Question 1 (6 marks)

Question 1a (2 marks)

The set of natural numbers ($\mathbb{N}$) and the set of integer numbers ($\mathbb{Z}$) are represented in the Venn diagram below.

Label the Venn diagram by placing the draggable numbers provided into the correct location.

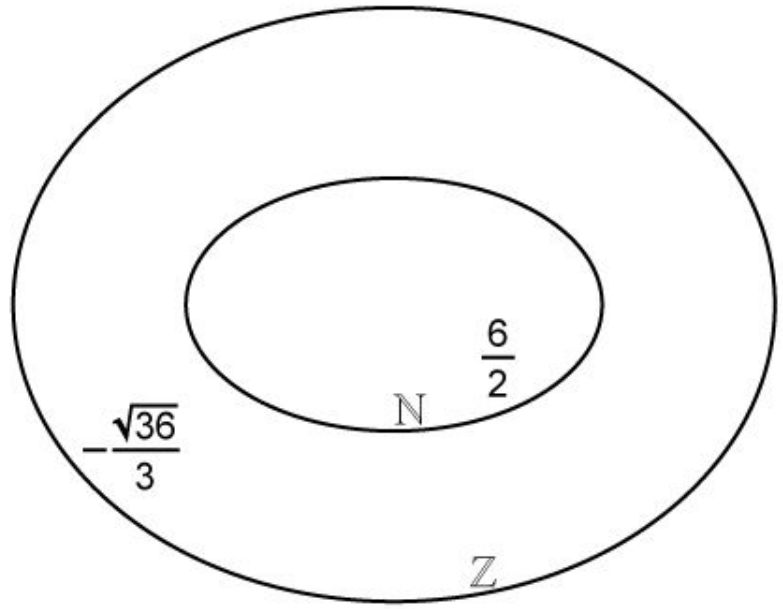
Draggable numbers

$49^{\frac{1}{2}}$

$\frac{12}{3}$

$-\sqrt{9}$

$3\sqrt{-8}$



Question 1b (3 marks)

The set of rational numbers ($\mathbb{Q}$) and the set of real numbers ($\mathbb{R}$) are added to the Venn diagram as shown below.

Label the Venn diagram by placing the draggable numbers provided into the correct location.

