2015 Junior Certificate Ordinary Level
Official Supplementary Sample Questions

Question 1 **(Suggested maximum time: 10 minutes)**

The photograph on the right shows an American Football stadium.

The pitch is outlined in white in the centre of the photograph.

The width of the pitch is 160 feet (marked W in the photograph).

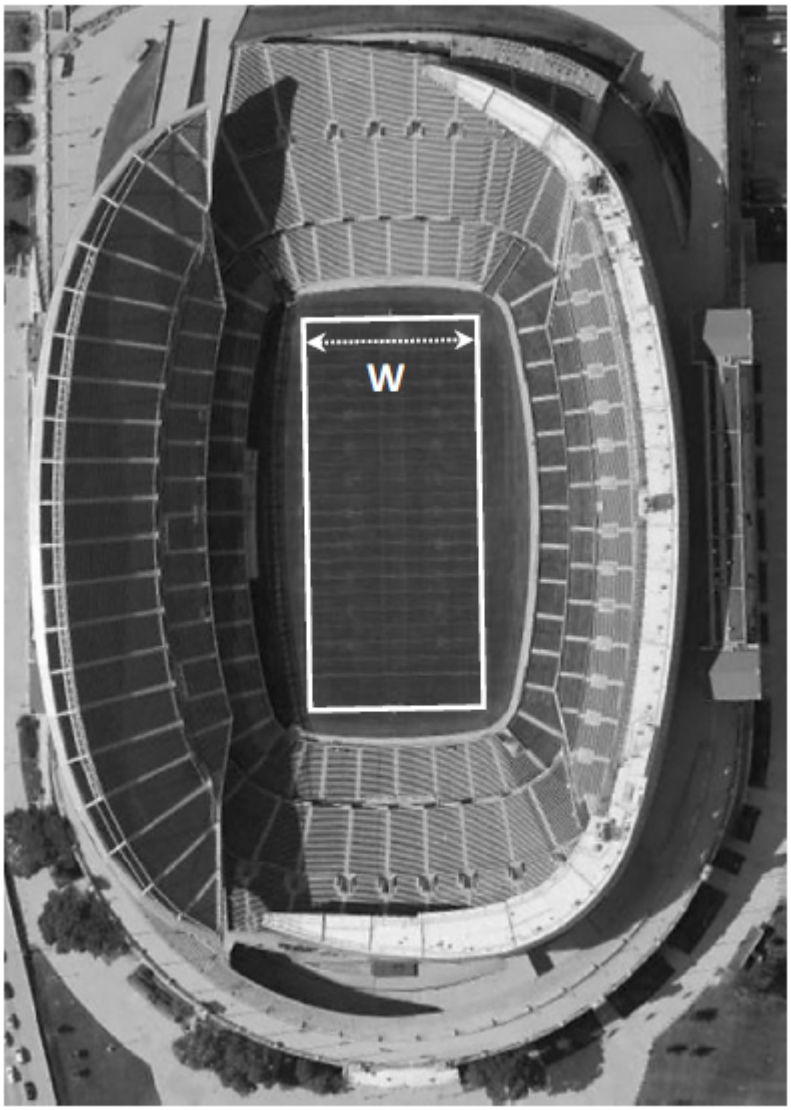
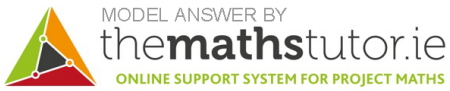


Photo: "Soldier Field aerial." Author: *NASA*. Wikimedia Commons. Public domain. (Altered)

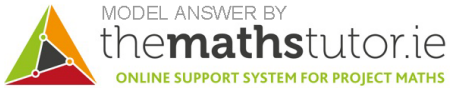
(a) By measuring the photograph and using an appropriate scale, estimate the length of the pitch (in feet) and the area of the pitch (in feet^2) as accurately as you can.

By measuring the picture, we see that the width of the pitch is 2.1 cm and the length is 4.8 cm (this may vary depending on your printer, but we will work from this estimate). If the actual width of the pitch is $w = 160$ ft, then the scale is 1 cm in the picture corresponds to $\frac{160}{2.1} = 76.19$ ft. This means that the actual width is $l = 4.8 \times \frac{160}{2.1} = 365.714$ ft. Hence the area is $w \times l = 58,514.24$ ft^2 correct to two decimal places.



(b) Sports pitches in Ireland are often laid out in metres rather than in feet. If one metre is 3.28 feet, find the area of this pitch in square metres. Give your answer correct to the nearest whole number.

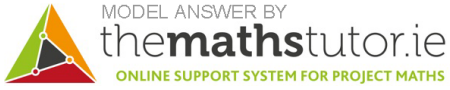
The actual width is $w = 160$ ft which corresponds to $w = \frac{160}{3.28} = 48.78$ m. Similarly, the actual length is $l = 365.714$ ft which corresponds to $l = \frac{365.714}{3.28} = 111.498$ m. Thus, the area in metres is $w \times l = 5,439$ m^2 correct to the nearest whole number.



Question 2 **(Suggested maximum time: 10 minutes)**

(a) Factorise $5x - 15$ and $6 - 2x$.

$$5x - 15 = 5(x - 3) \qquad \text{and} \qquad 6 - 2x = 2(3 - x) = -2(x - 3)$$



If A and B are variable quantities, we say that A is proportional to B if the fraction $\frac{A}{B}$ is a constant.

(b) Using your answers to part **(a)** above, show that $5x - 15$ is proportional to $6 - 2x$.

$$\frac{5x-15}{6-2x} = \frac{5(x-3)}{-2(x-3)} = -\frac{5}{2}$$

This fraction is a constant, so $5x-15$ is indeed proportional to $6-2x$.

