Learning Enquiry:

- What can I expect from the A-Level Further Mathematics course?

6th Form

Mathematics

Friday, 17 July 2020

Introducing A-Level Further Mathematics

LE: What can I expect from the A-Level Further Mathematics course?

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Course Details

A-level Further Mathematics Topics

- A Proof
- B Complex numbers
- C Matrices
- D Further algebra and functions
- E Further calculus
- F Further Vectors
- G Polar coordinates
- H Hyperbolic functions
- I Differential equations
- J Numerical methods

- DA Graphs
- DB Networks
- DC Network flows
- DD Linear programming
- DE Critical path analysis
- DF Game theory for zero-sum games
- DG Binary operations and group theory

- MA Dimensional analysis
- MB Momentum and collisions
- MC Work, energy and power
- MD Circular motion
- ME Centres of mass and moments

LE: What can I expect from the A-Level Further Mathematics course?

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Course Details

Exam Board AQA Realising potential

SUMMER 2022

Paper 1	Paper 2	Paper 3
Content: Pure Topics	Content: Pure Topics	Content: Mechanics Topics & Discrete Topics (in two separate booklets, sat in the same 2 hours)
Duration: 2 hours	Duration: 2 hours	Duration: 2 hours
Weighting: 33⅓ % of A-Level	Weighting: 33⅓ % of A-Level	Weighting: 33⅓ % of A-Level
Questions: A mix of questions from short, single-mark questions to multi-step problems.	Questions: A mix of questions from short, single-mark questions to multi-step problems.	Questions: A mix of questions from short, single-mark questions to multi-step problems.

LE: What can I expect from the A-Level Further Mathematics course?

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Course Details

At our 6th Form

- Two teachers
- Topics taught in parallel to allow time for consolidation
- Minimum of 8 hours of lessons per fortnight
- Variety of independent learning tasks
- Regular assessment and feedback
- Loaned copy of the textbooks
- System for providing additional support
- Your own ‘Folder of Awesomeness’

LE: What can I expect from the A-Level Further Mathematics course?

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Lessons

A mixture between discovery, application and consolidation

- Note taking
- Examples
- Opportunity to practice and asks questions
- Guidance for independent learning

You will require for each lesson

- Lined Paper
- Pen or Pencil
- AQA Formulae Booklet (provided in F.O.A.)
- Casio CLASSWIZ fx-991EX calculator

LE: What can I expect from the A-Level Further Mathematics course?

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The Keys to Success

- Detailed, accessible, well-organised notes
- Effective independent study
- Preparation for assessments
- Responding to feedback
- Accessing the additional support we provide
- Speaking to the experts on the KS5 Team

Mr Jolly
Course
Coordinator

Miss Webb
KS4 Leader, Yr13,
Mechanics,
Statistics and
Further
Mathematics
Specialist

Mr Watts
Senior Maths
Challenge,
Yr13, Mechanics
and Further
Mathematics
Specialist

Learning Enquiry:

- What is a traversable graph?
- How can this be applied to a Chinese Postman problem?

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Mathematics

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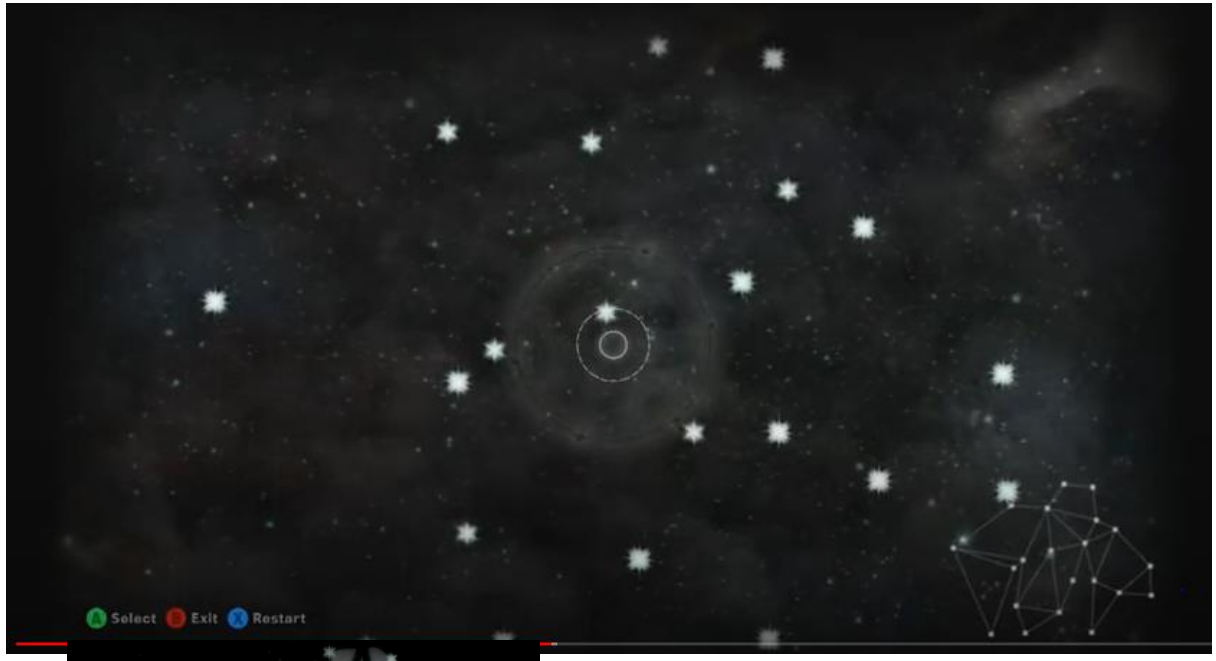
Chinese Postman Problems

