- $\vec{r} \cdot (\vec{r} \times \vec{h})$

Substitute: $\vec{r} \cdot (\vec{r} \times \vec{h}) = \vec{r} \cdot \left(\mu \vec{e} + \frac{\mu \vec{r}}{r}\right)$

cycle LHS: $\vec{r} \cdot (\vec{r} \times \vec{h}) = (\vec{r} \times \dot{\vec{r}}) \cdot \vec{h} = \vec{h} \cdot \vec{h}$

expand RHS: $\mu \vec{r} \cdot \vec{e} + \mu \frac{\vec{r} \cdot \vec{r}}{r} = \mu \vec{r} \cdot \vec{e} + \mu r$

equate $h^2 = \mu r + \mu \vec{r} \cdot \vec{e}$

take $\vec{e}$ as a reference to measure f

$$h^2 = \mu (r + r e \cos f)$$

factor out r and solve for r

$$h^2/\mu = r (1 + e \cos f)$$

$$r = \frac{h^2/\mu}{(1 + e \cos f)}$$ radial equation