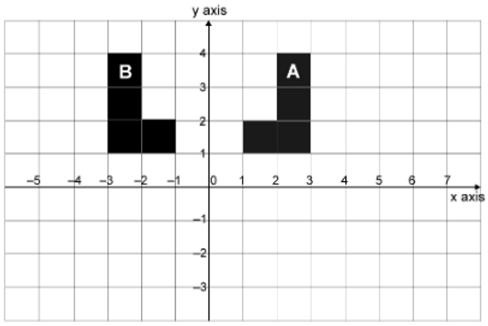
QUESTION 1 (6 Marks)

1. a. (1 Mark)

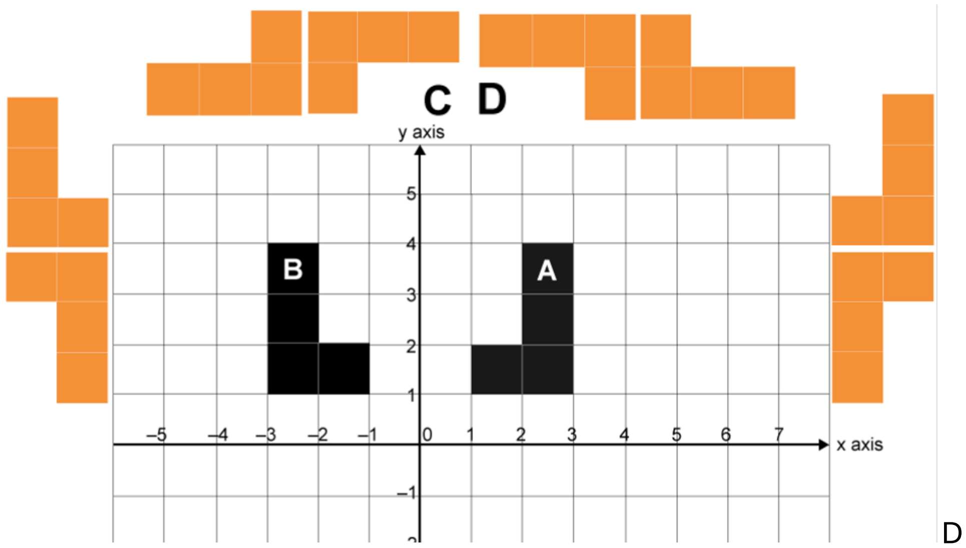


Write the equation of line that reflects shape A on to shape B :

1. b (3 Marks)

Translate shape B by vector $\begin{pmatrix} 8 \\ 2 \end{pmatrix}$, draw and label the new shape C; next reflect shape C in the line $y = 1$ and label the new shape D.

Ensure both shape C and shape D are on your final grid.



1. c (2 Marks)

Describe fully the rotation that maps shape D to shape A.

QUESTION 2 (8 Marks)

A manufacturer makes shoes to sell internationally. The manufacturer is contracted to make shoes for Egypt and Brazil.

Interquartile range

$IQR = Q_3 - Q_1$

Complementary events

$P(A) + P(A') = 1$

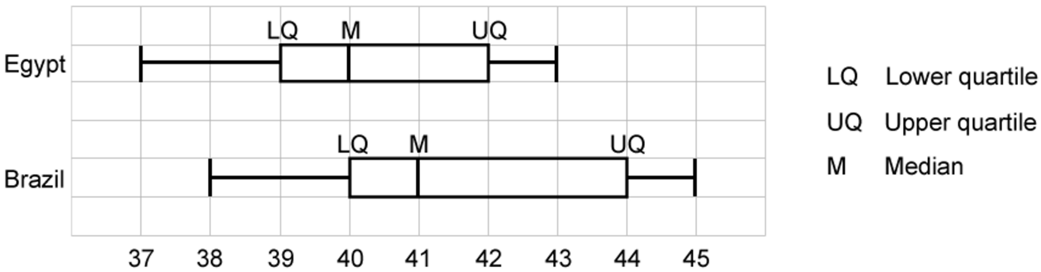
Independent events

$P(A \cap B) = P(A)P(B)$

Combined events

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

The box plots show the sizes of shoes sold in Egypt and Brazil. The distributions shown in the box plots are based on the medians and quartiles of the shoe sizes sold.



