

Friday worksheet 3 – Experimental technique

1) A student investigated the impact temperature has on the rate of a reaction. The student used the setup shown on the right. A Panadol tablet was placed in a flask with a certain amount of water and the volume of gas released captured in a syringe and its volume measured over time. The temperature of the water inside the flask was controlled using a heater with a temperature dial and verified by a thermometer placed in the water bath.

(a) Outline:

- the dependent and independent variables

DV = volume of gas produced

IV = temperature of the reaction mixture.

- all the controlled variables in this investigation.

- volume of water in the flask

- type of flask

- brand of tablet

- amount of stirring

- type of thermometer used

- distance the flask is immersed in the water bath

(b) Identify two possible random errors in this investigation.

- Accidental bumping of the setup causing excessive swirling of the water in the flask.

- Seals may be loose in both the flask and syringe allowing gas to escape.

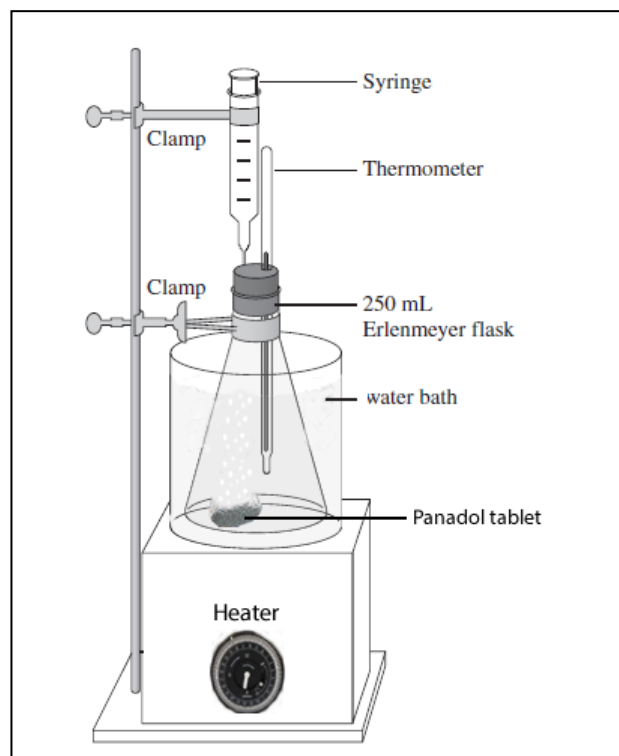
Any other event that is random and can impact the results.

(c) Identify a potential systematic error and explain how it may be reduced in this investigation.

- The syringe may not be properly evacuated of all gas and starts at a point other than zero.

- Thermometer might not be reading the right temperature is always out by a given amount.

- parallax errors caused by reading the scale at consistently the wrong angle

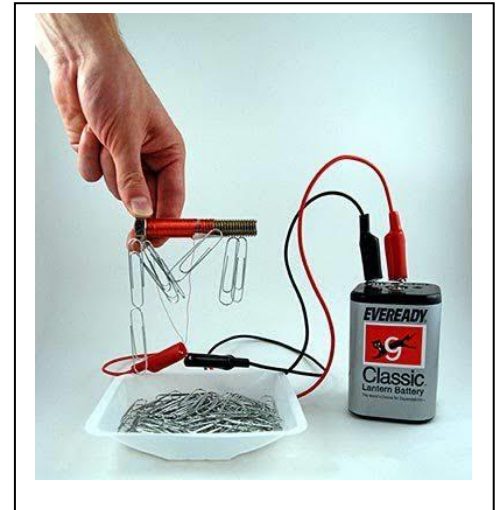


2) A student wanted to see if the magnetic force of an electromagnet is directly related to the number of coils of wire around a central iron bolt. Similar bolts and identical wire were used to construct 7 electromagnets, 4 of which are shown on the right.



Each electromagnet was tested to see how many paper clips it could pick up using a 6V battery. The exact same 6V battery was used throughout the investigation. The table below has the data.

