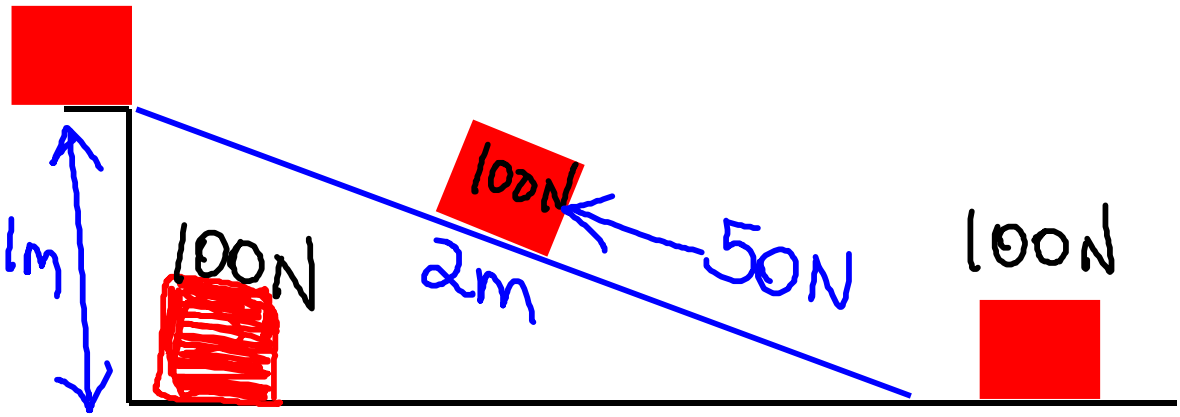
Aim: Understand how machines help us do work.

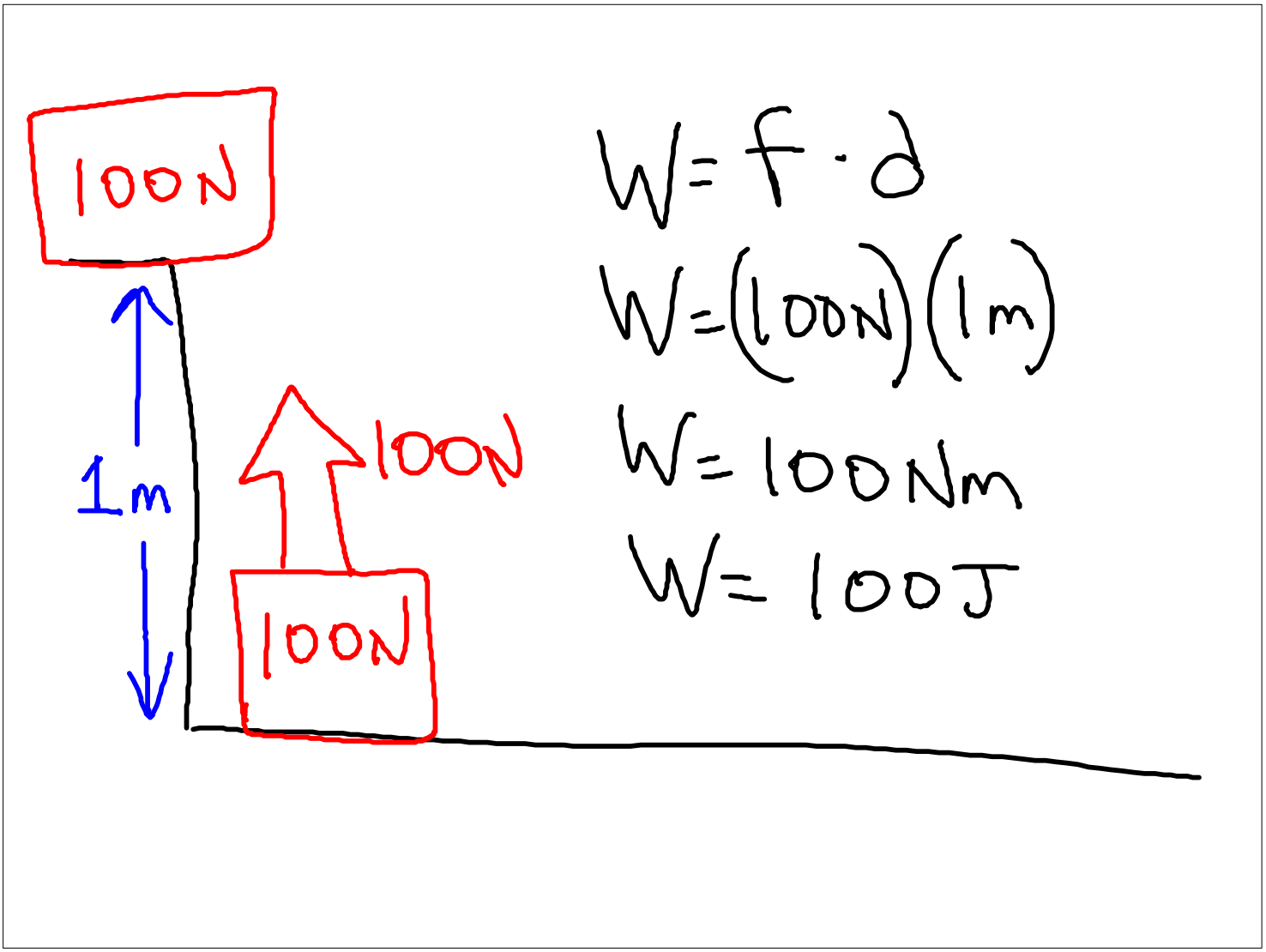
A machine is a device that makes doing **work** EASIER.

