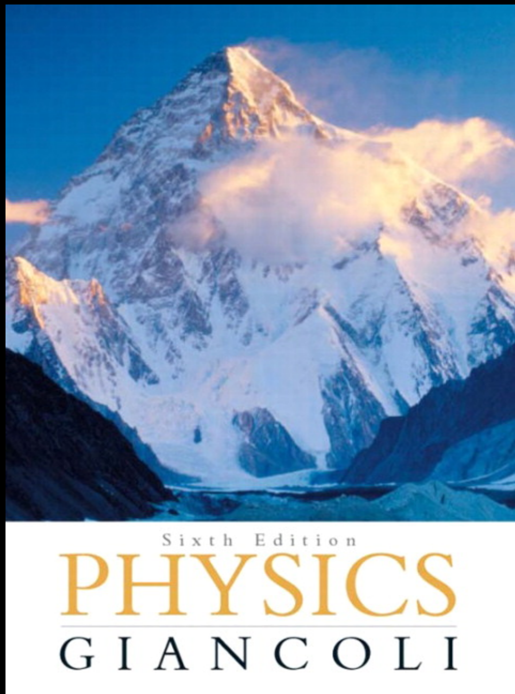


ConcepTest PowerPoints

Chapter 6

Physics: Principles with Applications, 6th edition

Giancoli

ConcepTest 6.1 To Work or Not to Work

Is it possible to do work on an object that remains at rest?

1) yes

2) no

ConcepTest 6.1 To Work or Not to Work

Is it possible to do work on an object that remains at rest?

1) yes

2) no

Work requires that a **force acts over a distance**. If an object does not move at all, there is **no displacement**, and therefore **no work done**.

ConcepTest 6.2a Friction and Work I

A box is being pulled across a rough floor at a constant speed. What can you say about the work done by friction?

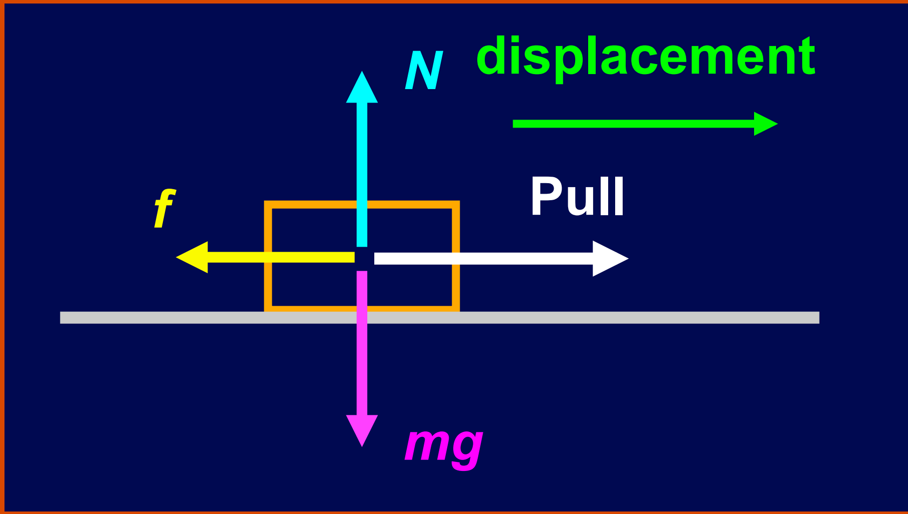
1) friction does no work at all
2) friction does negative work
3) friction does positive work

ConcepTest 6.2a Friction and Work I

A box is being pulled across a rough floor at a constant speed. What can you say about the work done by friction?

1) friction does no work at all
2) friction does negative work
3) friction does positive work

Friction acts in the opposite direction to the displacement, so the work is negative. Or using the definition of work: $W = F\, d \cos\theta$ since $\theta = 180^\circ$, then $W < 0$.



ConcepTest 6.2b Friction and Work II

Can friction ever do positive work?

1) yes

2) no

ConcepTest 6.2b Friction and Work II

Can friction ever do positive work?

1) yes
2) no

Consider the case of a box on the back of a pickup truck. If the box **moves along with the truck**, then it is actually the **force of friction that is making the box move**.

ConcepTest 6.2c Play Ball!

In a baseball game, the catcher stops a 90-mph pitch. What can you say about the work done by the catcher on the ball?

1) catcher has done positive work
2) catcher has done negative work
3) catcher has done zero work

ConcepTest 6.2c Play Ball!

In a baseball game, the catcher stops a 90-mph pitch. What can you say about the work done by the catcher on the ball?

1) catcher has done positive work
2) catcher has done negative work
3) catcher has done zero work

The force exerted by the catcher is **opposite in direction to the displacement of the ball, so the work is negative**. Or using the definition of work ($W = F\,d\cos\theta$), since $\theta = 180°$, then $W < 0$. Note that because the work done on the ball is negative, its speed decreases.

Follow-up: What about the work done by the ball on the catcher?

ConcepTest 6.2d Tension and Work

A ball tied to a string is being whirled around in a circle. What can you say about the work done by tension?

1) tension does no work at all
2) tension does negative work
3) tension does positive work

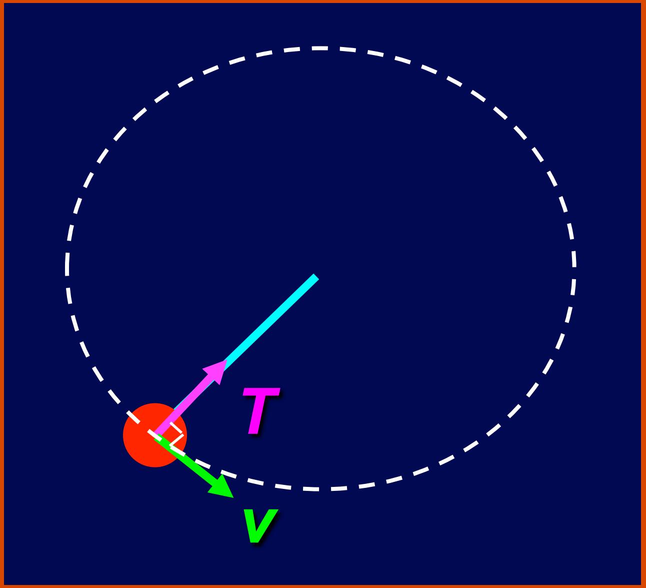
ConcepTest 6.2d Tension and Work

A ball tied to a string is being whirled around in a circle. What can you say about the work done by tension?

1) tension does no work at all
2) tension does negative work
3) tension does positive work

No work is done because the force acts in a **perpendicular** direction to the displacement. Or using the definition of work: $W = F\, d \cos\theta$

since $\theta = 90°$, then $W = 0$.

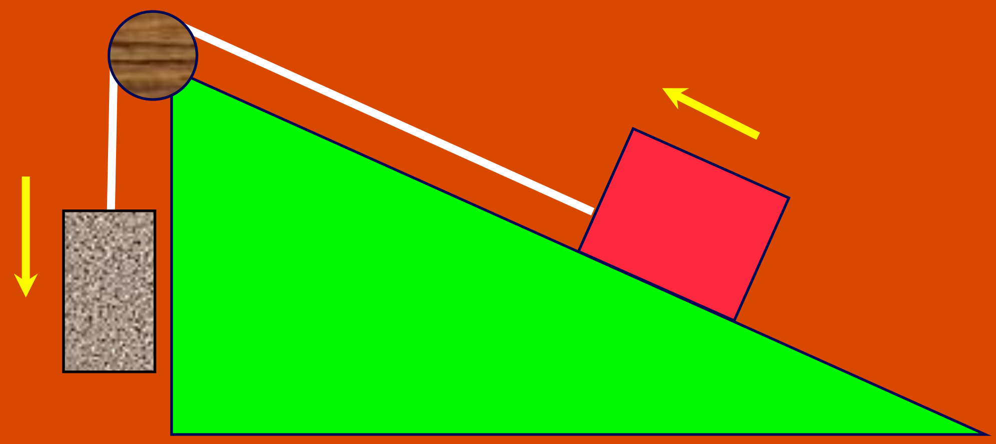


Follow-up: Is there a force in the direction of the velocity?

