KNOX GRAMMAR SCHOOL

STATE

DA VINCI DECATHLON 2019

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS IN YEARS 9, 10 & 11

da Vinci Decathlon® EXCITE ENRICH CHALLENGE An initiative of Knox Grammar School

MATHEMATICS

TEAM NUMBER _____

1	2	3	4	5	Total	Rank
/12	/8	/16	/12	/12	/60	

Complete the above table with question numbers and marks as required.

QUESTION ONE

BACKYARD MATHS

12 MARKS

Jim is doing some **landscaping** and gardening in his backyard, and he has the following **questions for you to complete**.

PART ONE (6 MARKS)

The edge of Jim's circular flower bed, 220 feet in diameter, requires mulch. How many cubic yards of mulch is needed to cover 3 feet in from the edge, and to a depth of 2.5 inches, all the way around the flower bed? There are 3 feet in a yard and 12 inches in a foot.

PART TWO (3 MARKS)

Jim has 5 very large pots that take 1.75 bushels of potting mix each. A bag of potting mix contains about 3 cubic feet. How many bags are needed? One bushel is 1.25 cubic feet.

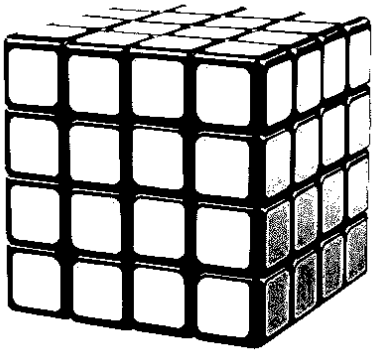
PART THREE (3 MARKS)

Finally, Jim has a kidney-shaped garden bed and wants to plant some herbs in it. Each plant will be 1ft away from each other. The shape is irregular and the width varies, but Jim nevertheless measured the width at intervals of 10ft, starting from one end of the bed. The widths recorded were 11ft, 13ft, 5ft and 17ft. How many plants will Jim need to fill the bed?

QUESTION TWO

CHANGING THE GAME

8 MARKS



There is a **new product** on the market, which is set to change the gaming landscape. Gone are the days of regular tic-tac-toe, for a much greater invention has come to light – **three-dimensional** noughts and crosses.

The game is played using a 4x4x4 board (see right), composed of 64 cells, and players take turns as usual. The first player to get **four in a row** of their symbol wins. Players place counters inside the cells – imagine that the board is comprised of 64 see-through boxes.

How many different ways can the game be won? Furthermore, what would be the formula for the number of ways to win on an n-dimensional board of k height/width/depth?

QUESTION THREE

SHIP SHAPE

16 MARKS

Two ships, S and T, are cruising on **straight courses** and at **constant speeds**. At 10.00am, they are 5km apart, at 11.00am they are 4km apart. By 1.00pm they are 10km apart. At 7.00am, S was due west of T.

Using this information, please answer the **following questions**:

a) How far apart were the ships at 7.00am? **(4 marks)**

b) When in future will they be 26km apart? **(2 marks)**

c) How close do the ships get to each other? At what time are they nearest? **(2 marks)**

d) When is S due north of T? **(2 marks)**

e) When is S southwest of T? **(2 marks)**

f) Suppose S and T have the same speed and T is heading due south. What is the speed and direction of S? **(4 marks)**