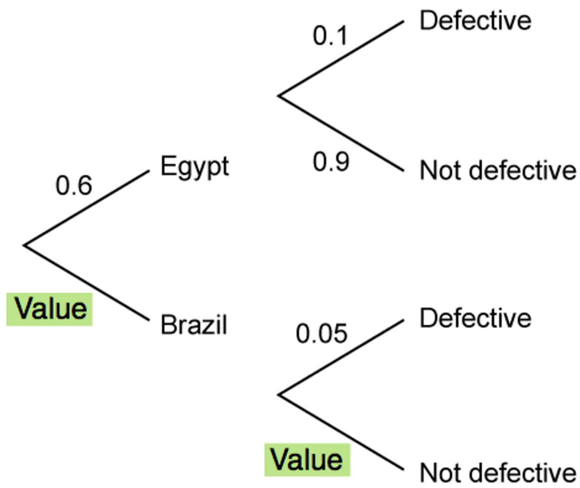
2 a. (2 Marks)	2 b. (2 Marks)
Compare the sizes of shoes in 2 two countries :	Determine the Range of Shoe Size to be Manufactured:

The manufacturer makes shoes in two factories; one in Egypt and one in Brazil. The factory in Egypt makes 60 % of the shoes and 10 % are defective. The factory in Brazil makes the rest of the shoes and 5 % are defective.

This information is illustrated in the tree diagram.

Question 2 c (1 Mark)

Write down the **two** missing values in the tree diagram.



Question 2 d (3 Marks)

Find the probability that a shoe, chosen at random from either factory, is defective.

QUESTION 3 (8 Marks)

3 a (3 Marks)

Given that a straight line L_1 has the equation $\frac{2y-1}{2} = x$, **show** y as the subject, by rearranging the equation for L_1 .

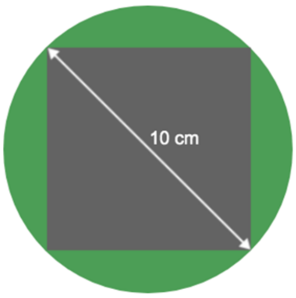
3 b (5 Marks)

Another straight line L_2 has the equation $y = \frac{x+5}{2}$.

Find the coordinates of point of intersection between L_1 and L_2 .

QUESTION 4 (10 Marks)

The diagram shows a circle with diameter 10 cm. Inside the circle is a square, the vertices of the square touch the circumference of the circle.



4 a. (1 Mark)

Show that the total area enclosed by the circle is 25π .

4 b. (3 Marks)

Find the length of one side of the square and write your answer as an exact value.

4 c (3 Marks)

