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CURRENT ISSUE
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INTERNATIONAL JOURNAL of
YOUNG SCIENTIST RESEARCH

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Ariaian Young Innovative Minds Institute, AYIMI
ADIB, Cultural and Artistic Institute
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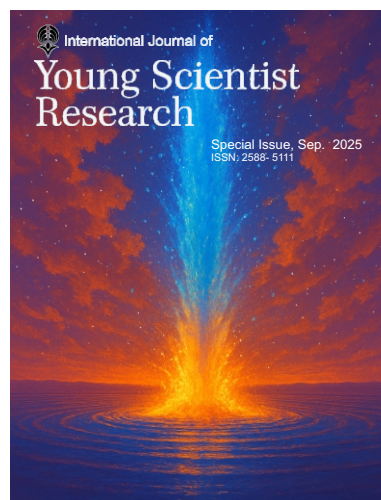http://www.ayimi.org/adib
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AQUA OPTIMIZER DEVICE

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1. Introduction

Aqua Optimizer is a device which is designed to help people with using water in various background, including home use, especially in bathing. Three steps are defined for the device, each step indicates the amount of water consumed by the water in which the green, yellow and red lights are respectively lit when the water is being used, and if the user exceeds the limits then the device will cut off the stream and eventually prevent it from wasting the water.

2. Experimental Procedures

When the flow of water is streamed, the flowmeter measures the amount of water output in terms of pulse. According to the number of pulses defined in the program, it activates some LED lights, if we use standard amount of water for example: 10 gallons, the green lights will turn on and if we use a bit more than the standard (20 gallons), the yellow lights will turn on and if we use more than the standard (30 gallons) the red lights will turn on and after the excessive use of water (after 7 minutes from Red light) the Solenoid valve will cut off the flow of water but based on user's decision they can press the restart button so that the device would start the process again from the beginning.

3. Results and Discussion

After all, Aqua Optimizer is lightweight and waterproof device (Fig.1) which has easy installation and the ability to change the limits for warning when we are using different LEDs for warning and by following a solenoid valve is required to cut off the stream by excessive use (after Red warning) and also we have some panels to show the water use of users while using the water and a restart button to reuse the device.

Fig.1. Aqua Optimizer device

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SWIMMING VIBRATED BUBBLES

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1. Introduction

This experiment is about the motions of gas bubbles in vertical oscillating fluids. This phenomenon is observed when a tank with different low-viscosity liquids is vibrated by a speaker. Although the gas bubbles positions which are made by turbulence on the surface might be over, under or on a limitation line of depth. It is observed that the bubbles sink when they pass the limitation line.

2. Experimental Procedures

A 50V speaker is connected to an amplifier (to empower the volume) and the amplifier is also connected to a smart device which has a frequency generating APP are used. A cylindrical glass with a plastic cap is used as the container. The container height and diameter is 10cm and 2cm. For gathering various data, different liquids, different frequencies, different amplitudes, different heights of the liquids and different volume of bubbles are used in this experiment.

(a)

(b)   (c)
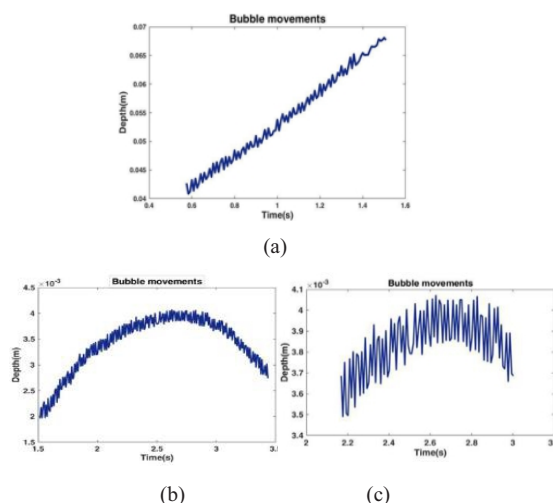
Fig.1: a) sinking bubble diagram b) floating bubble diagram c) constant bubble

3. Results and Discussions

There are three forces (i.e. gravity, buoyancy and drag) that act on the bubbles when they move. The inertia of the bubbles increase while they moves due to added mass. According to Laplace pressure, the bubbles compress when they go down and then added mass will decrease. Therefore, some of bubbles which pass a limitation line effectively sink and some of them float. We observed a limitation line that the bubbles sink when they pass it, they float when they don't pass it and they remain on the limitation line. The charts are achieved by tracking the bubbles motion. We can know the movement of the bubble theoretically by solving this differential equation:

$$-F(\dot{x})+(m-\rho Vb)(A\omega^2 \sin(\omega t) +g)=(m + m_0)\, \ddot{x}+ \dot{m_0}\, \dot{x}$$

Also we can use this technology in petroleum, stone purification and printing industry. We can put the solvent with lower density over the liquid with small resolvable particle. When we oscillate the container, the solvent bubbles will separate the particles for the liquid and make the liquid pure.
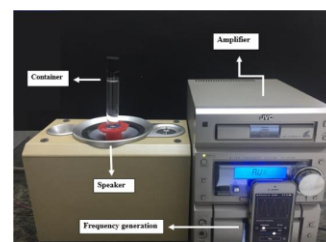
Fig.2: Experimental setup

References

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[2]   Zoueshtiagh, et al. "Air bubbles under vertical vibrations." The European Physical Journal (2006): 317 -325.

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DANCING BALL

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A R T I C L E   I N F O

1. Introduction

A Styrofoam disc or ball can be levitated by a water jet. In this phenomenon lots of principles take part and totally they cause the disk to remain stable for some time. In this paper, the most effective parameters are investigated such as the mass and volume of the ball, the flow rate of the water and the shape of the object (disc/ball). Depending on optimum parameters the object can withstand air turbulence, switching the objects, sudden water pressure drop and tapping the object, as external disturbances.

## 2. Experimental Procedures

By placing a Styrofoam ball in different masses and volumes on the edge of water jet various behaviors from ball was observed such as creating a sheet of water or drop ligaments. The experimental setup contains a tube which provides water jet and a ruler that measures how much the water jet can rise up and the alternation of ball's height during the phenomenon. The effective parameters namely mass, object's geometry (shape, diameter), properties of the water jet, object's roughness (friction) and external disturbances (switching the objects, air turbulence, sudden water pressure drop, tapping the object) were investigated and the results were demonstrated.

3. Results and Discussion

Newton's third law explains about the force on the water by the ball is equal and opposite to the force of the water back on the ball based on the reaction of water drops when they pass over the ball which is calculated by $F = mr\omega^2$, which ω is the angular velocity of the water drops. The surface tension of the water, making a thin film of water on the object plays an important role on the phenomena. By changing the mass of the ball and flow rate of water jet in several experiments stability of ball changes, actually there is an interaction between flow rate and the ball. Based on the observations the ball is more stable than the disc and in a same flow rate, the heavier the ball is, the less the ball can go up and besides when the flow rate increases, bigger and heavier balls can be levitated. Also if the diameter of the ball increase the water drops that are thrown will be smaller. When the ball is stable it can resist from air turbulence or water pressure drop or strike to some extent, also some balls can be switched during the phenomenon.

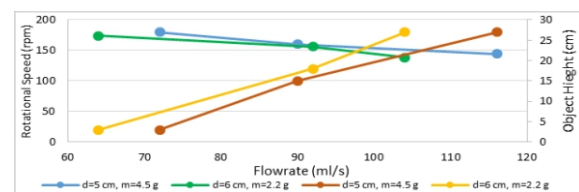**Fig.1.** : Experimental Setup

Fig. 2: Effect of flowrate on rotational speed and height of object

Fig3: Drop ligaments on the surface of the ball

References

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TORNADO SPHERES

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1. Introduction

Investigating the phenomenon of rotation of two steel and sticking balls that first hand and then blowing on them through a tube are rotating them. We investigated that by sticking two balls, rotating it and then blowing on them through a tube and finding the data. So we found that as the angular velocity increase, θ increases.

2. Theory

The movement of hurricane balls has three steps:
1. rising
2. speeding
3. steady,

that in steady-state situation, the double-sphere rolls without slipping during its motion. Also one of the balls will separate from the table so it will have an angle with horizontal axis. To calculate the angel, we need to calculate the potential and kinetic energy, and then with lagrangian approach we'll find θ (angle) according to angular velocity through the following equation:

$$\cos \theta = \frac{2}{5} - \frac{g}{\Omega^2 R}$$

3. Experimental Procedures

We used two ball bearings and joined them together (with glue) so we had constructed double-spheres of different sizes. (Different distances between two ball bearings was our parameter too, we used two, three, four balls between our main balls to have distances.) Then we recorded their motion using camera (240 frames per second). At last we Analyzed our videos using free video analysis program Tracker and after our last blow in a tube in video we got the time, θ and number of frames (ω) around the axis of the rotation with tracker until the end of the video (when θ in zero).
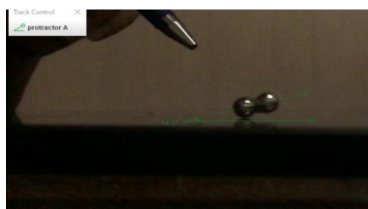
Fig.1. Blowing with a tube and see rolling of the hurricane ball
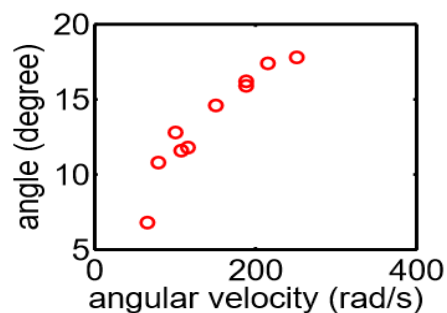
Fig. 2: Chart of angle according to angular velocity (d=1cm)

4. Results and Discussion

At last as a general result, we can say that: 1.As the angular velocity increases, the angle (θ) increases with horizon. 2. There is a minimum Angular velocity that if ω is less than that, the phenomenon doesn't occur. 3. We have maximum θ too.

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ANTI GRAVITY

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1. Introduction

Funnel and the ball is an educational experiment, which is used to analyze movement of fluids against a sphere when lift force is implied on the ball as anti gravity. So the main parameters are investigated in this research are : mass and volume of the ball, velocity of the air jet and the shape of the funnel.

2.30 g

5.30 g

Mass of the ball   Volume of the ball

velocity of air jet   Shape of the funnel
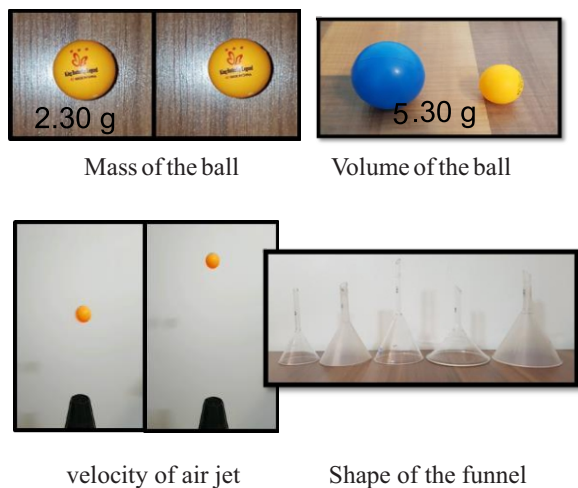
2. Experimental procedures

For performing this experiment, we need to create a stream of air inside the funnel to create difference of pressure inside a funnel, which results in the ball being picked up by the funnel; And in order to do that we need a funnel, a light ball (e.g. Ping-pong ball) and a stable stream of air.

3. Theoretical Part

In this part, we will analyze the forces that are implied on the ball and the physical factors, which cause the forces to happen.

According to the arrows in the diagram in (Fig.1) the arrows indicate the forces which are implied on the ball which are Lift force (F_L) Drag force (F_D) and weight (mg). In order for the ball to levitate inside the funnel F_L must be equal or above the sum of F_D and mg.
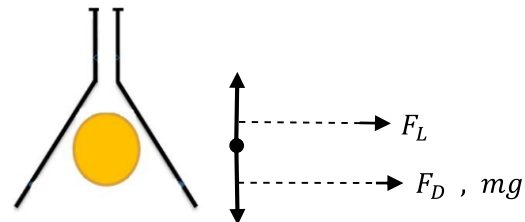
Fig.1. The forces

$$F_L \geq F_D + mg \rightarrow ball\ levitates\ in\ the\ funnel.$$

The forces which cause the levitation are the difference of pressure created inside the funnel; and as air passes through different diameters inside the funnel according to fluid discharges equation it will have different velocities (Fig.2).
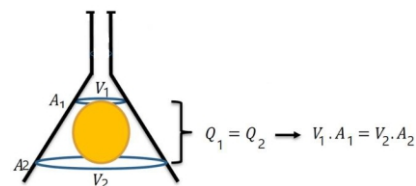
$$A_1 < A_2 \rightarrow V_1 > V_2$$

Fig. 2: Different velocities

And as velocity is increased in a section according Bernoulli's equation it will have different pressures.

$$V_1 > V_2 \xrightarrow{V\uparrow \leftrightarrow P\downarrow} P_1 < P_2$$

This difference of pressure creates the F_L which causes he ball to levitate.

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-through-a-funnel.845839/

POPSICLE CHAIN REACTION

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1. Introduction

When a number of Popsicle sticks are interlocked in each other a mesh is produced, known as "The Cobra Weave". As one of the sticks from the end of the lattice is taken out, an explosion is happened and the wooden sticks will be thrown consecutively, one after another. In this research this phenomenon was investigated and it was shown that using different sizes of popsicle, affect the chain reactions. It was seen that by increasing the length, moving speed decreases. Also the thicker popsicle lead higher speed. The elasticity (The Young's modulus) and the mass of the popsicle has effects on the height of the cobra and the shape of the wave. The width will not change the speed of the explosion.

2. Experimental Procedures

In the Cobra Weave, the sticks interlink in each other and a lattice will be formed. The phenomenon was investigated by utilizing popsicle in 4 different dimensions (width, thickness and length) in order to construct the cobra weave pattern (Fig 1). The phenomena was observed using a 120 frame/ sec camera. The behavior was investigated from two aspects:

1) Every single Popsicle and
2) A linear continuous medium (Cobra Weave)

It was seen that the height of the weave changes in the explosion for each of the 4 weaves. Its height was measured by pointing the center of one chosen Popsicle in 'Tracker' software (it can be measured directly by measuring the height of the highest thrown Popsicle).

3-Results and Discussion

The most relevant parameters for the velocity and the height of the explosion were the length, width, thickness, mass, young's modulus, special period of the mesh and θ (the angel of the lattice, a scaling factor which depends on the geometry of the mesh). It was realized that the width of the sticks doesn't effect on the velocity. The highest changes (especially on the velocity) were obtained by changing the θ angel. As was seen in the experiments, a deformation was observed all over the chain, which was because of the elastic energy. In all the weaves, Potential energy was stored in the mesh and by releasing one of the two Popsicle, which are placed in the edges, the stored energy was converted to kinetic energy and explosion was happened. From the balance between the kinetic energy and the potential energy, velocity of the wave was derived .

Fig.1. A side view of the observed phenomena
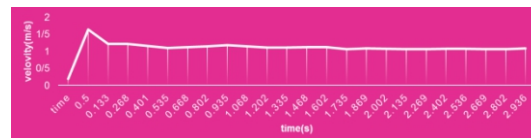
Fig.2. Wave's speed (m/s)

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LOOPING PENDULUM

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1. Introduction

Two loads are connected by a string over a horizontal rod. By releasing the lighter load, it doesn't let the heavier one fall down. I test it several times by changing the length of string, the angle of releasing, and the mass ratio. The lighter load because of frictional force sweeps around the rod.

2- Experimental Procedures

There are five set ups with equal string length (160 cm) and different mass ratios which are 20, 15, 10, 5 and 2 times in different angles which are between 90 – 0 degrees. Then for every set up I reduce length of the sting and test it till the light load doesn't sweep enough. the diameter of the rod is 2.5 cm. I film every experiment in slow-motion mood. I track them with tracker to have the plot as a result.

3- Theory

Weight force of heavy load wins on tension force till the tension force is equal to the weight force. Tension force of heavier load increases by increasing the tension force of lighter force, coefficient of friction (μ), and amount of the angle lighter load goes through (according to $T_h = T_l e^{\mu\theta}$ from this equation and math working I get:

$$\ddot{x} = -\left[\frac{g - \frac{m_2}{m_1}(g\sin\theta + l\theta^2)e^{\mu(\theta+\frac{\pi}{2})}}{1 + \frac{m_2}{m_1}e^{\mu(\theta+\frac{\pi}{2})}}\right]$$

$$\ddot{\theta} = \frac{g\cos\theta - r\theta^2 - 2l\theta}{l}$$

4- Results and Discussion

By reducing the length of the string (radius of rotation), rotation velocity increases so the string sweeps around the rod and causes the heavy load stops. If the angle, mass ratio, and the length of string is not big enough the light load doesn't have much force to sweep and the heavy load falls down.

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[2]   Halliday, David, R. Resnick, and J. Wallker. "Fundamentals of Physics, extended version." (1981)

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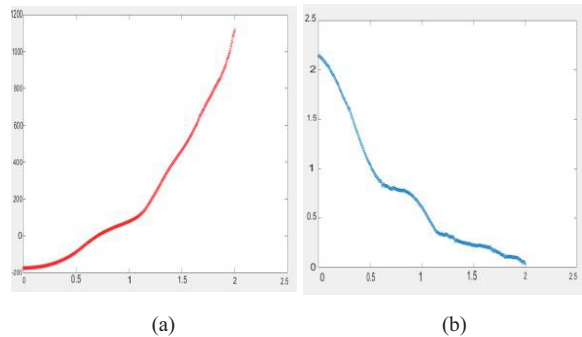

(a)   (b)

Fig.1: a) angle-time (light load) b) radius-time (light load)

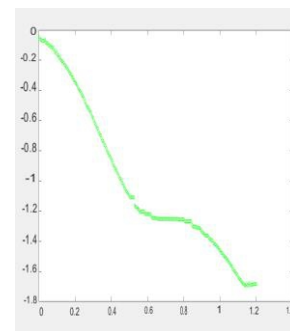**Fig.2**: Displacement-time (heavy load)

SCI-FI SOUND

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1. Introduction

When we tap a slinky spring we hear an amplified laser sound. Also after we tapped it we can see the slinky moving up and down. We use different slinky springs with different lengths, diameter and we show that there is a delay between higher frequencies and lower frequencies and it's the reason for this laser shot sound. By decreasing the length this delay will decrease.

2. Experimental Procedures

As you can see in figure1 which is showing our setup we hold our slinky spring is horizontally. We tap the slinky spring with a pen on a specific spot. We have a sound-recorder and a cup to hear the sound easier. We have a camera to record the slinky spring movement. We record the sound and analyzed our data with Wave Pad application. Then we do the experiment with different lengths.

3.Theory

For sound we have 2 parameters, ω and k which show frequency and wave number. It has been shown that Velocity = k/ω which is the slope on k-ω graph. The dispersion relation in slinky is , k=ω 2 , so higher frequencies have more velocity than lower frequencies and will be heard sooner. That is why we have delay.

