Question 1 (9 marks)

A sample of a school community are surveyed on how they travel to school. The table below shows the survey results.

Question 1a (2 marks)

Write down the missing values in the table below.

	Bus	Train	Car	Total
Students	66	8	20	
Teachers	12		15	56
Total	78	37	35	

One person is selected at random from the sample group.

Question 1b (2 marks)

Determine the probability that the person selected is a student who does not travel by train.

B I U x_2 x^2 Ω Σ

Styles

Question 1c (1 mark)

Given that the person selected is a teacher, **write down** the probability that this teacher travels by car.

B I U x_2 x^2 Ω Σ

Styles

Question 1d (4 marks)

Given that **three** teachers are selected at random from the sample group, **find** the probability that exactly **two** of them travel by bus.

Question 2 (7 marks)

Question 2a (2 marks)

$$f(x) = (x - 5)^2$$

$$g(x) = 4(x - 5)^2 - 1$$

The function f (x) is transformed to $g(x)$. **Determine** the transformations that map f (x) onto $g(x)$.

1st transformation

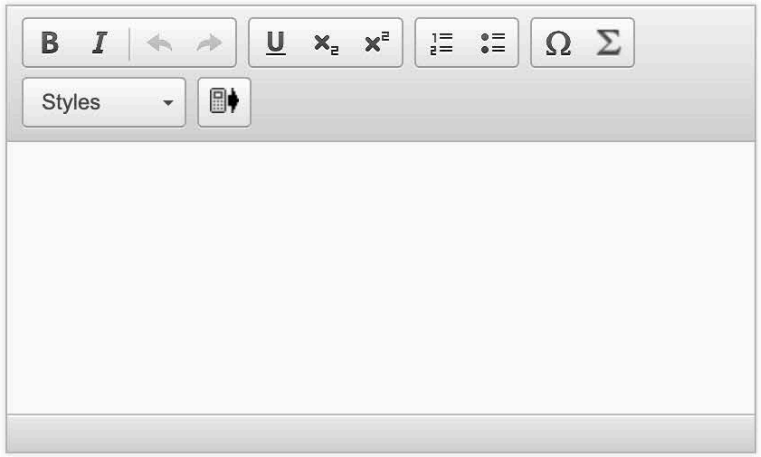
B I U x_2 x^2 Ω Σ Styles

2nd transformation

Question 2b (3 marks)

$g(x) = 4(x - 5)^2 - 1$

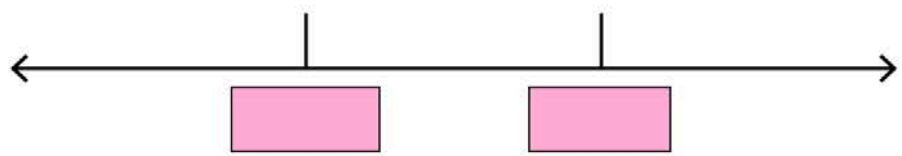
Solve for x when $g(x) = 0$.



Question 2c (2 marks)

Hence, **plot** the range of values of x that satisfies the inequality $g(x) < 0$. Use the draggable items to indicate the solution.

Draggable items:

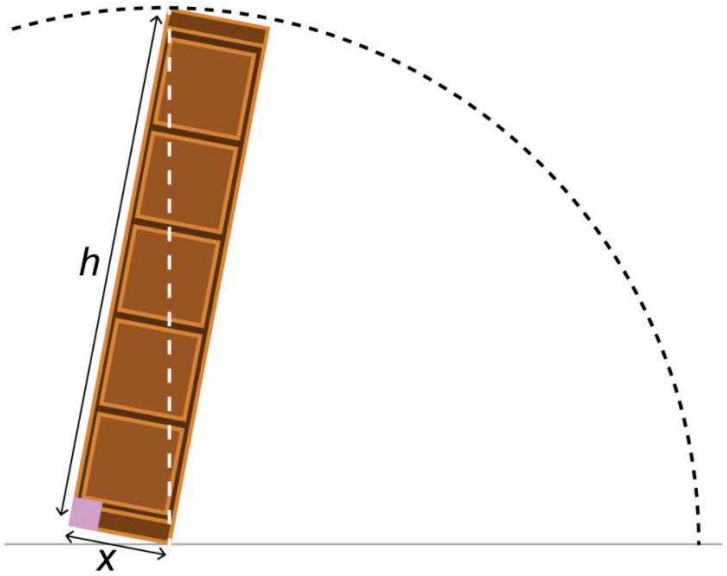


Video | Script

Storage units in the shape of a square-base prism are available to be purchased.

When a storage unit is delivered to the home it is lifted into place.

The dimensions of the storage unit must be chosen carefully otherwise it may not be possible to lift it into place.



The diagram above shows a storage unit of height (h) cm with a square base of length (x) cm.

