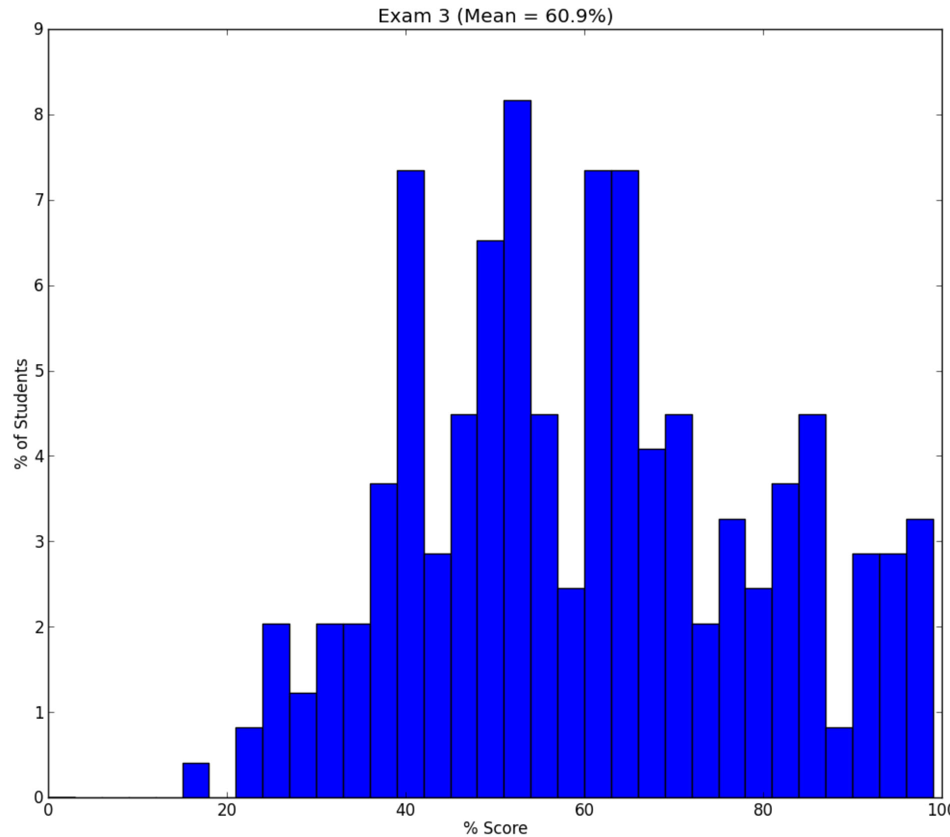
5-1) An atomic bomb explodes. Is energy conserved in the nuclear reactions of the bomb?

A) Yes
B) No
C) Maybe?