ConcepTest 6.3 Force and Work

A box is being pulled up a rough incline by a rope connected to a pulley. How many forces are doing work on the box?

1) one force
2) two forces
3) three forces
4) four forces
5) no forces are doing work



ConcepTest 6.3 Force and Work

A box is being pulled up a rough incline by a rope connected to a pulley. How many forces are doing work on the box?

1) one force
2) two forces
3) three forces
4) four forces
5) no forces are doing work

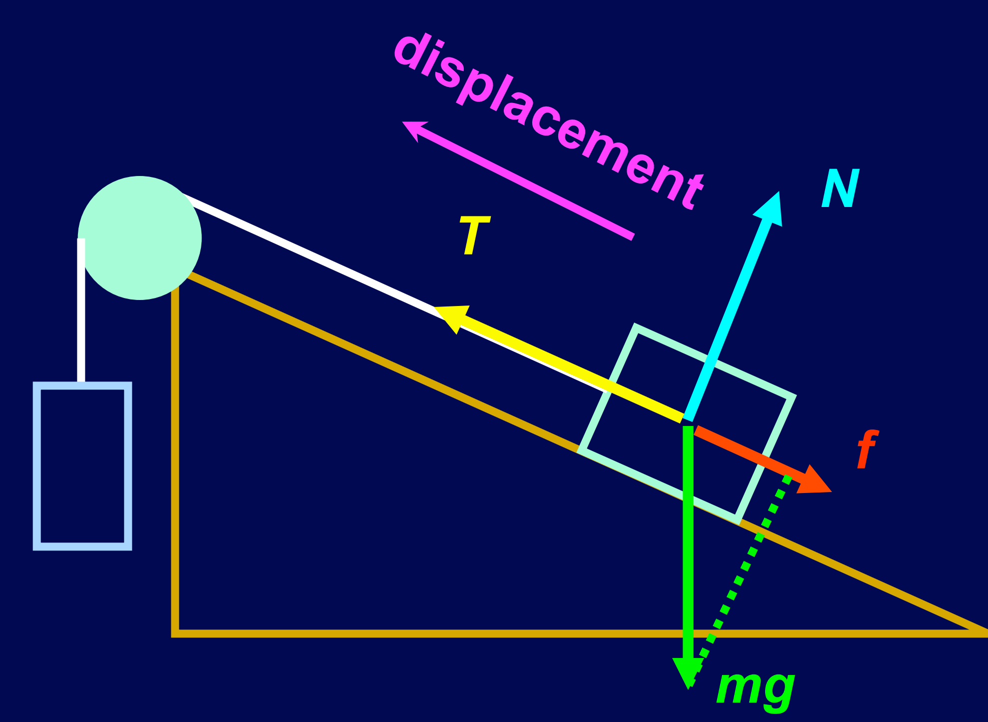
Any force not perpendicular to the motion will do work:

N does *no work*

T does positive work

f does negative work

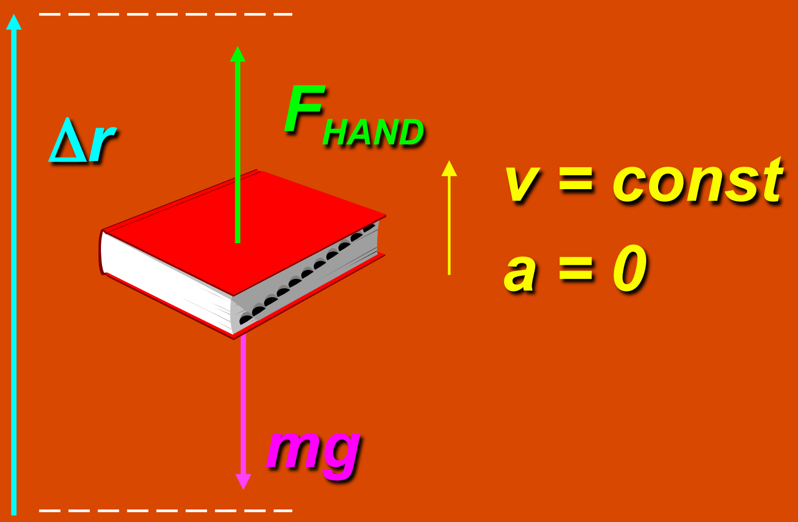
mg does negative work



ConcepTest 6.4 Lifting a Book

You lift a book with your hand in such a way that it moves up at constant speed. While it is moving, what is the total work done on the book?

1) $mg \times \Delta r$
2) $F_{HAND} \times \Delta r$
3) $(F_{HAND} + mg) \times \Delta r$
4) zero
5) none of the above



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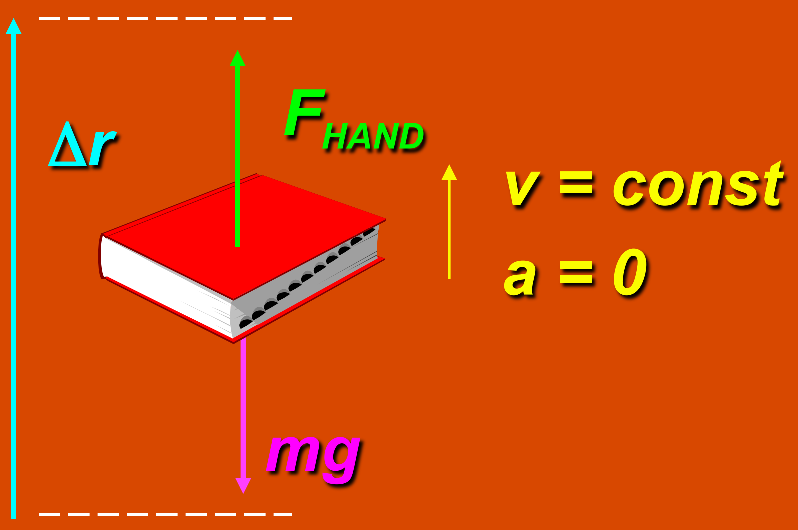
1) $mg \times \Delta r$
2) $F_{HAND} \times \Delta r$
3) $(F_{HAND} + mg) \times \Delta r$
4) zero
5) none of the above

The **total work is zero** since the **net force** acting on the book is **zero**. The work done by the hand is positive, while the work done by gravity is negative. The sum of the two is zero. **Note that the kinetic energy of the book does not change, either!**



Follow-up: What would happen if F_{HAND} was greater than mg?

ConcepTest 6.5a Kinetic Energy I

By what factor does the kinetic energy of a car change when its speed is tripled?

1) no change at all
2) factor of 3
3) factor of 6
4) factor of 9
5) factor of 12

ConcepTest 6.5a Kinetic Energy I

By what factor does the kinetic energy of a car change when its speed is tripled?

1) no change at all
2) factor of 3
3) factor of 6
4) factor of 9
5) factor of 12

Since the kinetic energy is $1/2\, mv^2$, if the **speed increases by a factor of 3**, then the **KE will increase by a factor of 9**.

Follow-up: How would you achieve a KE increase of a factor of 2?

ConcepTest 6.5b Kinetic Energy II

Car #1 has twice the mass of car #2, but they both have the same kinetic energy. How do their speeds compare?

1) $2 v_1 = v_2$
2) $\sqrt{2} v_1 = v_2$
3) $4 v_1 = v_2$
4) $v_1 = v_2$
5) $8 v_1 = v_2$

ConcepTest 6.5b Kinetic Energy II

Car #1 has twice the mass of car #2, but they both have the same kinetic energy. How do their speeds compare?

1) $2\,v_1 = v_2$
2) $\sqrt{2}\,v_1 = v_2$
3) $4\,v_1 = v_2$
4) $v_1 = v_2$
5) $8\,v_1 = v_2$

Since the kinetic energy is $1/2\ mv^2$, and the mass of car #1 is greater, then car #2 must be moving faster. If the ratio of m_1/m_2 is 2, then the ratio of v^2 values must also be 2. This means that the ratio of v_2/v_1 must be the square root of 2.

ConcepTest 6.6a   Free Fall I

Two stones, one twice the mass of the other, are dropped from a cliff. Just before hitting the ground, what is the kinetic energy of the heavy stone compared to the light one?

