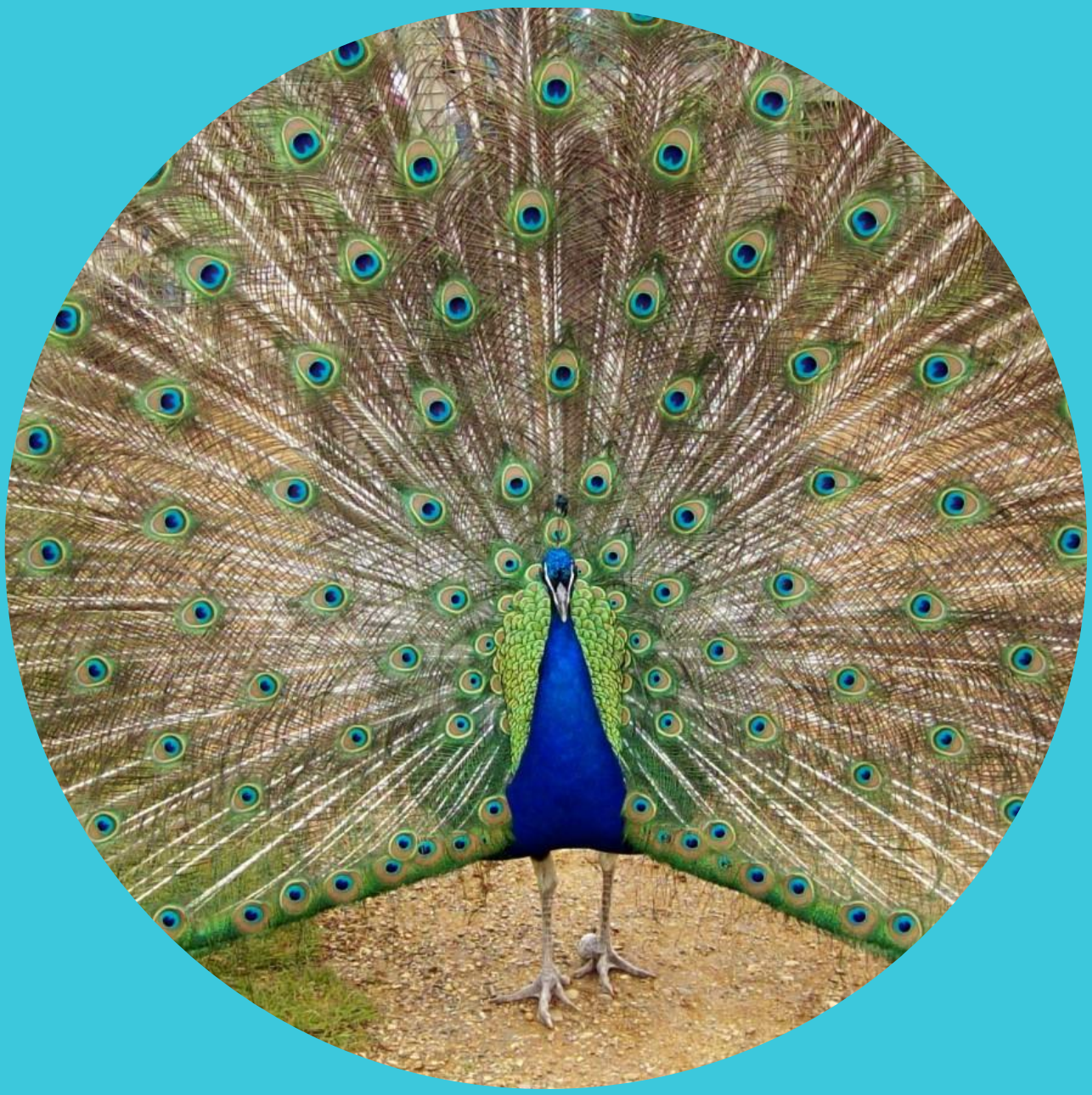
Researchers in Schools



Is Symmetry the language of the universe?

Pupil Name	
Coursebook Designed by	Dr Frith

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Symmetry is all around us	
Tutorial 2	Mathematical groups and symmetry	
Tutorial 3	Why is order important?	
Tutorial 4	Can equations be symmetrical?	
Tutorial 5	Is symmetry the language of the universe?	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on due date	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

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Uni Pathways launch event

Welcome to Uni Pathways! We are delighted to be able to launch the Uni Pathways programme with you. We hope that you are ready to embark on your Uni Pathways journey and that you enjoy the video.
You will be asked to pause the video at times to complete some work in this workbook, so make sure you have a pen / pencil to hand when you start the video.

By the end of the video, you will have

- Learnt about what studying at university means
- Learnt about some of the skills that you will develop during Uni Pathways
- Heard from pupils who have participated in Uni Pathways or The Scholars Programme (which is the same programme!)
- Heard from current university students talking about what life is like at university

If you are in school your teacher will play the video. If you are at home and logged in to a session with your teacher, your teacher will play the video and show it to you. If you are participating independently your teacher will email you the link to the video or the video file. There are opportunities for you to answer some questions, and you will be told when to pause the video to answer them.

