



KNOX
GRAMMAR
SCHOOL

STATE

DA VINCI DECATHLON 2021

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS
IN YEARS 5 & 6




SCIENCE SOLUTIONS

TEAM NUMBER _____

1	2	3	Total	Rank
/9	/31	/10	/50	


QUESTION 2

The three scientists shown below explored chance and uncertainty. Match the statements to the scientist most likely to express them by joining the photograph to the statement with a line. **One mark each correct arrow** (3 MARKS)




Erwin Schrödinger

The future of everything in the universe is entirely predictable if we can know its current state.



Werner Heisenberg

If I put a cat in a box with a bottle of poison and a hammer that will break the bottle if a radioactive material begins to decay, it is impossible for the cat to be both alive and dead when the box is closed.



Pierre Laplace

You can never be certain of both the position and the speed of a microscopic particle. If you precisely calculate the speed, you cannot be precise about the position. If you calculate the exact position, you cannot also be precise about the speed.

SECTION 2 – EXPERIMENTAL DESIGN

DROPPING MY TOAST

Have you ever heard someone claim that if you drop your piece of toast at breakfast time, the chance of it landing marmalade/vegemite/peanut butter side down is 100%? The Institute of Physics (physics.org) claims that the side that hits the floor is indeed **not** random chance.

They claim it all depends on **how you dropped it**, from where you dropped it and **how big your slice of toast actually is**. All of these factors contribute to the butter side up or butter side down landing position.

In our typical early morning scenario, the toast slips off the side of the table and is given a **slight rotation** as it starts to fall. As most kitchen tables and work surfaces are about waist height, the toast only manages half a rotation before it hits the floor, butter side down. So, if you want to have your toast landing butter side up, you'd better build your work surfaces twice as high or make smaller slices so that they have time to complete the rotation.

QUESTION 1

What three factors do the Institute of Physics claim will reduce the frequency with which the side with a sticky spread on it hits the floor? **(3 MARKS)**

1. _____ **How it is dropped - no rotation or a different amount of rotation** _____
2. _____ **Size of the toast – smaller might do a full rotation** _____
3. _____ **Higher bench height may result in full rotation** _____

QUESTION 2

Choose just one of the factors listed above and design a scientific investigation to investigate how it changes the chance of having your toast land on the floor spread side down.

Aim: **(2 MARKS)**

One mark for clear statement of experimental aim
One mark for aim that links directly to one of the factors listed above

Independent Variable (what you make different to examine its effect): **(2 MARKS)**

Dropping action OR size of toast OR bench height – and units/categories specified

Dependent Variable (what you measure to calculate that effect): **(2 MARKS)**

Count of number of times the toast lands spread side up and spread side down
OR Angle toast hits the ground (measured in degrees)

Controlled Variables (things you must keep the same to make it a fair test): **(4 MARKS)**

4 things such as type of spread, type of bread, drop height (if not the independent variable),
shape/size of toast (if not the independent variable), **dropping action** (if not the independent variable)
One mark each

Hypothesis (What you predict to show in your measurements/data): **(3 MARKS)**

1 mark for predictive statement

1 mark if it expresses a trend in the data using the variable names (e.g. when the bench height increases above 200cm, the toast will land spread side up at least 50% of the time)

1 mark if a reason is given (e.g. because the toast will have time to make a complete 360° rotation)

Diagram of Setup: **(4 MARKS)**

1 mark for 2D rather than 3D drawing

1 mark for labels

1 mark if it neatly and clearly shows the way the experiment will be set up

1 mark if it is proportional in size to the box

Procedure: **(7 MARKS)**

1 mark for clear logical set of steps

1 mark for listing each step on a separate line

1 mark for a procedure that matches the aim and hypothesis being tested

1 mark for specifying precise lengths and distances

1 mark for any information related to controlling variables to make it a fair/valid test

1 mark for including repetition (to assess reliability)

1 mark for appropriate verb choice (position, place, drop, angle, transfer, observe, record)

How will the reliability of the investigation be optimised? **(2 MARKS)**

1 mark for reference to repeating the experiment multiple times

1 mark for any evidence that reliability relates to how close the scores are across all the repeats rather than just the number of times it is repeated

How will the validity of the investigation be ensured? **(2 MARKS)**

1 mark for mentioning the way variables are controlled or fair testing

1 mark for evidence of understanding that validity is about making sure your results are actually a measure of what you are attempting to measure

Validity. In its purest sense, this refers to how well a **scientific** test or piece of research actually measures what it sets out to, or how well it reflects the reality it claims to represent.

SECTION 3 – EXTRACTING AND ANALYSING DATA

QUESTION 1

Describe a micromort:

(2 MARKS)

1 mark for identifying it as measure of exposure to the risk of dying

1 mark for specifying the measure at 1/1000 000

QUESTION 2

Tabulate (create a table of) the data presented in the article quantifying the comparative risk of **twelve** different activities named in the article.

(8 MARKS)

0.5 marks for 12 of the 13 events listed here with correct micromorts. Where a range of values is listed in the article, a single value within the range is correct

1 mark each for appropriate column headings

Event	Risk in Micromorts
Skydiving	8 or 9
Marathon running	7
Scuba diving	5 to 10
Climbing Mt Everest	40 000
Driving 400km	1
Motor Cycle 10km	10
10000km Commercial Jet flight	1
Sitting on a chair	1.3
Slipping and falling at home	13
Bath	0.3
Shark attack when swimming	0.125
Drowning when swimming	12
Proximity to kangaroo	0.1