Reminders



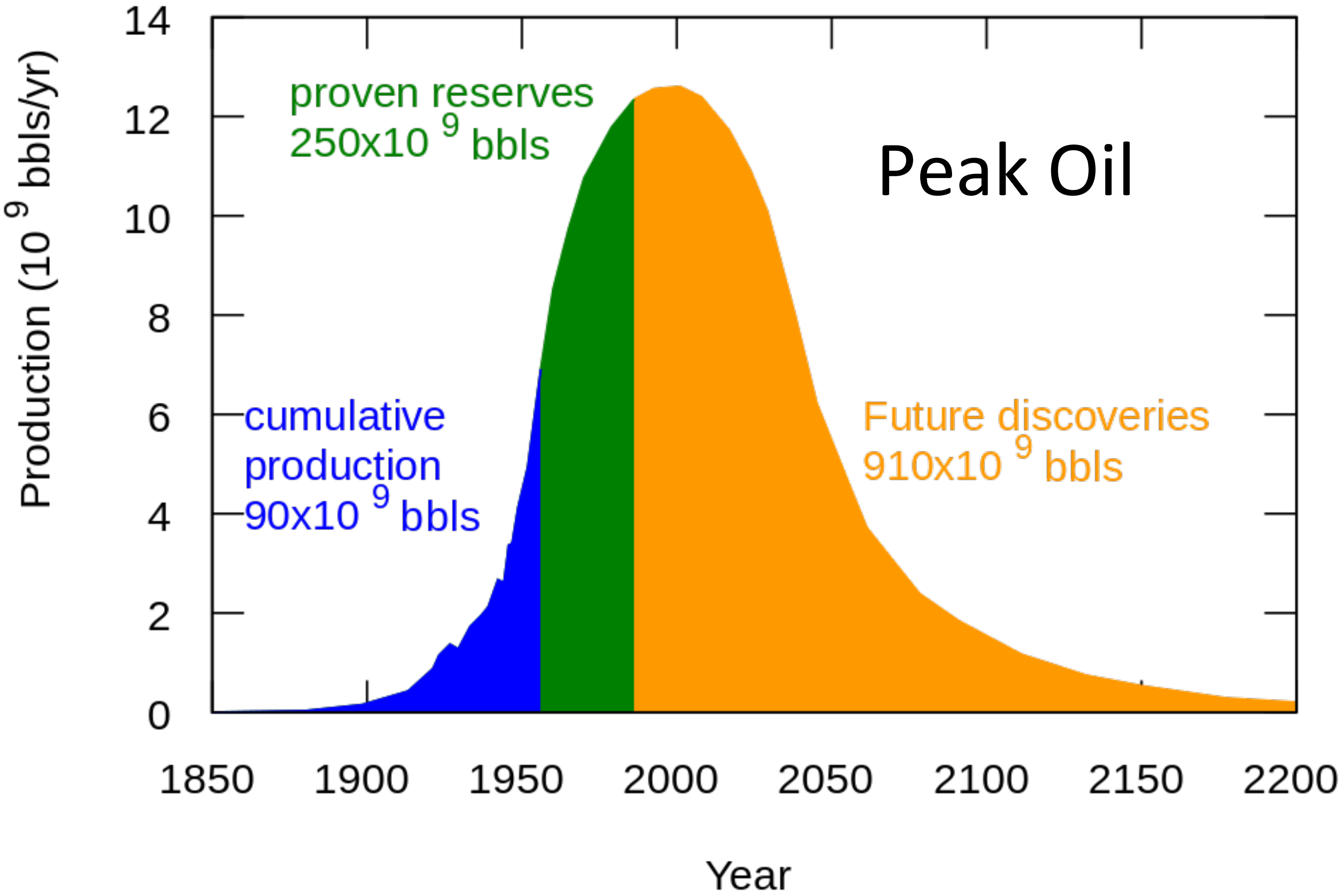
Last Problem = 24% Correct; What’s up?

My picture for the last exam problem was correct

A) Yes
B) No
C) I didn't draw a picture

A hanging mass, $M_1 = 0.590$ kg, is attached by a light string that runs over a frictionless pulley to a mass $M_2 = 1.67$ kg that is initially at rest on a frictionless table. Find the magnitude of the acceleration, a, of M_2.

Energy



Peak Oil
Production (10^9 bbls/yr)
Year
proven reserves
250x10 9 bbls
cumulative
production
90x10 9 bbls
Future discoveries
910x10 9 bbls
0
2
4
6
8
10
12
14
1850
1900
1950
2000
2050
2100
2150
2200

Write down as many forms of energy as you can

- Kinetic
- Thermal
- Potential (stored in position/configuration)
  - Gravitational
  - Electrostatic
    - Elastic
    - Chemical
    - Nuclear
- Radiant = energy of light
- Mass energy ($E=mc^2$)

Feynman on Energy

- "It is important to realize that in physics today, we have no knowledge what energy is."
- "Energy is a numerical quantity, which does not change when something happens...."
- "For those who want some proof that physicists are human, the proof is in the idiocy of all the different units which they use for measuring energy."

5-2a) Starting from rest, two identical boxes are pushed through the same distance. Box experiences a force, F, while box 2 experiences a force, 2F. What is true about their final kinetic energies?

A) The final kinetic energy of box 1 is twice box 2's.
B) The final kinetic energy of box 1 is equal to box 2's.
C) The final kinetic energy of box 1 is half of box 2's.
D) Something else.

5-2b) Starting from rest, two identical boxes are pushed through the same distance. Box experiences a force, F, while box 2 experiences a force, 2F. What is true about their final speeds?

