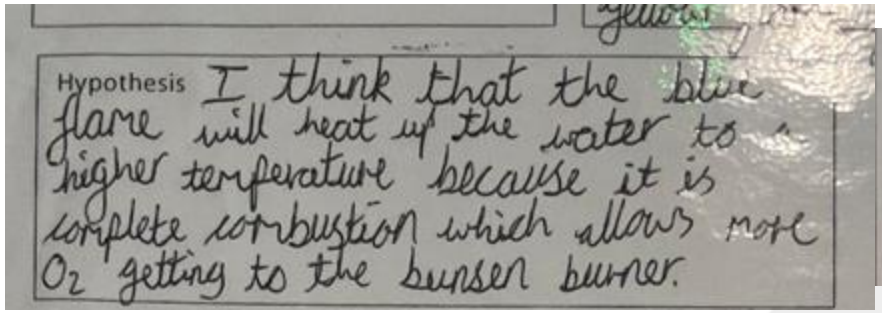
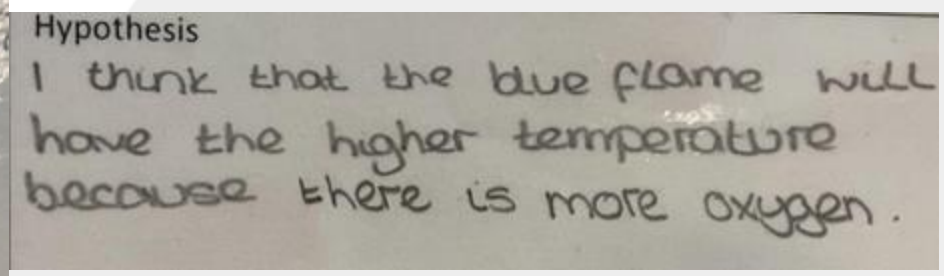
Progression in Science

Science investigative skills (AO3)

Hypothesis (Y7 & 8) HT1

Students are to use the scientific knowledge learnt in class to make predictions about an investigation

