How does temperature affect the viscosity of oils?

Prediction

I predict that as the temperature of the oil increases the viscosity will increase. This means that the ball bearing will drop down quicker as the oil is heated. I think this because when the oil is heated the molecules will vibrate because they are given energy by the heat. This causes the molecules to move apart leaving gaps in between which the ball bearing will be able to move through easily.

Method

Take a glass tube and hold it in a clamp stand. Mark up to where you want to put the oil. Fill up to the mark with C_6 oil at room temperature. Then drop a ball bearing from the rim of the glass tube. Make sure you start the watch at the exact same time as you drop the ball bearing. Stop the watch as soon as the ball bearing touches the bottom of the tube and put the time of this in the results table. Do this three times and take the average. Repeat these steps for C_8, C_{10}, C_{12} and C_{16} oils at room temperature. Put the jars of oil into a beaker of water and use a Bunsen burner to heat it. Try and prevent the water going over the top of the jars of oil, as the water may go into the oils and this would affect the results. When the oil is heated to the required temperature repeat what you did for the oils at room temperature. The oils should be heated to 30ºC then 40ºC, then 50ºC, then 60ºC, and finally 70ºC.

Apparatus

Clamp, Clamp stand, Glass tube, Ball bearing, Bunsen burner, Tripod, Gauze, Water, 250ml beaker, Stopwatch, Thermometer, C_6, C_8, C_{10}, C_{12}, and C_{16} oils.

Diagram

Preliminary Diagram

Preliminary Work

My preliminary work helped me significantly to write my plan. Through trying to carry out some practice tests, I found that it was hard and not particularly accurate if I just picked up the ball bearing and dropped it from a little bit above the tube because then my results will be inaccurate. This is why I decided to drop the ball bearing from the rim of the glass tube. This meant it would always be the same force being put on the ball bearing. My preliminary work has also helped me to determine what the angle the tube should be at. The reason I chose to have the tube at 35º to the tabletop was that at 90º the ball bearing fell much too fast making it difficult to measure the time. However at 0º to the table the ball bearing didn't move at all, that's why I chose a position between the two. This meant it would move down fairly quickly but not too fast as that we couldn't time it.

Here are some of our results

	Tube angled at 90º	Tube angled at 0º	Tube angled at 35º
1st time recorded	0.35 sec's	N/A*	1.96 sec's
2nd time recorded	0.39 sec's	N/A*	1.92 sec's

Variable Factors

One of many variable factors would be the gradient of the tube. This must be kept at the same angle - 35º. An easy way to do this is to leave the clamp alone and only open and

close the claw part of the clamp. Another factor is the temperature of the oils. To do this you must measure the oils temperature and make sure that you measure the oil, not just the water they are being heated in. The height of which the ball bearing is dropped should be kept the same so that it doesn't gather more momentum before it hits the oil. That is why it must be dropped from the same height; I chose the rim because then I know it will always be the same. The ball bearing you use must be the same because then the resistance of the ball bearing will be the same.

Accurate Results

To ensure that I get accurate results I will try and keep the entire variable factors the same all the way through the experiment. If I do this then it will not only make sure that my results will be accurate but it will make sure that the only thing I will be experimenting is the viscosity of the oils and how temperature affects it. I will not be testing anything else.

Range of Results

I want to take 5 times from each of the oils at each temperature. If I do this then I will be able to take an average score. This is a good thing because it means that if I mess up one of the drops then it won't matter as much because I will take an average of the 5 times.

I will set out my table like this:

E.g. Oil C6

Oil	Room temperature	35º	50ºC	65ºC	80ºC
C6					
1st Time					
2nd Time					
3rd Time					
4th Time					
Average					

Results

Oil	Room temperature	35º	50ºC	65ºC	80ºC
C_6					
1st Time	1.15	1.18	1.03	0.72	0.75
2nd Time	1.15	1.06	0.93	0.81	0.83
3rd Time	1.25	1.08	1.09	1.01	0.9
4th Time	1.18	1.19	0.96	0.97	0.81
5th Time	1.25	1.14	0.87	0.97	0.82
Average	**1.196**	**1.13**	**0.976**	**0.896**	**0.822**
C_8					
1st Time	1.59	1.39	1.1	0.99	0.8
2nd Time	1.71	1.31	1.21	1.08	0.93
3rd Time	1.61	1.49	1.1	1.1	0.94
4th Time	1.81	1.51	1.12	1.23	0.98
5th Time	1.54	1.56	1.15	1.09	0.89
Average	**1.652**	**1.452**	**1.136**	**1.098**	**0.908**
C_{10}					
1st Time	2.14	1.86	1.44	1.61	1.04
2nd Time	2.17	1.88	1.55	1.14	0.97
3rd Time	2.13	1.84	1.5	1.16	1.01
4th Time	1.19	2.01	1.49	1.12	1.01
5th Time	2.32	1.99	1.54	1.15	0.98
Average	**1.99**	**1.916**	**1.504**	**1.236**	**1.002**
C_{12}					
1st Time	2.7	1.92	1.57	1.16	1
2nd Time	2.67	2.18	1.66	1.25	1.05
3rd Time	2.67	2.01	1.63	1.15	0.97
4th Time	2.81	1.96	1.64	1.15	1.02
5th Time	2.69	1.95	1.62	1.29	1.1
Average	**2.708**	**2.004**	**1.624**	**1.2**	**1.028**
C_{16}					
1st Time	4.81	3.36	2.77	2.49	1.81
2nd Time	4.71	3.36	2.79	2.22	1.56
3rd Time	4.92	3.56	2.68	2.43	1.64
4th Time	4.75	3.52	3.14	2.31	1.57
5th Time	4.9	3.61	3.08	2.42	1.74
Average	**4.818**	**3.482**	**2.892**	**2.374**	**1.664**

Analysis

From my table and graph I can see that