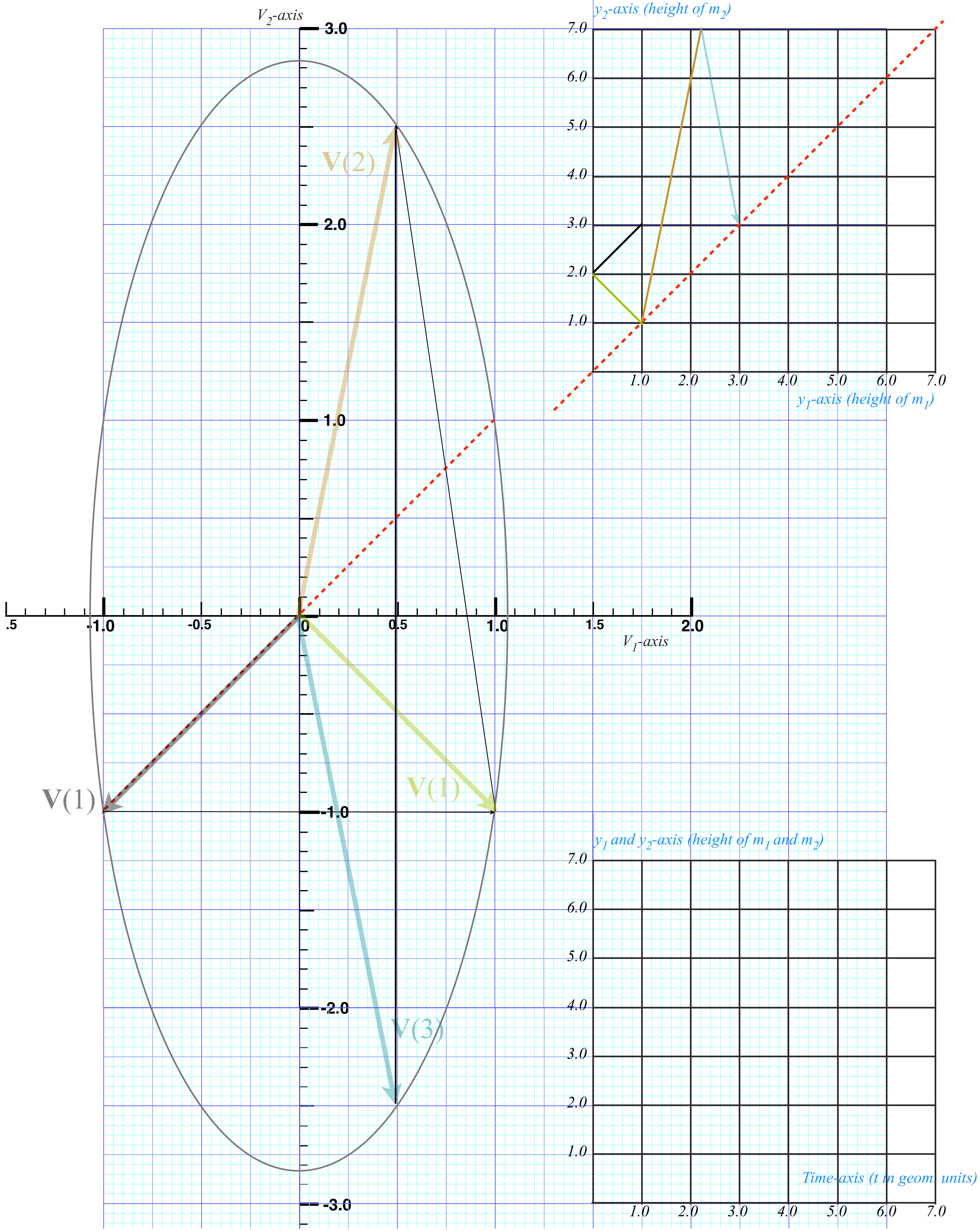
Ellipse radius 1

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

Ellipse radius 2

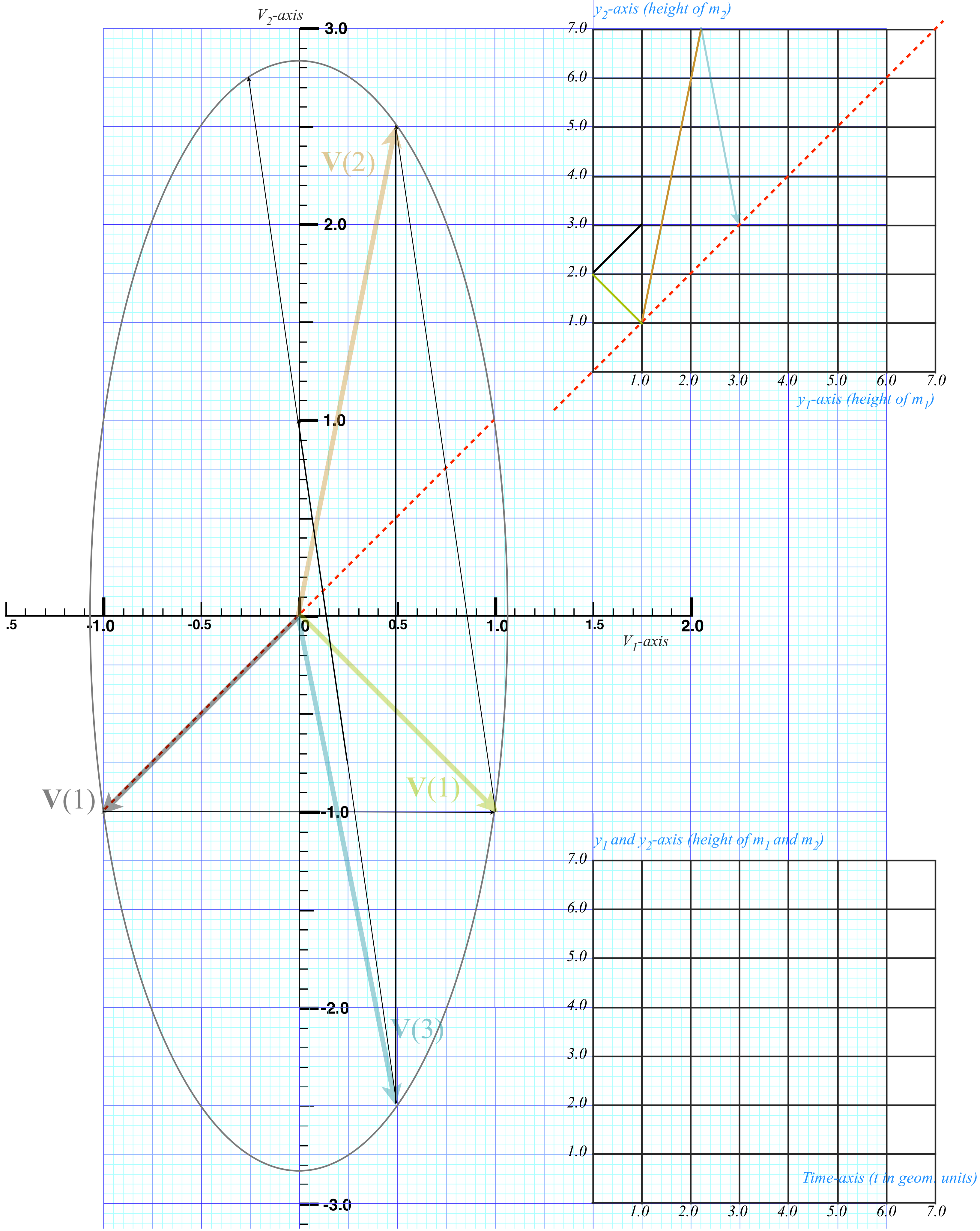
$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio $m_1 : m_2 = 7:1$



