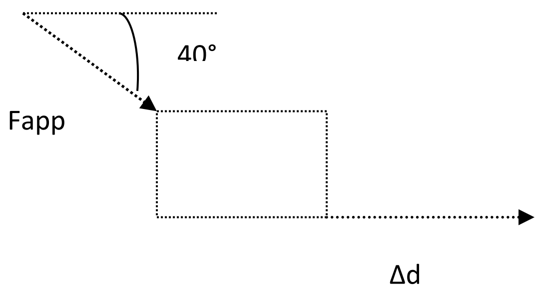
Work & Energy

Work 5.2

$W = F \cdot \Delta d$ Work = Force exerted over a distance Unit = Joule (J) or N•m

* Remember – Some component of force must be in the same plane as displacement. There must be some collinear-ness to force and displacement.

* If force applied at an angle, you must find the component.



You must use trigonometry to calculate Fappx which is parallel (collinear) to Δd.

Often $W = F\Delta d$ becomes $W = F \cos\theta \Delta d$
But do not assume.

Energies we are going to work with:

- Kinetic (moving) energy → $E_k = \frac{1}{2} mv^2$
- Gravitational potential energy → $E_g = mg\Delta h$
- Elastic Energy → $E_e = \frac{1}{2} kx^2$

+Work and –Work

If I lift a box up, then the work done is +Work. I assume I lift with Fapp = Fg which I can calculate (Fg = mg). This assumption is a fair one. We usually lift with constant velocity (acceleration = 0). If we lift with constant velocity, then Fnet = 0. (Balanced forces means no change in motion -- can be moving at constant velocity). If I set [up] = +ve, then Fapp = +ve and Δd = +ve, then Work is +ve!

If I lift a box down, then the work done is –work. Again, I assume I exert an upward force (so the box doesn't merely fall to the ground) equal to gravity. Fapp = Fg. Fapp is +ve since it is up. But the Δd is –ve since the box is moving down. Therefore, work is –ve when lifting down.

Energy 5.3, 5.4

Work-Energy Theorem

Work and Energy are very closely connected! Both are measure in Joules.
+work stores energy and energy is the ability to do work. –work uses energy.

Mathematically, we can say….

+W if $E2 - E1 > 0$ Whereas E2 = energy at 2nd spot and E1 = energy at 1st spot

-W if $E2 - E1 < 0$

Conservation of Energy

Energy is never created nor destroyed but it does transform into different forms.

Ie: When a diver jumps into the water, all the Eg on top of the diving board transforms into Ek as she enters the water.

If you have a closed system in which you understand all the variables, the total energy at one point is equal to the total energy at any other point. This is helpful in calculations.

Elastic Energy

Ee = ½ kx2 whereas k = elastic constant – unit is N/m

'k' is calculated experimentally and is the measure of how much compression or stretch an elastic material undergoes for a certain amount of newtons of force.

Any material is considered 'elastic' in nature if it has the ability to return to its original form after being compressed or stretched. Ie: rubber bands, springs, shock absorbers, tennis balls……

See graph pg. 250

Homework: pg. 238 # 1,3,4,5 (Work)

Pg. 242 # 1,2,5,6 (Ek)

Pg. 248 # 1,3,4 (Eg, Ee)