1) quarter as much
2) half as much
3) the same
4) twice as much
5) four times as much

ConcepTest 6.6a Free Fall I

Two stones, one twice the mass of the other, are dropped from a cliff. Just before hitting the ground, what is the kinetic energy of the heavy stone compared to the light one?

1) quarter as much
2) half as much
3) the same
4) twice as much
5) four times as much

Consider the work done by gravity to make the stone fall distance *d*:

$$\Delta KE = W_{net} = F\,d\cos\theta$$

$$\Delta KE = mg\,d$$

Thus, the stone with the **greater mass** has the **greater KE**, which is **twice** as big for the heavy stone.

Follow-up: How do the initial values of gravitational PE compare?

ConcepTest 6.6b Free Fall II

In the previous question, just before hitting the ground, what is the final speed of the heavy stone compared to the light one?

1) quarter as much
2) half as much
3) the same
4) twice as much
5) four times as much

ConcepTest 6.6b Free Fall II

In the previous question, just before hitting the ground, what is the final speed of the heavy stone compared to the light one?

1) quarter as much
2) half as much
3) the same
4) twice as much
5) four times as much

All freely falling objects fall at the same rate, which is *g*. Since the acceleration is the same for both, and the distance is the same, then the final speeds will be the same for both stones.

ConcepTest 6.7 Work and KE

A child on a skateboard is moving at a speed of 2 m/s. After a force acts on the child, her speed is 3 m/s. What can you say about the work done by the external force on the child?

1) positive work was done
2) negative work was done
3) zero work was done

ConcepTest 6.7 Work and KE

A child on a skateboard is moving at a speed of 2 m/s. After a force acts on the child, her speed is 3 m/s. What can you say about the work done by the external force on the child?

1) positive work was done
2) negative work was done
3) zero work was done

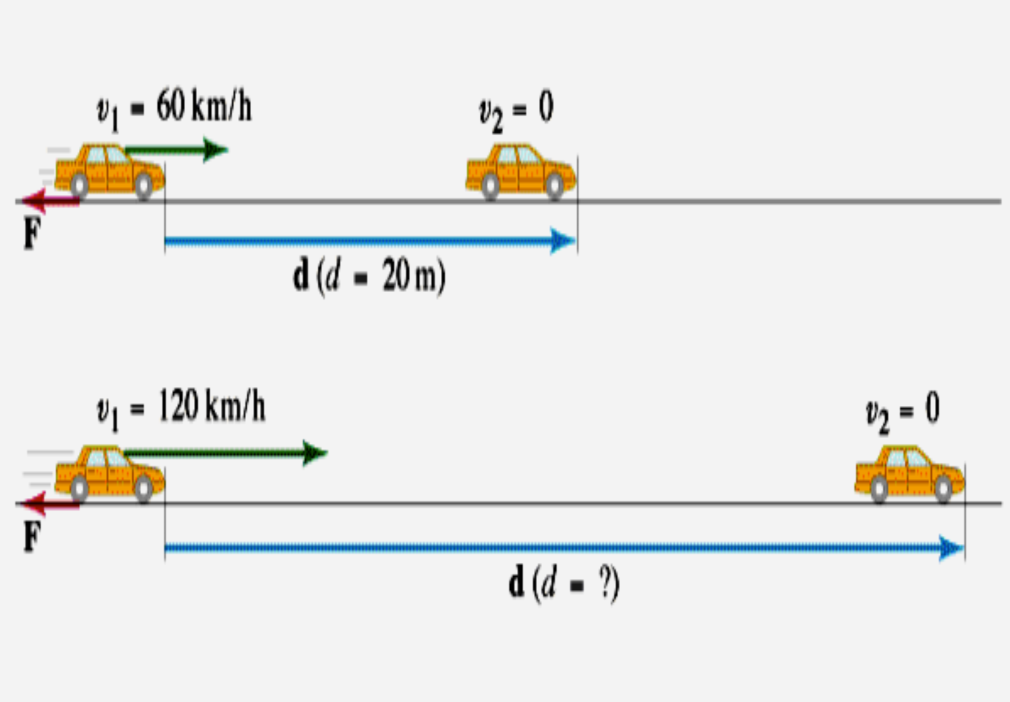
The kinetic energy of the child increased because her speed increased. This increase in KE was the result of positive work being done. Or, from the definition of work, since $W = \Delta KE = KE_f - KE_i$ and we know that $KE_f > KE_i$ in this case, then the work W must be positive.

Follow-up: What does it mean for negative work to be done on the child?

ConcepTest 6.8a Slowing Down

If a car traveling 60 km/hr can brake to a stop within 20 m, what is its stopping distance if it is traveling 120 km/hr? Assume that the braking force is the same in both cases.

1) 20 m
2) 30 m
3) 40 m
4) 60 m
5) 80 m



ConcepTest 6.8a Slowing Down

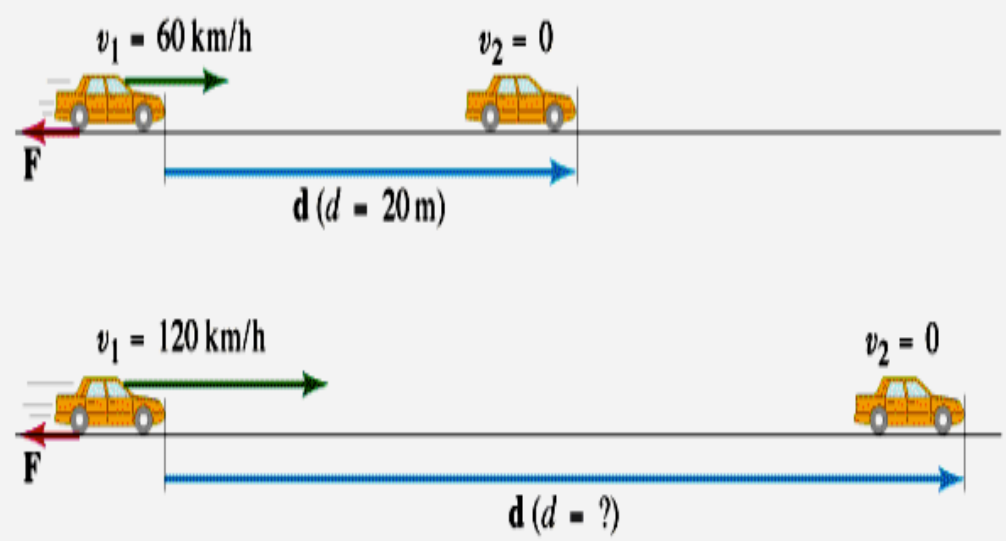
If a car traveling **60 km/hr** can brake to a stop within **20 m**, what is its stopping distance if it is traveling **120 km/hr**? Assume that the braking force is the same in both cases.

1) 20 m
2) 30 m
3) 40 m
4) 60 m
5) 80 m

$F\,d = W_{net} = \Delta KE = 0 - 1/2\ mv^2$

thus: $|F|\,d = 1/2\ mv^2$

Therefore, if the speed **doubles**, the stopping distance gets **four times larger**.



ConcepTest 6.8b Speeding Up I

A car starts from rest and accelerates to 30 mph. Later, it gets on a highway and accelerates to 60 mph. Which takes more energy, the 0→30 mph, or the 30→60 mph?

1) 0 → 30 mph
2) 30 → 60 mph
3) both the same

ConcepTest 6.8b Speeding Up I

A car starts from rest and accelerates to 30 mph. Later, it gets on a highway and accelerates to 60 mph. Which takes more energy, the 0→30 mph, or the 30→60 mph?

1) 0 → 30 mph
2) 30 → 60 mph
3) both the same

The change in KE ($1/2\ mv^2$) involves the ***velocity squared***.

So in the first case, we have: $1/2\ m\ (30^2 - 0^2) = 1/2\ m\ (900)$

In the second case, we have: $1/2\ m\ (60^2 - 30^2) = 1/2\ m\ (2700)$

Thus, the **bigger energy change** occurs in the **second case**.

Follow-up: How much energy is required to stop the 60-mph car?

ConcepTest 6.8c Speeding Up II

The work W_0 accelerates a car from 0 to 50 km/hr. How much work is needed to accelerate the car from 50 km/hr to 150 km/hr?