Quick Explanation



LE: What is a traversable graph?

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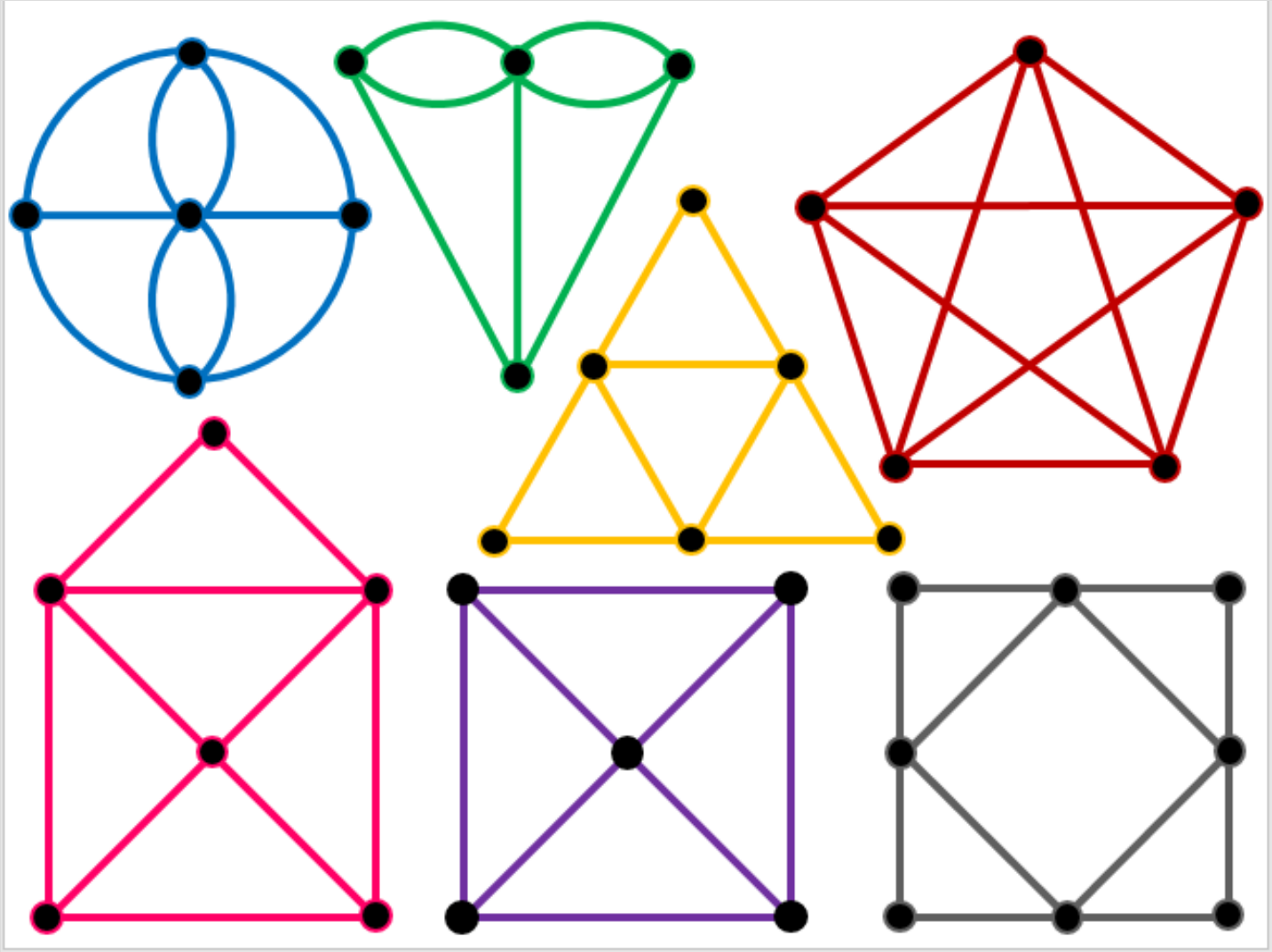

Which of these graphs can be drawn using a single continuous line (that doesn't trace back over the same edge)?

LE: What is a traversable graph?

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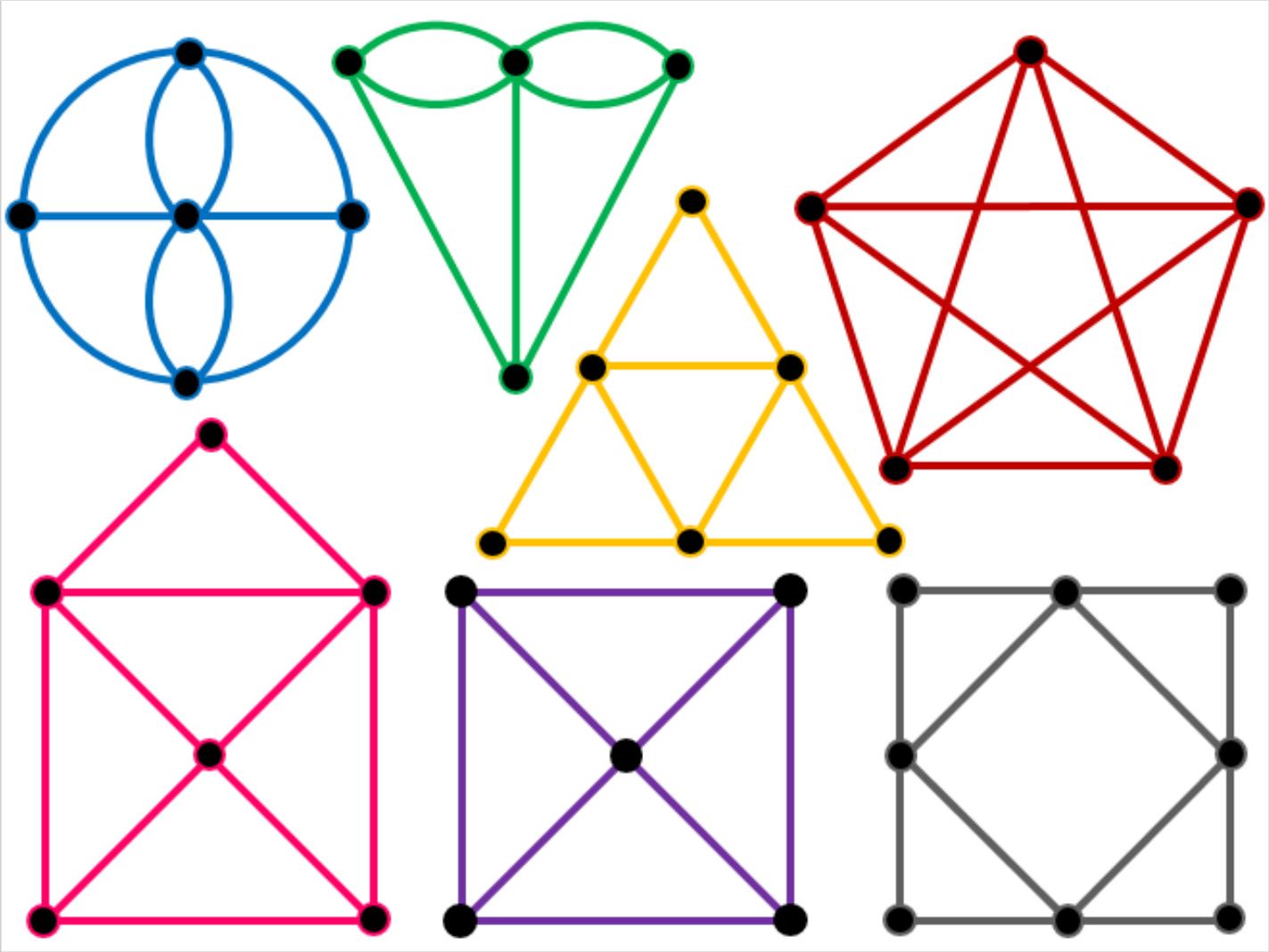

Were all the graphs traversable?

Were some graphs easier to traverse than others?

What property determines whether a graph fits into one of these three categories;
Easily traversable
Traversable
Not Traversable?

LE: What is a traversable graph?

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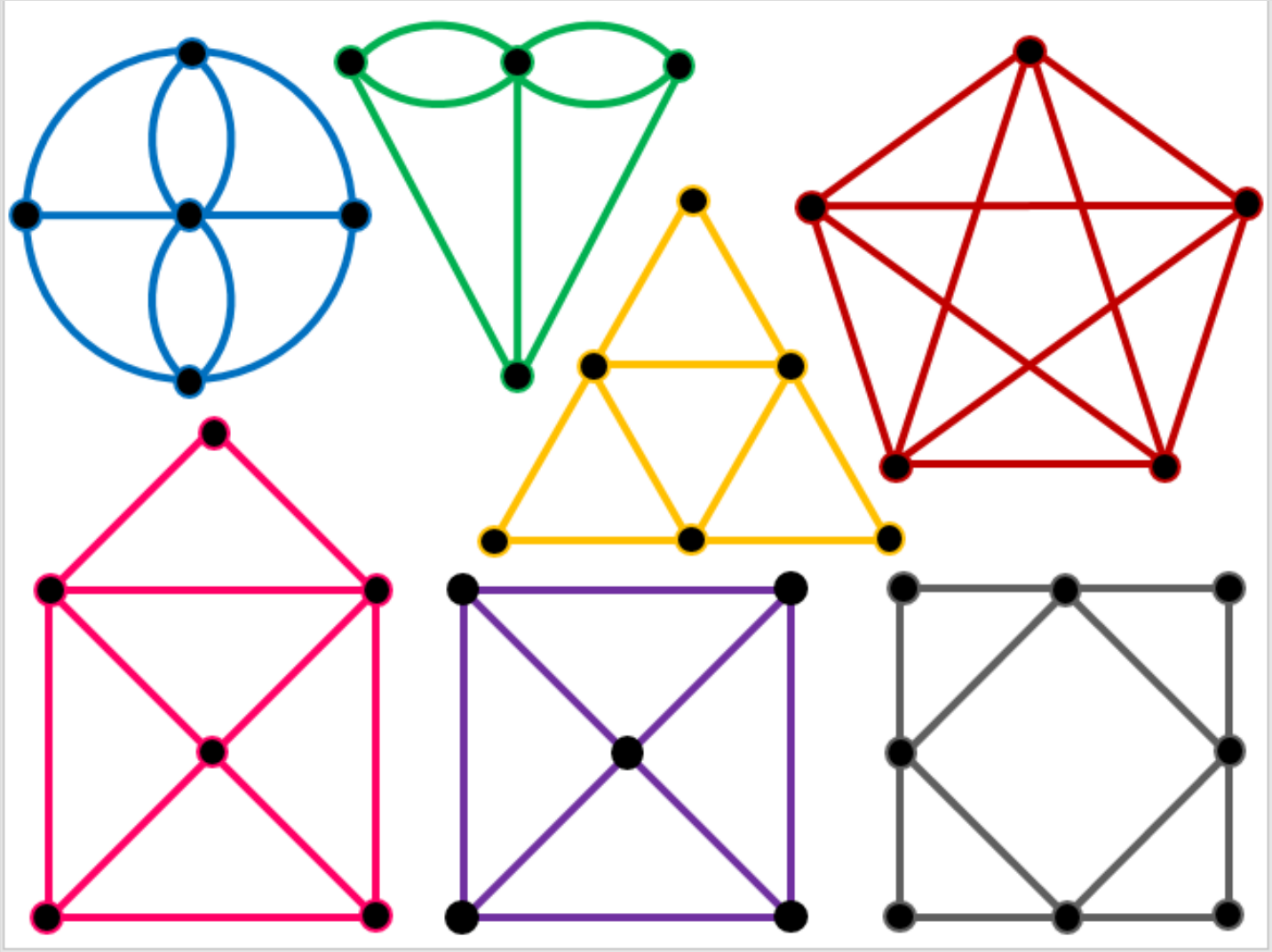

HINT:
Look at each vertex individually and count the number of edges connected to it

LE: What is a traversable graph?

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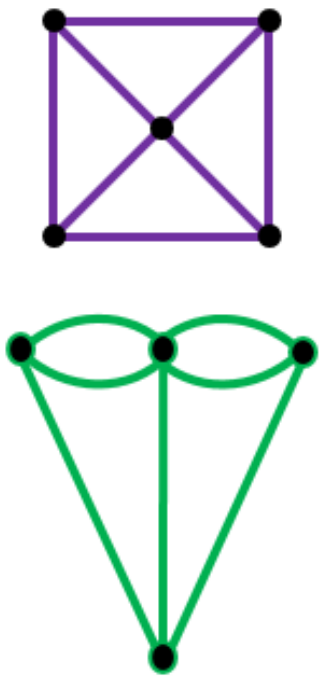
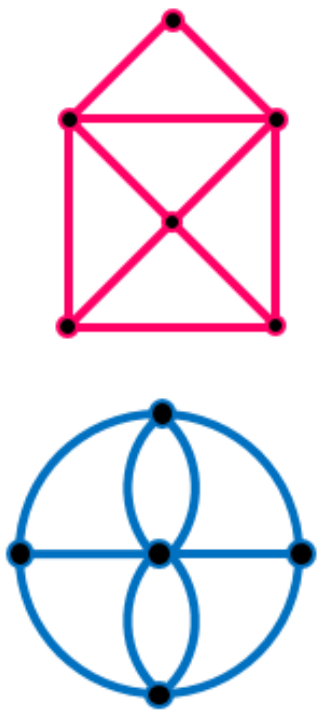
Non-Eulerian	Semi-Eulerian	Eulerian
		

Leonhard Euler
1707 - 1783

Notes

Eulerian Graphs:

- Are traversable
- Each vertex is connected to an even number of edges
- When traversing you start and finish at the same vertex
- Any vertex can be the start/finish

Semi-Eulerian Graphs:

- Are traversable
- Each vertex is connected to an even number of edges except for two 'odd' vertices
- To traverse the graph you must start at one odd vertex and finish at the other odd vertex

Non-Eulerian Graphs:

- Are not traversable
- There are more than two 'odd' vertices

LE: How can this be applied to a Chinese Postman problem?

