$\boxed{8}$. (a) $(15°) \times \dfrac{\pi \text{ rad}}{180°} = \boxed{0.26 \text{ rad}}$. (b) $(45°) \times \dfrac{\pi \text{ rad}}{180°} = \boxed{0.79 \text{ rad}}$.

(c) $(90°) \times \dfrac{\pi \text{ rad}}{180°} = \boxed{1.6 \text{ rad}}$. (d) $(120°) \times \dfrac{\pi \text{ rad}}{180°} = \boxed{2.1 \text{ rad}}$.

9. (a) $(\pi/6 \text{ rad}) \times \dfrac{180°}{\pi \text{ rad}} = \boxed{30°}$. (b) $(5\pi/12 \text{ rad}) \times \dfrac{180°}{\pi \text{ rad}} = \boxed{75°}$.

(c) $(3\pi/4 \text{ rad}) \times \dfrac{180°}{\pi \text{ rad}} = \boxed{135°}$. (d) $(\pi \text{ rad}) \times \dfrac{180°}{\pi \text{ rad}} = \boxed{180°}$.

17. $s = r\theta = (0.600 \text{ m})(7.50 \text{ rev}) \times \dfrac{2\pi \text{ rad}}{1 \text{ rev}} = \boxed{28.3 \text{ m}}$.

$\boxed{28}$. $\omega = \dfrac{\Delta\theta}{\Delta t} = \dfrac{2.5(2\pi \text{ rad})}{(3.0 \text{ min})(60 \text{ s/min})} = \boxed{0.087 \text{ rad/s}}$.

29. $\omega = \dfrac{\Delta\theta}{\Delta t}$, ☞ $\Delta t = \dfrac{\Delta\theta}{\omega} = \dfrac{2\pi \text{ rad}}{3.5 \text{ rad/s}} = \boxed{1.8 \text{ s}}$

36. $\bar{v} = \dfrac{\Delta x}{\Delta t} = \dfrac{2.55 \text{ m}}{2.30 \text{ s}} = 1.11 \text{ m/s}$. $\bar{v} = r\bar{\omega}$, ☞ $\bar{\omega} = \dfrac{\bar{v}}{r} = \dfrac{1.109 \text{ m/s}}{1.75 \text{ m}} = \boxed{0.634 \text{ rad/s}}$.

As calculated, the tangential speed is $\boxed{1.11 \text{ m/s}}$.

37. (a) $v = r\omega$, ☞ $\omega = \dfrac{v}{r} = \dfrac{15 \text{ m/s}}{(120 \text{ m})/2} = 0.25 \text{ rad/s}$.

$\theta = \omega\Delta t = (0.25 \text{ rad/s})(4.00 \text{ min})(60 \text{ s/min}) = \boxed{60 \text{ rad}}$.

(b) $s = r\theta = \dfrac{120 \text{ m}}{2} \times (60 \text{ rad}) = \boxed{3.6 \times 10^3 \text{ m}}$.

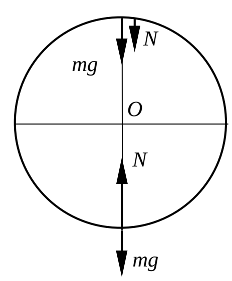
48. $a_c = r\omega^2$, ☞ $\omega = \sqrt{\dfrac{a_c}{r}} = \sqrt{\dfrac{9.80 \text{ m/s}^2}{(35000 \text{ m})}} = \boxed{0.053 \text{ rad/s or about 730 rev/day}}$.

49. $a_c = r\omega^2 = (3.80 \times 10^8 \text{ m})\left[\dfrac{2\pi \text{ rad}}{(27.3 \text{ day})(86400 \text{ s/day})}\right]^2 = \boxed{2.69 \times 10^{-3} \text{ m/s}^2}$.

55. The radius is $\dfrac{56.0 \text{ cm}}{2} = 28.0 \text{ cm} = 0.280 \text{ m}$. In one period, each mass travels a tangential distance that is equal to the circumference of a circle of radius 0.280 m. The tangential speed is then $v = \dfrac{2\pi(0.280 \text{ m})}{0.750 \text{ s}} =$ 2.345 m/s.

$F_c = m\dfrac{v^2}{r} = (1.50 \text{ kg}) \times \dfrac{(2.345 \text{ m/s})^2}{0.280 \text{ m}} = \boxed{29.5 \text{ N}} < 100 \text{ N}$. The $\boxed{\text{string will work}}$.

$\boxed{56}$. (a) The normal force is greater $\boxed{\text{at the bottom}}$, because at that position, the normal force has to provide the upward centripetal force, in addition to supporting the weight of the pilot.



(b) 700 km/h = 194 m/s. At the bottom, the centripetal force is provided by the difference $N - mg$. So $F_c = N - mg = m\dfrac{v^2}{r}$,

$N = mg + m\dfrac{v^2}{r} = mg + m\dfrac{(194 \text{ m/s})^2}{2.0 \times 10^3 \text{ m}} = mg + m(18.8 \text{ m/s}^2) = mg + 1.9mg = \boxed{2.9mg}$.