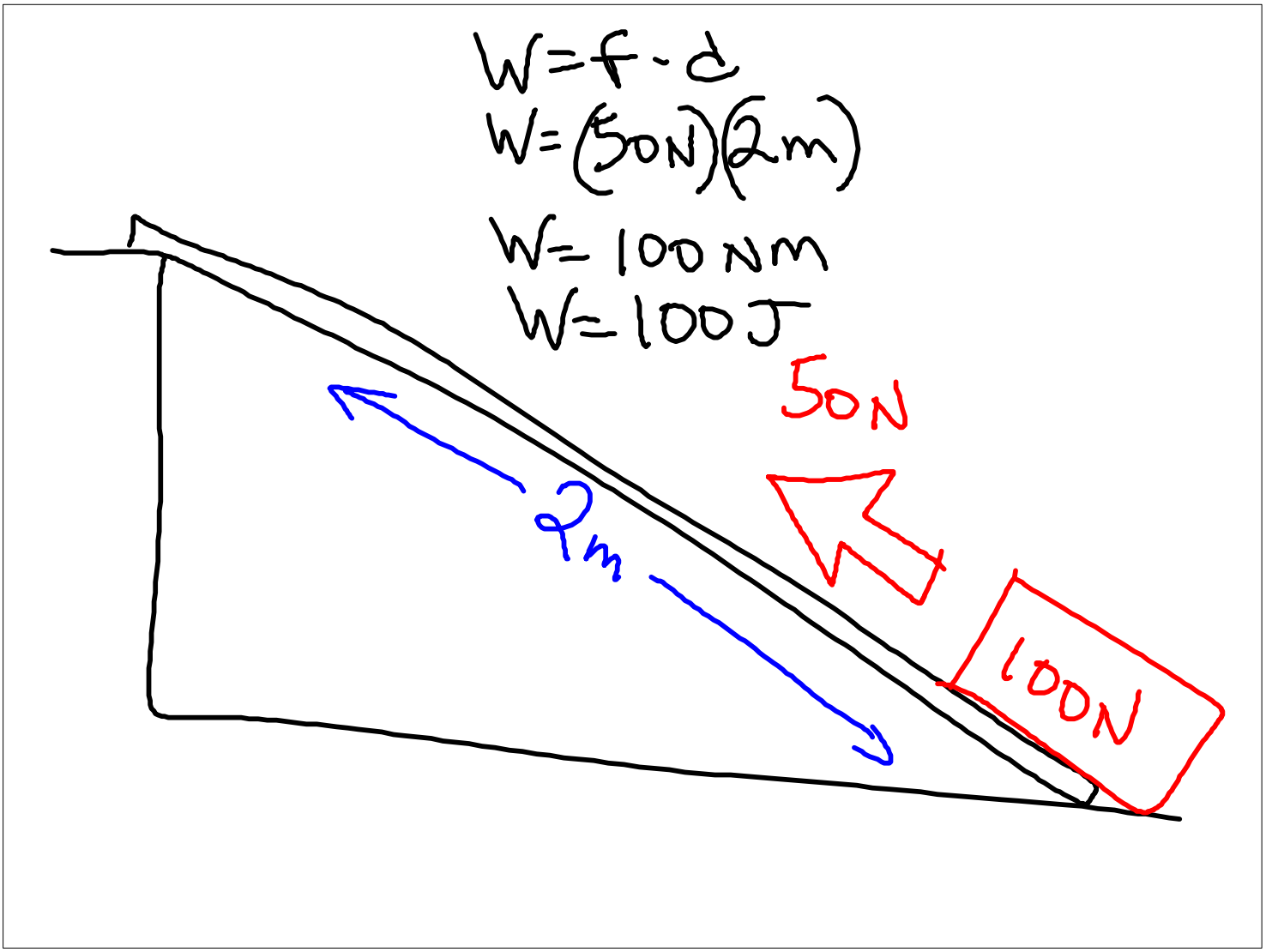
Remember W=Fd

Machines can change the force and the distance an object moves.

Example: Ramp




100N
1m
100N
100N
W = f · d
W = (100N)(1m)
W = 100Nm
W = 100J


W=f·d
W=(50N)(2m)
W=100Nm
W=100J
50N
2m
100N

Work done by a machine is ***equal*** to work put into a machine.

