Name: _____

Quiz 5

A roller coaster goes around a circular vertical loop of radius $r = 5.0m$. The car has a mass of $250kg$.

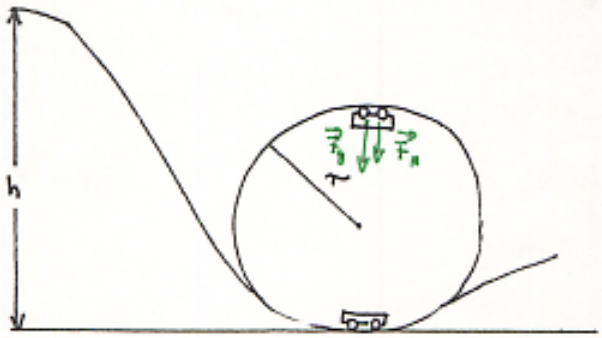
(0.5) (a) Draw all the forces acting on the car at the highest point of the loop.

(1) (b) In order for the car not to derail at the highest point, the tracks need to exert a normal force on the car, which is 0.30 times the weight of the car. How fast has the car to be at the highest point of the loop?

(1.5) (c) What is the normal force acting on the car at the lowest point of the loop?

(1) (d) How high does the roller coaster have to start off when it is released?

Good Luck!



(b) $\vec{F}_c = \vec{F}_g + \vec{F}_N = 1.3\,mg$

$m\frac{v_t^2}{r} = 1.3mg$

$v_t^2 = 1.3rg$ $\quad v = 8.0\ \frac{m}{s}$

(c) $\frac{1}{2}mv_B^2 = \frac{1}{2}mv_t^2 + mg\cdot 2r$

$v_B^2 = v_t^2 + 4gr = 5.3gr$

$F_c = F_N - F_g$

$F_N = m\frac{v_B^2}{r} + mg = m\cdot 6.3\,g = 1.5\cdot 10^4\,N$

(d) $mgh = \frac{1}{2}mv_B^2 = \frac{1}{2}mgr\ 5.3$

$h = \frac{5.3}{2}r = 13m.$

Name: _____

Quiz 6

There is a moat around a castle. As the castle is attacked by a dragon, the $11000N$ drawbridge over the moat is pulled up to an angle of 30°. At the end of the $5m$ long drawbridge there is the knight Kunibert of weight $1200N$ trying to fight off the dragon. The drawbridge is held up by a rope, which makes an angle of 40° with the bridge.

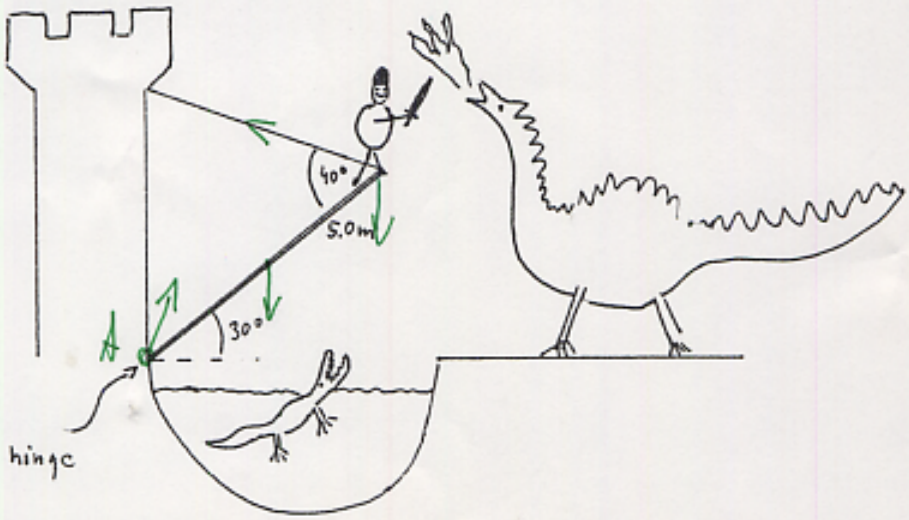
(1) (a) Draw all the forces acting onto the drawbridge into the figure and idicate an axis A of rotation.

(1.5) (b) What is the tension in the rope?

(1) (c) What are the components of the force acting on the hinge of the drawbridge?

(0.5) (d) What is the magnitude and direction of the force acting on the hinge of the drawbridge?

Good Luck!



(b) $-\frac{\ell}{2} \cdot \cos 30° \cdot 11000\,N - \ell \cdot \cos 30° \cdot 1200\,N + F_T \cdot \ell \cdot \sin 40° = 0$

$F_T = 9027\,N \approx \underline{9.0 \cdot 10^3 N}$

$\tan\theta = \frac{F_{Hy}}{F_{Hx}}$, $F_H = \sqrt{F_{Hx}^2 + F_{Hy}^2}$

(c) $x: \; -F_T \cdot \cos 10° + F_{Hx} = 0$ $\quad F_{Hx} = 8890\,N \approx 8.9 \cdot 10^3 N$

$y: \; F_T \cdot \sin 10° - F_{g1x} - F_{g1b} + F_{Hy} = 0$ $\quad F_{Hy} = 10600\,N \approx 1.1 \cdot 10^4 N$

$F_H = 13900\,N \approx 1.4 \cdot 10^4 N$

$\theta = 50.0° \approx 50°$