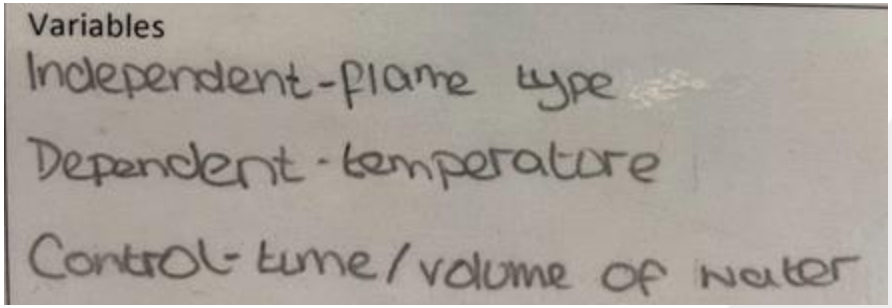


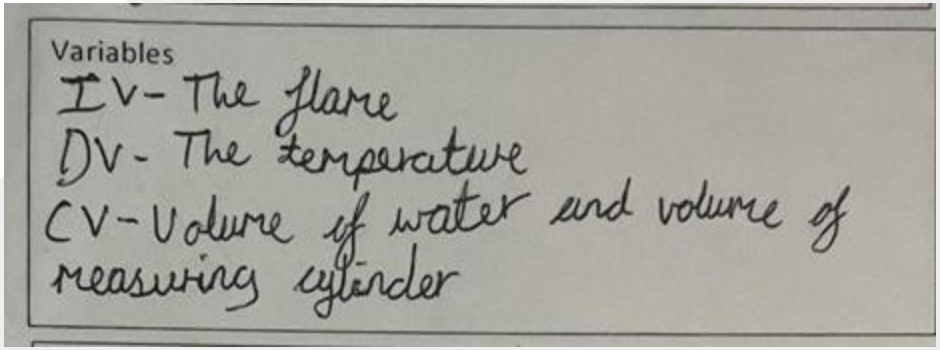


Variables (Y7 & 8) HT1

Students are to identify the following variables in a scientific investigation

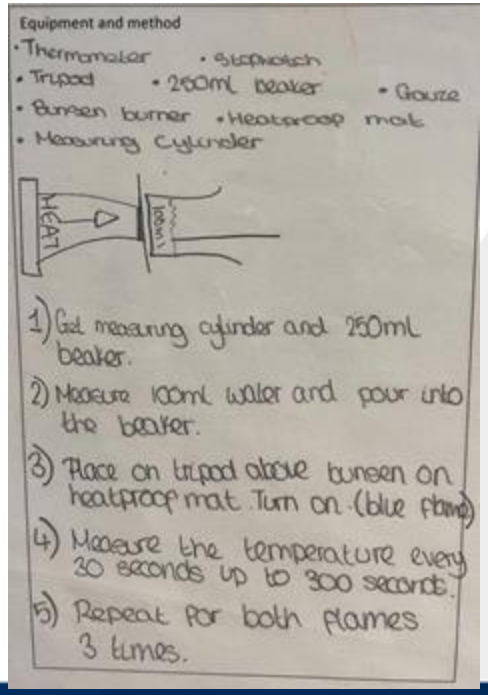
- Independent variable
- Dependent variable
- Control variable(s)





Method (Y7 & 8) HT2

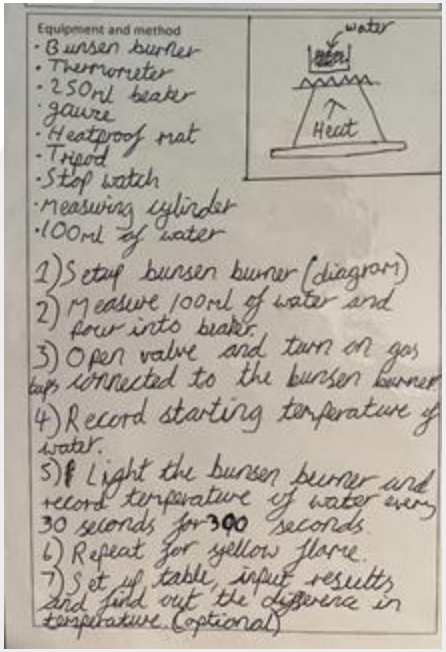
Students write a numbered, step by step method which could be followed by another person who would get the same results.



Equipment and method

- Thermometer
- Stopwatch
- Tripod
- 250ml Beaker
- Gauze
- Bunsen burner
- Heatproof mat
- Measuring Cylinder

1) Get measuring cylinder and 250ml beaker.
2) Measure 100ml water and pour into the beaker.
3) Place on tripod above bunsen on heatproof mat. Turn on (blue flame)
4) Measure the temperature every 30 seconds up to 300 seconds.
5) Repeat for both flames 3 times.



Equipment and method

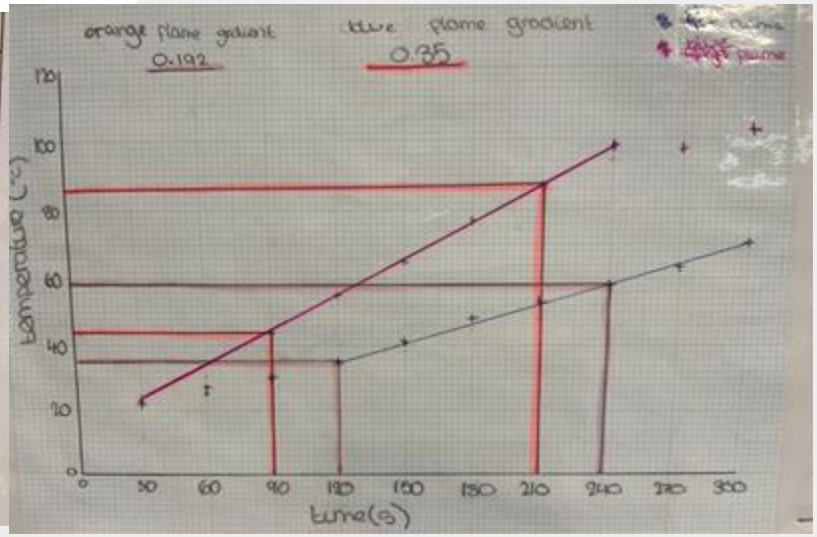
- Bunsen burner
- Thermometer
- 250ml beaker
- gauze
- Heatproof mat
- Tripod
- Stop watch
- Measuring cylinder
- 100ml of water

1) Setup bunsen burner (diagram)
2) Measure 100ml of water and pour into beaker.
3) Open valve and turn on gas taps connected to the bunsen burner
4) Record starting temperature of water.
5) Light the bunsen burner and record temperature of water every 30 seconds for 300 seconds.
6) Repeat for yellow flame.
7) Set up table, input results and find out the difference in temperature. (optional)

