

28. The gravitational potential energy is

$$U = -\frac{Gm(M-m)}{r} = -\frac{G}{r}(Mm - m^2)$$

which we differentiate with respect to m and set equal to zero (in order to minimize). Thus, we find $M - 2m = 0$ which leads to the ratio $m/M = 1/2$ to obtain the least potential energy. (Note that a second derivative of U with respect to m would lead to a positive result regardless of the value of m – which means its graph is everywhere concave upward and thus its extremum is indeed a minimum).