Draggable numbers

$-\sqrt{7}$

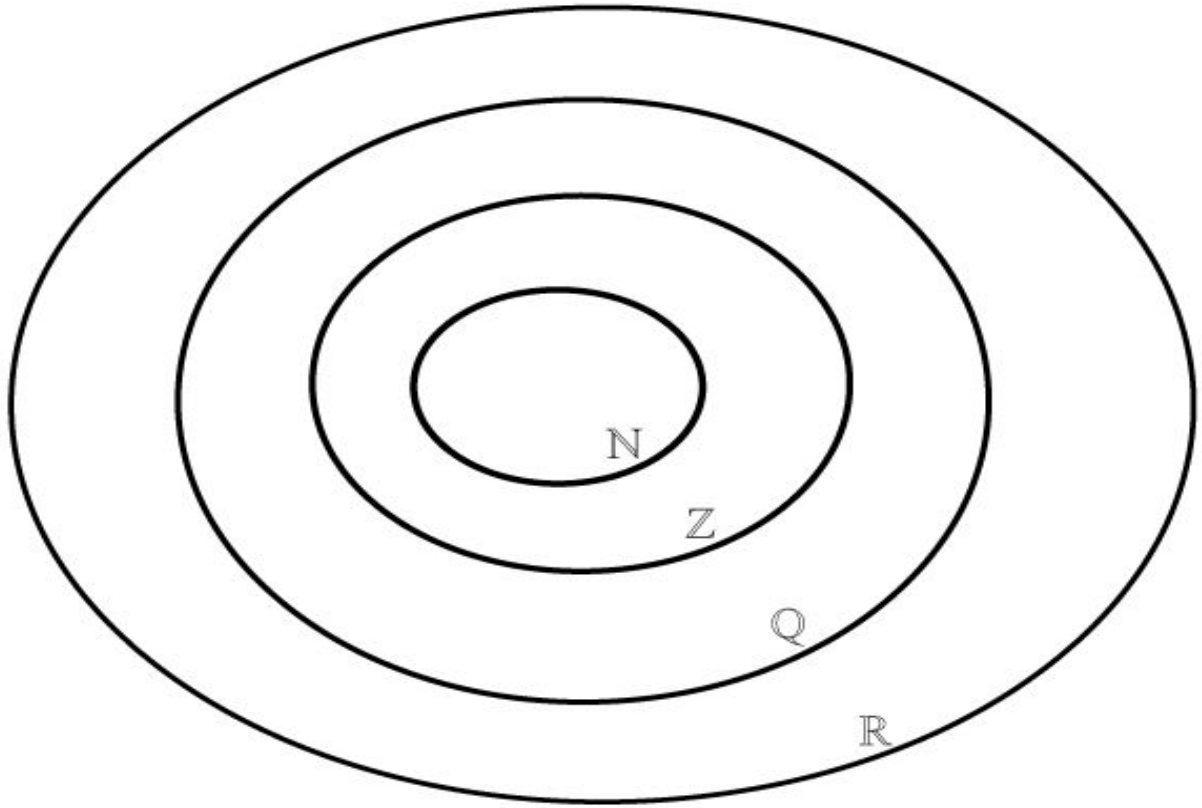
$\frac{22}{7}$

π

$\sqrt{|-4|}$

$\tan 30°$

$\log_2 1$



Given that $f(x) = \sqrt{x} - 4$, where $x \geq 4$, and $g(x) = 2x - 1$, **show that** $fg(7) = 3$.

B I U x_2 x^2 Ω Σ Styles

Given that $f(g(a)) = 4$, **find** the value of a.

B I U x_2 x^2 Ω Σ Styles

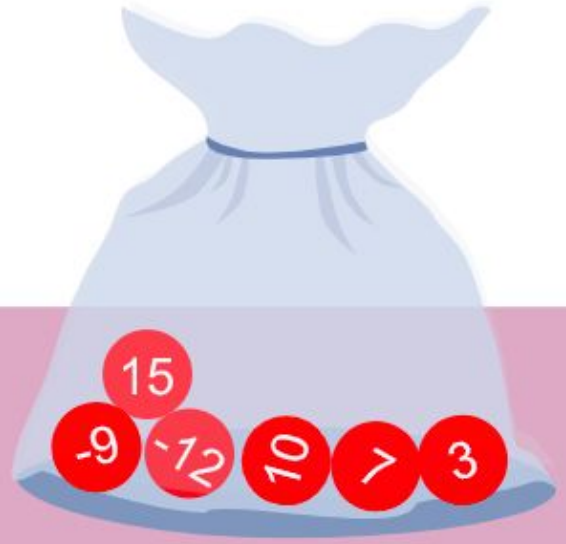
Question 3 (13 marks)

This media is interactive

The first ball is randomly selected from the bag

Next

0



A bag contains seven identical balls numbered as follows: –12, –9, 0, 3, 7, 10, 15

A game consists of randomly selecting two balls from the bag without replacement.
The rules of the game are:

The player wins 5 Australian dollars (AUD) if both balls are numbered with even numbers.

The player wins 10 AUD if the total of both numbers is even.

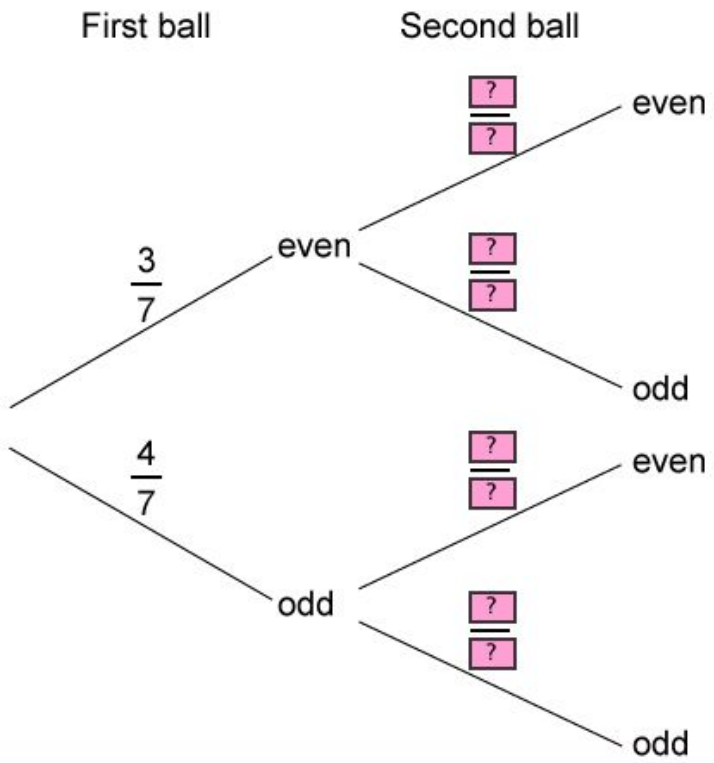
The player does not win anything otherwise.

Question 3a (2 marks)

The information provided in the animation is illustrated in the tree diagram below.

Write down the missing values in the tree diagram.

To insert your answers, click inside the box and replace the "?" with your answers in the "Add Label" box.



Scroll down to continue

Question 3b (4 marks)

Given that the player won 10 AUD, **show that** the probability that the first ball selected was even is $\frac{1}{3}$.

B I U x_2 x^2 Ω Σ Styles

Question 1c (1 mark)

Write down in set notation an expression representing the shaded region shown in the Venn diagram below. Drag and drop the appropriate notation into the response area.

