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P20 Unit C - UCM UA Pt. A

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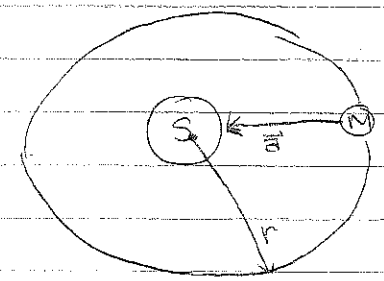
Due: Mon, Nov. 26



1. $|a_c| = \frac{4\pi^2 r}{T^2}$

$(0.040 m/s^2) = \frac{4\pi^2 (5.8\times10^{10} m)}{T^2}$

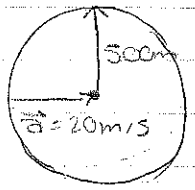
$T^2 = \frac{4\pi^2 (5.8\times10^{10} m)}{(0.040 m/s^2)}$

2/2 $T^2 = 5.7\times10^{13} s^2$

$T = 7.6\times10^6 s$

$7.6\times10^6 \div 60 sec. \div 60 min \div 24 hrs$ → 88 days

2. $|a_c| = \frac{4\pi^2 r}{T^2}$



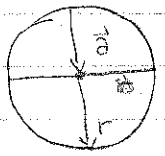
$(20 m/s^2) = \frac{4\pi^2 (500 m)}{T^2}$

2 $T^2 = \frac{4\pi^2 (500 m)}{(20 m/s^2)}$

$T^2 = 987.0 s^2$

$T = 31 s$

3.



$|\vec{a}_c| = \frac{v^2}{r}$

$|\vec{a}dr = v^2$

$(25 m/s^2)(2.5 m) = v^2$

$62.5 m^2/s^2 = \vec{v}^2$

$7.9 m/s = \vec{v}$

$\vec{v}_c = \frac{2\pi r}{T}$

$(7.9 m/s) = \frac{2\pi (2.5 m)}{T}$

$T = \frac{2\pi (2.5 m)}{(7.9 m/s)}$

$\vec{F}_c = \frac{v^2 m}{r}$

2 $\vec{F}_c = \frac{(6.0\,m/s)^2(0.30\,kg)}{(1.5\,m)}$

$\vec{F}_c = 7.2\,N$

9. $\vec{F}_c = \vec{F}_f$

$\frac{v^2 m}{r} = \mu m \vec{g}$

$\frac{v^2}{r} = \mu \vec{g}$

2 $\frac{v^2}{(80m)} = (0.81)(9.81\,m/s^2)$

$v^2 = (0.81)(9.81\,m/s^2)(80m)$

$v^2 = 636\,m^2/s^2$

$v = 25\,m/s$

10. $\vec{F}_c = \vec{F}_f$

$\frac{mv^2}{r} = \mu m \vec{g}$

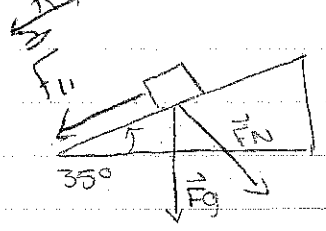
$\frac{v^2}{r} = \mu \vec{g}$

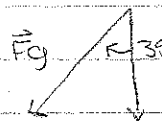
2 $\frac{(25\,m/s)^2}{(120m)} = \mu(9.81\,m/s^2)$

$5.25\,m/s^2 = \mu(9.81\,m/s^2)$

$0.53 = \mu$

11.





$\vec{F}_g = m\vec{g}$

$\vec{F}_g = (2500\,kg)(9.81\,m/s^2)$

$F_g = 24525\,N$

13. $20\,000\,km = 20\,000\,000\,m = 2.0\times10^{7}\,m$

$9500\,km = 9\,500\,000\,m = 9.5\times10^{6}\,m$

$$|\vec{a}_c| = \frac{v^2}{r}$$

$$(18\,m/s^2) = \frac{v^2}{(2.0\times10^{7}\,m + 9.5\times10^{6}\,m)}$$

2 $$(18\,m/s^2) = \frac{v^2}{(2.95\times10^{7}\,m)}$$

$$\sqrt{(18\,m/s^2)(2.95\times10^{7}\,m)} = v$$

$$2.3\times10^{4}\,m/s = v$$

14. $\vec{F}_c = \vec{F}_g$

$$\frac{m4\pi^2 r}{T^2} = \frac{Gmm_2}{r^2}$$

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

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

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

$$r = \sqrt[3]{\frac{(6.67\times10^{-11}\,Nm^2/kg^2)(5.97\times10^{24}\,kg)(86400\,s)^2}{4\pi^2}}$$

$$r = 4.2\times10^{7}\,m - 6.37\times10^{6}\,m = 3.6\times10^{7}\,m$$

15. $$\frac{mv^2}{r} = \frac{Gmm_2}{r^2}$$

2 $$v^2 = \frac{Gmr}{r}$$

$$v = \sqrt{\frac{Gmr}{r}}$$

$$v = \sqrt{\frac{(6.67\times10^{-11}\,Nm^2/kg^2)(5.97\times10^{24}\,kg)(100\,000\,m + 6.37\times10^{6}\,m)}{(100\,000\,m + 6.37\times10^{6}\,m)}}$$

$$v = 7.85\times10^{3}\,m/s$$