Merit

NZQA Intended for teacher use only

The AIM of the experiment is:
to see how the propulsion of a balloon is affected by how inflated it is.

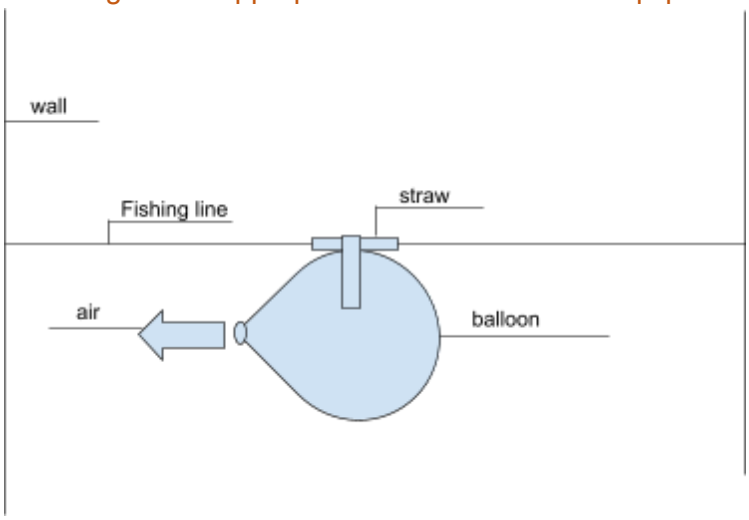
Which is the INDEPENDENT VARIABLE (the one that will be changed)?
How much air is in the ballon(ballon width once inflated)
What range of values will be used?
15 - 25 - 30 cm wide inflated balloons

Which is the DEPENDENT VARIABLE (the one that will be measured)?
The time it takes for the balloon to travel along a fishing line.

Which other variables will need to be CONTROLLED so that they don't affect the results? For each one explain why and how it will be controlled.
Balloon tension needs to be controlled, this can be solved by using a fresh balloon each time. We also need to prevent wind from additionally propelling the balloons, this is solved by conducting the experiment indoors.

Use the information from the previous questions to write a method to carry out your investigation. Your method must have enough detail to enable another student to repeat the experiment.
Measure out a length of fishing line and tie one end to one end of the room. Thread a straw onto the line and tie the other end to the opposite side of the room. Blow up a balloon until it is 15 cm wide and hold the hole shut. Tape the balloon to the straw and release the balloon at the same time as starting the stopwatch. When the balloon reaches the other side, stop the timer and record the time in a table. Repeat with a balloon that is 25 cm wide and again with a 30 cm wide balloon. Repeat experiment 2 more times for each size balloon.

Draw diagrams if appropriate and make note of equipment needed.



Fishing line
drinking straws
9 balloons (minimum)
Celotape
Scissors
Stopwatch

TASK 2: Gathering Evidence

Raw data.

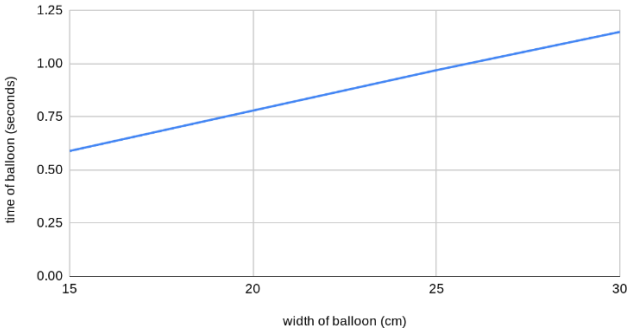
0.57 s (15 cm)
0.68 s (15 cm)
0.52 s (15 cm)
0.91 s (25 cm)
1.10 s (25 cm)
0.91 s (25 cm)
1.17 s (30 cm)
1.20 s (30 cm)
1.08 s (30 cm)

Table of results:

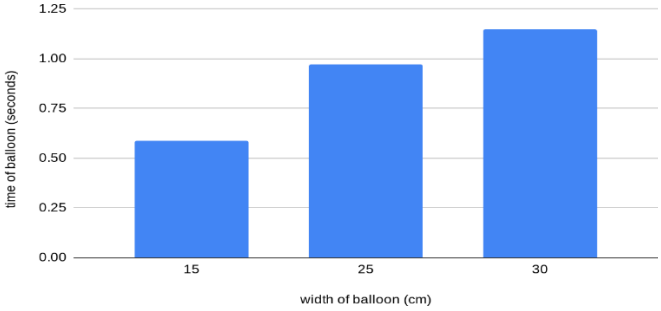
	Trial 1	Trial 2	Trial 3	Average
Small (15)	0.57 s	0.68 s	0.52 s	0.59 s
Medium (25)	0.91 s	1.10 s	0.91 s	0.97 s
Large (30)	1.17 s	1.20 s	1.08 s	1.15 s

TASK 3: Analysing Evidence.

the relationship between a balloon's width and its speed



the relationship between a balloon's width and its speed



Conclusion (what does the graph tell you?)

The graph says that as the size of the balloon increases so does the time taken to reach the end of the fishing line, this was because the larger balloons had a larger profile so their drag was greater and they didn't cut through the air as fast as the small balloon.

Evaluation (Include validity of method and reliability of data; what went well and what didn't go so well?)

The data isn't very precise, this is due to human error; the time was offset by the timer person's reaction speed for stopping and starting the timer. We also couldn't properly measure the balloons width due to them being spherical. In the bar graph it appears that the larger balloon's speed difference fell off, compared to how slow the medium balloon was to the small one. This was due to the fact the largest balloon is only 5 cm larger than the medium balloon, which is 10 cm larger than the small balloon. This was because the largest balloon was likely to pop if i had inflated it to 35cm wide.

TASK 4: Show your understanding of the relevant physics concepts involved in moving an object with air pressure.

Discussion (How does your conclusion relate to the real life scenario? What are the science ideas involved?)

A balloon's motion is caused by the air pressure in a balloon trying to equalize to the air pressure outside of the balloon, this causes the air to rush out and due to Newton's third law apply an opposite force to the balloon, another example of newton's third law is how the force of gravity upon an object is resisted by an opposite force generated by the ground.
The pressure in a balloon is generated by the elasticity of the balloon trying to return it to its resting width. The force created compacts the air, according to Newton's third law this creates an opposite force preventing the balloon from shrinking. This makes the air inside the balloon at a greater pressure than the air outside the balloon.
In my experiment I observed that as the size of a balloon increased so did the time that it took to travel along a string this was due to the increased drag.
As the balloon's size increases the surface area and profile also increases, because of this they hit more air particles and experience more drag. This can be observed in my experiment in how the 30 cm wide balloon was almost twice as slow as the 15cm wide one.

A real world example of this is in how as the fuel tanks size of a rocket increases it experiences more drag. Scientists get around this by making the tanks longer and skinnier, this decreases the profile and increases the speed by lowering drag.

In addition to increasing drag a higher profile and larger surface area can also increase the effect of wind on an object. larger objects are more likely for air particles to hit these air particles apart there speed onto the balloon, this explains why the largest balloon's speed isn't as slow as expected. Small changes in the wind could potentially have impacted the data of the larger balloons because of this.