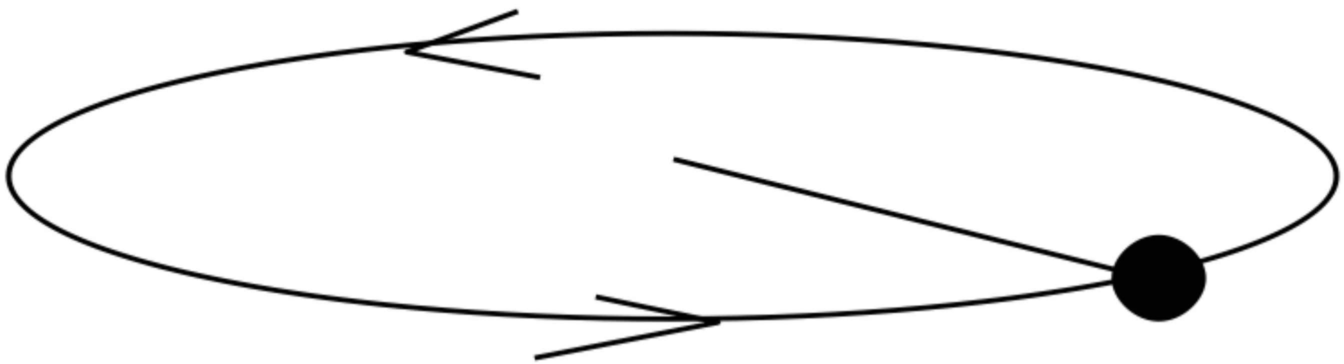
A) The final speed of box 1 is twice box 2's.
B) The final speed of box 1 is equal to box 2's.
C) The final speed of box 1 is half of box 2's.
D) Something else

5-3) Albert Einstein lowers a book of mass m **downward** a distance h at constant speed v. The **work done by** …

the force of gravity is… A) + B) - C) 0
the force of Albert’s hand is… A) + B) - C) 0
the net force on the book is… A) + B) - C) 0

5-4) A rock of mass m is twirled on a string in a horizontal plane. The work done **by the tension** in the string on the rock is…

A) +   B) -   C) 0

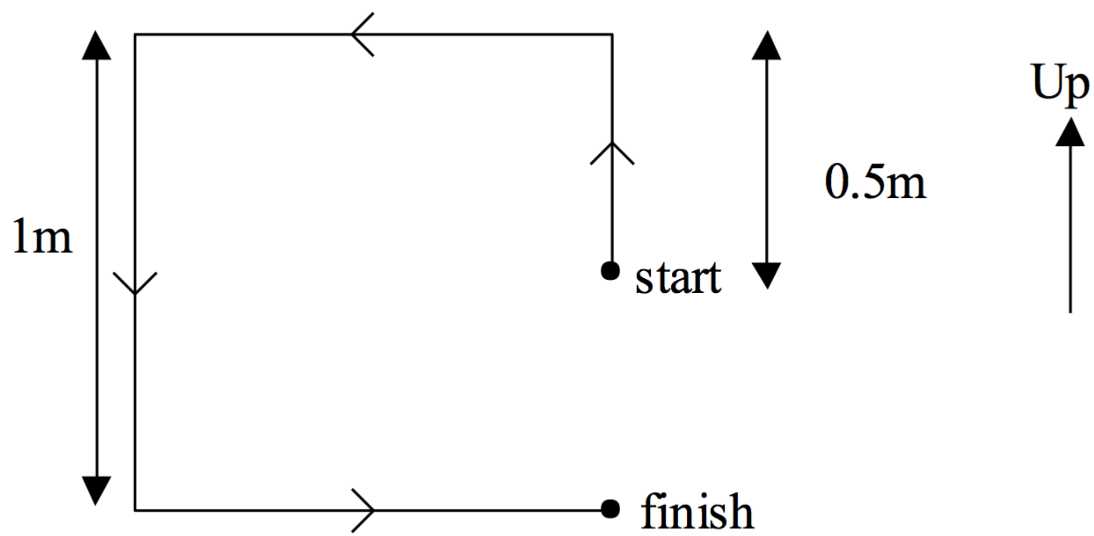


5-5) You toss a ball into the air and catch it again. While the object is in the air, what is the total work done by the gravitational force?

A) $W_{grav} < 0$
B) $W_{grav} = 0$
C) $W_{grav} > 0$

5-6a) A 1 kg mass is moved part way around a square loop as shown. The square is 1 meter on a side and the final position of the mass is 0.5 m below its original position. Assume that $g = 10\ m/s^2$. What is the work done by the force of gravity during this journey?