Introduction to Uni Pathways

1. Write down what you think a supra-activity is

_____
_____
_____

2. Independent learning is

_____
_____
_____

3. Write down in your own words what resilience means, and come up with a different example to the one mentioned in the PowerPoint.

_____
_____
_____
_____

4. Why do you think analysis and evaluation skills are useful in your academic career? _____
_____
_____
_____
_____
_____

5. Why do you think analysis and evaluation skills are useful in life in general? _____
_____
_____
_____

6. What are the different types of learning that university students do?

Pupils' experience of Uni Pathways
You will now watch some pupils talk about their experience of learning a PhD topic and producing a final assignment. Some may refer to The Scholars Programme rather than Uni Pathways. As you heard in the introduction PowerPoint, The Scholars Programme is a very similar programme to Uni Pathways. Listen carefully and then respond to the questions below. Be prepared to share some of your responses with your peers.

1. How did the pupils describe talking about writing a long essay for their final assignment?

2. Write down something that one of the pupils mentioned was particularly interesting in their course.

3. What were some challenges that the pupils met?

Virtual campus tours
You will now go on a virtual tour of some universities! Once you have seen some of the university campuses, respond to the questions below.
Note down something that you liked out of any of the campus tours you saw. It may be a particular building, space, city etc.

1. Were there any similarities between the different university campuses? If so, what are the similarities?

2. If you had to pick one of those universities to go and visit in person, which one would it be and why?

3. Note down some of the societies that you could join at different universities

Meet university students!
You are about to virtually meet or hear from some current university students.
If you are virtually meeting them, think about what questions you would like to ask the students, share your questions with a partner and note those questions down in the space below.

If you are not meeting them but watching some videos that they have made, use the space below to note down what else you would like to find out about university. You can then ask your teacher during Uni Pathways tutorials!

Reflection
Congratulations on completing the launch of the Uni Pathways programme. Before you go, take some time to reflect on what you have learnt by answering the following questions:

1. Are there any aspects of university style learning that you would look forward to? If so, what are they?

2. What challenges do you think students face when learning at university? How would you try to overcome these challenges?

3. What skills do you hope to develop during your Uni Pathways course?

4. What part of Uni Pathways seems the most challenging for you?

5. What are you most looking forward to about Uni Pathways?

Course Rationale

What is the universe trying to tell us about the fundamental nature of reality? How can we understand its message?

We see examples of symmetry everywhere in nature, from the structure of our own DNA, to beehives, butterflies, and snowflakes. From the very smallest quantum particle, to the solar system, the galaxy and beyond.

How can we use mathematics to quantify, classify and compare these types of symmetry? What does it mean to be mathematically symmetrical, and what happens when a symmetry is broken?

In this course, you will learn how to communicate with the universe on a mathematical level, learning a new tool, group theory, that will allow you to describe the symmetries they see in nature.

You will follow in the footsteps of great thinkers like Einstein and Schrodinger in asking fundamental questions about the universe we inhabit.

Ultimately, you will learn how the beauty of symmetry extends far beyond the physical universe, into language, music and the very mathematics used to describe it.

Uni Pathways Mark Scheme 2020

	Subject Knowledge	Critical Thinking	Written Communication
1st	The work shows a depth of knowledge and understanding of key concepts and mathematical methods, drawing on sources of evidence where appropriate. Knowledge is used to build and support highly effective mathematical arguments and explanations.	Analyses the available data/evidence and identifies all the relevant mathematical information. Identifies and critically evaluates available mathematical approaches and evidence, deciding on their credibility, strength and relative significance. Makes connections between different pieces of information and puts them together to form accurate solutions and verify answers and assumptions.	Mathematical arguments are complete, and the reasoning behind each step has been clearly communicated to the reader. The work has a coherent flow and is well structured. The writing style is appropriate; mathematical language and key mathematical terms are used accurately and effectively to support the arguments and explanations made. There are no, or very few, errors in spelling or grammar. Consistent referencing, appropriate paragraphing and use of correctly labelled tables and figures; matching the style taught in the course.
2:1	The work shows an understanding of key concepts and mathematical methods, drawing on sources of evidence where appropriate. Knowledge is used to build and support effective mathematical arguments and explanations.	Analyses the available data/evidence and identifies all the relevant mathematical information. Engages with multiple approaches and critically evaluates their utility, forming judgements and using reasoning and evidence to inform problem solving strategy. Shows some understanding of the relative value of evidence and data.	Mathematical arguments are clearly made, with few gaps in logical reasoning. The work is well-structured. The writing style is appropriate; mathematical language and key terms are used correctly. There are few errors in spelling or grammar. Mostly consistent referencing and use of tables and figures; matching the style taught in the course.
2:2	The work shows an understanding of key concepts and mathematical methods, with no major misconceptions. Beginning to apply this knowledge to build and support effective mathematical arguments and explanations.	Identifies and uses basic mathematical evidence and reasoning. Evaluates the quality of mathematical reasoning and evidence, forming judgements. Not yet showing understanding of the relative value of evidence and reasoning.	Mathematical arguments have been constructed, but there is little explanation from step to step. The work has some structure. The writing style can sometimes be informal; occasionally key terms are not used when it would be appropriate to do so.

