Ideal Springs and Hooke's Law U2P2a

- "Ideal" springs obey _____ Law, possess no _____ and generate no _____ and when they are _____ or _____. Real life metal coil springs best match the _____ assumption provided the spring is not stretched or compressed too far.
- Hooke's Law states force is _____ _____ to displacement from equilibrium: ___=_____, where k tells how difficult it is to _____/_____ the spring (called the _____ constant). Equilibrium is the position the spring will _____ after being stretched. The negative sign is present because the force always _____. When a spring system is at equilibrium, either ____ = 0 N or ____ = 0 N depending on problem wording.

Warning: spring problems have **two** possible equilibrium points.

1. If asked, "What is the force of _____ within the spring?" then equilibrium is the rest position with no extra _____ hung from the spring.
2. If asked, "What is the ***restoring*** force or ***net*** _____ acting on the attached object, then _____ is from the _____ position with _____.
   - The key difference is if your object of interest is the _____ (case 1) or the _____ (case 2).

At equilibrium (no mass)	Stretched/at equilibrium (with mass)	Stretched (with mass)

Graphing Springs

_____

_____

_____

Quantitative Examples A 5kg mass is hung vertically from a spring with k=200N/m.

1. When the spring is at equilibrium, what tension will it have?
2. How far is the spring stretched from its natural equilibrium point?
3. If the stretch is maintained, but the spring is rotated horizontally and placed on a frictionless table, what will the block's acceleration be when released?
4. What if the table has μ_K=0.2 and μ_S=0.2?

When Δx (separation from equilibrium) = max, speed is _____ and acceleration/____ is _____.

Because ____ = _____when passing through equilibrium (Δx = ____), acceleration = _____ and speed = _____.

Tension and Its Effects Using Ropes/Strings U2P2b

- The force inside of a string/rope that is pulled tight is called _____. Assuming the string has negligible mass, the _____ within a single string is _____ regardless of string _____ or _____, so long as no additional tangential forces act on any part of the middle of the string.
- Normal force always points _____ to a surface, so it _____ cause tension to be **un**even within a string. Note: It can cause tension to exist, though.
- Friction is always _____ to a surface, so it _____ cause **un**even tension.
- Gravity acting on a mass attached to a string can create _____. If the mass is on an incline only the _____ _____ creates tension. If the mass is accelerating, tension must _____/_____ so that ____ = _____.

Knots Connecting Strings

Pulleys System

Ideal Atwood Machine

Atwood On An Incline

Universal Law of Gravity

- The _____ Law of _____ applies _____ places, because it is _____.
- $F_G =$
  - Where m is the _____, M is the _____, r is the _____ between the _____ of the ___ & ___'s, and G is a _____ that is always true.
- So, why do we have both F_G and _____? Well, if you spend your whole life on _____, then ___, ___, and ___ never change *significantly*. (Note: r_{earth} = 6,378km and Mt. Everest <9km, so even climbing to the top of Mt. Everest only changes r by ____%. Climbing the stairs at Keppel has ___ measurable effect on ____.)
  - $F_G =$ = = =