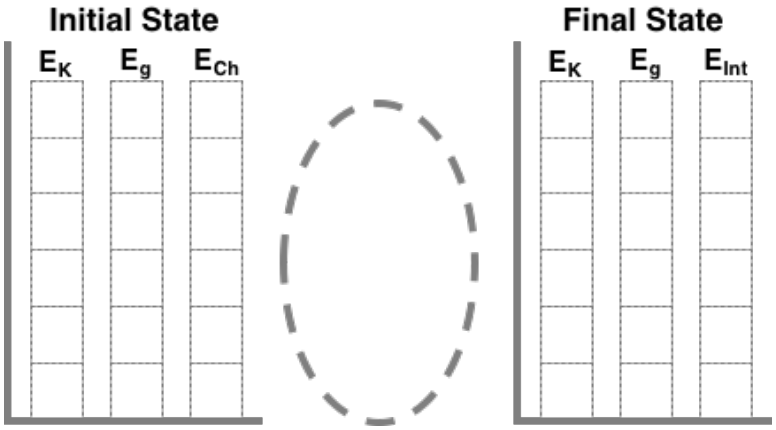
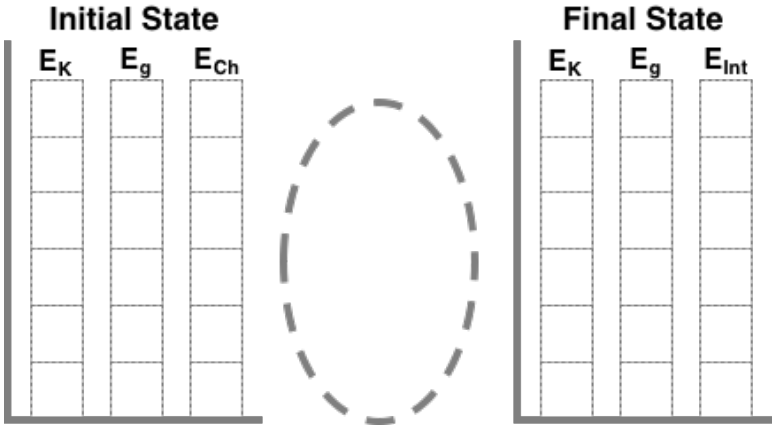
LOL Charts

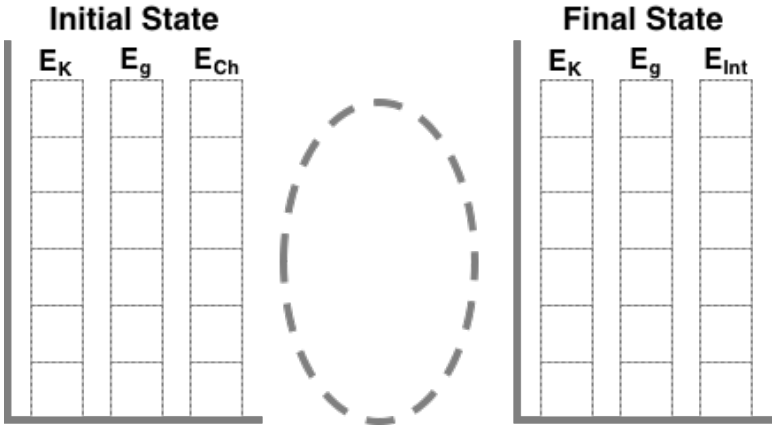
Apprentice Difficulty Level
Question Group 1
Question 1
Initial State: Car at rest at top of a hill.
Final State: Car in motion at bottom of the hill.
Notes: The system includes the car and earth. Resistance forces are negligible. The car coasts while in neutral.
System: Car-Earth
Constraint List:



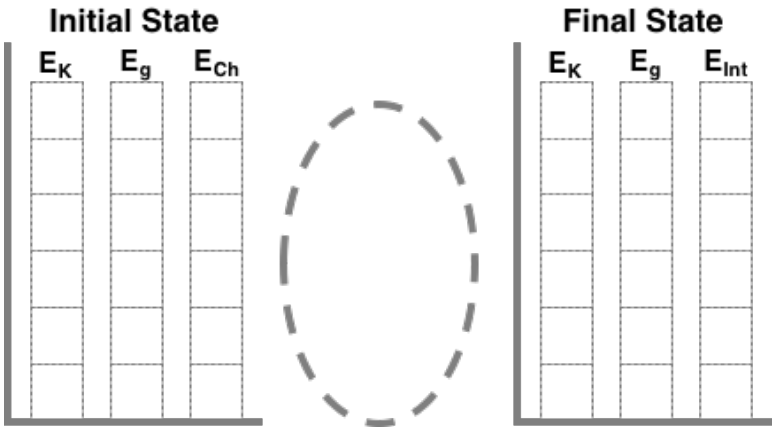
Question 2
Initial State: Ball at rest at top of a ramp.
Final State: Ball in motion at bottom of the ramp.
Notes: The system includes the ball and earth. Resistance forces are negligible.
System: Ball-Earth



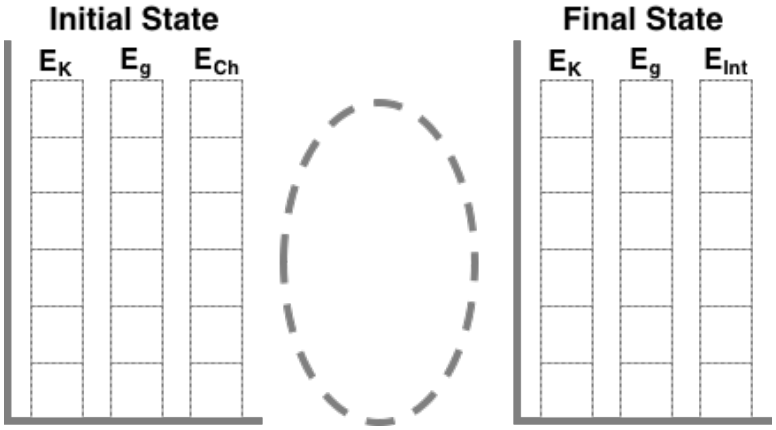
Question Group 2
Question 3
Initial State: A book is moving along the classroom floor.
Final State: A book is at rest on the classroom floor.
Notes: The system includes the book. Friction brings the book to a stop.
System: Book-Floor



