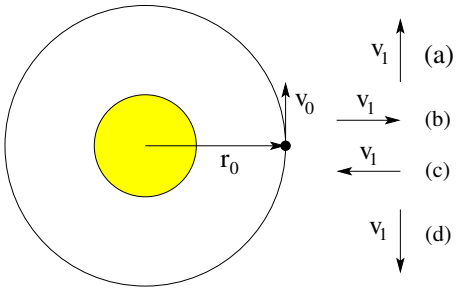
[mex163] Changing orbit by brief rocket boost

A satellite orbits the Earth in a circular orbit of radius r_0, traveling with velocity $\mathbf{v}_0$. Then a rocket on the satellite fires such that it acquires an additional velocity $\mathbf{v}_1$ of the same magnitude as $\mathbf{v}_0$ in a very short time. Give a detailed description of the nature of the subsequent orbit of the satellite for the four cases with different directions of $\mathbf{v}_1$ as shown.



Solution: