Unit 1 AOS1 Physics: Coke Can Challenge

Applying principles of Conduction, Convection and Radiation

Scenario: Today is the hottest day of the year – its 42°C. You're thirsty and would love a can of coke, BUT there is no electricity and your fridge and freezer aren't working.

The only chance you have of obtaining your delicious beverage is if you cool it yourself. But no need to worry because you have been learning about Thermodynamics in Physics so you can use your knowledge of conduction, convection radiation to cool the coke can.

You will need to select from a limited range of materials to make a fridge.
There are two awards;
Coke Can Cooler Award - The group who can get the cool can to the lowest temperature will be the winner and will gain one can of coke per group member.
Thermodynamics Genius Award – The group who can embed the most thermochemical principals into their design. Each thermochemical idea is awarded one point.

Materials

You can choose 6 out of these 11 materials:

- ~~150~~ 200 g Ice (150 g)
- ~~5 g~~ 10 g Salt (5 g)
- ~~10 L Bucket~~
- 2 L water
- 30 cm plastic wrap
- small plastic container
- ~~10~~ 20 cm aluminium foil
- ~~1 x zip lock bag~~ 1 container
- ~~20~~ x foam peanuts
- 20 cm foam insulation
- 20 cm bubble wrap

Materials required by each group
- temperature probe
- timer
- can of drink

10 L bucket

Procedure

The challenge is divided into three phases; design, build and test.

Design

You have 20 minutes to design your fridge. During this tim,e you will select your materials and draw a diagram to show your design. You will need to explain where you have used the ideas of conduction, convection and radiation in your design.

Build

You will have 10 minutes to construct your fridge. During this part of the challenge you will use all the materials except the Coke can in the construction of your fridge.

Test

You will have 10 minutes to test your fridge. You will put the can into the fridge along with a temperature probe and monitor the change in temperature.

we have 12

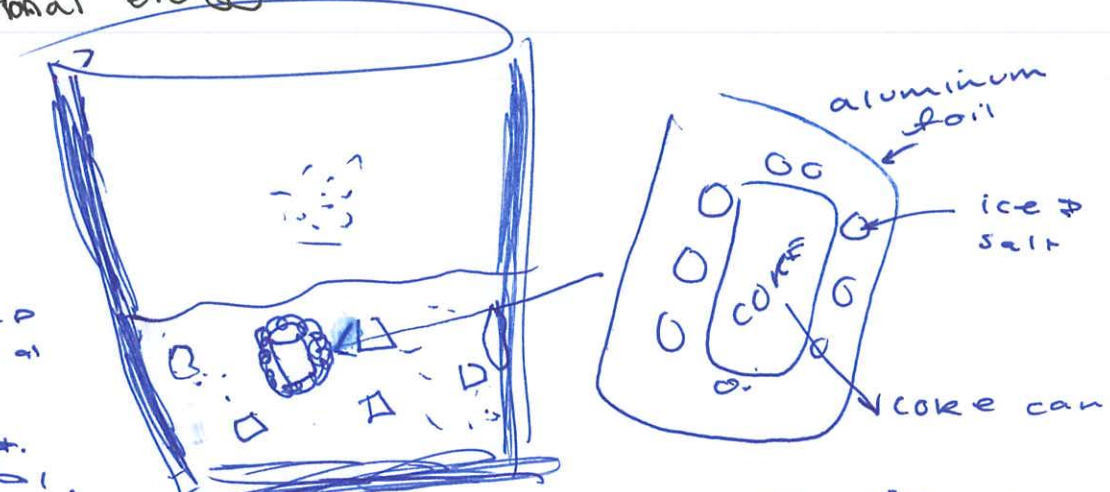
Alana | Max

6

Design

THERMODYNAMICS

1. APPLY WORK
2. BUBBLE RAP IS A GOOD INSULATOR
3. ~~ZIP LOCK BAG MAKES WATER IN LESS SURFACE AREA SO ITS FASTER TO COOL.~~
3. ALUMINUM FOIL REFLECTS LIGHT AND HEAT, KEEPING IT COOL.
4. Aluminum is good at conducting heat keeping things cold because ~~it~~ cuts down on the passage of heat.
5. Convection occurs therefore heat rises however surrounded by coke can at the bottom of bucket cool show moving particles.
6. Surface area increases ~~increasing~~ ~~cold energy~~ rate of convection ~~[illegible]~~ this is increased by crushing the ice
7. crushed ice, inbetween coke and aluminum because there is less surface area
8. Salt added to ice makes you end up with an ice cube above melting point
9. Placing the ~~heat~~ heat element (the can of coke) ~~increase~~ at the bottom of the bucket decreases its overall ~~heat~~ thermal energy. ~~rises~~
10. bubble rap is a good insulator of ~~heat~~ cool keeps air in.
11. water will cool with ice.



12. ice cools.

Flynn & Jacob

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Materials

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- ~~10~~ g Salt (5 g)
- ~~10 L Bucket~~
- 2 L water
- 30 cm plastic wrap
- small plastic container
- 15 cm aluminium foil
- 1 x zip lock bag
- 20 x foam peanuts
- 20 cm foam insulation
- 20 cm bubble wrap

Materials required by each group
- temperature probe
- timer
- can of drink
- Bucket

Procedure

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Design

You have 20 minutes to design your fridge. During this tim,e you will select your materials and draw a diagram to show your design. You will need to explain where you have used the ideas of conduction, convection and radiation in your design.

Build

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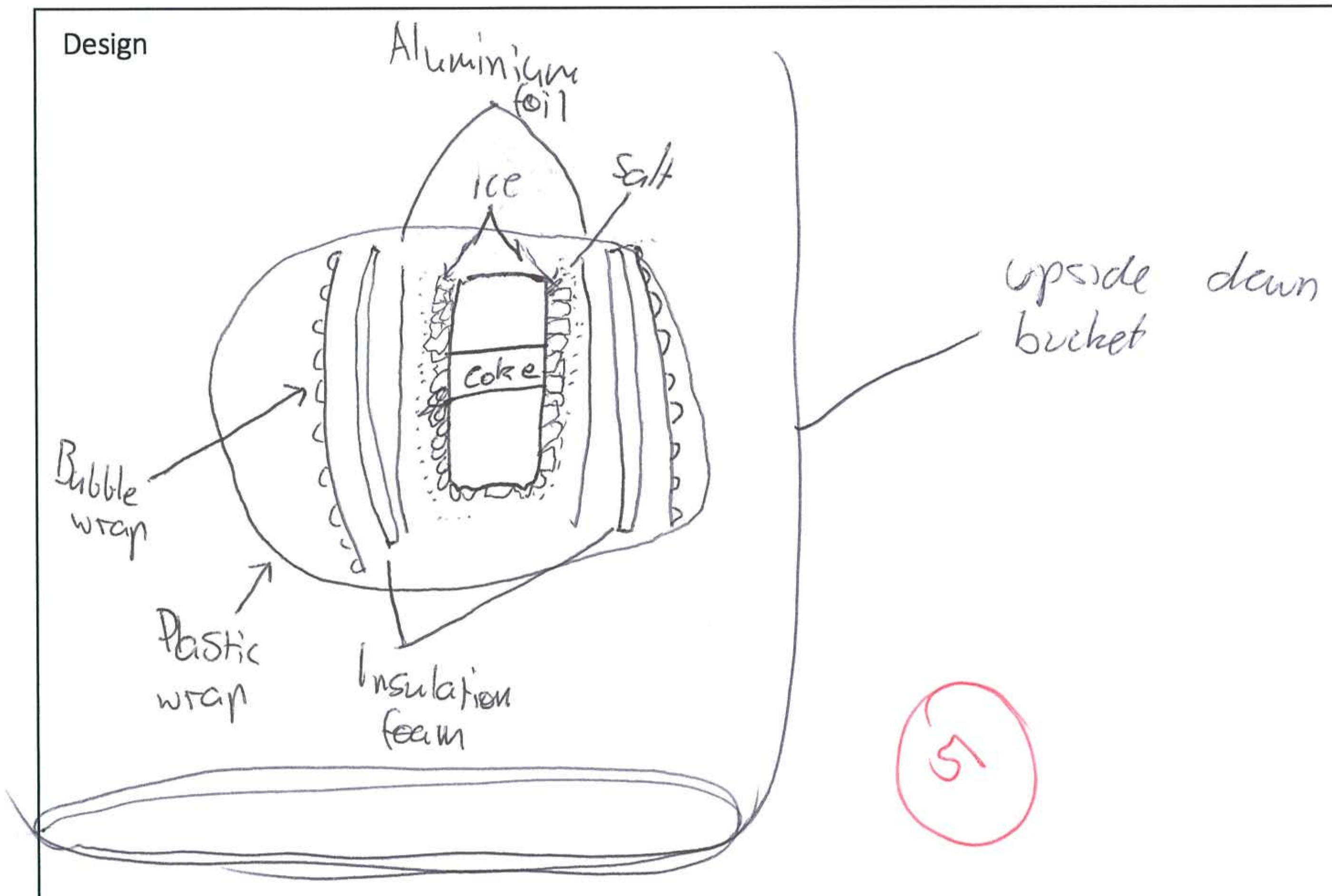
Test