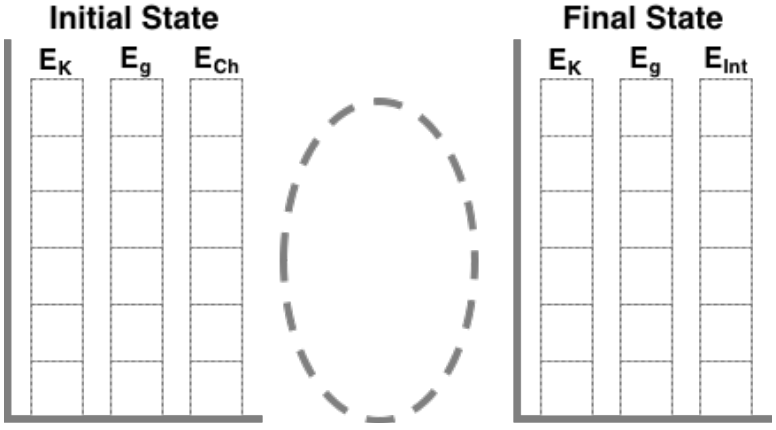
Question 4
Initial State: A hockey puck is moving at high speed along a frozen pond.
Final State: The hockey puck is at rest on the frozen pond.
Notes: The system includes the hockey puck. Friction brings the puck to a stop.
System: Puck-Ice



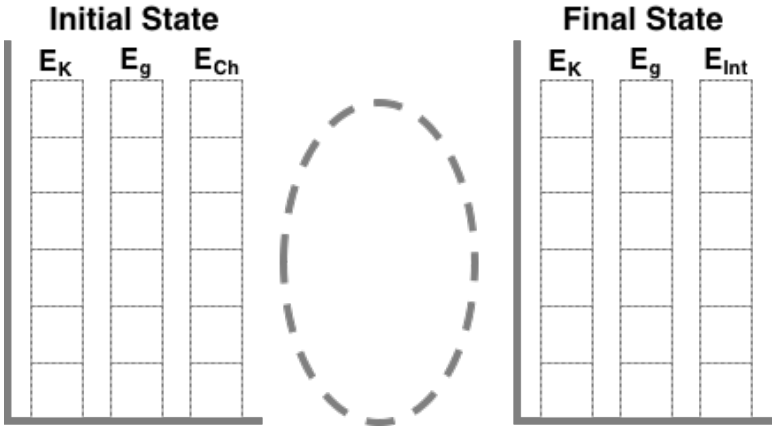
Question Group 3
Question 5
Initial State: A mountain climber stands at the bottom of a tall cliff.
Final State: A mountain climber stands at the top of the tall cliff.
Notes: The system includes the mountain climber and earth. The mountain climber uses the rock outcroppings to slowly climb the cliff.
System: Climber-Earth



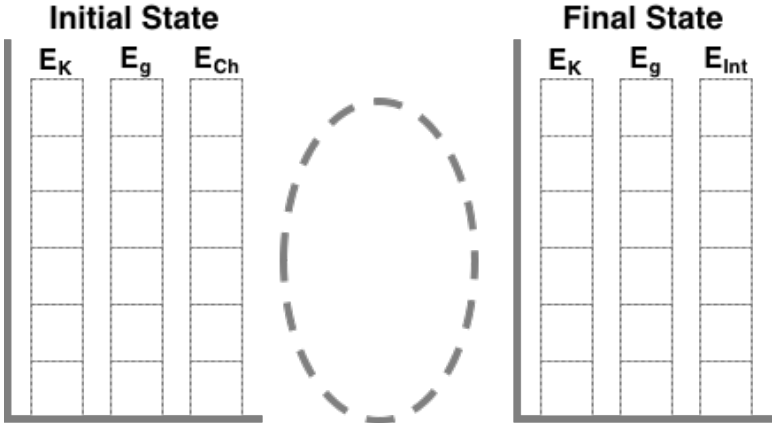
Question 6
Initial State: An 8-month old child is at rest at the bottom of a staircase.
Final State: The 8-month old child is at rest at the top of the staircase.
Notes: The system includes the child and earth. The child uses the steps to slowly crawl up the staircase.
System: Child-Earth



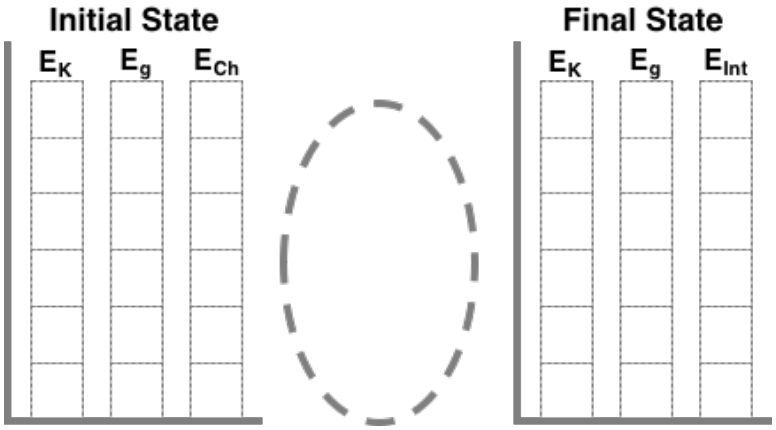
Question Group 4
Question 7
Initial State: A bucket of construction tools (attached to a rope) is at rest on the ground.
Final State: The bucket of tools is at rest on the third floor of a construction site.
Notes: The system includes the bucket and earth.
System: Bucket-Earth



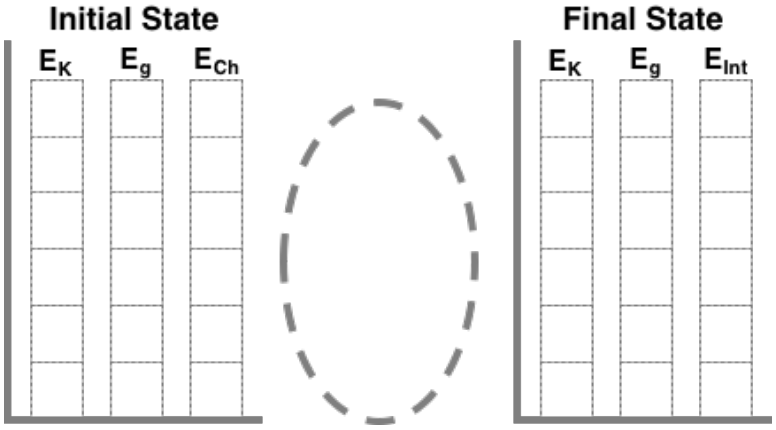
Question 8
Initial State: An elevator rider is at rest on the first floor of a shopping mall.
Final State: The rider is at rest on the third floor of the shopping mall.
Notes: The system includes rider and the earth. A cable/motor system lifts the elevator between floors.
System: Rider-Earth



