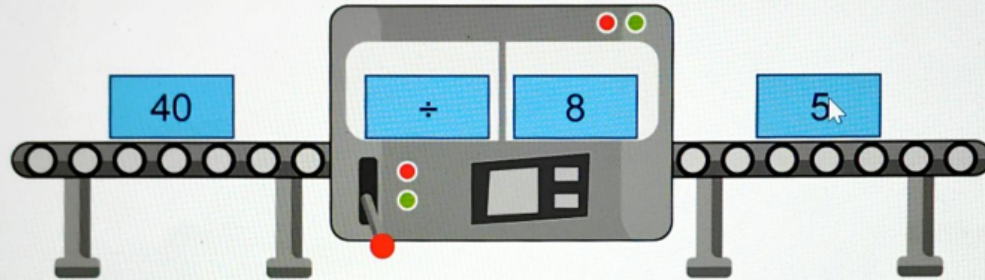


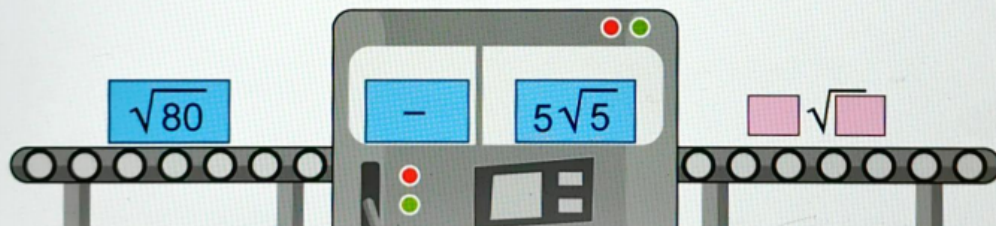
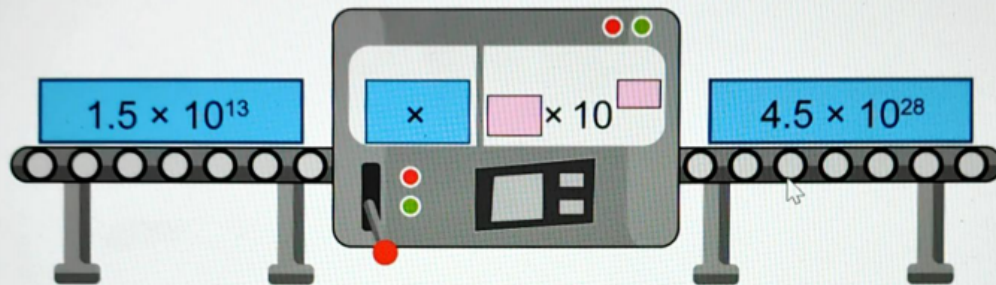


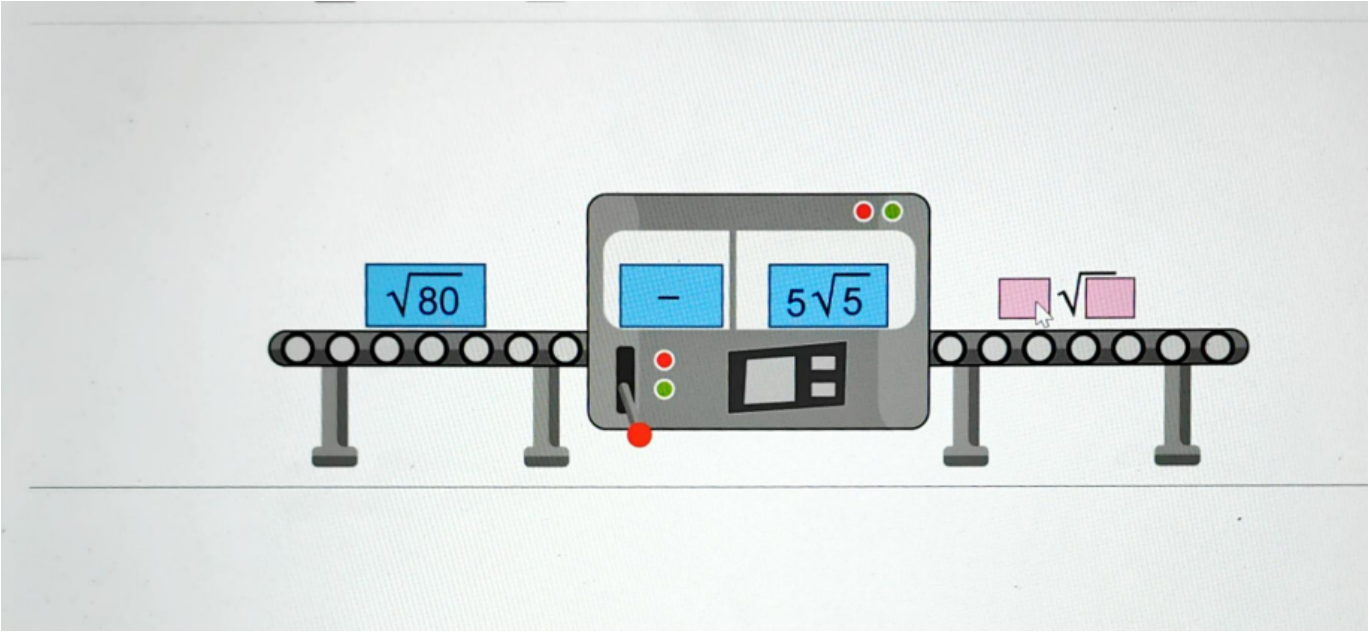
Question 1 (5 marks)

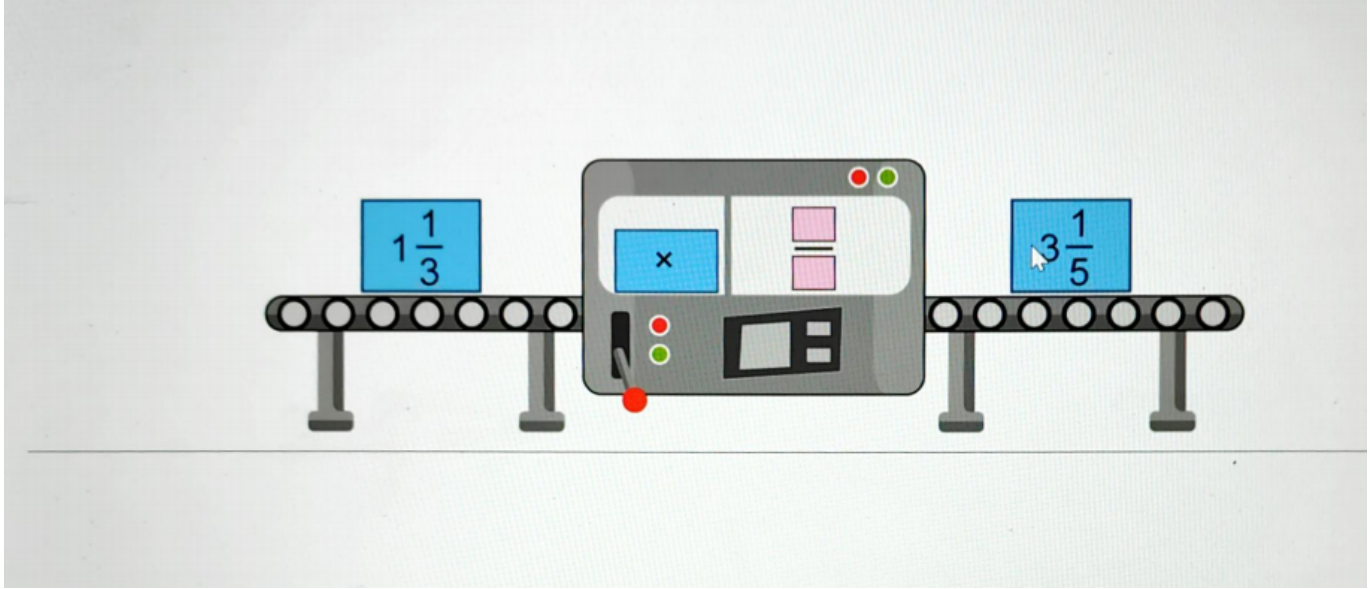
The image below shows an example of a complete operation for a function machine with an input of 40 and output of 5.

