



Highly Commended

Science Investigation

Year 5 - 6

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Background

I like erasable pens and I wondered if they were all as good as each other or if some were better.

I noticed that they could be erased by friction or by heat. This is because it when you rub it with the end of the pen, it “generates heat through friction. As you rub the eraser over the writing, it generates heat, reaching a temperature range above 60°C. The temperature regulator [inside the ink] is activated by this heat, which then breaks the bond between the colour former and the colour developer. This reaction causes the ink to become clear—effectively erasing your writing.” <https://pilotpen.com.au/blog/how-do-erasable-pens-work>

I predict that more expensive erasable pens are better at being erased.

I don't think the different colours of ink will change anything.

Aim

The purpose of this experiment is to test which erasable pens are better at being erased.

Planning and conducting

I am going to write lines on paper using different pens.

I will then put them in front of the heater for a set amount of time and then see how well each one vanishes.

I am going to use the heater instead of friction because the heater gets up to a certain temperature and stays at that temperature, which means that all the pen lines will get the exact same amount of heat, whereas if I used the pen eraser it would be too hard to push down the exact same amount of friction every time. Different erasers also might be made of different plastics so that may mean when I rub it on paper it might create different amounts of friction.

Variables

- How hard I push down onto the paper when drawing a line
- Whether the ink is slightly dried out and doesn't come out properly
- Pen brands
- Pen colour
- Paper
- The distance of the paper from heater

Controlling the variables

I will try to control how hard I am pushing with the pen to make it the same for each one.

At the start I will use up some ink from each of the pens until the ink comes out smoothly.
I will use a different sheet of paper for each time I repeat the experiment but the paper will be from the same pack.

I will do 2 trials (5 cm, 10cm) with the paper and heater at different distances.

I will keep the time the same for all tests.

I was not able to get the exact same colour pen for each brand.

Independent variable

I will deliberately change the pen brands. This is my independent variable.

Dependent variable

I will measure how faded the pen lines are based on my opinion.

Methods

Pens:

- J.Burrows 0.7mm ball point
- Pilot frixion 0.7mm ball point
- Scholar 0.7mm ball point
- Dinosaur - Legami. 0.5mm ball point

I researched the price of pens using the officeworks website for J.Burrows, Dinosaur Legami and Pilot Frixion.

J.Burrows \$2.00 each

Dinosaur Legami \$4.75

Scholar \$3.00

Pilot Frixion \$4.00

I drew 4 lines on a piece of paper using a different pen for each line.

I got a box and a blow heater. I placed the box in front of the heater on top of a flat ruler so it was 10 cm away from the heater.

I put the paper on against the box facing the heater so that hot air would blow on it.

I turned on the heater. Hot air blew on the paper for 1 minute.

Then I switched the paper with the next piece and reset the timer.

I did 2 repeats with 10 cm and then 3 repeats at 5 cm.

Il looked at the paper and gave the one with the most faded line the highest score, and the one with the least faded the lowest. 4 = most faded, 1 = least faded. When they were all the same, I gave them all a 4.

Note: The temperature of the heater was 40 degrees at approximately 20 cm away. I was not able to get the exact temperature at 10 cm because when I tried the thermometer got to more than 50 degrees and was too hot and blew up. I couldn't find a thermometer that went above 50 degrees.

Results

The results from the 5 cm tests.

In Figure 1A, every single erasable pen has been erased the same amount, fully.

In Figure 1B, Dinosaur has been erased the most, Pilot frixion has been erased the second-most, Scholar has been erased the third-most, and J.Burrows has been erased the least.

In Figure 1C, they have all been erased an equal amount, just like in Figure 1A.

The results from the 10 cm tests.

In Figure 1D, Dinosaur has been erased the most, next is Pilot frixion, third is J.Burrows, fourth is Scholar.

In Figure 1E, Dinosaur has been erased the most, pilot frixion is erased the second most, scholar has been erased the third-most, J.Burrows is fourth.

