Conservation of Energy

With Friction

Friction

- When the only force acting on an object is gravity, the total mechanical energy of the system stays constant.
- BUT when a frictional force acts on an object, the final mechanical energy will be less than the initial.
- This is because some of the initial mechanical energy gets converted to thermal energy (HEAT).
- HEAT = Thermal energy = Work done by friction

$$W = F_f d$$

$$TE_0 - W = TE$$

$$KE_0 + PE_0 - W = KE + PE$$

Ex 1: A 22 kg child starts from rest and descends a slide 4.5 m high. 320 J of heat is created in the process. What is the child's speed at the bottom?

$$KE_0 + PE_0 - W = KE + PE$$

Speed	Height	KE	PE	HEAT (W)	TE

Ex 2: A 1000 kg roller coaster has a speed of 1.70 m/s as it goes over the top of a 30 m high hill. On its way down, the roller coaster experiences an average force of resistance equal to 1960 N. What will its speed be at the bottom of the hill if the length of the track is 45 m?

$$KE_0 + PE_0 - W = KE + PE \qquad W = F_f d$$

Speed	Height	KE	PE	HEAT (W)	TE

Ex 3: A 1500 kg car is pushed down a 30 m long hill with an initial speed of 4 m/s. The hill is sloped at an angle of 30^{o} to the horizontal and an average frictional force of 1200 N impedes the car's motion on the way down. How fast is it moving at the bottom of the hill?

Speed	Height	KE	PE	HEAT (W)	TE

Ex 4: A 20 kg rock is dropped off a cliff and lands in some water. The rock is dropped from a height of 15 m above the cliff and the rock comes to rest 8.0 m below the surface of the water.

A) How fast is the roc moving as it enters the water?

B) How much heat is generated as the water stops the rock?

C) What is the average resistive force exerted on the rock by the water?

Speed	Height	KE	PE	HEAT (W)	TE