QUESTION THREE WORKING SPACE CONTINUED

QUESTION THREE WORKING SPACE CONTINUED

QUESTION FOUR

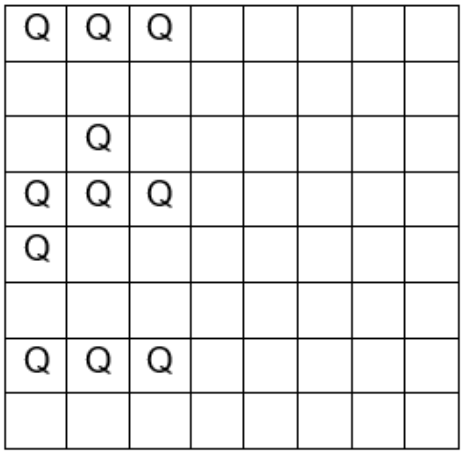
ACROSS THE BOARD

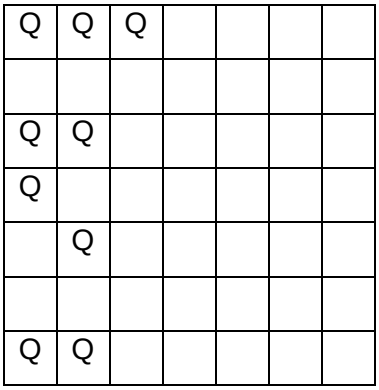
12 MARKS

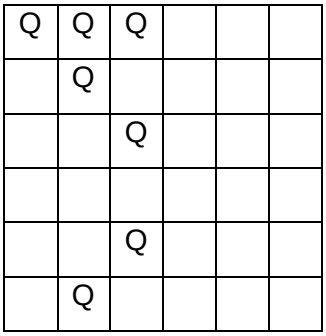
The **chessboard** is one of the ultimate **mathematical landscapes**, used for centuries as a form of leisure, entertainment, competition and challenge. Below are a number of chess-based puzzles for you to complete.

PART ONE – SINGLE QUEENS (6 MARKS)

This task is simple. Shade all the squares controlled by a single queen only.



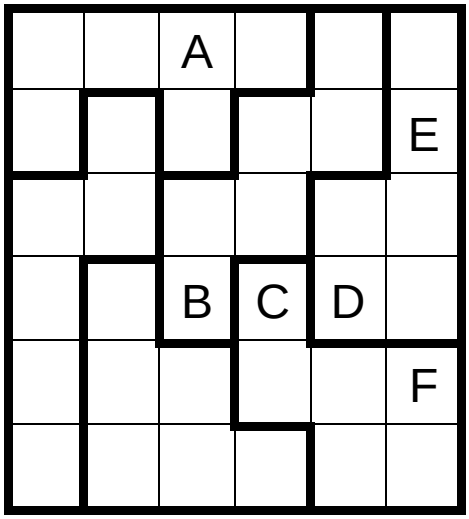




(Each square marked Q contains a Queen)

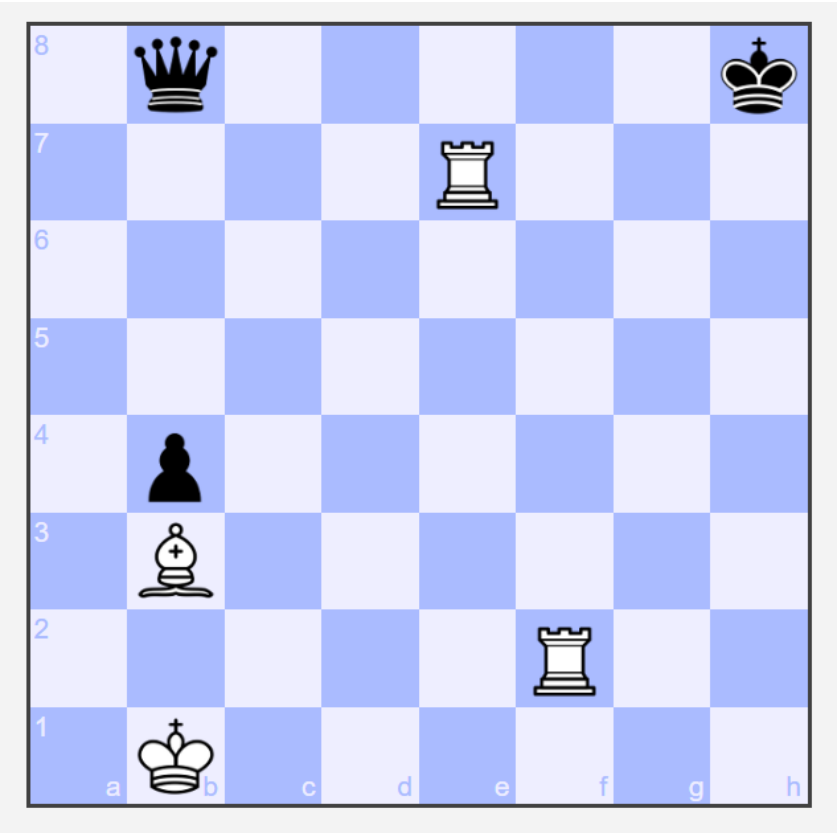
PART TWO – LATIN SQUARE (3 MARKS)

This problem is, in reality, more like sudoku than chess. Can you complete the square?