Displaying results; Tables and Graphs (Y7 & 8) HT3

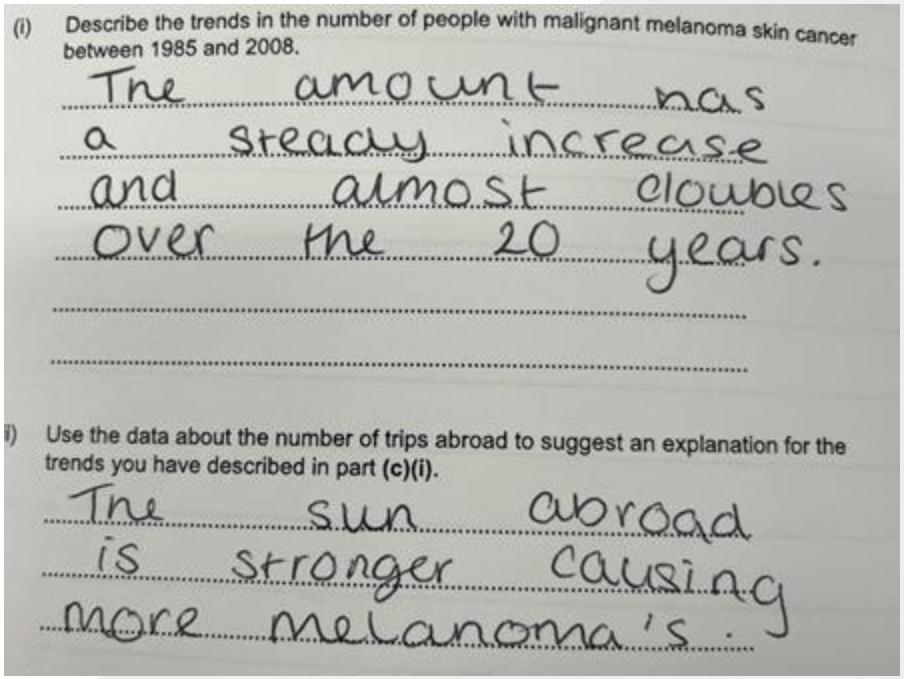
Students display data clearly and accurately, with correct headings and units

Time (secs)	Orange flame (oC)				Blue flame (oC)			
	Trial 1	Trial 2	Trial 3	average	Trial 1	Trial 2	Trial 3	average
30	24	21	20	22	~~25~~	24	20	23
60	30	27	24	27	35	34	35	35
90	31	30	30	30	43	45	45	44
120	34	36	35	35	58	58	50	55
150	38	41	44	41	65	71	60	65
180	49	44	55	48	76	84	70	77
210	48	50	62	53	85	98	78	87
240	50	54	69	58	98	100	85	94
270	54	60	76	63	102	100	90	97
300	60	65	84	70	102	100	100	101



Descriptions and Explanations (Y7 & 8) HT4

Students describe patterns and give reasons why an experimental result has occurred



(i) Describe the trends in the number of people with malignant melanoma skin cancer between 1985 and 2008.

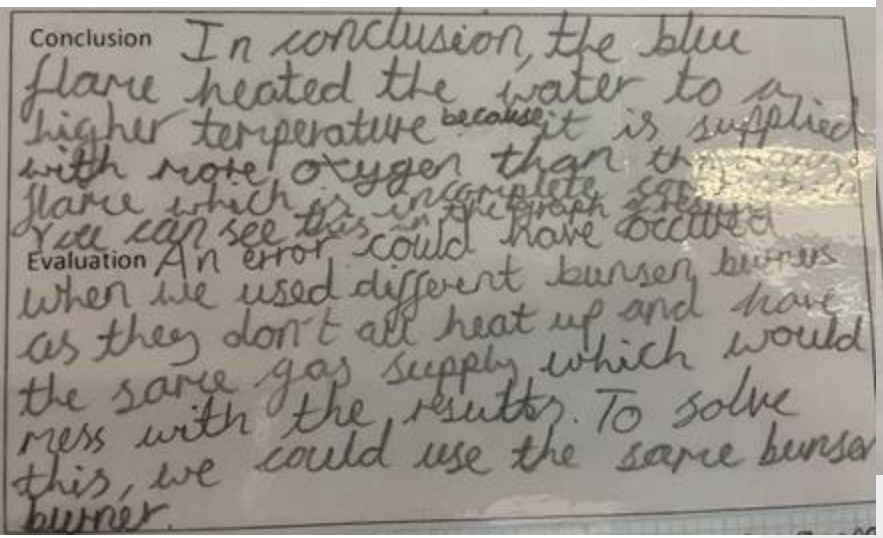
The amount has a steady increase and almost doubles over the 20 years.

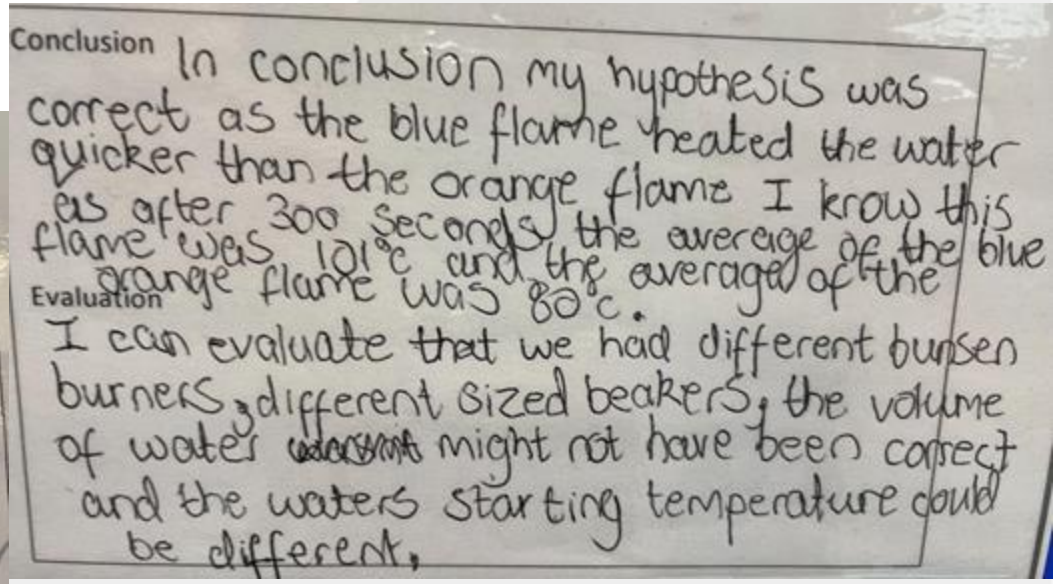
(i) Use the data about the number of trips abroad to suggest an explanation for the trends you have described in part (c)(i).

The sun abroad is stronger causing more melanoma's.

Conclusions and Evaluations (Y7 & 8) HT5

Students can summarise their investigations and make links to their hypothesis whilst also giving improvements if they were to do the experiment again.





Science skills at KS4

1. DEVELOPMENT OF SCIENTIFIC THINKING
2. EXPERIMENTAL SKILLS AND STRATEGIES
3. ANALYSIS AND EVALUATION
4. SCIENTIFIC VOCABULARY, QUANTITIES, UNITS, SYMBOLS AND NOMENCLATURE

Science skills at KS4

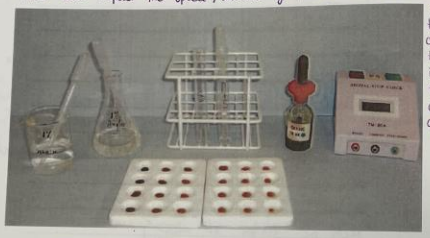
1. Development of scientific thinking

WS 1.1	Understand how scientific methods and theories develop over time.
WS 1.2	Use a variety of models such as representational, spatial, descriptive, computational and mathematical to solve problems, make predictions and to develop scientific explanations and understanding of familiar and unfamiliar facts.
WS 1.3	Appreciate the power and limitations of science and consider any ethical issues which may arise.
WS 1.4	Explain everyday and technological applications of science; evaluate associated personal, social, economic and environmental implications; and make decisions based on the evaluation of evidence and arguments.
WS 1.5	Evaluate risks both in practical science and the wider societal context, including perception of risk in relation to data and consequences.
WS 1.6	Recognise the importance of peer review of results and of communicating results to a range of audiences.

RP 4:Investigate the effect of pH on the rate of reaction of amylase enzyme.

How does the PH impact enzymes?

Retrieval: The higher the PH the more denatured the enzymes can be. This will impact the speed / success of reaction. For it to happen at the correct time it has to be at the optimum PH.



https://www.youtube.com/watch?v=8Ygbu56ImXk

- By using this method you will have the opportunity to develop the following science skills

Required Practical	Working Scientifically Requirements	Maths Skills	Aparatus and Techniques
4 Enzymes	WS 2.1, WS 2.4, WS 2.5, WS 2.6, WS 3.2, WS 3.3	1a, 1c	AT1, AT2, AT5

WS2 Your hypothesis: When I increase the time I think that the starch will get less and less present. Longer the time the more orange it will be. This is because the amylase will break the starch down into maltose. ↓ PH is orange colour.

rate of reaction ↓

Section 1 - Planning

For each variable state whether it is continuous or categoric

WS4

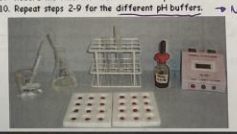
What will be the independent variable? (What will you change?)
time from when the reaction first occured ✓ PH ✓

What will be the dependent variable? (What will you measure?)
amount of time it took for starch to go. /PH ✓

What are the control variables? (What will you keep the same to make it a fair test?)
~~Volume~~ ~~Amount~~ of liquids ✓
- PH
- Iodine solution ✓
- Time inbetween each drop
- Temperature

WS5
Equipment you will youneed HIGHLIGHTED IN BOLD

1. Place one drop of **iodine solution** into each depression on the **spotting tile.**
2. Label a **test tube** with the pH to be tested.
3. Add 1 cm^3 **of buffer solution** to the **test tube** using a **syringe.** ↑ PH solution
4. Use another **syringe** to add 2 cm^3 **of starch** to the **buffer solution.**
5. Use a different **syringe** to place 2 cm^3 **of amylase** into the **buffer/starch solution** test tube and start your stop watch.
6. Take some of the solution up into the pipette (the reaction will still occur in the pipette) and place a drop of the solution in each depression on the dimple tile every 1 seconds.
7. The iodine will turn **black** if the starch is still present.
8. The iodine will stay **orange** if no starch is present.
9. Record the time the reaction was complete.
10. Repeat steps 2-9 for the different pH buffers. → No. 5



WS6 Write a **risk assessment.**

What are the hazards in this investigation?
1. Glass
2. Iodine
3. Other chemicals : Buffer

What is the risk? (how could it harm us?)
1. Glass breaking and cut skin
2. Stain clothes
3. burn skin

How will we prevent this from happening?
1. Dont set it down - keep in holder
2. Wear apron
3. Wash hands immediatly

Section 2 - Results

WS7 Record your results in a table.

neutreal : 7

pH of buffer	Time taken for amylase to break down starch (seconds)
2	75
4	45
6	30
8	62
10	66

Section 3- Conclusions

WS9 Can you describe what happened as you increased the independent variable?
PH

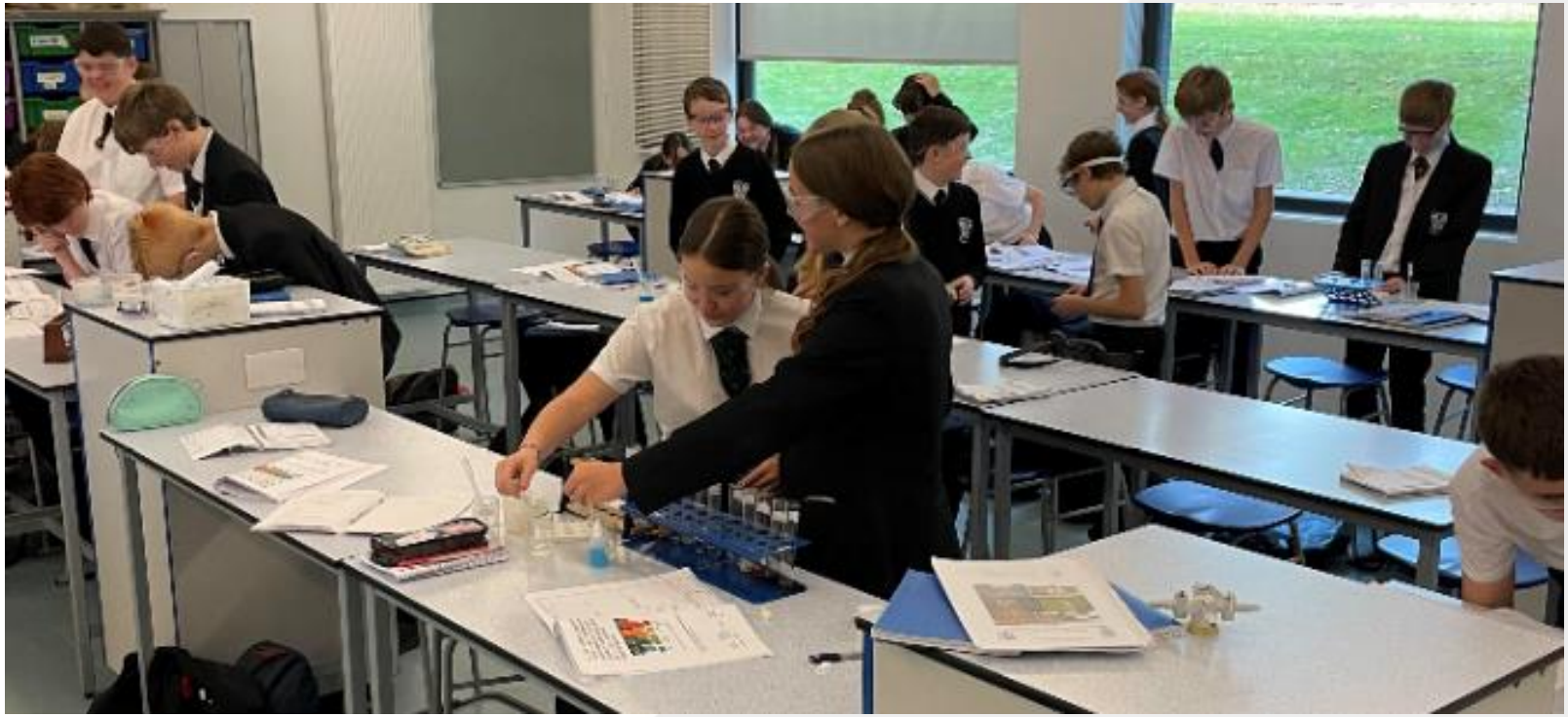
The higher the PH the more time it took, the same as the lower it is. The least time it took was the most nutreal PH.

Can you say why this happened?
This happened because the optimum PH is close to nutreal. when its at the optimum its the best conditions for amylase to break down the quickest.

WS10 How could the experiment be improved to get better or more reliable results?
To improve them you could work out an average by doing multiple tests.

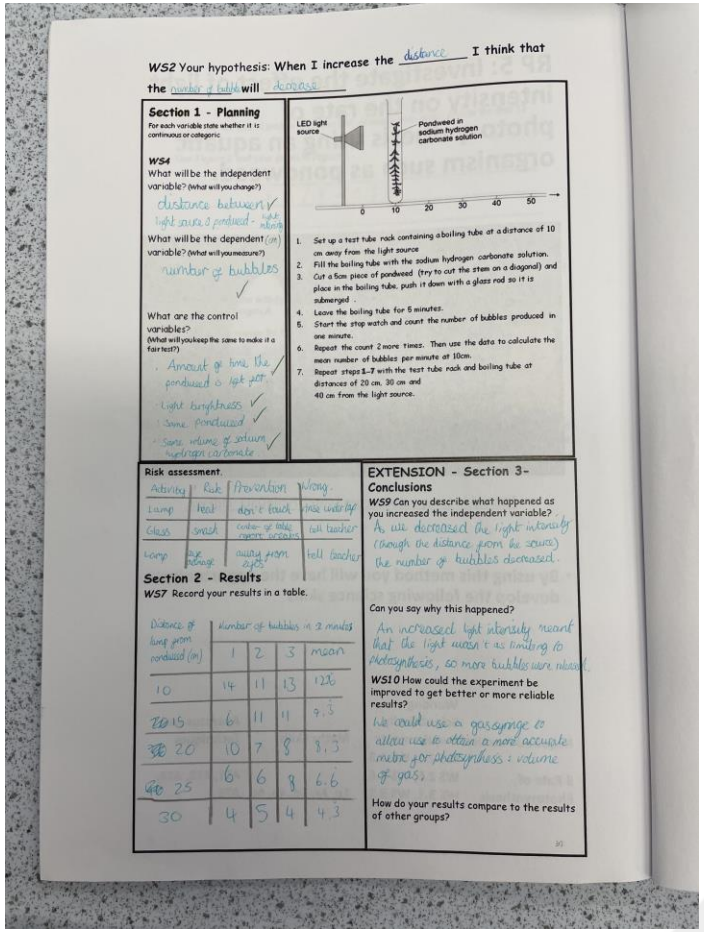
2. EXPERIMENTAL SKILLS AND STRATEGIES

WS 2.1	Use scientific theories and explanations to develop hypotheses.
WS 2.2	Plan experiments or devise procedures to make observations, produce or characterise a substance, test hypotheses, check data or explore phenomena.
WS 2.3	Apply a knowledge of a range of techniques, instruments, apparatus, and materials to select those appropriate to the experiment.
WS 2.4	Carry out experiments appropriately having due regard for the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations.
WS 2.5	Recognise when to apply a knowledge of sampling techniques to ensure any samples collected are representative.
WS 2.6	Make and record observations and measurements using a range of apparatus and methods.
WS 2.7	Evaluate methods and suggest possible improvements and further investigations.



