# KS3 Answer Pack
# Marvellous Minds....

Name: .....

## *Welcome to The Mechanical Art and Design Museum*

Kinetic Art is *Accept any of the following:* Art in motion, Moving art, 3D sculptures that move on their own or are machine operated.

Automata is *Accept any of the following:* man-made moving figures, motorised sculptures usually made of wood, moving object depicting a scene.

Find 2 pieces of Automata in the museum and write the names of the pieces here

*Accept any of the following 2:* John Morgan - Fish in a boat. Neil Hardy - Elephant, Ostrich and Sheep (3 separate pieces) and The Circus. Carlos Zapata - The Fisherman. Carlos Zapata - Flying Love. Philip Lowndes - Quiet Contemplation of a Sandwich. Tim Douglas - Man and his dog. Wanda Sowry - Heidi the Snorkeler. Wanda Sowry - Skeleton Band.

Pascal Bettex - Les Mechanisms De L'Argent

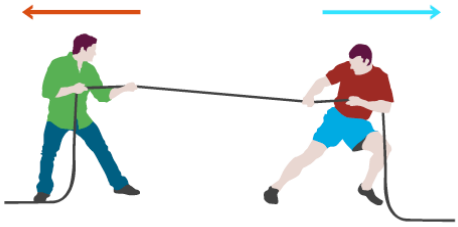
What makes the door open and close?

A motor on the door make a belt spin which makes two bevel gears rotate moving a rod around which opens and closes the door.

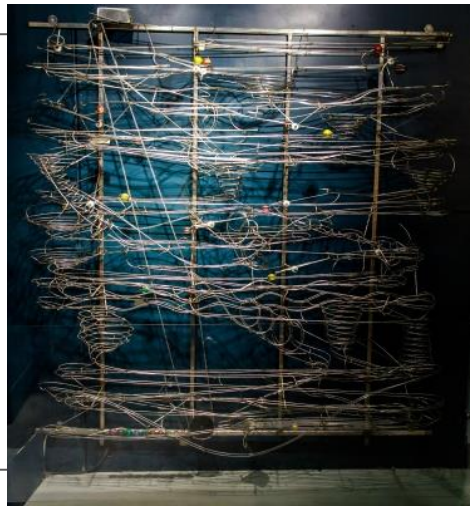
Find Standard Time in the museum.
Explain how this works?

Over the course of 24 hours, 72 workers produced a 4 x 12 metre large digital real time clock made from wooden planks. Set in Berlin, the clock display changes 1611 time over 24 hours. Each minute planks of wood are taken off, added and rearranged just in time.

# Forces



*Forces can cause objects to change shape, change direction and change speed. Forces can make stationary objects move by turning or twisting them, speeding them up or slowing them down, or changing direction. Gravity and friction are examples of forces that constantly affect objects.*



Matthew Gaulden – Machine #80

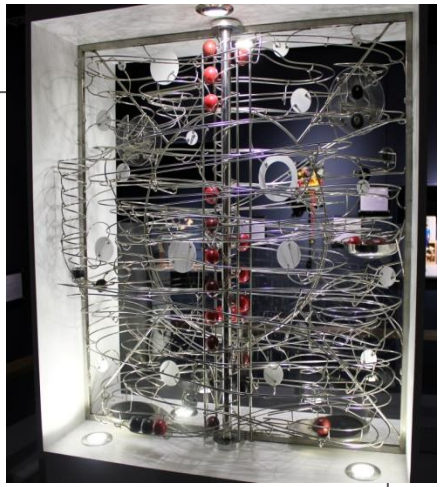
Watch the balls move up the lift mechanism. Which 2 of the following forces are causing the balls to move upwards?

(a) Electrical force
(b) Tension force
(c) Spring Force
(d) Applied Force

**Sir Isaac Newton -** English physicist and mathematician, most famous for his law of gravitation, was instrumental in the scientific revolution of the 17th century.

Newton's Laws of Motion:

1. An object's speed will only change if a force is applied.
2. Speed or acceleration is proportional to the force.
3. Every action has an equal and opposite reaction.



Robert Moore - Rolling Ball Machine

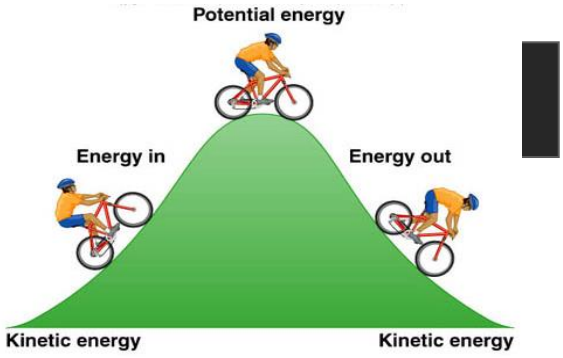
Find an area of the machine where the balls slow down. Aside, from friction, name a type of force that could be responsible.