$$W_{in}=W_{out}$$

$$F_{in}xd_{in}=F_{out}xd_{out}$$

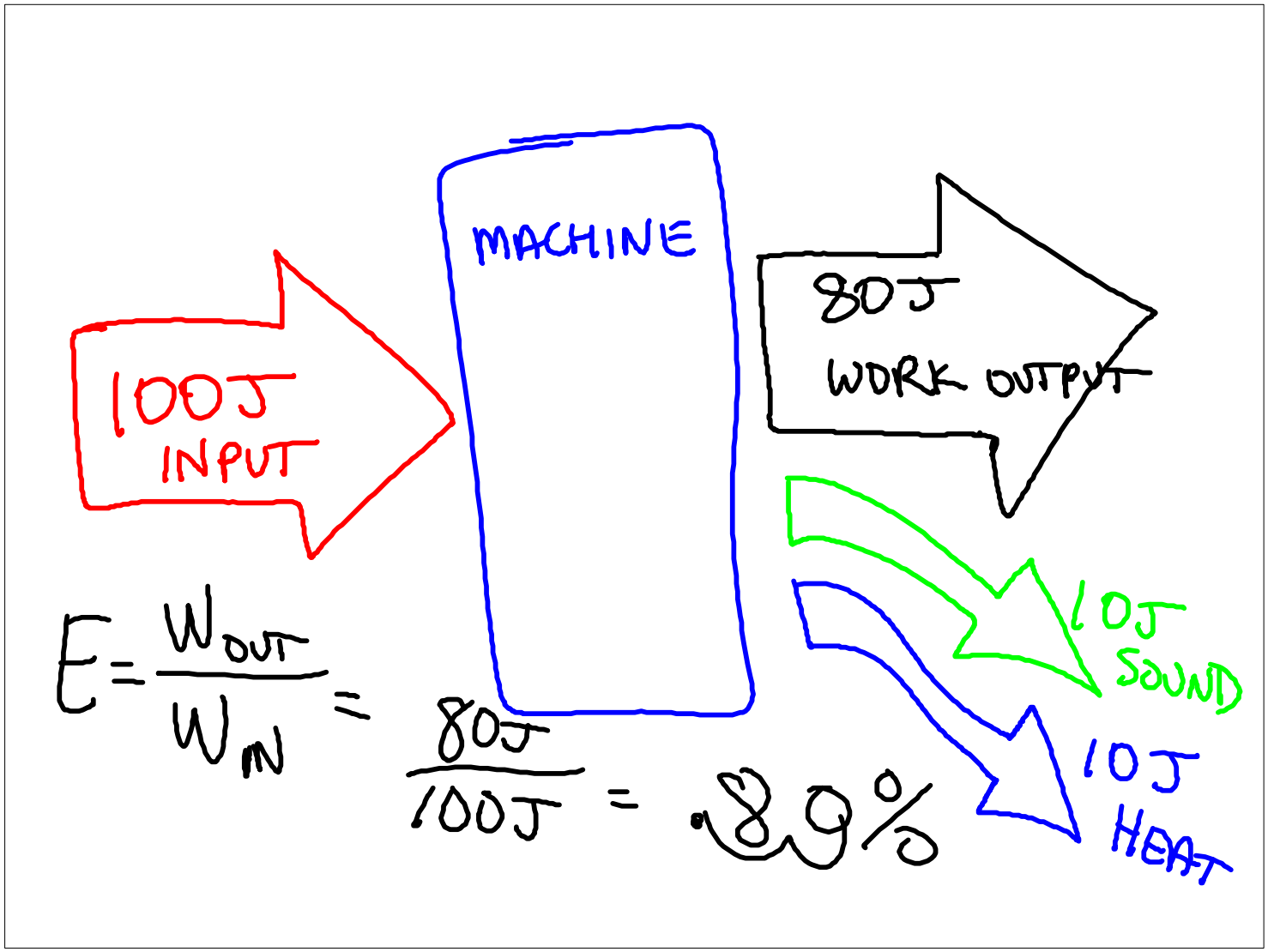
$(50N)x(2m) = (100N)(1m)$

$100J = 100J$

Efficiency is the measure of how much work input is changed to work output.

No machine is 100% efficient

$$\text{Efficiency}(\%) = \frac{\text{Work}_{out}}{\text{Work}_{in}}$$


MACHINE
100J
INPUT
80J
WORK OUTPUT
10J
SOUND
10J
HEAT
$E = \frac{W_{OUT}}{W_{IN}} = \frac{80J}{100J} = .8 9\%$

Machines waste energy on heat and sound.

Reducing friction will increase efficiency.

