Rotating objects have angular momentum as well

$$\frac{\tau_{net}}{I} = \alpha = \frac{\Delta\omega}{\Delta t} \rightarrow \underbrace{I\Delta\omega}_{\text{change in angular momentum}} = \underbrace{\tau_{net}\Delta t}_{\text{rotational impulse}}$$

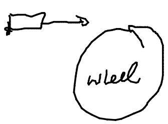
$p = mv$

$L = I\omega$ angular momentum

No external torque $\rightarrow$ L is conserved

e.g. ice skater –

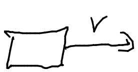
pull arms in
decreases I
if L conserved,
then increases ω
so that $I\omega$
stays the same



block hits wheel & causes it to spin

L for wheel is not conserved
because block exerts
an external torque

wheel + block together
- no external torque
- angular momentum should be conserved
- objects moving linearly can also have angular momentum



$L \neq 0$ around pivot

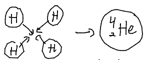
Energy

kinetic (motion)
light, sound, thermal energy,
chemical, electrical, elastic
gravitational, mass

Energy is a scalar quantity
measured in Newton-meters or Joules (J)

(also calories & kW-hr)

Energy is <u>conserved</u>! it cannot be created or destroyed, but must flow around or change from one form to another

e.g. 

+ a lot of energy!

H bomb or nuclear fusion

4 H atoms have slightly more mass than 1 He atom

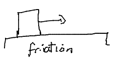
mass is a type of energy

$$E = mc^2$$

e.g. 1 kg of mass

$$E = (1\,kg)(3\times10^8\,m/s)^2$$
$$= 9\times10^{16}\,J \quad = 2.5\times10^{10}\,kW\,hr$$
= 2 million American homes for a year

Energy <u>flow</u> & <u>change</u> is most important

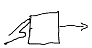


Initial: kinetic energy

friction <u>steals</u> the energy by way of a force & converts it to heat & sound

friction <u>dissipates</u> energy

An energy flow due to a force is called <u>WORK</u>.



"hand does +5J of work on block"
hand gives energy to the block

"block does −5J of work on hand"
block stealing energy

$\Delta E =$

~~A) −8J~~ B) −2J
$\boxed{\text{C) +2J}}$ D) +8J

runaway car.
I push on it & bring it to a stop

Superman stops the car much more quickly

Who does more work?
A) me B) Superman C) both the same

Same work, but Superman does it faster

Superman exerts more <u>power</u>

$$P = \frac{W}{\Delta t} \quad \text{units: } \frac{J}{s} = \text{Watts (W)}$$