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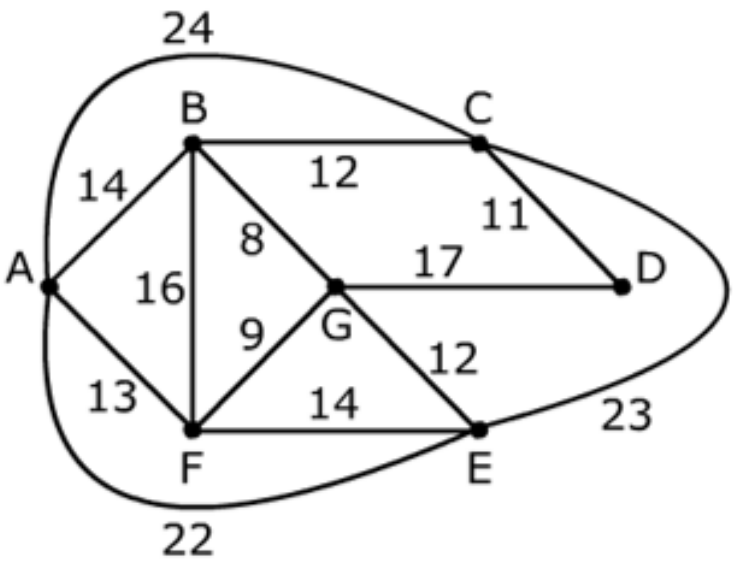
Chinese Postman Problem ~ (Algorithm published by Mei-Ko Kwan in 1962)

<u>Basic Example</u>



Vertex	Order	Vertex	Order
A	4	E	4
B	4	F	4
C	4	G	4
D	2		

Hence find a route of minimum weight that traverses every edge at least once, starting and ending at A.

Route: ACEABCDGEFGBFA

Weight: 195

LE: How can this be applied to a Chinese Postman problem?

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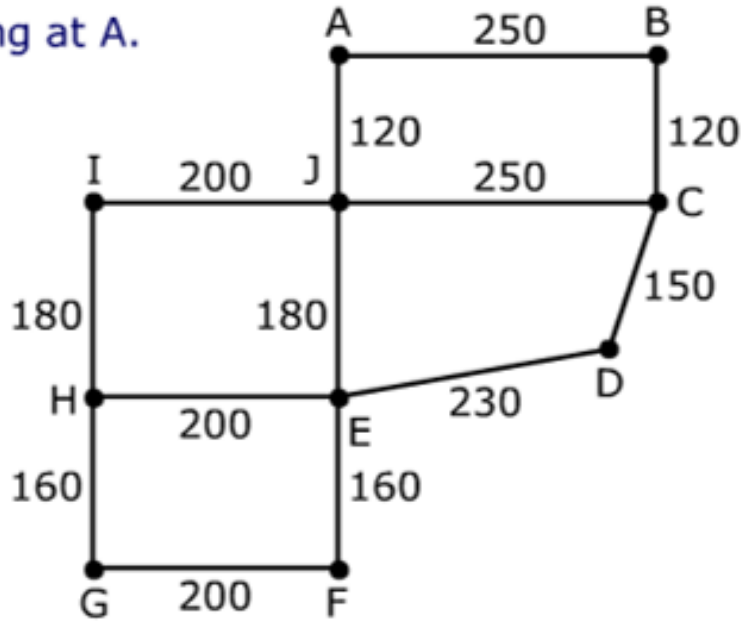
Advanced Example

Find a route of minimum length starting and ending at A.

Find the orders of the vertices.

Vertex	Order	Vertex	Order
A	2	F	2
B	2	G	2
C	3	H	3
D	2	I	2
E	4	J	4



The shortest path from C to H is CDEH with weight 580

Route: ABCDEFGHIJCDEHEJA

Weight: 2980

LE: How can this be applied to a Chinese Postman problem?