A) +10 J
B) +5 J
C) 0 J
D) -10 J
E) -5 J



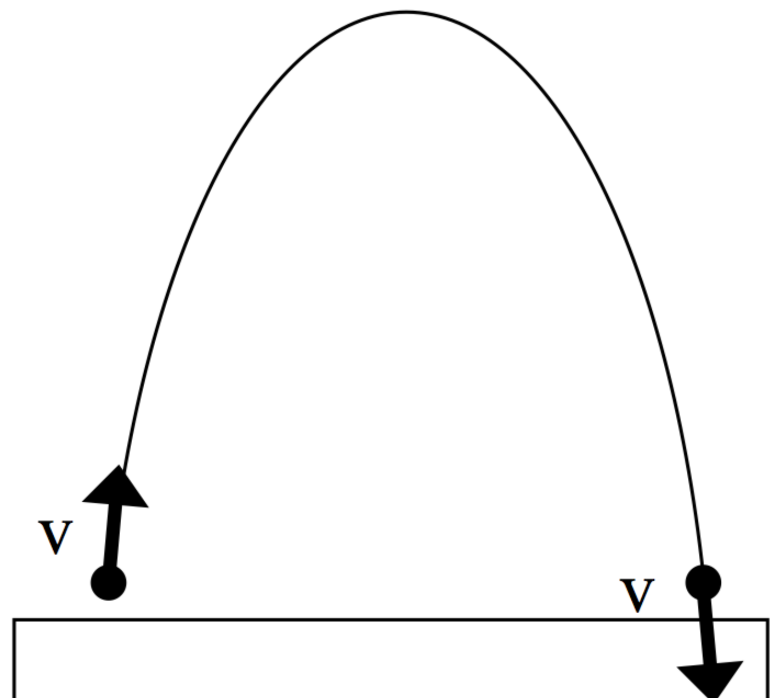
$W_{grav} = mg\Delta h = (1\ kg)\ (10\ m/s^2)\ (\Delta h)$

5-6b) If instead of moving part way around a square, the mass where taken on a long and tortuous journey to the Moon, Tibet, and Lithuania and then returned to the same finish point as before, would the total work done by gravity be the …

A) same.
B) different.

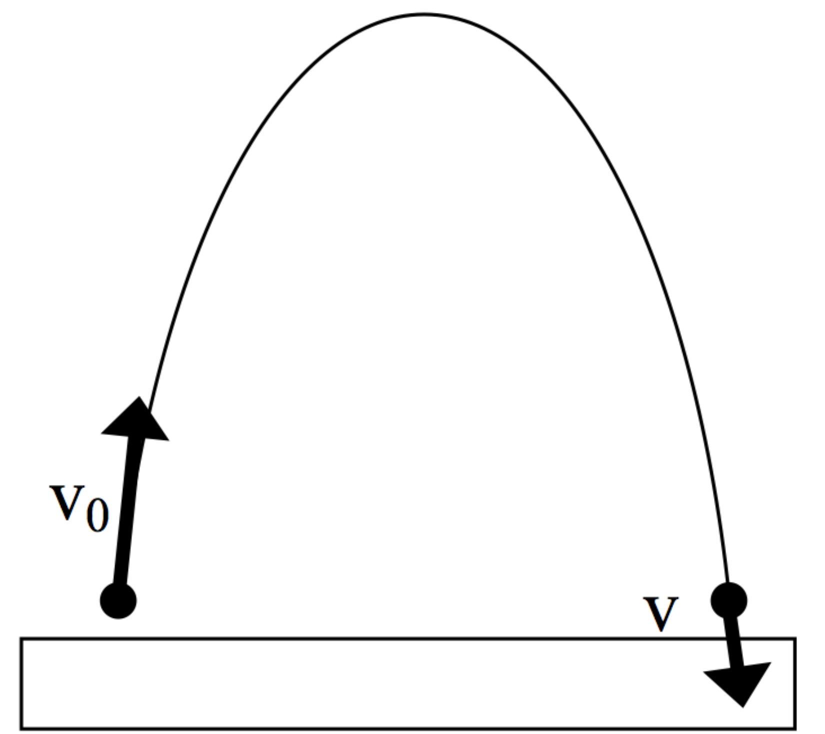
5-7a) A projectile is fired upward with an initial speed v **on an airless world**. A short time later, it comes back down and has a final speed v (just before it hits the ground). What was the sign of the total work done by the force of gravity during the flight?