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Question 3 **(Suggested maximum time: 5 minutes)**

In a shop, the VAT rate for each item is 10%.

The shopkeeper knows the selling price of an item, before VAT is added.

Give an example to show how she could calculate what the selling price of this item should be, after VAT is added.

We need to calculate the VAT to be charged for the item, and then add the VAT to the cost of the item. If 10% VAT is added, then the price **including** VAT is 110% of the price **excluding** VAT. So we multiply the price **excluding** VAT by 110% to get the price **including** VAT.

For example, suppose that an item is being sold for €50 before VAT of 10% has been charged. We multiply the price **excluding** VAT by 110% to get $50 \times 1.1 = €55$ as the selling price **including** VAT.

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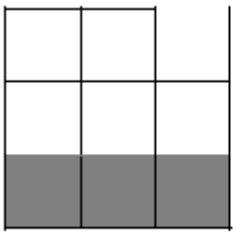
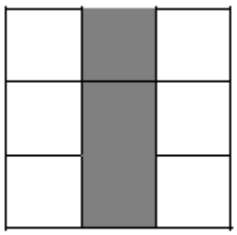
Question 4 **(Suggested maximum time: 15 minutes)**

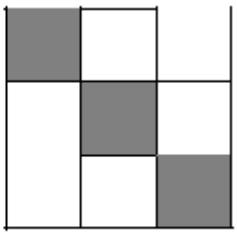
Noughts and Crosses is a two-person game played on a 3×3 grid, made up of 9 small squares. We call each of the 3 rows, 3 columns, and 2 diagonals a *line*. An example of one type of line is shaded in each of the 3×3 grids below.



Row



Column



Diagonal

(a) In the 3×3 grid below, write in each small square the number of different lines to which

it belongs. Two small squares are already filled in for you – one belongs to 3 different lines, and the other belongs to 2 different lines.

	2	
		3

Firstly, we note that every cell is contained in one row and one column, so each cell will belong to at least 2 lines. The four corners are on one of the diagonals, so they belong to 3 lines. The centre cell is on both diagonals, so it belongs to 4 lines. Thus, our grid becomes:

3	2	3
2	4	2
3	2	3

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Noughts and Crosses can also be played on an 6×6 grid, made up of 36 small squares.

A *line* of this grid is one of its rows, one of its columns, or one of its 2 diagonals.

(b) How many different **rows** are in this grid? How many different **columns** are in this grid?

There will be 6 different rows and 6 different columns in this grid.

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(c) Explain why each small square of the 6×6 grid must belong to at least 2 lines.

Each cell is contained in one row and one column, but not necessarily a diagonal. Thus, each cell in an 6×6 grid will belong to at least 2 lines.

(d) Find the maximum number of lines to which a small square in the 6×6 grid may belong. Show all of your work.

We will construct the 6×6 grid:

3	2	2	2	2	3
2	3	2	2	3	2
2	2	3	3	2	2
2	2	3	3	2	2
2	3	2	2	3	2
3	2	2	2	2	3

We can see that the maximum number lines a cell will belong to is 3.

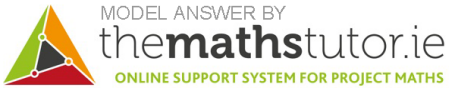
Question 5 **(Suggested maximum time: 5 minutes)**

(a) Find the maximum and the mean of the following data:

$$3, 5, 7, 8$$

The maximum element of the data is 8.

The mean of the data is $\bar{x} = \frac{3+5+7+8}{4} = \frac{23}{4} = 5.75$.

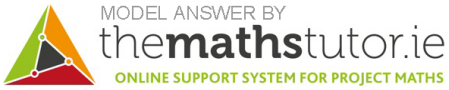


(b) Gerry starts to give an example of a list of 4 numbers where the maximum is the same as the mean. Fill in the 2 missing numbers in Gerry's list, and write down the mean of his list.

Gerry's list $= 6, 6, \square, \square$

Mean $= \square$

The only way a set can have its maximum the same as the mean is if all the numbers are the same. Thus, Gerry's set is $\{6,6,6,6\}$, which has mean $\bar{x} = \frac{6+6+6+6}{4} = 6$.

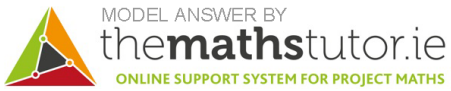


Question 6 **(Suggested maximum time: 10 minutes)**

(a) Marcel has a number trick where he asks the audience to "think of a number". He calls this number x. Marcel gives the audience the instructions in the table below and then "magically" tells them what answer they got. Fill in the table to show the effect of each of the instructions.

Instruction	**Result of each instruction**
Think of a number.	x
Multiply the number by 3.	$3x$
Add 2 to your answer.	
Subtract your original number (i.e. x).	
Divide your answer by 2.	$x+1$
Subtract your original number.	

Instruction	Result of each instruction
Think of a number.	x
Multiply the number by 3.	$3x$
Add 2 to your answer.	$3x+2$
Subtract your original number (i.e. x).	$2x+2$
Divide your answer by 2.	$x+1$
Subtract your original number.	1



(b) Marcel has a second number trick. It is shown in the table below, but some of the instructions are missing. Complete the table to show the missing instructions. Each instruction should be to add a number, subtract a number, multiply by a number, or divide by a number.

Instruction	Result of each instruction
Think of a number.	x
	$2x$
	$2x+6$
Add your original number (i.e. x).	$3x+6$
	$x+2$
	2

Instruction	Result of each instruction
Think of a number.	x
Multiply the number by 2	$2x$
Add 6 to your answer	$2x+6$
Add your original number (i.e. x).	$3x+6$
Divide your answer by 3	$x+2$
Subtract your original number	2