List the 6 simple machines

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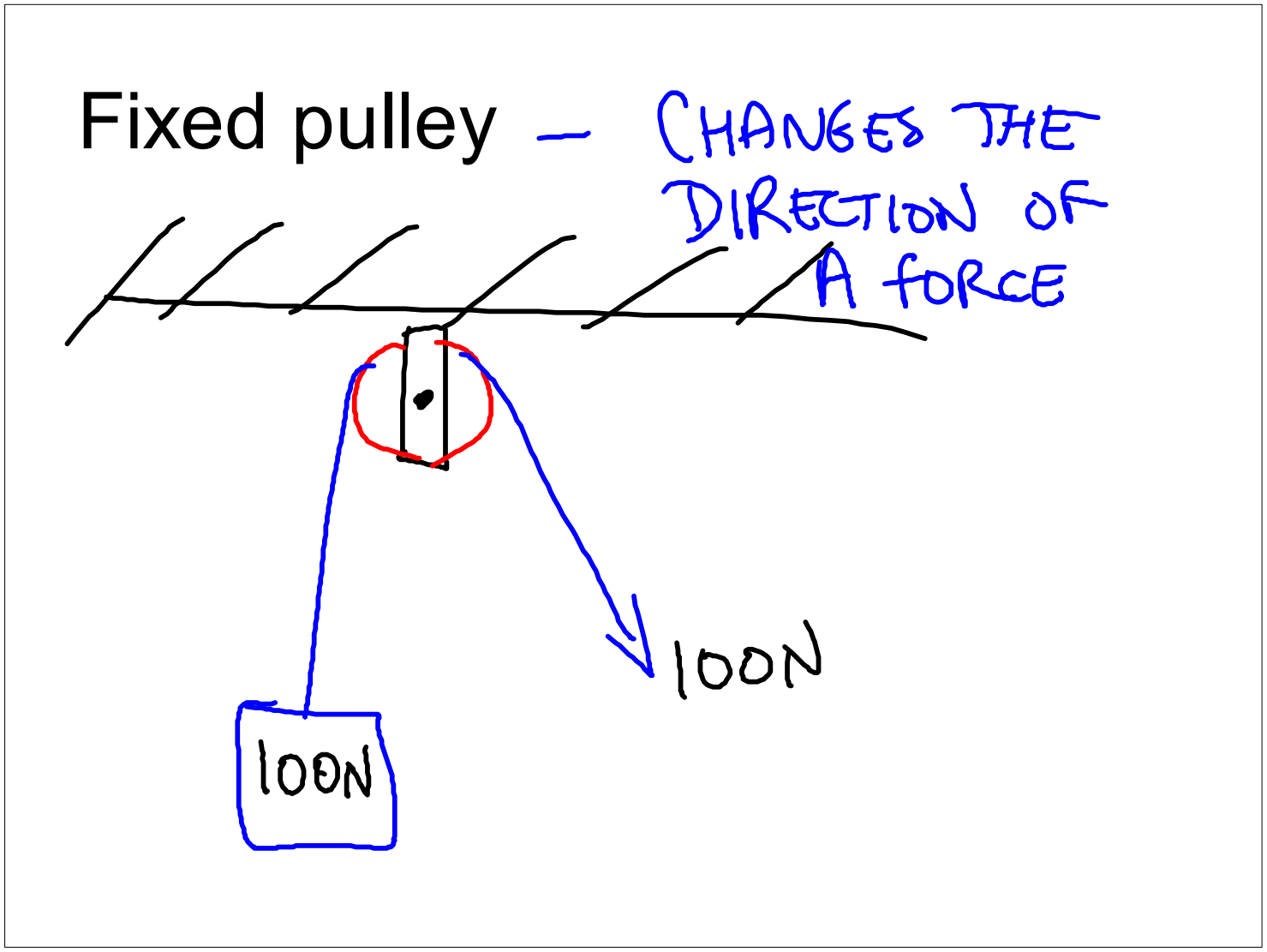