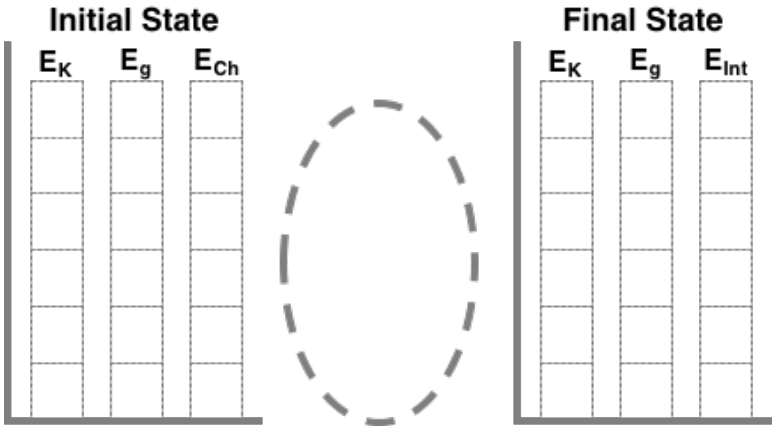
Master Difficulty Level
Question Group 5
Question 9
Initial State: Car at rest at top of a hill.
Final State: Car in motion at about the half-way point to the bottom of the hill.
Notes: The system includes the car and earth. Resistance forces are negligible. The car coasts while in neutral.
System: Car-Earth



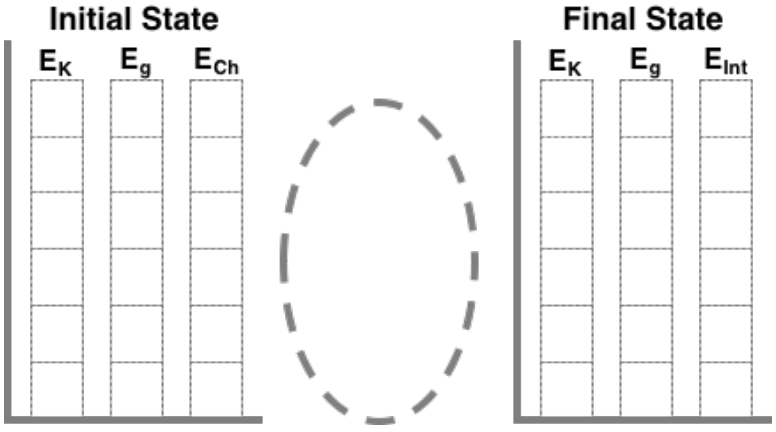
Question 10
Initial State: Ball at rest at top of a ramp.
Final State: Ball in motion at about the half-way point to the bottom of the ramp.
Notes: The system includes the ball and earth. Resistance forces are negligible.
System: Ball-Earth



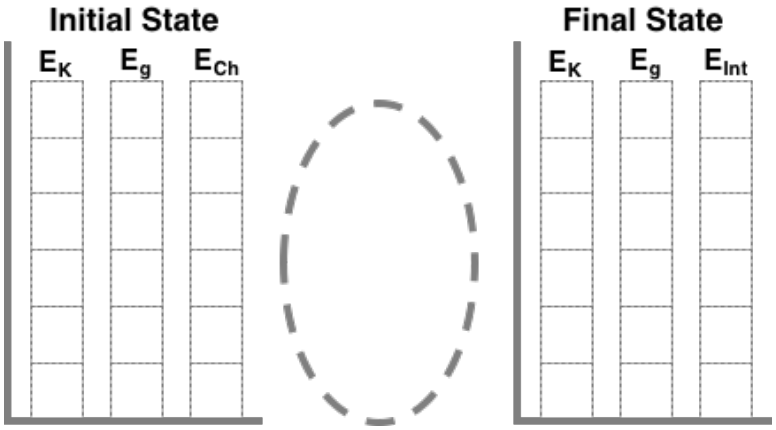
Question Group 6
Question 11
Initial State: A child on a sled is in motion at the bottom of a small hill.
Final State: The child is in motion at the top of the small hill.
Notes: The system includes the child and the Earth. Resistance forces are negligible. The child glides between initial and final state without any effort.
System: Child-Earth



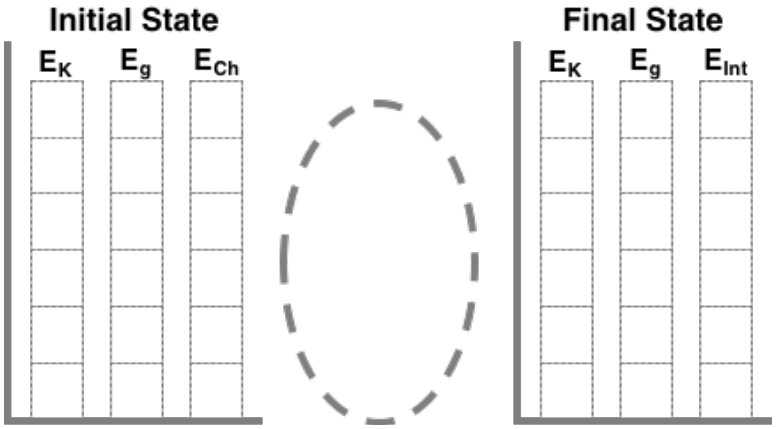
Question 12
Initial State: A cross-country skier is in motion at the bottom of a small hill.
Final State: The skier is in motion at the top of the small hill.
Notes: The system includes the skier and the Earth. Resistance forces are negligible. The skier glides between initial and final state without any effort.
System: Skier-Earth



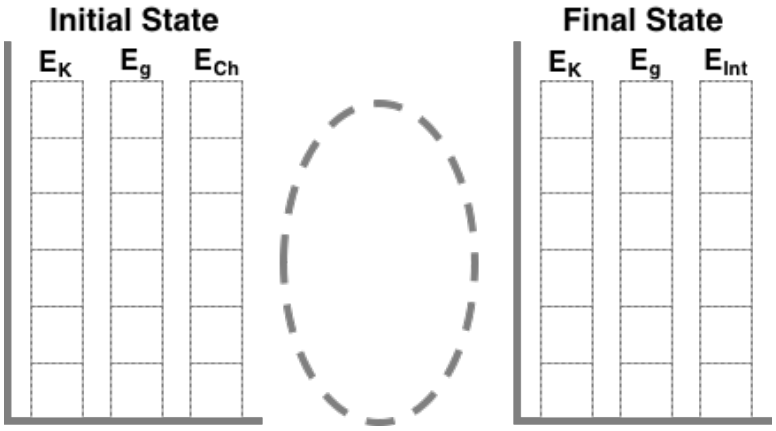
Question Group 7
Question 13
Initial State: A pendulum bob is in motion at the lowest point along its arc.
Final State: A pendulum bob has reached the highest point along its arc.
Notes: The system includes the pendulum bob and Earth. Resistance forces are negligible.
System: Pendulum-Earth



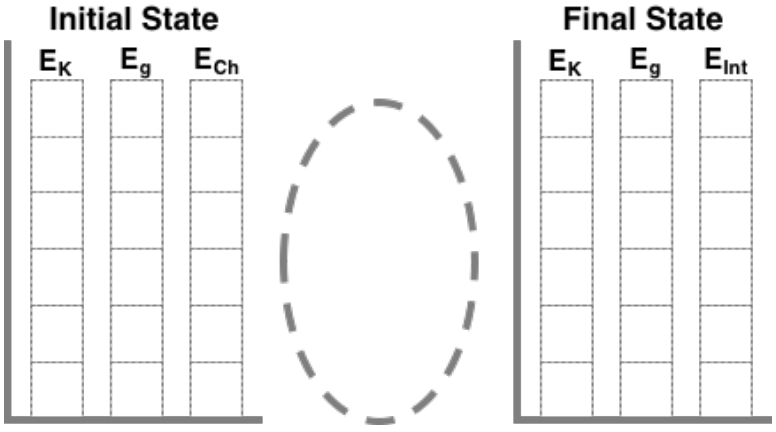
Question 14
Initial State: A child in a swing is in motion at the lowest point along its arc.
Final State: The child has reached the highest point along its arc.
Notes: The system includes the child and the Earth. Resistance forces are negligible.
System: Child-Earth



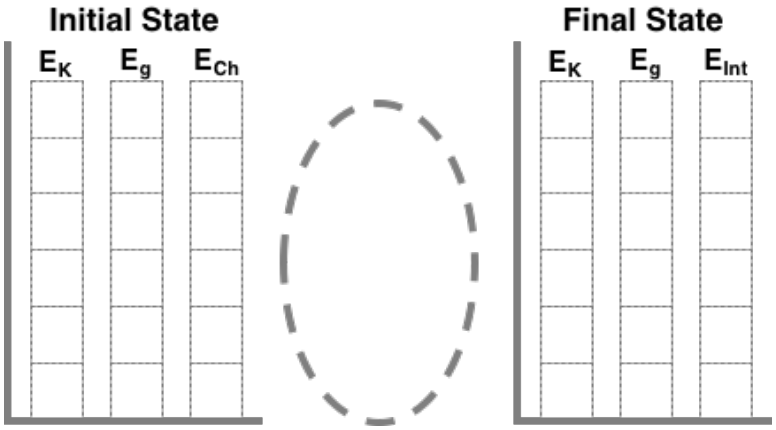
Question Group 8
Question 15
Initial State: A softball is at rest in the hand of a softball player.
Final State: Shortly after being thrown, the softball is in motion at the highest point along its trajectory.
Notes: The system includes the ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Ball-Earth



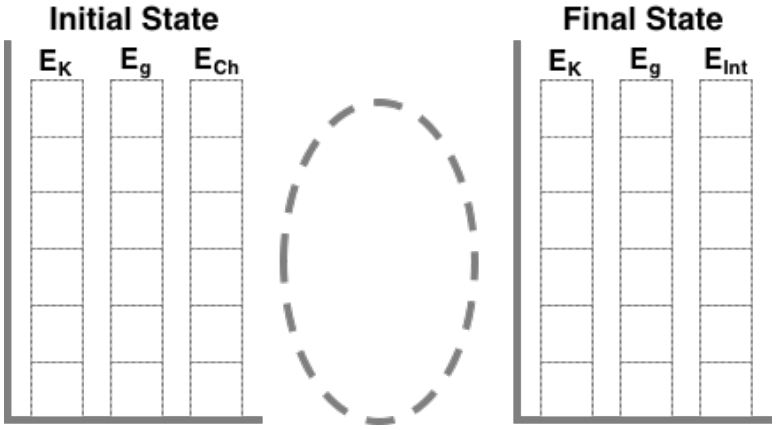
Question 16
Initial State: A baseball is at rest in the hand of a baseball player.
Final State: Shortly after being thrown, the baseball is in motion at the highest point along its trajectory.
Notes: The system includes the ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Ball-Earth



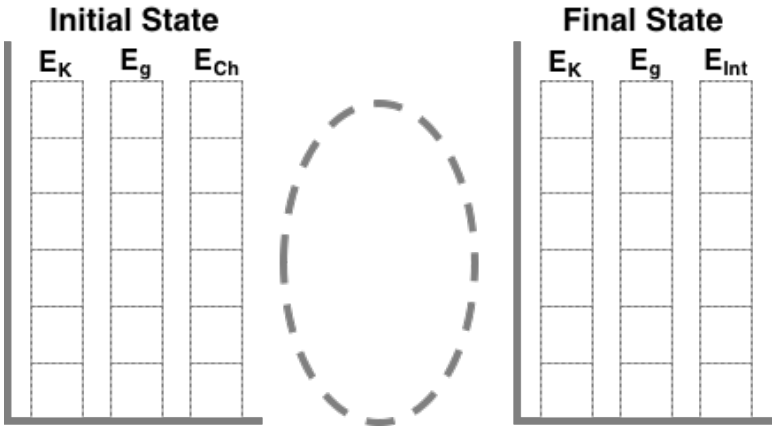
Question Group 9
Question 17
Initial State: A bobsled and its team are at rest at the top of the track.
Final State: Several seconds after having pushed the bobsled, the sled and team are at a low point along the track.
Notes: The system includes the bobsled, the team, and the Earth. There is friction acting upon the bobsled.
System: Sled-Team-Earth



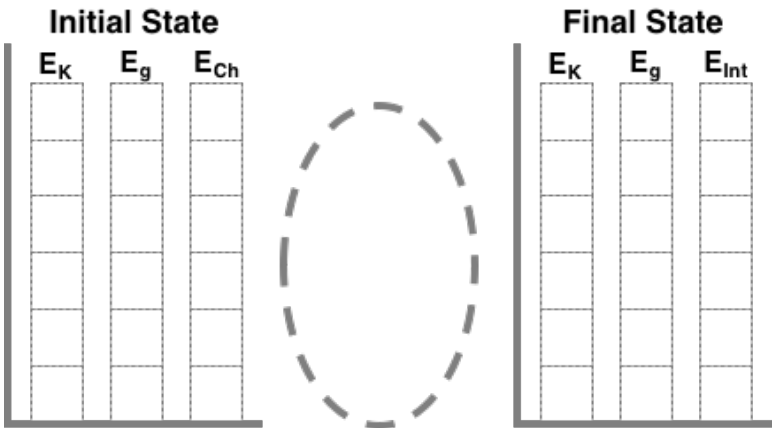
Question 18
Initial State: A ski jumper is at rest at the top of a ski run.
Final State: A few seconds after using the poles to propel herself forward, she is at the low point preparing to launch into her jump
Notes: The system includes the skis, the jumper, and the Earth. There is friction acting between the ski jumper and the ski slope.
System: Skis-Jumper-Earth