4. Results and Discussion

As you can see in figure 2, it's a graph of tapping a slinky spring. We tap the slinky spring several times. You can see that their TFFT graph is the same it means that no matter how hard we tap the sound seems the same on special condition so the way I tap the slinky is not important. By time passing the frequencies will decrease it shows the difference between higher frequencies and lower frequencies. And when the length decreases the delay will decrease either.
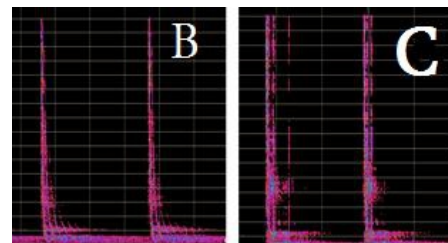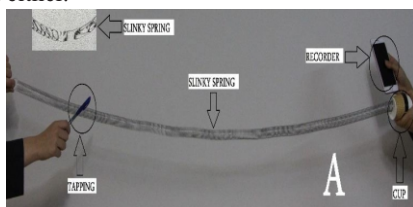
Fig.1: (A) Experiment setup , (B,C) TFFT graph in different lengths (B) 2.67m (C) 0.93m

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EXTERNAL ANTIOXIDANTS; AN EFFECTIVE AND AFFORDABLE WAY TO OVERCOME SALINITY STRESS IN PLANTS

Yasmin Karbalaei Kamran, Negin Alidoost Zoghi, Farzanegan 1 High School, Tehran/Iran

1. Introduction

When plants expose to sodium chloride, their cellular ion homeostasis becomes defective and free radicals accumulate in cells, resulting in an imbalance in cellular antioxidant/ pro-oxidant equilibrium and the accumulation of oxidized forms. As a result, the oxidative stress develops in the plants, leading to DNA damage and enzymes' inactivation. Thus, it is likely that exogenous antioxidants can increase plants' tolerance to salinity stress and its derived oxidative stress.

2. Experiments

In the present study, natural resources had been selected for extraction and the extract of colorful fruits', pomegranate, lemon and pistachio, peelings was obtained using polar and semi-polar solvents and ultrasonic bath. Next, the sensitivity of bean, lettuce and fennel seeds to 50 Mm NaCl aqueous solution was studied. The effect of fruit peeling extracts on the seed germination and growth was then evaluated. The results were then compared with positive control group (absence of sodium chloride and extracts) and negative control group (presence of sodium chloride and absence of the extracts). Finally, the antioxidant potency of the best extracts was evaluated by using 2,2-diphenyll-1-picryl- hudrazyl-hydrate(DPPH) assay.

3.Results

The DPPH results showed that the antioxidants of the extracts enhanced the seeds' tolerance to the salinity stress. Regarding the significant effects of the extracts obtained by using water on the germination and growth of bean seeds (pistachio: 1 out of 3 seeds, 2 cm; lemon: 3 out of 3 seeds, 5 cm) and the extracts obtained by using ethyl acetate on the germination and growth of lettuce seeds (pistachio: 3 out of 3 seeds, 3 cm; lemon: 3 out of 3 seeds, 3 cm); it seemed that the compounds affecting the germination and growth of bean seeds were polar, while lettuce seeds were affected by semi-polar compounds. Also, the results showed that the superior extracts had a significant antioxidant power, therefore, they can be used for improving the germination and growth of plants under salinity stress.
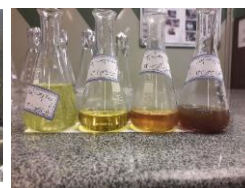
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MAGIC PENDULUM

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1. Introduction

Two masses connected with a string are hanged on a horizontal rod. The heavy mass is lifted up by pulling the light one. When the light mass is released, it loops around the rod keeping the heavy mass from falling. The velocity of the light mass and the number of loops are depended on parameters such as the ratio of the masses, the release angle, the length of the string, the radius of the rod and the coefficient of friction between the string and the rod.

2. Experimental Procedures

When the heavy load falls it accelerates downwards increasing the light load's velocity. As a result, the light load wraps around the bar in a form of a spiral then friction and its velocity stop the heavy mass. Hence, the motion is divided into two phases, phase 1: rotation and falling and phase 2: rotation (when the heavy mass no longer falls). For investigating the effect of different ratios of the masses the experiment was done with ratios of (1/1 to 17/1), the string length of 50 cm, and the release angle of 60° with a metal rod. Laps won't be made with 1/1,2/1 and 3/1 ratios, and the light mass only swings back and forth since its velocity is not enough to make full laps. With the same experimental condition and one load being seven times heavier, the light load was released from 0°,30°,45°,60° and 90°. The phenomenon doesn't happen with the release angle of 0°.

3. Results and Discussion

It has shown that by increasing the ratio of the masses the velocity of the light load increases but the number of loops decreases and also due to the fact that the string slips faster, as the graph shows the initial radius of the spiral in phase 2 decreases. If the light mass is released from a higher angle it laps faster and makes more coils because its potential energy is more. By decreasing the radius of the rod the number of laps increases. In this case, in phase 2, Δr (radius of the spiral) is equal to $2\pi r$ (radius of the rod).

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         lab/experiments/magic-pendulum/

[2]   https://www.istitutotrento5.it/
         images/test/bre_15_16_looping_pendulum_2_bil.pdf

[3]   https://m.youtube.com/watch?v=SXQ9VaYm3yQ

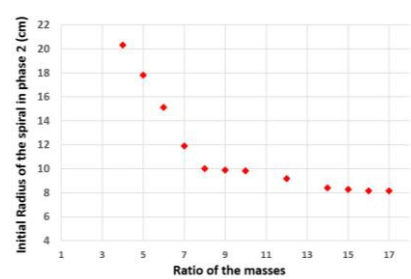**Fig.1.** : Experiment setup and the pendulum path

Fig. 2: Initial radius of the spiral in phase 2 vs. ratio of the masses

BUILDING AN ELECTROSTATIC MOTOR

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1. Introduction

Corona motors are mostly used in special environments. Their advantage compared to electromagnetic motors is their light weight, which results in a high rotation speed. Their nonmetallic fabrication makes them usable in many fields. As an electrostatic motor, corona motors build large torques compared to their size. In this work, the motor consists of a Kelvin water dropper and a Van de Graaff as voltage sources and a simply made plastic rotor. The rotor's rotation is observed by increasing the voltage on the electrodes until a certain point which breakdown of the air occurs. Effective parameters on the rotation such as air gap and lining in the inner surface of the rotor were investigated. In the air gap of 0.6 cm, the maximum speed of 2150 rpm was attained.

2. Experimental Procedures

To observe the rotation, the rotor should be made of an insulating material to constrain surface charges on it. To have the corona, the voltage on the electrodes should increase until the ionization of the air in the air gap occurs. Then, a quantity of charges will be deposited on the rotor. The charge, being of the same polarity as the electrode it emanated from, is in mechanically unstable equilibrium with respect to the electric field. If the rotor is slightly disturbed, a couple will act on it which causes the rotation, carrying the charge with it. If this happens continuously, the rotor will rotate. In this work, an ac excitation was replaced with Kelvin water dropper and Van de Graaff. The number of the electrodes were two, and with a plastic rotor with length of 1.4cm, weight of 0.19g and with aluminum foil coating beneath, the effect of air gap length on the rotational speed was investigated. The coating beneath plays the role of an opposite electrode against the corona electrodes. As a result, the efficiency of the setup increases and corona occurs in stable position . By optimizing the setup, in the air gap of 0.6cm, the rotation speed of 2160 rpm was observed. How the rotor is placed between the electrodes3- Results and Discussion

As the generators work, the conductive air gap causes rotation of a rotor which is placed between the electrodes. With a fixed input voltage, the effect of air gap length was investigated. It was observed that as the length of the air gap increases, the quantity of charges on the rotor decreases . Thus, the rotation speed decreases. For more optimization of the setup, there should be some optimizations done in the geometrical configurations of the setup. Also, the effect of the number and tilt angle of the electrodes, geometry of the electrodes and conditions of the setup should be investigated.

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Serbia

THE INTELLIGENT DIAGNOSIS AND TREATMENT OF POSTURAL DEFORMITIES BY ANALYZING THE GIVEN DATA FROM KINECT CAMERA

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1. Introduction

In the implementation of the project we used Kinect camera, a gaming device provided by Microsoft company, because it has functional features with a reasonable price. The Kinect camera is capable of body tracking, joint coordinating and motion capturing. If the user stands in the proper distance from the camera, the system receives some data from the user's body, analyzing this data, we could implement the diagnosis phase. The treatment of the deformities is defined in the form of different exercises according to the medical references, having these exercises and knowing that Kinect camera is capable of motion capturing, we could guide and monitor the user during the treatment phase.

After the enhancement made on the system the accuracy of the whole system was calculated, the results showed that the system provides enough validity for this purpose. This system can be used instead of a doctor in schools and clinics and any places with large number of users, to save money and also the accelerating the amelioration process.

2 . Creating a Profile for the Patient

Before entering the program users will go through a profiling process in which some personal information will be received from them and will be held in a profile with a profile number that will be also provided for the users. As the profile is created an email will be send to the patient's doctor so that the doctor would have access

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Full Paper: STEM Fellowship Canadian Journal
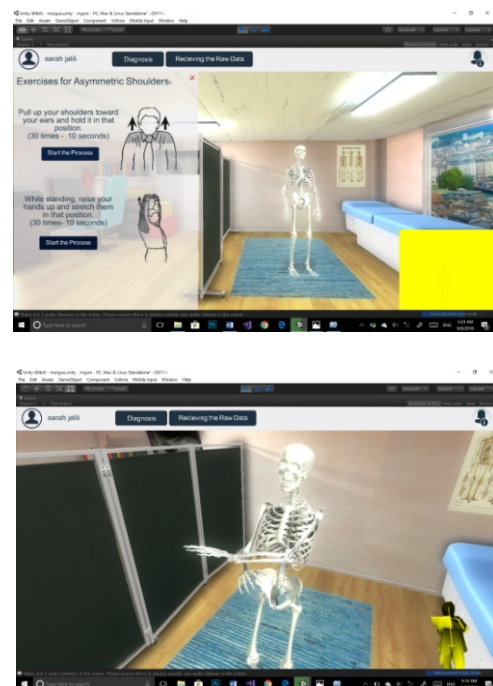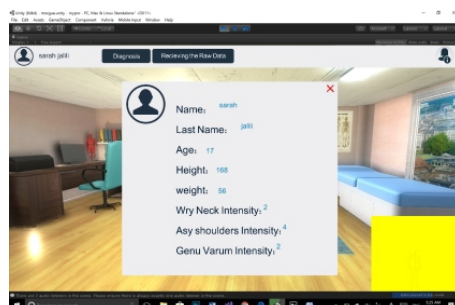
INVESTIGATING OF AN HOURGLASS

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1. Introduction

Our question is that whether or not the weight of a running hourglass differs from the weight of the hour glass at rest. When the sand starts pouring, part of it is freely falling and it may reduce the weight of the hourglass. In the other hand, when the grains arrive at the bottom, they apply an impulse.

Some examiners would simply calculate that these two affairs sum up to zero and they will ignore them but we want to show that these two affairs have their own effect on the weight of the hourglass and they are measurable.

2. Theory

We decompose the running hourglass into three states:

1) the beginning state ,when the hourglass starts to flow until the first bit of sand hit the ground

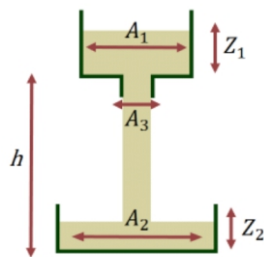2) the steady state when both upper and lower chambers contain a portion of sand

3) the end state ,when the last bit of sand leaves the upper chamber until it hits the ground

whereas we assume that flow rate is constant during the hourglass flowing and sand grains do not have any interaction to each other during the falling , so we can find the weight of sands in free fall:

$$\delta W_1 = -Q\sqrt{2gH}$$

In the steady state we have both free fall and impulse in the same time. The force of impact can be obtained by:

$$\delta W_3 = \frac{\delta P}{\delta T} = \frac{0 - (-mv)}{\delta T} = \frac{Q\delta tv}{\delta t} = Qv$$

$$\delta W_3 = Q\sqrt{2g(H - z_1)}$$

The net deviation of weight in the steady state would be :

$$\delta W_2 = Q\sqrt{2g(H - z_1)} - Q\sqrt{2g(H - z_1)} = 0$$

Then in steady state we expect not changing in weight of hourglass during a time but a very important thing that w missed in calculation is the moving of center of mass. acceleration of center of mass of a system is ignorable in comparison in the first and last state so we focus on the acceleration of center of mass in the steady state. since we have $A_1, A_2 > A_3$ then the acceleration is always greater than zero which means it is upward .the change of weight in the steady state will be:

$$\delta W_2 = M\frac{d^2 z_{cm}}{dt^2} = \frac{Q^2}{\rho}\left[\frac{A_1}{(A_1 - A_3)^2} + \frac{1}{A_2} - \frac{A_3}{(A_1 - A_3)^2}\right]$$

3. Experiment

The hourglass was made with two rods, a glass container, a funnel and the gate for controlling the time when we want the grains to pour. The upper container was filled with salt and it was put on the scale. Then the variation of weight was just measured. When the sand starts pouring, the weight had fluctuation. It increased and then went up and down but it was actually upper than zero (the weight of the hourglass at rest).

A sudden increase in weight after 43 seconds was seen when the upper container was becoming empty and the last sands was pouring in the lower container.

changes of weight in hour glass
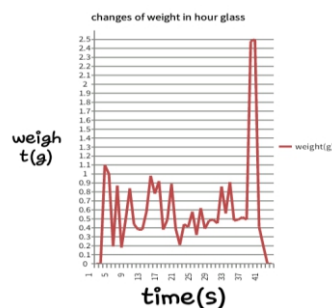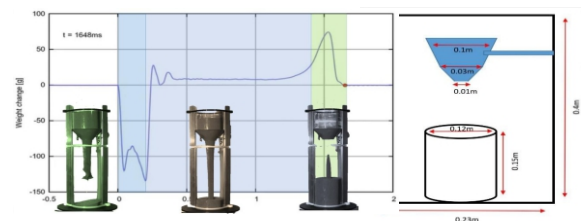
4. Results

The weight of a pouring hourglass is equal to the weight of the hourglass at rest. The matter is that the impulse in at the end of the fall effects on the weight of an hourglass and in those seconds we can perfectly see the increase of weight. We should also consider the weight at the beginning of the fall that should decrease because of the free falling of sands. The effect is tiny and hardly measurable using standard laboratory equipment.
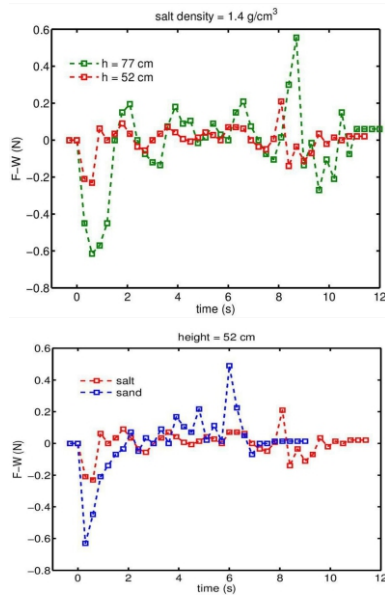
We showed that these two effects do not cancel each other because we have acceleration of center of mass(which is upward) during the hourglass flowing. The experiments shows that by increasing the density the flow rate will be increased and then the changing weight will be increase too. When we increase the height, free fall and the impact will be grater.

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INVESTIGATING ON THE EFFECTS OF OXYGEN AND HYDROGEN PLASMA ATMOSPHERES ON ANTIMICROBIAL PROPERTIES OF ZNO NANOWIRES

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1. Introduction

The main purpose of this project is to lower the cytotoxicity level of ZnO nanowires using Oxygen and Hydrogen plasma atmospheres. Plasma treatment can induce reactive Oxygen and Zinc ions under the effect of a powerful electric field; therefore, biocompatible ZnO nanowires can be achieved and prepared for biomedical applications.

 Zinc Oxide (ZnO) nanostructures are one of the most applicable semiconductors that are widely used in various industries such as chemical industries and sensors such as gas sensors, UV and PH detectors, chemical sensors, and biosensors.

There are numerous methods for synthesizing ZnO nanowires such as chemical vapor deposition (CVD), physical vapor deposition (PVD), sputtering, sol gel, wet chemical, and electro spinning which simplify provision of them.

        ZnO nanowires are biocompatible in normal concentrations, however, recent researches have shown a noteworthy level of cytotoxicity in high concentrations. As studies have shown, cytotoxicity of ZnO nanowires is attributed to Oxygen vacancies.

2. Experiment

ZnO nanowires are synthesized by a wet chemical method. Zinc acetate dehydrate [Zn(CH3COOH)22H2O] and PVP are used in the experiments as precursor and capping and methanol is used as solvent. Subsequently the synthesized nanowires are exposed to Oxygen and Hydrogen plasma atmospheres to reduce the amount of Oxygen vacancies.
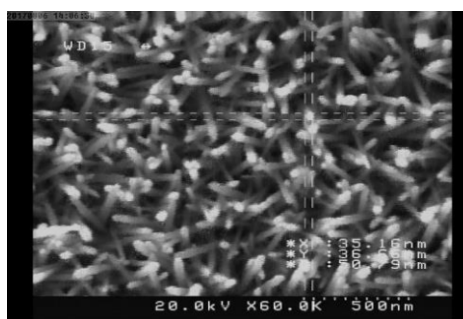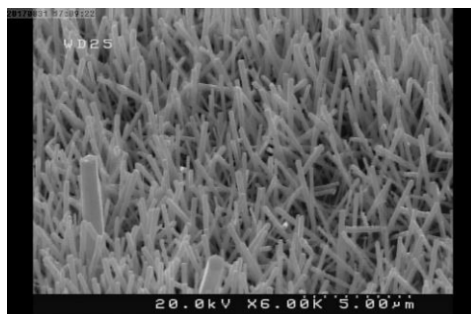
Fig. 1: SEM images showing the synthesized ZnO nanowires. The average nanowire diameter is 50nm.

3. Conclusion

ZnO nanowires can be used in biomedical fields; however, cytotoxicity of them, which is attributed to existence of Oxygen vacancies, might limit their applications as biosensors. In this project plasma treatment is used for reducing the cytotoxicity of nanowires by reducing the amount of Oxygen vacancies. There has been studies on reducing the Oxygen vacancies by heat treatment. Our study shows the cytotoxicity of the nanowires can be reduced by removing the Oxygen vacancies in near room temperatures by exposing the nanowires to Hydrogen and Oxygen plasma atmospheres. However, better results can be achieved using Oxygen plasma to remove Oxygen vacancies.

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DESIGNING REAL TIME AND SAFE TLC INSTRUMENT AS AN EFFICIENT DEVICE IN ACCURATE PURIFICATION OF UV-ACTIVE THERAPEUTIC COMPOUNDS

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A R T I C L E   I N F O

1. Introduction

Pharmaceutical companies are looking to discover new compounds to design new drugs to treat various diseases such as antibiotics for infectious and therapeutic compounds for metabolic diseases like cancers, cardio-metabolic disorders, hypertension, and diabetes and so on. So they screen promising natural sources including plants and microorganisms. After finding source which contain therapeutic compound they are faced with a very complex mixture of biocompounds which should be purified after several fractionations. Many fractions are obtained during purification steps. In order to accurately separate same fractions should be mix with each other. The researchers using various strategies detect same and different fractions one of these methods is thin layer chromatography (TLC). Thin layer chromatography (TLC) is used to primarily characterize the fractions and detect same and different fractions. Usual approach is running the spotted TLC plates in a TLC tank which contain solvents and observing formed bands on the TLC plates under UV-light. There are some limitations in this current method. For example, if the fractions have more polarity than solvent system in TLC box their spots don't move on TLC plates and the research does not understand this issue until the end of the experiment and has to repeat this test several times to find suitable polarity for running TLC. Another disadvantage of this method is that if some compounds with same polarity were present in the mixture it is possible that they form single band on TLC and cause misunderstanding for researchers. In addition, UV-lamps don't have protective layer to protect the users and can damage in long time.

2. Materials and Methods

In order to eliminate existing limitations, we designed and manufactured real time TLC box. Real time TLC box consist of two glass TLC tanks which are resistant to solvents to observed TLC profiles of fractions in more than one solvent system which have different polarity index to prevent misunderstanding about un-purified compound or mixture which show single band in TLC but contain more than one compounds. In new designed devise the researchers can observe movement of existing compounds in a spot because of joining TLC tanks and UV-lamp in a one space and therefore users can adjust the polarity of solvent systems and find the suitable polarity of uninvestigated extracts in one running. Safety is considerable advantages of real time TLC box because using a protective glass layer between UV lamp and users' life threatening effect have been minimized. And most importantly we have used LED lamps and special filter in manufactured real time TLC box using these conditions the researches can observe UV-active bands without need to UV therefore this option make this instrument safer. The used UV and LED lamps in real time TLC box have low ampere and this property makes long term use possible and prolongs life-time of designed real time TLC box.

3. Results and Conclusion

Therefore, we designed real time and safe TLC instrument which have two small TLC tanks to use two different solvent systems to prevent misunderstanding about compounds with same polarity in a mixture. Researchers can easily find polarity of uncharacterized fractions because UV-active bonds can be observed during TLC. The UV-active bond can be safely observed using LED-light and special filter instead of UV-light.

MANUFACTURING A LIGHTWEIGHT CONCRETE BY USING FOOD WASTE

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1. Introduction

Today, the use of lightweight concrete in buildings is of increasing importance. Also, the use of environmental friendly materials is also a new approach to engineers. Hence, the research team used natural wastes in concrete. According to this study, three materials of egg skin and walnut and nano-cellulose skin were selected as hardening and lightening, and each was tested as a cement alternative. The egg skin sample had the highest strength compared to other specimens, and even showed a stronger strength, 13%, than the control sample. It also showed the lowest density among the samples.

2. Experiments and Results

According to the results, an egg skin sample was selected as the preferred sample. In the second step, the factors such as the size and amount of egg skin, the amount of water and the lightening additives were investigated. Therefore, two sizes of egg skin and under the mesh 200 were used. According to the results, the more particles are finer, the compressive strength and density will increase. In the next step, the percentage of egg replacement was tested instead of cement. Between 7%, 14% and 21% the 7% replacement had the highest compressive strength instead of cement. The third factor was the effect of the amount of water consumed.

Fig. 1: Pouring concrete into the mold

The strength of the samples is directly related to the amount of water consumed, so this concrete is usable in curb exposed to rain water.

Also, two natural gum and lightweight E600 (Unolith) were used as a lightener, which reduced the density to 9 to 19 percent, compared with the control sample, but decreased the strength of the specimen due to the formation of air bubbles. Thus, it was concluded that the best example of the 14 specimens was a sample of 7% eggs under the mesh of 200 replaced by cement which 12% of the total mass is formed of water.
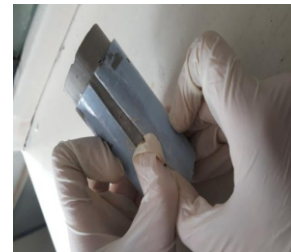

Fig. 2: Removing the concrete sample from the mold

BOTTLE FLIPPING

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A R T I C L E   I N F O

1. Introduction

Water bottle flipping involves taking a plastic water bottle that is partially empty and throwing it so that it lands up right. First of all, some principals and rules of physics which effect on the water bottle movement were studied, then we started to do this challenge and compared our different results from different volumes of water. At last according to the results we got, the most success we gained was between 30% to 35% water filled.

2. Experiments and Results

First of all, some physical rules such as center of mass, gravity, and angular momentum which were the foundation of our project were studied. The second step was checking out the water behavior in different situation. In fact, all the variables were kept fixed except the volume of the water which were 5%, 25%, 30%, 33%, 35% and 70% filled.

The bottle was thrown 6 times with different volumes of water and the most success was for 30% and 33% filled that the bottle land upright about 5 times. All were shown by high speed camera and different behavior of the water in 30% and 33% was totally obvious so that water turned into a crescent and on the sides of the bottle the amount of the water was equal it was balanced.
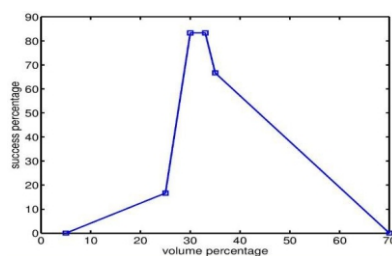

Fig.1: Success versus volume of water

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INVESTIGATING A PNEUMATIC HORN

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1. Introduction

A pneumatic horn is a device to create an extremely loud noise for signaling purposes. It can be constructed by stretching a balloon over the opening of a small container or cup with a tube through the other end. Blowing through a small hole in the side of the container can produce a sound. These horns are widely installed on large semi-trailer trucks, fire trucks, trains, and some ambulances as a warning device and on ships as a signaling device. We must investigate how relevant parameters affect the sound.

2. Theory

These horns, normally, have a constant volume of air inside the bottle with temperature and pressure which is the same as pressure and temperature outside the bottle but when the air is blown to the air horn the pressure inside the bottle becomes more than the pressure outside. Since the temperature and the bottle volume has a little change, as Ideal gas law it can be written:

$PV = n\,RT$

Sound is a longitudinal wave that the direction of propagation is parallel to the direction of vibration. There are different types of acoustic pipes, open ended pipe or closed ended pipe. Here we need to use open ended pipe.
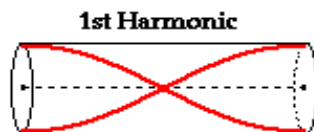

Fig. 1: Standing waves in open ended pipe

The quality in a sound of being deep is called resonance. When the inherent frequency of voice pipe resonates with frequency wave it creates better sound.

3. Experiments

Fast Fourier transform analysis converts a signal from its original domain (often time or space) to a representation in the frequency domain and vice versa.

$$X_k = \sum_{n=0}^{N-1} x_n e^{-i2\pi kn/N} \qquad k = 0, \ldots, N-1.$$
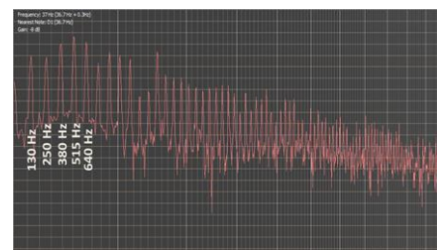
Fig. 2: FFT analysis in air horn
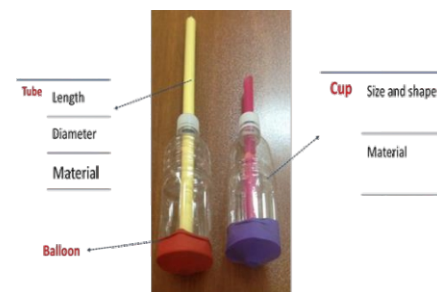
Fig. 3: Different shapes of a pneumatic horn

4. Conclusion

Different parameters like the shape, size and material of the components have been investigated. Membrane has a dramatic effect on the sounds. These changes have a significant impact on the elasticity, thickness and also material. If the traction of balloon becomes further, the voice become thinner and vice versa.

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ANTIMICROBIAL POTENTIAL OF BIOSURFACTANT ISOLATED FROM OIL-DEGRADING BACTERIA AGAINST MULTI-DRUG-RESISTANT PATHOGENS

Anita Shafieesabet, Farzanegan 1 High School, Tehran/Iran

1. Introduction

Hospital acquired infections are still a serious and common issue around the world leading to many undesirable consequences and even death of considerable percent of patients. Among the possible solutions, using biosurfactants seem to result in promising outcomes. The biosurfactants (BS) are materials that decrease the surface tension (SFT) and interfacial tension (IFT) making the bacteria to be disconnected from the surface. Besides, they possess other desirable properties such as biodegradability, low toxicity and high activity at extreme conditions. In this project, the effect of a biosurfactant on the bacteria that causes sort of hospital acquired infections is investigated.

2. Experiments and Results

The biosurfactant used in present work is derived out of existing bacteria in oil-contaminated soils in different refinery sites in Iran. Five soil samples were collected from different areas. The isolates were separated by serial dilution method. The bacterial isolates were purified by repeated subculturing. Bacteria produced biosurfactants when they were in some special conditions like yeast extract and olive oil. Screening was performed by using oil spreading test in order to find promising producers. Eventually, the antimicrobial activities of biosurfactants against Staphylococcus aureus and Pseudomonas aeruginosa were determined. The results were promising. Therefore, isolated strain of oil-contaminated soil may be a valuable candidate of favorable biosurfactant-producing bacteria for the inhabitation of infectious bacteria.
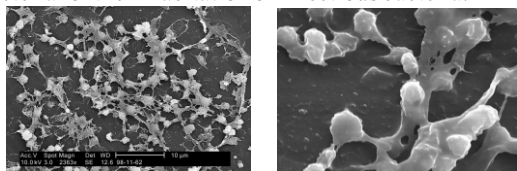
Fig. 1: Biofilms

Fig. 2: Purification
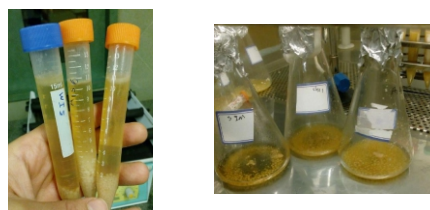
Fig. 3: Production of the biosurfactants

Screening the strength of biosurfactant samples
•Parafilmtest
•Oil spreading test
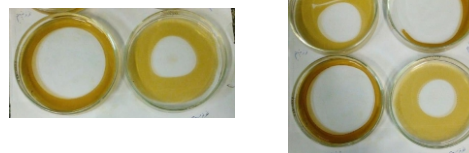
Fig. 4: Screening
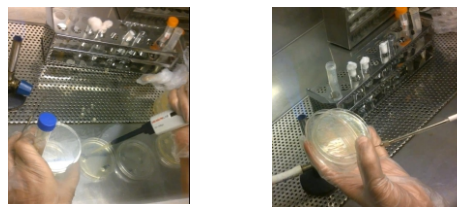
Fig. 5: Analyzing the antibacterial feature
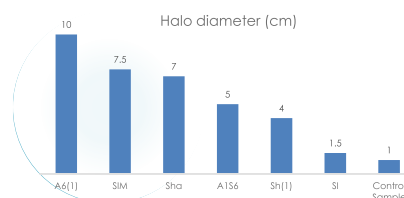
Fig. 6: Results of oil spreading test

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GREEN NANOTECHNOLOGY APPROACH IN MANUFACTURING OF CaCO3 NANOPARTICLES FROM EGGSHELL

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1. Introduction

Nanotechnology is a broad term that refers to all the advanced technologies in the field of work at the nano scale. Green nanotechnology is the study of how nanotechnology can benefit the environment such as by using less energy during the manufacturing process, the ability to recycle products after use and using eco-friendly materials. Eggshell is a part of waste products which is found in household and industrial waste in abundance and despite its low value, its biocompatible calcium carbonate in nano scale can produce a great value added.
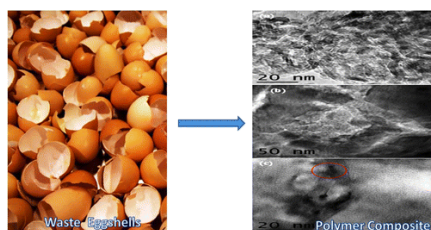
2. Results and Conclusion

In this study, a green, top-down procedure for making CaCO3 nanoparticles from eggshell was investigated. Coarse powder gained from hot water treatment followed by grinding was passed from a leach at size of about 300-400 microns. In the next step colloidal particles in a solution of distilled water were repeatedly exposed to a programmable ultrasonic homogenizer device. Particle size was determined using a DLS Particle Size Analyzer. The samples were centrifuged to remove large particles and samples supernatant were then converted into powder by freeze-drying. The final powder was characterized by UV-Visible and DLS size analyzer. The results showed that sizes of the particles were in micrometer scale after grinding but were below 100 nano meter after ultrasonic and centrifuge. Nano calcium carbonate powder in this study was produced without the use of any chemical substance and from this aspect; it can be called green nanotechnology.

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STUDY THE EFFECT OF NIGELLA SATIVA AND HONEY ON THE RAT IMMUNE SYSTEM

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1. Introduction

The immune system is a host defense system comprising many biological structures and processes. It must detect a wide variety of agents, known as pathogens. Since the advent of communication technology, as humans are exposed to diversified kinds of pollutions including air, water, soil, etc. Their immune system can be threatened by causing different types of disorder and deficit. Consequently, consumption of medicine is the reasonable procedure which is really prevalent. As the drawbacks of synthetic drugs outweigh the benefits, consumption of herbal medicines are superior to them. Furthermore, some herbal medicine such as Nigella sativa is an Iranian endemic plant which has a host of various properties as much as honey.

2. Results and Conclusion

The aim of the present study was to investigate the effectiveness of combination of Nigella sativa and honey in reduction of inflammation and strengthen the immune system. Twenty male mice aged 45 days were divided in to the four groups. Inflammation was induced by the gavage needle. Then they were treated orally for 17 days. The first group was the negative control and was given distilled water. The second, third and fourth groups were given honey, Nigella sativa oil and combination of both respectively and equally. The reduction of Tn f-α in the last group is more significant versus others. In the final analysis, the potential combination of honey and Nigella sativa oil in augmentation of the immune system is higher than others.

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DESIGNED SHOES TO PREVENT DISEASE PROGRESSION BASED ON THE PATTERN OF PRESSURE SENSITIVE PARTS OF THE FOOT

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1. Introduction

The ability to walk properly is necessary to prevent injury. Strong muscles and joints with the mobility are needed to create an efficient and appropriate cycle.

Walking is one of the easiest cardio exercises you can do, and it's an exercise that comes loaded with health and fitness benefits. As well as helping you maintain a healthy cardiovascular and respiratory system, walking keeps many important muscle groups working, key muscles that you use every day. As your feet hit the floor, normally with a heel-to-toe movement, your calves interact with your ankles to allow each foot to be pulled back on forth.

Trauma, disease and injuries are the most likely causes of foot pain. Poor biomechanical alignment and the type of footwear can also cause pain or discomfort. Shoes that fit tight or are tied too tightly can cause pain on the top of the foot. High heels can cause pain around the ball of your foot just below your toes. Pain and tenderness in a specific area for a prolonged period of time is telltale sign of a possible problem. A few insights into when you feel the pain will be helpful in identifying the problem and finding a possible solution. Is the pain affected by weight bearing, or do you feel it when there is movement of the foot? Does it affect the way you walk?

According to the common foot diseases among most of people I decided to design kind of shoes to prevent progression of this disease. Pressure sensitive sensors, to alert the person, are used.

2. Experiments

To design the shoes, pressure points were identified by scanning the foot. Vibrating motors placed in replica shoes.

This plan not only avoids making the wrong foot in healthy volunteers, but also helps patients with diabetes that have neuropathy. For diabetics LED warning system is applied instead of vibrating motor.

The advantages of this system: low-volume, light weight, low cost, usability for everyone, reducing health care costs.

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Fig. 1: Scanning foot shows high pressure in toe

CONSTRUCTING A PETRI DISH WITH CAPPING ABILITY AND THE ABILITY OF ADJUSTING INSIDE AERATION

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1. Introduction

Petri dish (plate) is a shallow cylindrical glass or plastic lidded dish, used for collecting, storing and culturing laboratory samples. They have two pans, smaller and larger one. The smaller pan is used as a test's place and the larger one functions as the lid. There is no grappling between the container and the lid therefore they are easily separated from each other and this causes some problems, such as increasing the risk of contamination once they are exited from the package and drying out during the experiment. This leads to decrease of test reliability and taking more care during the experiment. In the present study, to overcome these limitations a Petri dish with screwing lid and sealing ring was constructed.

2. Experiments

In this study, diagonal threads on the wall of lid and container were precisely created and a screw structure dish capped with a whole turn was constructed. Staphylococcus aureus sensitive to vancomycin and resistance to penicillin and cotrimoxazole was cultured in the designed (with a half turn rotation) and control Petri dishes for 24 h. Also, moisture retention capability of the designed Petri dish was evaluated by incubating at 50°C for 120 h. The growth rate of aerobic bacteria and moisture retention capability were calculated by measurement of cell volume after centrifuging and evaluating macroscopically, respectively.

3. Results and Conclusion

The results of bacterial growth showed the same rates in the both dishes while the designed Petri dish indicated significant superiority in moisture preservation compared to the control Petri dish. Findings of the study suggested the designed Petri dish is suitable for biological researches.

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AN OPTICAL DEVICE TO MEASURE THE GLASS PROPERTIES

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1. Introduction

An optical device has been constructed to determine the properties of a glass sheet such as refractive index and thickness without direct contact. One of the standard methods to determine the refractive index is semicircle shaped glass. But here it is a method to overcome the disadvantages of the previous devices and to provide thickness measuring apparatus which is able to determine the thickness of a transparent workpiece in a high degree of accuracy and more inexpensively, due to its construction.

2. Methodology and Experiments

Laser Light is impinged on the glass to provide a pair of beams reflected from the front and back surfaces of the glass plate respectively. These two points on the front of the device are detected by Pixycam which takes successive photos. These photos are sent to Arduino board which by using different theories in Matlab the characteristics of glass can be obtained programmatically. Then these data are shown on a LED screen. Several glasses have been applied to find the results of this setup successfully.
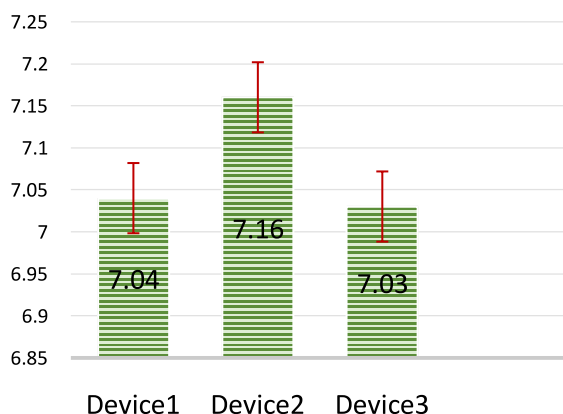
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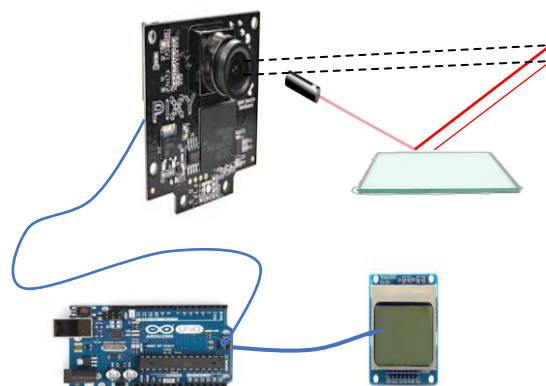
THE INTELLIGENT AMELIORATION SYSTEM FOR POSTURAL DEFORMITIES

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1. Introduction

Postural deformities are spreading among people at the meantime. In postural deformities, there is an imbalance in the loads imposed on different areas. Where loads exceed normal physiological limits consistently and over prolonged periods of time, structural changes occur in the skeletal bones. These structural changes cause postural deformities, such as: genu valgum, genu varum, asymmetric shoulders, kyphosis and etc. Diagnosing and curing these deformities instantaneously not only optimizes the treatment, but also reduces the remedial expenses. Yet many people ignore these deformities for several reasons like: lack of knowledge, lack of time or heavy fees for the doctor's referral.

Lordosis is the inward curvature of spine which creates problem in standing and walking and 'Bow legs' is also a postural deformity which the knees are widely apart (Fig.1).
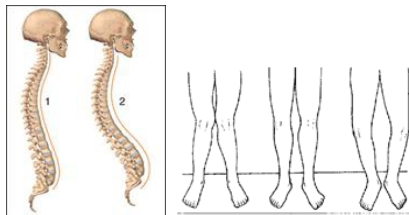
Fig. 1: Lordosis and Bow legs as postural deformity

2. Methodology

Our purpose for doing this project was to present a proper solution, to simplify and promote the quality of both diagnosis and treatment phases of the postural deformities and still is more accessible than other solutions. In the diagnosis phase the system is programmed to receive the coordination of the joints of user's body by connecting a computer device to a Kinect camera, and also by using a marker-based method recognition for the joints that weren't recognized meticulously by the Kinect device. So combining these two methods and using the most accurate results obtained in each, has improved the accuracy of the diagnosis. Having the coordination of one's joints, the system diagnoses the deformities based on medical standards.

The implementation of the treatment phase is based on the diagnosis part, which means suggesting a treatment for a postural deformity is related to what we diagnosed in the diagnosis phase. The treatment is usually accomplished by doing some specific exercises for the deformity; these exercises are called therapeutic exercises. According to the fact that Kinect camera is able to monitor the user's movements, we control the suggested exercises to see whether they're done correctly by the user or not. By these methods every user can do the whole process of the diagnosis and treatment intelligently and without the supervision of any expert.

3. Conclusion

The expansion of this system can raise the velocity and accuracy of the diagnosis and treatment process, and also can decrease the requirement of an agent as far as possible. This system can be used as a replacement of the doctor in places with the large number of users such as schools which can prevent the waste of time and money.

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PAPER SPRINGS

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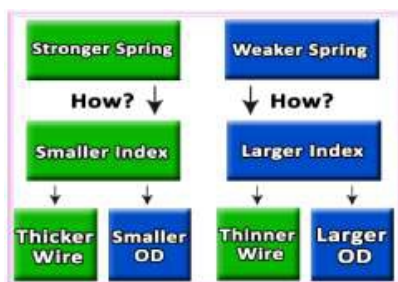
1. Introduction

   An object is labeled as a spring when it has an elastic feature. Now depending on the object, it's elastic nature differs from others; generally springs are made of metals. Aside from the material of the spring, the way a spring is designed matters in terms of the elasticity of a spring too. When all are kept together, the application and usage of the spring wrap it all up. When considering all of these factors, paper as an object with a simple elastic nature can be redesigned and rebuilt to give it a reliable application. For my project, I have tested the elasticity of a few types of paper and have named them as my first tests which to me, as the experimenter, define the elasticity of a few types of paper with different sizes. I've spun paper around markers and paint brushes, giving it a spiral form and different diameters, depending on the object that it was spun around. Also, in the process of researching, I figured that a strong spring is one that has a smaller outer diameter yet has a bigger wire diameter. Based upon the above data, I determined the size of my springs. I then hung various masses and found the capability of my springs. I have then tried to make paper springs that come in different shapes which adds origami in the process of making them. Then, I have focused on where these can be applied and based on the thorough research that I had done, I figured that paper springs are used as a form of art, are used as origami and most importantly, in the making of robots.

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NUCLEAR FUSION : AN INFINITE CLEAN ENERGY RESOURCE FOR FUTURE

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1. Introduction

This article initially describes the energy demand and production rate in the world based on other fuels. We will also have a look on common fuels. Then the reasons to need renewable resources, clean energies with infinite resource, like nuclear fusion, will be discussed. Also a study of further understanding of nuclear fusion technology, the required fuels, its pros and cons will be provided. Finally you will see what makes it cost efficient to invest in this technology.

2. Method and Research

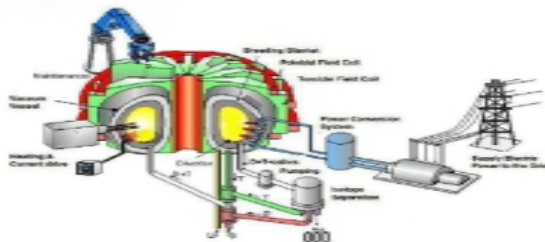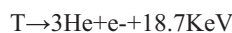The most common fuel for fusion is the reaction between D and T hydrogen isotopes.

$$D+T \rightarrow 4He\,(3.5MeV)+n(14.1MeV)$$

Fig. 1: Nuclear fusion function and nuclear fusion reactor

Tritium is a radioactive isotope of hydrogen. It has a short life of 12.3 years.

$$T \rightarrow 3He+e-+18.7KeV$$

Tritium existing proportion in the nature is not enough to apply to technical usages but in this article we obtained some formulas for creating Tritium :

$$6Li+n \rightarrow 4He\,(2.05MeV)+T\,(2.73MeV)$$

$$7Li+n \rightarrow 4He+T+n-2.47MeV$$

3. Conclusion

Considering the increasing rise of demand, it is essential to invest in infinite and eco-friendly energies.

Fusion is one of the best options, and regarding its unique feature, can be a good source of energy.

Fuel: the basic fuels for fusion are non-radioactive, and their exploitation is absolutely eco-friendly.

Safety: fusion reactors will switch off in case of radioactive decay and Chernobyl disaster will never happen.

Environment: fusion product is free from radioactive and its related problems. However, neutron and tritium reactions are radioactive and produce short-lived waste. Furthermore, unlike fossil fuels, in fusion does not produce gas and will not have any part in greenhouse effects, acid rain and ozone depletion

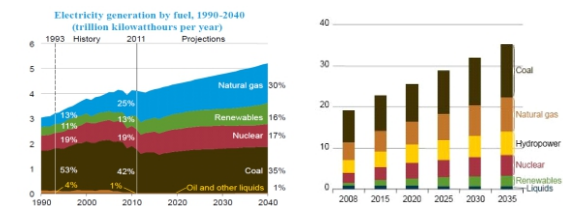Cost efficient :because of abundance and high energy it is affordable.

Fig. 2: Hydroelectricity

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EFFECT OF EGGPLANT SKIN IN THE PROCESS OF APOPTOSIS IN CANCER CELLS

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1. Introduction

The process of programmed cell death, or apoptosis, is generally characterized by distinct morphological characteristics and energy-dependent biochemical mechanisms. Apoptosis is considered a vital component of various processes including normal cell turnover, proper development and functioning of the immune system, hormone-dependent atrophy, embryonic development and chemical-induced celldeath. Inappropriate apoptosis (either too little or too much) is a factor in many human conditions including neurodegenerative diseases, ischemic damage, autoimmune disorders and many types of cancer. The ability to modulate the life or death of a cell is recognized for its immense therapeutic potential.

2. The Main Research

Cancer is a disease in which damaged cells do not cause apoptosis and uncontrolled cell division leading to the formation of malignant tumor.

Since the eggplant skin is rich in antioxidant- containing compounds causes the body's cells become resistant against premature aging and can also cause cancer cells to apoptosis. In this study the effect of alcoholic extract of eggplant skin on apoptosis of gastric cancer cells) AGS) and normal skin cells (FIB) was examined by MTT assay.

The MTT assay is a colorimetric assay for assessing cell metabolic activity. In this way, the yellow MTT salt becomes insoluble Formosan, which has a purple colour by dehydrogenase enzymes found in the mitochondria of active cells. The absorption of this compound is measurable after solution in DMSO at 570 nm. The results showed positive effect of eggplant peel extract on cancer cell apoptosis.

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A MECHANICAL RANDOM NUMBER GENERATOR

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1. Introduction

Truly random numbers are a very valuable and rare resource. Design, produce, and test a mechanical device for producing random numbers. Analyse to what extent the randomness produced is safe against tampering. So many ways were in use to generate random numbers until now .There were simple ways like throwing a dice or flipping a coin and some complex ways like lotto machine .Also there are many ways to generate random numbers in computer.

Random numbers are rare, useful and valuable resources and they are used for gambling, statistical sampling, computer simulation, cryptography, completely randomized design, and other areas where producing an unpredictable result is desirable. There are many ways to generate them like mechanical devices as roulette wheels, lotto machine, dice and so on; and the computer methods as defining a function like rand function in quick basic programing language and so on. But how random are they and how can we get sure that no one can cheat?

2. Experiments

To solve this problem two ideas were closer to reality. The first one was to make an icosahedron dice and the second was to prove that a disk gives us numbers randomly. So I have two ways to test the randomness of the numbers; first is the practical way which is to get a large amount of random numbers of the device and calculate the percentage of numbers, and the second is to theoretically prove that they are random. Actually both of them were used to prove that this dice is what the question asked to make.

