

$$2c) \quad f(r) = k r^n$$

circular solution

$$u_0 = -\frac{m}{L^2 u_0^2} \frac{k}{u_0^n}$$

$$u = u_0 + \delta u$$

$$\Rightarrow \frac{d^2 \delta u}{d\varphi^2} + \delta u = -\frac{m}{L^2} \frac{k}{(u_0 + \delta u)^{n+2}} - u_0$$

$$= +\frac{m}{L^2} \frac{k(n+2)\delta u}{u_0^{n+3}}$$

$$\Rightarrow \frac{d^2 \delta u}{d\varphi^2} = -\delta u \left(1 - \frac{m}{L^2} \frac{k(n+2)}{u_0^{n+3}} \right)$$

$$= -\delta u (n+3)$$

$$\frac{d^2 \delta u}{d\varphi^2} > 0 \quad \text{for } n < -3 \Rightarrow$$

motion is unstable