Review for Exam 2

1. Monday 3/6, same time and place
2. Topics:

a. Forces
b. Linear, static forces
c. Friction
d. Work

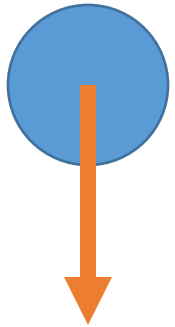
Reminder about Syllabus

Week 3 Forces + exam 1 review; 1/30	**Ch. 4**	**111. Projectile motion**
Exam 1 1D&2D motion, units,vectors; 2/6	On Weeks 1-2	
Week 4 Linear static forces 2/6	Ch. 5.1 and 11	**112 Newton's 2nd**
Week 5 Friction 2/13	Ch. 5.2-3	**103 Linear statics**
Week 6 Work and Kinetic Energy 2/20	Ch. 1.10 and 6	**106 Friction**
Week 7 Potential and conservation of Energy + exam 2 review 2/27	Ch. 7	**New: Work and Kinetic Energy**
Exam 2 Forces, friction, energy 3/6	**On weeks 3-6**	

R1. Ball forces

1. A ball, of mass 10kg, falls on a planet where the gravitational field is g=1.2N/kg. What are the upward and downward forces on it in Newtons?

a. 12,12; b. 1.2, 1.2; c. 0, 12; d. 0, 1.2; e. 12, 1.2

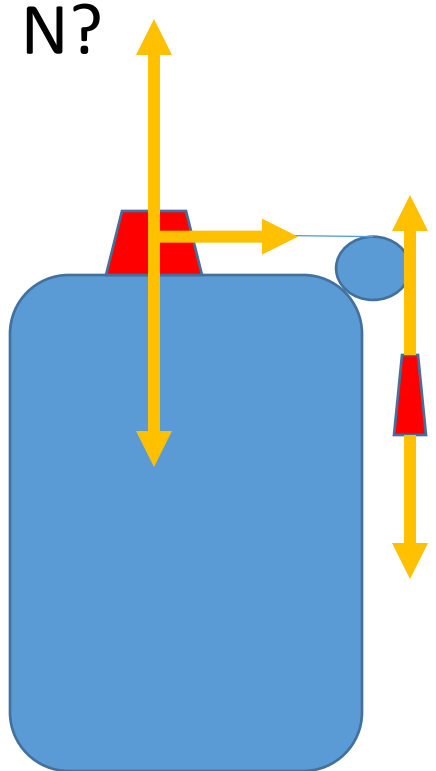


R2. Burglar force

2. A burglar, m1=200kg, is on the icy roof of a building. His partner, m=60 kg is over the side of the building on a rope over a pulley. They slip.

What is magnitude of the force on the burglars, in N?

a. 2550; b.60; c. 2000; d. 580; 140

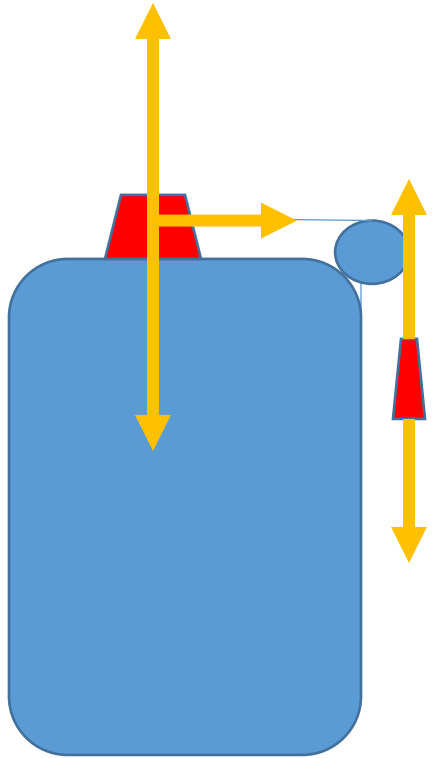


R3. Burglar acceleration

3. A burglar, m1=200kg, is on the icy roof of a building. His partner, m=60 kg is over the side of the building on a rope over a pulley. They slip.

What is magnitude of their acceleration, in m/s^2?

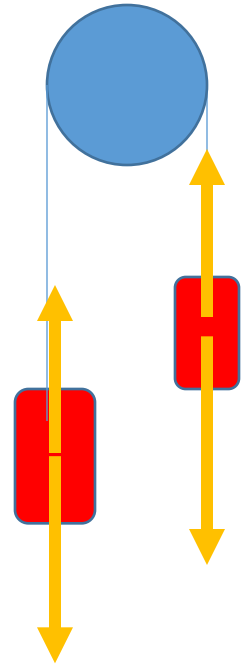
a. 1.3; b.4.0; c. 8.0; d. 9.8; e. 2.3



R4. Elevator forces

4. An elevator, m1=2000kg, is attached to a cable. The cable goes over a pulley to a counter weight, m=1800kg. The elevator falls without friction (the motor fails). What is the force, in N on the elevator?