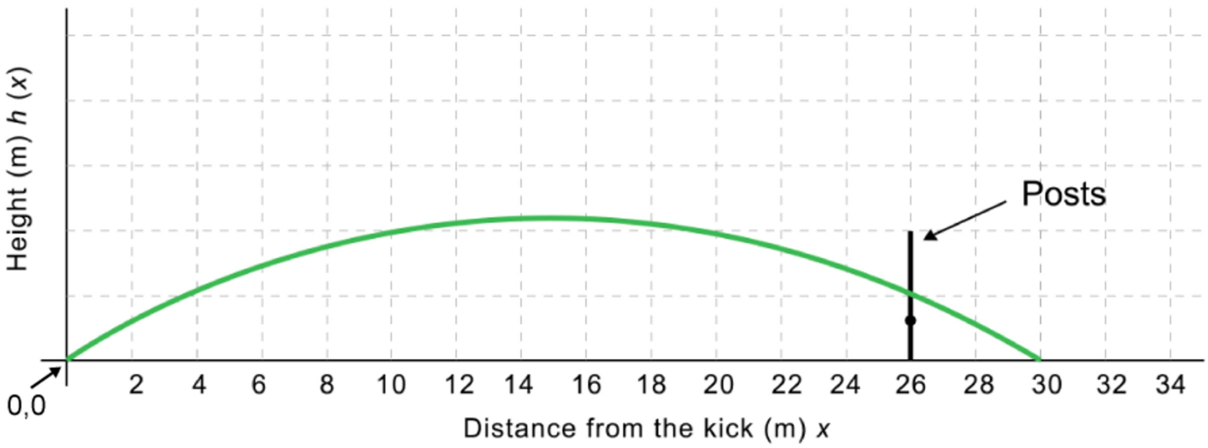
Calculate the total area of the green shaded segments that do not include the square. Write your answer to one decimal place.

4 d. (3 Marks)

Find the circumference of the outer circle.

QUESTION 5 (10 Marks)

A ball is kicked from (0,0) towards the posts and describes the path of a parabola as shown



Axis of symmetry of graph of a quadratic function

$$f(x) = ax^2 + bx + c \Rightarrow \quad \text{axis of symmetry } x = -\frac{b}{2a}$$

Solutions of a quadratic equation

$$ax^2 + bx + c = 0 \Rightarrow \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \quad , \quad a \neq 0$$

Discriminant

$$\Delta = b^2 - 4ac$$

5 b (3 Marks)

Show that the :

The height in metres (m) of the ball above the ground is given by the function $h(x) = \dfrac{x(30-x)}{25}$.

To score points the ball is kicked from the point (0,0) and must go over a bar on the posts that is
3 m above the ground and 26 m away from the point the ball was kicked. This is illustrated in the diagram in Tab 2 above.

Remember the function for the height of the ball is $h(x) = \dfrac{x(30-x)}{25}$.

5 b (3 Marks)

Using the equation given , Show that the team scored points .

Later in the game another kick is taken from the point $(x,0)$ towards the posts.

This time the height of the ball above ground is represented by the function
$g(x) = \dfrac{-x^2 + 30x - 125}{25}$.

Note that the posts cannot be moved.

5 c (3 Marks)