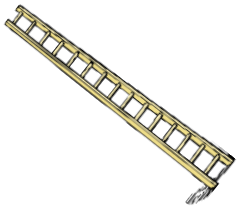


PART THREE – CHECKMATE (3 MARKS)

Finally, a traditional puzzle – can you checkmate in three moves (as white)? Please provide your answer in the space underneath.



QUESTION FIVE



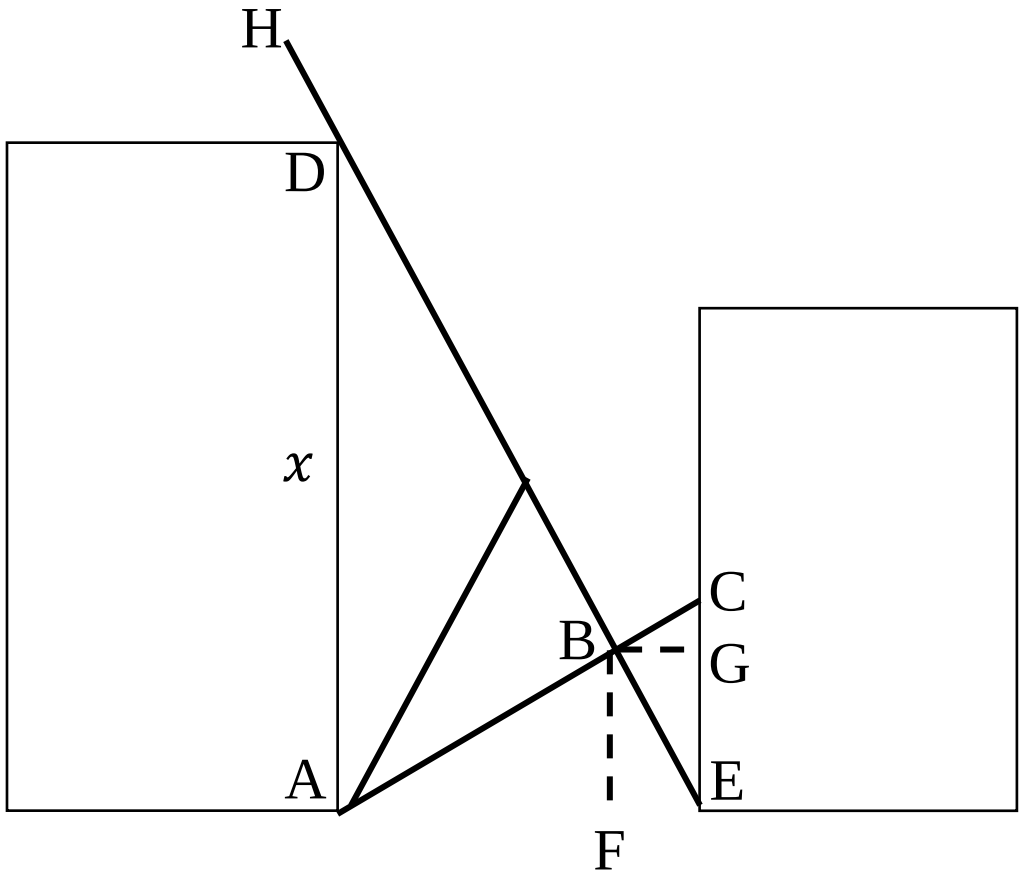
LADDER LINKUP

12 MARKS

This problem is represented by the **diagram below**. In essence, there are **two buildings** on opposite sides of a street, and a **series of ladders** laid across the space in between. Your task is to **determine x,** the height of the **taller building** (i.e. length DA).

Length HD is 2 feet 2 inches, while ladder AC is 22 feet 11 inches. Ladder HE is 70 feet and length BF is 5 feet 10 inches.

For reference, one foot is twelve inches. The capital letters in the diagram represent **points**. Please use them in your working out.



Hint: You will eventually reach the number 586,971 as one side of an equation. This can be expressed as:

1. $1386^2 - 1155^2$
2. $814^2 - 275^2$
3. $770^2 - 77^2$

QUESTIONG FIVE WORKING SPACE

QUESTIONG FIVE WORKING SPACE CONTINUED