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$F_1(1;-1)$ $F_2(1;3)$ $d: y=\frac{11}{2}$

a) $P(x;y)$ $\overline{PF_1}+\overline{PF_2}=6$

$$\sqrt{(x-1)^2+(y+1)^2}+\sqrt{(x-1)^2+(y-3)^2}=6$$

$$\left(\cancel{\sqrt{}}(x-1)^2+(y+1)^2\right)^{\cancel{2}}=\left(6-\sqrt{(x-1)^2+(y-3)^2}\right)^2$$

$$(\cancel{x-1})^2+(y+1)^2=36+(\cancel{x-1})^2+(y-3)^2-12\sqrt{(x-1)^2+(y-3)^2}$$

$$\cancel{y^2}+1+2y=36+\cancel{y^2}+9-6y-12\sqrt{(x-1)^2+(y-3)^2}$$

$$12\sqrt{(x-1)^2+(y-3)^2}=-8y+44 \qquad \sqrt{(x-1)^2+(y-3)^2}=-\frac{\cancel{8}^{\,2}}{\cancel{12}_{\,3}}y+\frac{\cancel{44}^{\,11}}{\cancel{12}_{\,3}}$$

$$(x-1)^2+(y-3)^2=\left(-\frac{2}{3}y+\frac{11}{3}\right)^2 \qquad x^2+1-2x+y^2+9-6y=\frac{4}{9}y^2+\frac{121}{9}-\frac{44}{9}y$$

$$x^2+1-2x+y^2+9-6y=\frac{4}{9}y^2+\frac{121}{9}-\frac{44}{9}y$$

$$(x-1)^2+\frac{5}{9}y^2-\frac{10}{9}y-\frac{31}{9}=0 \qquad (x-1)^2+\frac{5}{9}\left(\underbrace{y^2-2y}_{(y^2-2y+1)-1}-\frac{31}{5}\right)=0$$

$$(x-1)^2+\frac{5}{9}\left[(y-1)^2-\frac{31}{5}-1\right]=0$$

$$(x-1)^2+\frac{5}{9}(y-1)^2-\frac{36}{9}=0 \qquad (x-1)^2+\frac{5}{9}(y-1)^2=\frac{\cancel{36}^{\,4}}{\cancel{9}}$$

$$\frac{(x-1)^2}{4}+\frac{5}{36}(y-1)^2=1$$

b) $Q(x;y)$ $\quad \frac{\overline{QH}}{\overline{QF_2}}=\frac{3}{2}$ $\quad \overline{QH}=d\,(Q;d)$

$$\frac{\left|y-\frac{11}{2}\right|}{\sqrt{(x-1)^2+(y-3)^2}}=\frac{3}{2} \qquad \left(\left|y-\frac{11}{2}\right|\right)^2=\left(\frac{3}{2}\sqrt{(x-1)^2+(y-3)^2}\right)^2$$

$$\left(\left|y-\frac{11}{2}\right|\right)^2=\left(\frac{3}{2}\sqrt{(x-1)^2+(y-3)^2}\right)^2 \qquad y^2+\frac{121}{4}-11y=\frac{9}{4}\left[(x-1)^2+(y-3)^2\right]$$

$$y^2+\frac{121}{4}-11y=\frac{9}{4}\left(x^2+1-2x+y^2+9-6y\right)$$

$$y^2+\frac{121}{4}-11y=\frac{9}{4}x^2+\frac{9}{4}-\frac{9}{2}x+\frac{9}{4}y^2+\frac{81}{4}-\frac{27}{2}y$$

$$\frac{9}{4}(x-1)^2+\frac{5}{4}y^2-\frac{5}{2}y-\frac{31}{4}=0 \qquad (x-1)^2+\frac{5}{9}y^2-\frac{10}{9}y-\frac{31}{9}=0$$

$$(x-1)^2+\frac{5}{9}\left[y^2-2y-\frac{31}{5}\right]=0 \qquad (x-1)^2+\frac{5}{9}\left[y^2-2y+1-1-\frac{31}{5}\right]=0$$

$$(x-1)^2+\frac{5}{9}(y-1)^2=\frac{36}{9} \qquad \frac{(x-1)^2}{4}+\frac{5}{36}(y-1)^2=1$$