A) $W_{grav} > 0$
B) $W_{grav} = 0$
C) $W_{grav} < 0$



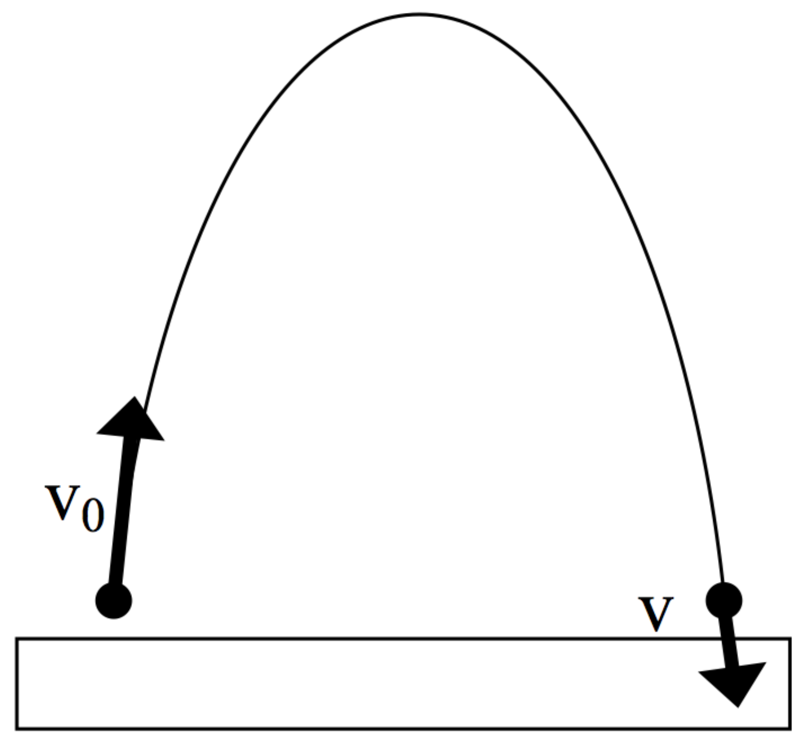
5-7b) A projectile is fired upward **through air** with an initial speed v_0. A short time later, it comes back down and has a final speed $v < v_0$. Air resistance is NOT negligible. What was the sign of the work done by friction during the flight?

A) $W_{fric} > 0$
B) $W_{fric} = 0$
C) $W_{fric} < 0$



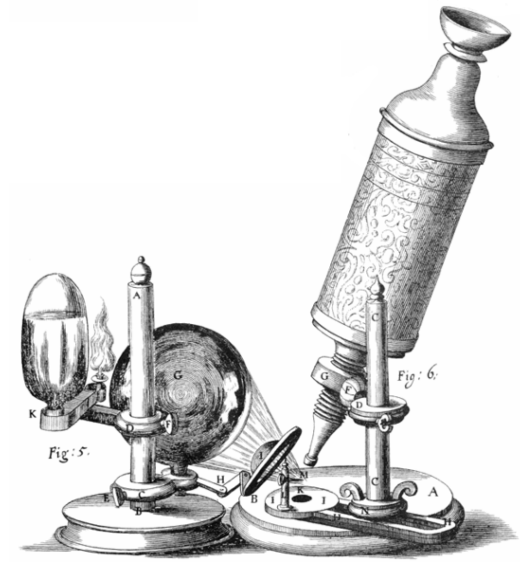
5-7c) A projectile is fired upward **through air** with an initial speed v_0. A short time later, it comes back down and has a final speed $v < v_0$. Air resistance is NOT negligible. The work done by friction W_{FRIC} during the flight is…

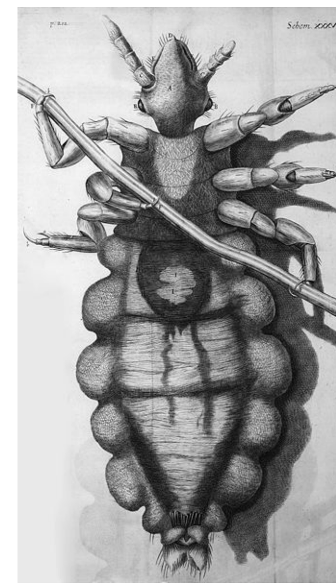
A) $\Delta K = K_f - K_i$
B) $-\Delta K$
C) Neither of these