a. 20,000; b. 2000; c. 9000; d. 18000; e. 100

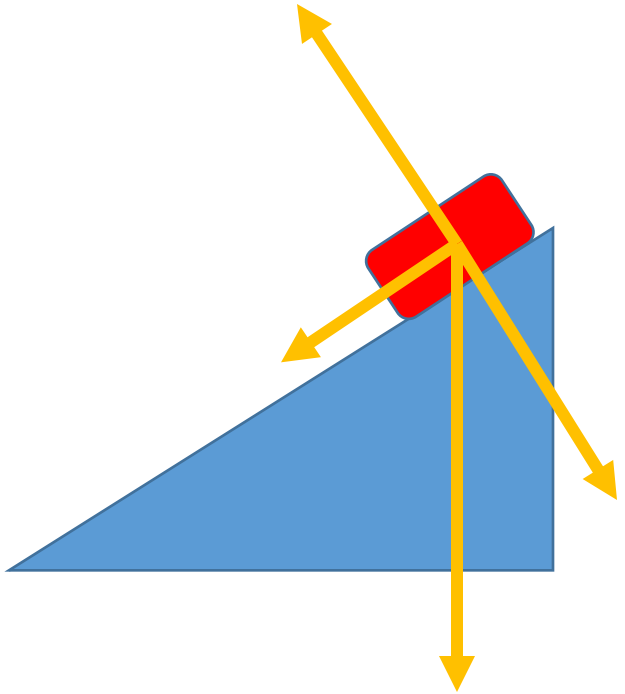


R5. Force on a ramp

- 5. A student of mass 60 kg is sitting on a icy ramp with a 30 degree slope. If he starts to slide down with no friction, what is the approximate force, in N, pushing him down the ramp?

a. 580; b. 30; c. 9.8; d. 290; e. 60

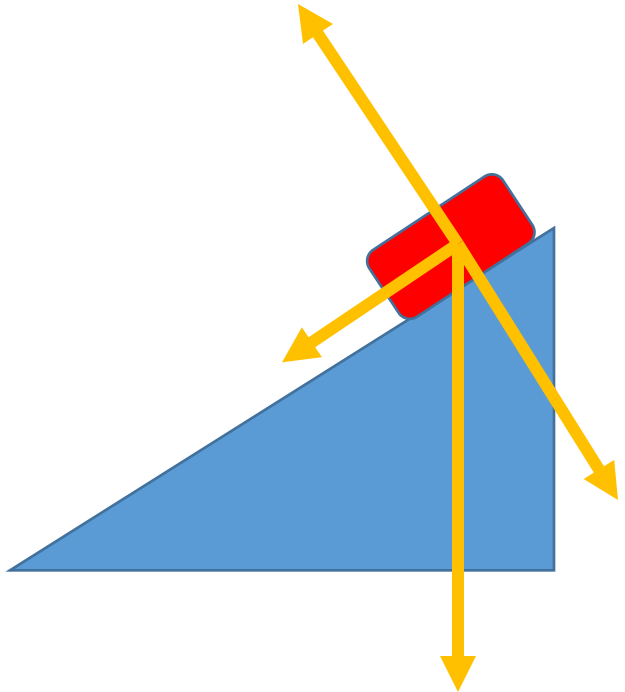
Free Body Diagram



R6. Response on a ramp

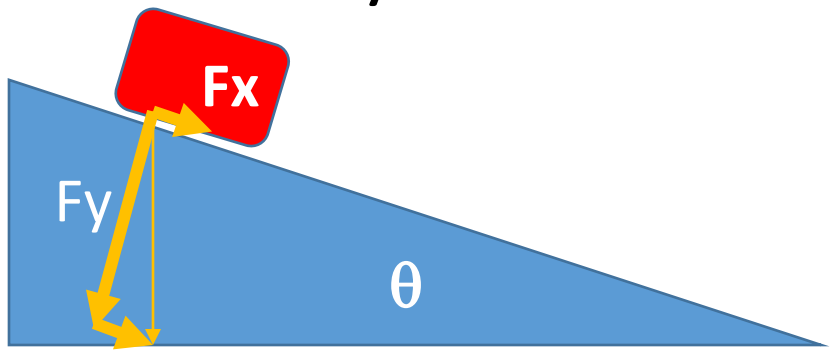
6. A student of mass 60 kg is sitting on a icy ramp with a 30 degree slope. If he starts to slide down with no friction, what is his response (ma) to the gravitational force, in N, pushing him down the ramp?

a. 580; b. 30; c. 9.8; d. 290; e. 60



R7: What happens to a car on an icy hill?

Similar triangles



Mg=100 N; angle=60, mu=0.1;

Draw the free body diagram.

A. Calculate the approximate value of Ff in N.

   a. 87; b. 5; c. 0; d. 50; e. 870

B. Calculate the approximate acceleration in m/s^2 .

   a. 8; b. 80; c. 0; d. 50; e. 870

R8. Vectors and geometry

A drone moves up a vector displacement in m:

d1= 40 **i** + 50 **k**

And then down by d2:

