Physics 20 - Lesson 22
Gravitational Field Strength

/22

1)

$$a_g = G\frac{m_1}{r^2}$$

/3

$$a_g = 6.67\times10^{-11}\ {}^{Nm^2}\!/_{kg^2}\ \frac{(1.90\times10^{27}\,kg)}{(7.18\times10^{7}\,m)^2}$$

$$\boxed{a_g = 24.4\ {}^{m}\!/_{s^2}}$$

2)

$$m = \frac{F_g}{a_g} = \frac{780N}{9.81\ {}^{N}\!/_{kg}}$$

$$m = 79.5kg$$

/6

$$a_g = G\frac{m_1}{r^2}$$

$$a_{gMoon} = 6.67\times10^{-11}\ {}^{Nm^2}\!/_{kg^2}\ \frac{(7.34\times10^{22}\,kg)}{(1.74\times10^{6}\,m)^2}$$

$$a_{gMoon} = 1.62\ {}^{m}\!/_{s^2}$$

$$F_{gMoon} = ma_{gMoon}$$

$$F_{gMoon} = 79.5kg(1.62\ {}^{m}\!/_{s^2})$$

$$\boxed{F_{gMoon} = 129N}$$

3)

first, find the mass of the payload

$$m = \frac{F_g}{g}$$

/6

$$m = \frac{890N}{9.81\ {}^{m}\!/_{s^2}}$$

$$m = 90.7kg$$

second, find the distance from the center of the Earth to the rocket

$$r = 6.38\times10^{6}\ m\ +\ 25500\times10^{3}\ m\ =\ 3.19\times10^{7}\ m$$

third, calculate the weight of the payload in orbit

$$F_g = G\frac{m_1 m_2}{r^2}$$

$$F_g = 6.67\times10^{-11}\ {}^{Nm^2}\!/_{kg^2}\ \frac{(5.98\times10^{24}\,kg)(90.7\,kg)}{(3.19\times10^{7}\,m)^2}$$

$$\boxed{F_g = 35.6N}$$

4)

$$a_g = G\frac{m_1}{r^2}$$

/4

$$a_{gSaturn} = 6.67\times10^{-11}\ {}^{Nm^2}\!/_{kg^2}\ \frac{(5.67\times10^{26}\,kg)}{(6.03\times10^{7}\,m)^2}$$

$$\boxed{a_{gSaturn} = 10.4\ {}^{m}\!/_{s^2}}$$

$$F_{gSaturn} = ma_{gSaturn}$$

$$F_{gSaturn} = 60kg(10.4\ {}^{m}\!/_{s^2})$$

$$\boxed{F_{gSaturn} = 624N}$$

5) $F_g = ma_g$

$a_g = \frac{F_g}{m}$

/3 $a_g = \frac{72.6N}{7.50kg}$

$\boxed{a_g = 9.68 \, {}^{m}/_{s^2}}$