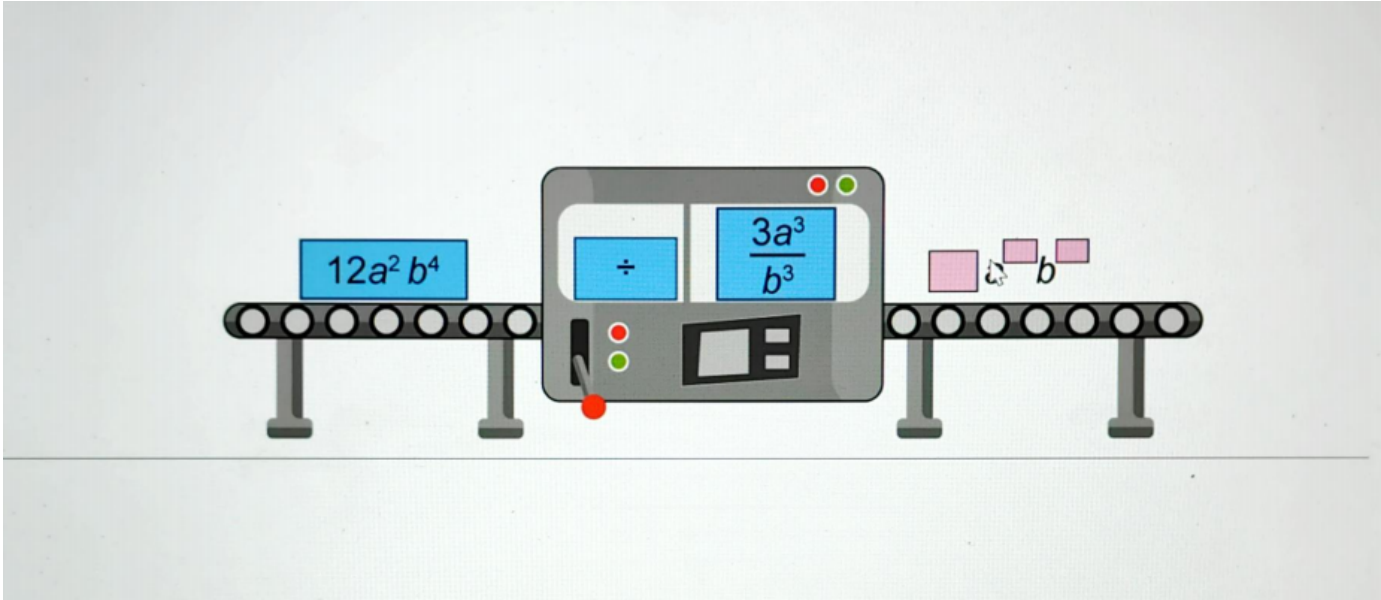


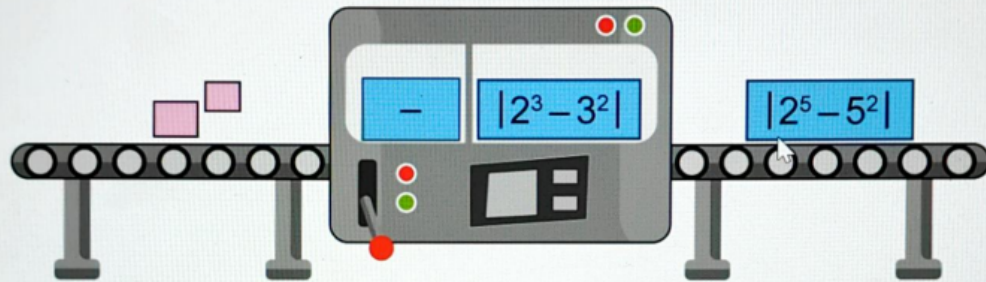
Write down the unknown values to complete the operation for each function machine.













Question 2 (8 marks)

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



Question 2a (2 marks)

Write down the missing values in the table below.

	Bus	Train	Car	Total
Students	66	8	20	<input type="text"/>
Teachers	12	<input type="text"/>	15	56
Total	78	37	35	<input type="text"/>



Question 2a (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 2b (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 \int \sum Ω Σ

Styles ▾



Question 2c (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 \int \sum Ω Σ

Styles ▾



Question 2d (3 marks)

Three people are selected at random from the sample group.

Find the probability that the three people are teachers who travel by bus.

B

I



U

x_2

x^p

$\frac{1}{n}$

$\frac{1}{m}$

Ω

Σ

Styles





Question 3 (7 marks)



Question 3a (2 marks)

Given that $5x + 1 \leq 11$, **solve** for x .

B **I** \leftarrow \rightarrow U x_2 x^2 \int $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ

Styles \downarrow



Question 3b (3 marks)

Given that $-3(3x + 2) < 5x + 1$, **solve** for x .

B **I** \leftarrow \rightarrow U x_2 x^2 \int $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ

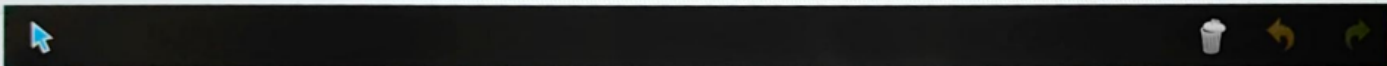
Styles \downarrow



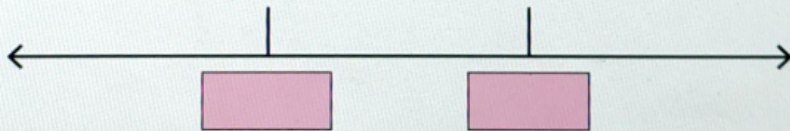
Question 3c (2 marks)

Hence, **plot** the range of values of x that satisfies the inequality below. Use the draggable items to indicate the solution.

$$-3(3x + 2) < 5x + 1 \leq 11$$



Draggable items:





Question 4 (11 marks)

Video

Script

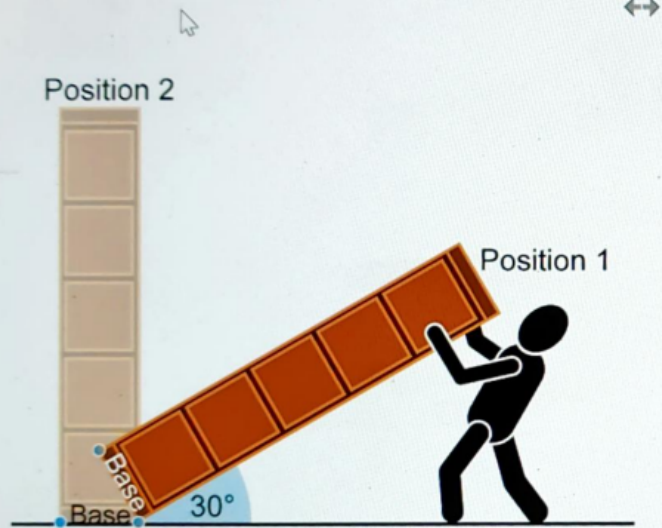
Storage units in the shape of a square-base prism are available to be purchased.

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.

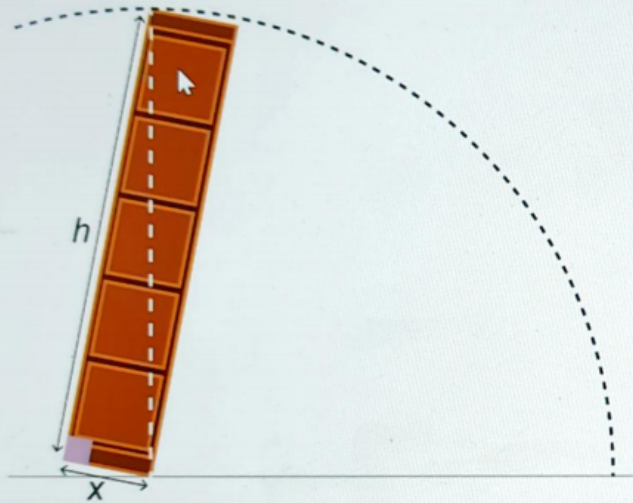


Question 4a (2 marks)



Identify the transformation that maps position 1 onto position 2.

Rich text editor toolbar with the following icons: Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x_2), Superscript (x^2), Bulleted List (\bullet), Numbered List ($1=$), Link (Ω), and Unlink (Σ). Below the toolbar is a 'Styles' dropdown menu and a 'Send to Back' icon.



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.



Question 4b (3 marks)

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

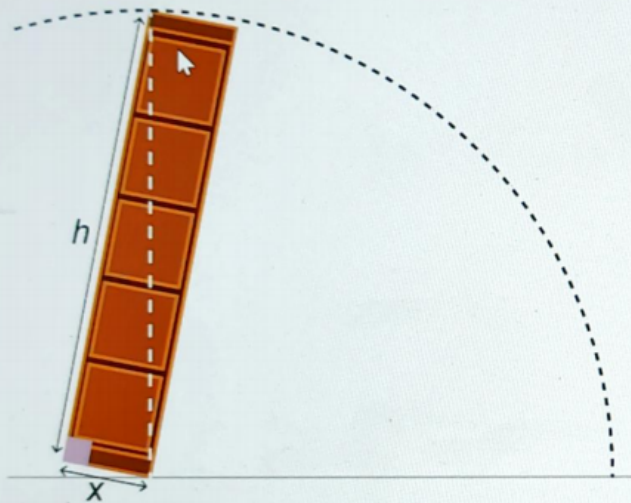
Show that it cannot be lifted to the vertical position in the room.

B **I** ← → x_2 x^2 $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ

Styles -



Question 4 (3 marks)



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.



Question 4c (2 marks)

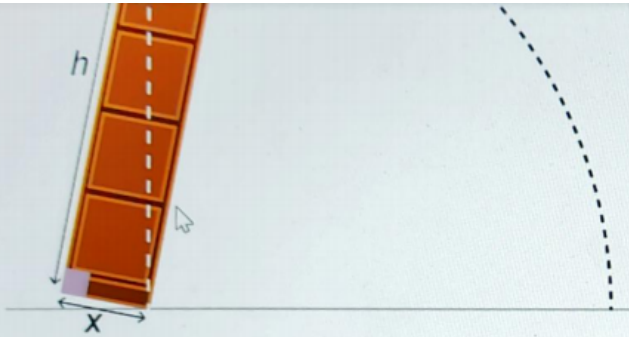
Determine the maximum possible value of h in terms of x .

B **I** **←** **→** **U** x_2 x^e \int $\frac{d}{dx}$ Ω Σ

Styles **↕**



Question 4d (1 mark)



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 4d (1 mark)

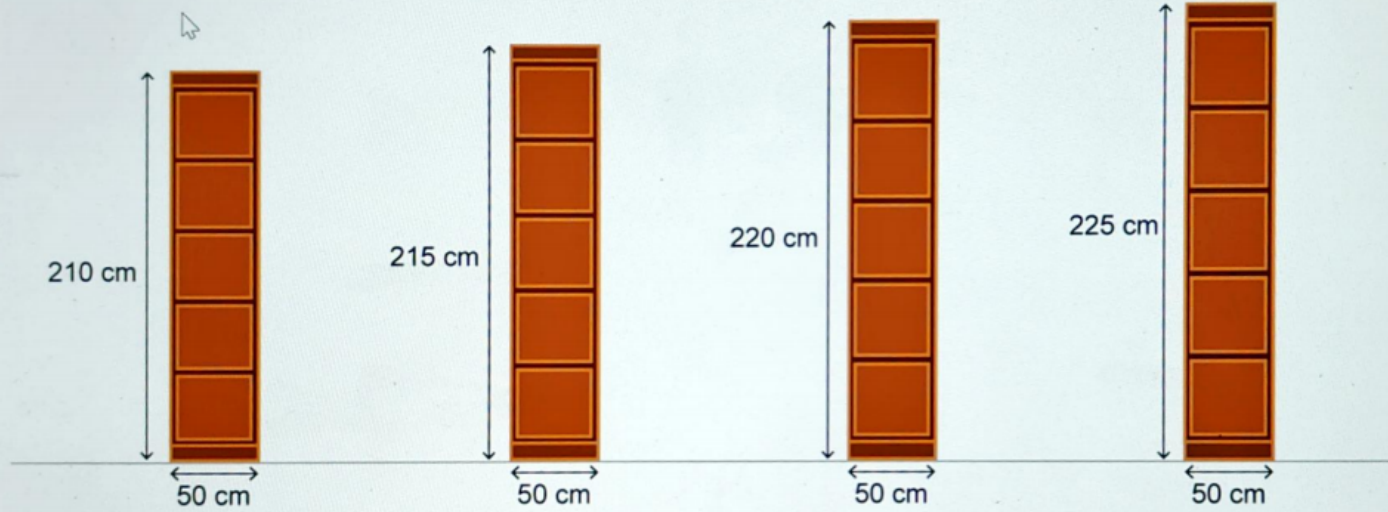
Hence, **determine** the maximum possible value of h when x is 50 cm.

B *I* ← → U x_2 x^2 \int \sum Ω Σ

Styles -



Diagram not to scale





Question 4e (1 mark)

Select the storage unit with the maximum volume that will fit in the room.

Select cm

Select

210

215

220

225



Question 4f (2 marks)

Determine the volume of the storage unit you selected.

B *I* | ← → | U x_2 x^2 | \int \sum | Ω Σ | Styles |



Question 4f (2 marks)

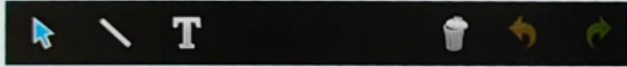
Determine the volume of the storage unit you selected.

B *I* | ← → | U x_2 x^2 | \int \sum | Ω Σ | Styles - |

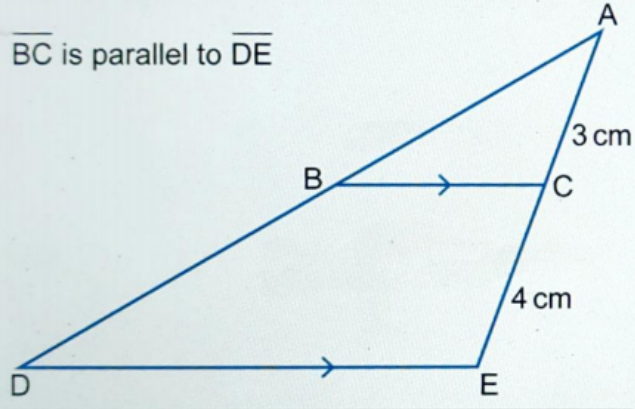


Question 5a (2 marks)

Diagram not to scale



\overline{BC} is parallel to \overline{DE}

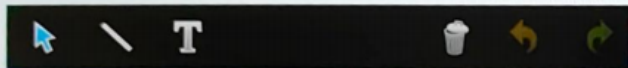


Show that triangle ABC is similar to triangle ADE.

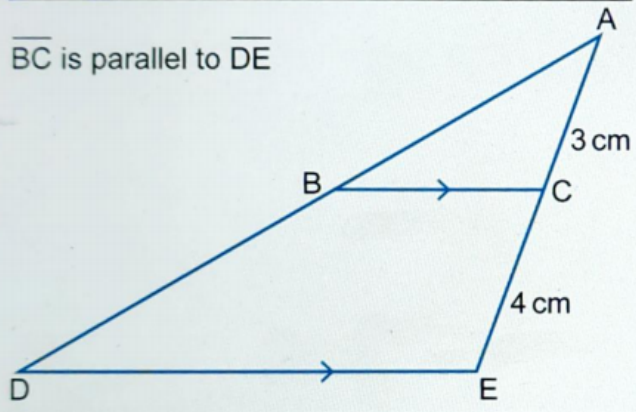
B **I** \leftarrow \rightarrow \times_2 \times^2 $\dot{=}$ $:=$ Ω Σ

Styles

Diagram not to scale



\overline{BC} is parallel to \overline{DE}



Question 5b (1 mark)

Hence, determine the ratio of BC:DE.

B

I



\times_2

\times^2

$\frac{1}{2}$

$\frac{1}{3}$

$\frac{1}{4}$

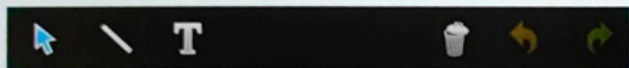
Ω

Σ

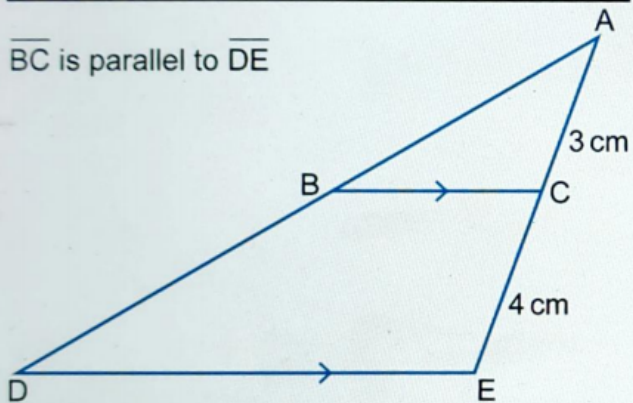
Styles



Diagram not to scale



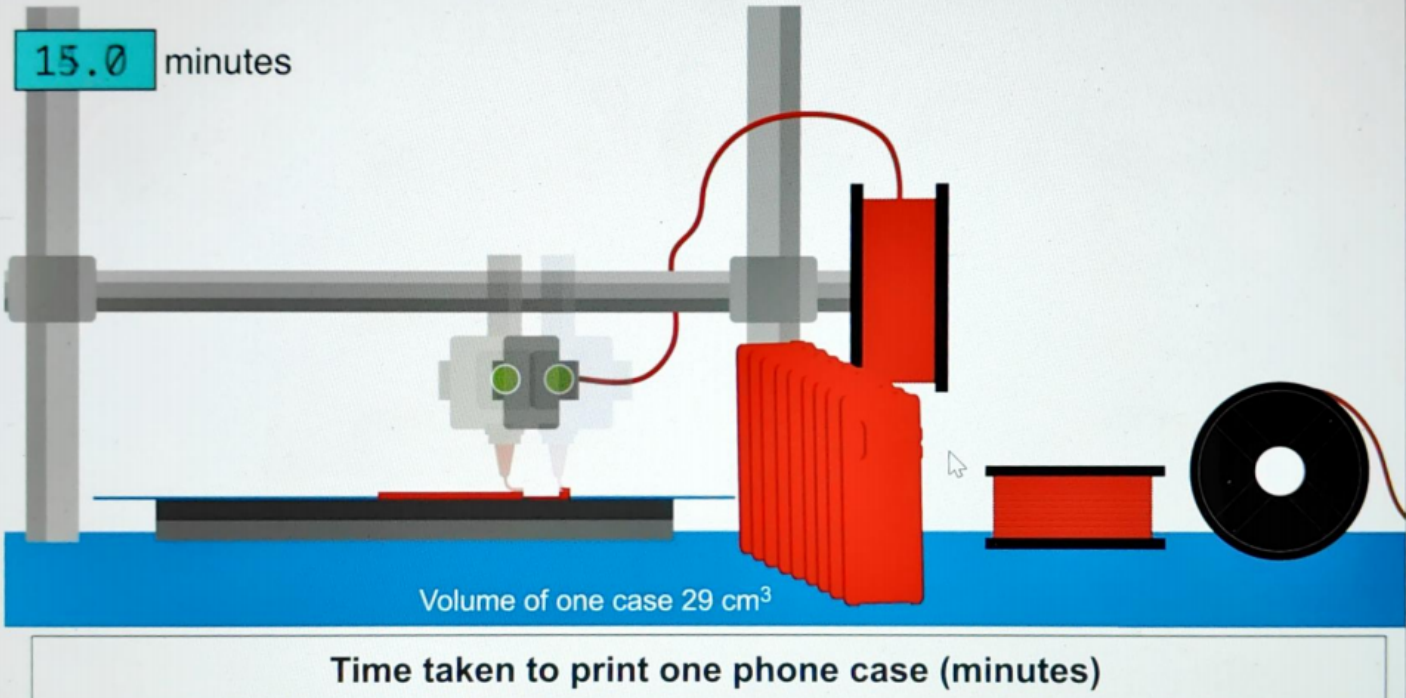
\overline{BC} is parallel to \overline{DE}



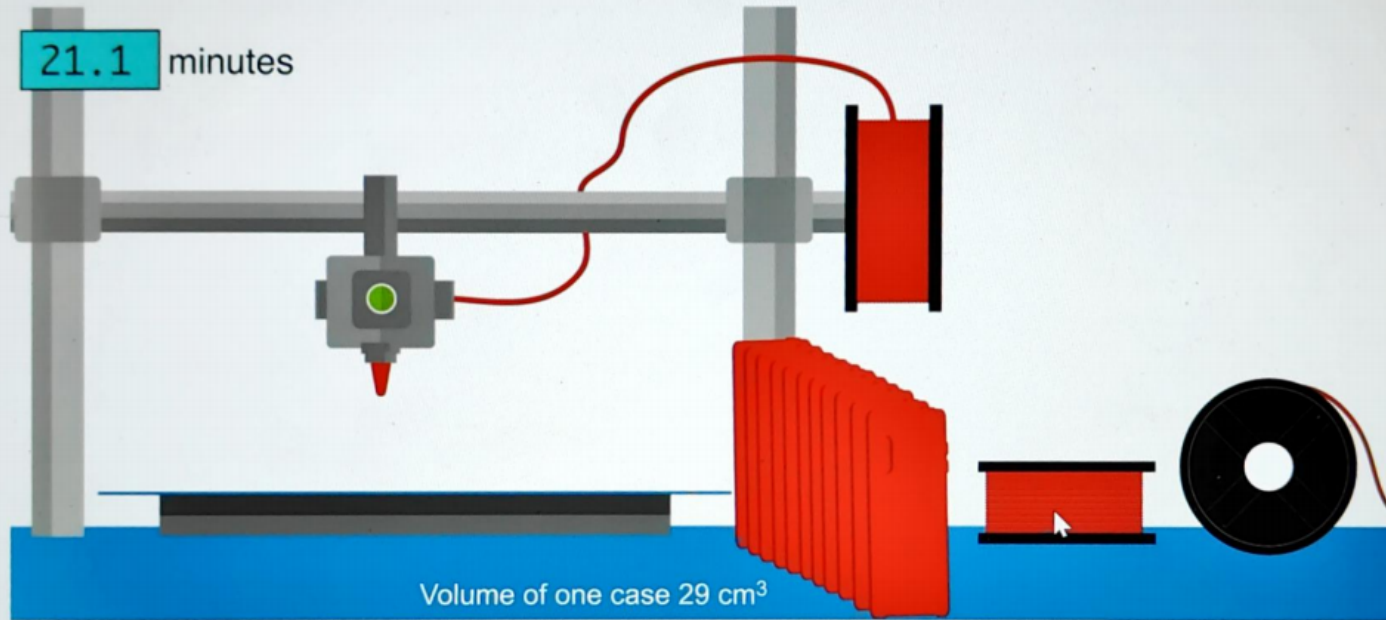
Question 5c (3 marks)

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

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.