d2= -60 **i** -40 **k**

A. Draw a diagram. What is the angle between the final position vector and the x=axis?

a. 63; b. 54; c. 33; d. 27; e. 7

-20+10 22 27

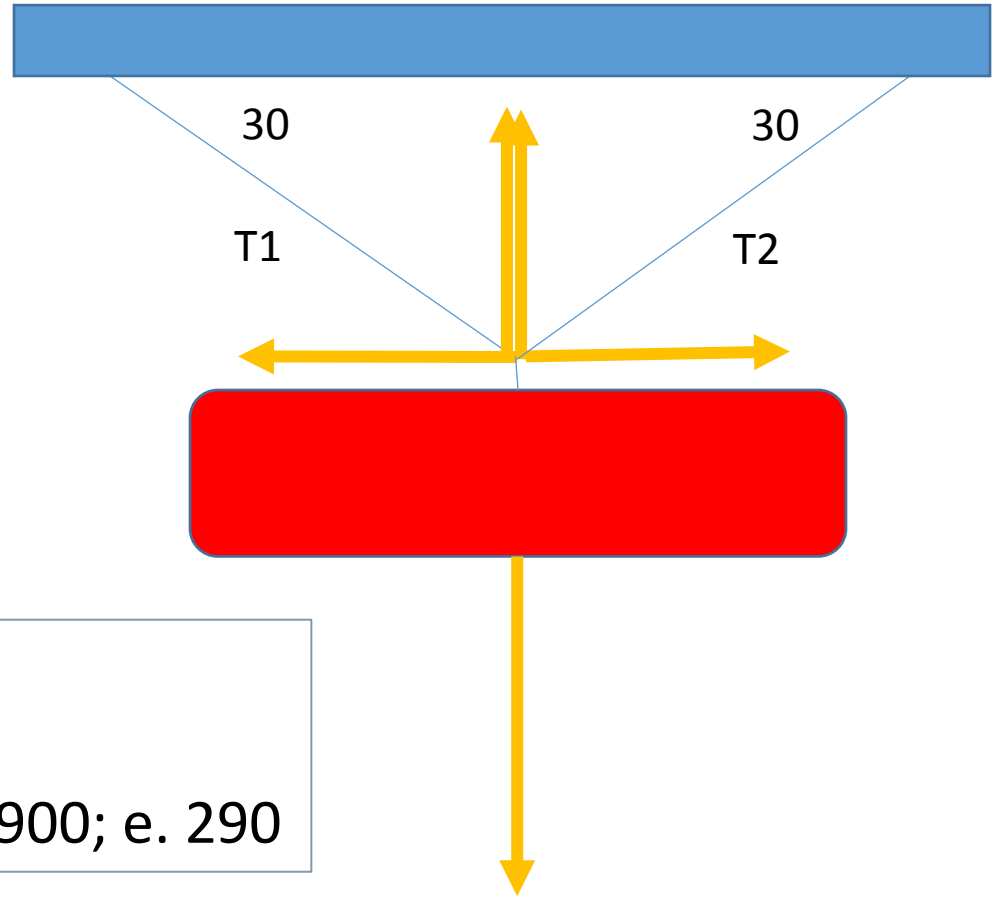
B. Approximately how much work (J) does the drone do, if it weighs 20N?

a. 1800; b. 2000; c. 10; d. 20; e. 2000

R9. Force table

- On a Force table, forces are applied to a small ring near the center. If the vector forces are **F1**=(20 **i** + 0**j**) N and **F2**=(0**i** + 30**j**) N . What is the approximate magnitude, in N, of a third force which will keep the ring in equilibrium without touching the pin at the center?
- 13
- 5
- 3.6
- 0.9
- 0.6

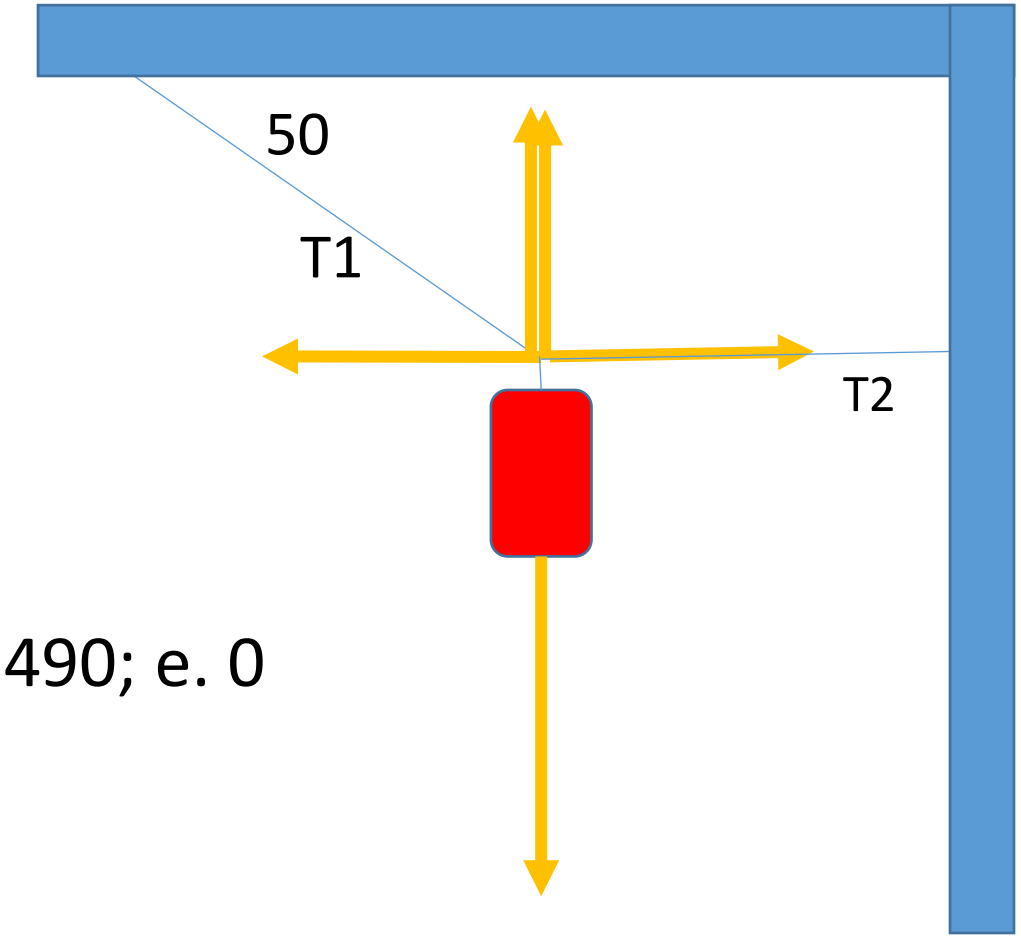
R10: Hanging m=600 kg



What is T2?