..... air resistance .....

The ball is travelling at a constant speed of 4 cm/s. Which one of the following statements is **false**?

(a) The forces are unbalanced
(b) Gravity is pulling the ball down
(c) The forces are balanced

# Energy




*Energy is the ability to do work and make all movements. Energy can be transferred from one place to another in many different forms.*

Bryan Parkes - The Eye

Circle what type of energy activates the eye?

Kinetic Energy  Sound Energy  Motion Energy  Thermal Energy

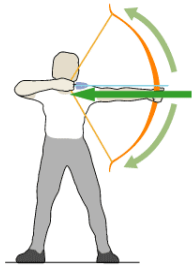
Name 3 different types of energy.

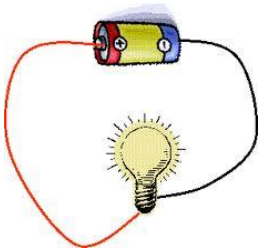
*Fill in the missing letters and then match the words up with the images*

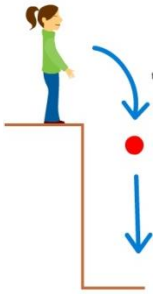
P O T E N T I A L energy

K I N E T I C energy

L I G H T energy







___ Potential ___  ___ Light _____  ___ Kinetic _____

LED Panel

Which is the type of energy transfer that is occurring?

a) Light energy → electrical energy
b) Electrical energy → Kinetic energy
c) Electrical energy → Light energy

Which two of the following are the most energy efficient

a) Low-energy bulb
b) Tungsten filament light bulb
c) Candle

The light emitting from the panels reaches you at a speed of....

a) 300 m/s
b) 300 million m/s
c) 300 million km/h

# Gravity and Movement

*Gravity is a force that attracts objects towards each other. Any object with mass exerts a force of gravity. The greater the mass, the greater the force. The force of gravity between two objects decreases as the objects move further apart.* The act or an instance of moving; a change in place or position. The speed of an object tells you how fast or slow it is moving. You can work out the average speed by using this equation: distance travelled divided by the time taken to travel that distance.

Klaus Bosch - Aurora Borealis/ Sunset

Turn the picture. Explain how gravity affects the movement of the sand particles

The sand particles slowly drop to the bottom of the frame and form a heaped pattern.

Jelle Bakker - Marble MAD House

*Finish the formula using the words below*

Speed = Distance / Time

Time Volume Distance Gravity Air


A marble takes 6 seconds to travel along the top rail,
which measures 60cm. What is the average speed of the ball in cm per second?

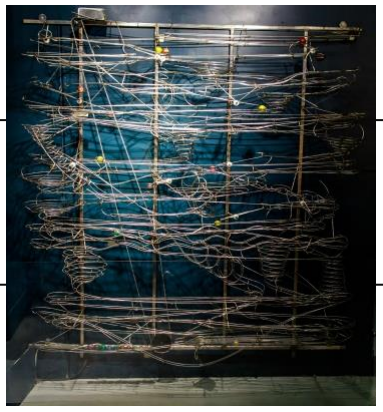
10 seconds

# Friction

*When two things move against one another **friction** is created and it makes it harder for things to move. This frictional forces acts in the opposite direction to the movement.*

*The smoother the surface, the smaller the frictional force - that is why we slide on ice.*

Here is Matthew Gaulden's rolling ball machine, number 80. Find it and look at how it works.....



What would using larger balls do to the amount of friction produced on Matthew Gaulden's Rolling ball machine?

(a) Reduce the amount of Friction (b) Increase the amount of Friction (c) No change

Find and describe a section of the balls journey where friction is not making an impact?

When the balls are travelling up the escalator or when they are stationary at the base of the machine.

Friction can also be unhelpful as well as helpful. Over time, the friction on the brass chains and axles can increase. What must Matthew do regularly to prevent this from happening?

..... Lubricate the chains and axles with oil .....

MAD's air conditioning system has had a serious malfunction and as a result all of the rolling ball machines are covered in ice.

- What is the effect of this on the amount of friction produced when the balls roll along the tracks? Decrease the amount of friction or a raised amount of friction?

..... Decrease the amount of friction .....