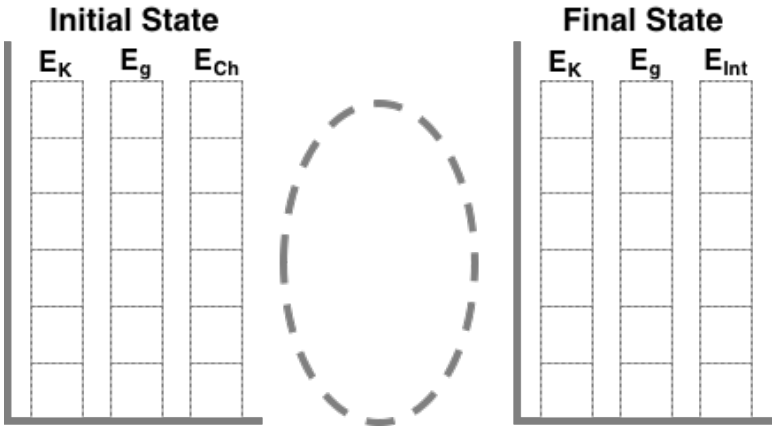
Question Group 10
Question 19
Initial State: A glass vase is at rest on the edge of a table.
Final State: After a few bounces on the carpet, the vase is at rest (and unbroken).
Notes: The system includes vase and the Earth. Air resistance is negligible. A gentle bump of the table caused the vase to fall.
System: Vase-Earth



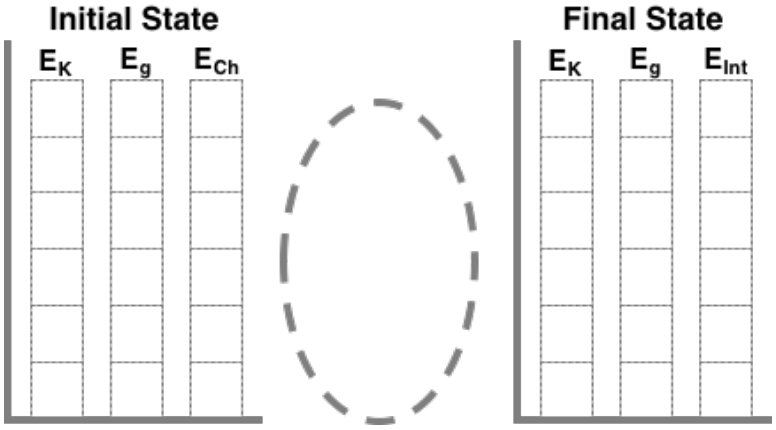
Question 20
Initial State: A coffee mug is a rest on the edge of a table.
Final State: After a few bounces on the carpet, the coffee mug is at rest (and unbroken).
Notes: The system includes the coffee mug and the Earth. Air resistance is negligible. A gentle bump of the table caused the mug to fall.
System: Mug-Earth



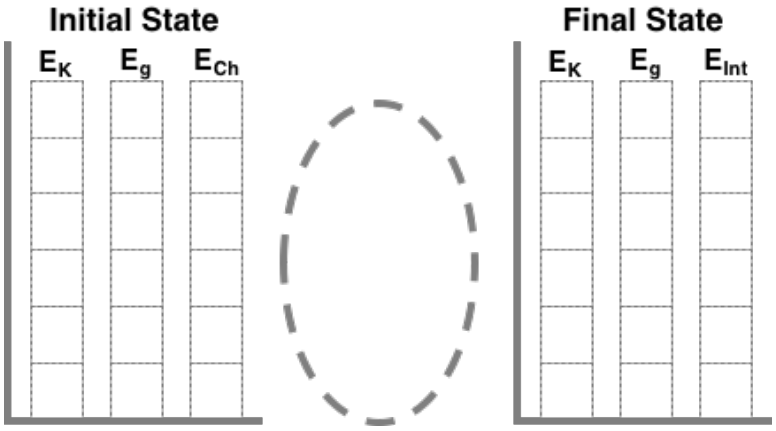
Question Group 11
Question 21
Initial State: A sled and child are in motion halfway down a hill.
Final State: The sled and child are at rest at the bottom of the hill..
Notes: The system includes the sled, the child, and the Earth. The sled glides freely until finally stopped by a rough patch of snow.
System: Sled-Child-Earth



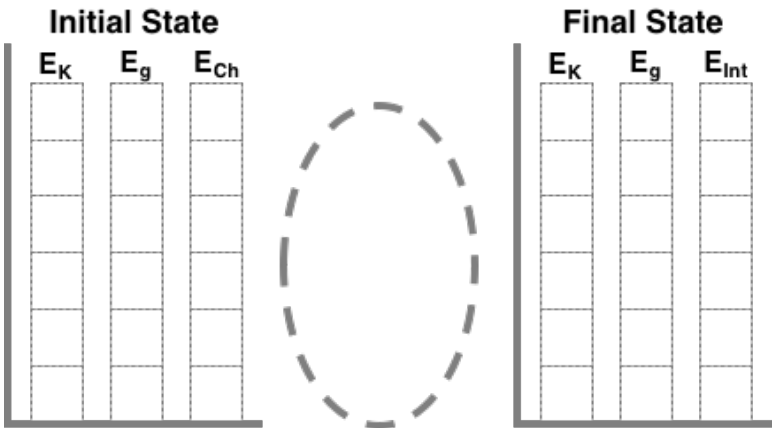
Question 22
Initial State: A person on skis is in motion about halfway down a ski hill..
Final State: The person is at rest at the bottom of the ski hill.
Notes: The system includes person, the skis, and the Earth. The skier glides freely until she finally brakes near the bottom.
System: Person-Skis-Earth



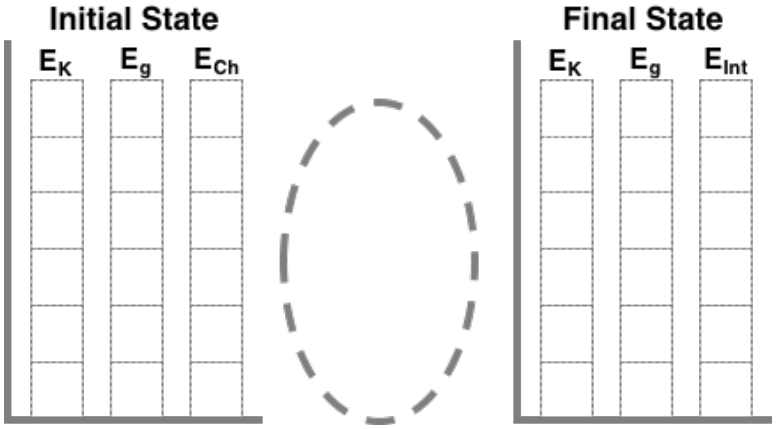
Question Group 12
Question 23
Initial State: A softball is at rest in the hand of a softball player.
Final State: Shortly after being thrown, the softball is in motion at the highest point along its trajectory.
Notes: The system includes the player, ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Player-Ball-Earth



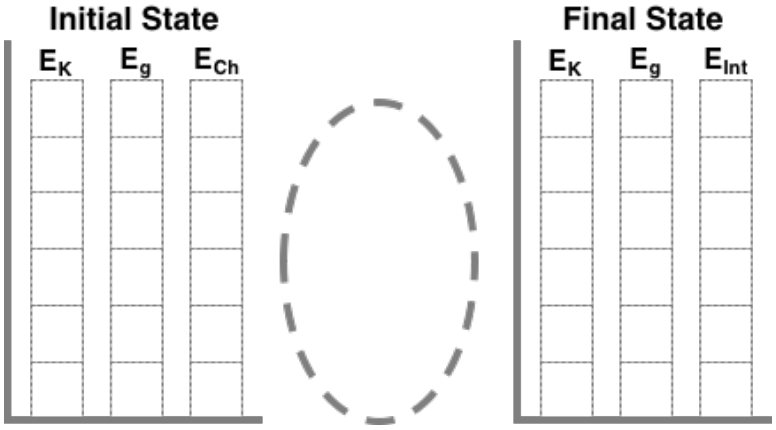
Question 24
Initial State: A baseball is at rest in the hand of a baseball player.
Final State: Shortly after being thrown, the baseball is in motion at the highest point along its trajectory.
Notes: The system includes the player, ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Player-Ball-Earth



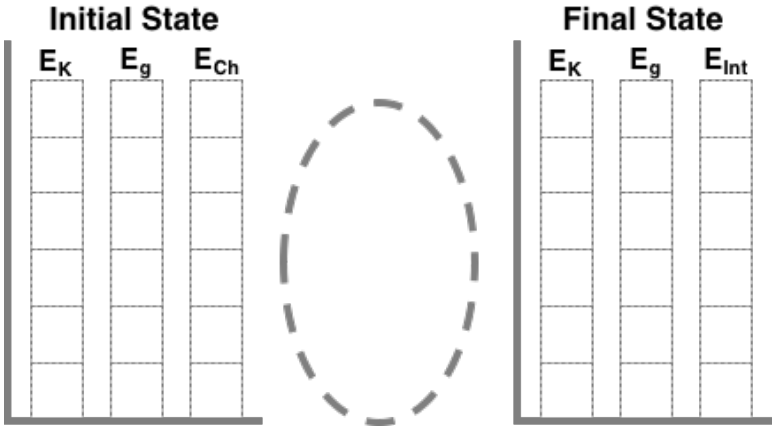
Wizard Difficulty Level
Question Group 13
Question 25
Initial State: A softball is at rest in the hand of a softball player.
Final State: Shortly after being thrown, the softball is in motion at the highest point along its trajectory.
Notes: The system includes the player, ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Player-Ball-Earth



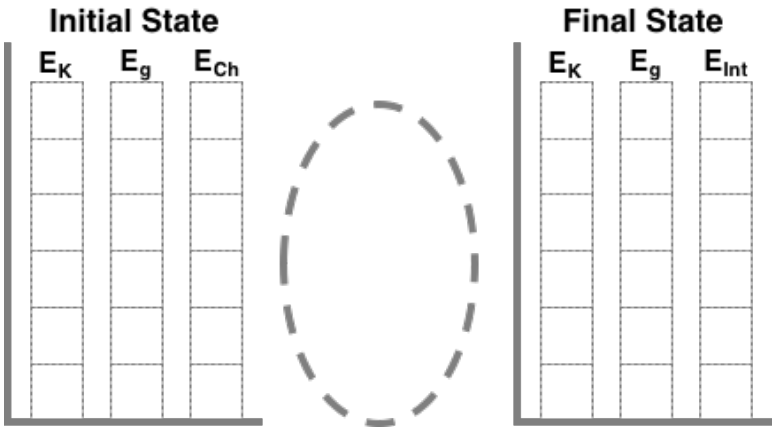
Question 26
Initial State: A baseball is at rest in the hand of a baseball player.
Final State: Shortly after being thrown, the baseball is in motion at the highest point along its trajectory.
Notes: The system includes the player, ball and Earth. Air resistance is negligible. The player threw the ball upward at an angle.
System: Player-Ball-Earth



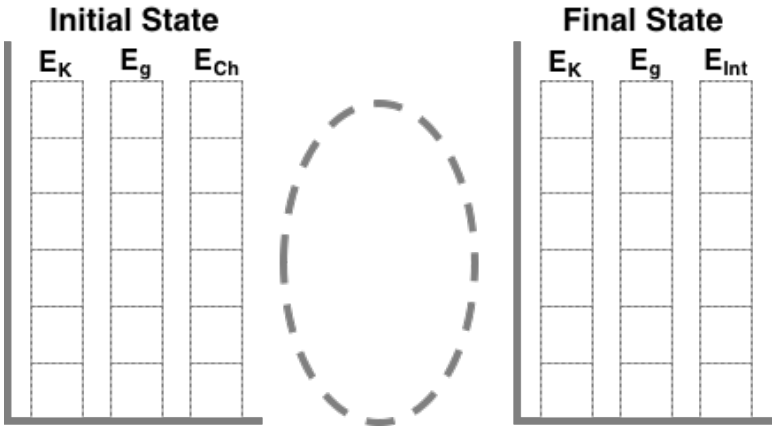
Question Group 14
Question 27
Initial State: A cross-country runner is in motion half-way up a steep hill.
Final State: The runner is in motion at the top of the hill.
Notes: The system includes the runner and the earth. Ignore air resistance.
System: Runner-Earth



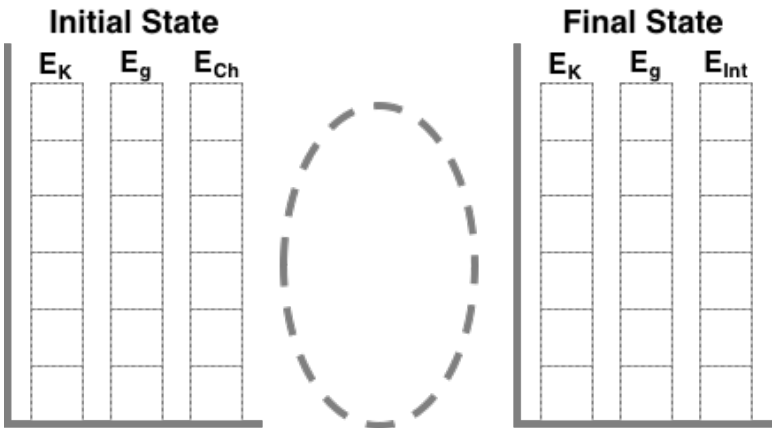
Question 28
Initial State: An athlete is running and located half-way up a stair case.
Final State: The athlete is still in motion at the top of the stair case.
Notes: The system includes the athlete and the earth. Ignore air resistance.
System: Athlete-Earth