a. 600; b. 11760; c. 2900; d. 5900; e. 290

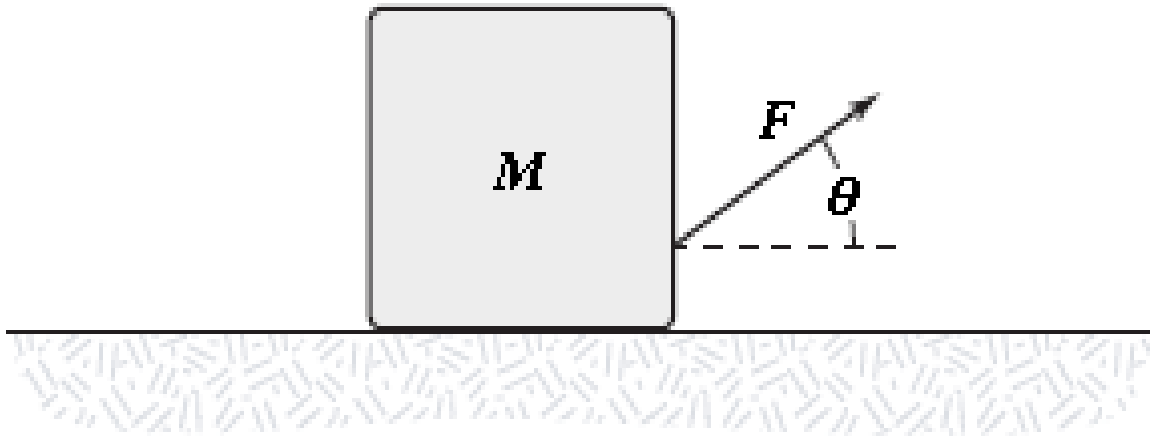
R11. Hanging mass=35



What is T2?

a. 290; b. 450; c. 350; d. 490; e. 0

R12: Tugging on suitcase



Mg=100 N; angle=30; F=180 N; μ=0.2

Draw the free body diagram.

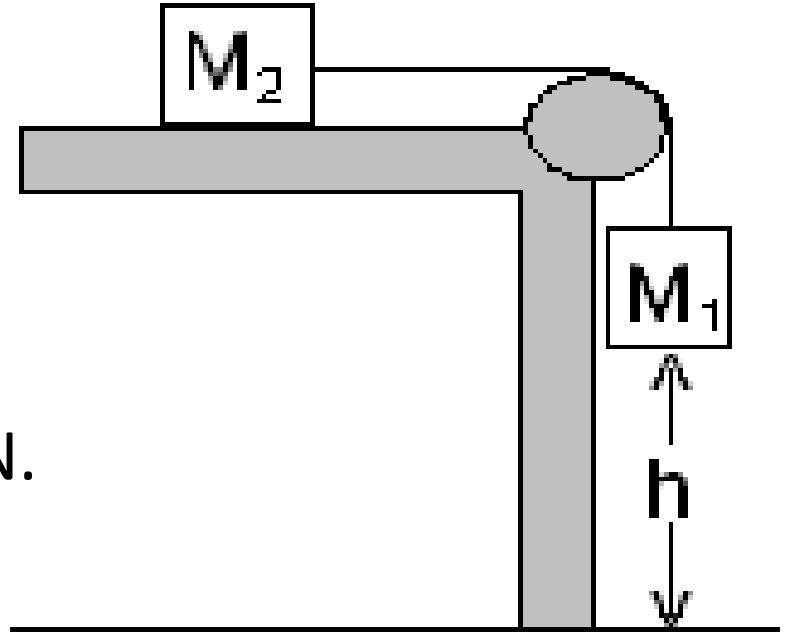
A. Calculate the approximate frictional force in Newtons.

a. 20; b. 36; c. 2; d. 90; e. 100

B. Calculate the approximate acceleration in m/s^2.

a. 1.5; b. 2.5; c. 0.15; d. 0; e. 17;