3. ANALYSIS AND EVALUATION

WS 3.1	Presenting observations and other data using appropriate methods.
WS 3.2	Translating data from one form to another.
WS 3.3	Carrying out and represent mathematical and statistical analysis.
WS 3.4	Representing distributions of results and make estimations of uncertainty.
WS 3.5	Interpreting observations and other data (presented in verbal, diagrammatic, graphical, symbolic or numerical form), including identifying patterns and trends, making inferences and drawing conclusions.
WS 3.6	Presenting reasoned explanations including relating data to hypotheses.
WS 3.7	Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error.
WS 3.8	Communicating the scientific rationale for investigations, methods used, findings and reasoned conclusions through paper-based and electronic reports and presentations using verbal, diagrammatic, graphical, numerical and symbolic forms.



WS2 Your hypothesis: When I increase the distance I think that the number of bubbles will decrease

Section 1 - Planning

For each variable state whether it is continuous or categoric

WS4

What will be the independent variable? (What will you change?)

distance between light source & pondweed - light intensity ✓

What will be the dependent (DV) variable? (What will you measure?)

number of bubbles ✓

What are the control variables? (What will you keep the same to make it a fair test?)

- Amount of time the pondweed is left put ✓
- Light brightness ✓
- Same pondweed ✓
- Same volume of sodium hydrogen carbonate ✓

1. Set up a test tube rack containing a boiling tube at a distance of 10 cm away from the light source
2. Fill the boiling tube with the sodium hydrogen carbonate solution.
3. Cut a 5cm piece of pondweed (try to cut the stem on a diagonal) and place in the boiling tube, push it down with a glass rod so it is submerged .
4. Leave the boiling tube for 5 minutes.
5. Start the stop watch and count the number of bubbles produced in one minute.
6. Repeat the count 2 more times. Then use the data to calculate the mean number of bubbles per minute at 10cm.
7. Repeat steps 5-7 with the test tube rack and boiling tube at distances of 20 cm, 30 cm and 40 cm from the light source.

Risk assessment.

Activity	Risk	Prevention	Wrong.
Lamp	heat	don't touch	rinse with water
Glass	smash	center of table more room	tell teacher
Lamp	fire hazard	away from zips	tell teacher

Section 2 - Results

WS7 Record your results in a table.

Distance of lamp from pondweed (cm)	Number of bubbles in 2 minutes			
	1	2	3	mean
10	14	11	13	12.6
15	6	11	11	9.3
20	10	7	8	8.3
25	6	6	8	6.6
30	4	5	4	4.3

EXTENSION - Section 3- Conclusions

WS9 Can you describe what happened as you increased the independent variable?

As we decreased the light intensity (through the distance from the source) the number of bubbles decreased.

Can you say why this happened?

An increased light intensity meant that the light wasn't as limiting to photosynthesis, so more bubbles were released

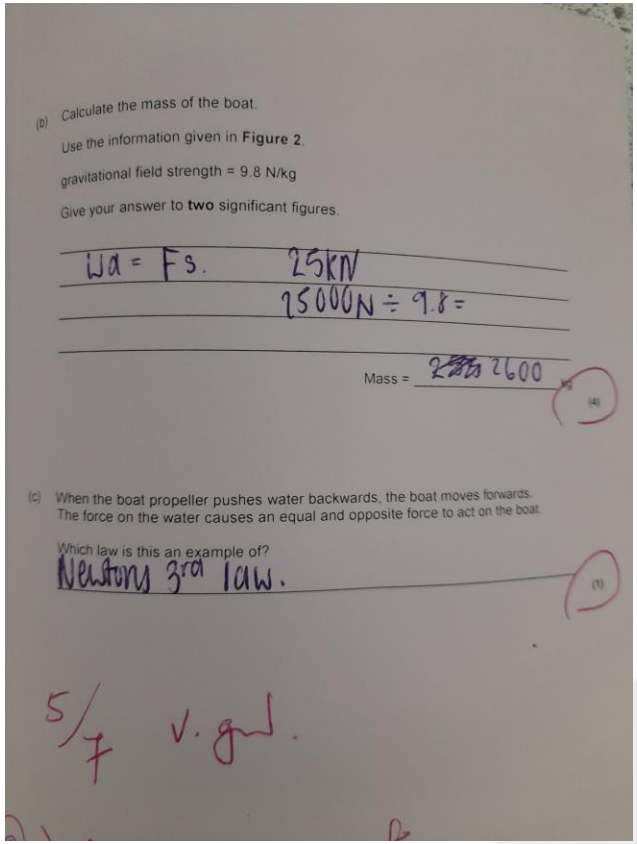
WS10 How could the experiment be improved to get better or more reliable results?