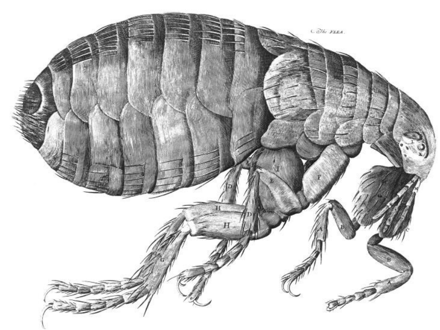


Robert Hooke (1635 – 1703)

Modern artist’s impression







From Hooke’s *Micrographia*

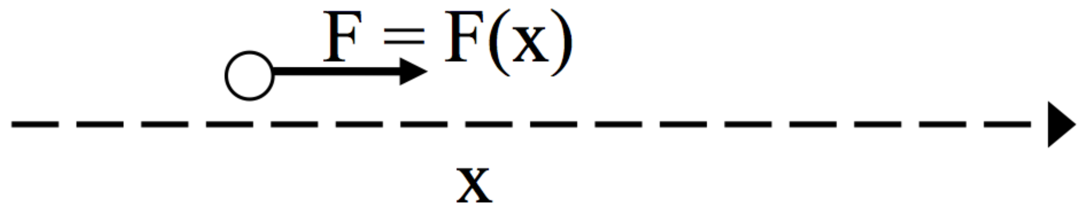
Example: MIT Water Balloon Fight

During the spring semester at MIT, residents of the parallel buildings of the East Campus Dorms battle one another with large sling-shots made from surgical hose mounted to window frames. Water balloons (with a mass of about 0.5 kg) are placed in a pouch attached to the hose, which is then stretched nearly the width of the room (about 3.5 meters). If the hose obeys Hooke's Law, with a spring constant of 100 N/m, how fast is the balloon traveling when it leaves the dorm room window?

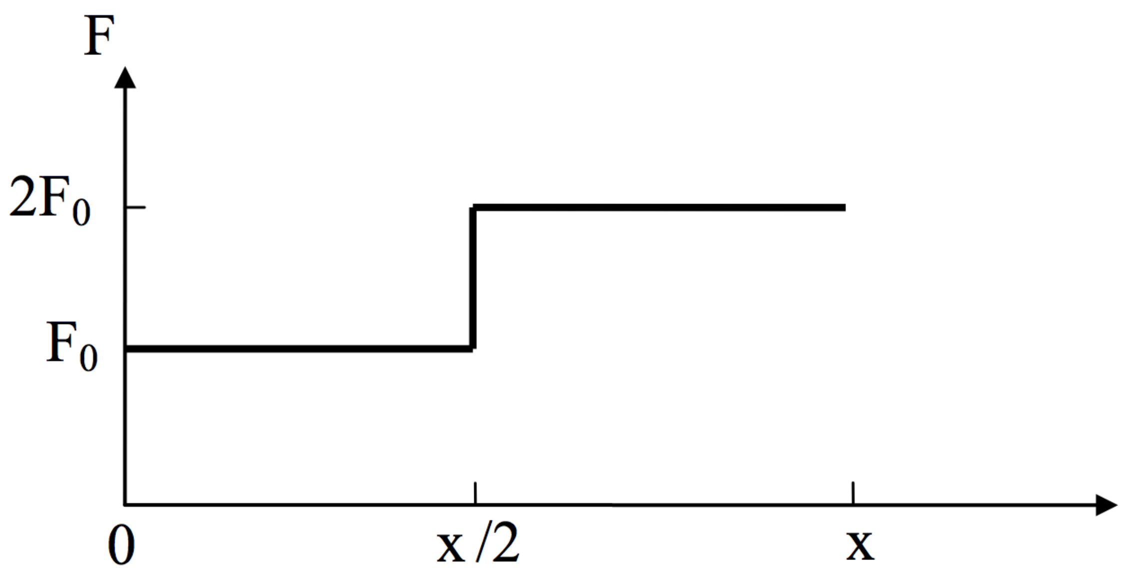
5-8) One end of a spring is fixed in place. I stretch the spring by pulling on the other end. What is the sign of the work done by the force from my hand?