The room has a ceiling height of 230 cm.

You are selecting a storage unit that can be lifted to the vertical position in the room.

Question 3a (3 marks)

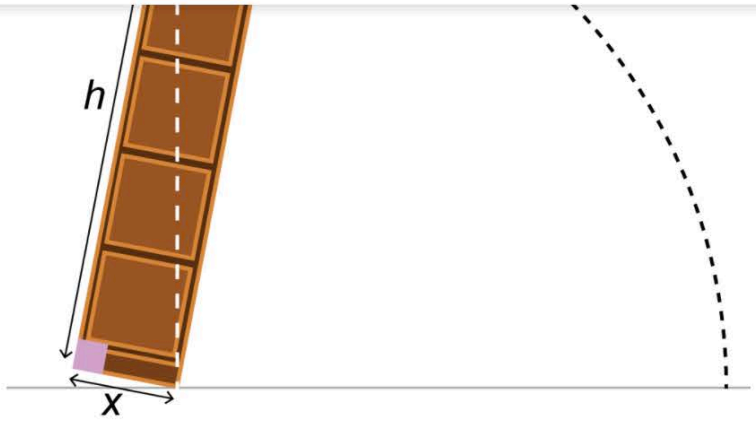
A storage unit has $x = 50$ cm and $h = 225$ cm.

Show that it cannot be lifted to the vertical position in the room.

B I U x_2 x^2 Ω Σ Styles

Question 3b (2 marks)

Determine the maximum possible value



The diagram above shows a storage unit of height (h) cm with a square base of length (x) cm.

The room has a ceiling height of 230 cm.

You are selecting a storage unit that can be lifted to the vertical position in the room.

Question 3c (1 mark)

Hence, **determine** the maximum possible value of h when x is 50 cm.

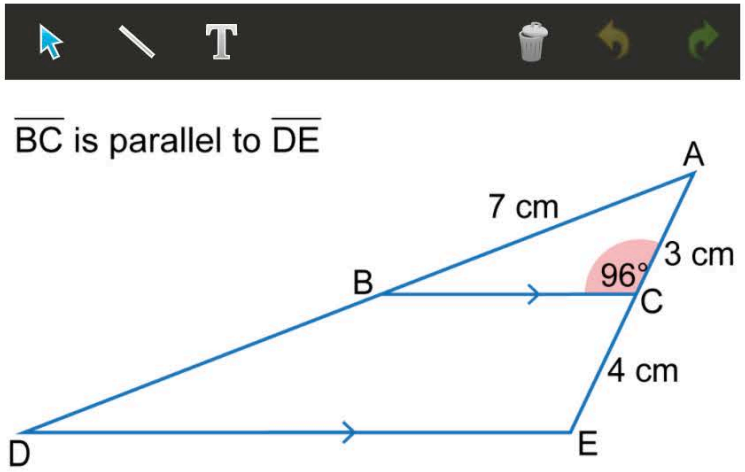
B I U x_2 x^2 Ω Σ Styles

Question 3d (2 marks)

You chose a storage unit with $x = 50$ cm and $h = 220$ cm. **Determine** its volume.

Question 4a (2 marks)

Diagram not to scale

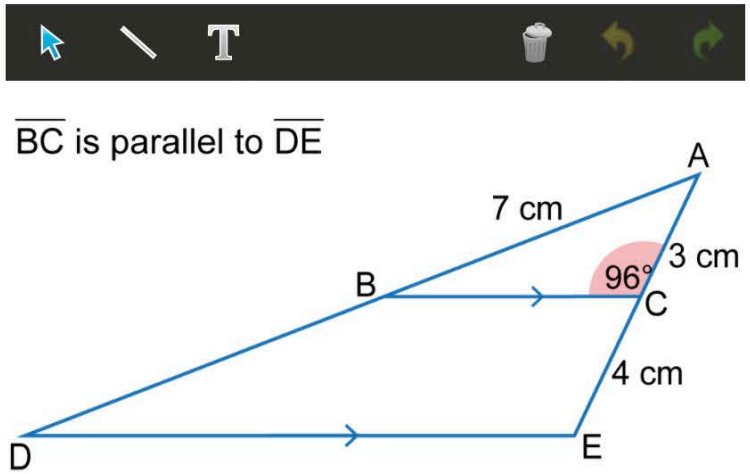


Show that triangle ABC is similar to triangle ADE.

Question 4b (4 marks)

Given that the area of triangle ABC is 9 cm^2 to the nearest cm^2, **find** the area of trapezium BCED.

Diagram not to scale



Show that ∠ABC is 25° to the nearest degree.