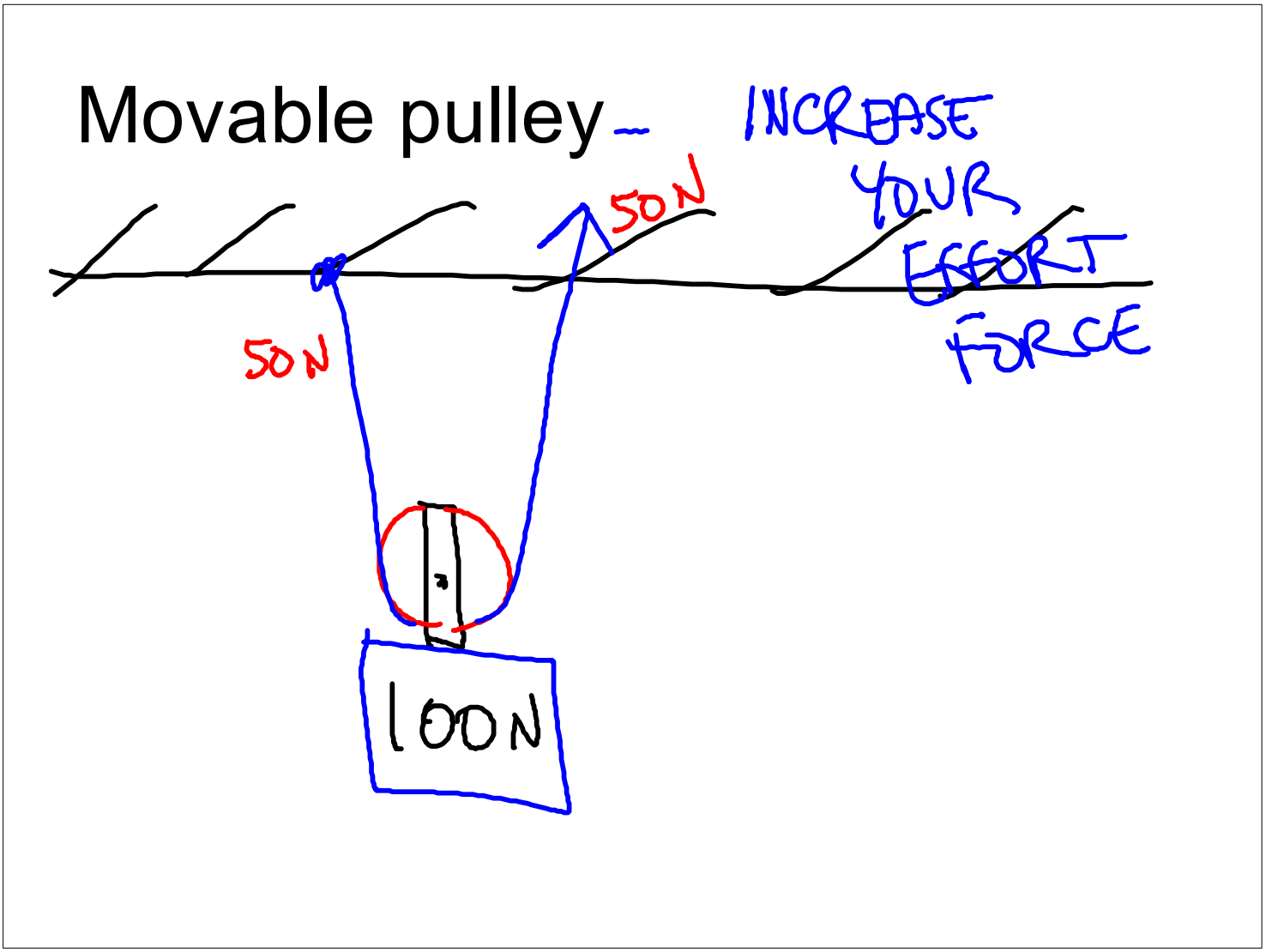
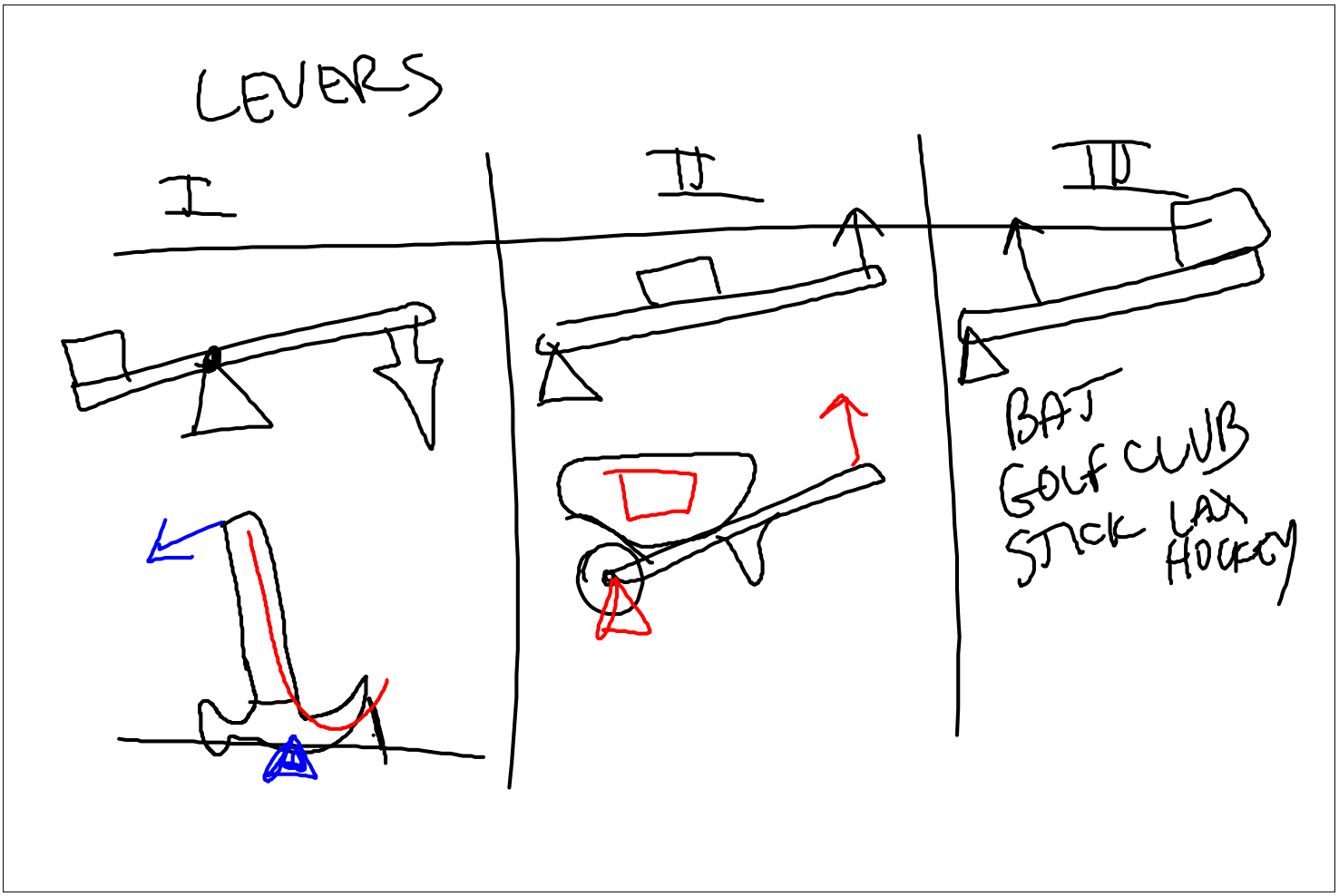
Lever	Inclined Plane
Pulley	Wedge
Wheel and Axle	Screw