A) Positive
B) Negative
C) Zero
D) Answer depends on the direction in which I pull
E) Answer depends on the coordinate system I choose

5-9a) A force is applied in the x-direction while an object moves a distance x along the x-axis.



The force varies with position according to this graph.



The work done by this force is:

A) $0.5\ F_0x$

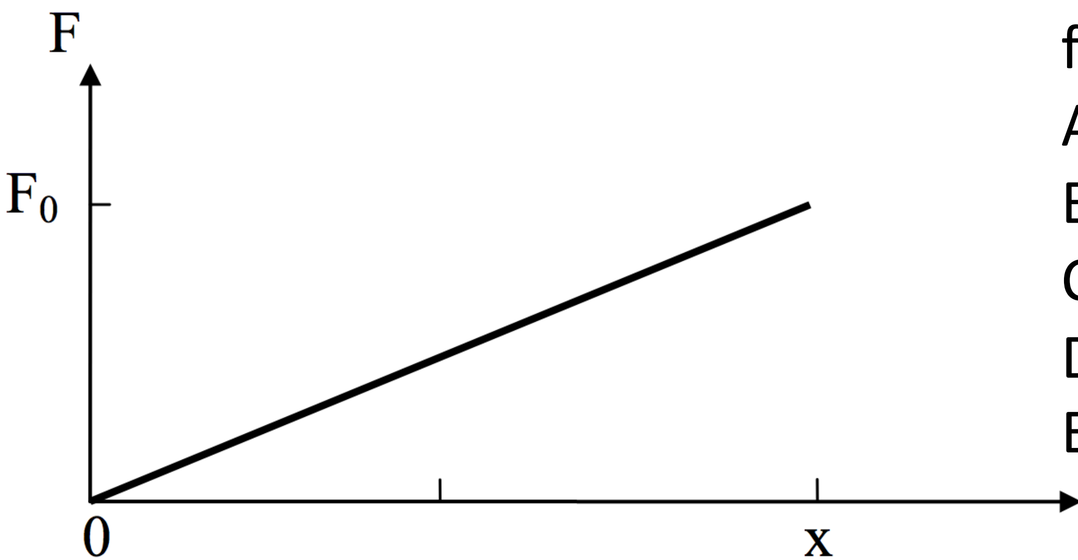
B) F_0x

C) $1.5\ F_0x$

D) $2\ F_0x$

E) $2.5\ F_0x$

5-9b) Now suppose the force varies with position according to this graph



The work done by this force is:

A) $0.5\ F_0x$
B) F_0x
C) $1.5\ F_0x$
D) $2\ F_0x$
E) $2.5\ F_0x$

5-10) A block initially at rest is allowed to slide down a frictionless ramp and attains a speed *v* at the bottom. To achieve a speed 2*v* at the bottom, how many times higher must a new ramp be?

A) 1
B) 2
C) 3
D) 4
E) 5

5-11) A spring-loaded toy dart gun is used to shoot a dart straight up in the air, and the dart reaches a maximum height of 24 m. The same dart is shot from the same gun a second time, but this time the spring is compressed only half as far before firing. How far up does the dart go this time, neglecting air resistance and assuming an ideal spring?

A) 48 m
B) 24 m
C) 12 m
D) 6 m
E) 3 m

5-12) A sports car accelerates from zero to 30 mph in 1.5 s. How long does it take for it to accelerate from zero to 60 mph, assuming the power of the engine to be independent of velocity and neglecting friction?

A) 2 s
B) 3 s
C) 6 s
D) 9 s
E) 12 s

Power

tuincentrum
H. Versteeg
Bert Maassen
stralen en conserveren
WIKSELAAR
SATELLITE
TRADING B.V.
HARSKAMP

5-13a) In competitive truck pulling, a large pickup pulls a sled across a dirt track. ‘Cause why not, right? Consider a truck with a 1000 hp (7.5e5 W) after market engine pulling a sled at 20 mph (9m/s) for 2 s. What is frictional force acting on the sled?

A) 50 N
B) 111 N
C) 41.6 kN
D) 83.3 kN
E) Something else

5-13b) If the coefficient of kinetic friction between the sled and the dirt is 0.5, what is the approximate mass of the sled? ($g=10 m/s^2$)

A) 8300 kg
B) 16500 kg
C) 165000 kg
D) Something else