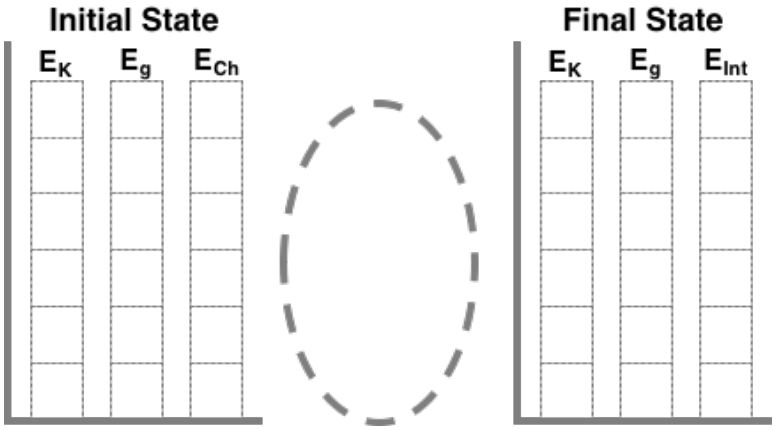
Question Group 15
Question 29
Initial State: A crate is in motion near the bottom of a ramp of a loading dock.
Final State: The crate is in motion at the same speed near the top of the ramp of a loading dock
Notes: The system includes the crate and Earth. Friction is negligible. A worker is pushing the crate up the ramp.
System: Crate-Earth



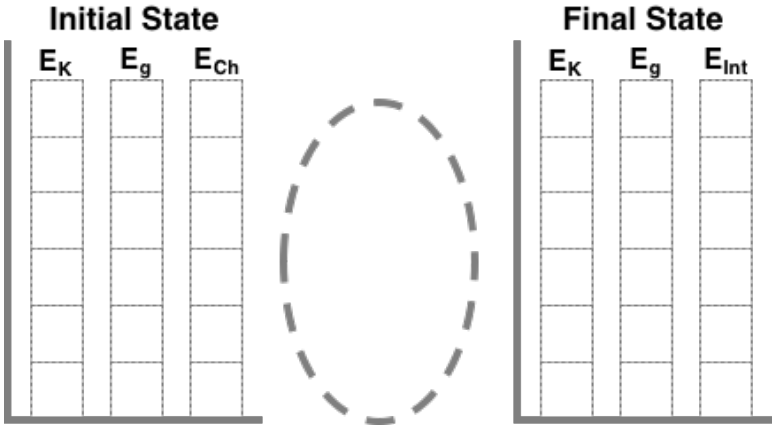
Question 30
Initial State: A cart is in motion near the bottom of an inclined plane.
Final State: The cart is in motion at the same speed near the top of the inclined plane.
Notes: The system includes the cart and Earth. Friction is negligible. A student is pulling the cart.
System: Cart-Earth



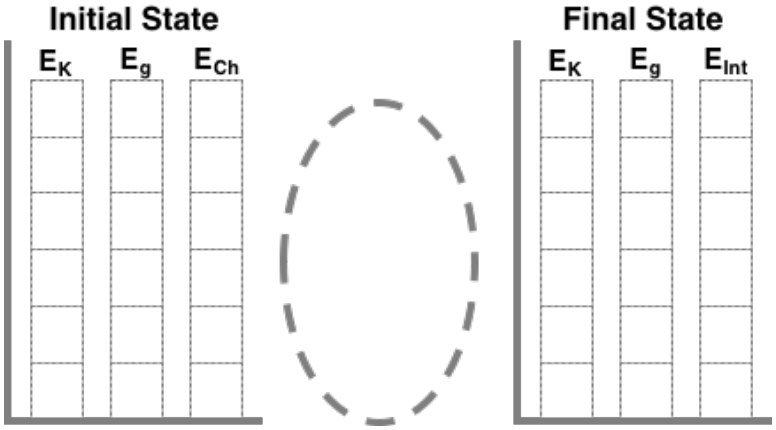
Question Group 16
Question 31
Initial State: A crate is in motion near the bottom of a ramp of a loading dock.
Final State: The crate, being pushed by a worker, is in motion at the same speed near the top of the ramp of a loading dock.
Notes: The system includes the crate, the worker, and Earth. Friction is negligible. A worker is pushing the crate up the ramp.
System: Crate-Worker-Earth



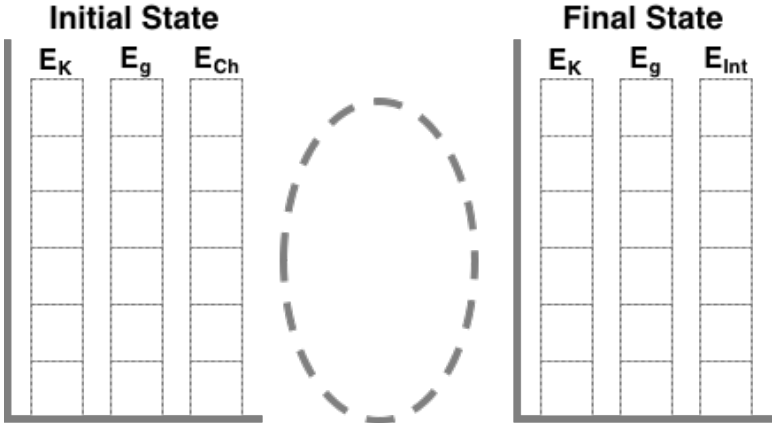
Question 32
Initial State: A cart is in motion near the bottom of an inclined plane.
Final State: The cart, being pulled by a student, is in motion at the same speed near the top of the inclined plane.
Notes: A student is pulling the cart. The system includes the cart, the student, and Earth. Friction is negligible.
System: Cart-Student-Earth



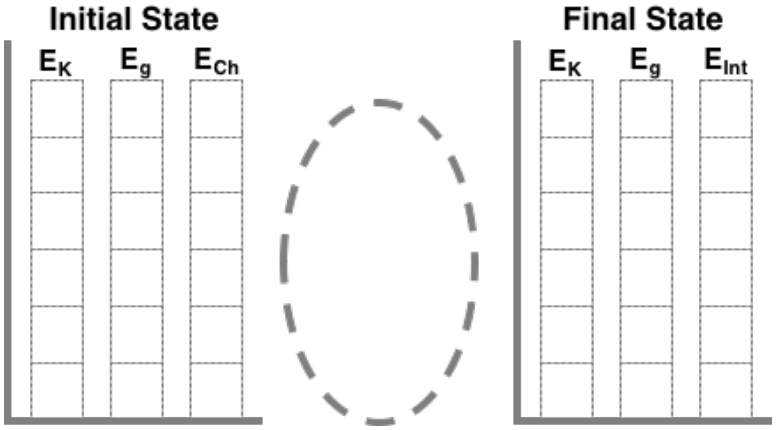
Question Group 17
Question 33
Initial State: A barbell is at rest on the floor of the weight room.
Final State: The barbell is held 3-meters above the floor by a weight lifter.
Notes: The system includes the barbell and Earth.
System: Barbell-Earth



