GreatHearts
Irving

Remote Learning Packet

NB: Please keep all work produced this week. Details regarding how to turn in this work will be forthcoming.

April 20 - 24, 2020

Course: 11 Physics
Teacher: Miss Weisse natalie.weisse@greatheartsirving.org
Resource: *Miss Weisse's Own Physics Textbook* — new pages found at the end of this packet

Weekly Plan:

Monday, April 20
- ☐ Read & Understand Notes on *Unit 8 Part 1 – An Introduction to Energy* (pages 39-43)
- ☐ Organize the information from Unit 8 Part 1.

Tuesday, April 21
- ☐ Read & Understand Notes on *Unit 8 Part 2 – Tracking Energy – Systems* (pages 44-48)
- ☐ Complete practice problems a-d on pages 49-50
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Wednesday, April 22
- ☐ Re-read & Understand Notes on *Unit 8 - Energy* (pages 39-49)
- ☐ Complete Unit 8 Worksheet 1a
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Thursday, April 23
- ☐ Read & Understand Notes on *Unit 8 - Energy* (pages 39-49)
- ☐ Complete Unit 8 Worksheet 1b #1-4
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Friday, April 24
- ☐ Read & Understand Notes on *Unit 8 - Energy* (pages 39-49)
- ☐ Complete Unit 8 Worksheet 1b #5-8
- ☐ Email Miss Weisse with Questions and to Ask for Solutions

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

____
Student Signature

I affirm that, to the best of my knowledge, my child completed this work independently

____
Parent Signature

Monday, April 20

➔ Read & Understand Notes on *Unit 8 Part 1 – An Introduction to Energy* (pages 39-43)

➔ On a sheet of paper with a full heading, organize the information from Unit 8 Part 1. Make sure you understand the terms so they don't hold you back for the next few weeks.

Tuesday, April 21

➔ Read & Understand Notes on *Unit 8 Part 2 – Tracking Energy – Systems* (pages 44-48)

◆ If you are able and allowed, follow the following link which will take you to a simulation referenced in the notes. https://phet.colorado.edu/sims/html/energy-skate-park-basics/latest/energy-skate-park-basics_en.html

➔ On a sheet of paper with a full heading, complete practice problems a-d on pages 49-50

Wednesday, April 22

➔ Review Notes on *Unit 8 - Energy* (pages 39-49)

➔ On a sheet of paper with a full heading, complete Unit 8 Worksheet 1a #1-6.

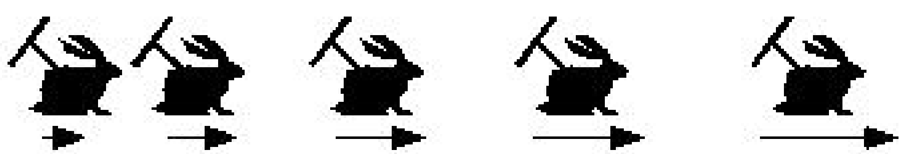
Directions: Use pie charts to analyze the energy changes in each situation given of the wind-up bunny toy moving (or not) on wheels.

Hint 1: Your system includes the wind-up mechanism, the toy itself, and the surface.

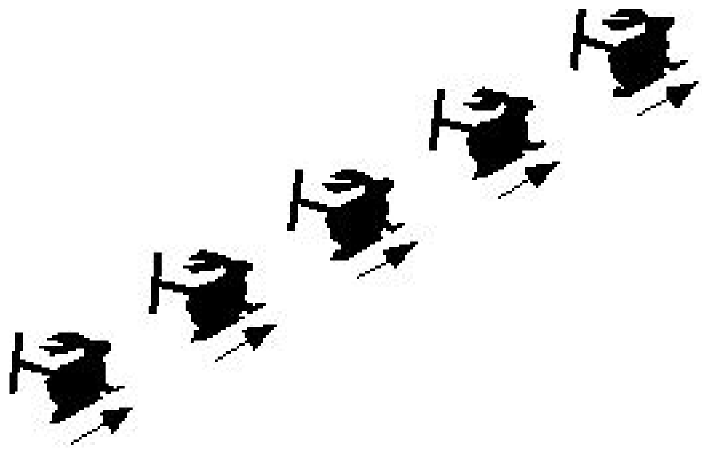
Hint 2: Possible sources of energy are gravitational potential energy (E_g), kinetic energy (E_k), elastic energy from wind-up mechanism (E_{el}), and thermal energy (E_{th}) from friction with the surface.