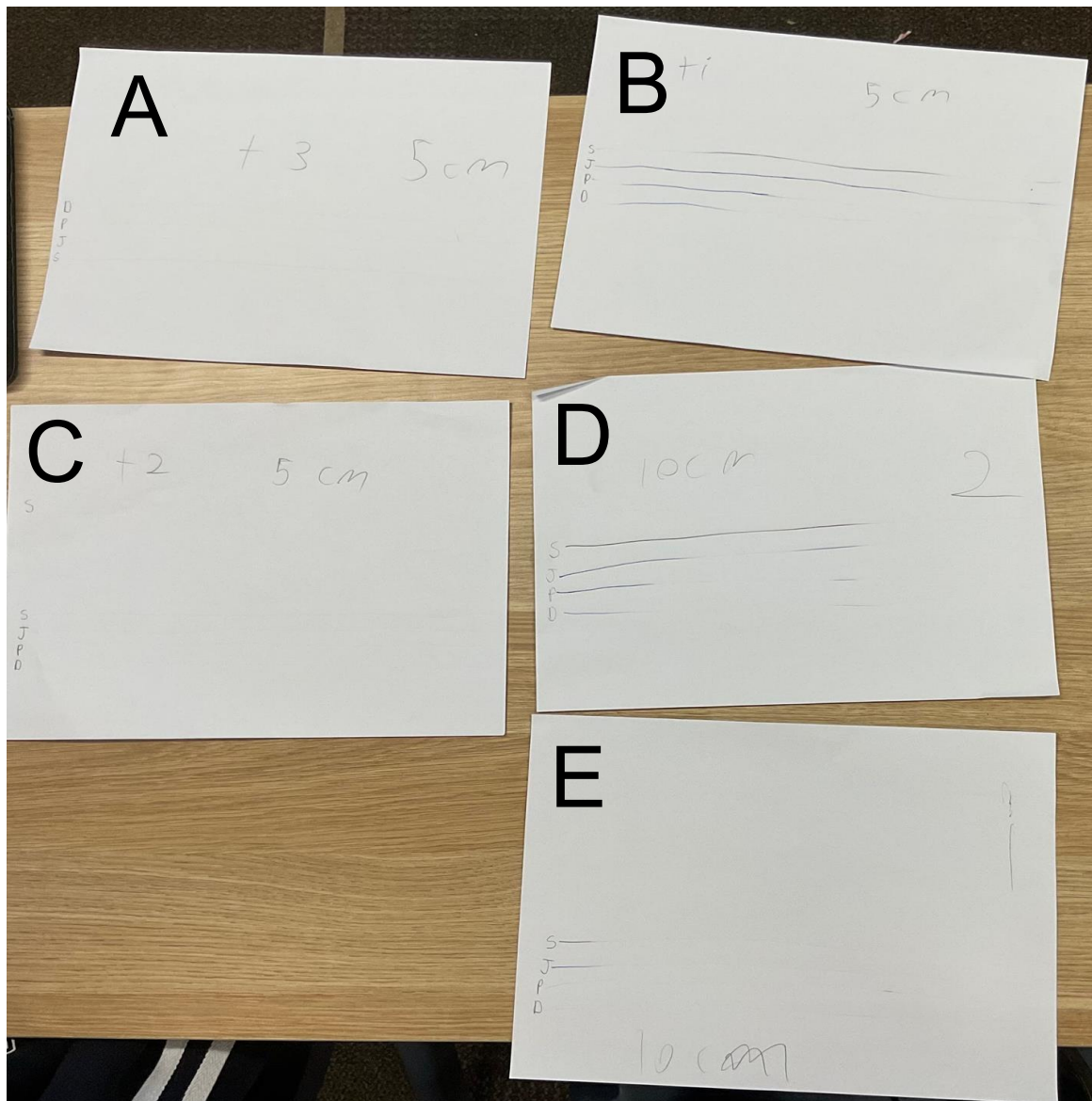


Figure 1. The paper from the experiment. A. Test #3 at 5 cm; B. Test #1 at 5 cm; C. Test #2 at 5 cm; D. Test #2 at 10 cm; E. Test #1 at 10 cm. Pen brands: S= Scholar P= Pilot frixion J= J.Burrows D= Dinosaur Legami.

Table of results

These results have been transferred into this table. 4 = most faded, 1=least faded.

Distance from heater	Test Number	J.Burrows	Pilot frixion	Scholar	Dinosaur
5 cm	1	1	3	2	4
5 cm	2	4	4	4	4
5 cm	3	4	4	4	4
10 cm	1	1	3	2	4
10 cm	2	2	3	1	4
Average		2.4	3.4	2.6	4

The table of results was turned into graphs shown in Figure 2.