Draggable notations

$\subseteq$

$\cup$

$\cap$

$\mathbb{N}$

$\mathbb{N}'$

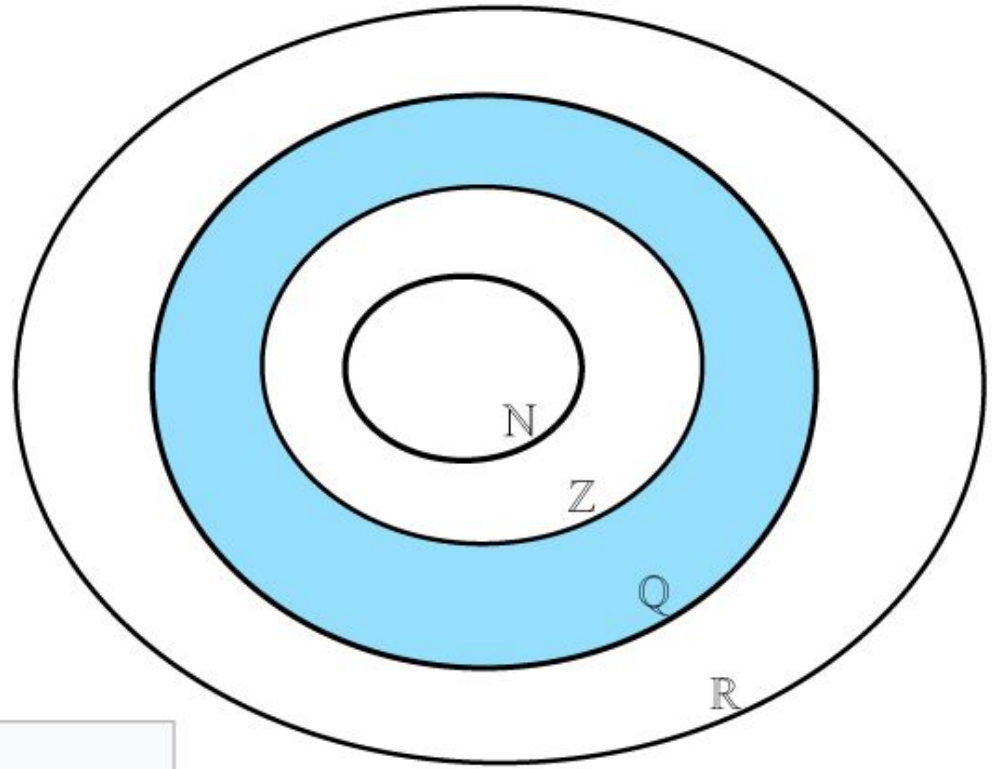
$\mathbb{Z}$

$\mathbb{Z}'$

$\mathbb{Q}$

$\mathbb{Q}'$

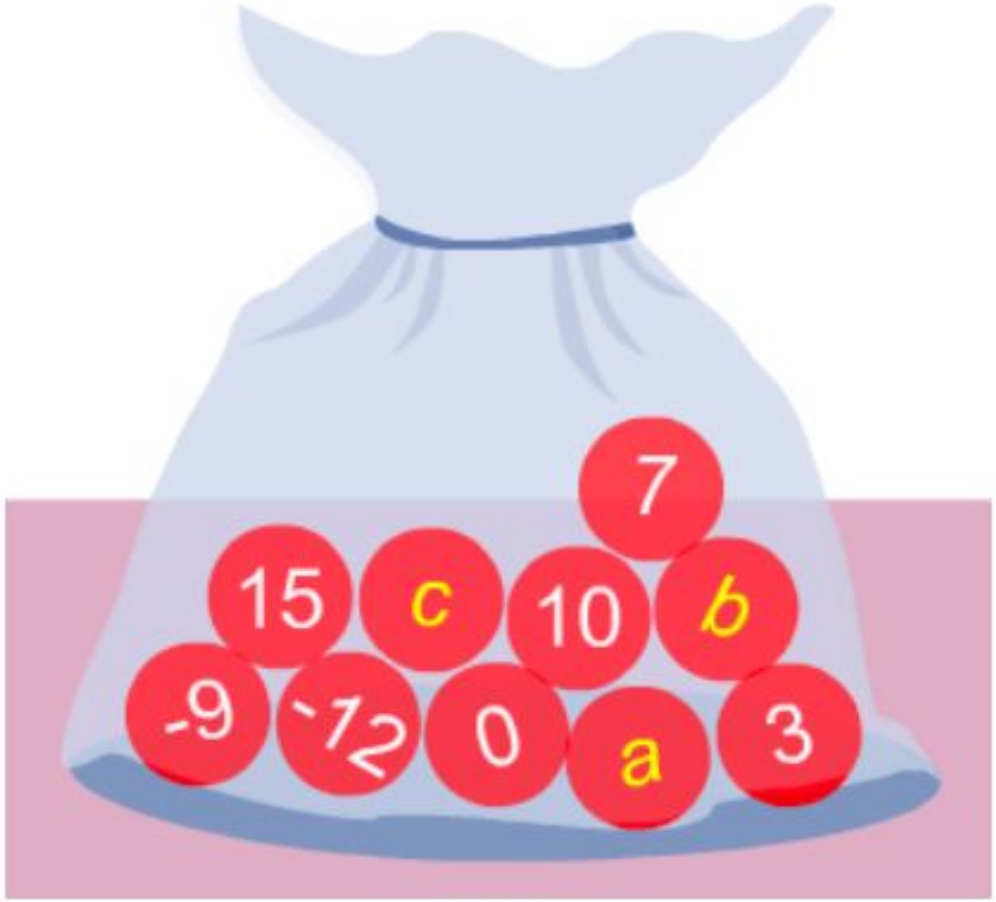
$\mathbb{R}$



Response area

Three balls numbered *a*, *b* and *c* are added to the bag. The balls, arranged in numerical order, are now:

a, –12, –9, 0, 3, *b*, 7, 10, 15, *c*



Question 3c (1 mark)

Given that the median is 5, **show that** $b = 7$.

B I U x_2 x^2 Ω Σ

Styles

Question 3d (6 marks)

Given that the range is 34 and the arithmetic mean is 2.7, **find** the values of a and c.

