



Year 12 Further Mathematics – Algorithms



West Kirby
Grammar School

Learning about this topic is important because:

Learning these algorithmic ideas is important because they build the logical and computational thinking that underpins all of computer science and modern problem-solving.

This builds on: Basic Algebra, Logical reasoning, Ordering Systematically

This leads to: All further decision topics Y12FM/13FM, Computer science and Engineering in Further Education

We will learn:

- Use and understand an algorithm given in words
- Understand how flow charts can be used to describe algorithms
- Carry out a bubble sort
- Carry out a quick sort
- Carry out the three bin-packing algorithms and understand their strengths and weaknesses
- Determine the order of an algorithm

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Finite, step-by-step, flow chart, function, instruction, decision, unordered, ordered, list, bubble sort, quick sort, adjacent, pass, swap, pivot, sub-list, less than, greater than, bin-packing, first-fit, first-fit decreasing, full-bin, lower bound, optimal, order, complexity, run time.

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, seeking additional support from your teachers at lunchtime drop-in sessions, searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 12 Further Mathematics – Algorithms



West Kirby
Grammar School

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.



Year 12 Further Mathematics – Graphs and Networks

Learning about this topic is important because:

Learning about graphs and networks is important because it gives you a powerful way to model real-world systems using clear mathematical structures. Understanding basic graph-theory terminology and recognising special types of graphs helps you describe connections, pathways, and relationships with precision, whether you're analysing transport routes, social networks, or communication systems.

This builds on: Algorithms Y12FM

This leads to: Algorithms on graphs Y12FM, Route inspection Y12FM, Graphs and Networks Y13FM, Travelling Salesman problem Y13FM, Critical Path Analysis Y12FM

We will learn:

- Know how graphs and networks can be used to create mathematical models
- Be familiar with basic terminology used in graph theory
- Know some special types of graphs
- Understand how graphs and networks can be represented using matrices

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Vertices, nodes, connected, edges, arcs, weight, weighted graph, network, vertex set, edge set, subgraph, degree, valency, order, even, odd, walk, path, trail, cycle, Hamiltonian cycle, loop, simple graph, directed graph, digraph, Euler's handshaking lemma, tree,

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, Seeking additional support from your teachers at lunchtime drop in sessions, Searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding





Year 12 Further Mathematics – Graphs and Networks

spanning tree, complete graph, isomorphic graph, adjacency matrix, distance matrix.

new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.



Year 12 Further Mathematics – Algorithms on Graphs

Learning about this topic is important because:

Learning these algorithms is important because they give you practical, efficient methods for solving real optimisation and routing problems that appear throughout maths, computer science, engineering, and logistics. Kruskal's and Prim's algorithms model the cheapest way to connect systems like electrical grids or communication networks and Dijkstra's algorithm forms the core idea behind GPS navigation and network routing.

This builds on: Algorithms Y12FM, Graphs and Networks Y12FM

This leads to: Travelling Salesman Problem Y13FM

We will learn:

- Use Kruskal's algorithm to find a minimum spanning tree
- Use Prim's algorithm on a network to find a minimum spanning tree
- Apply Prim's algorithm to a distance matrix
- Use Dijkstra's algorithm to find the shortest path between two vertices in a network
- Use Floyd's algorithm

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Minimum spanning tree, shortest, cheapest, fastest, arc, edge, ascending order, cycle, vertex, weight, connected, distance matrix, row, column, shortest path, network, working value, final label, order of labelling, directed arcs, distance table, route table, path.

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, seeking additional support from your teachers at lunchtime drop-in sessions, searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding





Year 12 Further Mathematics – Algorithms on Graphs

	new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.
--	--

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.



Year 12 Further Mathematics – Route Inspection



West Kirby
Grammar School

Learning about this topic is important because:

Studying the route inspection problem is important because it teaches you how to find the most efficient way to cover every edge of a network, which is a core idea in optimisation and real-world planning. This problem models tasks like planning delivery routes, gritting roads, inspecting pipelines, or organising maintenance schedules, where you want to minimise time, distance, or cost while ensuring full coverage.