1. A wind-up toy is fully wound and at rest.

2. A wind-up toy is wound up and moving across level ground. The toy is speeding up.

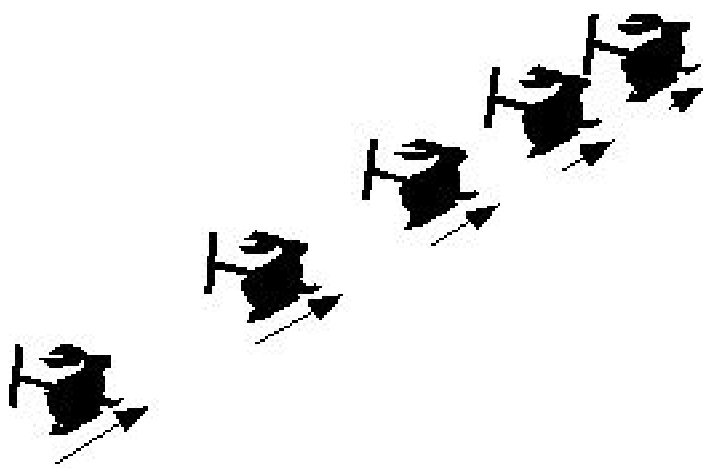


3. The toy is wound up and is moving at a constant speed up an incline.

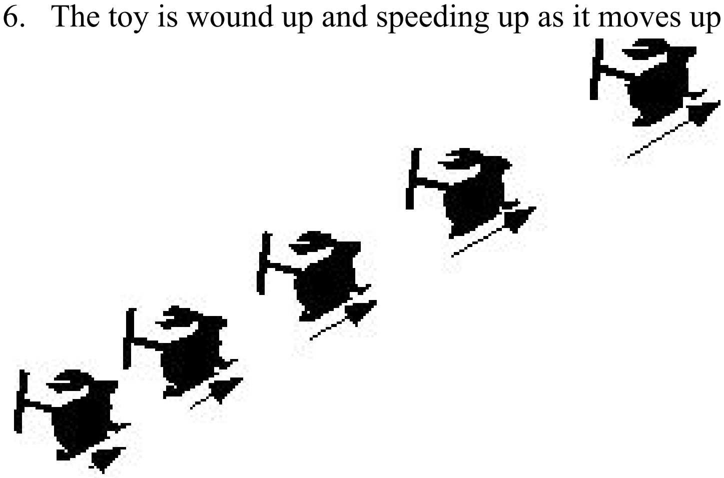


4. The toy is wound up and moving along at a constant speed.

5. The toy is wound up and slowing down as it moves up an incline.



6. The toy is wound up and speeding up as it moves up an incline.



Thursday, April 23

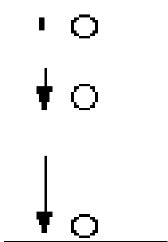
- ➔ Review Notes on *Unit 8 - Energy* (pages 39-49)
- ➔ Complete Unit 8 Worksheet 1b #1-4
- ➔ Email Miss Weisse with Questions and to Ask for Solutions

Directions: Use pie charts to analyze the energy changes in each situation given of the wind-up bunny toy moving (or not) on wheels.

