

## Lesson 5

### Further A-Level Pure Mathematics : Core 1 Matrix Systems of Equations

#### 5.1 Word Problems

The examination may feature a question in which the matrix calculations can be done on a calculator. Before getting to that point, however, the problem given may be in words, and setting up the matrix equation in the first place becomes a significant part of the problem.

#### 5.2 Example

Miranda has decided to invest £24500 spread between three bank accounts which pay the following interest rates per annum;

Account X : An “Extra Gold” Account ... .. 4 %

Account Y : A “Why settle for less ?” Account ... .. 5.5 %

Account Z ; An “eZee saver” Account ... .. 6 %

The amount of money that Miranda places in the “Extra Gold” account is four times the amount of money that she places in the “Why settle for less ?” account. One year later, she has made £1300 in interest.

Set up a matrix equation from the information provided and then solve that equation to determine how much money Miranda initially placed in each account.

Teaching Video : <http://www.NumberWonder.co.uk/v9095/5a.mp4>  
<http://www.NumberWonder.co.uk/v9095/5b.mp4>



<== Part 1

Part 2 ==>



Watch the video and then write out a full solution here:



[ 6 marks ]

### 5.3 Exercise

*Any solution based entirely on graphical  
or numerical methods is not acceptable*

Marks Available : 30

#### Question 1

Harry, Boris and Sid went to the shop, "Play and Party", to buy decorations for their school's sixth form dance. For £244, Harry purchased three inflatable space aliens, four boxes of indoor fireworks and five bags of party poppers. Boris spent £304 when he bought six inflatable space aliens, five boxes of indoor fireworks and two bags of party poppers. Sid bought three inflatable space aliens, two boxes of indoor fireworks and one bag of party poppers. Sid spent £134.

Form a system of equations in matrix form from the information provided and then solve them to determine the unit cost of each item.

[ 6 marks ]

## Question 2

A specialist farmer breeds only Suri Alpacas, Huacaya Alpacas or Domestic Llamas.



The BBC's Kate Humble with a young Suri Alpaca in Peru

Initially the farm has 2810 of these three types of animal.  
There were 160 more Suri Alpacas than Huacaya Alpacas.

After one year :

- the number of Suri Alpacas had increased by 5 %
- the number of Huacaya Alpacas had increased by 3 %
- the number of Domestic Llamas had decreased by 4 %
- overall the farm had 46 more of these three types of animal

Form and solve a matrix equation to find out how many Suri Alpacas, how many Huacaya Alpacas and how many Domestic Llamas there were initially.

[ 6 marks ]

**Question 3**

Oscar is making a tropical fruit punch for his school's sixth form dance using bananas, oranges and papayas. Altogether he uses seventy pieces of fruit, costing £34.20. He uses twice as many oranges as bananas.

Each banana cost 27p, each orange cost 32p and each papaya cost £1.60.

Form and solve a matrix equation to find out how many of each type of fruit were used in Oscar's (rather good) tropical fruit punch. Cheers Oscar !

[ 6 marks ]

**Question 4**

A colony of bats is made up of brown bats, grey bats and black bats.

Initially there are 2000 bats and there are 250 more brown bats than grey bats.

After one year;

- the number of brown bats had fallen by 1 %
- the number of grey bats had fallen by 2 %
- the number of black bats had increased by 4 %
- overall there were 40 more bats

Form and solve a matrix equation to find out how many of each colour bat there were in the initial colony.

[ 7 marks ]

**Question 5**

Use a calculator to find the unique solution to this system of equations,

$$\begin{aligned}x + y + z + w &= 13 \\2x + 3y + 0z - w &= -1 \\-3x + 4y + z + 2w &= 10 \\x + 2y - z + w &= 1\end{aligned}$$

[ 5 marks ]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2023 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from [mhh@shrewsbury.org.uk](mailto:mhh@shrewsbury.org.uk)