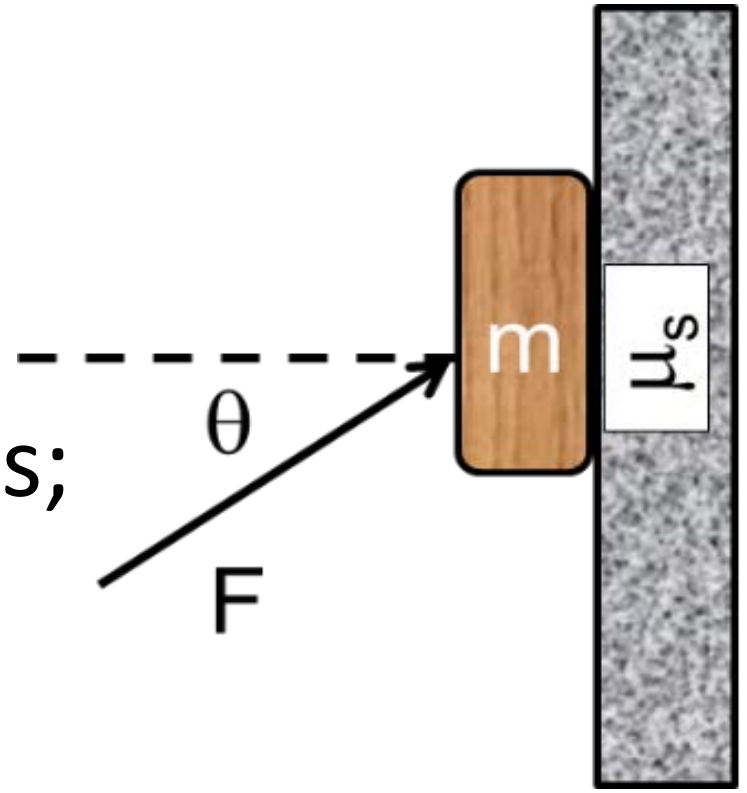
R13: Burglars



M_1g=100 N; M_2g=400 N; mu= 0.5
Draw free body diagram.
A. Calculate the magnitude of Ff in N.
a. 400; b. 0; c. 100; d. 50; e. 200

B. Calculate the approximate a in m/s^2.
a. 40; b. 20; c. 10; d. 5; e. 0

R14: Holding up



mg=10N; mu=0.1; angle=30 degrees;
F=20 N;
A. Calculate Ff in N.
a. 17; b. .87; c. 8.7; d. 1.; e. 1.7
B. Calculate the net force on the block
a. 17; b. 21; c. 1.7; d. 10; e. 20

R15. Example of work: Stone falls in water

A 2.5kg stone falls in water at a constant speed of 2.5m/s. The water does -20 J of work. How far does the stone fall?

a. 2 b. 0.3 c. 8 d. 0.8 e. can't tell

W=F.d;
-20= mg*d
d=-20/2.5*9.8=-0.82 m

R16. Example of Work with a vector

A force in the y-direction acts on a particle. The particle moves from the origin to a point (3**i**+3**j**-1**k**). The work done is -45J. What is the force?

a. -45 b. -15 c. -5 d. 15 e. 4.5

W=F.d

-45=(0**i** ,F**j**, 0**k**).(3**i**+3**j**-1**k**)

-45=F 3

F=-45/3=-15

R17. Example of work and kinetic energy: Falling

A river sweeps a man, weighing 600 N, over a waterfall. He goes 1m out and 7m down. His initial kinetic energy is 50 J. What is his final kinetic energy?

$W=KE-KEo$

$W=F.d$

$KE=F.d+Keo$

$=600*7+50=4250\ J$

End

- Supplementary material on conservation of energy follows.

R12. Weight of a car: units

My car weighs 3300 pounds. 1 pound is 4.45 Newtons. What's the mass of my car in kg?

1500 10**8

Conservation of work and kinetic energy

$$m\,a\,x = (1/2)mv^2 - (½)mv_0^2$$

Work = KE final – KE initial

Difference in kinetic Energy

F x (in the same direction) ;