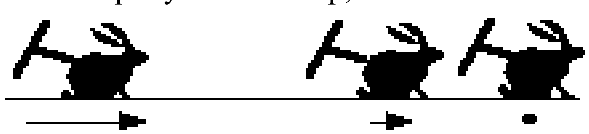
Hint 1: Your system includes the wind-up mechanism, the toy itself, and the surface.

Hint 2: Possible sources of energy are gravitational potential energy (E_g), kinetic energy (E_k), thermal energy (E_{th}) from friction with the surface, elastic energy from a wind-up mechanism or an otherwise bouncy surface (E_{el}), chemical energy from the combustion of gas in a car (E_{ch}).

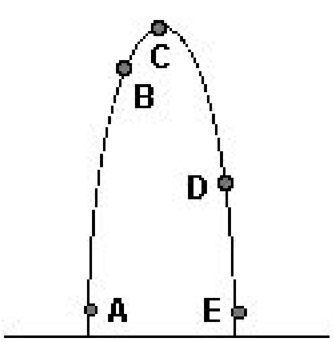
1. A ball is held above the ground, and then is dropped so it falls straight down. (Restrict your analysis to the ball being in the air, BEFORE it hits the ground.)



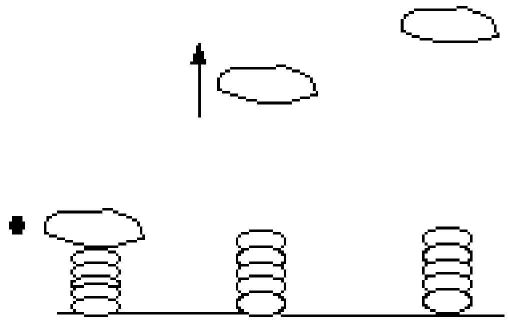
2. A wind-up toy is wound up, then "walks" across a table and comes to a stop.



3. A baseball is thrown up in the air and then falls back down. Place velocity vectors beside each corresponding baseball in the drawing, and draw an energy storage pie for each lettered position.



4. An object rests on a coiled spring, and is then launched upwards.



Friday, April 24

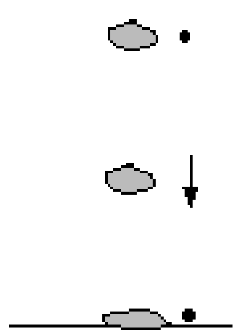
- ➔ Review Notes on *Unit 8 - Energy* (pages 39-49)
- ➔ Complete Unit 8 Worksheet 1b #5-8
- ➔ Email Miss Weisse with Questions and to Ask for Solutions

Directions: Use pie charts to analyze the energy changes in each situation given of the wind-up bunny toy moving (or not) on wheels.

Hint 1: Your system includes the wind-up mechanism, the toy itself, and the surface.

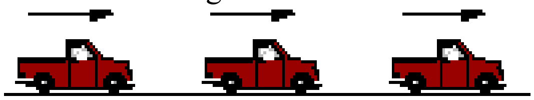
Hint 2: Possible sources of energy are gravitational potential energy (E_g), kinetic energy (E_k), thermal energy (E_{th}) from friction with the surface, elastic energy from a wind-up mechanism or an otherwise bouncy surface (E_{el}), chemical energy from the combustion of gas in a car (E_{ch}).

5. A piece of clay is dropped to the floor.

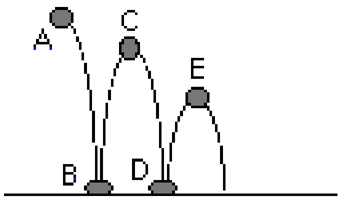


6. A ball rolls to a stop on the floor.

7. A truck being driven down the street.



8. A superball is dropped and bounces up and down. Draw a pie chart for each position of the ball shown. Why does the ball not bounce as high each time? Where does the energy "go"?