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	20.3	20.4	20.7	20.8	21.1
------	------	------	------	------	------	------	------	------	------	------

One spool of filament



Diameter = 1.75 mm

Mass = 1000 g

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

Glossary:

Filament = material used in 3D printing

One mobile phone case



Volume of one case 29 cm³



Question 6a (1 mark)

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

B *I* | ← → | x₂ x² | := := | Ω Σ

Styles ▾ | 📄 ↕



Question 6b (2 marks)

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

B *I* | ← → | x₂ x² | := := | Ω Σ

Styles ▾ | 📄 ↕

I

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 6c (2 marks)

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

B *I* | ← → | x_2 x^2 | \int \sum | Ω Σ | Styles ▾ |



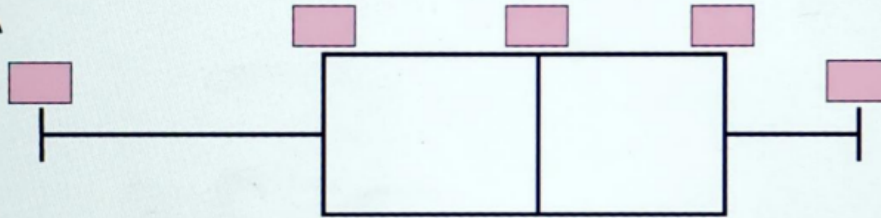


Question 6d (3 marks)

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.

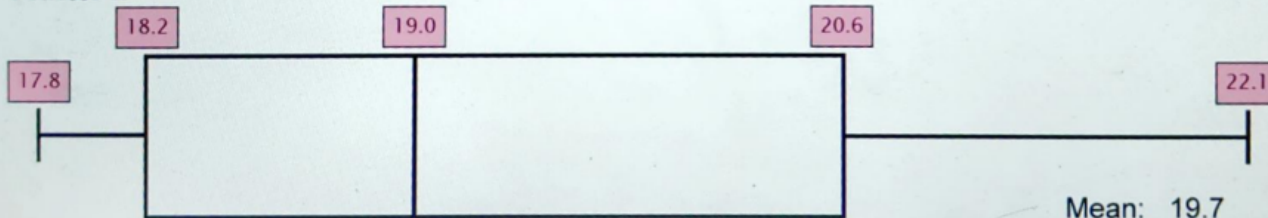
Printer A



Mean: 19.9

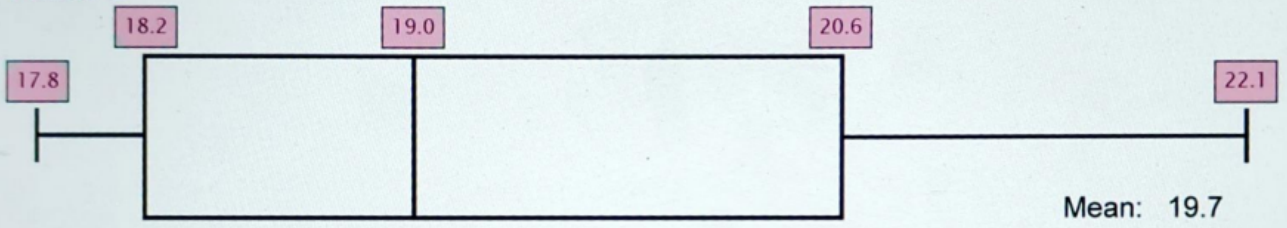
Mode:

Printer B



Mean: 19.7

Printer B



Mode:

Mean: 19.7


Mode: 20.6



Question 6e (1 mark)

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

B *I* | ← → U x_2 x^2 \int $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ


Styles ▾ 



Question 6f (1 mark)

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

B *I* | ← → U x_2 x^2 \int $\frac{1}{x}$ $\frac{1}{x^2}$ Ω Σ

Styles ▾ 

I





Question 7 (23 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).

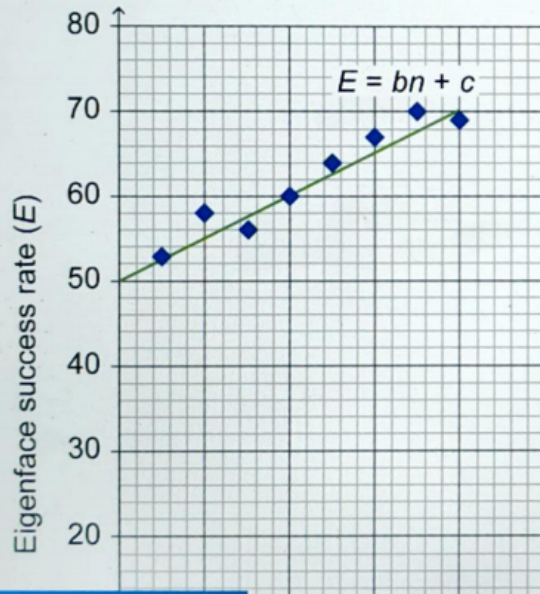
All methods of machine learning require multiple observations of the object. For example, in face recognition the programme will take many 'facial observations' in order to learn the features of the face to improve the success rate of face recognition.

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



Question 7a (2 marks)

The graph below shows data of the Eigenface method.



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

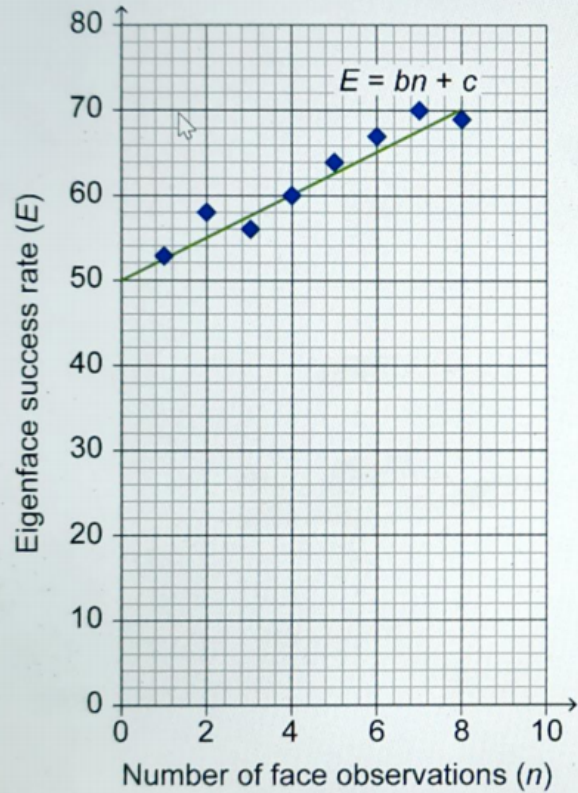
n is the number of face observations recorded per person.

Determine the values of b and c .

B **I** ← → U x_n x^2 \int $\frac{d}{dx}$ Ω Σ

Styles

Eigenface method.



Eigenface method

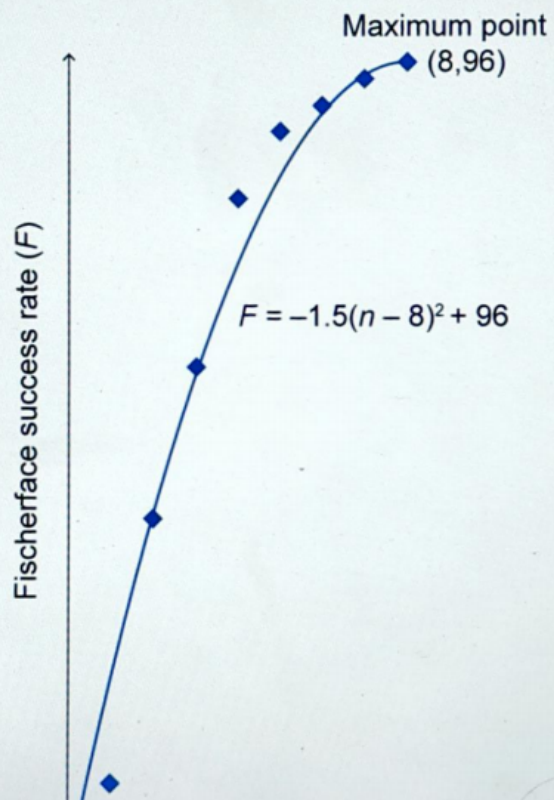
n is the number of face observations recorded per person.

Determine the values of b and c .

Rich text editor interface showing a toolbar with formatting options (B, I, U, x₂, x², subscript, superscript, bold, italic, underline, strikethrough, link, unlink, list, indent, outdent, undo, redo) and a text area below it.



The graph below shows data of the Fisherface method.



The Fisherface method can be modelled using the equation

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

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

n is the number of face observations recorded per person

F has a maximum point at (8,96).



Question 7b (2 marks)

Show that the function F passes through the point $(2,42)$.

B I ← → **U** x_2 x^2 \int \sum Ω Σ

Styles ▾



Question 7c (5 marks)

Find the first value of n for which the Fisherface method will have a higher success rate than the Eigenface method.

B I ← → **U** x_2 x^2 \int \sum Ω Σ

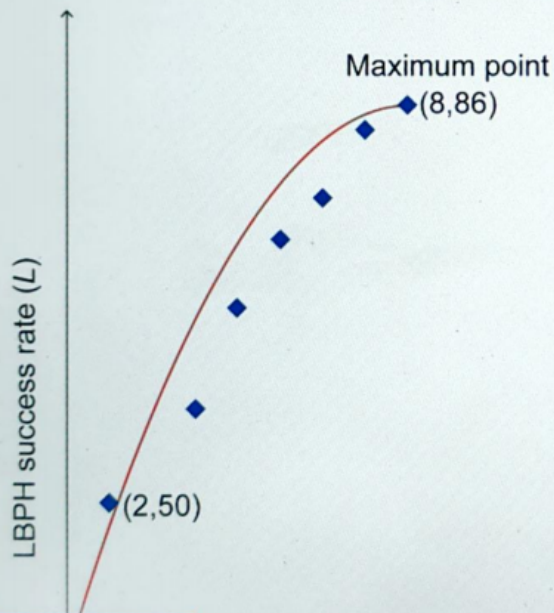
Styles ▾





Question 7d (4 marks)

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



The LBPH method can be modelled using the quadratic equation

$$L = a(n - h)^2 + k; \quad 0 < n \leq 8, \text{ where}$$

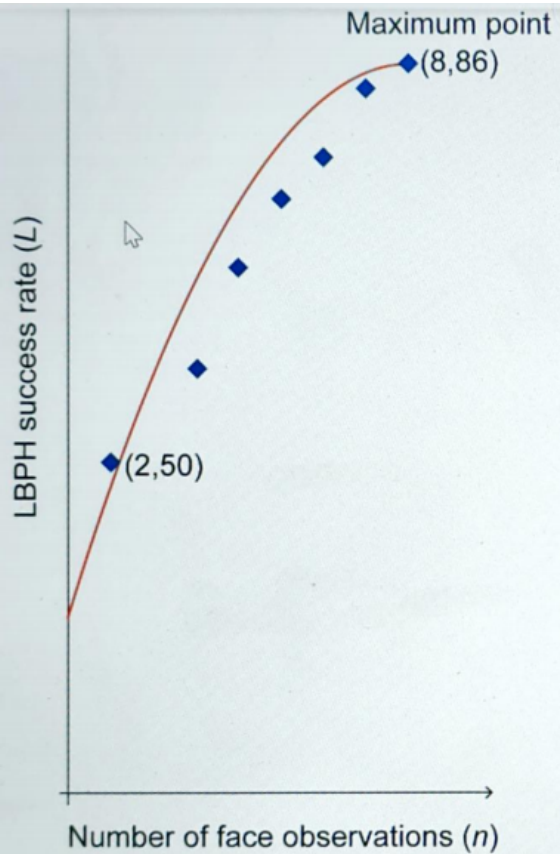
L is the success rate (%) of the LBPH method

n is the number of face observations recorded per person

L has a maximum point at (8, 86).

Find the values of a , h , and k .

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x₂), Superscript (x²), Bulleted List, Numbered List, Omega (Ω), and Sigma (Σ). Below the toolbar is a 'Styles' dropdown menu and a small icon.



n is the number of face observations recorded per person

L has a maximum point at $(8, 86)$.

Find the values of a , h , and k .

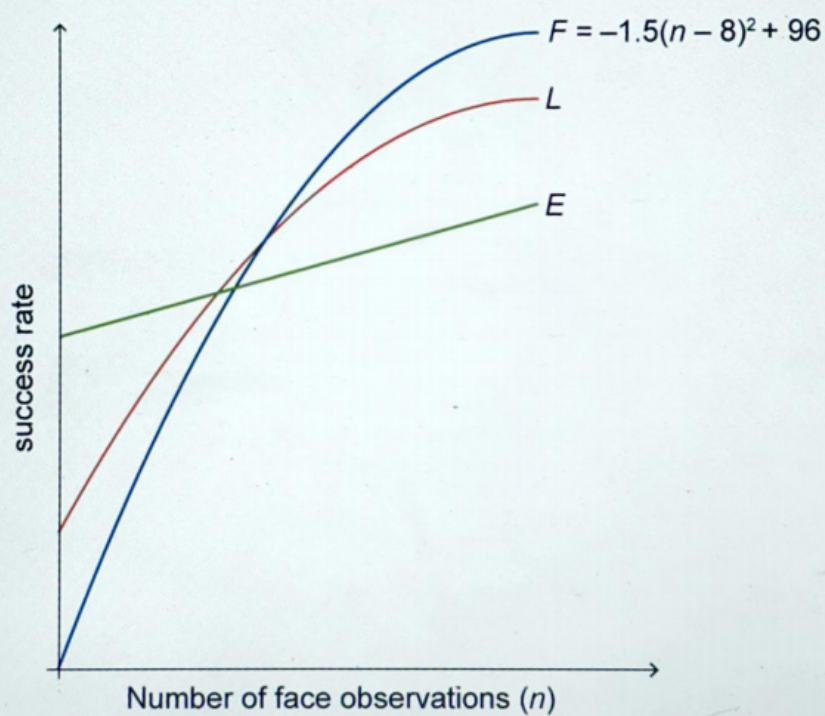
Rich text editor toolbar with the following icons: Bold (B), Italic (I), Undo, Redo, Underline (U), x_2 , x^2 , Bulleted list, Numbered list, Link (Ω), and Unlink (Σ). Below the toolbar is a "Styles" dropdown menu and a "Media" icon.





Question 7e (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:

B

I



U

x_2

x^2

$\frac{1}{2}$

$:=$

Ω

Σ

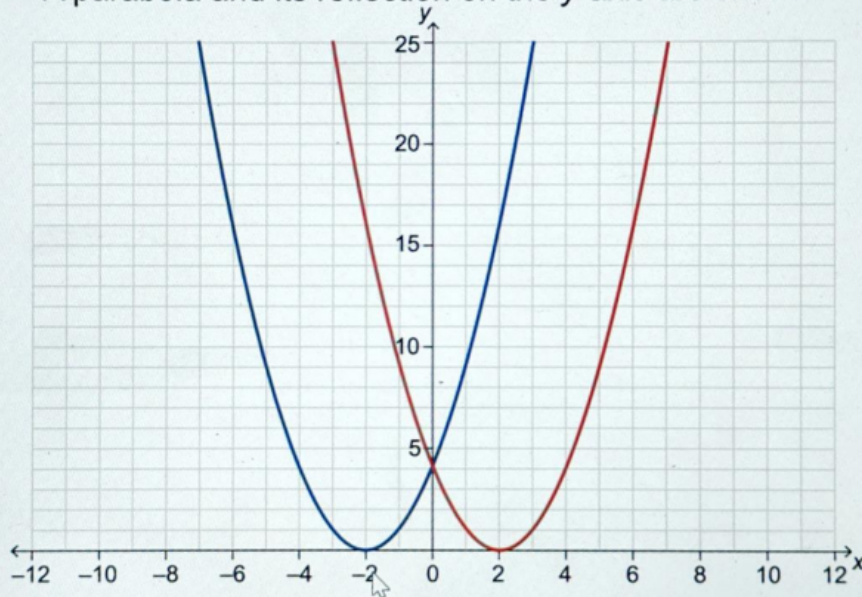
Styles



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

A parabola and its reflection on the y-axis are shown.

Stage 0



00:03

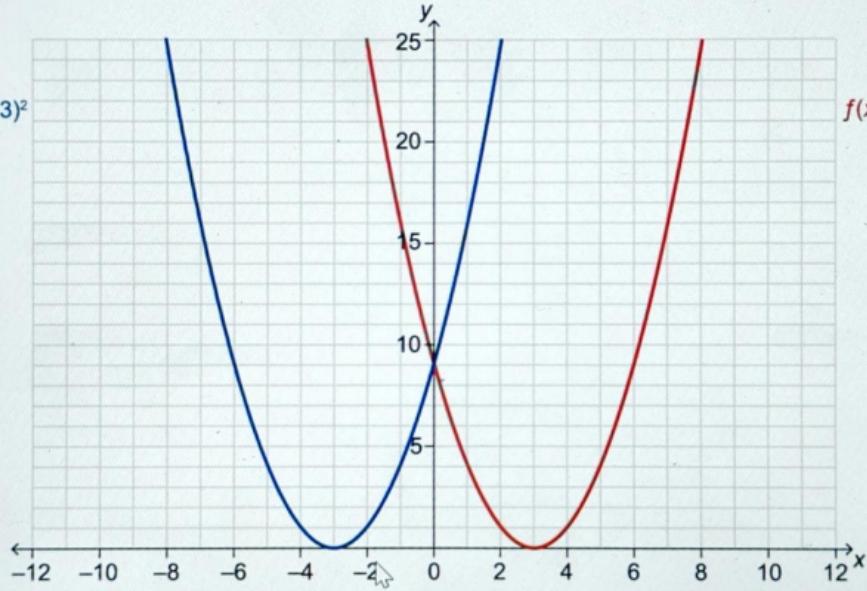


Investigate the relationship between the number of squares inside a rectangle between two parabolas.

Stage 1

$$g(x) = (x + 3)^2$$

$$f(x) = (x - 3)^2$$



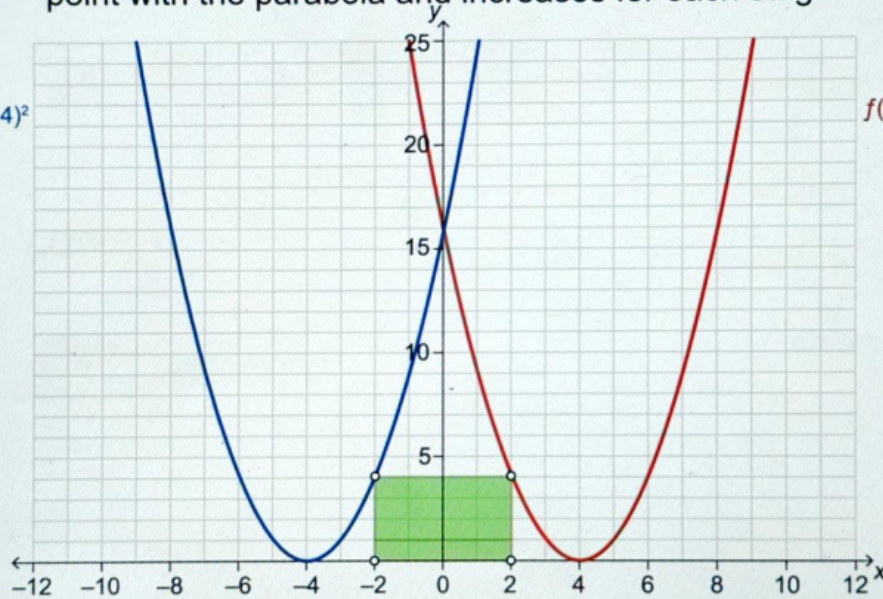
Investigate the relationship between the number of squares inside a rectangle between two parabolas.

The height of the rectangle is determined by the intersection point with the parabola and increases for each stage.

Stage 2

$$g(x) = (x + 4)^2$$

$$f(x) = (x - 4)^2$$



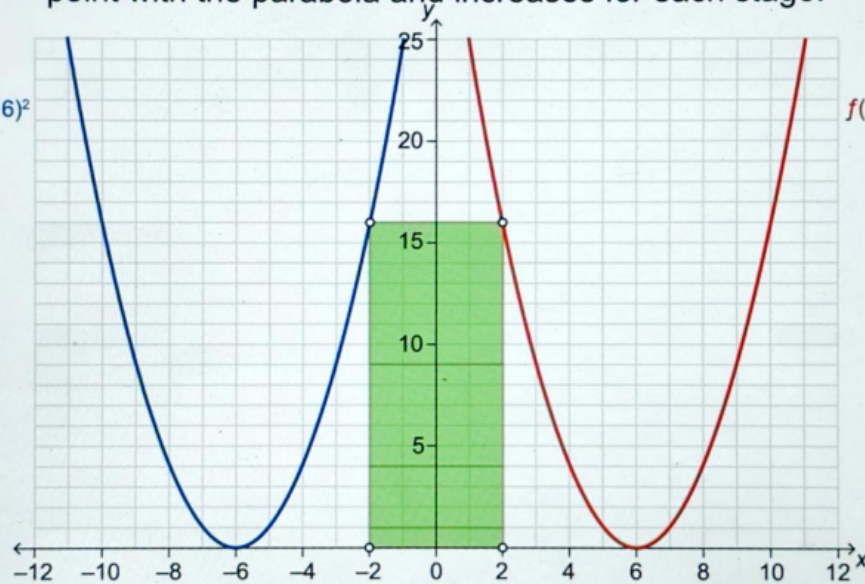
Investigate the relationship between the number of squares inside a rectangle between two parabolas.

The height of the rectangle is determined by the intersection point with the parabola and increases for each stage.

Stage 4

$$g(x) = (x + 6)^2$$

$$f(x) = (x - 6)^2$$

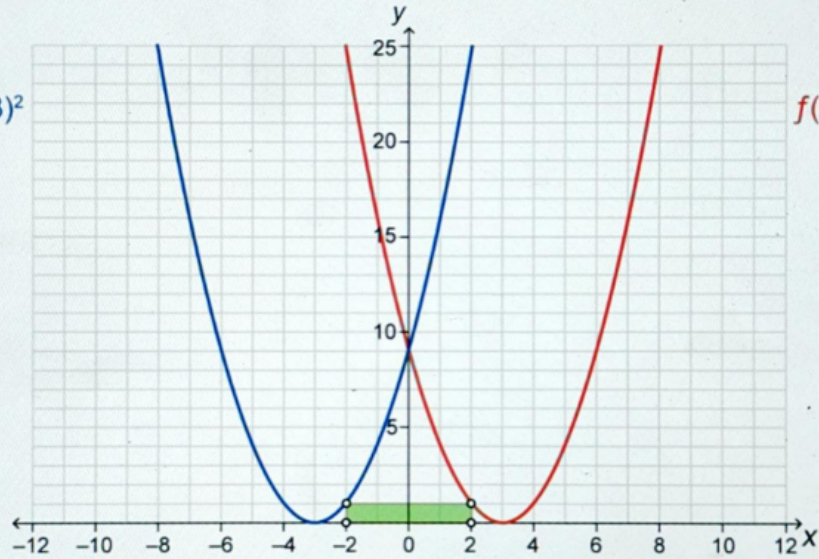
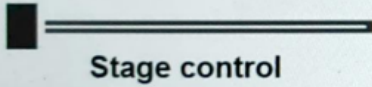


Drag the slider to see how the squares are added.

Stage 1

$$g(x) = (x + 3)^2$$

$$f(x) = (x - 3)^2$$

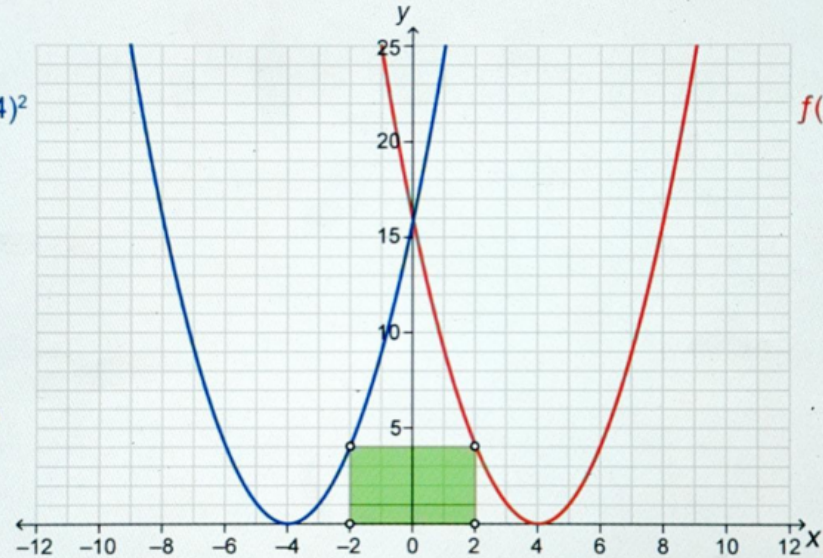
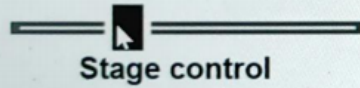


Drag the slider to see how the squares are added.

Stage 2

$$g(x) = (x + 4)^2$$

$$f(x) = (x - 4)^2$$

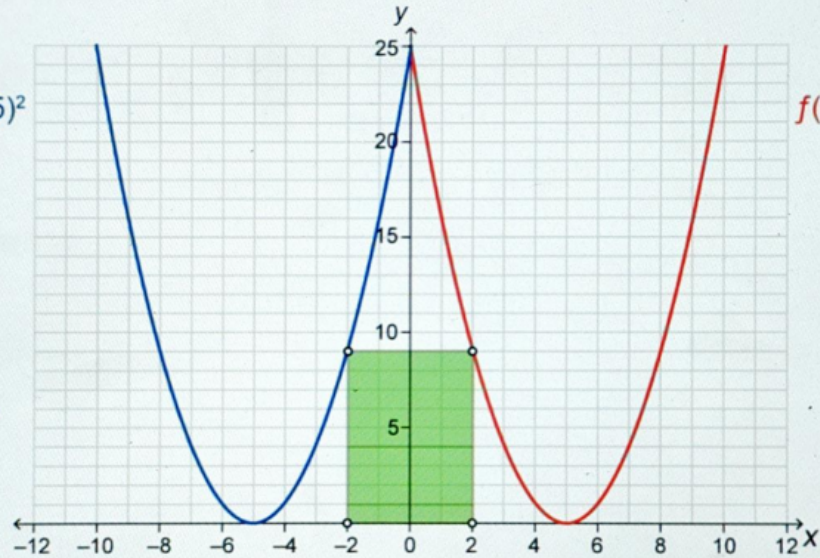
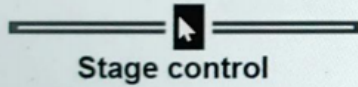


Drag the slider to see how the squares are added.

Stage 3

$$g(x) = (x + 5)^2$$

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

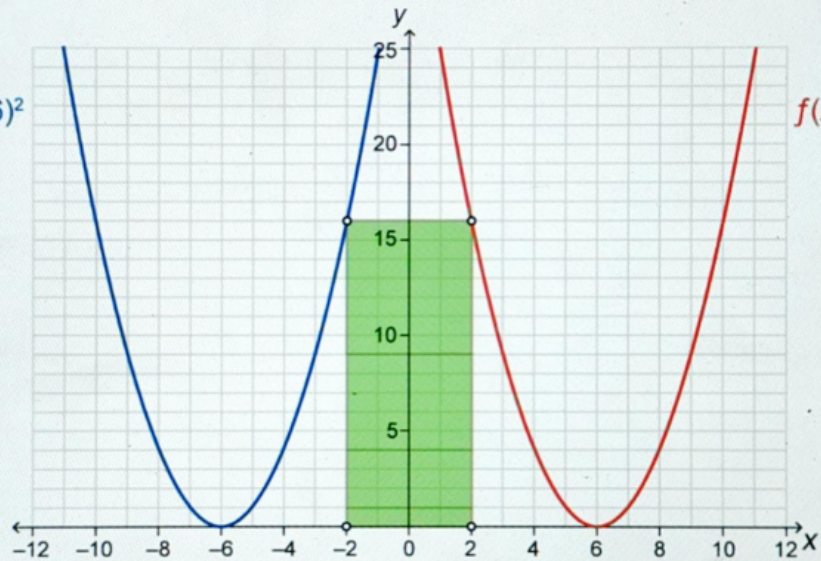
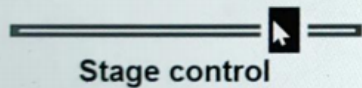


Drag the slider to see how the squares are added.

Stage 4

$$g(x) = (x + 6)^2$$

$$f(x) = (x - 6)^2$$





Question 8a (2 marks)

Using both equations of stage 3, **show that** the height of the rectangle is 9 units.

B *I* | ← → | U x_2 x^2 | \int $\frac{1}{x}$ $\frac{1}{x^2}$ | Ω Σ | Styles |

I



Question 8b (1 mark)

Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	12
3	20
4	28
5	
6	



Question 8c (2 marks)

Describe in words two patterns for S .

B *I* ← → U x_2 x^e ;= := Ω Σ

Styles -



Question 8b (1 mark)

Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	12
3	20
4	28
5	
6	



Question 8d (2 marks)

Write down a general rule for S in terms of n .

B

I



U

x_2

x^2

$\frac{1}{2}$

$\frac{1}{3}$

Ω

Σ

Styles





Question 8b (1 mark)

Write down the missing values in the table.

Stage (n)	Number of new squares (S)
1	4
2	12
3	20
4	28
5	
6	



Question 8e (3 marks)

Verify your general rule for S .

B *I* ← → U x_n x^2 \int \sum Ω Σ

Styles -



Question 8f (20 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	12	16	
3	20	36	
4	28	64	
5			
6			

Rich text editor toolbar with the following elements:

- Buttons for Bold (B), Italic (I), Undo, and Redo.
- Buttons for Underline (U), subscript (x_2), and superscript (x^2).
- Buttons for bulleted list, numbered list, and link.
- Buttons for Insert link, Unlink, and Insert table.
- A "Styles" dropdown menu.
- A mobile device icon.