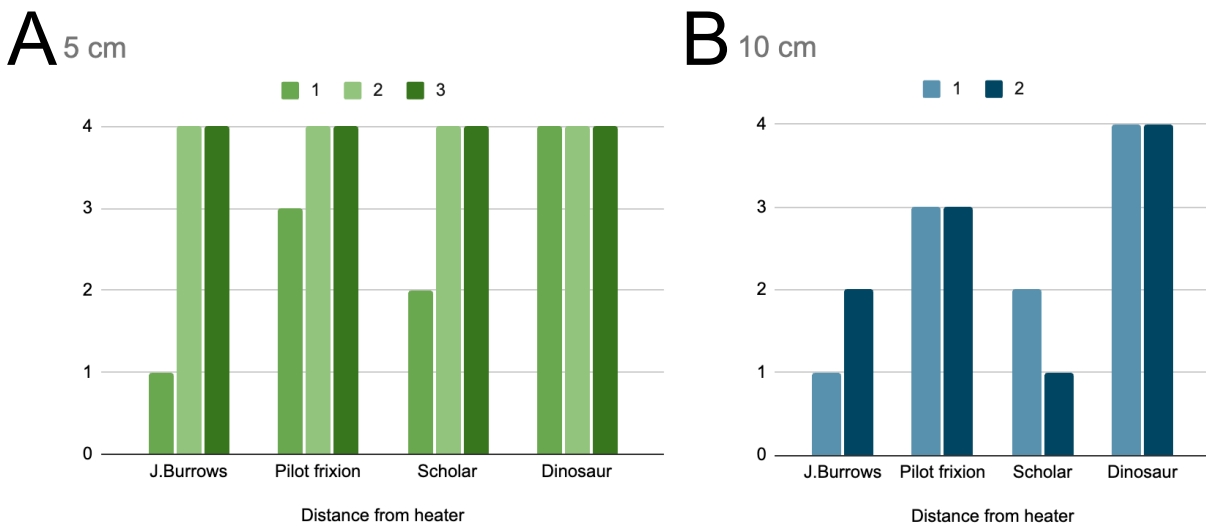


Figure 2. A. The 5 cm test results. B. The 10 cm test results.

Pen Erasableness vs Price

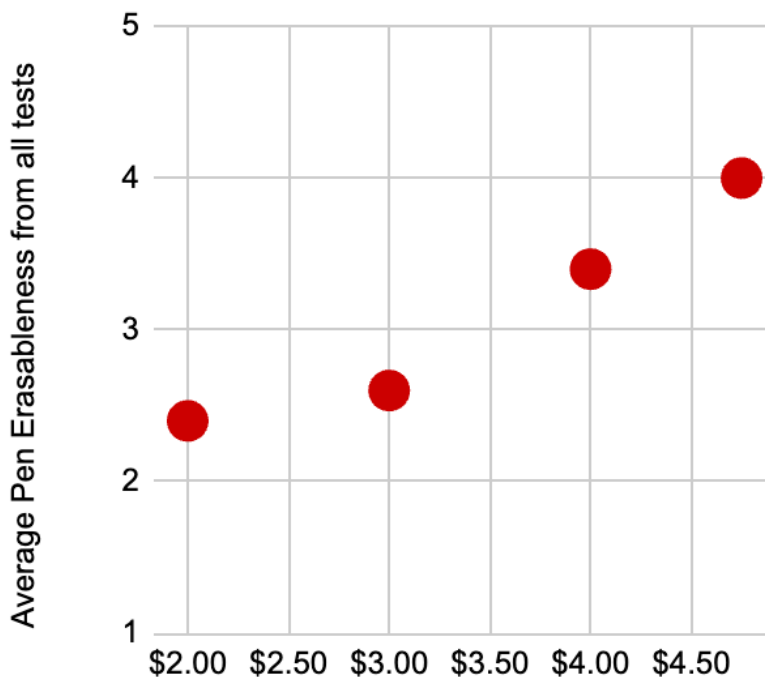


Figure 3. Average Pen Erasableness from all tests vs Price.

In Figure you can see that the price, ranging from \$2.00 to \$4.75, and the average pen erasableness across all the tests. The price of the erasable pen seems to go together with the quality, meaning the more expensive erasable pens erased better than the cheaper pens.

Discussion

The result from the 5 cm and 10 cm results mostly agreed.

Dinosaur was always the best because it was erased the most in every experiment. Second was always Pilot Frixion.