Styles

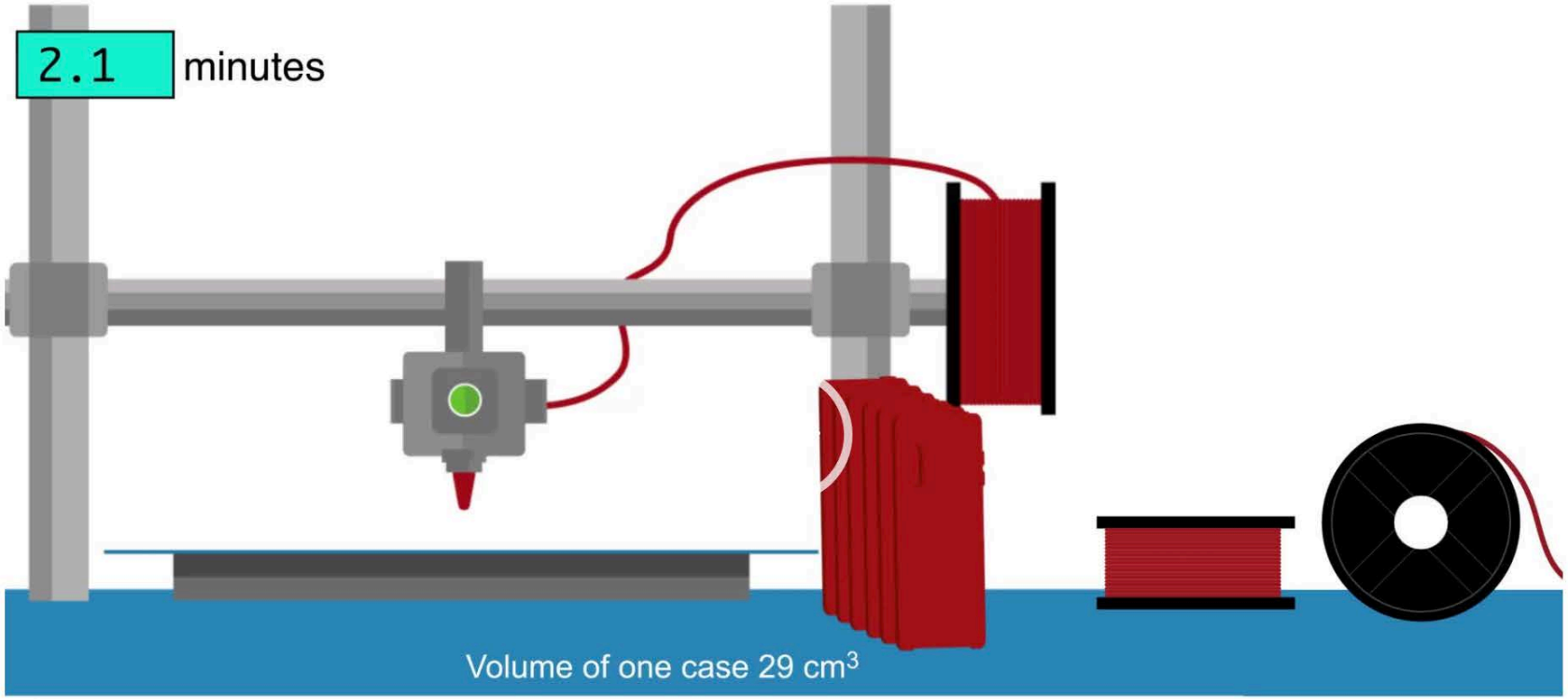
Question 4d (3 marks)

Hence, **find** the length of BE.

Styles

Question 5 (10 marks)

The animation below shows the three-dimensional (3D) printing of a mobile phone case.
The time taken to print a mobile phone case is not constant.



Time taken to print one phone case (minutes)										
18.3	18.5	19.1	19.8	19.8	19.9					

One spool of filament

Diameter = 1.75 mm

Mass = 1000 g

$$Density = \frac{Mass}{Volume}$$

Glossary:
Filament = material used in 3D printing

One mobile phone case

Volume of one case 29 cm^3

Question 5a (1 mark)

Given that the density of the filament is 1.25 g/cm^3. **Determine** the mass of one phone case in grams.

Question 5b (2 marks)

Hence, **determine** the number of phone cases that can be printed from one spool of filament.

