90. (a) Because it is moving in a circular orbit, F/m must equal the centripetal acceleration:

$$\frac{80\text{ N}}{50\text{ kg}} = \frac{v^2}{r}$$

But $v = 2\pi r/T$, where $T = 21600$ s, so we are led to

$$1.6\text{ m/s}^2 = \frac{4\pi^2}{T^2}\,r$$

which yields $r = 1.9 \times 10^7$ m.

(b) From the above calculation, we infer $v^2 = (1.6\text{ m/s}^2)r$ which leads to $v^2 = 3.0 \times 10^7\,\text{m}^2/\text{s}^2$. Thus, $K = \frac{1}{2}mv^2 = 7.6 \times 10^8$ J.

(c) As discussed in §14-4, F/m also tells us the gravitational acceleration:

$$a_g = 1.6\text{ m/s}^2 = \frac{GM}{r^2}$$

We therefore find $M = 8.6 \times 10^{24}$ kg.