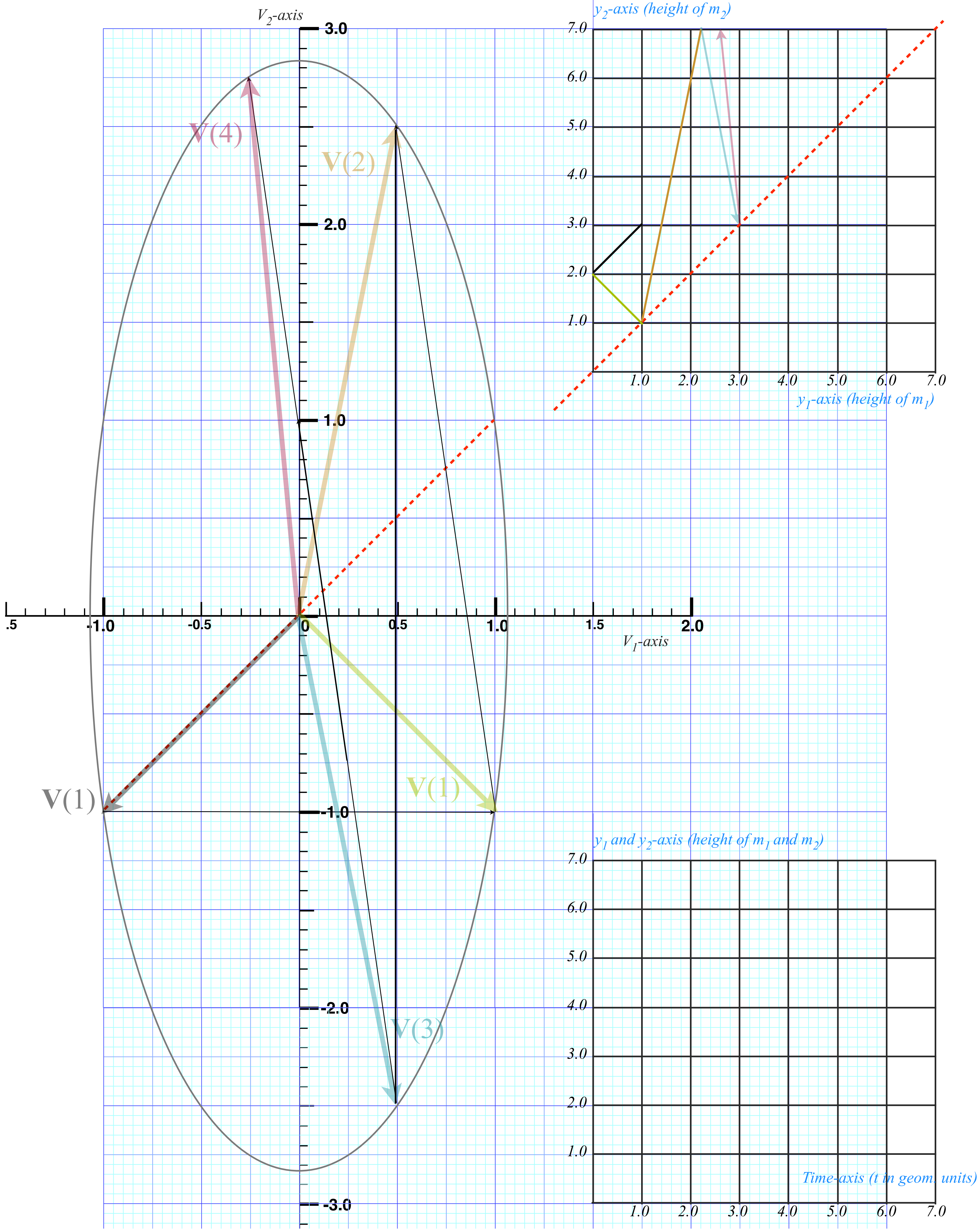
Ellipse radius 1	*Ellipse radius 2*
$a_1 = \sqrt{2KE/M_1}$	$a_2 = \sqrt{2KE/M_1}$
$= \sqrt{2KE/7}$	$= \sqrt{2KE/1}$
$= \sqrt{8/7}$	$= \sqrt{8/1}$
$= 1.07$	$= 2.83$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



