Is air a good insulator?

Plan

In this experiment I am trying to find out if air is a good insulator.

There are three different types of heat transfer Conduction, Convection and Radiation.

Conduction mostly occurs in metals because as metals get hotter the ions in it start to vibrate and they get a lot more kinetic (movement) energy. Then this energy is transferred to the cooler parts of the metal where it has free electrons as they diffuse through the metal, bumping into other ions and electrons. Metals are really good conductors because they allow energy through them quickly on the other hand non-metals are not good conductors because they let energy through them slowly but that makes them a good insulator.

Convection only occurs in liquids and gasses. As a liquid or gas gets hotter and hotter the particles move faster causing it to expand and becomes less dense then other regions. Once the liquid or gas is warm it will rise and be replaced with colder denser regions.

Radiation always emits in infrared and the warmer the object the more heat energy it gives out. It depends on the surface of an object on how much radiation is given in/taken out.

An insulator is something that does not conduct thermal energy easily. I think air is not a good insulator because its particles are going anywhere but if the air were trapped in someway then it would make a good insulator.

Trapped air is important because if the air were not trapped in some way the air would just be roaming around anywhere and would not be

insulating anything. I am now going to tell you what I did on my preliminary experiment.

First I took a metal can and filled it with water from the kettle. Next we put the lid on and took the temperature. When the temperature began to fall we started the clock and recorded the temperature every 30 seconds for 10 minutes. Finally I repeated the whole experiment with a ½ filled can of water.

Here are my results that I got from my preliminary experiment.

Full can		1/2 Full can	
Time	Temperature	Time	Temperature
0	82	0	76
0.5	81	0.5	75
1	80	1	75
1.5	79	1.5	74
2	79	2	74
2.5	78	2.5	73
3	78	3	72
3.5	77	3.5	72
4	77	4	71
4.5	76	4.5	70
5	76	5	70
5.5	76	5.5	69
6	75	6	69
6.5	75	6.5	68
7	74	7	68
7.5	74	7.5	67
8	73	8	67
8.5	73	8.5	66
9	72	9	65
9.5	72	9.5	65
10	71	10	64

Conclusion *(for preliminary experiment)*

According to these results I think that I should wait a little bit longer in between because I think if you measure it for 30 seconds you still may have the same result. I would say I should wait about 45 seconds in between recording my result. It was not a fair test because I may have measured the results wrong and we do not have the appropriate equipment. We could have also read the timer wrong and the lids were not tightly secured.

To help me in the actual experiment I learnt how to set up all of the equipment so I know how to do everything accurately and I know I would not make any mistakes.

I decided to do the ½ full can in my actual experiment because I recognised in the preliminary experiment that I got better more spread out results compared to the full can.

The First experiment I am doing is the small bubble wrap, which will be rapped around the whole can including the bottom. This is so that the bubble wrap can insulate underneath the can as well as the sides. This bubble wrap will be held with an elastic band to make sure that the bubble wrap will not come off the can during the experiment. After everything is set-up, the boiling water will be poured inside the can. As soon as the boiling water is poured in the can, the can will start to get hot straight away. As the can starts to get warm the air inside the little bubbles in the bubble wrap will start to vibrate against the metal can and because metal is a good conductor the vibrating of the small bubble wrap will then vibrate against the particles in the can causing the can to keep warm longer.

The Next experiment is the large bubble wrap this again will be rapped around the can including the bottom and held by an elastic band. When the boiling water is poured in this will start to heat up the can straight away again. These particles in the metal can will start to vibrate. This then causes the air particles in the large bubble wrap to vibrate. Which will then vibrate against the can causing the can to keep hot. I think that the small bubble wrap will be better than the large bubble rap because in the small bubble wrap the air particles have a smaller space to vibrate in. So the particles in the smaller space will vibrate a lot more. And then this will vibrate more against the metal can. Causing the metal can to keep warm. However in large bubble rap there are large spaces so the air particles take longer for the particles to vibrate enough against the metal can to keep it warm.

The third experiment is when a polythene bag is rapped around the metal can with no air around it. So when the metal can is filled with boiling water there will be no air particles to vibrate in the polythene bag.