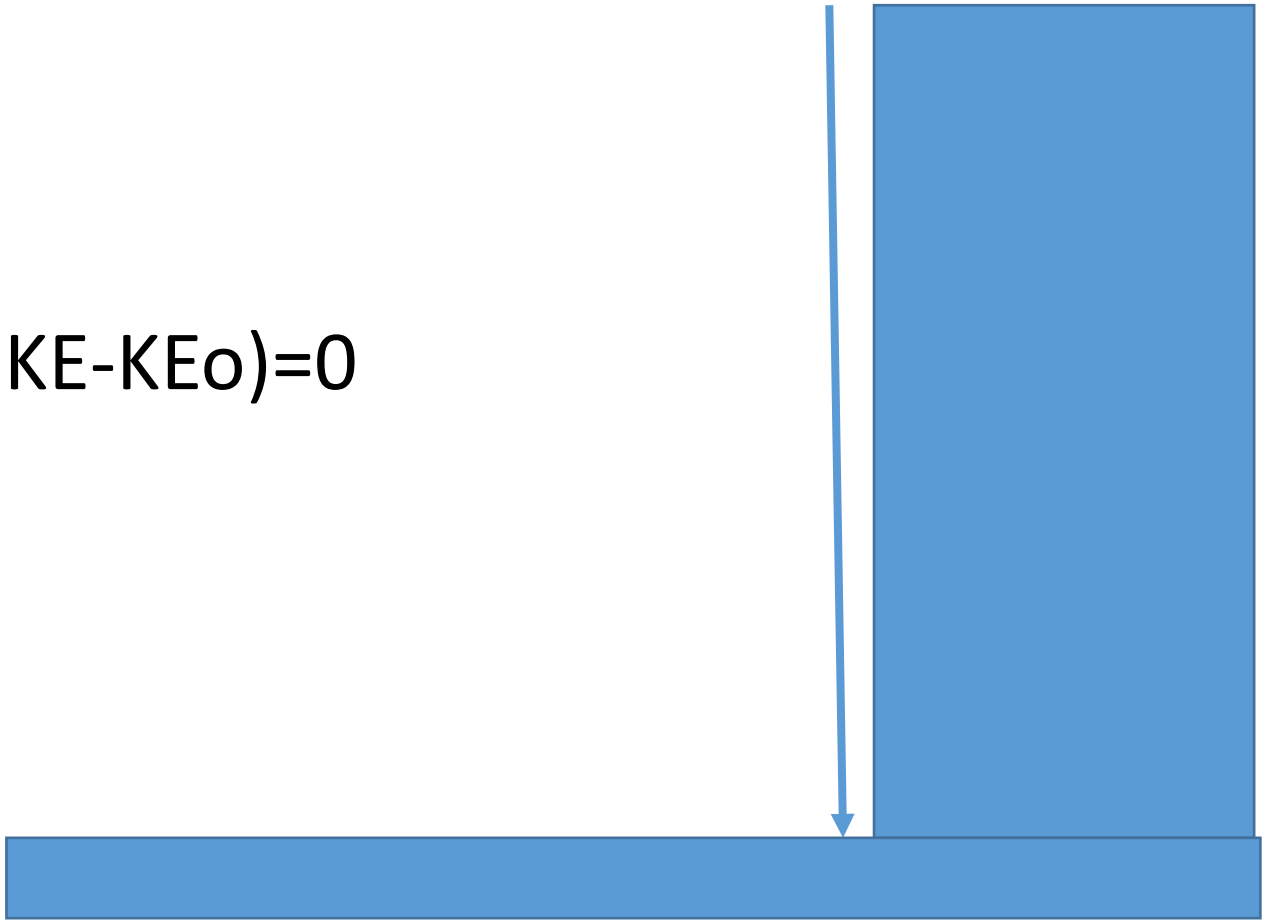
2 forms of energy

Potential energy and its conservation

Potential energy change: U-Uo
Kinetic energy change=KE-KEo

Conservation of energy: (U-Uo)+(KE-KEo)=0

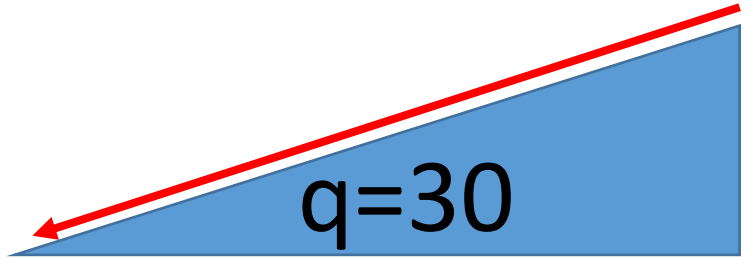
For fall, possible unknowns?
m, g, h, v . Wording?
$0-mgh+(1/2)mv^2-0=0$
Unknown: h, values: v=10; g=10
$mgh=mv^2/2$
$h=v^2/2g=10*10/(2*10)=5$



- Sliding down hill:

Potential energy change: U-Uo

Kinetic energy change=KE-KEo



Conservation of energy: (U-Uo)+(KE-KEo)=0

For sliding object, possible unknowns?

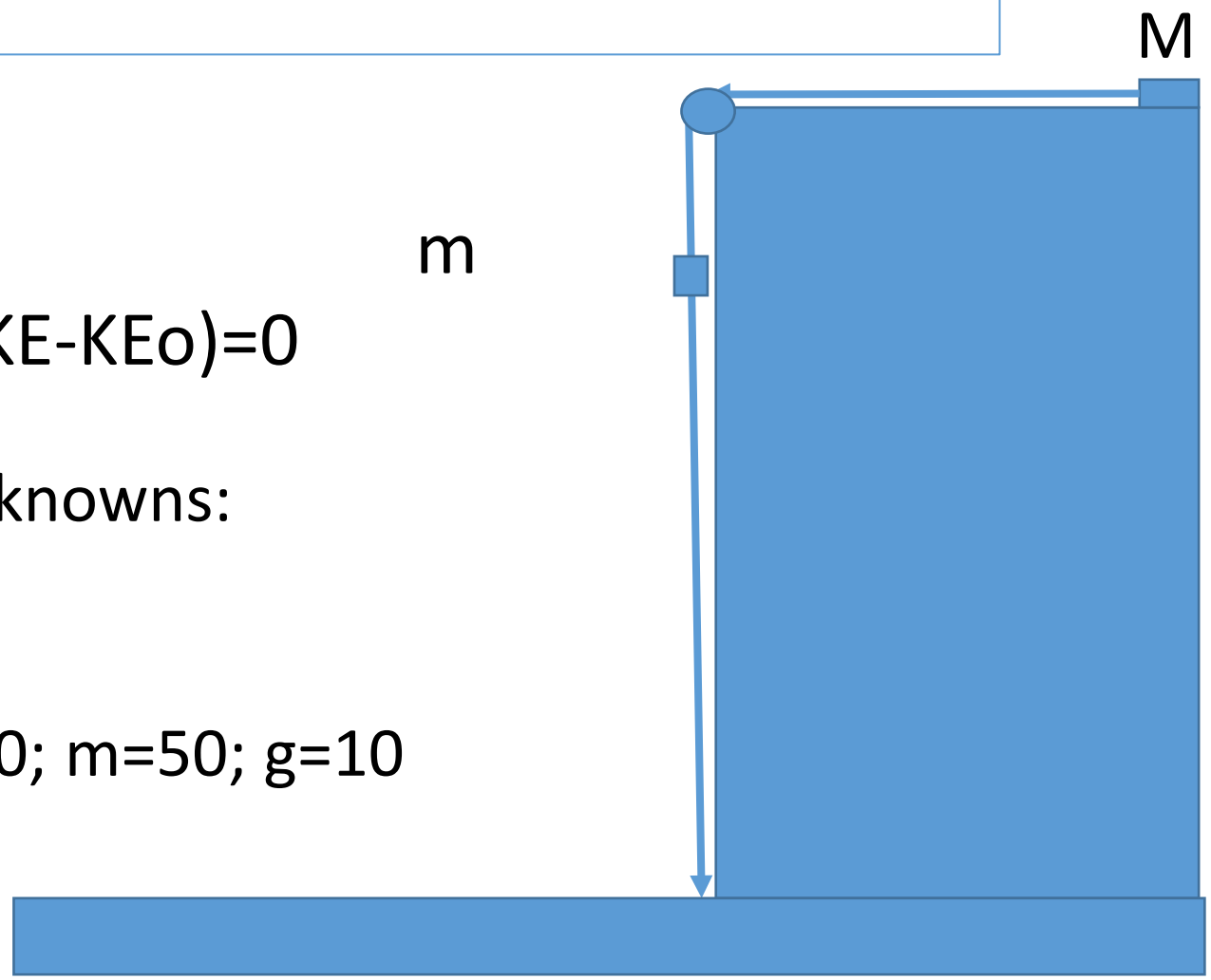
m, g, h, v, q $0- mgh+(1/2)mv^2-0=0$

Unknown: h, values: v=10; g=10; q=30; Wording?