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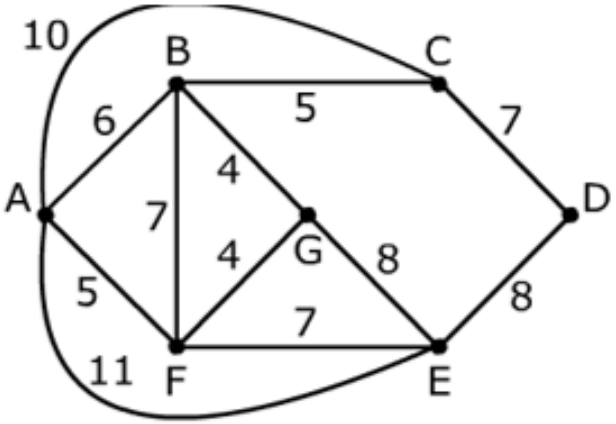
Your Turn

Question 1

The graph shows the roads in a village, with distances in 100s of m.

The postman must travel along every road at least once to deliver the post.

Fill in the answers to find the minimum distance the postman must travel and a possible route starting and ending at G.



Vertex	Order	Vertex	Order
A		E	
B		F	
C		G	
D			

The odd vertices are ____ and ____

The shortest path between the odd vertices is ____ with weight ____

A minimum length route is ____

The length of this route is ____ 100s of m = ____ m

LE: How can this be applied to a Chinese Postman problem?

6th Form
MATHEMATICS

Friday, 17 July 2020

Your Turn

Question 1

The graph shows the roads in a village, with distances in 100s of m.

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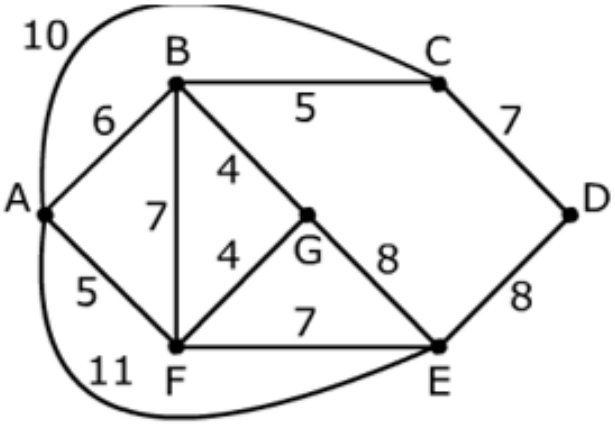

Vertex	Order	Vertex	Order
A	4	E	4
B	4	F	4
C	3	G	3
D	2		

The odd vertices are C and G

The shortest path between the odd vertices is CBG with weight 9

A minimum length route is GEACDEFABFGBCBG

The length of this route is 91 100s of m = 9100 m

LE: How can this be applied to a Chinese Postman problem?

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Friday, 17 July 2020

Your Turn

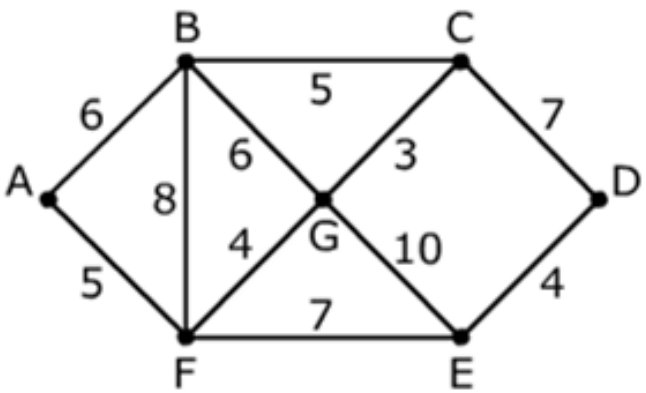
Question 2

The graph shows the roads in a village, with distances in 100s of m.

A council worker needs to walk along every road at least once to check the state of the pavements.

He will be dropped off at the start of his inspection and picked up at the end so can start and finish at different points.

Find the minimum distance the council worker must walk and write down a suitable route for his inspection.



Vertex	Order	Vertex	Order
A		E	
B		F	
C		G	
D			

The council worker should start his inspection at ____ and finish at ____

A minimum length route is ____

The length of this route is ____ 100s of m = ____ m

LE: How can this be applied to a Chinese Postman problem?

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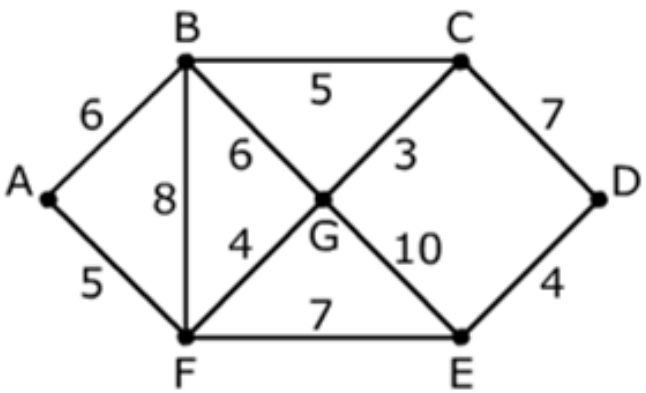
Friday, 17 July 2020

Your Turn

Question 2

The graph shows the roads in a village, with distances in 100s of m.
A council worker needs to walk along every road at least once to check the state of the pavements.
He will be dropped off at the start of his inspection and picked up at the end so can start and finish at different points.
Find the minimum distance the council worker must walk and write down a suitable route for his inspection.