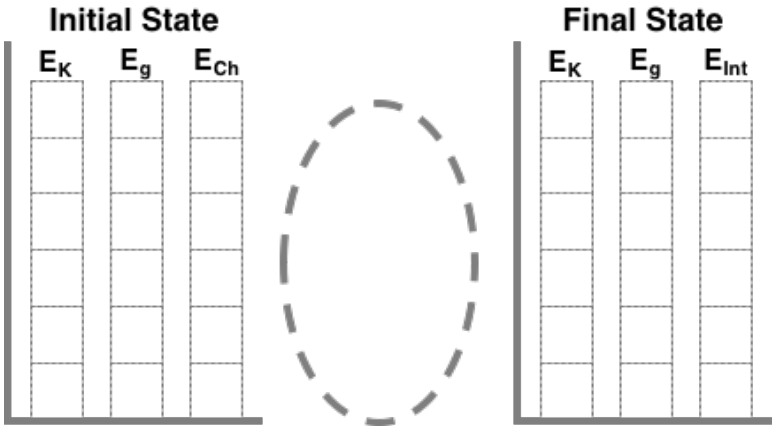
Question 34
Initial State: A sack of groceries is at rest on the kitchen floor.
Final State: The sack of groceries is 1-meter above the floor on the kitchen table.
Notes: The system includes the groceries and Earth. The sack of groceries was lifted upward by a person.
System: Groceries-Earth



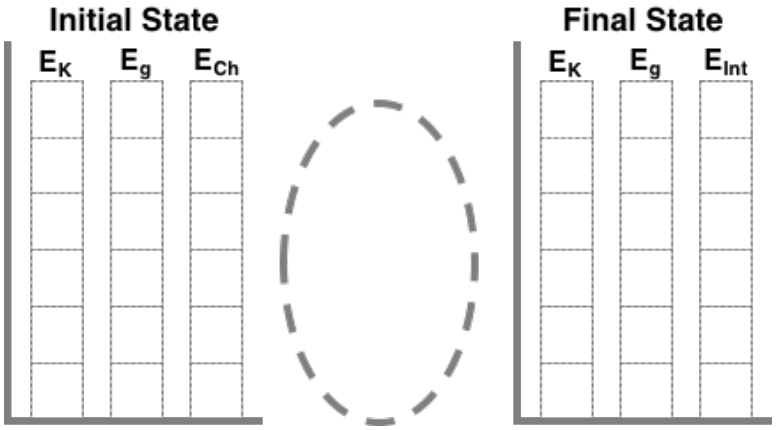
Question Group 18
Question 35
Initial State: A barbell is at rest on the floor of the weight room.
Final State: A barbell is held 3-meters above the floor by a weight lifter.
Notes: The system includes the barbell, the weight lifter and Earth.
System: Barbell-Weight lifter-Earth



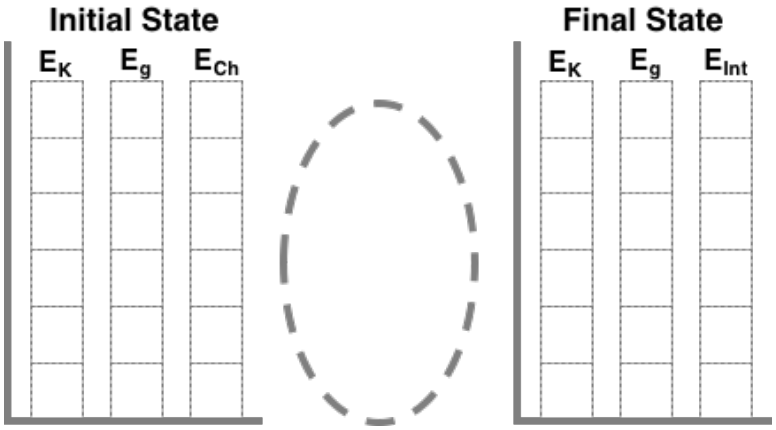
Question 36
Initial State: A sack of groceries is at rest on the kitchen floor.
Final State: The sack of groceries is 1-meter above the floor on the kitchen table, being lifted to that location by a person.
Notes: The system includes the groceries, the person, and Earth. The sack of groceries was lifted upward by a person.
System: Groceries-Person-Earth



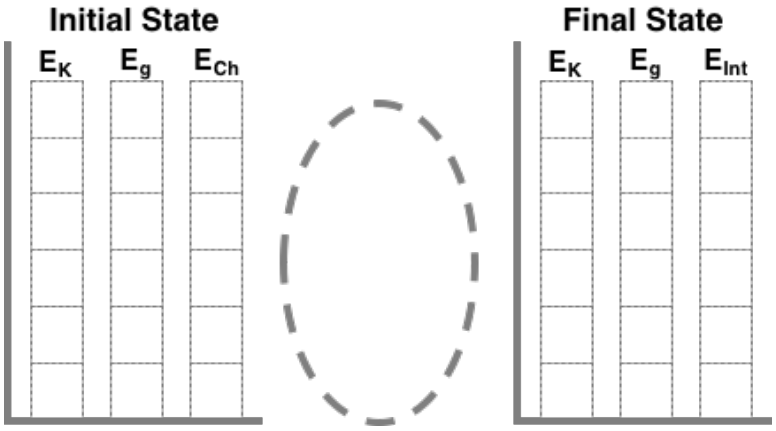
Question Group 19
Question 37
Initial State: A baseball is in motion at high speed, having just left the pitcher's hand..
Final State: The baseball is at rest in the catcher's mitt.
Notes: The system includes the baseball and Earth. Assume a negligible change in height.
System: Baseball-Earth



Question 38
Initial State: A softball is in motion at high speed, having just left the pitcher's hand..
Final State: The softball is at rest in the catcher's mitt.
Notes: The system includes the softball and Earth. Assume a negligible change in height.
System: Softball-Earth



Question Group 20
Question 39
Initial State: A roller coaster car is in motion on the crest of a large hill.
Final State: A roller coaster car is in motion at a faster speed on the crest of a second, smaller hill.
Notes: The system includes the roller coaster car, the track, and Earth. During the motion, the car undergoes significant bouncing and wobbling on the track.
System: Car-Track-Earth



Question 40
Initial State: A roller coaster car is in motion on the crest of a small hill.
Final State: A roller coaster car is in motion on the crest of a second, higher hill.
Notes: The system includes the roller coaster car, the track, and Earth. During the motion, the car undergoes significant bouncing and wobbling on the track.
System: Car-Track-Earth