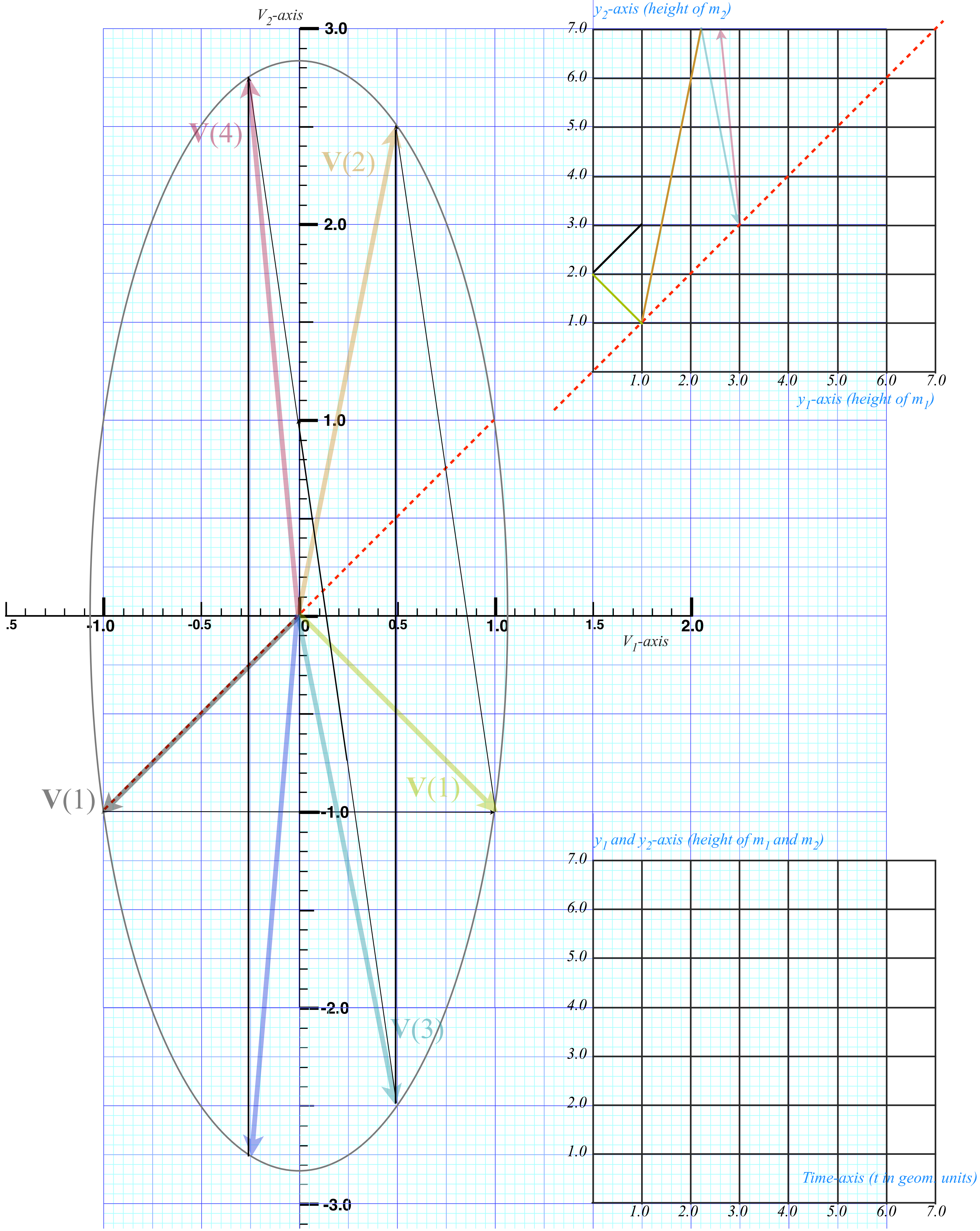
Ellipse radius 1	Ellipse radius 2
$a_1 = \sqrt{2KE/M_1}$	$a_2 = \sqrt{2KE/M_1}$
$= \sqrt{2KE/7}$	$= \sqrt{2KE/1}$
$= \sqrt{8/7}$	$= \sqrt{8/1}$
$= 1.07$	$= 2.83$