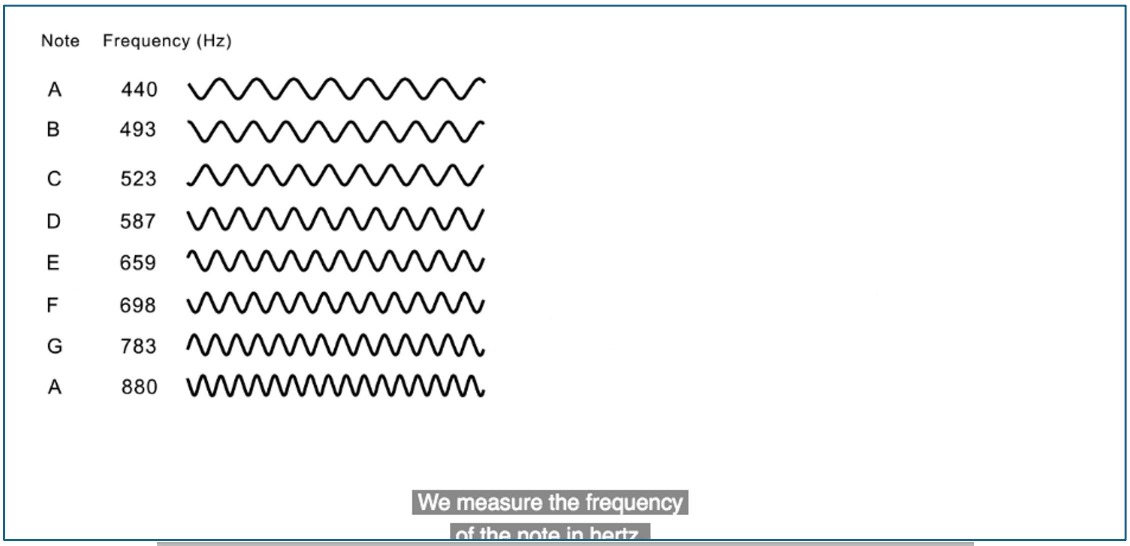
Solve g(x) = 0

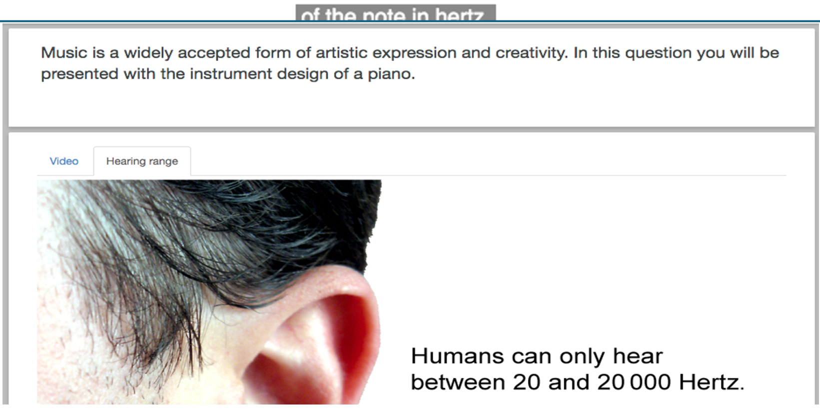
5 d (2 marks)

Did the team score points ?

QUESTION 6 (21 Marks)

Music is a widely accepted form of artistic expression and creativity. In this question you will be presented with the instrument design of a piano.





Here is a table with some information on the first four octaves and frequencies of the note A on the piano.

Octave (n)	0	1	2	3
Note (A)	A_0	A_1	A_2	A_3
Frequency (F) Hertz (Hz)	27.5	55	110	220

6 a (1 Mark)

Write down , what happens to the frequency “f” as otaves increase.

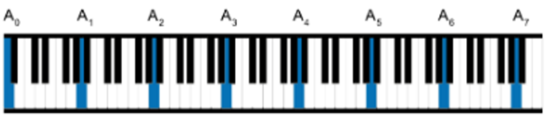
6 b (1 Mark)

Write down the frequencies for A_4 and A_5.

A_4

A_5

6 c (2 Marks)



Deduce that all the A notes on the piano are within human hearing.

6 d (3 Marks)

The frequency F_3 can be written as $F_0 \times 2^k$. Calculate the value of k, where k is an integer.

6 d (2Marks)

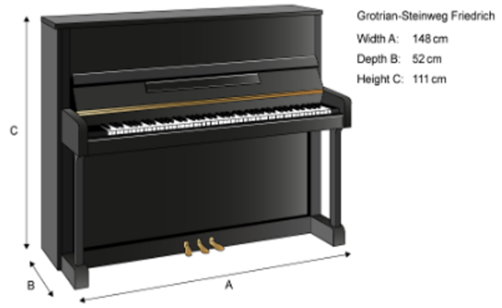
Find a formula for F in terms of “n”

6 f (2Marks)

A Note has frequency of 28160 Hz . Is it a Note ? Justify Your answer .

6 g (10 Marks)

Piano | Keys | Hearing range | Arm span



A new design for a piano will contain all of the A notes within human hearing.

Use the information provided in the tabs on the left to **discuss** the practicality of the new design for the piano. In your discussion you should:

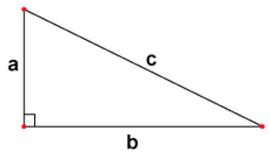
- identify the relevant information for the new design
- calculate relevant measurements for the new design
- justify your degree of accuracy
- justify the practicality of the new design.