Vertex	Order	Vertex	Order
A	2	E	3
B	4	F	4
C	3	G	4
D	2		

The council worker should start his inspection at C and finish at E

A minimum length route is CDEFABFGCBGE

The length of this route is 65 100s of m = 6500 m

LE: How can this be applied to a Chinese Postman problem?

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Friday, 17 July 2020

Your Turn

Question 3

The graph shows the roads connecting 8 towns, with distances in km.

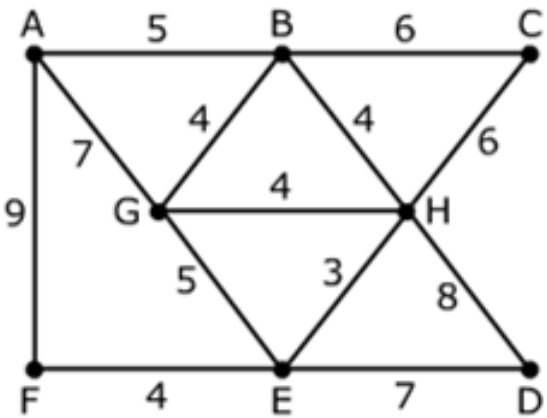
A lorry must travel along every road at least once to repaint the white lines.

Fill in the answers to find the minimum distance the lorry must travel and give a possible route starting and ending at A.

Vertex	Order	Vertex	Order
A		E	
B		F	
C		G	
D		H	

[2]

The odd vertices are ____ and ____ [1]



The shortest path between the odd vertices is ____ with weight ____ [3]

A minimum length route is ____ [3]

The length of this route is ____ km [2]

LE: How can this be applied to a Chinese Postman problem?

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Friday, 17 July 2020

Your Turn

Question 3

The graph shows the roads connecting 8 towns, with distances in km.

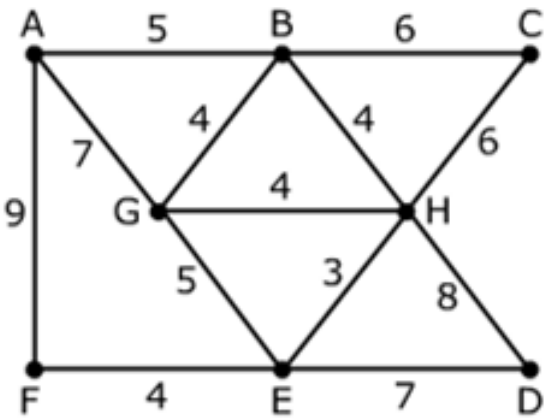
A lorry must travel along every road at least once to repaint the white lines.

Fill in the answers to find the minimum distance the lorry must travel and give a possible route starting and ending at A.

Vertex	Order	Vertex	Order
A	3	E	4
B	4	F	2
C	2	G	4
D	2	H	5

[2]

The odd vertices are A and H [1]



The shortest path between the odd vertices is ABH with weight 9 [3]

A minimum length route is ABCDEFAGBHEGHBA [3]

The length of this route is 81 km [2]

LE: How can this be applied to a Chinese Postman problem?

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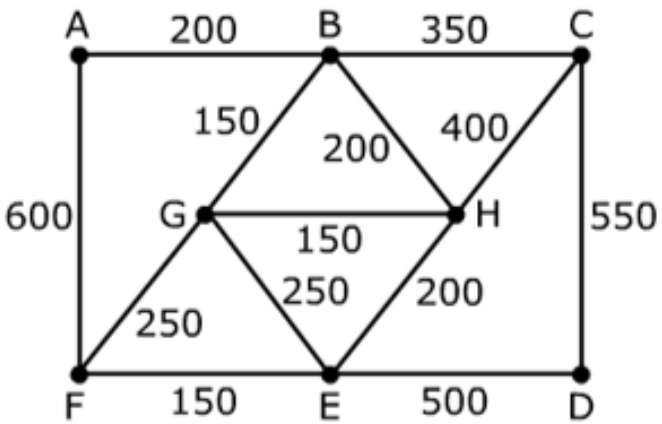
Your Turn

Question 4

Andrew has a paper round. His Mum drops him off at the start and picks him up at the end.

The graph shows the roads on his route, with distances in m.

Andrew needs to walk along every road at least once. He wants to keep the total distance walked to a minimum.



Where should Andrew ask to be dropped off and picked up? ☐ and ☐ [2]

Write down a possible route of minimum length. ☐ [3]

Find the length of this route. ☐ m [2]

LE: How can this be applied to a Chinese Postman problem?