Collisions for mass ratio m_1:m_2= 7:1



Ellipse radius 1	Ellipse radius 2
$a_1 = \sqrt{2KE/M_1}$	$a_2 = \sqrt{2KE/M_1}$
$= \sqrt{2KE/7}$	$= \sqrt{2KE/1}$
$= \sqrt{8/7}$	$= \sqrt{8/1}$
$= 1.07$	$= 2.83$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



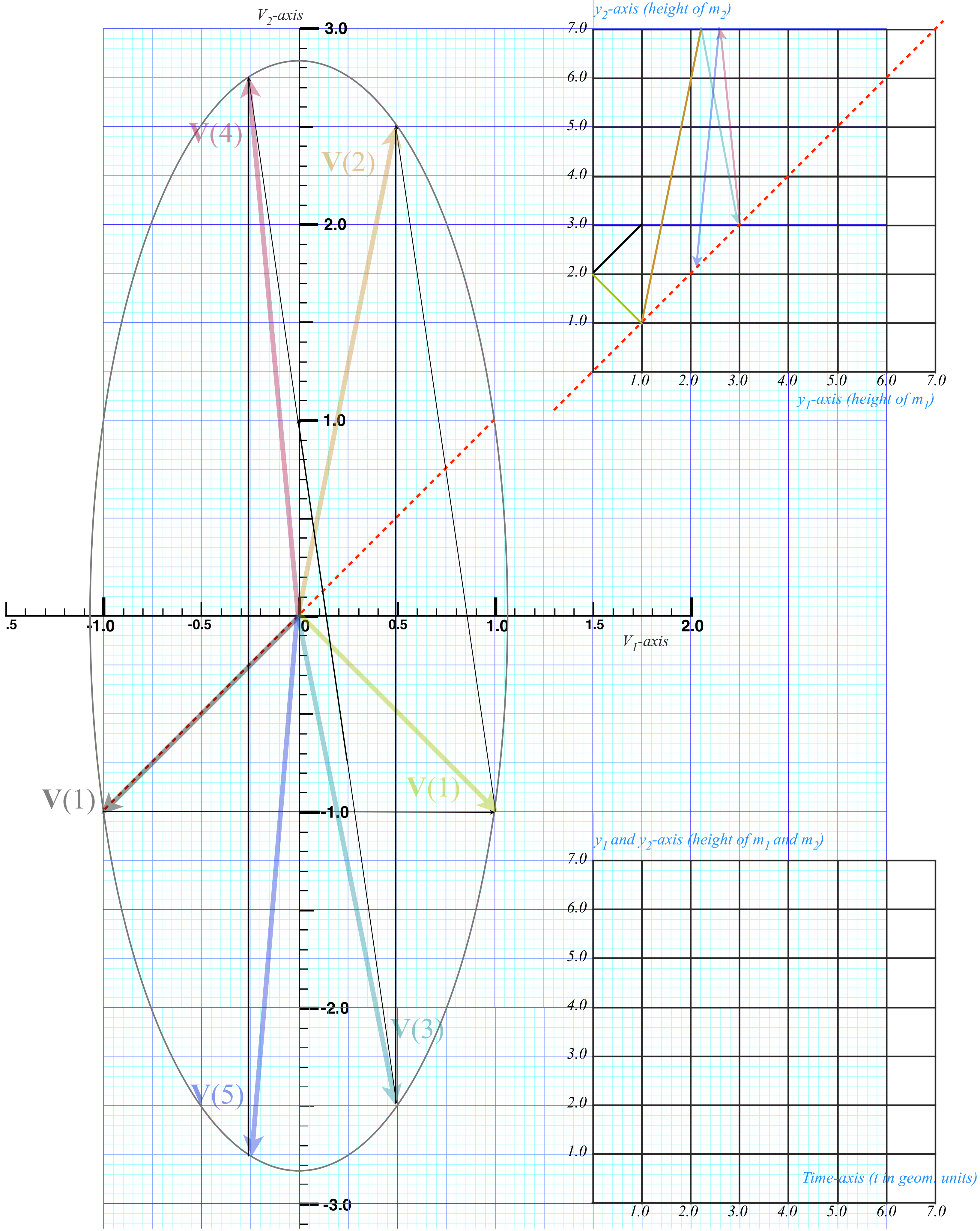
Ellipse radius 1

$$a_1 = \sqrt{2KE/M_1}$$
$$= \sqrt{2KE/7}$$
$$= \sqrt{8/7}$$
$$= 1.07$$

Ellipse radius 2

$$a_2 = \sqrt{2KE/M_1}$$
$$= \sqrt{2KE/1}$$
$$= \sqrt{8/1}$$
$$= 2.83$$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



