1. The spacecraft is at 3.00 Earth radii from the center of the Earth, or three times as far from the Earth's center as when at the surface of the Earth. Therefore, since the force of gravity decreases as the square of the distance, the force of gravity on the spacecraft will be one-ninth of its weight at the Earth's surface.

$$F_G = \tfrac{1}{9} m g_{\substack{\text{Earth's}\\ \text{surface}}} = \frac{(1480\,\text{kg})(9.80\,\text{m/s}^2)}{9} = \boxed{1610\,\text{N}}$$

This could also have been found using Eq. 6-1, Newton's law of universal gravitation.

23. The shuttle must be moving at "orbit speed" in order for the satellite to remain in the orbit when released. The speed of a satellite in circular orbit around the Earth is shown in Example 6-6 to be $v_{\text{orbit}} = \sqrt{G\frac{M_{\text{Earth}}}{r}}$.

$$v = \sqrt{G\frac{M_{\text{Earth}}}{r}} = \sqrt{G\frac{M_{\text{Earth}}}{(R_{\text{Earth}} + 680\text{ km})}} = \sqrt{(6.67\times10^{-11}\,\text{N}\bullet\text{m}^2/\text{kg}^2)\frac{(5.98\times10^{24}\,\text{kg})}{(6.38\times10^6\,\text{m} + 6.8\times10^5\,\text{m})}}$$

$$= \boxed{7.52\times10^3\,\text{m/s}}$$

37. Use Kepler's third law for objects orbiting the Earth. The following are given.

$$T_2 = \text{period of Moon} = (27.4\text{ day})\left(\frac{86,400\text{ s}}{1\text{ day}}\right) = 2.367\times10^6\text{ sec}$$

$$r_2 = \text{radius of Moon's orbit} = 3.84\times10^8\,\text{m}$$

$$r_1 = \text{radius of near-Earth orbit} = R_{\text{Earth}} = 6.38\times10^6\,\text{m}$$

$$(T_1/T_2)^2 = (r_1/r_2)^3 \quad \rightarrow$$

$$T_1 = T_2(r_1/r_2)^{3/2} = (2.367\times10^6\text{sec})\left(\frac{6.38\times10^6\,\text{m}}{3.84\times10^8\,\text{m}}\right)^{3/2} = \boxed{5.07\times10^3\text{sec}}\,(= 84.5\text{ min})$$

51. The acceleration due to the Earth's gravity at a location at or above the surface is given by $g = G M_{\text{Earth}}/r^2$, where $r$ is the distance from the center of the Earth to the location in question. Find the location where $g = \tfrac{1}{2} g_{\text{surface}}$.

$$\frac{GM_{\text{Earth}}}{r^2} = \frac{1}{2}\frac{GM_{\text{Earth}}}{R_{\text{Earth}}^2} \quad \rightarrow \quad r^2 = 2R_{\text{Earth}}^2 \quad \rightarrow \quad r = \sqrt{2}R_{\text{Earth}}$$

The distance above the Earth's surface is as follows.

$$r - R_{\text{Earth}} = (\sqrt{2}-1)R_{\text{Earth}} = (\sqrt{2}-1)(6.38\times10^6\,\text{m}) = \boxed{2.64\times10^6\,\text{m}}$$