Quiz 6

Name: _____ Student Number: _____

CALCULATORS ALLOWED.

1. (3 marks) Write down Newton's three laws.

1. A body remains at rest or continues moving with constant velocity unless acted on by a force.
2. Force causes acceleration proportional to body's mass $\vec{F} = m\vec{a}$
3. Whenever body A exerts force on body B, body B exerts force of equal magnitude & opposite direction on A.

2. (4 marks) Geosynchronous Orbit
   a) Find the height above the Earth's surface for orbiting satellite to have a period of 24 hours. $M_{Earth} = 6 \times 10^{24}$ kg, $R_{Earth} = 6{,}400$ km
   b) Find the speed of the satellite.

a) $\frac{GM_E m}{r^2} = \frac{mv^2}{r}$

$= \frac{m}{r}\left(\frac{2\pi r}{T}\right)^2$

$GM_E = \frac{4\pi^2 r^3}{T^2}$

$r = \left(\frac{GM_E T^2}{4\pi^2}\right)^{1/3}$

$= \left(\frac{6.67\times10^{-11} \times 6\times10^{24} \times (24\times3600)^2}{4\pi^2}\right)^{1/3}$

$= 4.23 \times 10^7$ m

$r = 42{,}300$ km $\Longrightarrow$ Height above Earth surface is 35,900 km.

b) Speed $v = \frac{2\pi r}{T}$

$= \frac{2\pi \times 4.23\times10^7 \text{ m}}{24\times3600 \text{ sec}}$

$= 3.1\times10^3$ m/sec

$= 3.1$ km/sec

3. (3 marks) An astronomer sees two moons of a distant planet orbiting with periods of 100 days and 200 days.
   a) What is the ratio of their distances from the planet center?
   b) What is the ratio of the masses of the two moons?

a) Kepler's 3rd Law $R^3 \propto T^2$

$\left(\frac{R_2}{R_1}\right)^3 = \left(\frac{T_2}{T_1}\right)^2$

$\frac{R_2}{R_1} = \left(\frac{200}{100}\right)^{2/3} = 1.59$

b) Insufficient information to do problem.