			There are some errors in grammar and spelling, but these do not get in the way of communicating the content. Referencing has some consistency; matching the style taught in the course. Limited use of tables and figures.
3rd	Shows a developing understanding of key concepts and mathematical methods, with some misconceptions. Not yet applying this knowledge to build and support mathematical arguments and explanations.	Beginning to analysis mathematical evidence and reasoning. Describes or attempts to solve the problem without any/or little evaluation of whether the approach was reasonable or accurate.	Mathematical arguments to solve problems are poorly sequenced, with little or no explanation. The grammar, spelling, style, and structure of the work need improving in order to communicate ideas to the reader. Key terms are not always used correctly. Limited, or no use of referencing, tables and figures.

Baseline Assignment (problem-set): Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Percentage	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 16		OVERALL PERCENTAGE	
DEDUCTED PERCENT		FINAL PERCENTAGE (including any deductions)	
		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Problem Set	
Comment	*mark*

Final Assignment (problem-set): Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Percentage	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 50		FINAL PERCENTAGE	
DEDUCTED PERCENTAGE		FINAL PERCENTAGE (including any deductions)	
		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark
Problem Set	
Comment	*mark*

Subject Vocabulary

Word	Definition	In a sentence
Symmetry	A property of an object whereby it remains unchanged when an action is performed on it.	A square has 4 rotational symmetries and 4 reflectional symmetries.
Invariant	Something that does not change when an action is performed on it.	An equilateral triangle is invariant under a 60-degree rotation about its centre.
Abelian/Non-abelian	Abelian is the property of a set of actions whereby it does not matter in which order they are performed. Non-abelian means that the order affects the outcome.	A set of directions for how to find the nearest supermarket is non-abelian, because the order in which you follow the directions is crucial.
Commute	The order in which two actions are performed does not affect the outcome.	The actions of doing a 360-degree spin, and then talking a step forward commute because you can do them in any order. Doing a 180-degree spin and then taking a step forward do not commute because you would end up in a different position depending on which one you did first.
Operation	A mathematical action performed on an object or number.	Rotating a square 180-degrees is an operation on the square.
Identity	An element that when combined with another element or object, it returns the other element or object unchanged.	When doing $1x5$, 1 is an identity because $1x5 = 5$ and we just get back the other element. Similarly, a 360-degree rotation of any 2d shape is also an identity because the shape ends up in the same position as it started.
Group	A set of objects that is self-contained. Together with an action, the set of objects must contain an identity, and an inverse for every element that returns the identity.	The set of rotations of a square in 90-degree increments is a group.
Axiom	A statement on which a theory is built.	An axiom of addition is that $1 + 1 = 2$.
Mapping	An action that changes the input into something new.	Changing x to $3x + 1$ is a mapping.
Odd	A function that becomes the negative of itself when $x \rightarrow -x$ for $f(-x) = -f(x)$.	$f(x) = sin(x)$ is an odd function

Even	A function that stays the same when $x \rightarrow -x$ for $f(-x) = f(x)$	$f(x) = cos(x)$ is an even function

Tutorial 1 – Symmetry is all around us

What is the Purpose of Tutorial 1?

- Define mathematical symmetry
- List examples of symmetry in the natural world
- List examples of symmetry in human culture

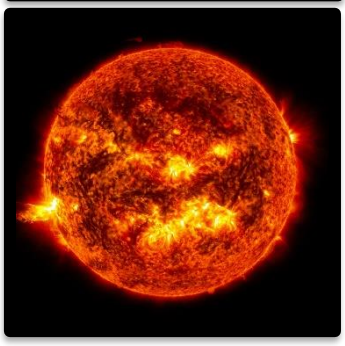
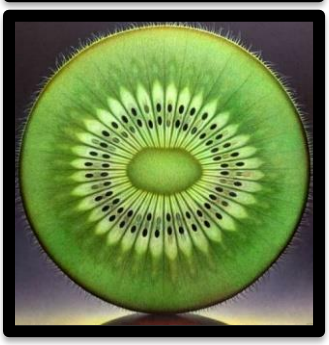
Activity 1 – All types of symmetry

$$F = \frac{GM_1M_2}{r^2}$$

What do these three things have in common?

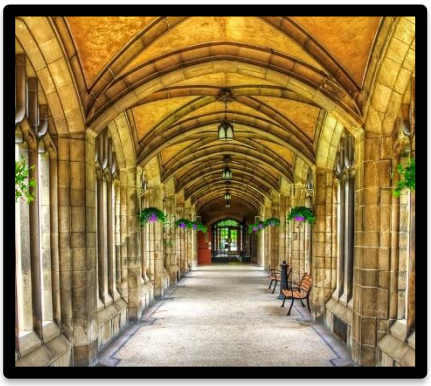
Mathematical symmetry:

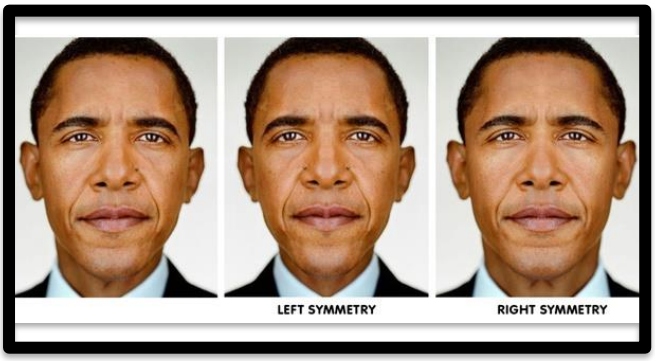
Activity 2 – Symmetry in nature

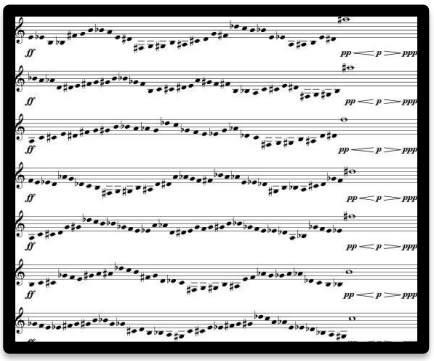



Symmetry in nature:

Activity 3 – Symmetry in human culture







Symmetry in human culture:

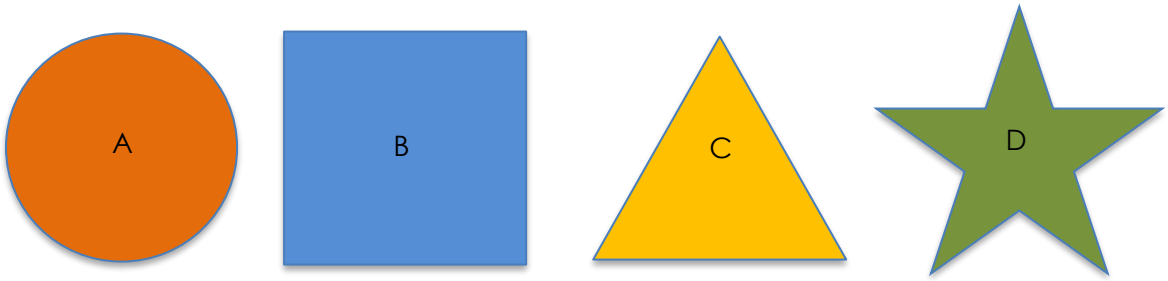
Homework Assignment 1: Baseline

1) Give two examples of symmetry in nature that were not discussed in the tutorial. State what types of symmetry each example exhibits. (4 marks)

2) Give two examples of symmetry in human culture that were not discussed in the tutorial. State what types of symmetry each example exhibits. (4 marks)

3) Write one paragraph on why you think the study of symmetry is important in mathematics and in science. (8 marks)

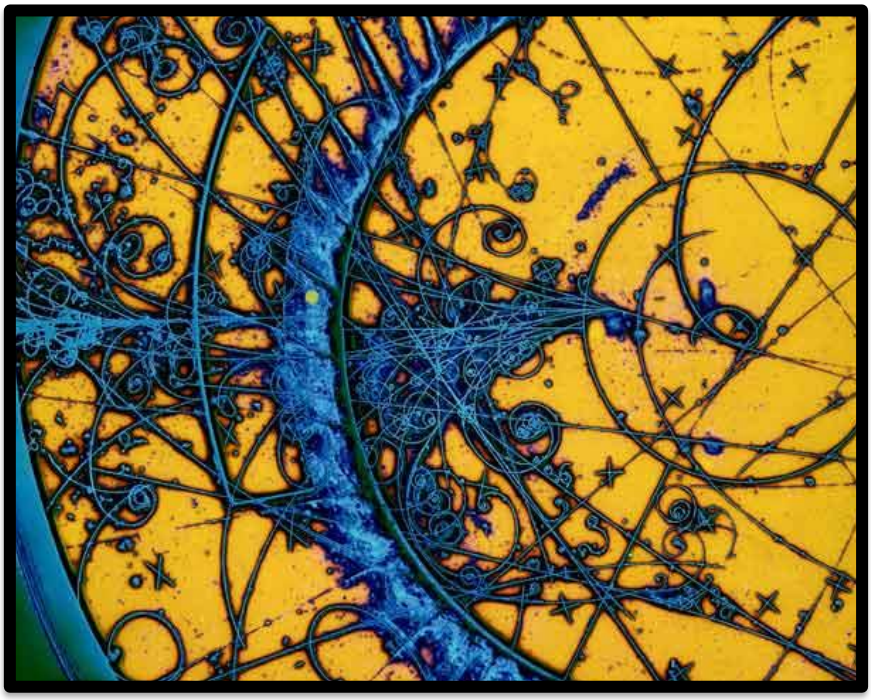
4) Order these shapes from most symmetrical to least symmetrical, giving a reason for your arrangement. (16 marks)



Success criteria:

- You should demonstrate an understanding of the fundamental ideas of symmetry.
- You should show you have an awareness of the abundance of symmetry in everyday life.
- For the final question, solid mathematical reasoning should be given in relation to the types and quantities of symmetry each shape exhibits.