Miss Weisse's Own

Physico Textbook

Unit 8
Part 1

An Introduction to Energy

ENERGY is difficult to define. If you look up a definition of energy you are most likely going to find something similar to "energy is the ability to do work." But this is like saying "force is the ability to change the motion of an object." Neither of these definitions explain what the thing is, but, rather, what the thing does.

Here are more concrete things we know about energy (though I'm still unconvinced we can say it is a definition).

Energy is...

...Universal. → although we name different "kinds" of energy (kinetic, potential, chemical, etc.) the energy itself does not change. As an analogy, we do the same thing with force (push force, frictional force, gravitational force) but all "kinds" of forces are simply a push or pull on an object.

...a Substance-Like Quantity. → We can measure and quantify the amount of energy an object (or a system) has. We can even quantify how much of each "kind" of energy an object has at a given moment.

...Conserved. → energy cannot be created or destroyed, but sometimes it appears to be as it changes the "kind" of energy.

...a Scalar Quantity. → unlike velocity, acceleration, force, and momentum, energy does NOT have direction. It is just a number.

... the capability to produce change. → this is like the statement "energy is the ability to do work." In a very basic way, we can think of energy as fueling motion or fueling-up for future motion.

STORAGE MODES OF ENERGY

Energy always has a home. There are generally three types of homes or storage modes.

1. Energy can be stored in an object.
   - → Kinetic Energy (E_K) is energy stored in an object that is in motion.
   - → Elastic Energy (E_{el}) is energy stored in an object when the object is undergoing restorable deformation.

     Examples:
     - the stretching of a spring or rubberband
     - gearing up a wind-up toy
     - a bouncy ball compressing against a surface

2. Energy can be stored by a field.
   - it is only energy caused by non-contact forces (the gravitational force, magnetic force, and electrical force) that are stored in fields. Fields are NOT physical, just like energy is not physical.

→ Gravitational Energy (E_g), also known as gravitational potential energy, is stored in a field. We know an object that is lifted above a surface has the potential to fall. The higher the object the more capability to produce a change when the object falls compared to a lower object. On the other hand, if you move an object horizontally while heald above a surface, the possible change is not changed because the object will fall the same vertical distance. So the field stores energy relative to how far two objects are from eachother (it is ok if you do not understand).

→ Electrical Energy (E_e), also known as electrical potential energy, is stored in a field. From your knowledge of chemistry you know positive and negative charges attract. The field holds the energy of this attraction and this energy can be transformed into kinetic energy if the charges have a path to travel toward eachother. The further the charges are from eachother, the more electrical energy is stored in the field because the charges have more capability to produce a change

Example:

- Think about your hair standing on end when an electrical (lightning) storm is about to happen or when you rub your hair with a balloon. This action opposite of gravity is due to stored energy from the field.

3. Energy can be stored in the ENVIRONMENT. (By "environment" we mean the air or the surface on which another object is in contact.)

→ We know air is actually made up of many (and many types) of small particles. Energy stored in air is really just a way to say energy stored in these many, many objects.

Examples:

- Sound Energy (E_{sound} OR E_{sonic})
- Thermal Energy (E_{Th})

→ We have experienced our hands warming up as we rub them together or as we drag a hand along a surface. The interaction between the two surfaces causes the random motions of particles which is felt as heat, or Thermal Energy (E_{Th}). This is also described as a <u>non</u>-restorable deformation.

Energy Transfer can occur in two ways, but ALWAYS requires FORCE

1. Energy is transferred between storage modes by forces between objects.

2. Energy is transferred between storage modes by forces between an object and a field.

Unit 8

Part 2

Tracking Energy – Systems

- We track energy by dividing up the universe into groups of objects we call SYSTEMS. Everything outside of a given system is the surroundings or environment.
- Although we like to think of systems in isolation, we know, and should be aware of the possibility that, the surroundings/environment can interact with the system.
- Energy is stored within a system in one or more of the three storage modes (in an object, in a field, or in the environment of the system) The total amount of energy in the system is typically unchanging, unless there is an interaction with something from the surroundings.
    - → If energy enters or leaves our system, we say the surroundings are doing work on our system to either give the system work or take it away.
    - → We know there is a law of conservation of energy - energy cannot be created or destroyed - but within a system it is possible that energy is gained from the surroundings or lost to the surroundings.
- The choice of what is in our system is arbitrary, we get to pick, but it is helpful to add as much to the system as possible to keep the energy in our system conserved.

ANALYZING ENERGY IN A SYSTEM

Assuming energy is conserved, a handy way to keep track of energy in a system is using a pie chart.

If energy is conserved the size of the pie does not change, but you can cut different size pieces... I am unsure this analogy will hold up, so let's use a pie chart in a money analogy instead.

You Have $100

All of it is in the bank.

You still have $100 but...

You took $50 out in cash
And the other $50 is still in the bank.

Of that $100...

You Spent $20
You Have $30 Cash
You still have $50 in the Bank.

Total $100 → Total $100 → Total $100

The Money is Conserved, but the Pie Chart Told Us Where (or what kind of) the money is.

We Can Do The Same Thing With Energy.

NOTE

You can model all of the following examples using the PhET Simulation online. (link in lesson plan)

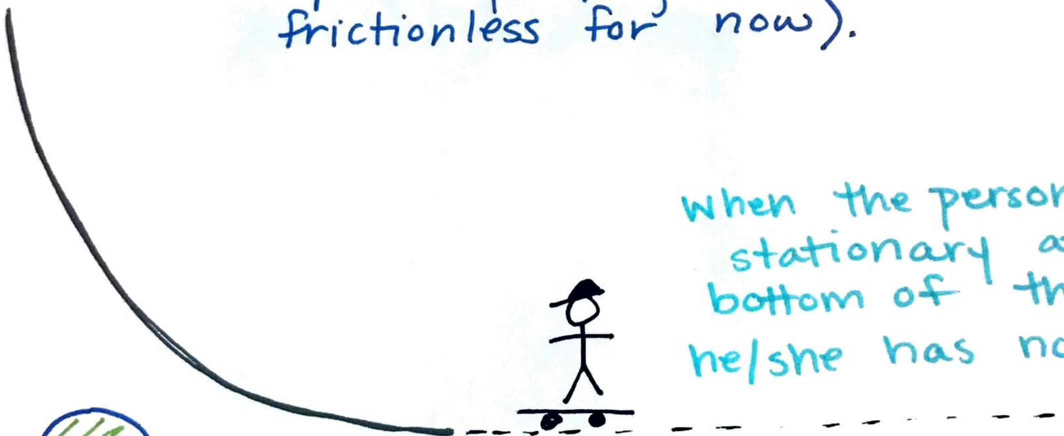
When you get there, choose "Intro" then select the following setting

- → By the Pause and Play Buttons near the bottom of the screen, select <u>Slow Motion</u>
- → In the top right corner of the screen, select <u>Pie Chart</u>
- → You must click on the person and place him/her on the track

* Select the Ramp Like the One Below on the Right Side of the Screen.