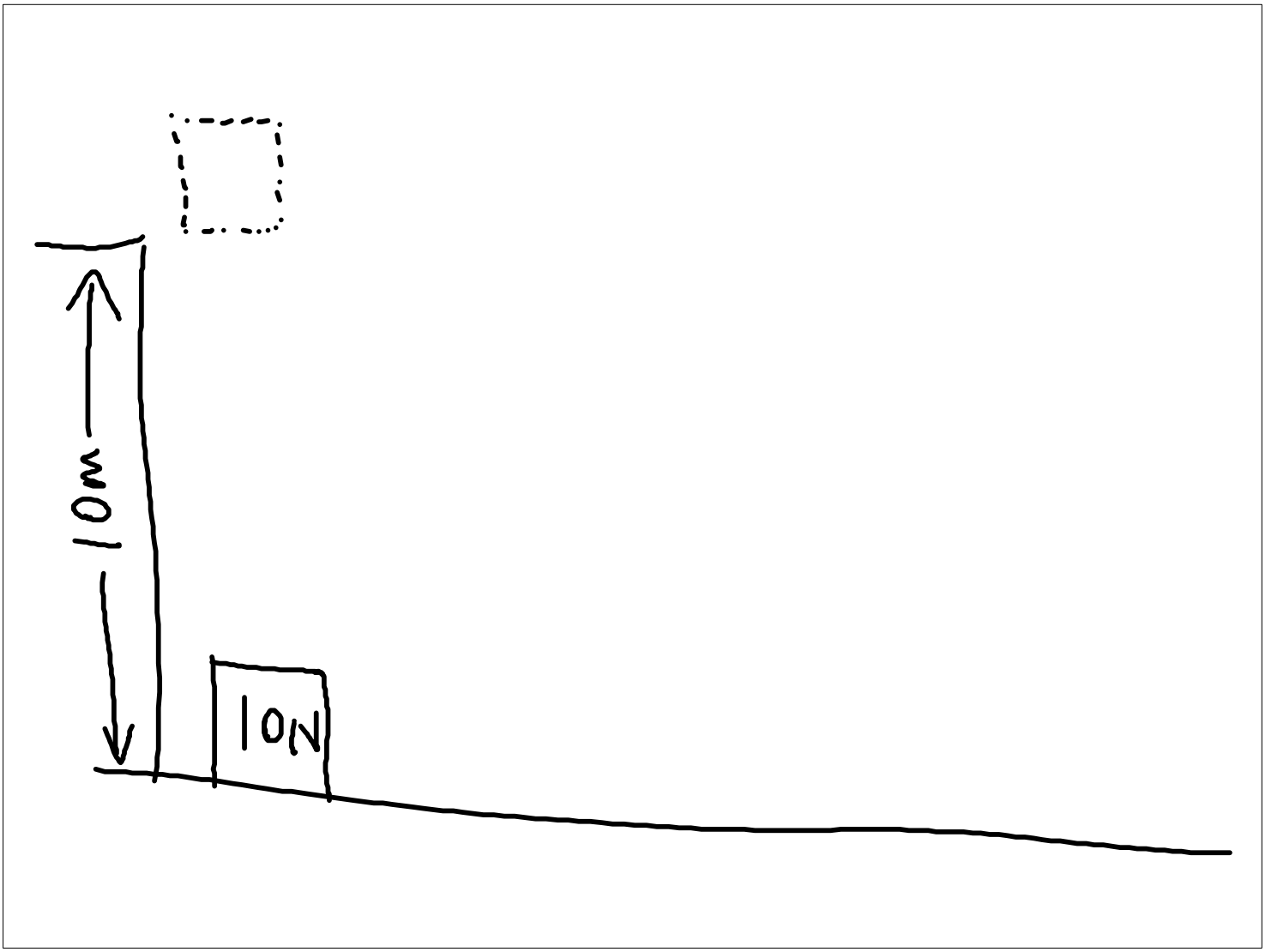
List the 6 simple machines

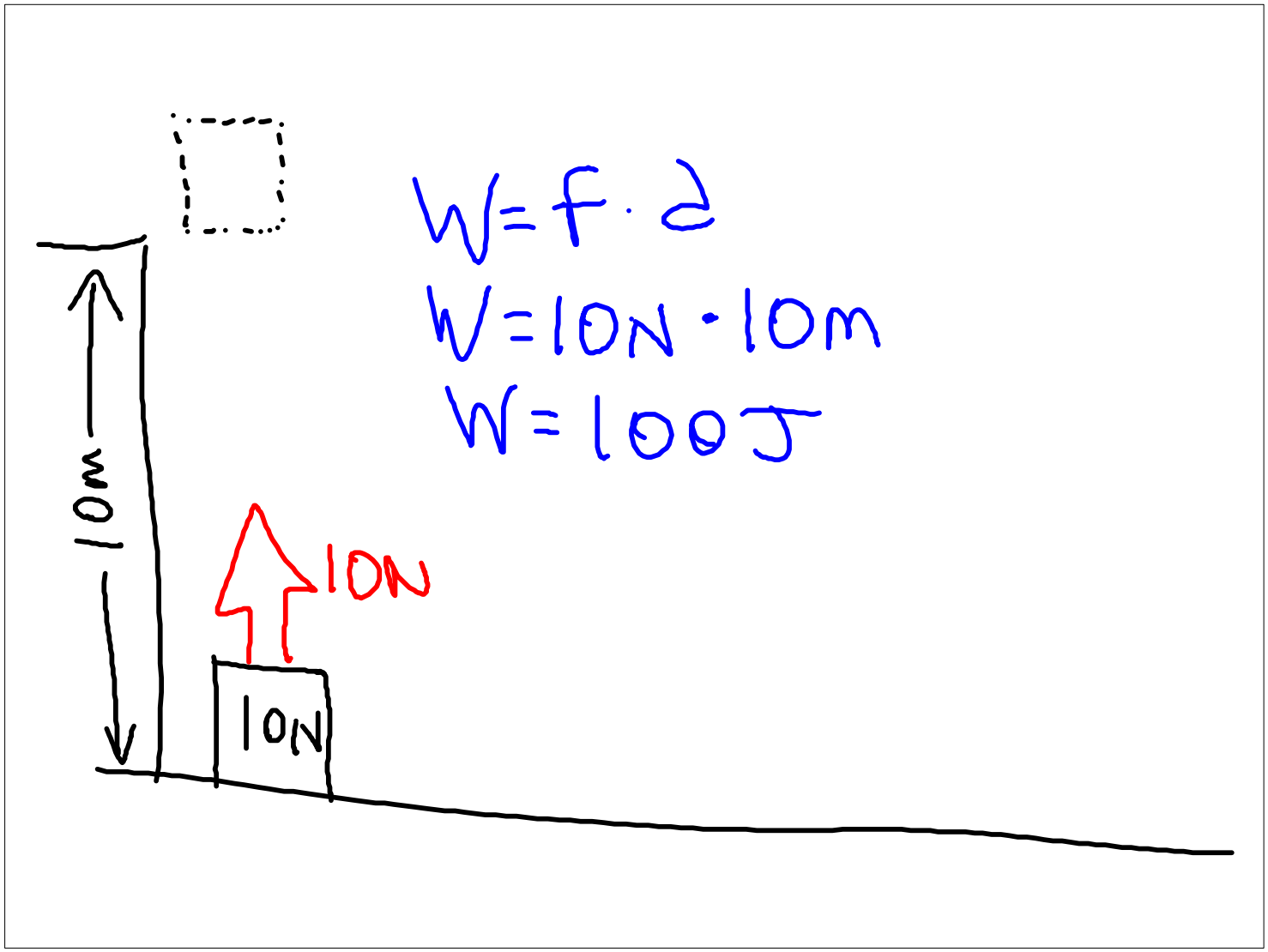
Rotating	Ramped
Lever	Inclined Plane
Pulley	Wedge
Wheel and Axle	Screw