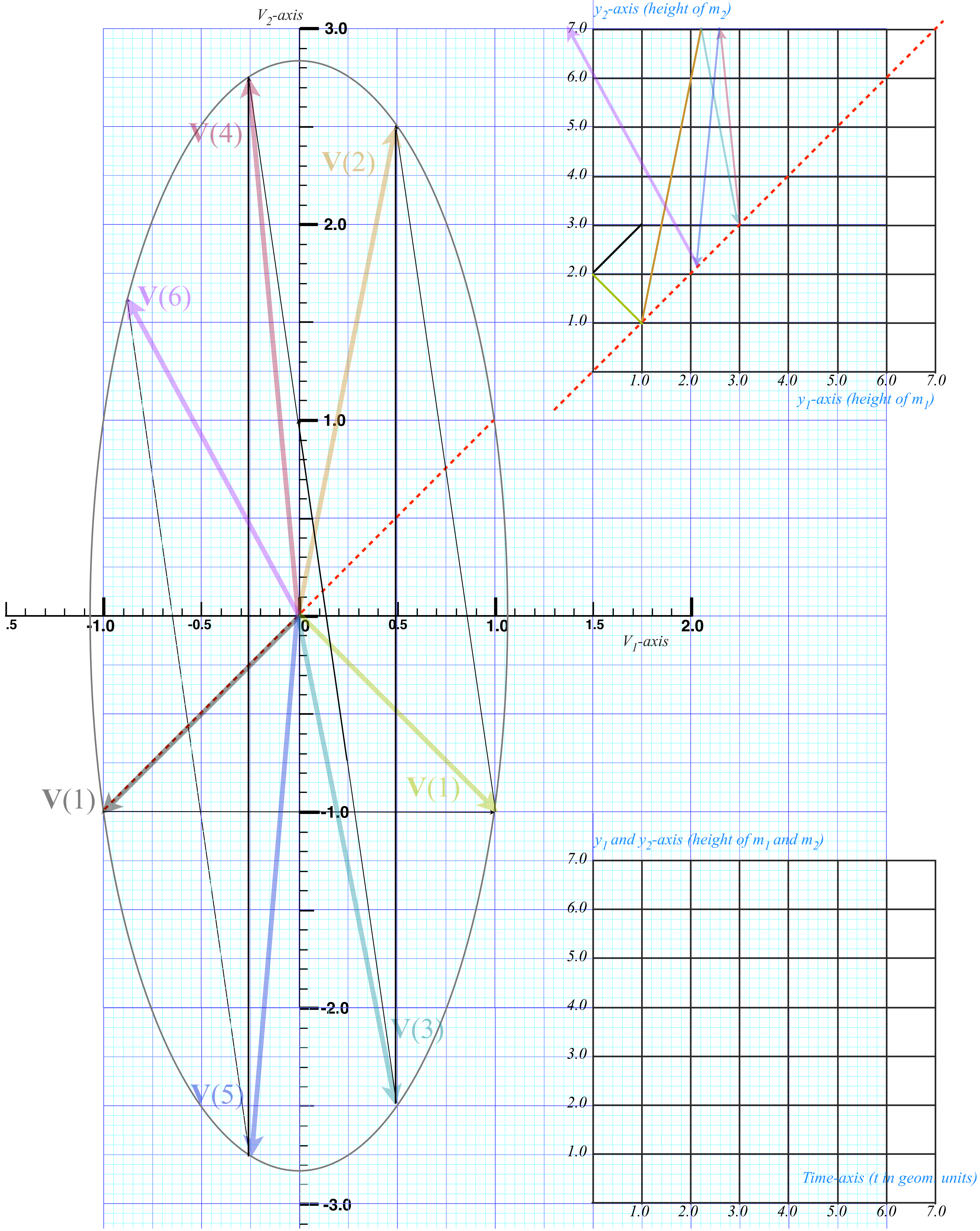
Ellipse radius 1

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

Ellipse radius 2

$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio m_1:m_2= 7:1



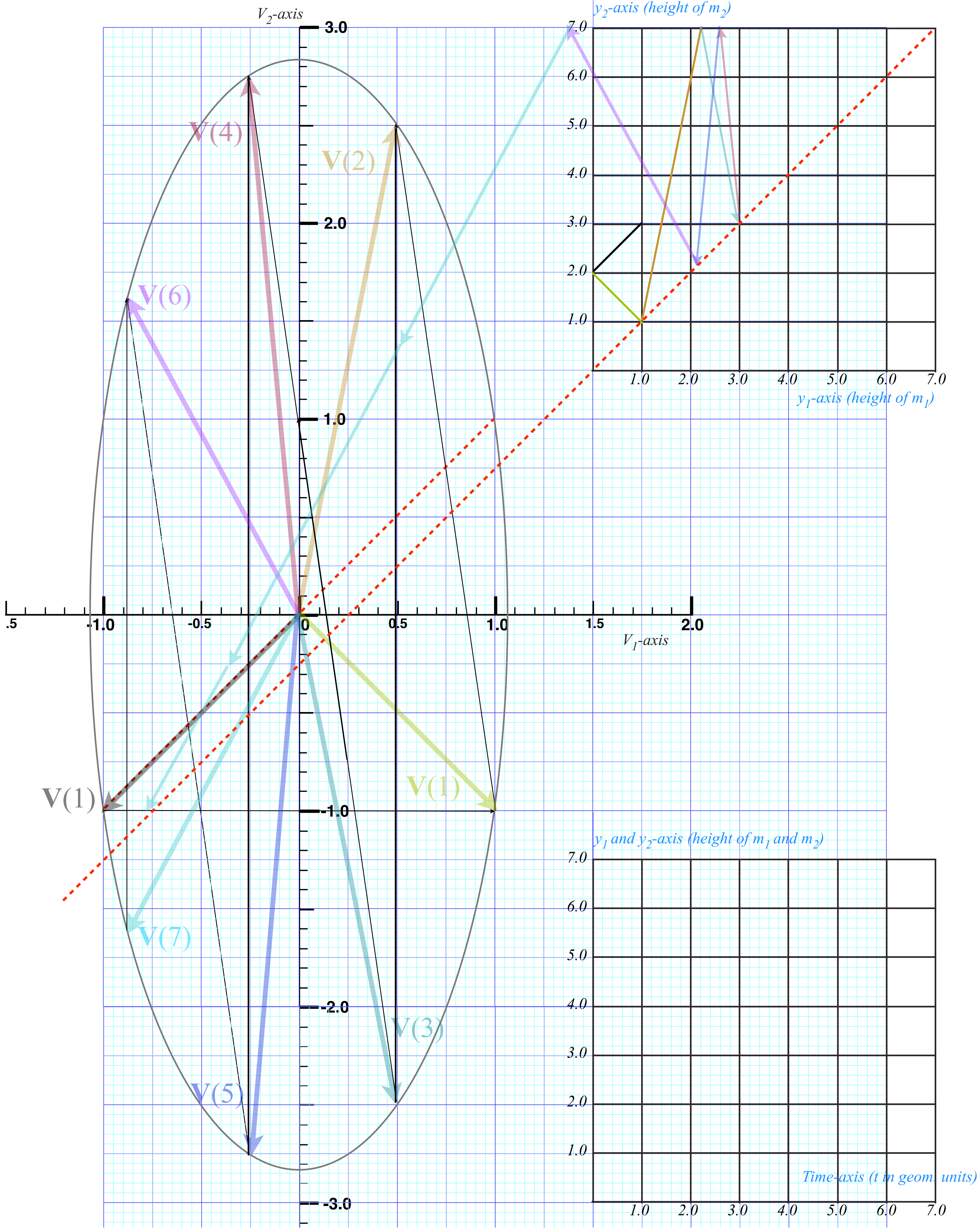
Ellipse radius 1

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