Finally in this experiment there will be a polythene bag around the metal can and it will be full of air. The air will stay in the polythene bag with an elastic band holding the top. When the boiling water is poured in I can tell that there are more air particles around the metal can in a confined space. So as the metal can gets hot the particles in the metal can will start to vibrate against the air particles in the polythene bag. And eventually causing the air particles to vibrate more will help the tin keep warmer for longer.

Fair Test

I thought I would like all the cans to start at the same temperature but it wont because we do not have the correct equipment to make sure that the water is at the same temperature each time and if there is the exact amount of water. Also the lids of the metal can may not have been totally secure and I may have taken some of the wrong measurements down at certain points.

Prediction

I think that the best insulator would be the small bubble rap, next the big bubbles rap, then the metal can with the bag full of air and finally the experiment where there is no air jus rapped by a polythene bag. I chose this order because this is the order that I think would most likely be correct.

Evaluation

The things that could have made my results inaccurate are that half the measurements that I did may have been wrong. On the lid, the whole where you put the thermometer was a bit big so a little air was being lost through that whole. On some of my experiments the thermometer was taken in and out of the metal can so that may have changed something slightly.

To make this experiment more accurate I would use proper cans because these one's I used where not that good and I would make sure that we use cans which have no chance of letting any air out. I would make sure that the bubble raps and the polythene bags were on securely and tightly. Make sure there is always the right amount of water and that the temperature always starts off at the same time. Finally I would make sure that there would be no outside disturbing of the metal can and make sure the thermometer was accurately red.

On my tables I have circled any unusual results to show where some mistakes may have occurred during this experiment. In my graph I have circled two parts because in these two parts the wrong results has affected it and made the graph look like this.

The prediction I made was correct, the order in which I thought the insulators would work best was the correct order.

Little Bubble Wrap

Time	***Temp 1***	***Temp 2***	***Averages***
0	87	92	90
.5	86	91	89
1	85	90	88
1.5	85	90	88
2	84	89	87
2.5	83	89	86
3	82	88	85
3.5	82	88	85
4	81	87	81
4.5	81	87	81
5	80	86	83
5.5	79	86	83
6	78	85	82
6.5	78	85	82
7	77	84	81
7.5	77	84	81
8	76	83	80
8.5	76	83	80
9	75	82	79
9.5	75	82	79
10	74	81	78
Temp Drop	13	11	12

Big Bubble wrap

Time	***Temp 1***	***Temp 2***	***Averages***
0	86	90	88
.5	85	89	87
1	84	88	86
1.5	84	86	85
2	83	85	84
2.5	83	85	84
3	82	84	83
3.5	82	84	83
4	81	84	83
4.5	81	83	83
5	80	83	82
5.5	79	83	81
6	78	82	80
6.5	78	82	80
7	77	81	79
7.5	77	81	79
8	76	80	79
8.5	76	80	79
9	76	79	79
9.5	75	79	77
10	75	78	77
Temp Drop	11	12	11

Bag with no air

Time	***Temp 1***	***Temp 2***	***Averages***
0	84	84	84
.5	82	83	83
1	81	82	82
1.5	80	81	81
2	79	81	80
2.5	79	80	80
3	79	80	80
3.5	78	80	79
4	78	79	79
4.5	77	79	78
5	77	78	78
5.5	76	78	77
6	76	78	77
6.5	76	78	77
7	75	77	76
7.5	75	77	76
8	74	76	75
8.5	74	76	75
9	74	76	75
9.5	73	75	74
10	73	75	74
Temp Drop	11	9	10

Bag with air

Time	***Temp 1***	***Temp 2***	***Averages***
0	86	86	86
.5	85	85	85
1	84	84	84
1.5	83	83	83
2	83	83	83
822.5	82	82	82
382	82	82	82
3.5	81	82	82
4	81	81	81
4.5	80	81	81
5	80	80	80
5.5	80	80	80
6	79	80	80
6.5	79	79	79
7	78	79	79
7.5	77	79	78
8	77	78	78
8.5	77	78	78
9	76	78	77
9.5	75	77	76
10	75	77	76
Temp Drop	11	9	10