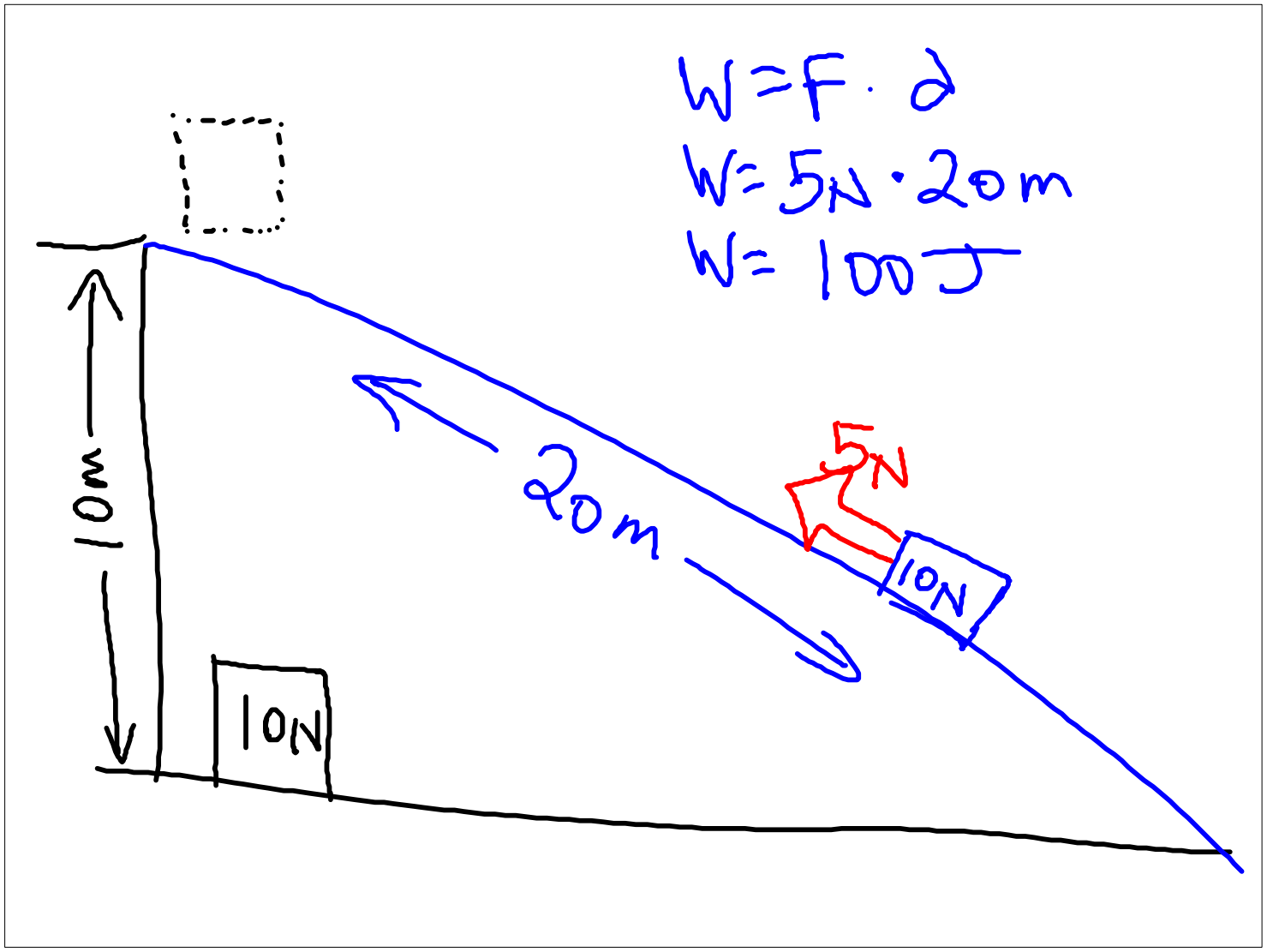

Fixed pulley – CHANGES THE DIRECTION OF A FORCE
100N
100N

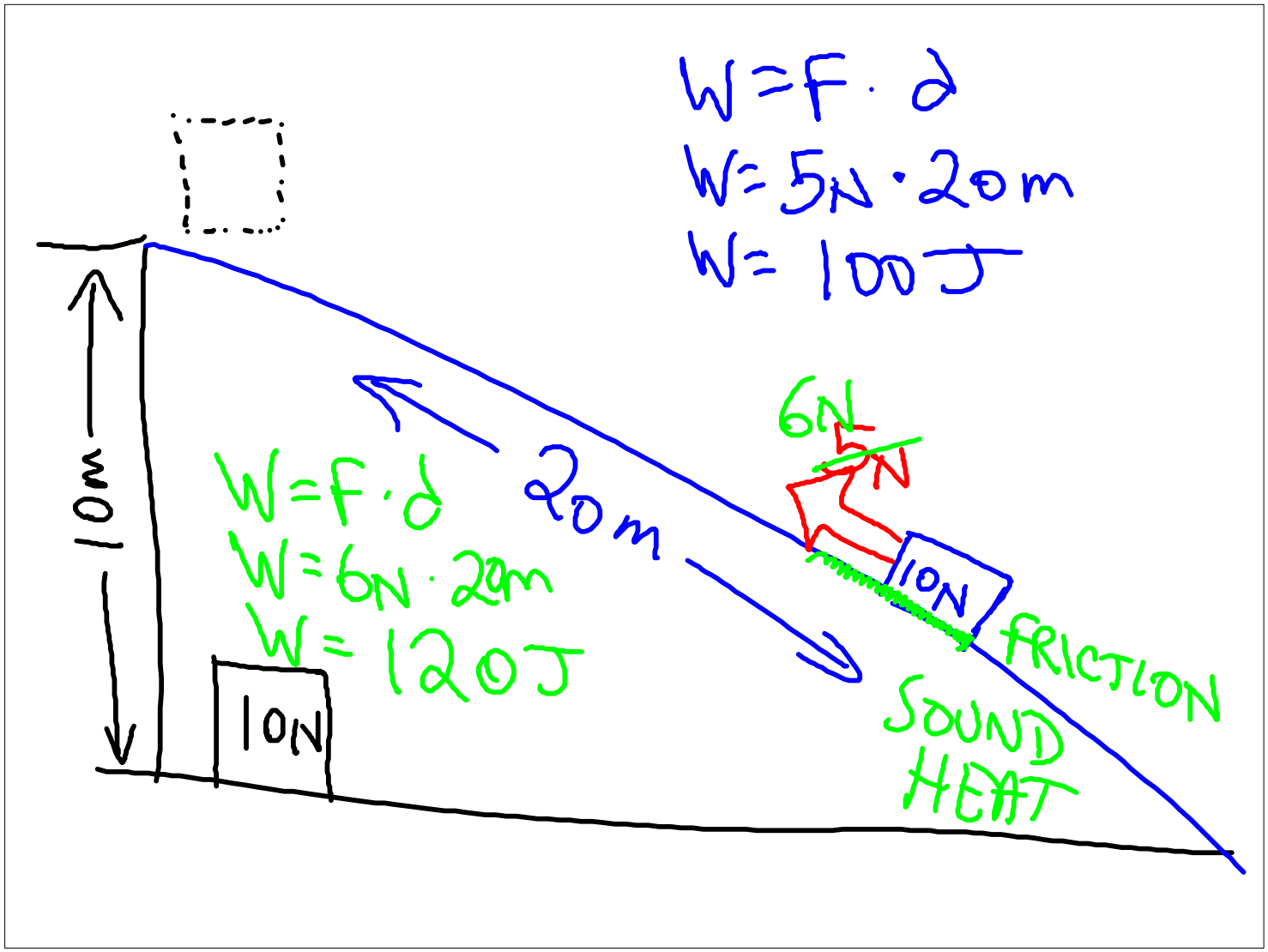

Movable pulley
INCREASE
YOUR
EFFORT
FORCE
50N
50N
100N


LEVERS
I
II
III
BAT
GOLF CLUB
STICK
LAX
HOCKEY


10m
10N


W=F·d
W=10N·10m
W=100J
10m
10N
10N

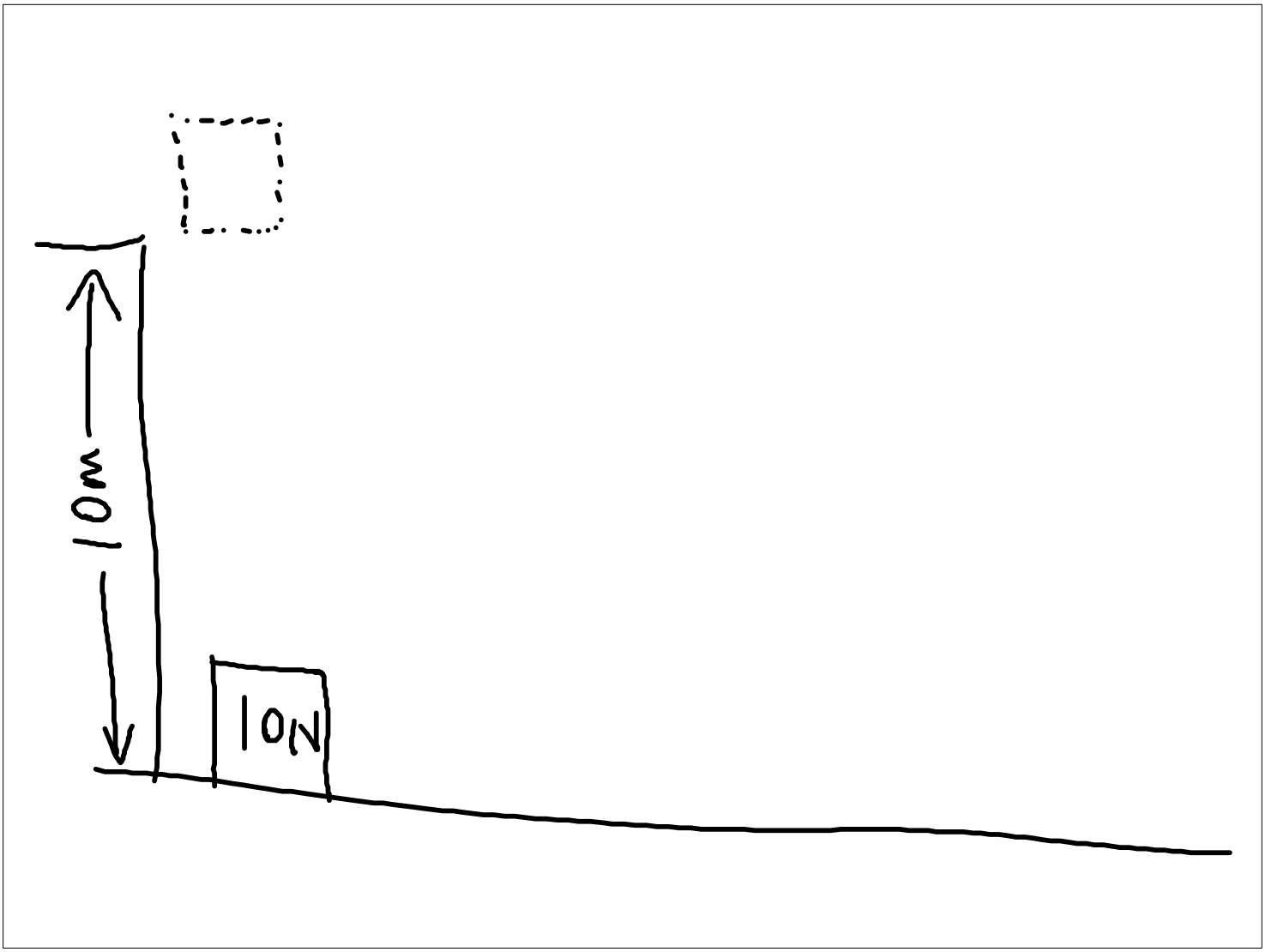

W=F·d
W=5N·20m
W=100J
10m
20m
5N
10N
10N


W=F·d
W=5N·20m
W=100J
10m
W=F·d
W=6N·20m
W=120J
20m
6N
5N
10N
FRICTION
SOUND
HEAT
10N

$$E = \frac{\text{WORK OUTPUT}}{\text{WORK INPUT}} \times 100\%$$

$$E = \frac{\text{ENERGY (WORK) W/O MACHINE}}{\text{ENERGY (WORK) W/MACHINE}} \times 100\%$$

$$E = \frac{100\text{J}}{120\text{J}} \times 100\% \quad 0.8333 \quad \boxed{83\%}$$


10m
10N

Work: The transfer of energy through motion.

A force must be exerted through a distance.

The movement must be a result of the force.

They are in the same direction.

Work is always done on an object.

The amount of work done can be calculated.

Work = Force x Distance

W = F x d

The units of work are the joule (J).