# Air Resistance and Acceleration

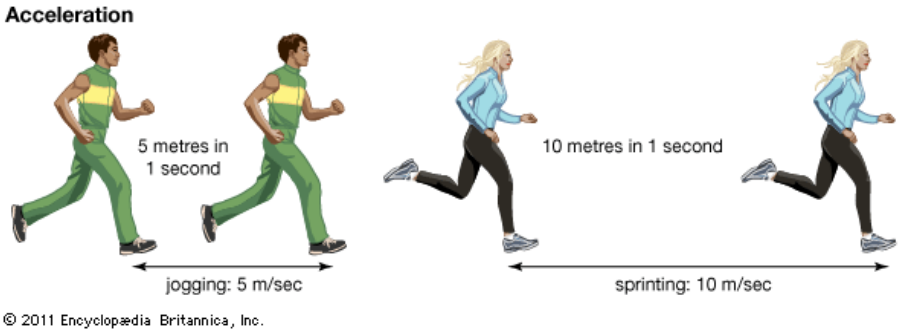
*Air resistance or drag is a frictional force that acts against an object as it moves through the air. The friction between the air and the object slows it down.*

*Fill in the blanks...*

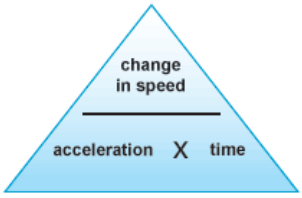
The rolling ball machines at The MAD Museum are all affected by air resistance, also known as drag. It slows down the moving balls by pushing them as they move through the air. The weaker the air resistance, the greater the speed of the balls.

move greater drag slows down weaker

*Acceleration is the rate at which an object changes speed. If something is speeding up we say it is "accelerating". If it is slowing down we say it is "decelerating". Acceleration is calculated using the equation....*



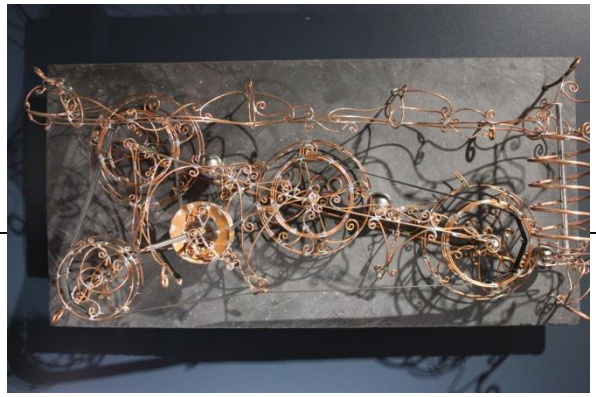

$$\frac{\text{Change in speed}}{\text{Time taken}} = \text{Acceleration}$$




Didier Legros - Pathfinder

When the balls are released at the top, they are travelling at 2cm/s (2cm per second). 3 seconds later they are travelling at 8cm/s. Calculate the rate of acceleration.

$$\frac{8 \text{ cm/s} - 2 \text{ cm/s}}{3 \text{ seconds}} = 2 \text{ cm/s}^2$$

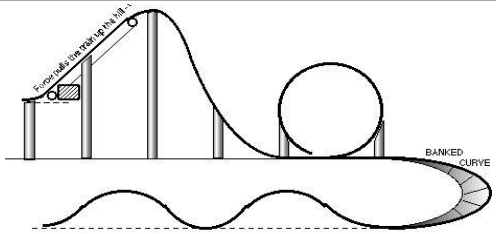


# Engineer your own Roller Coaster

**Using inspiration from the rolling ball machines around The MAD Museum, design your own roller coaster....**

Important things to think about when designing:

- Forces and friction
- Air resistance
- Materials
- Movement




*Essentially a roller coaster is being pushed off a hill. Remember acceleration is key. Newton's law of motion states you can't have acceleration without a force.*

What is the name of your ride?

.....

What is its thrill factor? 1= very tame 5= extreme!

.....

You can get all sorts of roller coasters - water rides, tunnels, big drops, loops and hoops. What kind of a roller coaster do you plan on designing?

.....

Explain how your roller coaster will start moving and climb to its highest point?

.....

.....

Time to design.....

Draw your roller coaster here....

Describe your roller coaster's journey from start to finish?

.....

.....

.....

.....

.....

.....

Look at where there would be acceleration on your own rollercoaster. What forces would the people on your rollercoaster feel at the bottom and top of the hills?

.....

.....

.....

.....

.....

Imagine you are sitting in the  a chair on your roller coaster.
Use **3 words** to describe how people might feel during your ride.

1. .....
2. .....
3. .....

How would you slow your roller coaster down at the end?

.....

.....

Time to tell people about your fantastic new roller coaster...

**Design a poster to advertise your new rollercoaster...**