B I U x_2 x^2 Ω Σ

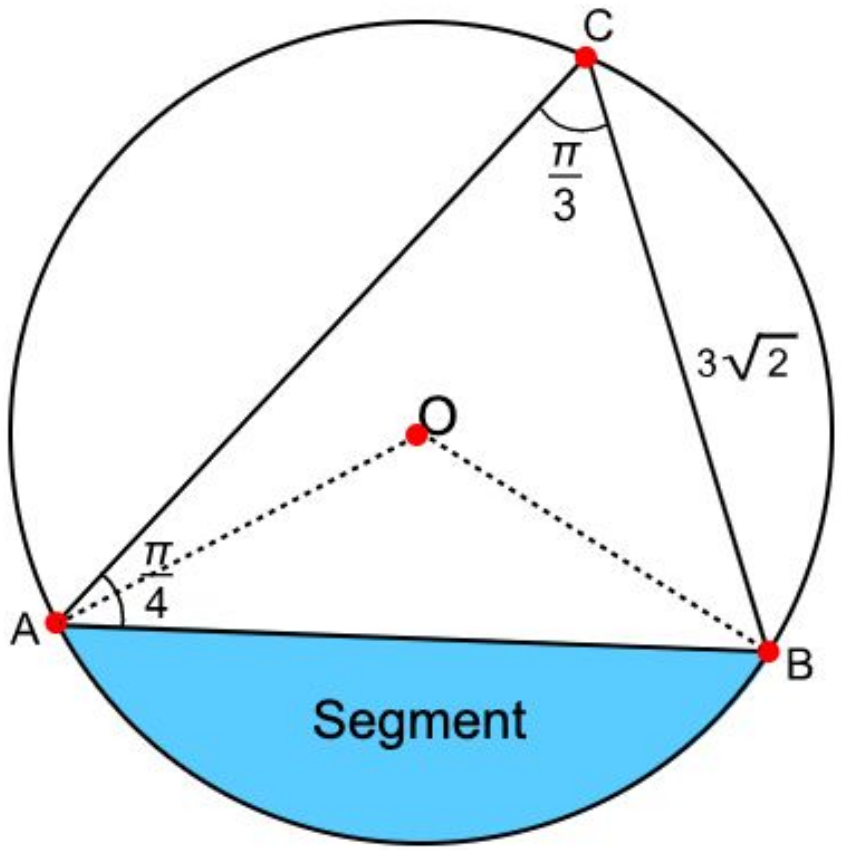
Styles

In the animation below, O is the centre of a circle drawn such that it passes through the vertices of the triangle ABC.

This media is interactive

Diagram not to scale

Start

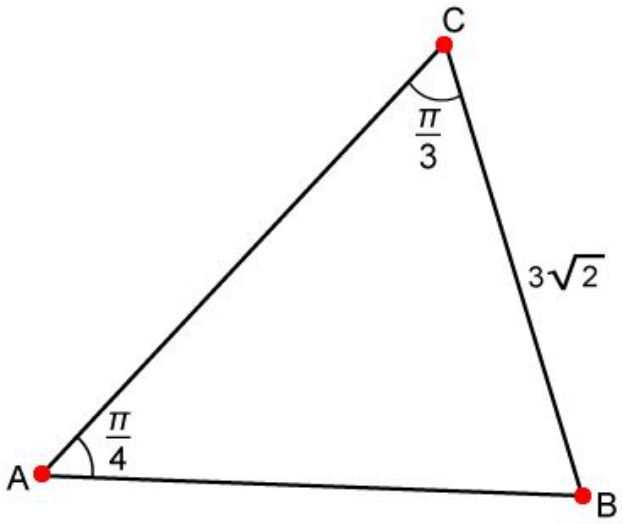


Reset

Question 4a (2 marks)

The diagram below shows triangle ABC. The length of BC is $3\sqrt{2}$ cm, angle ACB measures $\frac{\pi}{3}$ radians and angle BAC measures $\frac{\pi}{4}$ radians. **Show that** the length of AB is $3\sqrt{3}$ cm.