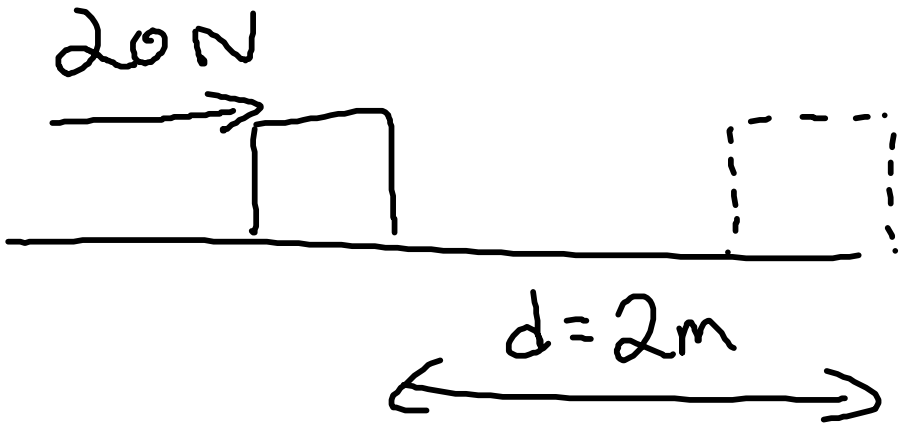
The units for energy are the same.

Work = Force x Distance

Work = Newton x meter

Work = N x m

Work = Nm or J



$W = F \cdot d$

$W = (20\,N) \cdot (2m)$

$W = 40\,Nm$ OR $40\,J$

Power is the rate at which work is done.

Formula: $\text{Power} = \frac{\text{Work}}{\text{time}}$ $P = \frac{F \cdot d}{t}$

$$P = \frac{W}{t}$$

Unit of Power: Watt

Calculate the power of a forklift that can lift a 2000N box to a height of 3m in 20 seconds.

$P = ?$

$F = 2000\,N$

$d = 3\,m$

$t = 20\,s$

$$P = \frac{F \cdot d}{t}$$

$$P = \frac{(2000\,N)(3\,m)}{(20\,s)}$$

$$P = \frac{6000\,Nm}{20\,s} = 300\,W \quad 300\,\frac{Nm}{s}$$

Calculate the power of a forklift that can lift a 2000N box to a height of 3m in 20 seconds.

$P = ?$

$F = 2000\,N$

$d = 3\,m$

$t = 20\,s$

$W = F \cdot d$

$W = 2000\,N \cdot 3\,m = 6000\,J$

$P = \frac{W}{t} = \frac{6000\,J}{20\,s} = 300\,\frac{J}{s} = 300\,W$

Othman struggles to lift a 100 kg weight over his head to a height of 2m. It takes him 10 seconds to do this. How much power has he exerted?