Sometimes Scholar was third in both Figure 2B and 2A, sometimes J.Burrows was third, like in Figure 2B.

The results of my repeat experiments were not always the same, in the 5 cm test #2 and 5 cm test #3, the pens were all completely erased, but in test #1 they were not. The experiments where they were all completely erased were not useful because the fact they all erased doesn't tell me about how well they compare to each other.

The Scholar pen was the only pen in a different colour. The results of the scholar pen didn't look particularly different from the others. This makes me think that pen colour doesn't seem to make a difference to the results. If I wanted to know if that was true, I could do the entire experiment again with more pens in different colours for all the brands.

Conclusions

The more expensive an erasable pen is, the better it is likely to be.

Note:

We had to guess the price of the pen from Mrs Finney (Scholar) as we couldn't find it online.
Can we please get an estimate of this or help identify the brand online?

Acknowledgements:

This is all my own work. My mum helped me edit my writing and showed me how to use the spreadsheet program.

Log book

31/3

Our job was to figure out what experiment we were going to be doing for the rest of term. I've chose to do an experiment to test which erasable pens are best.

I considered what to test. I could test how smudgy they were or how well they erase.

In the end I decided to test the erasableness because the others were too hard to test.

I decide the independent variable would be different pen brands. The dependent variable would be how well they erased.

My question: Does the price of an erasable pen determine the erasableness?

I predict: That more expensive pen brands would better at erasing.

29/4

During this week, I gathered 3 different types of erasable pens and I drew small circles on paper. I tried to erase some of them using each different type of eraser and pen.

The 3 pens were

- J.Burrows 0.7mm ball point
- Scholar 0.7mm ball point
- Dinosaur - Legami. 0.5mm ball point

I tried push down as hard as I could with the eraser on the end of each pen and go back and forth 10 times over a dot and see which one erased the quickest.

I was thinking that this experiment is not very good because the variables are too hard to control.

I was thinking when I was doing it that it is too hard to push down the same amount every time and that I am using different erasers every time, and the temperature in the room might change too. If I did this over multiple weeks, the temperature in the room might change.

I already knew that erasable types of pens erase when you add friction, and I knew that friction creates heat and that was how it works. On a TV show called "Inbestigators" I learned that when you put erasable pen paper in the freezer, the writing comes back and that heat with no friction erased erasable ink because they put it on a photocopier and that creates heat and made the writing disappear.

This made me think I could do an experiment using heat to test erasable pens.

I thought I could put a piece of paper in an oven to test it.

5/5

I got 1 more pen to use this week.

- Pilot frixion 0.7mm ball point

I thought about using the oven method but I thought the paper might catch on fire and that it might be a safety hazard which would be bad.

On Monday when we had a rain bell, we had a heater because the classroom air conditioner was broken. I realised that instead of using an oven, that the heater could be way more safe and reliable for testing how well each line erases.

Today, I did a test run.

I decided to draw lines on a piece of paper using the 4 pens and put them in front of my teacher's heater. I did this so I could get an even amount of heat over each line.

I did a test run to see if any lines would become more transparent when I put the paper in front of the heater. After around 30-40 seconds, most of the lines started erasing.

When I saw this I realised that using a heater seems to be an appropriate method for this experiment.

I am not sure how far the paper was away from the heater for this test, probably around 5-10 cm.

12/5

I wanted to get thermometers so I could determine the exact temperature of the heater so that I could find out how hot the paper was when the lines were starting to erase.

I asked teachers whether they had thermometers. In the end, one of the teachers recommended that I got to the library. I finally went to the library and got two thermometers, just to be safe.

These thermometers were red alcohol thermometers with a maximum temperature of 50 degrees and a minimum temperature of -20.C.

19/5

On Monday there was another rain bell. I decided to work on my science project.

I got out both of the thermometers and taped one to the heater but it got too hot and broke. I realised that the thermometer temperatures must have exceeded 50 degrees celsius so I decided that next time I would hold it slightly away from the heater.

Today I needed to figure out the distance from the heater that the paper needs to be in order to erase without taking too much time. I also needed to figure out how much time was needed.