Tutorial 2 – Mathematical groups and symmetry



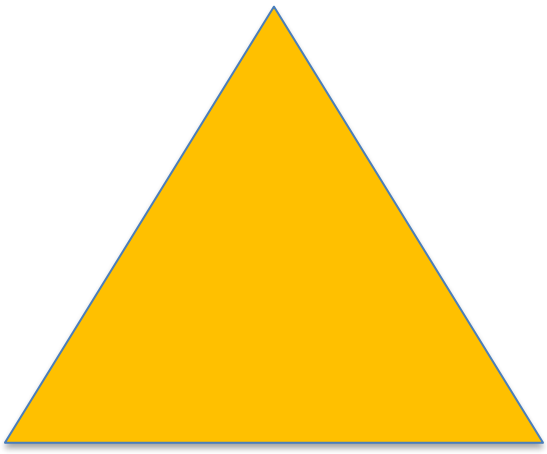
What is the Purpose of Tutorial 2?

- Construct symmetry tables for rotation and reflection operators
- List the 4 group axioms
- List some uses of groups in physics

Activity 1 – Rotations and Reflections

Mathematical operator:

What are the symmetries of the equilateral triangle?



Symmetry operators						

Observations on the symmetry table:

Activity 2 – Group theory

Axioms of group theory:

1.

2.

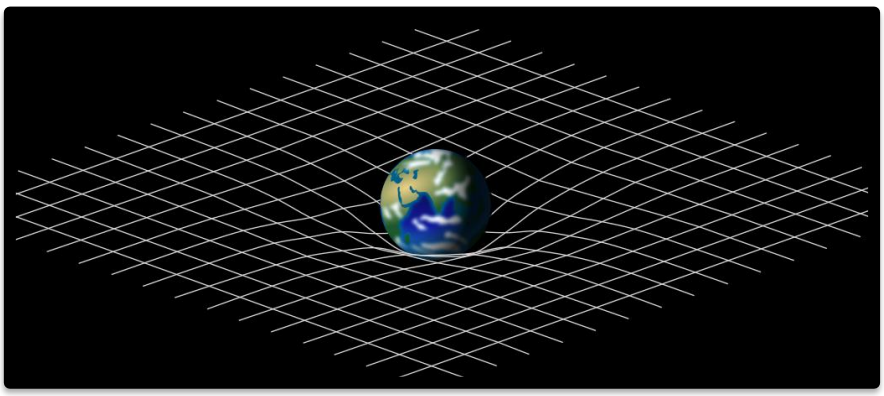
3.

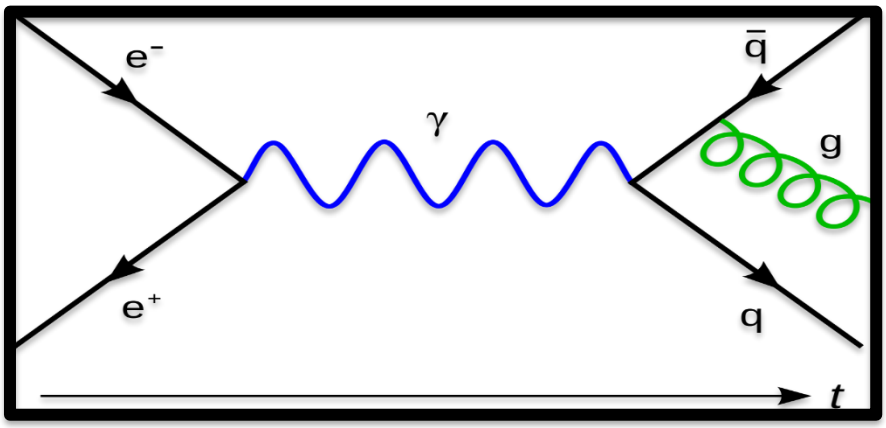
4.

Identity:

Invariant:

Activity 3 – Uses of Groups





Why are groups useful in mathematics and physics?

Homework Assignment 2:

1) Find the symmetry operators for a rectangle and write them below, explain what each of the does to the rectangle.

2) Now considering their actions on the rectangle below. Put your operators as the column and row headers of a symmetry table and fill in the centre.

3) Which operator is the identity and why?

4) Explain how each of the 4 axioms of group theory is obeyed by the symmetry table.

5) Research extension: Can you find the name of this symmetry group?

6) Research extension: Find additional uses of groups in physics not covered in this tutorial.

Homework success criteria:

The operators in the symmetry table must be clearly defined in relation to what they do to the rectangle and the combination of two operations must be correctly written in. Refer to the equilateral triangle example we did in the tutorial.
You must explain how each symmetry table is a group by using the 4 axioms of group theory.

This homework is designed to solidify the idea of a mathematical symmetry group and to give you practise at applying the 4 axioms.

Tutorial 3 – Why is order important?

What is the Purpose of Tutorial 3?

- Determine whether a set of objects or operators forms a group
- State whether two operators commute
- State whether a group is abelian or non-abelian

Activity 1 – Identifying Groups

Is this a group?

{…-2, -1 ,0 ,1 ,2 ,3…} The set of all integers under addition "+"

Is this a group?

{…-2, -1 ,0 ,1 ,2 ,3…} The set of all integers under multiplication "x"

Activity 2 – What is commutativity?

Commute:

Where have I seen examples of commutation before?

Abelian/non-Abelian:

Is D_3 Abelian or non-Abelian? How does this compare to the symmetry group you found for homework 2? (Refer to the symmetry table from tutorial 2 and homework 2)

Why is order important?