Loops of wire	Paper clips picked up
50	12
100	25
150	38
200	51
250	64
300	30
350	12



a) Formulate a testable hypothesis for this investigation

If the number of coils of wire increases around an iron bolt so will the force exerted by the electromagnet also increase proportionally.

b) Graph the results on a set of axis using the graph paper provided on the right.

c) Is the hypothesis supported? Explain

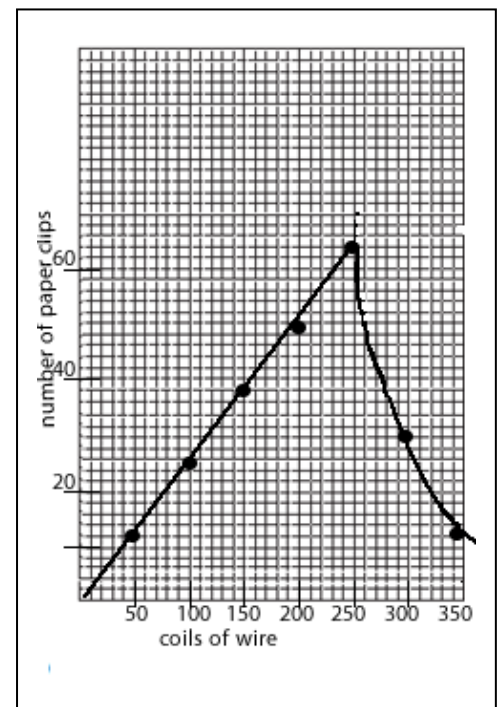
Up to 250 coils of wire the hypothesis is supported. We notice a direct relationship between coils of wire and force strength. At 300 and 350 the data, if correct, does not support the hypothesis.

d) Are the data points at 300 and 350 coils outliers? How can you substantiate that they are or are not outliers?

conduct several more trials and average the results at each number of coils.

e) Are the results obtained valid and reliable?

Is the investigation really measuring what it is supposed to be measuring ie. The relationship between coils of wire and strength of the magnetic force. If so then the results are valid if not the results are invalid and the method/procedure has to be modified. In this case you will notice that variables other than the DV (coils of wire) and the IV (clips picked up) are not



controlled. For example the length of wire increases steadily as the coils also increase. In this case the method needs to be changed to control for the length of wire. The battery also is not delivering the same current as it did at the start of the investigation as it is being used up. You will also notice that the coils of wire spread at different lengths along each bolt. This should also be controlled..

As for reliability of results we need to have multiple sets of data at each number of coils to see if the results are similar each time.

f) Are the results accurate? If yes, explain why?

If not explain why not and suggest what can be done to improve the accuracy?

Accurate results are those that are close to a known value. Since in this case we do not know the exact value we need to ensure that our investigation is repeatable and reproducible.

If we repeat the investigation several times and find that we obtain similar results every time then the investigation is repeatable. If other groups follow the exact procedure and arrive at similar results then the investigation is reproducible.

Accuracy is eroded by systematic errors and random errors. Systematic errors may produce reliable results but not accurate results.

g) Write a procedure as a set of logical and sequential steps indicating the equipment that will be used and how each variable will be either measured, changed or controlled.

Equipment

- a box of 6 cm long iron bolts of 0.50 cm diameter.
- 1.00 metre long enamelled fine copper wire
- a box of grade 2 paper clips
- an electrical power source that delivers consistent current

Step 1. Draw a 4 cm line along 7 bolts.

Step 2. Prepare 7 bolts by winding coils of wire around each bolt along the 4 cm line. The first bolt will have 50 coils and each subsequent bolt will increase by 50 coils.

50, 100, 150, 200, 250, 300, 350 coils of wire.

Step 3. Connect each bolt to the power source set at 6 volts and bring the electromagnet close to the open box of paper clips and touch the surface of the pile of clips with the part of the electromagnet that has the hexagonal head.

Step 4. Count the number of clips picked up on immediate contact.

Step 5. Repeat five times for each number of coils.

Step 6. Average the number of paper clips picked up at each number of coils and present the data in table form.