1) 2 W_0
2) 3 W_0
3) 6 W_0
4) 8 W_0
5) 9 W_0

ConcepTest 6.8c Speeding Up II

The work W_0 accelerates a car from 0 to 50 km/hr. How much work is needed to accelerate the car from 50 km/hr to 150 km/hr?

1) $2\ W_0$
2) $3\ W_0$
3) $6\ W_0$
4) $8\ W_0$
5) $9\ W_0$

Let's call the two speeds v and $3v$, for simplicity.

We know that the work is given by: $W = \Delta KE = KE_f - KE_i$

Case #1: $W_0 = 1/2\ m\ (v^2 - 0^2) = 1/2 m\ (v^2)$

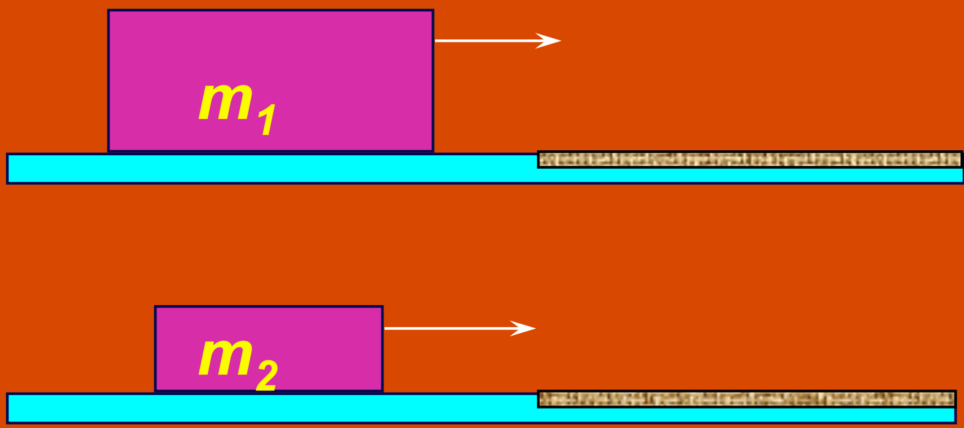
Case #2: $W = 1/2\ m\ (3v)^2 - v^2) = 1/2 m\ (9v^2 - v^2) = 1/2\ m\ (8v^2) = 8\ W_0$

Follow-up: How much work is required to stop the 150-km/hr car?

ConcepTest 6.9a Work and Energy I

Two blocks of mass m_1 and m_2 ($m_1 > m_2$) slide on a frictionless floor and have the **same kinetic energy** when they hit a long rough stretch ($\mu > 0$), which slows them down to a stop. **Which one goes farther?**

1) m_1
2) m_2
3) they will go the same distance



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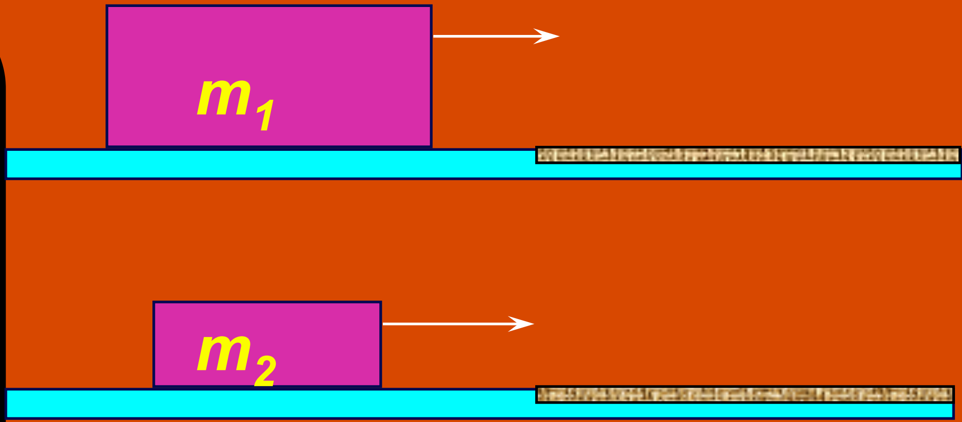
1) m_1
2) m_2
3) they will go the same distance

With the same ΔKE, both blocks must have the same work done to them by friction. The friction force is less for m_2 so stopping distance must be greater.



Follow-up: Which block has the greater magnitude of acceleration?

ConcepTest 6.9b Work and Energy II

A golfer making a putt gives the ball an initial velocity of v_0, but he has badly misjudged the putt, and the ball only travels one-quarter of the distance to the hole. If the resistance force due to the grass is constant, what speed should he have given the ball (from its original position) in order to make it into the hole?

1) $2\ v_0$
2) $3\ v_0$
3) $4\ v_0$
4) $8\ v_0$
5) $16\ v_0$

ConcepTest 6.9b Work and Energy II

A golfer making a putt gives the ball an initial velocity of v_0, but he has badly misjudged the putt, and the ball only travels one-quarter of the distance to the hole. If the resistance force due to the grass is constant, what speed should he have given the ball (from its original position) in order to make it into the hole?

1) $2\ v_0$
2) $3\ v_0$
3) $4\ v_0$
4) $8\ v_0$
5) $16\ v_0$

In traveling **4 times the distance**, the resistive force will do **4 times the work**. Thus, the ball's **initial KE must be 4 times greater** in order to just reach the hole — this requires an **increase in the initial speed by a factor of 2**, since **KE = 1/2 mv^2**.

ConcepTest 6.10 Sign of the Energy I

Is it possible for the kinetic energy of an object to be negative?

1) yes

2) no

ConcepTest 6.10 Sign of the Energy I

Is it possible for the kinetic energy of an object to be negative?

1) yes

2) no

The kinetic energy is $1/2\ mv^2$. The mass and the velocity squared will always be positive, so KE must always be positive.

ConcepTest 6.11 Sign of the Energy II

Is it possible for the gravitational potential energy of an object to be negative?

1) yes
2) no

ConcepTest 6.11 Sign of the Energy II

Is it possible for the gravitational potential energy of an object to be negative?

1) yes
2) no

Gravitational PE is *mgh*, where **height *h* is measured relative to some arbitrary reference level where PE = 0**. For example, a book on a table has positive PE if the zero reference level is chosen to be the floor. However, if the **ceiling is the zero level**, then the **book has negative PE on the table**. It is only ***differences*** (or changes) in PE that have any physical meaning.

ConcepTest 6.12 KE and PE

You and your friend both solve a problem involving a skier going down a slope, starting from rest. The two of you have chosen different levels for $y = 0$ in this problem. Which of the following quantities will you and your friend agree on?

1) only B
2) only C
3) A, B, and C
4) only A and C
5) only B and C

A) skier's PE

B) skier's change in PE

C) skier's final KE

ConcepTest 6.12 KE and PE

You and your friend both solve a problem involving a skier going down a slope, starting from rest. The two of you have chosen **different levels for *y* = 0** in this problem. **Which of the following quantities will you and your friend agree on?**

1) only B
2) only C
3) A, B, and C
4) only A and C
5) only B and C

A) skier's PE B) skier's change in PE C) skier's final KE

The **gravitational PE depends upon the reference level**, but the ***difference* ΔPE does not**! The work done by gravity must be the same in the two solutions, so **ΔPE and ΔKE should be the same**.

Follow-up: Does anything change ***physically*** by the choice of *y* = 0?

ConcepTest 6.13 Up the Hill

Two paths lead to the top of a big hill. One is steep and direct, while the other is twice as long but less steep. How much more potential energy would you gain if you take the longer path?

1) the same
2) twice as much
3) four times as much
4) half as much
5) you gain no PE in either case

ConcepTest 6.13 Up the Hill

Two paths lead to the top of a big hill. One is steep and direct, while the other is twice as long but less steep. How much more potential energy would you gain if you take the longer path?

1) the same
2) twice as much
3) four times as much
4) half as much
5) you gain no PE in either case

Since your vertical position (height) changes by the same amount in each case, the gain in potential energy is the same.

Follow-up: How much more work do you do in taking the steeper path?

Follow-up: Which path would you rather take? Why?

ConcepTest 6.14 Elastic Potential Energy

How does the work required to stretch a spring 2 cm compare with the work required to stretch it 1 cm?