We could use a gas syringe to allow use to obtain a more accurate metric for photosynthesis : volume of gas.

How do your results compare to the results of other groups?

4. SCIENTIFIC VOCABULARY, QUANTITIES, UNITS, SYMBOLS AND NOMENCLATURE

WS 4.1	Use scientific vocabulary, terminology and definitions.
WS 4.2	Recognise the importance of scientific quantities and understand how they are determined.
WS 4.3	Use SI units (eg kg, g, mg; km, m, mm; kJ, J) and IUPAC chemical nomenclature unless inappropriate.
WS 4.4	Use prefixes and powers of ten for orders of magnitude (eg tera, giga, mega, kilo, centi, milli, micro and nano).
WS 4.5	Interconvert units.
WS 4.6	Use an appropriate number of significant figures in calculation.



(b) Calculate the mass of the boat.

Use the information given in **Figure 2**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

Wd = Fs. 25kN

25000N ÷ 9.8 =

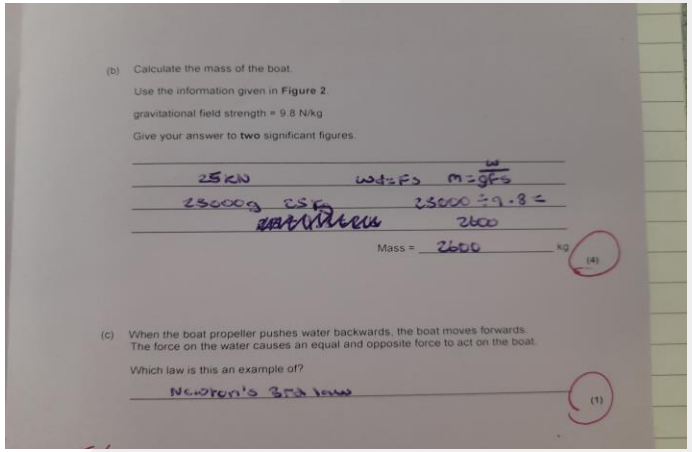
Mass = ~~2~~ 2600 kg (4)

(c) When the boat propeller pushes water backwards, the boat moves forwards. The force on the water causes an equal and opposite force to act on the boat.

Which law is this an example of?

Newtons 3rd law. (1)

5/7 v. good.



(b) Calculate the mass of the boat.

Use the information given in **Figure 2**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

25kN Wd=Fs $m = \frac{W}{gFs}$

25000g F=F $25000 \div 9.8 =$

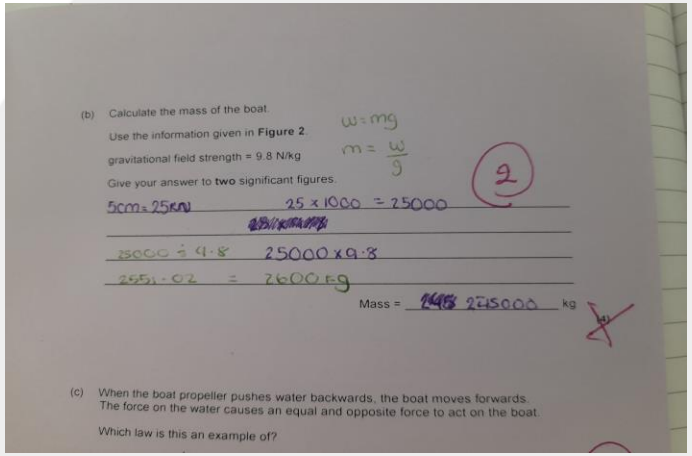
2600

Mass = 2600 kg (4)

(c) When the boat propeller pushes water backwards, the boat moves forwards. The force on the water causes an equal and opposite force to act on the boat.

Which law is this an example of?

Newton's 3rd law (1)



(b) Calculate the mass of the boat.

Use the information given in **Figure 2**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

$w = mg$

$m = \frac{w}{g}$

5cm = 25kN $25 \times 1000 = 25000$ (2)

25000 ÷ 9.8 25000×9.8

2551.02 = 2600 kg

Mass = ~~2~~ 245000 kg (4)

(c) When the boat propeller pushes water backwards, the boat moves forwards. The force on the water causes an equal and opposite force to act on the boat.

Which law is this an example of?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