Homework Assignment 3:

1) Is this a group? $0 < x \leq 1$, where x is a decimal, under multiplication "x". Give your reasons.

2) Give two examples of operations that do not commute in the real world and explain why the order is important.

3) Give two examples of operations that do not commute in mathematics and explain why the order is important.

4) The set of rotations for a circle is called O(2), this stands for orthogonal group in 2 dimensions. State whether the successive rotations of a circle commute and therefore state whether O(2) is Abelian or non-Abelian.

5) The set of rotations for a sphere is called O(3), unsurprisingly this stands for orthogonal group in 3 dimensions. State whether successive rotations of a sphere commute and there state whether O(3) is Abelian or non-Abelian.

Homework success criteria:

The reasoning for stating whether a set of objects/numbers is a group must be related to the 4 axioms of group theory.
The questions on O(2) and O(3) require you to think about rotating circles and spheres. In order to successfully answer these questions, you need to articulate your thought process in concrete mathematical language.

This homework will enable you to identify groups in relation to the 4 axioms and then to distinguish between Abelian and non-Abelian groups.

Tutorial 4 – Can equations be symmetrical?

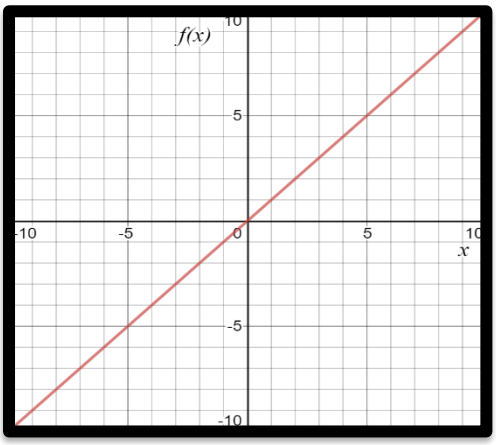
What is the Purpose of Tutorial 4?

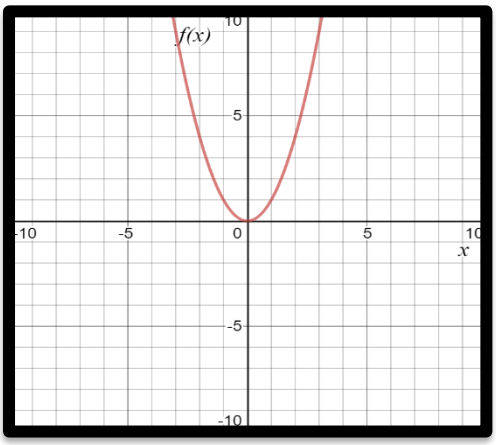
- State whether a function is odd or even
- List the uses of symmetry mappings in physics

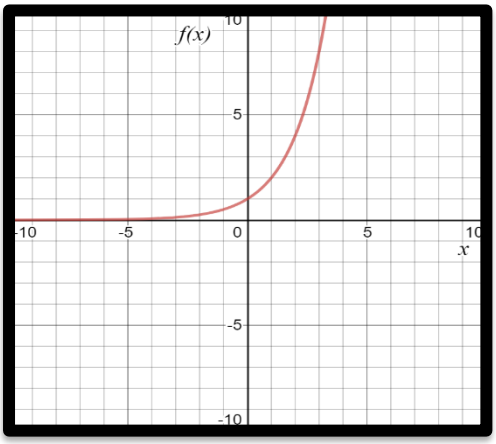
Activity 1 – Nature of symmetry

Can symmetry be abstract? Does it have to be geometrical?

What are your comments on the symmetry of these graphs?







Activity 2 – Algebraic symmetry

Odd function:

Even function:

Mapping:

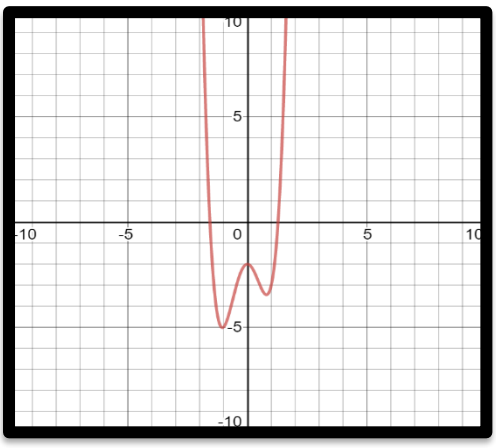
How is a mapping similar to a rotation or a reflection?

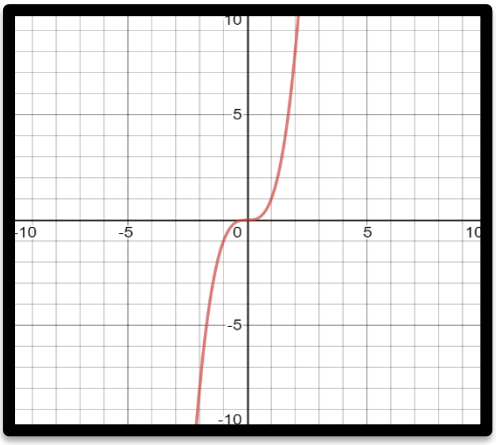
Why are algebraic symmetries important in mathematics and physics?