So I made my icosahedron by magnets and then I put numbers 1 to 20 on its faces. It weights nearly 1kg and its longest diameter is about 8cm and the edges are 4cm. For the first method (to get a large amount of numbers and calculate the percentage of every number), I diced for 640 times.

As we got in the practical way its tolerance of randomness is about 2%. If we use the method of having the highest and the lowest percentage difference as our tolerance, that it should be less than 5%, if we want to assert that it gives us random. The second method is to calculate the average of tolerances of each number. By this way it will become 0.45% and if we want to assert that it's randomly, it should be less than a limit between 1% and 2% (according to how much random do we expect it to be); that the dice lives up to this too.

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FRISBEE VORTICES

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A R T I C L E I N F O

1. Introduction

When you submerge a large circular disk such as dinner plate vertically and partially into the swimming pool until it covers half of it a pair of interesting vortices is created in the surface of the water. They will persist for long time. They keep going next to each other and the perfect black circle is made on the bottom of pool. If you look from above and dust chalk you can see mushroom spiral pattern is exposed.

2. Experiments

A vortex can be described as a fluid structures that rotating around axis line. When you place a large circular disk, such as dinner plate into a swimming pool the water right next to the plate is moved but the farther water is inert so we have different speeds and when the front water is pulled to the back it is intensified. They can continue going along together, because the vortices want to keep their angular momentum so continue rotating as move to the water but lose some energy because of friction (Fig. 1).


Fig. 1: Experiment shows if the vortices reach the wall they are scattered from each other

Figure (2) shows the velocity contour of the fore going vortices simulated by the software Comsol multiphysics 3.5a.

Two vortices go along together when the plate is submerging. Figure 3 shows the condition of vortices after formation and reaching a stable condition. The whole pattern is called "mushroom pattern" which is a rotational a linear motion simultaneously.
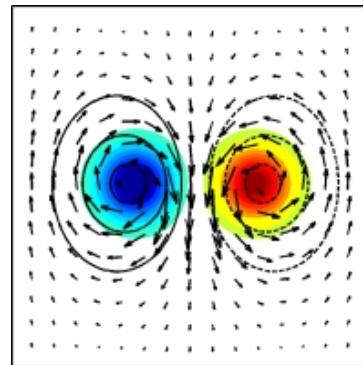
Fig. 2: Velocity contour of vortices
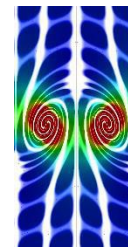
Fig. 3: The mushroom pattern of vortices motion at stable condition

Some Parameters influence on this phenomenon:
Diameter of the plate,
Viscosity of the fluid,
Temperature,
Shape of the plate

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HOT WATER FOUNTAIN PHENOMENON

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1. Introduction

If you half fill the pipette with hot water, the water stays at the bottom and the air at room temperature will be in the upper part. Then you block the top end of the pipette with the tip of your finger and turn the pipette upside down, so the hot water starts flowing down to the blocked side. After that you observe the water flowing out from the tip of the pipette. In this paper we investigate the reason and parameters affecting this phenomenon.

2. Experiments

We did our experiments by a pipette (41.4ml volume) filled with different amounts of water and measured the amount of the water which came out from the pipette and calculated the initial and the final volume of the air in the pipette, then the results were compared with what the Ideal Gas Law predicts. But as shown in fig.1 this phenomenon cannot be justified with the Ideal Gas Law.
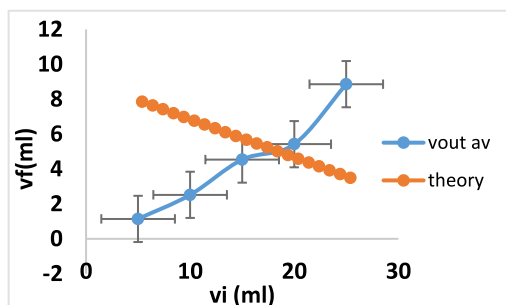

Fig.1: The initial volume of the air versus the final volume

The amount of emerging water from the pipette was investigated by increasing the initial volume of the water and also water temperature in several experiments.

3. Conclusion

Our experiments were compared with a reasonable theory to justify this phenomenon by consideration the effects of the saturated vapour pressure.

WHY TWO WHEELED SUITCASES TURN OVER UNDER CERTAIN CIRCUMSTANCES

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1. Introduction

When two wheels suitcase is pulled along, under certain circumstances it can wobble side to side so strongly to the limit that it may turn over. Can it be suppressed or intensified by changing of the luggage packing?

2. Basic Information

Here, the suitcase has been presumed as a rigid object. So, the following two forces are considered as the most effective forces in the existed torque of suitcase:

1. The hand force
2. The force of suitcase load

Hypothesis 1: The suitcase is in balance condition

Hypothesis 2: The suitcase is not in proper stability

Mass of center, spin factor: Due to that the suitcase contain is not in balance condition by improper packing, thus the mass of center is not positioned on any of three axis *(x, y, z)* as it is asymmetrical.

X Axis: The length of resistant arm is more than mover arm, Therefor, the resistant force is increased and existed torque is around *X* axis. So, the stack of bags falls from the person who takes it.

Z Axis: If the mass of center is shifted to sides due to way of packing, it could leads to rotation of suitcase around *Z* axis and consequently suitcase turns round while it is being pulled.

-Uneven Surfaces

Z Axis: When one wheel is placed on the steep surface and other is stood on the ground vertically, so, suitcase rotate around *Z* axis while it is being pulled on slop, therefore, torque is generated on the one wheel.
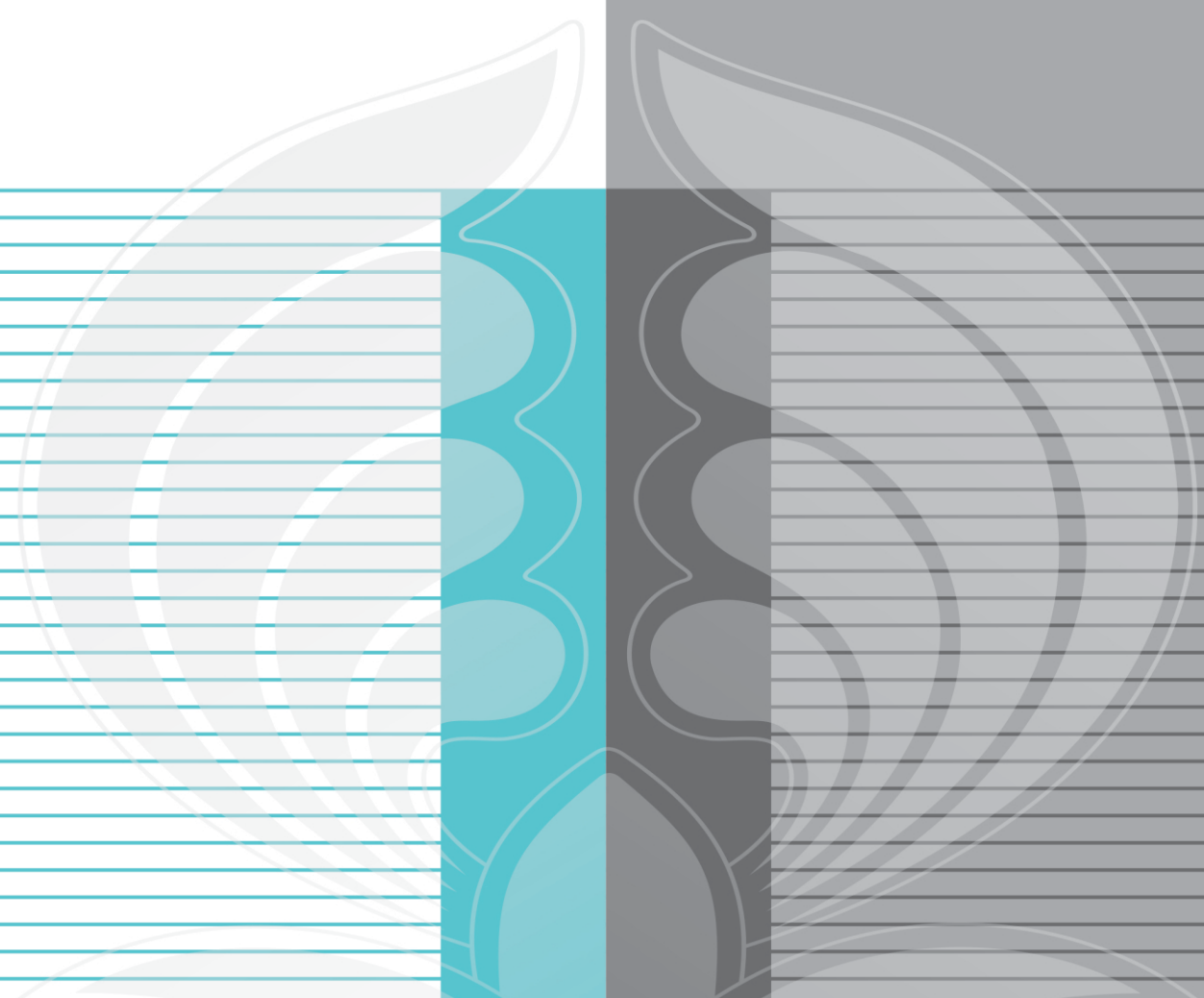
Y Axis: Load force vector inclines to shift the center of rotation axis and therefore is more vertical in proportion to rotation axis by increasing of packing load.

3. Conclusion

We can optimize this phenomenon by changing the package. If the load of suitcase are so packed that the center of mass is placed at the lowest height and the minimum distance from three axes and the same distance from them and stand in the middle of luggage, it can reduce the torque of suitcase. Also, if the objects placed on the sides of suitcase, it will make a balance in baggage that prevents it gets crazy.

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