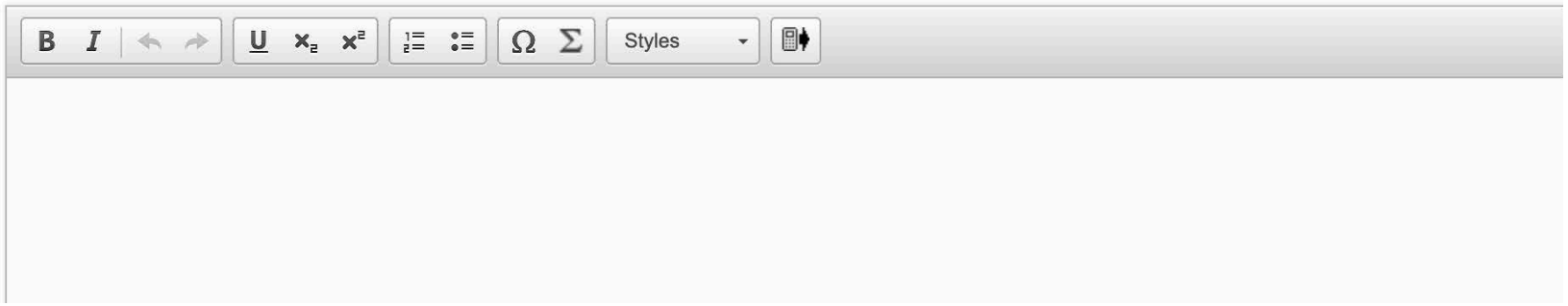
Eleven phone cases are printed by Printer A. The time taken to print each case is recorded in the table below. Time is recorded in minutes, correct to 1 decimal place.

Printer A

Time taken to print one phone case (minutes)										
18.3	18.5	19.1	19.8	19.8	19.9	20.3	20.4	20.7	20.8	21.1

Question 5c (2 marks)

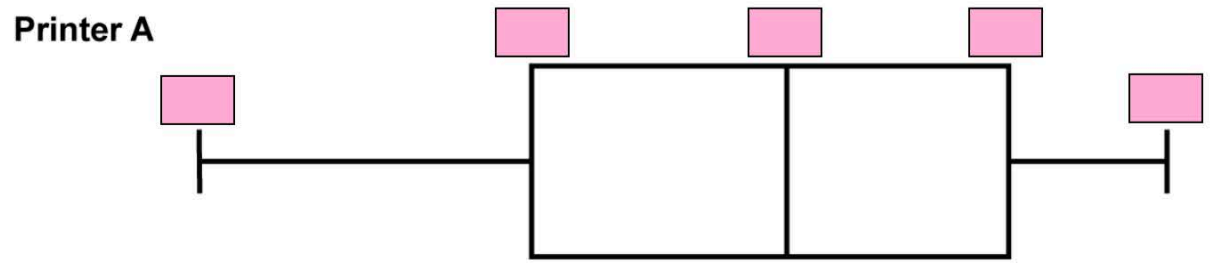
Show that the mean time taken to print one phone case is 19.9 minutes, correct to 1 decimal place.



Question 5d (3 marks)

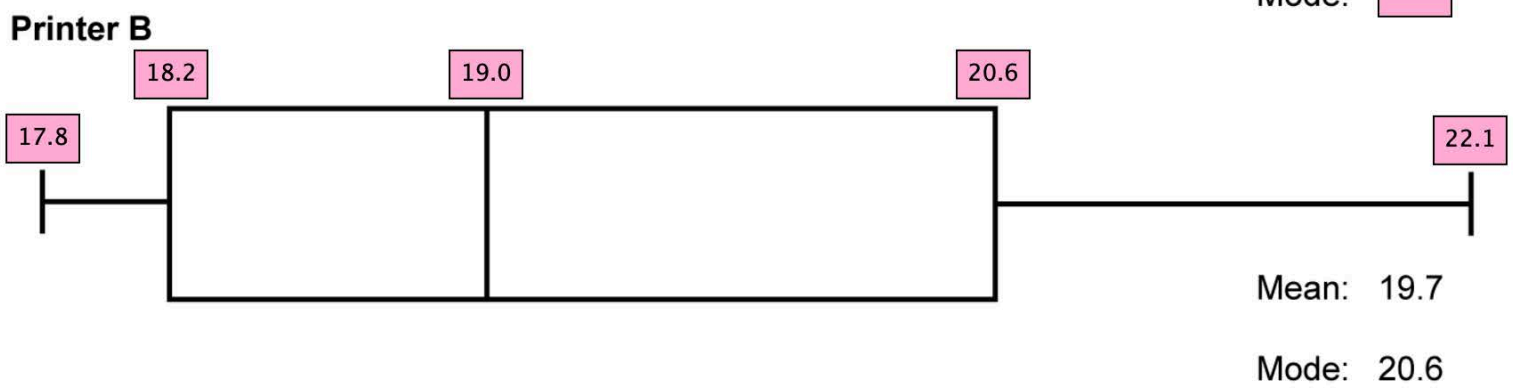
The box-and-whisker plots represent the time taken by Printer A and Printer B to print 11 phone cases.

Label the box-and-whisker plot for Printer A.



Mean: 19.9

Mode:



Mean: 19.7

Mode: 20.6

Question 5e (1 mark)

Identify one valid reason why Printer A might be considered better than Printer B.

Styles

Question 5f (1 mark)

Identify one valid reason why Printer B might be considered better than Printer A.

Styles

Question 6 (22 marks)

Video | Script

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.