This builds on: Algorithms Y12FM, Graphs and Networks Y12FM

This leads to: Route Inspection Y13FM

We will learn:

- Use the orders of nodes to determine whether a graph is Eulerian, semi-Eulerian or neither
- Use the route inspection (Chinese postman) algorithm to find the shortest route in a network

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Eulerian graphs, semi-Eulerian graphs, degree, vertex, even, odd, trail, connected graph, Chinese-postman, weight, shortest route, pairings, least sum.

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, seeking additional support from your teachers at lunchtime drop-in sessions, searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 12 Further Mathematics – Route Inspection



West Kirby
Grammar School

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.	



Year 12 Further Mathematics – Linear Programming

Learning about this topic is important because:

Studying linear programming is important because it teaches you how to turn real-world optimisation problems into clear mathematical models that can be solved systematically. It shows you how to maximise profit, minimise cost, or use resources efficiently when there are constraints, which mirrors the kinds of decisions made in business, engineering, logistics, and data science.

This builds on: Algorithms Y12FM, Graphs and networks Y12FM, Graphing inequalities Y11

This leads to: The simplex algorithm Y13FM

We will learn:

- Formulate a problem as a linear programming problem
- Illustrate a two-variable linear programming problem graphically
- Locate the optimal point in a feasible region using the objective line (ruler) method
- Use the vertex testing method to locate the optimal point
- Determine solutions that need integer values

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Decision variables, objective function, constraints, inequality, feasible region, optimal solution, maximise, minimise, ruler method, vertex method, integer.

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, seeking additional support from your teachers at lunchtime drop-in sessions, searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.





Year 12 Further Mathematics – Linear Programming

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.	



Year 12 Further Mathematics –Critical Path Analysis

Learning about this topic is important because:

Studying critical path analysis is important because it gives you a systematic way to plan and manage complex projects by identifying the sequence of tasks that determines the minimum time needed for completion. It helps you spot which activities are critical, which have flexibility, and where delays would impact the whole project, making it essential for efficient scheduling in fields like engineering, construction, computing, and business.

This builds on: Algorithms Y12FM, Graphs and Networks Y12FM.

This leads to: Critical Path Analysis Y13FM

We will learn:

- Model a project by an activity network using a precedence table
- Use dummy activities
- Identify and calculate early and late event times in activity networks
- Identify critical activities
- Calculate the total float of an activity
- Calculate and use Gantt (cascade) charts

We will develop/practise skills including:

- Use and apply standard techniques: Select and correctly carry out routine procedures; and accurately recalling facts, terminology and definitions.
- Reason, interpret and communicate mathematically: Construct rigorous mathematical arguments, make deductions and inferences, assess the validity of mathematical arguments, explaining your reasoning; and using mathematical language and notation correctly.
- Solve problems within mathematics and in other contexts: Translate problems in mathematical and non-mathematical contexts into mathematical processes, use mathematical models and interpret solutions to problems in their original context, and, where appropriate, evaluating their accuracy and limitations and explain how to refine them.

Some of the vocabulary that we will use includes:

Modelling, project, completion, activities, dependencies, precedence table, activity network, arc, events, nodes, source node, sink node, dummy activity, early and late times, duration, preceding, forward pass, forward scan, backward pass, backward scan, critical activity, critical path, float, delay, Gantt chart.

You could learn more about this topic by:

Completing all exercises, mixed exercises, challenges and review questions from the textbook, seeking additional support from your teachers at lunchtime drop-in sessions, searching online for the topic and GeoGebra to find relevant visual and interactive tools for understanding





Year 12 Further Mathematics –Critical Path Analysis

	new concepts, using free question banks and revision tools on websites such as MathsGenie and Physics Maths Tutor.
--	--

Your teacher will assess your knowledge & understanding throughout the topic by looking at your work, questioning, discussion and giving you feedback in lots of different ways. The work you produce in class (your file), homework, independent study and regular assessment all form the key pieces of work in this topic.