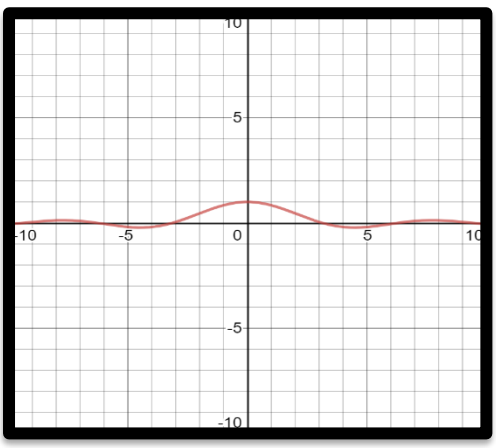
Homework Assignment 4:

1) Give an example of Noether's theorem that was not discussed in the tutorial.

2) State whether the following functions are odd, even or neither from their graphs. State your reasoning.







3) State whether the following functions are odd, even or neither from their equations. Show your working.

$$\boldsymbol{f(x) = x^2 - 4}$$

$$\boldsymbol{f(x) = 1/x}$$

$$\boldsymbol{f(x) = 3x + 5}$$

Tutorial 5 – Is the symmetry the language of the universe?

What is the Purpose of Tutorial 5?

- Show a mapping is a symmetry of an expression
- Given an expression, find its symmetry
- Critique the limits of symmetry in mathematics in the context of unsolved physics problems

Activity 1 – Symmetry in expressions

Example: Show that $x^2 + 6x - 4$ has a symmetry $x \to -x - 6$

Exercise: Show that $x^2 - 7x + 3$ has a symmetry $x \to -x + 7$

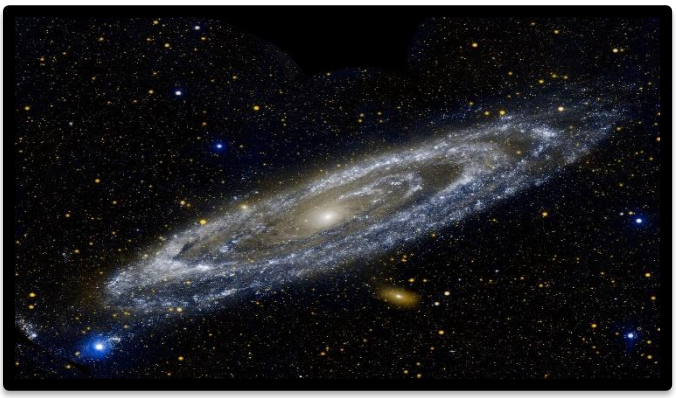
Example: What is the symmetry mapping of $3x^2 + 4x - 2$?

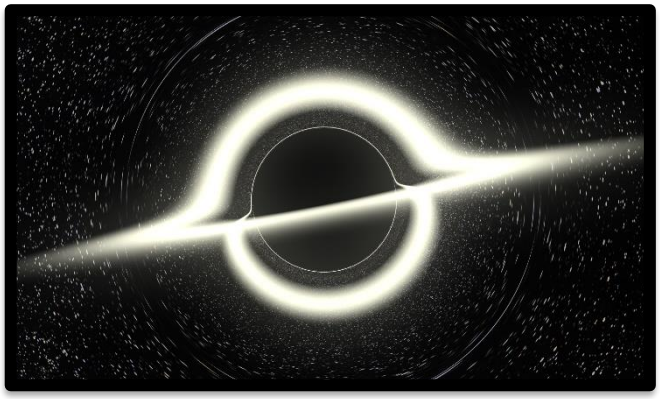
Exercise: What is the symmetry mapping of $2x^2 - 5x - 3$?

Activity 2 – Symmetry in the universe

Conclusions on symmetry in the universe:

Activity 3 – Limits in the universe





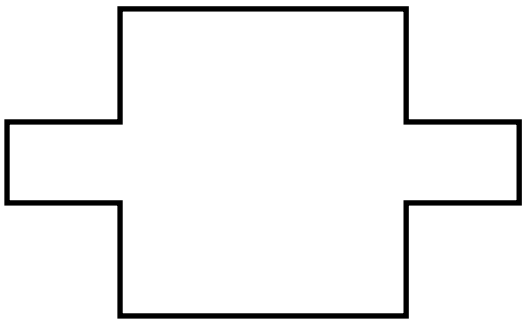
Limits of symmetry to describe the universe:

Final Assignment

Complete the problem set before moving onto the essay question.

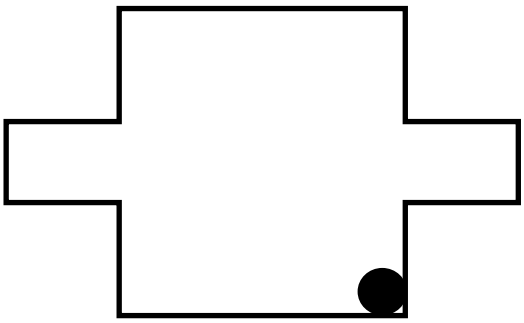
Problem set (50 marks)

1)



Draw the 2 lines of reflectional symmetry on the shape above and label them F_1 and F_2. (1 marks)

2) Now the shape has an addition in the bottom right-hand corner.



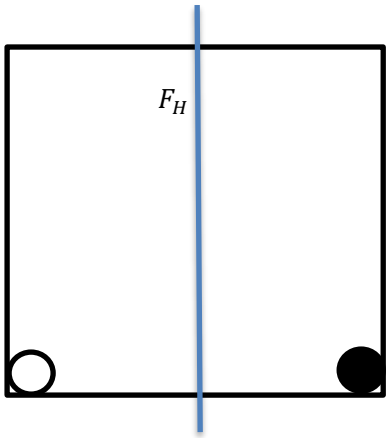
Fill in the symmetry table below using the rotation operators for 180 and 360 degrees and the reflection operators F_1 and F_2. The top row is the operation that is performed first. You should fill in the gaps with a single operation. (4 marks)

Symmetry operators	$\boldsymbol{R_{180}}$	$\boldsymbol{R_{360}}$	$\boldsymbol{F_1}$	$\boldsymbol{F_2}$
R_{180}				
R_{360}				
F_1				
F_2				

3) How do these 4 operators obey the 4 axioms of group theory? (8 marks)

4) Do R_{180}, R_{360}, F_1 and F_2 form a group? (1 mark)

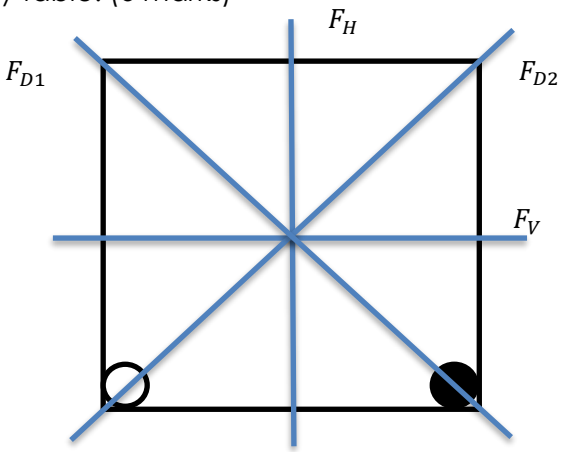
5) Now consider the square shown below:



Draw the result of doing a 90-degree clockwise rotation, R_{90}, followed by a reflection along the line shown F_H. Label this A. Then draw the result of doing the same operations, but in the reverse order and label it B. Underneath each, write the order of operations on the shape above. (4 marks)

Finally, draw the lines of reflection on the original shape that represent the single operation to get to shapes A and B. Label the lines also A and B corresponding to the shapes you have drawn. (2 marks)

6) The original square now has all lines of symmetry drawn and labelled, use it to complete the symmetry table. (6 marks)



Symmetry operations	$\boldsymbol{R_{90}}$	$\boldsymbol{R_{180}}$	$\boldsymbol{R_{270}}$	$\boldsymbol{R_{360}}$	$\boldsymbol{F_H}$	$\boldsymbol{F_V}$	$\boldsymbol{F_{D1}}$	$\boldsymbol{F_{D2}}$
R_{90}	R_{180}	R_{270}	R_{360}	R_{90}		F_{D1}	F_H	
R_{180}	R_{270}	R_{360}	R_{90}	R_{180}	F_V			F_{D1}
R_{270}	R_{360}	R_{90}	R_{180}	R_{270}	F_{D1}			F_H
R_{360}	R_{90}	R_{180}	R_{270}	R_{360}		F_V	F_{D1}	
F_H	F_{D1}			F_H	R_{360}	R_{180}	R_{90}	
F_V		F_H	F_{D1}		R_{180}	R_{360}		R_{90}
F_{D1}		F_{D2}	F_H			R_{90}	R_{360}	R_{180}
F_{D2}	F_H			F_{D2}	R_{90}		R_{180}	R_{360}

7) Is the group in the table abelian? Give a reason. (2 marks)

8) Identify a group *within* the group (this is called a sub-group). To do this find a set of operators within the table (this is called a sub-set) that obey the 4 axioms of group theory and list them below. The sub-set must be smaller than the full set of symmetry operators. (4 marks)

9) For the following functions, say whether they are odd, even, or neither. (4 marks)

$$f(x) = x^5 + 3x^3 - 5x$$

$$f(x) = 3x + 1$$

$$f(x) = x^4 - 2$$

$$f(x) = sin^2(x) - cos(x)$$

10) Show that $x \rightarrow -x - 2$ is a symmetry of the following expression $x^2 + 2x + 1$. (4 marks)

11) Find the symmetry of the following expression $4x^2 - 2x + 3$. (5 marks)

12) Why are algebraic symmetries important in the study of the universe? (5 marks)

Does the universe prefer symmetry? (50 marks)

Do this essay on separate paper.

In your essay, please include an introduction to symmetry in the natural world and in mathematics.

You should also consider the following information when writing your answer:
- Noether's Theorem.
- The work of Einstein.
- The standard model of particle physics.
- Physics at large scales and the limits of science.
- Biology and human culture.

You should use specific mathematical language to describe the symmetries in your examples.

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Notes

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