These days machine learning technology is used in many aspects of our lives, including the fingerprint recognition and face recognition used to unlock smartphones.

The process of learning begins by multiple observations of an object, this helps a system to identify patterns in that object and therefore make better decisions in the future.

The primary aim is to allow the computers to learn automatically without human intervention or assistance and to adjust their actions accordingly.

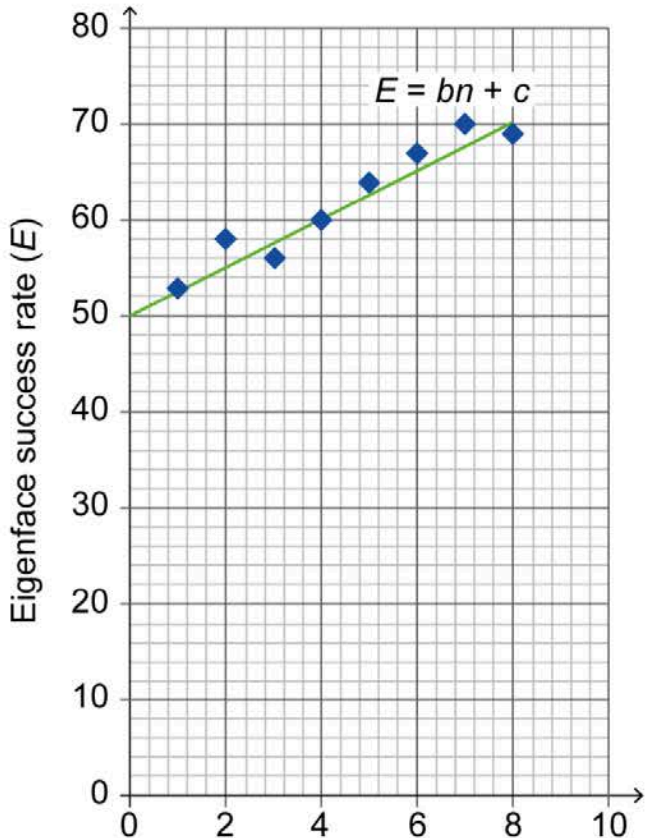
There are different methods for machine learning: Eigenface, Fisherface and Local Binary Patterns Histogram (LBPH).

All methods of machine learning require multiple observations of the object. For example, in face recognition the programme will take many 'facial observations' in order to learn the features of the face to improve the success rate of face recognition.

In this question, you will explore the success rate for different methods of face recognition.

Question 6a (2 marks)

The graph below shows data of the Eigenface method.



E is the success rate (%) of the Eigenface method

n is the number of face observations recorded per person.

Determine the values of *b* and *c*.

B I U x_2 x^2 Ω Σ

Styles

The Fisherface method can be modelled using the quadratic equation

$F = -1.5(n - 8)^2 + 96; 0 < n \leq 8$, where

F is the success rate (%) of the Fisherface method

n is the number of face observations recorded per person.

Question 6b (1 mark)

Write down the highest success rate (F max) and the corresponding value of n.

F max

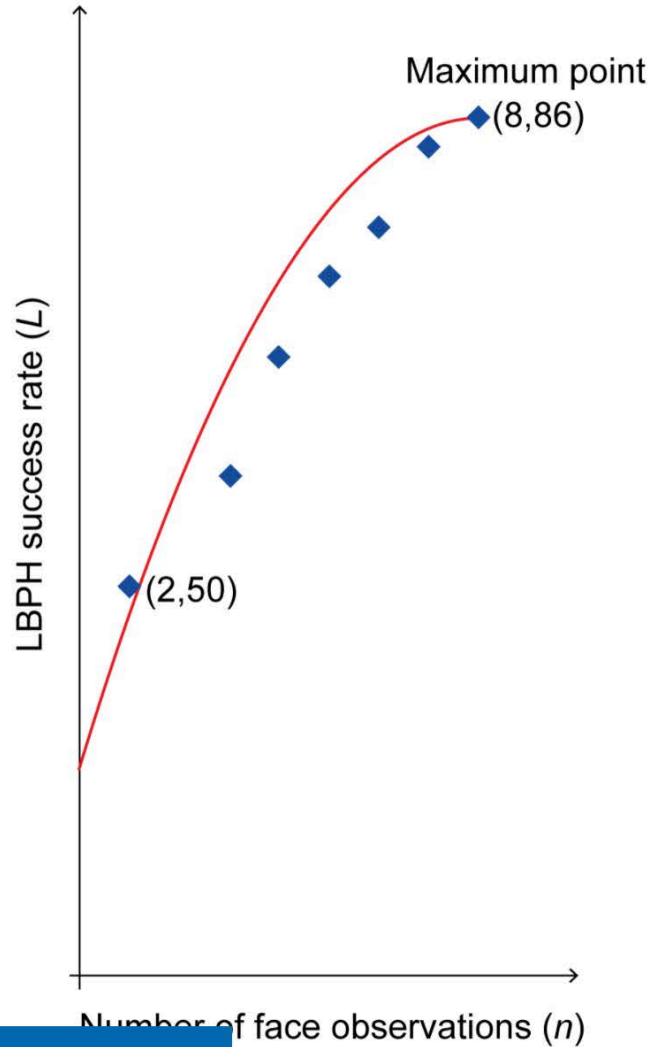
n

Question 6c (5 marks)

Find the value of n at which the Fisherface method has the same success rate as the Eigenface method.

Styles

The graph below shows data of the Local Binary Patterns Histogram (LBPH) method.



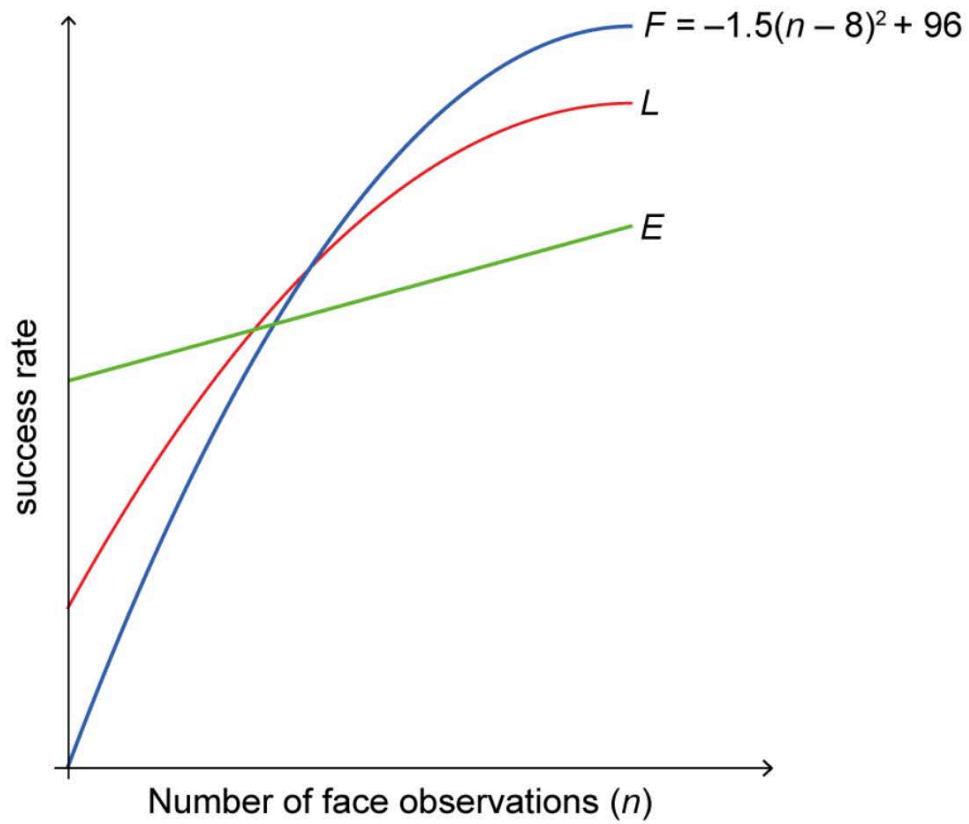
Using the data in the graph, **find** a quadratic equation that models the LBPH method (L) in terms of n.

B I U x_2 x^2 Ω Σ

Styles

Question 6e (10 marks)

The graph below shows the models for the three methods.



Analyse the three methods in order to choose the best method. In your answer you should:

- identify the factor that affects the percentage success rate
- make calculations for the point of intersection between the FisherFace (F) and LBPH (L) methods
- comment on the accuracy of your results
- justify your choice for the best method.

The factor:

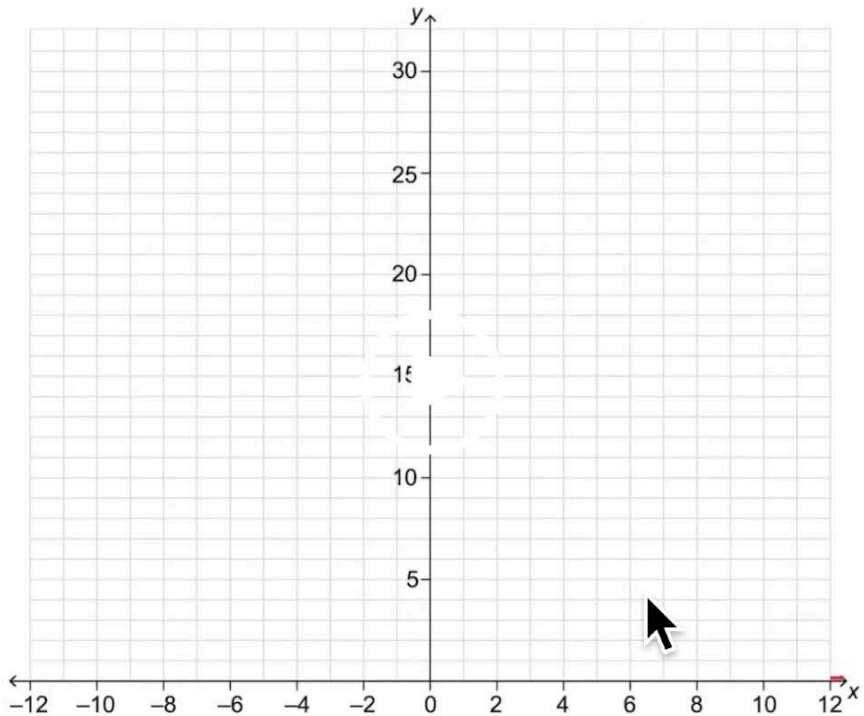
Styles

Question 7 (32 marks)

Investigate the relationship between the number of squares inside a rectangle between two exponential functions.

An exponential function and its reflection on the *y*-axis are shown.

Stage 0

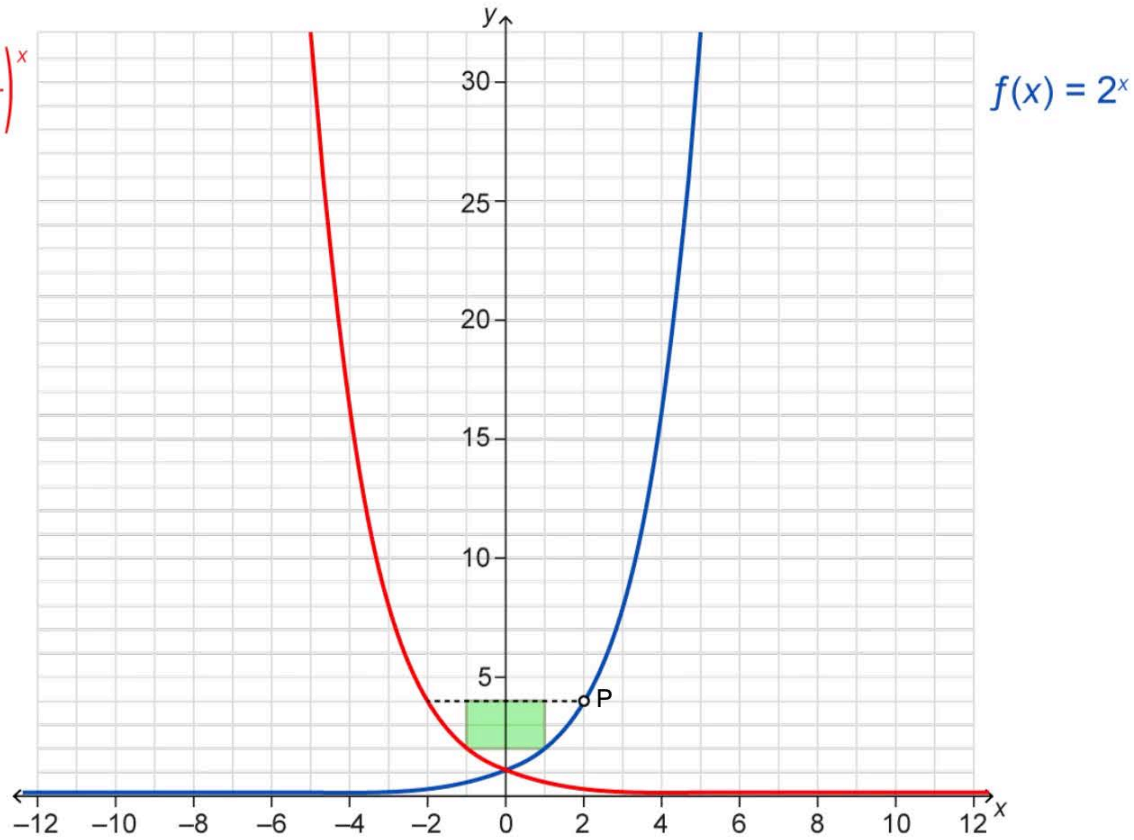


Drag the slider to see how the squares are added.

Stage 1

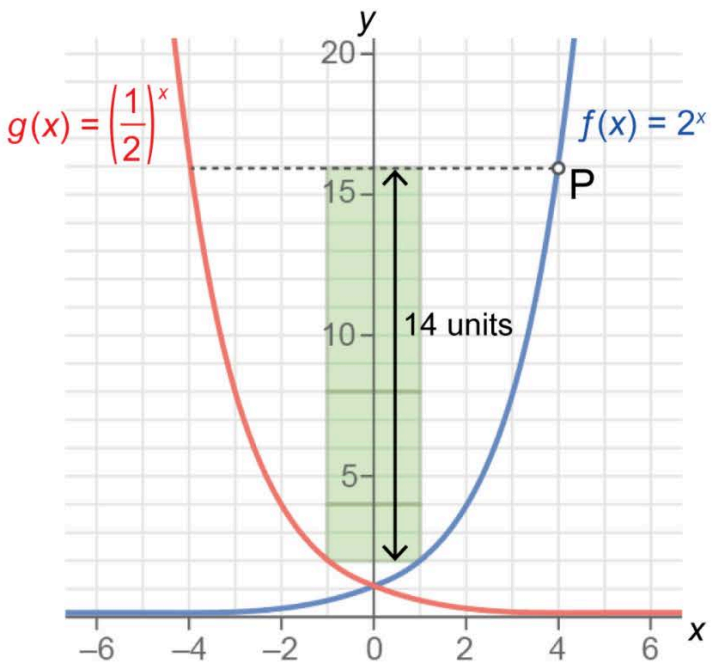
$g(x) = \left(\frac{1}{2}\right)^x$

Stage control

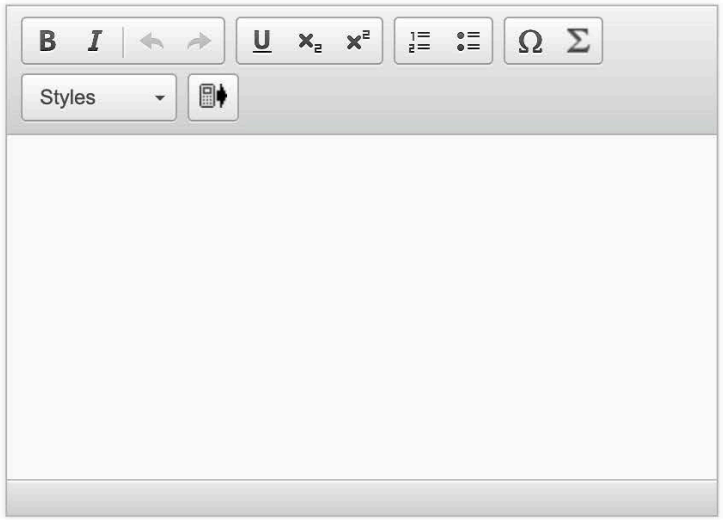


$f(x) = 2^x$

Question 7a (2 marks)



In stage 3, **show that** the height of the rectangle is 14 units. In your workings you must use the laws of exponents.



Question 7b (1 mark)

Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	8
3	16
4	32
5	
6	

Reset

Question 7c (2 marks)

Describe in words **two** patterns for S.

B I U x_2 x^2 Ω Σ

Styles

Question 7b (1 mark)

Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	8
3	16
4	32
5	
6	

Reset

Question 7d (2 marks)

Determine a general rule for S in terms of n.

B I U x_2 x^2 Ω Σ

Styles

Question 7b (1 mark)

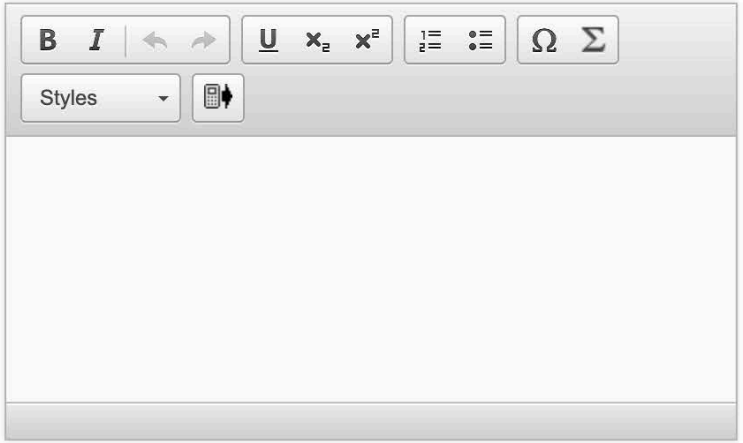
Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	8
3	16
4	32
5	
6	

Reset

Question 7e (3 marks)

Verify your general rule for S.



Question 7f (22 marks)

Investigate the values in the table to find a relationship for the total number of squares (T) in terms of *n*. In your answer you should:

- predict more values and record these in the table
- describe in words **two** patterns for column T
- determine a general rule for T in terms of *n*
- test your general rule for T
- verify and justify your general rule for T
- ensure that you communicate all your working appropriately.

Stage (*n*)	Number of new squares (S)	Total number of squares (T)	
1	4	4	
2	8	12	
3	16	28	
4	32	60	
5			
6			

Reset

B I U x_2 x^2 Ω Σ

Styles