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(C) - Gravitation Lecture Solutions

1. $F = \frac{GmM}{R^2} = mg_{new}$ $g = \frac{Gm_e}{(r_e)^2}$ (on Earth)

$$g_{new} = \frac{GM}{R^2} = \frac{G(2m_e)}{(3r_e)^2} = \frac{2}{9}\frac{Gm_e}{(r_e)^2} = \frac{2}{9}g$$ **B**

2. Kepler's Third Law: $T^2 \propto R^3$

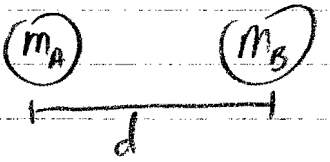
$$\frac{T^2}{h^3} = \frac{T_{new}^2}{(2h)^3}$$

$$8T^2 = T_{new}^2, \quad T_{new} = \underline{T\sqrt{8}}$$ **D**

3. Centripetal acceleration: $a = \frac{v^2}{r}$

$$v^2 = ar = \left(\frac{GM}{r^2}\right)r = \frac{GM}{r}, \quad v = \sqrt{\frac{GM}{r}} = \sqrt{\frac{GM}{h}}$$

$$v_{new} = \sqrt{\frac{GM}{h/2}} = \sqrt{\frac{2GM}{h}} = \underline{v\sqrt{2}}$$ **C**

4. 

$$F = \frac{Gm_A m_B}{d^2} = 16\ N$$

$d_{new} = 4d$ $\quad F_{new} = \frac{Gm_A m_B}{(4d)^2} = \frac{1}{16}\left(\frac{Gm_A m_B}{d^2}\right) = \frac{1}{16}(16\ N) = \underline{1\ N}$ **A**

5. $g = \frac{GM}{R^2}$

I. $\frac{GM}{(2R)^2} = \frac{1}{4}\frac{GM}{R^2}$ III. $\frac{G(2M)}{R^2} = 2\frac{GM}{R^2}$

II. $\frac{G(8M)}{(2R)^2} = 2\frac{GM}{R^2}$ IV. $\frac{GM}{R^2}$

<u>II & III</u> have the same free-fall acceleration. **B**