Ellipse radius 2

$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



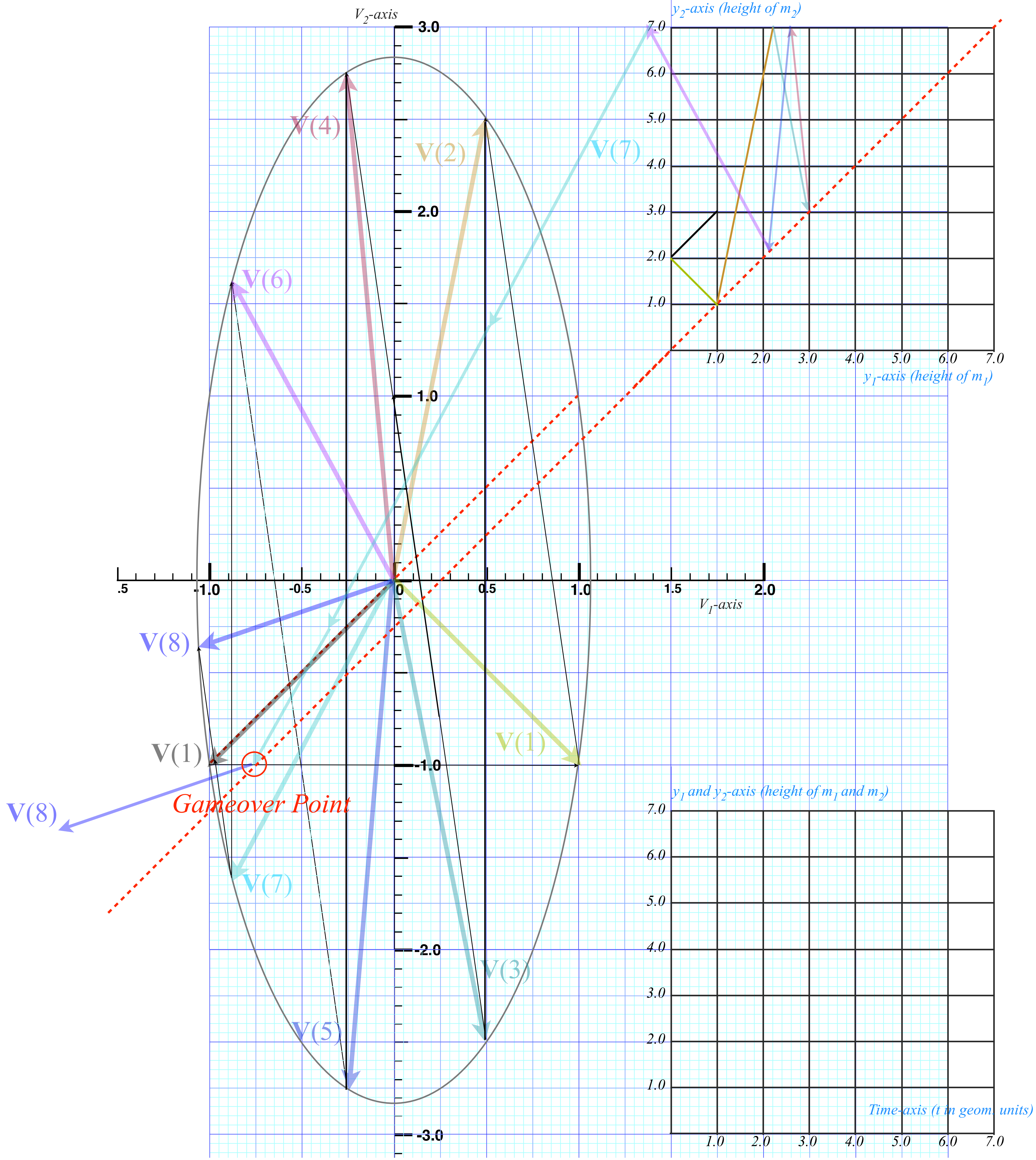
<u>*Ellipse radius 1*</u>

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

<u>*Ellipse radius 2*</u>

$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio $m_1{:}m_2 = 7{:}1$