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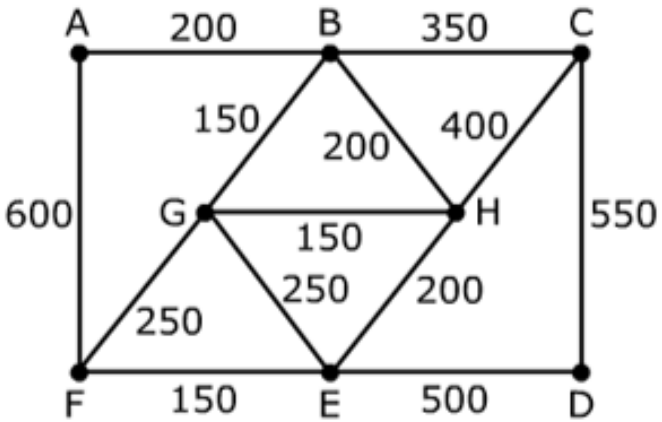
Your Turn

Question 4

Andrew has a paper round. His Mum drops him off at the start and picks him up at the end.

The graph shows the roads on his route, with distances in m.

Andrew needs to walk along every road at least once. He wants to keep the total distance walked to a minimum.



Where should Andrew ask to be dropped off and picked up?

C and F [2]

Write down a possible route of minimum length.

CDEFABCHBGHEGF [3]

Find the length of this route.

3950 m [2]

So what now?

- Q&A Session
- Extension Problem slides
- Summer Assignment

LE: How can this be applied to a Chinese Postman problem?

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Extension: What about a Non-Eulerian graph?

Chinese Postman Problem

Step 1: Find the orders of the vertices and identify the odd vertices.

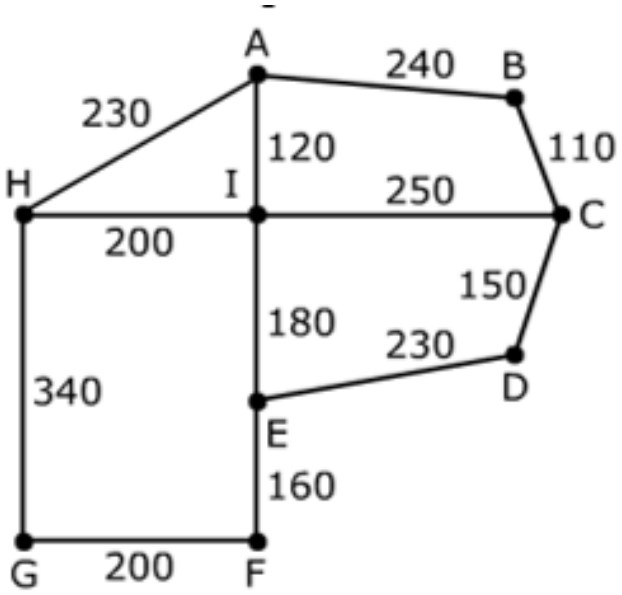
Step 2: Write down all the possible pairings of the odd vertices.

Step 3: For each pairing, find the shortest paths between the vertices.

Add up the weights on the shortest paths and choose the pairing with the smallest total.

Step 4: Write down a trail using the shortest paths from the chosen pairing twice, and all the other edges once.

Step 5: Add up the weights from the original graph and the total from Step 3.



LE: How can this be applied to a Chinese Postman problem?

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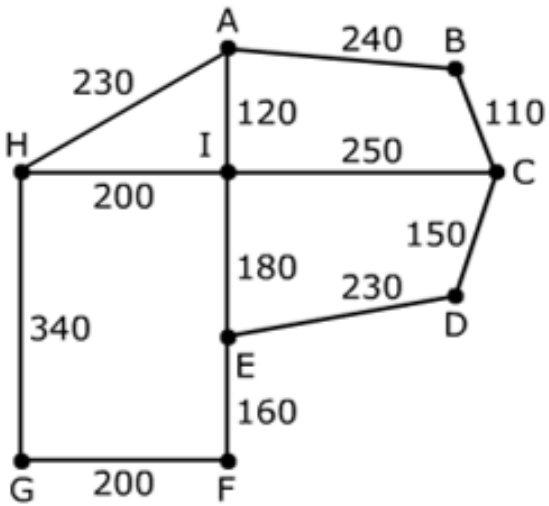
Extension: What about a Non-Eulerian graph?

Find a route of minimum length that the farmer could use, starting and ending at A.

Fill in the orders and identify the odd vertices.



Vertex	Order	Vertex	Order
A	3	F	2
B	2	G	2
C	3	H	3
D	2	I	4
E	3		

The odd vertices are

A , C , E and H

Route: ABCDEFGHAICDEIHA

Weight: 3020

Possible Pairs	Shortest Paths	Weights
AC and EH	ABC and EIH	350 + 380 = 730
AE and CH	AIE and CIH	300 + 450 = 750
AH and CE	AH and CDE	230 + 380 = 610