$mgh=mv^2/2$

$h=v^2/2g=10*10/(2*10)=5$

Burglars' Potential energy and its conservation



Potential energy change: U-Uo

Kinetic energy change=KE-KEo

Conservation of energy: (U-Uo)+(KE-KEo)=0

For falling burglar, list the possible unknowns:

m, M, g, h, v

$0-mgh+(1/2)(M+m)v^2-0=0$

Unknown: h; Knowns: v=10; M=100; m=50; g=10

Wording?

$mgh=(M+m)v^2/2$

$h=(M+m)v^2/2mg=$

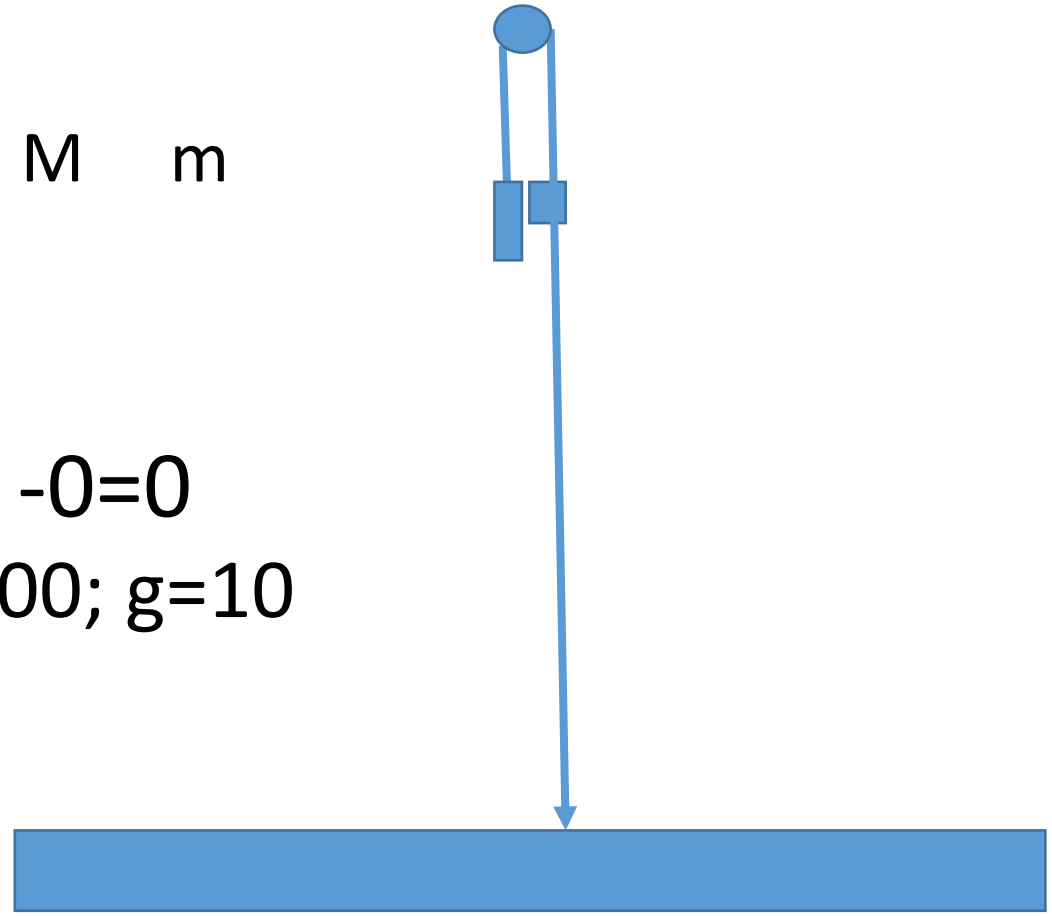
$150*100/(2*50*10)=15$

Elevator's Potential energy and its conservation

Potential energy change: U-Uo

Kinetic energy change=KE-KEo

Conservation of energy: (U-Uo)+(KE-KEo)=0



Pick the unknown:

$0-mgh+2Mgh-Mgh+(1/2)(M+m)v^2-0=0$

Unknown: h; Known: v=10; M=50; m=100; g=10

Wording?