QUESTION 7 (18 Marks)

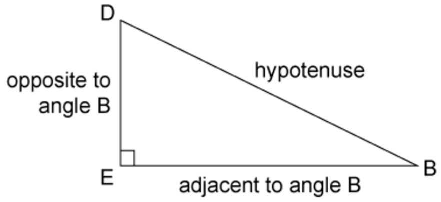
Ancient civilizations built pyramids to express cultural identity. In this question you will make calculations for a model of Chichén Iztá pyramid.

Pythagoras' Theorem

$c^2 = a^2 + b^2$



Trigonometric ratios



$$\sin B = \frac{\text{opposite to angle } B}{\text{hypotenuse}}$$

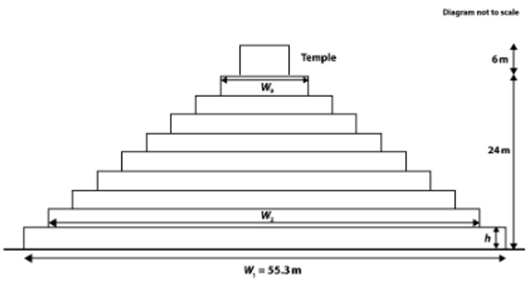
$$\cos B = \frac{\text{adjacent to angle } B}{\text{hypotenuse}}$$

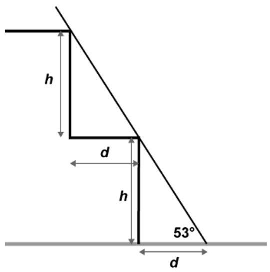
$$\tan B = \frac{\text{opposite to angle } B}{\text{adjacent to angle } B}$$

Chichén Iztá pyramid is composed of nine platforms. The width of the first platform is 55.3 m and on the ninth platform there is a temple that is 6 m high.

All lengths provided are given to the nearest centimetre (cm) and angles are to the nearest whole degree.

You are planning to construct a scale model of the Chichén Iztá Pyramid and will use 1:100 as scale for your model. In this question you will work out values of lengths. The validity of the accuracy of your model will be required in part (e).





7 a (2 Marks)

determine the total height of your model pyramid including the nine platforms and the temple. Write your answer in cm.

Total height = ______ cm

7 b (3 Marks)

Using the diagram in Tab 1, **find** the height h of each platform in your model. Write your answer in cm correct to one decimal place.

Model height h = ______ cm

7 c (4 Marks)

The average inclination of the slant is 53° to the nearest degree.

Using the diagram in Tab 2, **find** the depth d of each pyramid step. Write your answer in cm correct to the nearest whole number.

Model d = ______ cm

7 d (3 Marks)

Using the diagram in Tab 1, **find** the width W_9 in cm of the top platform in your model.

Model width W_9 = ______ cm

7 e (6 Marks)