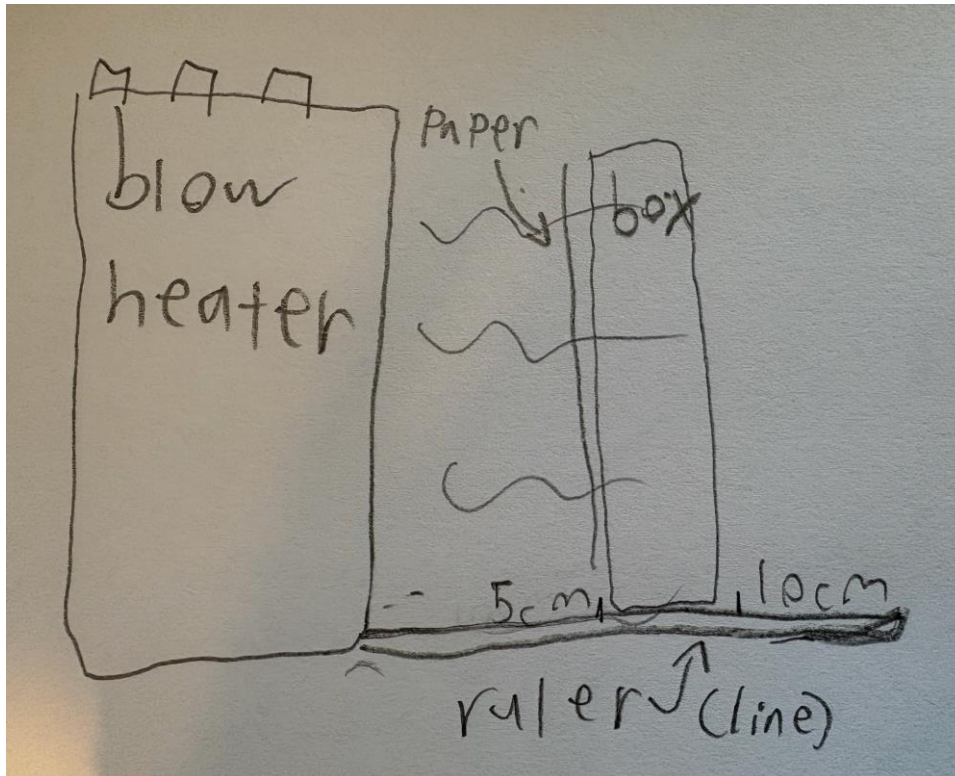
I did an experiment to determine this. This time I controlled and measured more of the variables.

I controlled the distance of the paper from the heater by using a box to keep it in the same spot.

I controlled the time. I chose to test leaving the paper there for different amounts of time, starting with 5 minutes.

To do the test, I got 3 different bits of paper from the printer and drew lines on them.

I got a box to put the paper against and a ruler and got the heater.



This is a picture showing how I set up the experiment.

The paper was placed against the box and the box was put at 5, 10, 20 and 30 cm from the heater. I did them for 5, 3, 2 or 1 minute.

The results showed for all the times more than 1 minute, all the lines vanished. This meant that I had no way of telling which one was best because they were all erased the same amount.

Only 1 minute time showed some lines disappearing but not all.

The 20 and 30 cm distances took too long. Even after 5 minutes, basically nothing had happened.

Based on these experiments, I chose 5 and 10 cm as the distances and 1 minute as the time for my final experiment.

26/5

This time I measured the temperature using the thermometer. I held the second thermometer 20 cm away from the heater for about 1 minute. The temperature was around 40 degrees. I couldn't find a thermometer that went above 50 degrees so I did not test the temperature at 5 or 10 cm as I thought it might get too hot.

I drew 4 lines on a piece of paper using a different pen for each line.

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I put the paper on against the box facing the heater so that hot air would blow on it.

