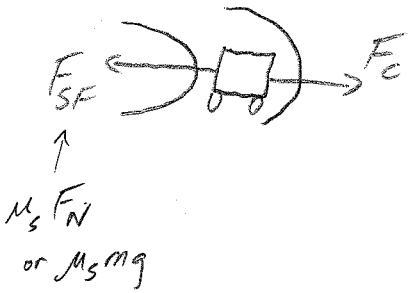
Physics 10154 - Exam #7A

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A car can barely stay on the road if it goes around a flat curve of radius 85 meters at a speed of 45 miles/hour. What is the maximum speed of the same car on the same road if it goes around a curve of radius 35 meters? Answer in miles/hour.

1st case $\quad V = 45 \frac{mi}{hr} = 20.1 \frac{m}{s}$



$$\Sigma F_{rad} = F_{SF} - F_c = 0$$

$$\mu_s mg - \frac{mv^2}{r} = 0$$

$$\mu_s = \frac{v^2}{rg} = \frac{20.1^2}{(85)(9.8)} = 0.4856$$

2nd case

$$v^2 = \mu_s r g$$

$$v = \sqrt{(.4856)(35)(9.8)}$$

$$= 12.9 \frac{m}{s}$$

$$= \boxed{29 \frac{mi}{hr}}$$

2. A test rocket is fired straight up with an initial speed of 19,000 miles/hour. To what maximum altitude above the Earth's surface does it rise?

The constants you should need are on your formula sheet.

$$U_i = -\frac{GMm}{r_i} = -\frac{(6.67\times10^{-11})(5.98\times10^{24})m}{6.38\times10^{6}}$$

$$= -6.252\times10^{7}\ m$$

$$U_f = -\frac{GMm}{r_f} = -\frac{3.989\times10^{14}\ m}{r_f}$$

$$V_0 = 19000\ mi/hr = 8492\ m/s$$

$$K_i = \frac{1}{2}mv_0^2 = 3.606\times10^{7}\ m$$

$$K_f = 0$$

$$U_i - U_f = K_f - K_i$$

$$-6.252\times10^{7} - \frac{3.989\times10^{14}}{r_f} = 0 - 3.606\times10^{7}$$

$$\frac{3.989\times10^{14}}{r_f} = 2.65\times10^{7}$$

$$r_f = 1.51\times10^{7}\ m$$

$$h = r_f - R_E = \boxed{8.72\times10^{6}\ m}$$

or 5420 miles