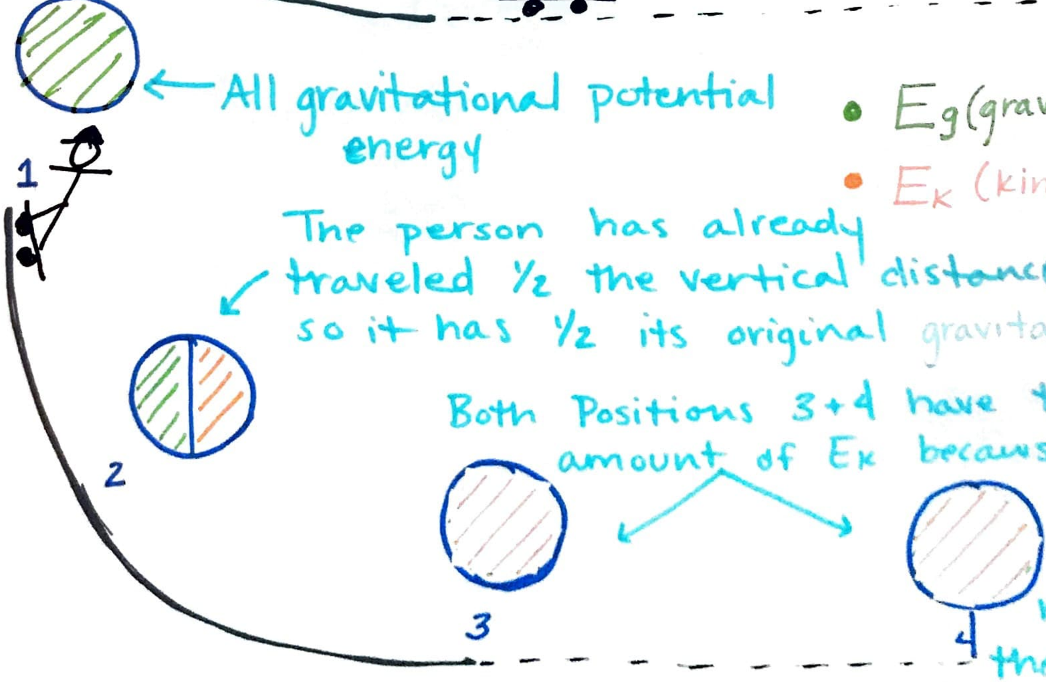
Example 1: We are watching a person at a skate park playing on a ramp (which is frictionless for now).

a)



When the person is stationary at the bottom of the ramp, he/she has no energy.

b)



← All gravitational potential energy

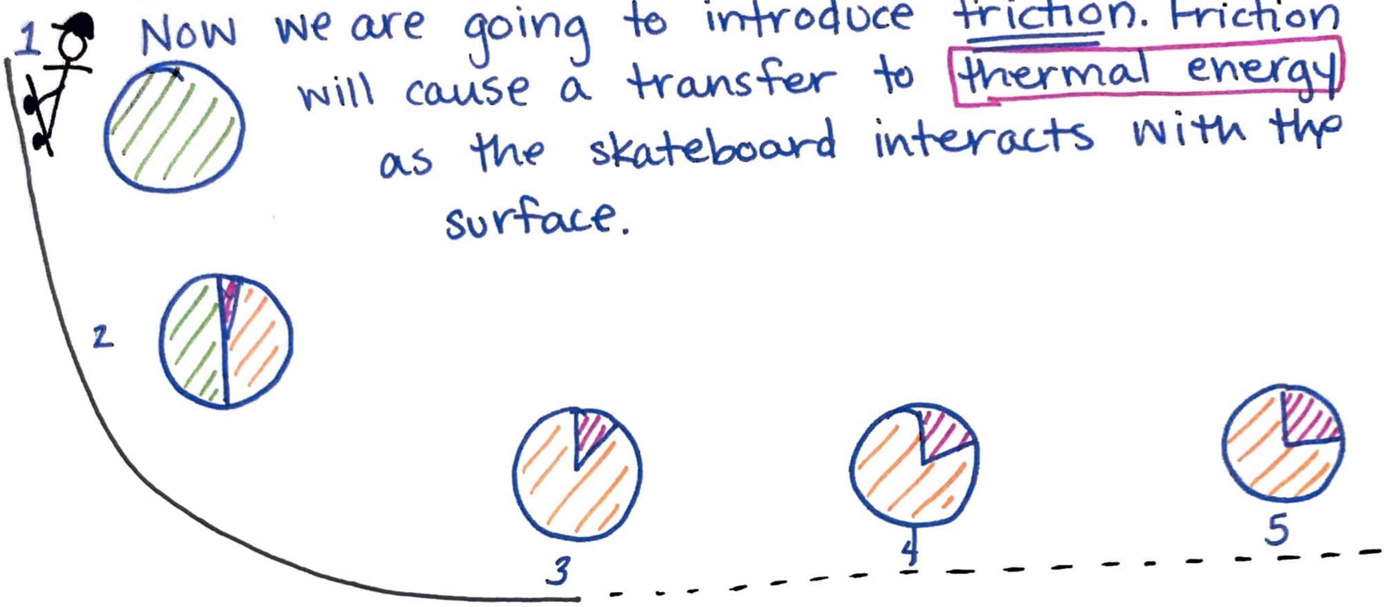
- E_g (gravitational energy)
- E_K (kinetic energy)