1) same amount of work
2) twice the work
3) 4 times the work
4) 8 times the work

ConcepTest 6.14 Elastic Potential Energy

How does the work required to stretch a spring 2 cm compare with the work required to stretch it 1 cm?

1) same amount of work
2) twice the work
3) 4 times the work
4) 8 times the work

The elastic potential energy is $1/2\ kx^2$. So in the second case, the elastic PE is 4 times greater than in the first case. Thus, the work required to stretch the spring is also 4 times greater.

ConcepTest 6.15 Springs and Gravity

A mass attached to a vertical spring causes the spring to stretch and the mass to move downwards. What can you say about the spring's potential energy (PE_s) and the gravitational potential energy (PE_g) of the mass?

1) both PE_s and PE_g decrease
2) PE_s increases and PE_g decreases
3) both PE_s and PE_g increase
4) PE_s decreases and PE_g increases
5) PE_s increases and PE_g is constant

ConcepTest 6.15 Springs and Gravity

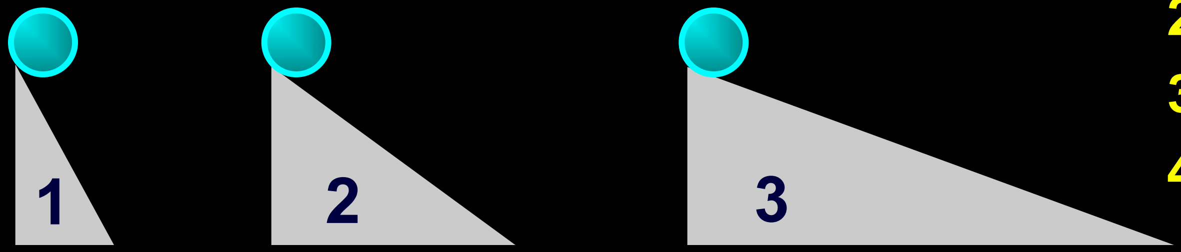
A mass attached to a vertical spring causes the spring to stretch and the mass to move downwards. What can you say about the spring's potential energy (PE_s) and the gravitational potential energy (PE_g) of the mass?

1) both PE_s and PE_g decrease
2) PE_s increases and PE_g decreases
3) both PE_s and PE_g increase
4) PE_s decreases and PE_g increases
5) PE_s increases and PE_g is constant

The spring is **stretched**, so its **elastic PE increases**, since $PE_s = 1/2\, kx^2$. The mass moves down to a **lower position**, so its **gravitational PE decreases**, since $PE_g = mgh$.

ConcepTest 6.16 Down the Hill

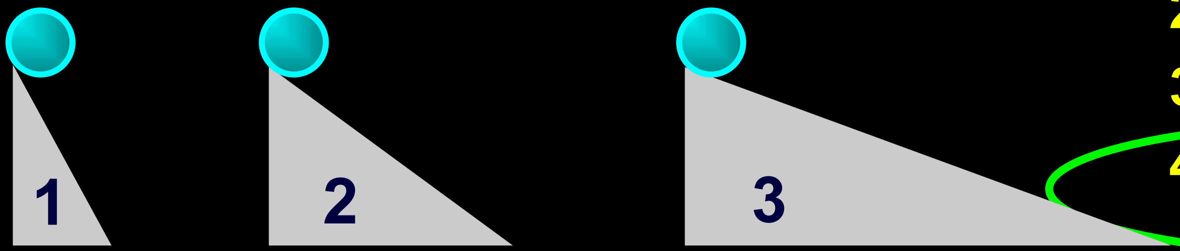
Three balls of equal mass start from rest and roll down different ramps. All ramps have the same height. Which ball has the greater speed at the bottom of its ramp?



1) Ball 1
2) Ball 2
3) Ball 3
4) same speed for all balls

ConcepTest 6.16 Down the Hill

Three balls of equal mass start from rest and roll down different ramps. All ramps have the same height. Which ball has the greater speed at the bottom of its ramp?



1) Ball 1
2) Ball 2
3) Ball 3
4) Same speed for all balls

All of the balls have the same initial gravitational PE, since they are all at the same height (PE = mgh). Thus, when they get to the bottom, they all have the same final KE, and hence the same speed (KE = 1/2 mv^2).

Follow-up: Which ball takes longer to get down the ramp?

ConcepTest 6.17a Runaway Truck

A truck, initially at rest, rolls down a frictionless hill and attains a speed of *20 m/s* at the bottom. To achieve a speed of *40 m/s* at the bottom, how many times higher must the hill be?

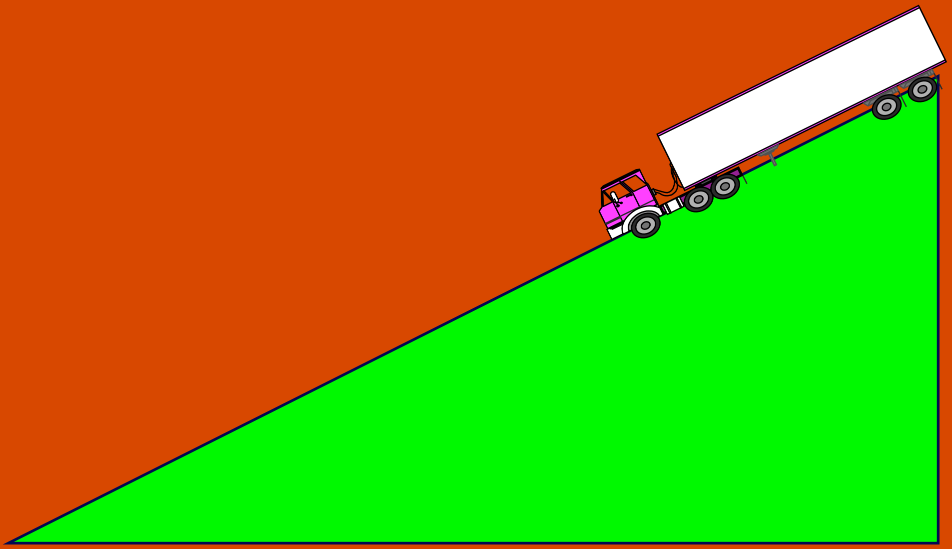
1) half the height

2) the same height

3) $\sqrt{2}$ times the height

4) twice the height

5) four times the height



ConcepTest 6.17a Runaway Truck

A truck, initially at rest, rolls down a frictionless hill and attains a speed of *20 m/s* at the bottom. To achieve a speed of *40 m/s* at the bottom, how many times higher must the hill be?

1) half the height
2) the same height
3) $\sqrt{2}$ times the height
4) twice the height
5) four times the height

Use energy conservation:

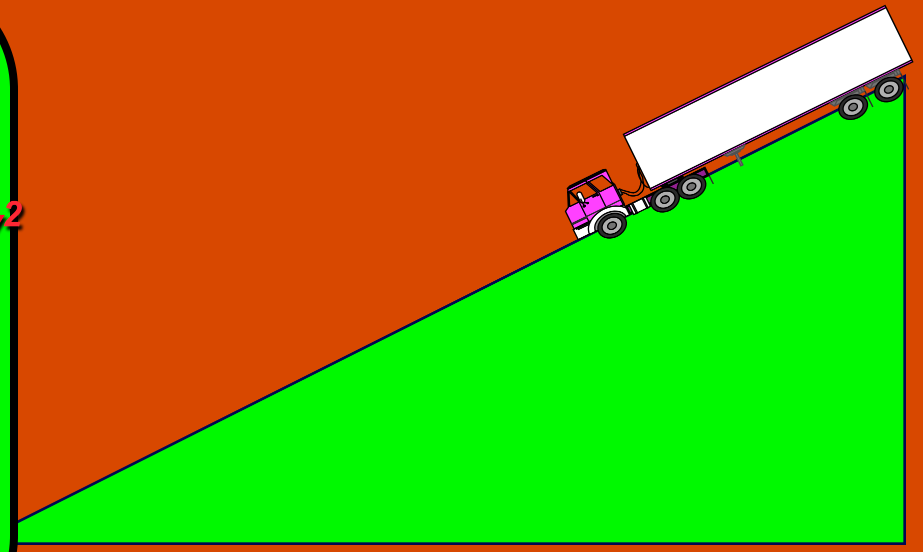
- *initial energy:* $E_i = PE_g = mgH$
- *final energy:* $E_f = KE = 1/2\ mv^2$