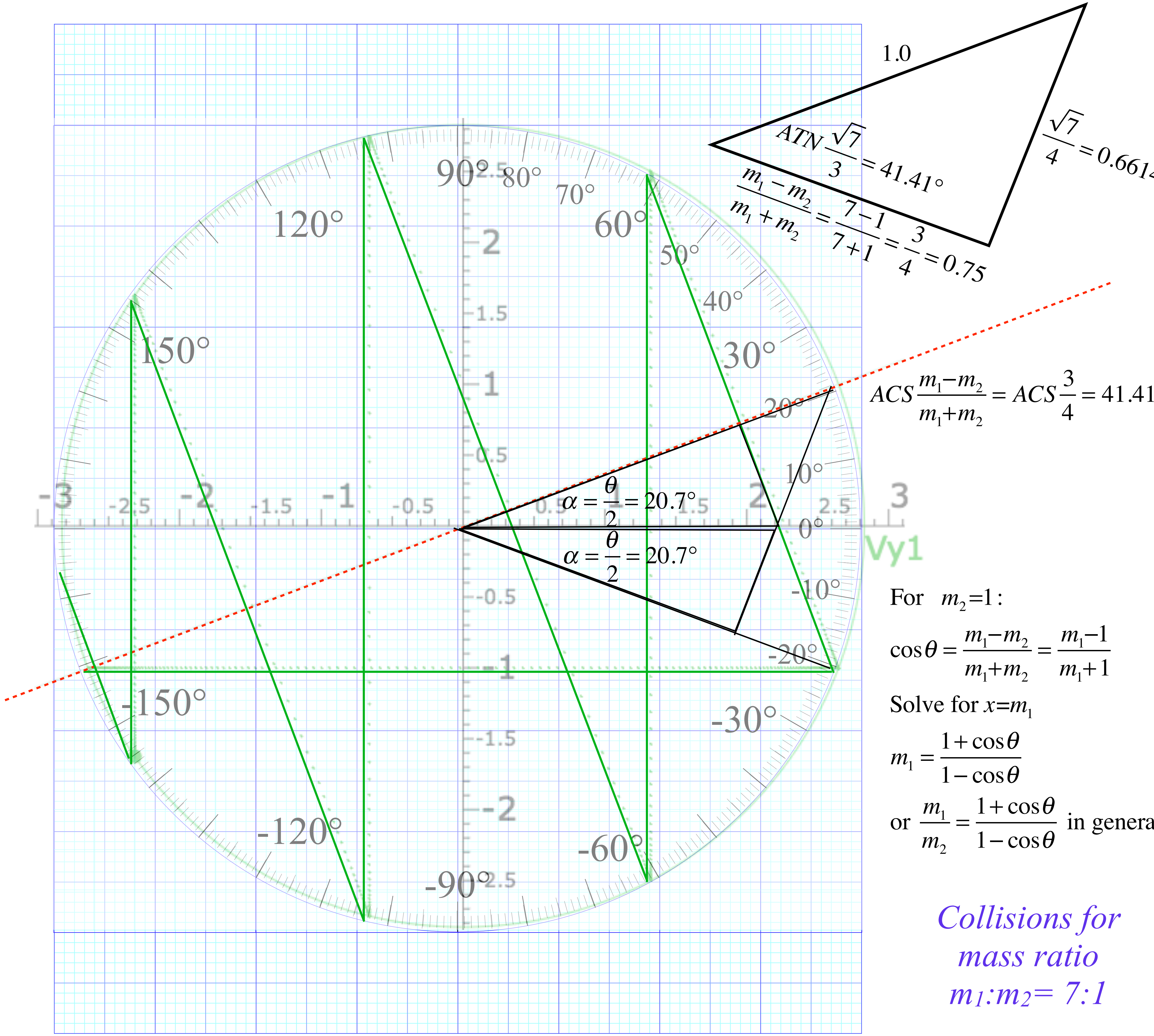
<u>*Ellipse radius 1*</u>

$$a_1 = \sqrt{2KE/M_1} = \sqrt{2KE/7} = \sqrt{8/7} = 1.07$$

<u>*Ellipse radius 2*</u>

$$a_2 = \sqrt{2KE/M_1} = \sqrt{2KE/1} = \sqrt{8/1} = 2.83$$

Collisions for mass ratio m_1:m_2= 7:1



For $m_2=1$:

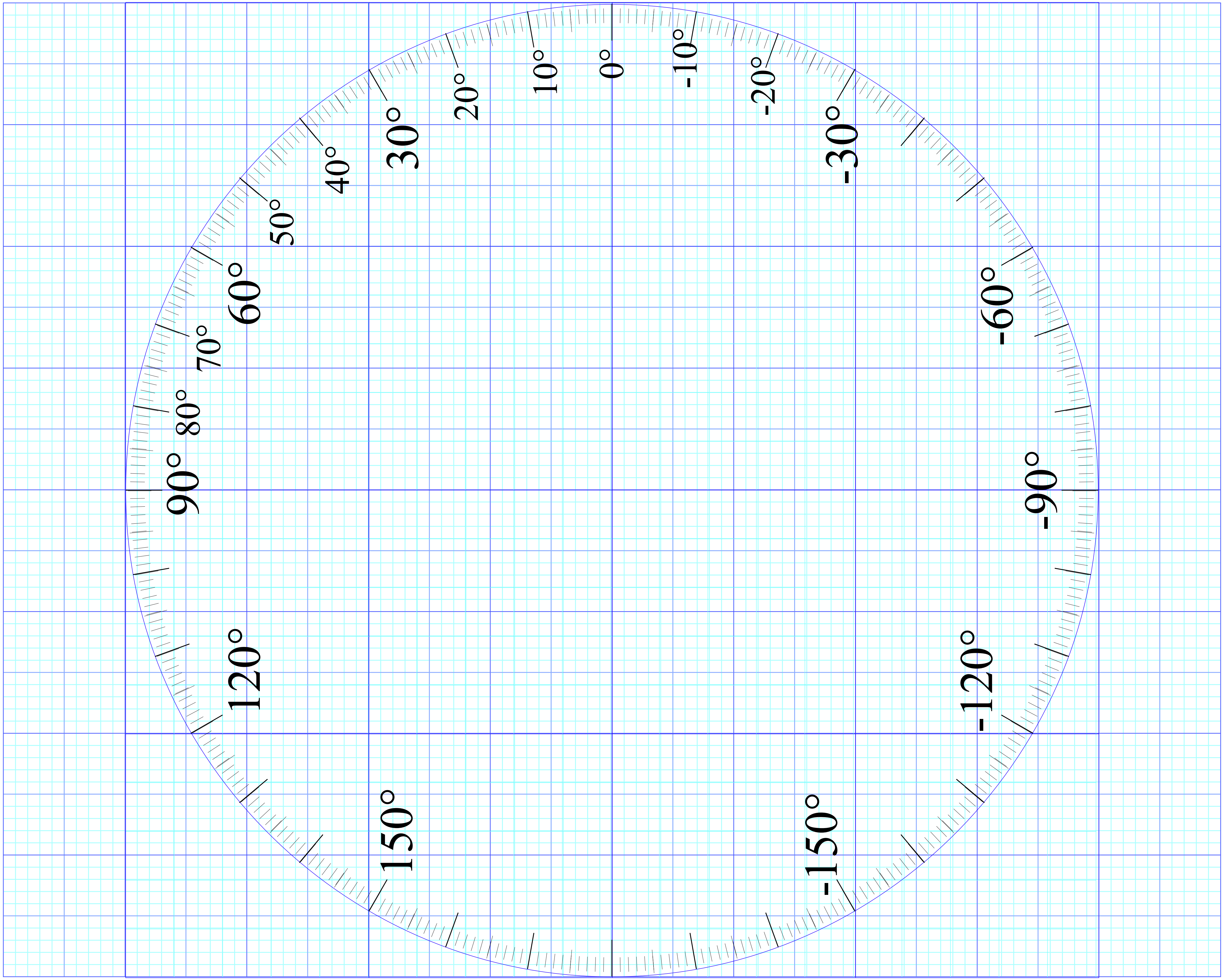
$$\cos\theta=\frac{m_1-m_2}{m_1+m_2}=\frac{m_1-1}{m_1+1}$$

Solve for $x=m_1$

$$m_1=\frac{1+\cos\theta}{1-\cos\theta}$$

or $\frac{m_1}{m_2}=\frac{1+\cos\theta}{1-\cos\theta}$ in general.

Collisions for mass ratio m_1:m_2= 7:1


0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
120°
150°
-10°
-20°
-30°
-60°
-90°
-120°
-150°