The person has already traveled ½ the vertical distance so it has ½ its original gravitational energy.

Both Positions 3+4 have the same amount of E_K because they are on the surface and there is nowhere for the energy to transfer with no friction.

* Select FRICTION at the very bottom of the screen.

C) Now we are going to introduce friction. Friction will cause a transfer to thermal energy as the skateboard interacts with the surface.



Explanations:

1 

While the skateboarder is at the top of the ramp at his/her highest point above the surface, he/she has ALL gravitational potential energy (E_g). The original height also determines the total amount of energy in the system because it determines how much change can be produced.

2 

When the skateboarder is half way down the ramp he/she is half the height above the ground. Therefore, half the change that could occur already has so there is 1/2 as much E_g. The other half is mostly kinetic energy, but already some energy has been transferred to the ramp as E_{th} due to friction.

3
4
5


Once the skateboarder is level with the surface there is no more gravitational energy. Most of the energy is kinetic energy but energy is also continuously being transferred to the ramp as thermal energy (E_{th}) due to friction. This is why the skateboarder might eventually stop.

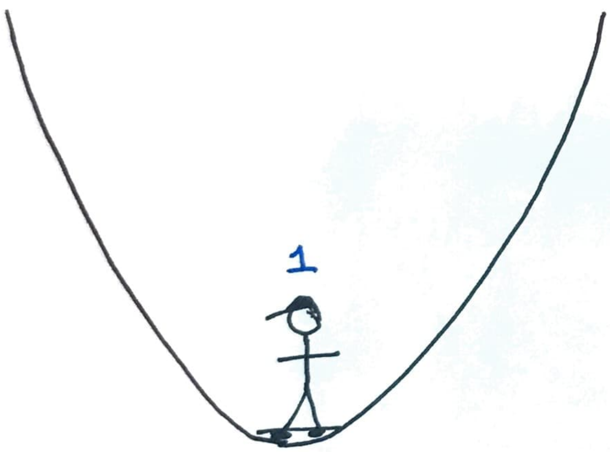
TRY THESE YOURSELF!

Fill in the pie chart for each marked position and write a short explanation justifying your answer.