(b) At the top, the centripetal force is provided by $N + mg$.

$N = m\dfrac{v^2}{r} - mg = m\dfrac{(194 \text{ m/s})^2}{2.0 \times 10^3 \text{ m}} - mg = m(18.8 \text{ m/s}^2) - mg = 1.93mg - mg = \boxed{0.93mg}$.

66. 700 rpm = 73.3 rad/s, 3000 rpm = 314 rad/s. $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{314 \text{ rad/s} - 73.3 \text{ rad/s}}{3.0 \text{ s}} = \boxed{80 \text{ rad/s}^2}$.

67. Given: $\omega_o = 0$, $\omega = 2.5$ rpm = 0.262 rad/s, $\theta = 5.0$ rev = 10π rad. Find: α.

$\omega^2 = \omega_o^2 + 2\alpha\theta$, ☞ $\alpha = \frac{\omega^2 - \omega_o^2}{2\theta} = \frac{(0.262 \text{ rad/s})^2 - 0}{2(10\pi \text{ rad})} = \boxed{1.1 \times 10^{-3} \text{ rad/s}^2}$.

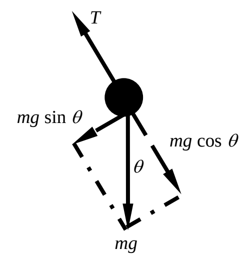
$\boxed{72}$. (a) In the tangential direction, $\Sigma F = mg \sin\theta = ma_t$.

So $a_t = g \sin\theta = (9.80 \text{ m/s}^2) \sin 15° = \boxed{2.5 \text{ m/s}^2}$.

$a_c = \frac{v^2}{r} = \frac{(2.7 \text{ m/s})^2}{0.75 \text{ m}} = \boxed{9.7 \text{ m/s}^2}$.

(b) At the $\boxed{\text{lowest point}}$ of the swing, since v is maximum there.

$a_t = \boxed{0}$ since $\theta = 0$ so $\sin\theta = 0$.



76. (d), because $a_g = \frac{GM_E}{(R_E + h)^2}$. When $h = R_E$, a_g becomes $\frac{1}{2^2} = \frac{1}{4}$ as large.

$\boxed{80}$. $g_M = \frac{GM_M}{R_M^2} = \frac{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(7.4 \times 10^{22} \text{ kg})}{(1.75 \times 10^6 \text{ m})^2} = \boxed{1.6 \text{ m/s}^2}$.

81. $F = \frac{GM_E M_M}{r_{E\text{-}M}^2} = \frac{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(5.98 \times 10^{24} \text{ kg})(7.4 \times 10^{22} \text{ kg})}{(3.8 \times 10^8 \text{ m})^2} = \boxed{2.0 \times 10^{20} \text{ N}}$.

83. $F_1 = F_3 = \frac{Gm^2}{d^2} = \frac{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(2.5 \text{ kg})^2}{(1.0 \text{ m})^2} = 4.17 \times 10^{-10}$ N,

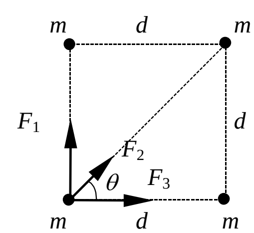
The diagonal distance is $\sqrt{(1.0 \text{ m})^2 + (1.0 \text{ m})^2} = \sqrt{2}$ m,

so $F_3 = \frac{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(2.5 \text{ kg})^2}{(\sqrt{2} \text{ m})^2} = 2.08 \times 10^{-10}$ N.

From symmetry the net force is

$F = \sqrt{(4.17 \times 10^{-10} \text{ N})^2 + (4.17 \times 10^{-10} \text{ m})^2} + 2.08 \times 10^{-10}$ N

$= \boxed{8.0 \times 10^{-10} \text{ N, toward opposite corner}}$.



98. The Kepler constant for orbiting Mars is

$K_M = \frac{4\pi^2}{Gm_M} = \frac{4\pi^2}{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(6.4 \times 10^{23} \text{ kg})} = 9.24 \times 10^{-13} \text{ s}^2/\text{m}^3$.

T = 1 day = 24(3600 s) = 86 400 s (synchronous satellite).

From $T^2 = Kr^3$, ☞ $r = \sqrt[3]{\frac{T^2}{K_M}} = \sqrt[3]{\frac{(86400 \text{ s})^2}{9.24 \times 10^{-13} \text{ s}^2/\text{m}^3}} = \boxed{2.0 \times 10^7 \text{ m}}$.

102. T = 48 h = (48 h)(3600 s/h) = 1.728×10^5 s. r = 550 km + 1500 km = 2050 km = 2.05×10^6 m.

From Kepler's third law, $T^2 = \left(\frac{4\pi^2}{GM}\right) r^3$,

$M = \frac{4\pi^2 r^3}{GT^2} = \frac{4\pi^2 (2.05 \times 10^6 \text{ m})^3}{(6.67 \times 10^{-11} \text{ N·m}^2/\text{kg}^2)(1.728 \times 10^5 \text{ s})^2} = \boxed{1.7 \times 10^{20} \text{ kg}}$.