You will have 10 minutes to test your fridge. You will put the can into the fridge along with a temperature probe and monitor the change in temperature.

Design



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- Salt and ice react which reduces the melting point and temperature of ice. This means more heat is taken from the can to the ice because the temperature difference is higher. This is the conduction of heat.
- The aluminium foil wrapped around the ice helps to reflect heat energy from outside the coke can instead of absorbing it. This will minimise the amount of radiated heat reaching the can.
- The bubble wrap stops the conduction of heat energy by trapping it in the air pockets. This reduces the heat that reaches the ~~can~~ foil and can.
- The insulation foam traps the circulating air which is going through the process of convection. This keeps the cooler air closer to the can.

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Materials

You can choose 6 out of these 11 materials:

- 200g ~~150 g~~ Ice ~~(150 g)~~ 200g
- 10g ~~5 g~~ Salt (5 g)
- 10 L Bucket
- 2 L water
- 30 cm plastic wrap
- small plastic container
- 15 cm aluminium foil
- 1 x zip lock bag
- 20 x foam peanuts
- 20 cm foam insulation
- 20 cm bubble wrap

Materials required by each group
- temperature probe
- timer
- can of drink

-10 litre bucket

Procedure

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Test

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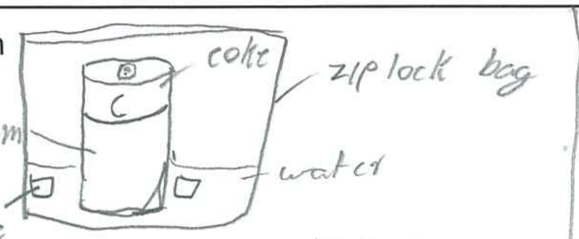
Luke.S, Joseph

Design



We will wrap the coke can in foam to absorb the water to accelerate the cooling rate. this is latent heat of vapourisation.

We are wrapping the design in insulating foam which will also trap the heat and keep what its surrounded in at a cool temperature.

The ice and water and salt will help to cover the surface area of the can which will assist in the time in which it cools as the conductive material is able to take the cold temperature in all aspects.

Ziplock lock is used to have decreases the surrounding gases and traps the cool gases with causing a cool temp to remain.

It uses the zeroth law as the ice is here ice and can if its the same temp it will make them at equilibrium at ice.

Aaron Ram + Xaanula W

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- 1 x zip lock bag
- 20 x foam peanuts
- 20 cm foam insulation
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Materials required by each group
- temperature probe
- timer
- can of drink

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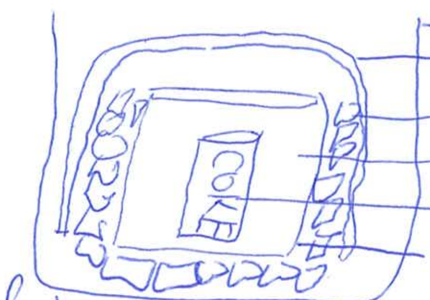
Design

5



5) The aluminium foil will be turned 'reflective-side out' which will reflect away any heat radiation.

Thermodynamic principles:

1) Increasing the surface area of the ice by crushing it, (relative to the volume of the ice when un-crushed), increasing the number of particles involved in the transfer process, hence increasing the rate of conduction (cooling).