Conservation of Energy:

$$E_i = mgH = E_f = 1/2\ mv^2$$

therefore: $gH = 1/2\ v^2$

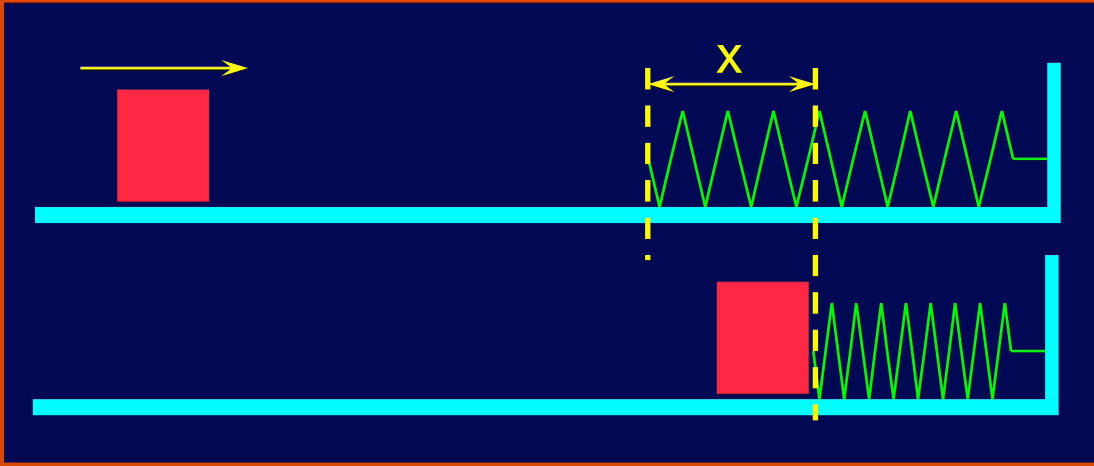
So if *v* doubles, *H* quadruples!



ConcepTest 6.17b Runaway Box

A box sliding on a frictionless flat surface runs into a fixed spring, which compresses a distance ***x*** to stop the box. If the initial ***speed*** of the box were ***doubled***, how much would the spring compress in this case?

1) half as much
2) the same amount
3) $\sqrt{2}$ times as much
4) twice as much
5) four times as much



ConcepTest 6.17b Runaway Box

A box sliding on a frictionless flat surface runs into a fixed spring, which compresses a distance *x* to stop the box. If the initial *speed* of the box were *doubled*, how much would the spring compress in this case?

1) half as much
2) the same amount
3) $\sqrt{2}$ times as much
4) twice as much
5) four times as much

Use energy conservation:

initial energy: $E_i = KE = 1/2\,mv^2$

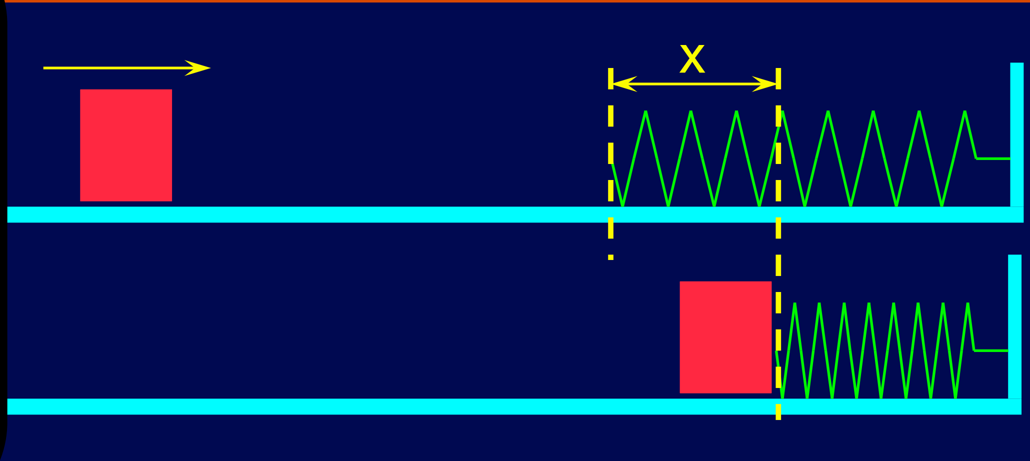
final energy: $E_f = PE_s = 1/2\,kx^2$

Conservation of Energy:

$E_i = 1/2\,mv^2 = E_f = 1/2\,kx^2$

therefore: $mv^2 = kx^2$

So if *v* doubles, *x* doubles!



ConcepTest 6.18a Water Slide I

Paul and Kathleen start from rest at the same time on frictionless water slides with different shapes. At the bottom, whose velocity is greater?

1) Paul
2) Kathleen
3) both the same

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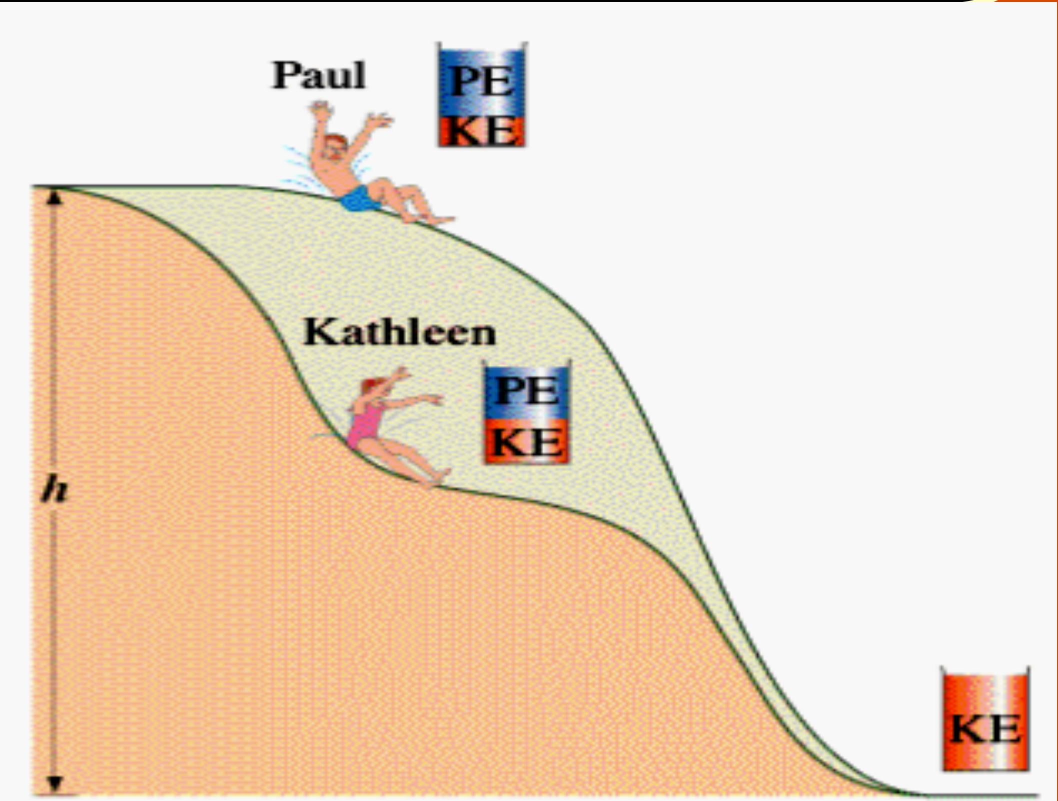
1) Paul
2) Kathleen
3) both the same

Conservation of Energy:

$E_i = mgH = E_f = 1/2\, mv^2$

therefore: $gH = 1/2\, v^2$

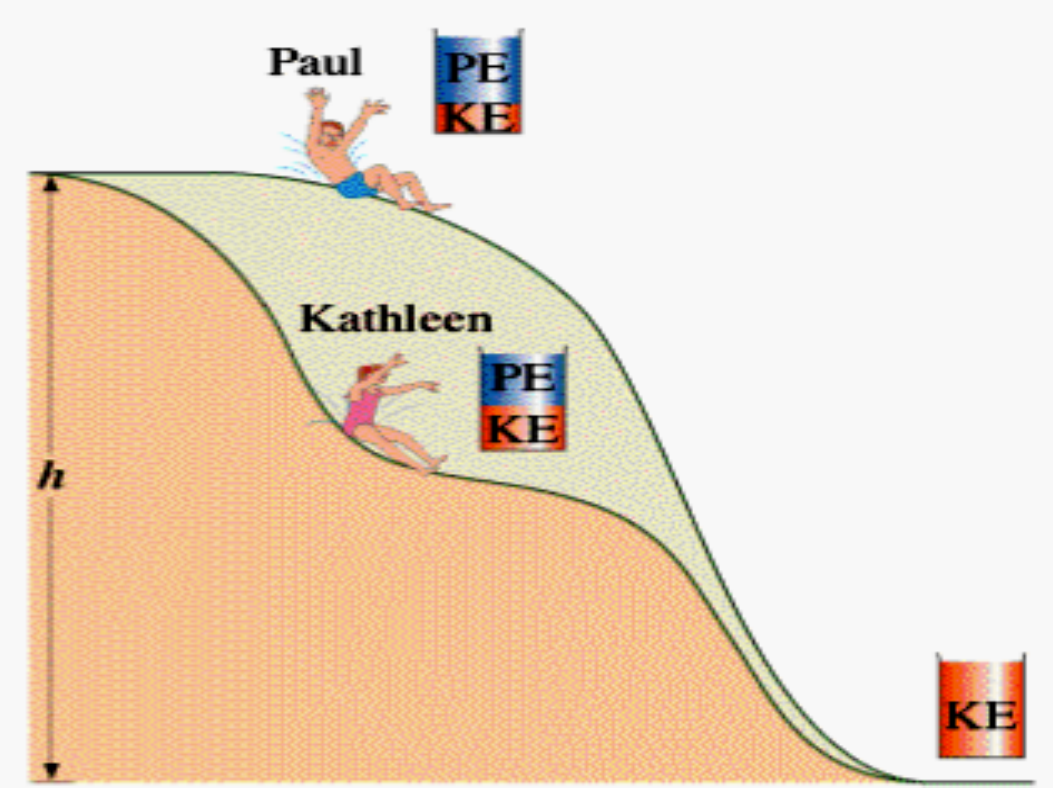
Since they both start from the same height, they have the same velocity at the bottom.



ConcepTest 6.18b Water Slide II

Paul and Kathleen start from rest at the same time on frictionless water slides with different shapes. Who makes it to the bottom first?

1) Paul
2) Kathleen
3) both the same

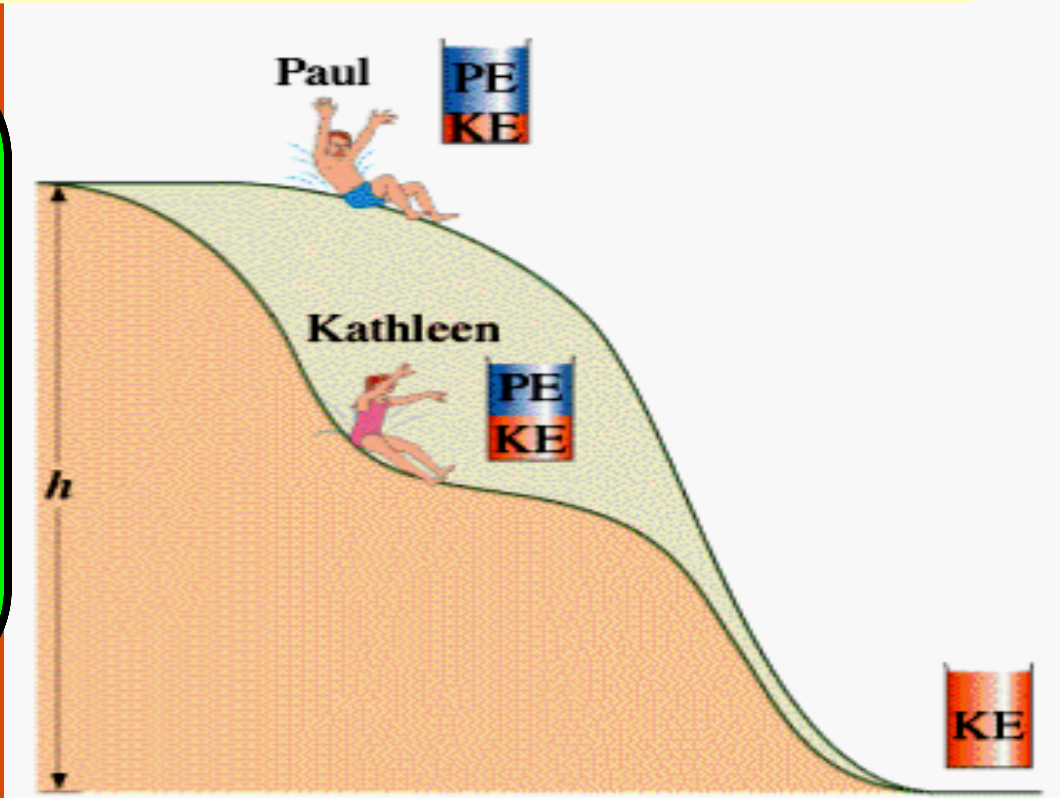


ConcepTest 6.18b Water Slide II

Paul and Kathleen start from rest at the same time on frictionless water slides with different shapes. Who makes it to the bottom first?

1) Paul
2) Kathleen
3) both the same

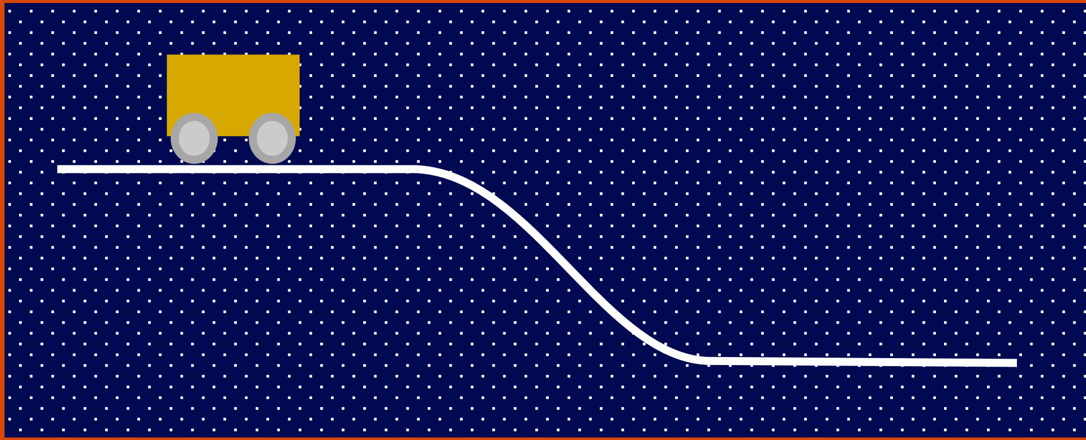
Even though they both have the same *final velocity*, **Kathleen is at a lower height than Paul for most of her ride.** Thus she always has a ***larger velocity*** during her ride and therefore arrives earlier!



ConcepTest 6.19 Cart on a Hill

A cart starting from rest rolls down a hill and at the bottom has a speed of 4 m/s. If the cart were given an initial push, so its initial speed at the top of the hill was 3 m/s, what would be its speed at the bottom?

1) 4 m/s
2) 5 m/s
3) 6 m/s
4) 7 m/s
5) 25 m/s



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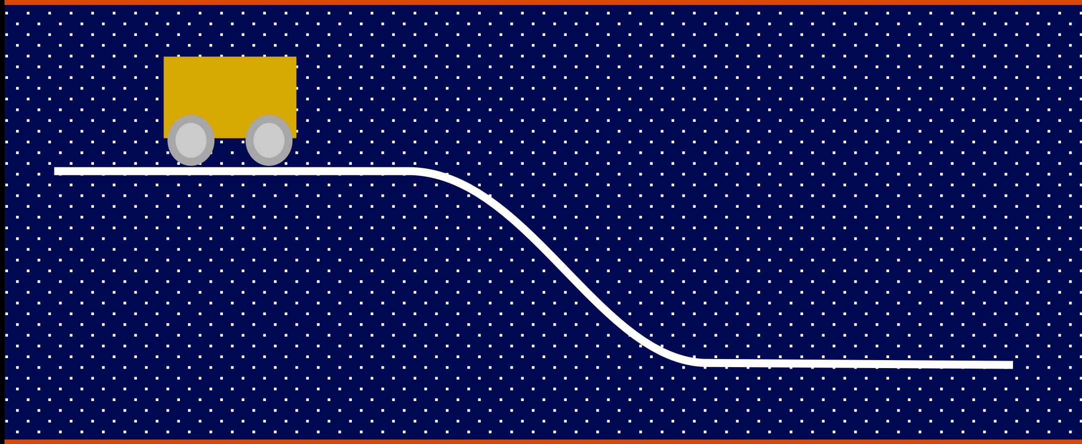
1) 4 m/s
2) 5 m/s
3) 6 m/s
4) 7 m/s
5) 25 m/s

When starting from rest, the cart's PE is changed into KE:

$$\Delta PE = \Delta KE = 1/2\, m(4)^2$$

When starting from 3 m/s, the final KE is:

$$KE_f = KE_i + \Delta KE$$
$$= 1/2\, m(3)^2 + 1/2\, m(4)^2$$
$$= 1/2\, m(25)$$
$$= 1/2\, m(5)^2$$



Speed is not the same as kinetic energy

ConcepTest 6.20a Falling Leaves

You see a leaf falling to the ground with *constant speed*. When you first notice it, the leaf has initial total energy $PE_i + KE_i$. You watch the leaf until just before it hits the ground, at which point it has final total energy $PE_f + KE_f$. How do these total energies compare?

1) $PE_i + KE_i > PE_f + KE_f$
2) $PE_i + KE_i = PE_f + KE_f$
3) $PE_i + KE_i < PE_f + KE_f$
4) impossible to tell from the information provided

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As the leaf falls, air resistance exerts a force on it opposite to its direction of motion. This force does negative work, which prevents the leaf from accelerating. This frictional force is a non-conservative force, so the leaf loses energy as it falls, and its final total energy is less than its initial total energy.

Follow-up: What happens to leaf's KE as it falls? What is net work done?

ConcepTest 6.20b Falling Balls

You throw a ball straight up into the air. In addition to *gravity*, the ball feels a force due to *air resistance*. Compared to the time it takes the ball to go up, the time it takes to come back down is:

1) smaller

2) the same

3) greater

ConcepTest 6.20b Falling Balls

You throw a ball straight up into the air. In addition to *gravity*, the ball feels a force due to *air resistance*. Compared to the time it takes the ball to go up, the time it takes to come back down is:

1) smaller
2) the same
3) greater

Due to air friction, the ball is **continuously losing mechanical energy**. Therefore it has **less KE** (and consequently a **lower speed**) on the way down. **This means it will take more time on the way down** !!

Follow-up: How does the force of air resistance compare to gravity when the ball reaches terminal velocity?

ConcepTest 6.21a Time for Work I

Mike applied 10 N of force over 3 m in 10 seconds. Joe applied the same force over the same distance in 1 minute. Who did more work?

1) Mike
2) Joe
3) both did the same work

ConcepTest 6.21a Time for Work I

Mike applied 10 N of force over 3 m in **10 seconds**. **Joe** applied the same force over the same distance in **1 minute**. Who did more work?

1) Mike
2) Joe
3) both did the same work

Both exerted the **same force** over the **same displacement**. Therefore, both did the ***same amount of work***. **Time does not matter for determining the work done.**

ConcepTest 6.21b Time for Work II

Mike performed **5 J** of work in **10 secs**. **Joe** did **3 J** of work in **5 secs**. Who produced the greater power?

1) Mike produced more power
2) Joe produced more power
3) both produced the same amount of power

ConcepTest 6.21b Time for Work II

Mike performed 5 J of work in 10 secs. Joe did 3 J of work in 5 secs. Who produced the greater power?

1) Mike produced more power
2) Joe produced more power
3) both produced the same amount of power

Since power = work / time, we see that Mike produced 0.5 W and Joe produced 0.6 W of power. Thus, even though Mike did more work, he required twice the time to do the work, and therefore his power output was lower.

ConcepTest 6.21c Power

Engine #1 produces twice the power of engine #2. Can we conclude that engine #1 does twice as much work as engine #2?

1) yes
2) no

ConcepTest 6.21c Power

Engine #1 produces twice the power of engine #2. Can we conclude that engine #1 does twice as much work as engine #2?

1) yes

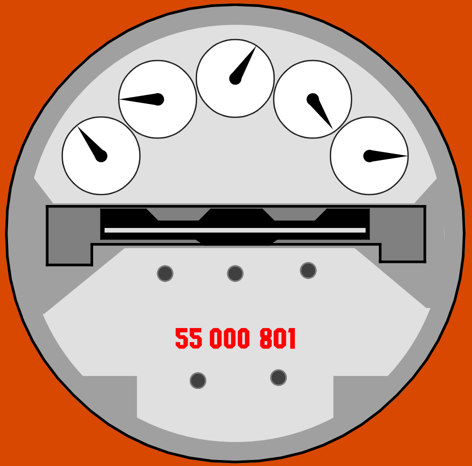
2) no

No!! We cannot conclude anything about how much work each engine does. Given the power output, the **work will depend upon how much time is used**. For example, engine #1 may do the same amount of work as engine #2, but in half the time.

ConcepTest 6.22a Electric Bill

When you pay the electric company by the **kilowatt-hour**, what are you actually paying for?

1) energy
2) power
3) current
4) voltage
5) none of the above



ConcepTest 6.22a Electric Bill

When you pay the electric company by the **kilowatt-hour**, what are you actually paying for?

(1) energy

(2) power

(3) current

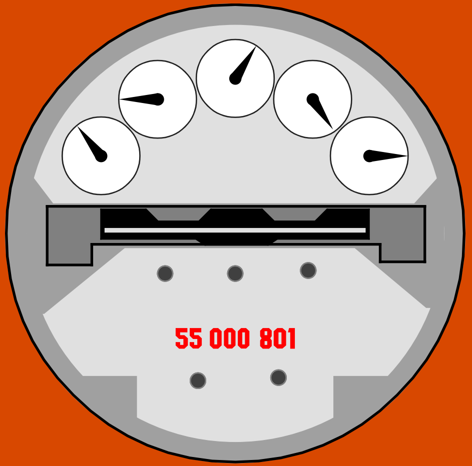
(4) voltage

(5) none of the above

We have defined: Power = energy / time

So we see that: Energy = power x time

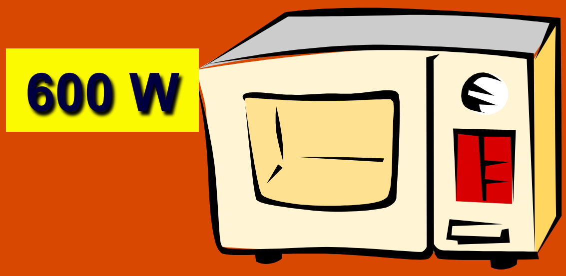
This means that the unit of power x time (watt-hour) is a unit of energy !!



ConcepTest 6.22b Energy Consumption

Which contributes more to the cost of your electric bill each month, a 1500-Watt hair dryer or a 600-Watt microwave oven?

1) hair dryer
2) microwave oven
3) both contribute equally
4) depends upon what you cook in the oven
5) depends upon how long each one is on



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(1) hair dryer

(2) microwave oven

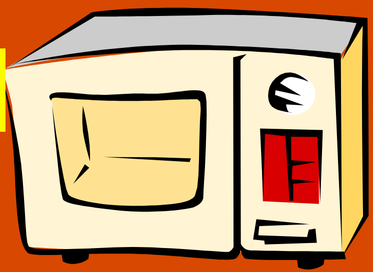
(3) both contribute equally

(4) depends upon what you cook in the oven

(5) depends upon how long each one is on

We already saw that what you actually pay for is ***energy***. To find the energy consumption of an appliance, you must know more than just the power rating — **you have to know how long it was running**.

600 W



1500 W