Aim

To find the effect of temperature of water on the rate of diffusion of the KmNO4 crystals.

Hypothesis

The KmNO4 crystals will diffuse faster as the temperature of the water gets warmer, because the water particles in hot water are moving more rapidly than in cold water, so the KmNO4 crystals spread quicker.

Variables

Independent Variable (what I change)

- Temperature of water (4 different temperatures, over 2 trials)

0-1°
17°
39 °
82 °

Dependent Variable (what I am measuring)

- distance travelled by KmNO4 crystals in the water over time

Fixed Variables

- bumping (none)
- size of particle (we look to find which KmNO4 crystals looked the same in shape, because the scales were too big to weigh the KmNO4 crystals as they didn't weigh enough)
- slope (make sure that the petri dish is on a flat surface)
- changed temperature over time (must be kept the same so you don't record the wrong temperature)
- surface area of KmNO4 crystals (we had to assume that they were just the same weight as we couldn't measure them, because it wasn't big enough to weigh or measure)
- amount of water (keep it 20mL for every trial in the petri dish)
- same container (petri dishes)
- depth of water (same petri dish in size)
- distance travelled (2 cm from the dot we drew in the little circle)

Apparatus

- KmNO4 crystals (1 crystal per different temperature)
- Petri dish (9cm in diameter)
- Water (10mLs of water for each temperature)
- Straw (to drop the KmNO4 crystals to the centre of the Petri dish)
- Ruler
- Pen
- Paper (to draw on 2cm radius circle and Petri dish size)
- Stop watch
- Tweezers
- Measuring cylinder (10mL)
- Beaker (250mL)
- Thermometer

Method

1. Draw out on a piece of paper a circle with 9cm diameter and a circle with 2cm diameter in the centre of the previous circle, and mark middle point. (refer to the diagram that I have drawn please)
2. Place Petri dish over the circle.
3. Create different temperatures of water by mixing tap water with boiling water and measure the temperatures produced.
4. Place water in Petri dish.
5. Vertically hold the straw so it is at the centre point of the 2 circles.
6. Select a KmNO4 crystal and place it in the mouth of the straw, take the straw away, and start the stop watch at the same time.
7. Observe the diffusion of KmNO4 crystals in water and when the diffusion reaches any point of the 2cm radius, record time.
8. Repeat experiment twice.

Trial 1

The effect of temperature of water on the rate of diffusion of the KmNO4 crystals

Temperature of water (C°)	Time taken for KmNO4 crystals to travel 2cm (minutes)
0-1	7.16
17	4.38
39	2.24
82	1.03

Trial 2

The effect of temperature of water on the rate of diffusion of the KmNO4 crystals

Temperature of water (C°)	Time taken for KmNO4 crystals to travel 2cm (minutes)
0-1	7.26
17	4.42
39	2.34
82	1.19

Data Processing

- Average of the time taken for KmNO4 crystals to travel 2cm (trial 1)

7.16+4.38+2+24+1.03= 14.81
14.81/4= 3.70 (2dp) which equals to 4 minutes 10 seconds

- Average of the time taken for KmNO4 crystals to travel 2cm (trial 2)

7.26+4.42+2.34+1.19= 15.21
15.21/4= 3.80 (2dp) which equals to 4 minutes 20 seconds

Conclusion

I stated in my hypothesis that the KmNO4 crystals would diffuse faster as the water gets warmer, and my hypothesis was correct as temperature is a measure of molecular motion, heat produces more kinetic energy in KmNO4 crystal particles which results in faster diffusion.

The two trials were very consistent even though we changed our method slightly for both of them. The slight variation of the data collected maybe a result of this.
Thus if the temperature of a substance is high, this means the molecules have lots of kinetic energy that can be converted to heat energy. Atomic vibrations created by temperature assist diffusion.

You can see in the graph that at 0-1°, it took 7 minutes 16 seconds to reach the 2cm radius circle, and same with the second trial, with a slight difference of 10seconds, which indicates that it takes a lot longer for the KmNO4 crystals to diffuse in cold temperatures, but as the water got warmer with each trial, we came to realize that the diffusion rate was increasing. When the temperature of the water was 17°, the time it took for the KmNO4 crystals to diffuse decreased dramatically to 4 minutes 38 seconds, and in second trial it took 4 minutes 42 seconds.

The rate of diffusion increased even greater once the temperature of the water was 39°. This time it only took 2 minutes 24 seconds in the first trial, and by now, you can see in the graph, that the times for each trial is decreasing as the temperature of the water is increasing.

Also the averages calculated showed the approximate time needed for KmNO4 crystals to diffuse. The first trial showed that the average was 4 minutes 10 seconds whereas the average time needed for the second trial was 4 minutes 20 seconds, very close in values. The averages help to determine the value of the other temperatures and their timings.

Evaluation

Our experiment supported the hypothesis however; there may have been ways which we could have improved on our experiment such as:

Bumping the table on which the Petri dish was on would have caused agitation and therefore may have caused the crystal to diffuse faster. Next time we can improve this time by using benches instead of tables because the benches are more stable than the tables we have in the classroom.

It was difficult to decide weather we should record time when the crystal had diffused completely passed the 2cm radius circle or if we should just collect the data of the first spec that passed the 2cm radius circle. We decided to record our data when the first spec had passed the 2cm radius circle, and we found it to be more accurate.

We dropped the KmNO4 chemical in to the Petri dish, on the dot, after the stop watch has been on, which slightly changed the time of diffusion for the crystals. We can improve on this by just making sure that the stop watch was on at the time when the KmNO4 crystal was dropped, and not beforehand.

We also changed our experiment slightly for the second trial. For the first trial we used tweezers to place crystals in the centre but it did not work efficiently as the crystal was dropped slightly away from the centre. We improved our experiment by doing a second trial and using a straw to drop the crystal in the centre of the 2cm radius circle.

Next time we can use different temperatures (extremes) to see if the experiment still carried on with the same trend. Next time we can use boiling water and ice water to find out whether our findings will determine the same data we collected, or maybe extreme temperatures will affect the rate of diffusion and the time it takes to reach the 2cm diameter circle.

Class results could have been used to increase the validity of the data collection. Several teammates read the temperature from the thermometer. Each teammate could read the thermometer differently. The thermometer should always be viewed from a perpendicular angle. Only one student should read the thermometer, or several students should read the thermometer and reach consensus on the temperature reading.