2) Newton's Law of cooling states that the rate at which an object cools is proportional to the difference in temperature between the object and the objects surroundings. Therefore, the salt decreasing the freezing point of the water and ice, will be colder, and hence increase the difference of the temperature of the coke can and its surroundings (ice + water).

3) Thicker materials require a greater number of collisions between particles or movement of electrons to transfer energy from one side to another, hence using a foam insulation mat, which is a thick ~~material~~ material, it will require a greater number of collisions caused by the 'hotter' coke can, in order for the foam to cool and achieve thermal equilibrium with its surroundings.

4) The larger a material's thermal conductivity, the more rapidly it will conduct heat energy. Aluminium being highly conductive, thermally, ensures that it will make the coke can cooler, quicker.

Michael M A Nick R

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- temperature probe
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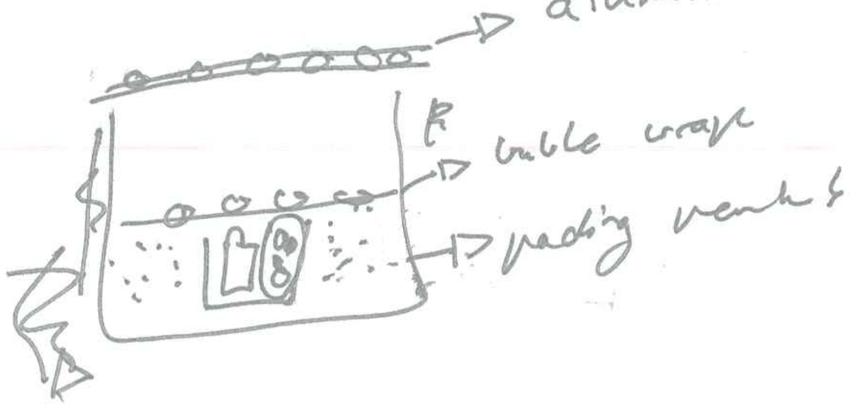
Design

- Can ~~only~~ cover outside & top
- bubble wrap on top. as plastic & air are bad conductors
- coke in ziplock, styrofoam, packing peanuts around - ice in ziplock
- or - ice in ziplock next to coke near packing peanuts
- aluminium on outside
-



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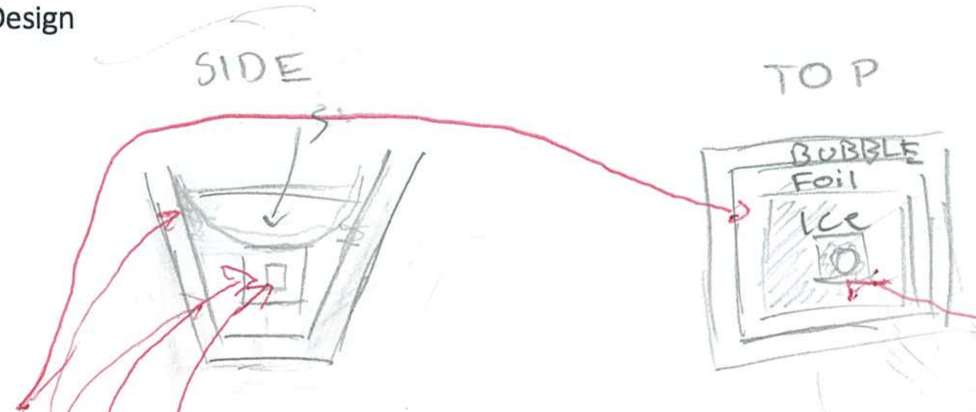
Nick | Kareesh

(6)

Design



→ Keep can at the bottom so the hot air goes to top and bottom is cool - Convection

→ Using Salt decreases the freezing point of ice therefore using up energy from surrounding at a higher rate cooling it.

→ Using a sloped roof will trap hot air away from can due to convection.

→ Using foil and bubble wrap will act as a insulator therefore keeping it coolest.

→ Using foil will reducing the rate of melting as it is a metal.

→ The ice changing states will need energy to change this taking energy from can and surroundings therefore cooling it.