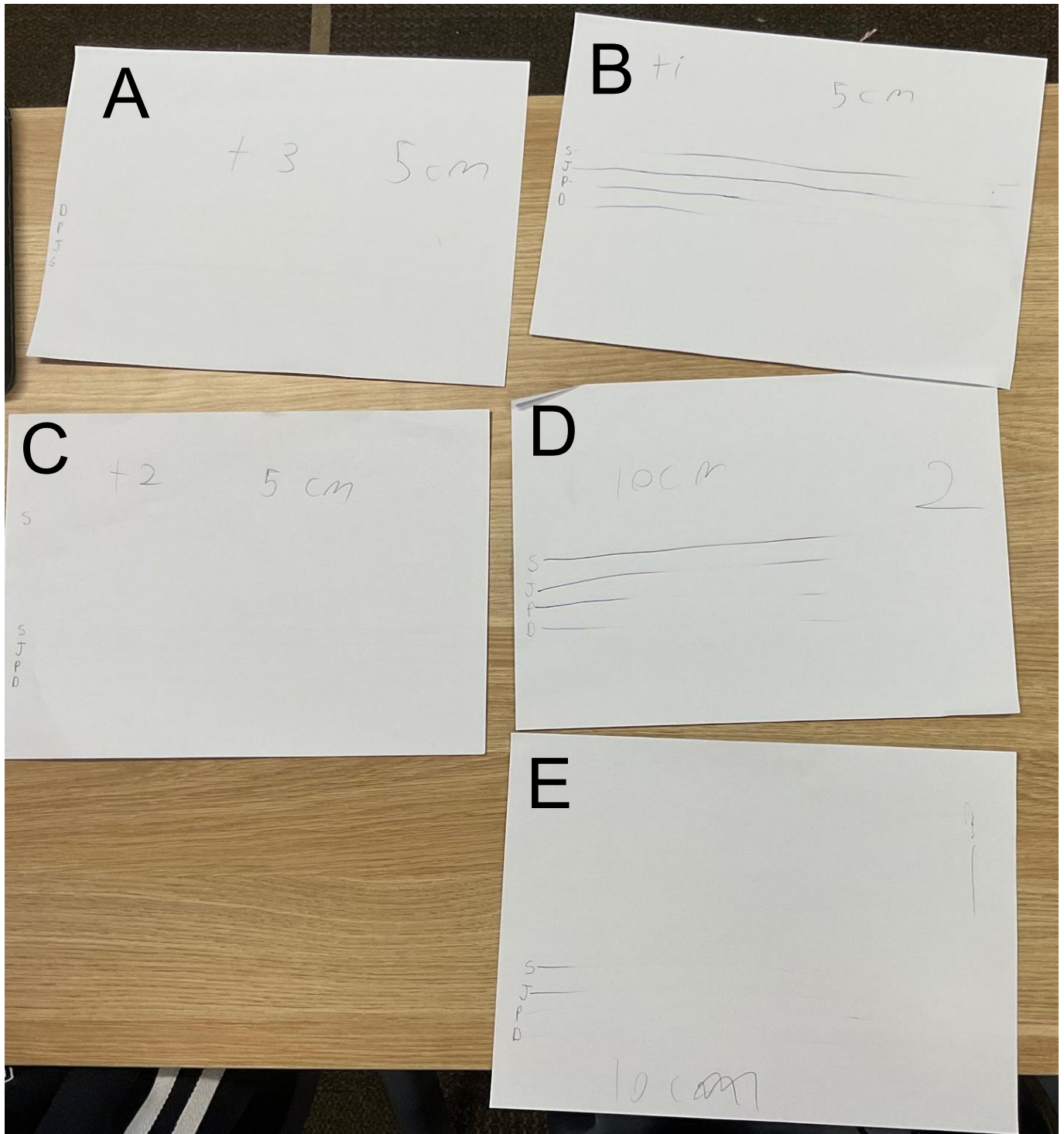
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As part of doing this experiment, I did some research into why the ink erases. The Pilot pen website had some information on how it works

When you rub it with the end of the pen, it “generates heat through friction. As you rub the eraser over the writing, it generates heat, reaching a temperature range above 60°C. The temperature regulator [inside the ink] is activated by this heat, which then breaks the bond between the colour former and the colour developer. This reaction causes the ink to become clear—effectively erasing your writing.”

<https://pilotpen.com.au/blog/how-do-erasable-pens-work>

OSA RISK ASSESSMENT FORM

for all entries in ☒ Models & Inventions and ☒ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Edwin ID: 0694-006

SCHOOL: seps

Activity: Give a brief outline of what you are planning to do.

test erasable pens erasableness using a fan heater.

Are there possible risks? Consider the following:

- Chemical risks: Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks: Are you heating things? Could you be burnt?
- Biological risks: Are you working with micro-organisms such as mould and bacteria?
- Sharps risks: Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks: Are you using mains (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
the heater blew up my 50c. thermometer It's an electrical heater that needs 230-240V to power	I used an alcohol based thermometer instead of mercury I held the paper a safe distance from the heater I held the thermometer a safe distance from the heater

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Edwin

SIGNATURE(S): _____

☒ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Sarah Funnery

SIGNATURE: Funnery DATE: 12/6/26