$mgh-Mgh=(M+m)v^2/2$

$h=(M+m)v^2/2(m-M)g=$

$150*10*10/(2*50*10)=100$

Spring's Potential energy and its conservation

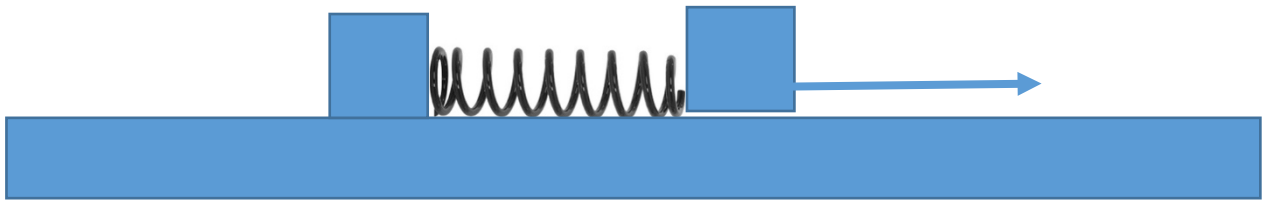
Potential energy change: U-Uo: $kx^2/2$
Kinetic energy change=KE-KEo

Conservation of energy: (U-Uo)+(KE-KEo)=0

For object on recoiling spring, list the possible unknowns:
k, x, m, v

0-

$kx^2/2+(1/2)(m)v^2-0=0$
Numbers: v=10; m=100; g=10; k=100; x=?
$kx^2/2=mv^2/2$
$x=sqrt(mv^2/k)=10*sqrt(100/100)=10$



Burglars' Potential energy with friction

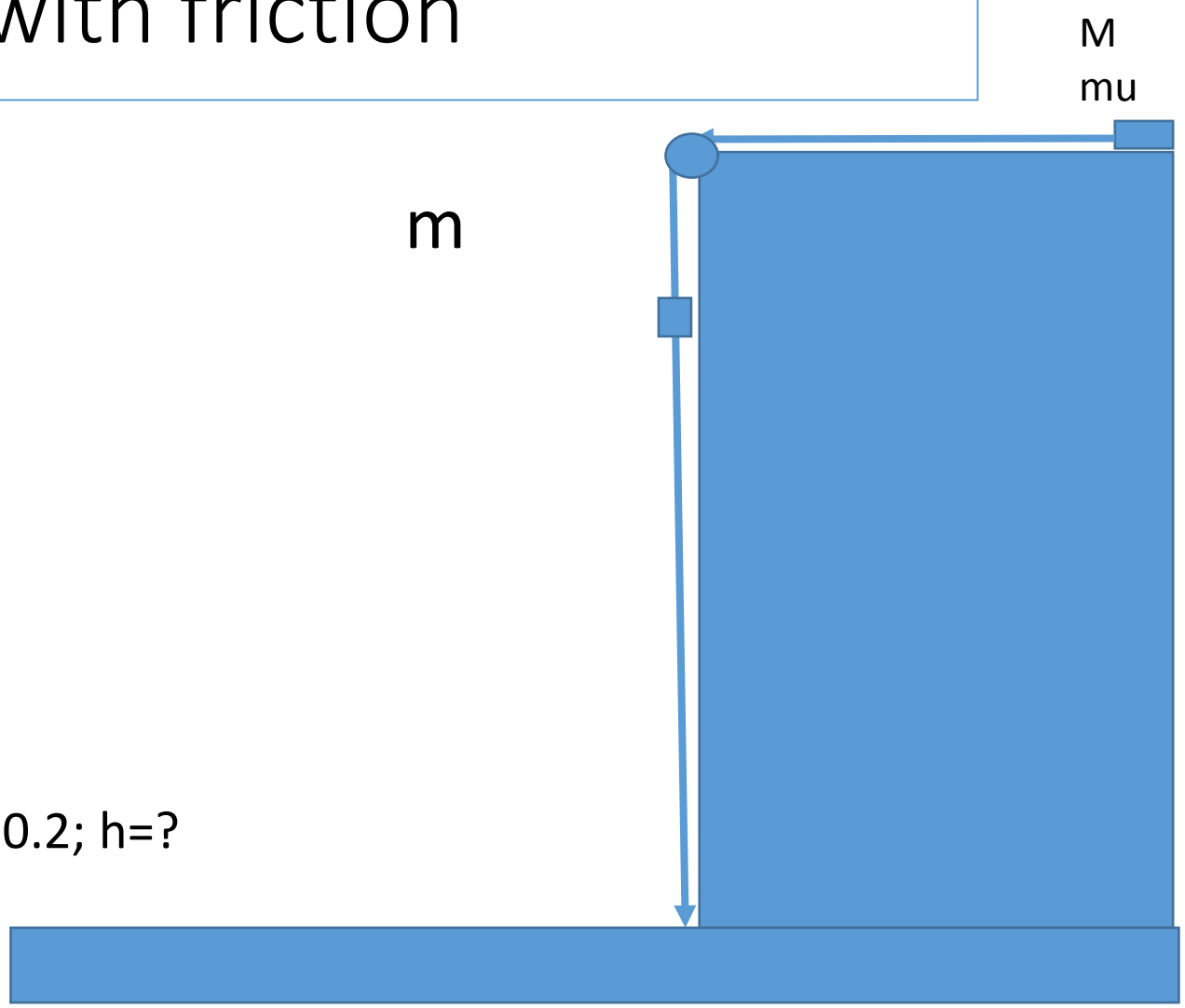
Potential energy change: U-Uo

Kinetic energy change=KE-KEo

Frictional energy change=W-Wo

Conservation of energy:

(U-Uo)+(KE-KEo)+(W-Wo)=0



For falling burglar: List the variables

m, g, h, M, v, mu

$mgh+(1/2)(M+m)v^2 -0 +mu*Mgh-0=0$

Numbers: v=10; M=100; m=50; g=10; mu=0.2; h=?

$mgh=(M+m)v^2/2m+mu*Mgh$

$h=\{(M+m)v^2/2\}/(mg - mu*Mg\}$

$=\{150*100/2\}/(50*10-.2*100*10)=25$