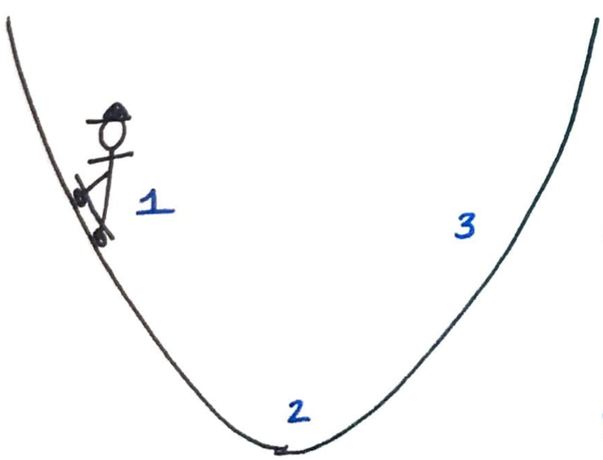
NOTE

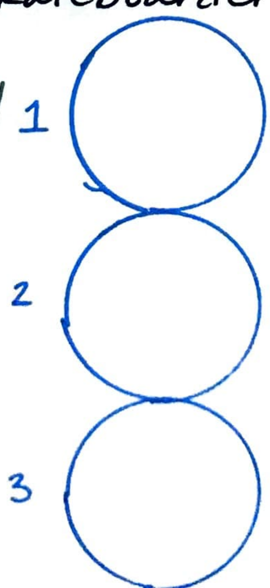
If you are using the PHET simulation, ATTEMPT THESE PROBLEMS YOURSELF FIRST! You can check your work by choosing the corresponding ramp on the right side of the screen. Don't forget to reset your other settings described on page 47.

a) Frictionless Ramp - Skateboarder begins at the bottom.

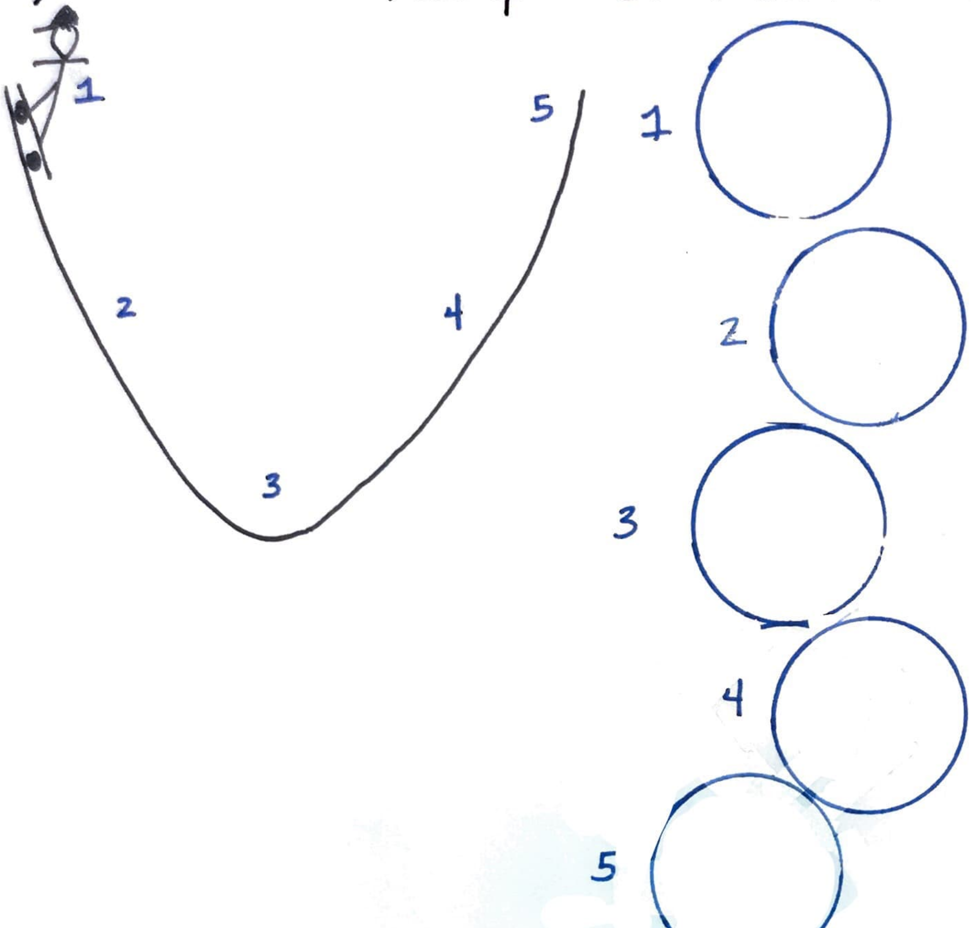


b) Frictionless Ramp - Skateboarder begins half way up.





c) Frictionless Ramp – Skateboarder begins at the top left.



d) Ramp WITH Friction – Skateboarder begins at top left.