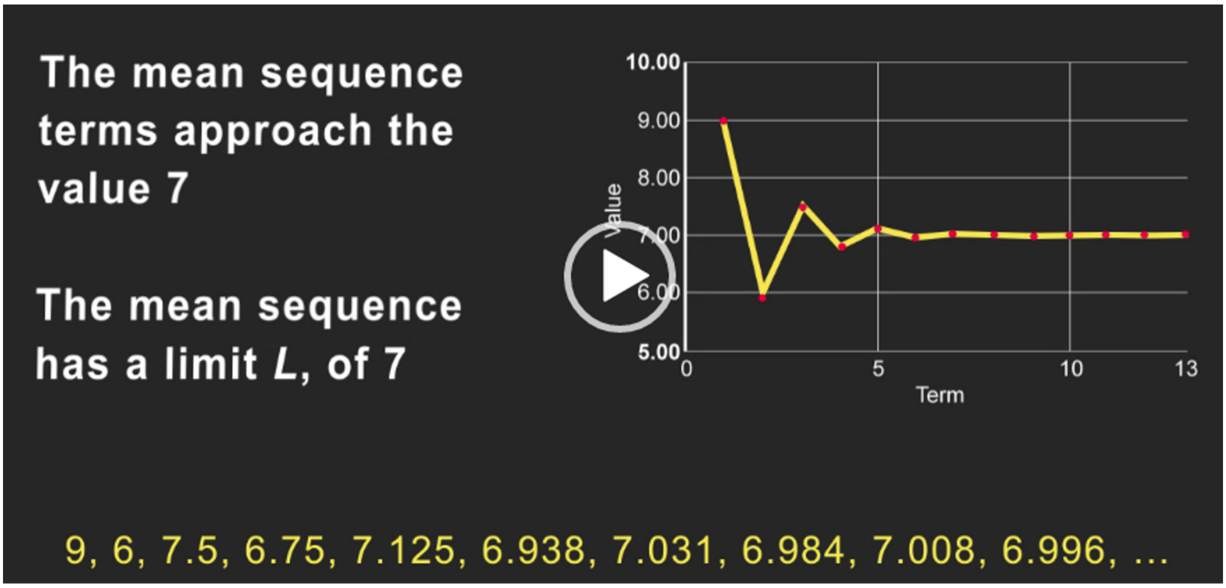
Discuss the validity of your model for Chichén Iztá pyramid. In your discussion you should:

- identify relevant information required to discuss the validity
- consider the implications of the chosen degree of accuracy
- comment on the validity of the model to Chichén Iztá.

QUESTION 8 (20 Marks)

A recursive sequence is one where the next term is a specific combination of the previous terms.

In this question the recursive sequence is created where the next term is the mean of the previous two terms. This is called a mean sequence.



8 a (2 marks)

Here is a mean sequence with starting terms 6 and 9.

6, 9, 7.5, 8.25, …

Show that the next term in the sequence is 7.875 and **write down** the limit of the sequence.

All mean sequences have limits and there is a connection between the first two terms a and b and the limit L of each sequence.

8 b (2 Marks)

The table below shows the first two terms and the limit L, for some mean sequences. The different starting terms a are provided and b is fixed at 3.

Write down in the table the limit values L, for row 2, 3 and 4 for the mean sequences provided.

Row	First term (a)	Second term (b)	Limit (L)
1	6	3	4
2	9	3	
3	12	3	
4	15	3	

8 c (2 Marks)

Describe in words **two** patterns you have found from the table.

8 d (2 Marks)

Describe the general rule connecting "a" & "L"

8 e (12 Marks)

Using your previous results, **investigate** and **find** a general rule connecting *a*, *b* and *L*. The simulator and a blank table are provided below to support your investigation. In your answer you should:

- describe patterns
- find a general rule
- test your general rule
- use correct mathematical notation
- prove or verify and justify your general rule.

QUESTION 9 (19 Marks)

We can also use an algebraic approach to investigate mean sequences.

If a and b are the first two terms, the mean sequence will start with the terms below.

$a, b, \frac{1}{2}a + \frac{1}{2}b, \ldots$

9 a. (1 Mark)

Explain why the third term is $\frac{1}{2}a + \frac{1}{2}b$.

9 b. (4 Marks)

Predict the seventh and eighth terms from the table and write your answers in the relevant response box.

Term (T)	Sequence
1	a
2	b
3	$\frac{1}{2}a + \frac{1}{2}b$
4	$\frac{1}{4}a + \frac{3}{4}b$
5	$\frac{3}{8}a + \frac{5}{8}b$
6	$\frac{5}{16}a + \frac{11}{16}b$
7	$\frac{\square}{\square}a + \frac{\square}{\square}b$
8	$\frac{\square}{\square}a + \frac{\square}{\square}b$

Term 7:

Term 8: