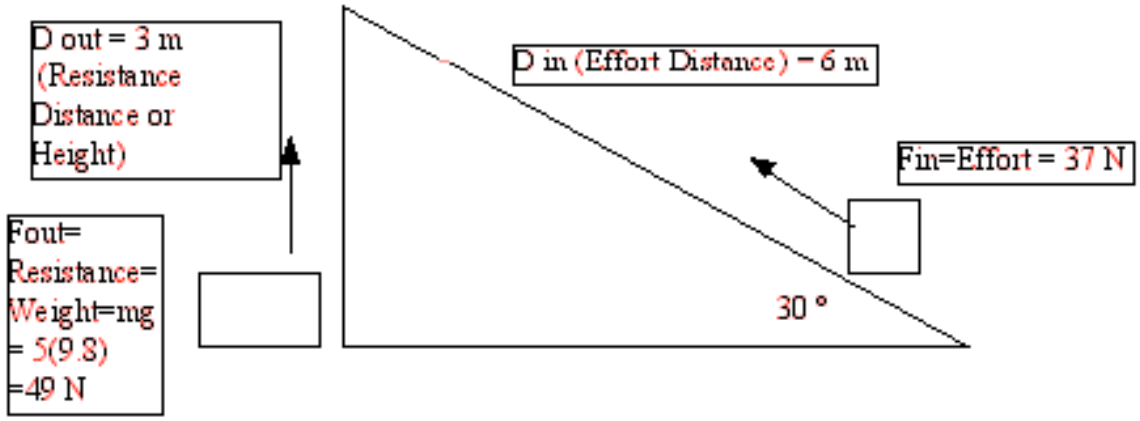
NAME_____

Simple Machine Review

1) I am pushing a block up a ramp that is 3 meters high and 6 meters long. It is a 30-degree angle ramp. The block has a mass of 5 Kg. It is taking me 37 Newtons of force to push it.

Draw a picture.



What is the Effort Force? What is the Resistance Force?

Effort Force=Fin= 37 N, Resistance Force =Fout= Weight=49 N

What is the Effort Distance? What is the Resistance Distance?

Effort dist=DistOut= 6 m, Resistance Dist= DistIn= 3 m

What is the IDEAL mechanical advantage of this system?

*IMA = if WorkIn=WorkOut, so Fin*DistIn=Fout*DistOut*

IMA= DisIn/DistOut = Length/Height= 6/3=2:1

For ramp Length/Height = 1/sinθ = IMA

For lever IMA=Effort Arm/ResistanceArm

For pulley IMA= # strings pulling up

For wheel/axle= axle diameter/wheel diameter

What is the ACTUAL mechanical advantage of this system?

AMA= Fout/Fin= Weight/Effort= 49 N/37N= 1.32:1

What is the Work OUT?

*Work = Fout*DistOut=Weight*Height=mgh=49N*3m=147 Joules*

What is the Work IN?

*Work=Fin*DistIn=Effort*Length=37N*6m=222 Joules*

What is the Efficiency of this machine?

Efficiency = WorkOut/WorkIn= 147J/222J= 66%

Or AMA/IMA= 1.32/2 = 66%

Why?

33% was lost, or 75 Joules, was lost to friction and changed from mechanical energy to heat energy.

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The efficiency of a squeaky pulley system is 73 percent. The pulleys are used to raise a mass. What force is exerted on the machine if a rope is pulled 18 m in order to raise a 58 kg mass a height of 3 m?

*Work Out = Weight * Height = mg h = 58*9.8 * 3 = 568.4 N * 3m = 1705 Joules*
Efficiency = .73 = WorkOut/WorkIn so .73 = 1705 J /WorkIn
Work In =1705 J/ .73 =2335.89 Joules
*Work In = Fin * Dist in*
*2335.9 J = Fin * 18m , Fin = 2335.9 Joule/ 18 m =129.77 N*

Check: AMA = Fout/Fin=568.4/129.77= 4.38
IMA=Din/Dout=18/3=6
Efficiency= AMA/IMA=4.38/6= 73%!

#3 a person pushes a 950N box up an incline. If the person exerts a force of 250 N along the incline, what is the mechanical advantage of the incline?

AMA= Fout/Fin=950 N/250 N = 3.8:1

Pg 309
52 Why is it easier to loosen the lid from the top of a paint can with a long-handled screwdriver than with a short-handled screwdriver?

53. If a machine cannot multiply the amount of work, what is the advantage of using such a machine?

54. You are attempting to move a large rock using a long lever. Will the work you do on the lever be greater than, the same as, or less than the work done by the lever on the rock??? Explain.

53. You are attempting to move a large rock with a long lever. Is it more effective to place the lever's axis of rotation nearer to your hands or nearer to the rock? Explain…

56. A perpetual motion machine is a machine that, when set in motion, will never come to a halt. Why is such a machine not possible?

57. If you were use a machine to increase the output force, what factor would have to be sacrificed? Give an example….

Winnie, a waitress, holds a 5 N tray stacked with twelve 3.5 N dishes in one hand. The length of her arm from her hand to her elbow is 30 cm and her biceps exert a force 5 cm from her elbow, which acts as a fulcrum? What type of lever is this? How much force must her biceps exert to allow her to hold the tray?

Resistance Force: 5N+ 12(3.5)= 47N*

1st class lever IMA = effort arm/rest arm = .05/.3= .1667 or 1:6

MA= ForceOut/ForceIn = 1/6= 47/ForceIn , so Force in =282 Newtons

*WorkIn=WorkOut Force*Dist=Force*Dist*
*ForceIn*5=47*30, ForceIn=282 Newtons*

A windmill uses sails blown by the wind to turn an axle that allows a grindstone to grind corn into meal with a force of 90 N. The windmill has sails of radius 6 m blown by a wind that exerts a force of 15 N on the sails, and the axle has a radius of 50 cm.
What is the IDEAL mechanical advantage of this system?

IMA= DistIN/DistOut, 6 m/ .5 m = 12:1

What is the ACTUAL mechanical advantage of this system?

AMA=ForceOut/ForceIn=90N/15N=6:1

What is the Work OUT*? =Force*Dist= 90N*.5m= 45 Joules*
What is the Work IN*?= Force*Dist= 15 N*6m = 90 Joules*
What is the Efficiency of this machine?

Efficiency=AMA/IMA= 6/12 = 50% or WorkOut/WorkIn=45J/90J=50%

*** When building the pyramids, the ancient Egyptians were able to raise large stones to very great heights by using inclines/ If an incline has an ideal mechanical advantage of 4 and the pyramid is 15 m tall, how much of an angle would the incline need in order for the Egyptian builder to reach the top?

IMA= DistIn (Length)/DistOut(Height)
4 = Length/15 m
Length= 60 m

Sin0 = Opp/Hyp = 15/60 = .25,
$\theta = \sin^{-1}(.25) = 14.5°$