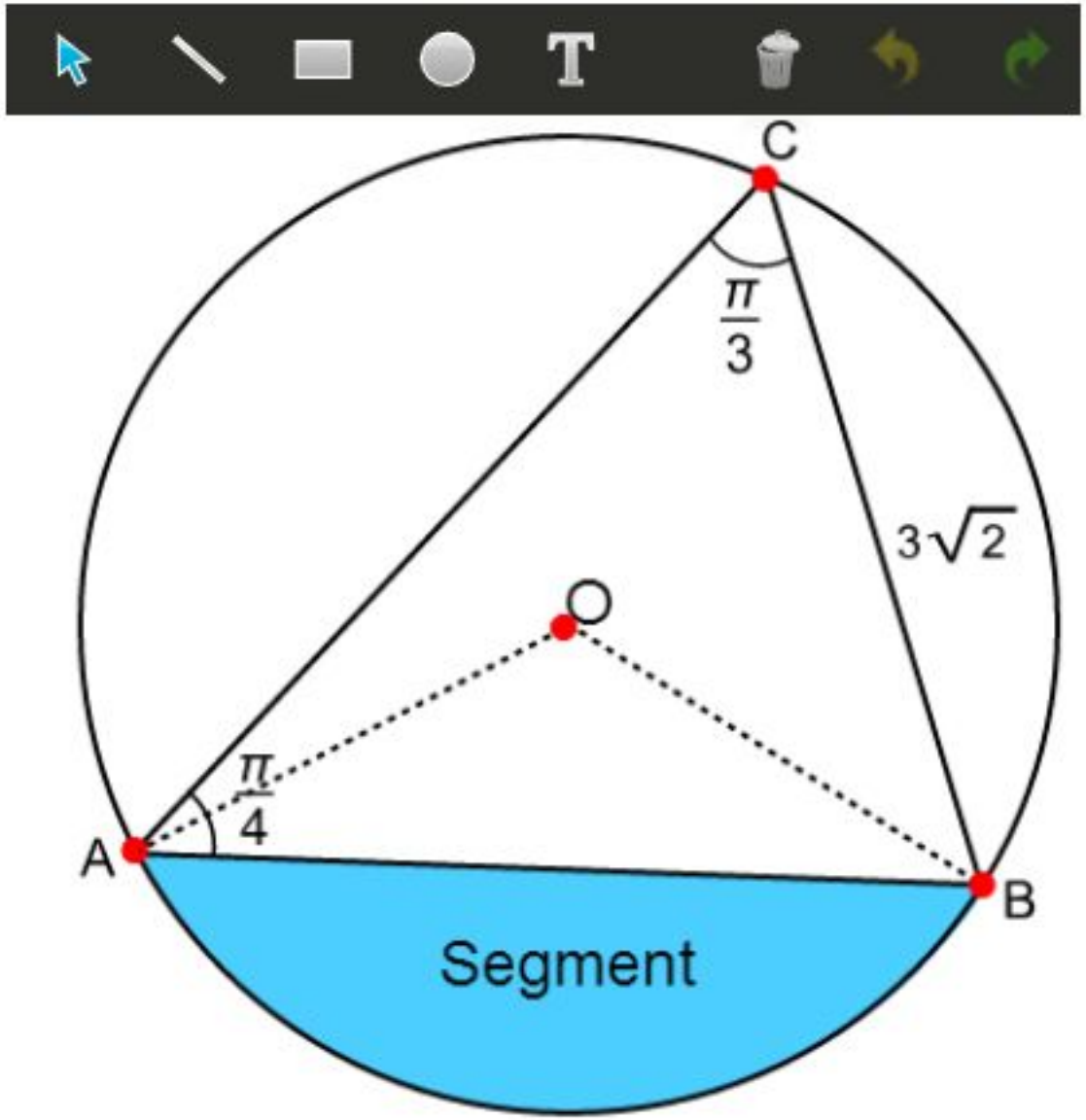
Diagram not to scale



Styles

Scroll down to continue

Question 4b (4 marks)



Find the length of the radius of the circle.

B I U x_2 x^2 Ω Σ

Styles

Question 4c (2 marks)

Hence, **determine** the exact value of the perimeter of the shaded segment.

B I U x_2 x^2 Ω Σ

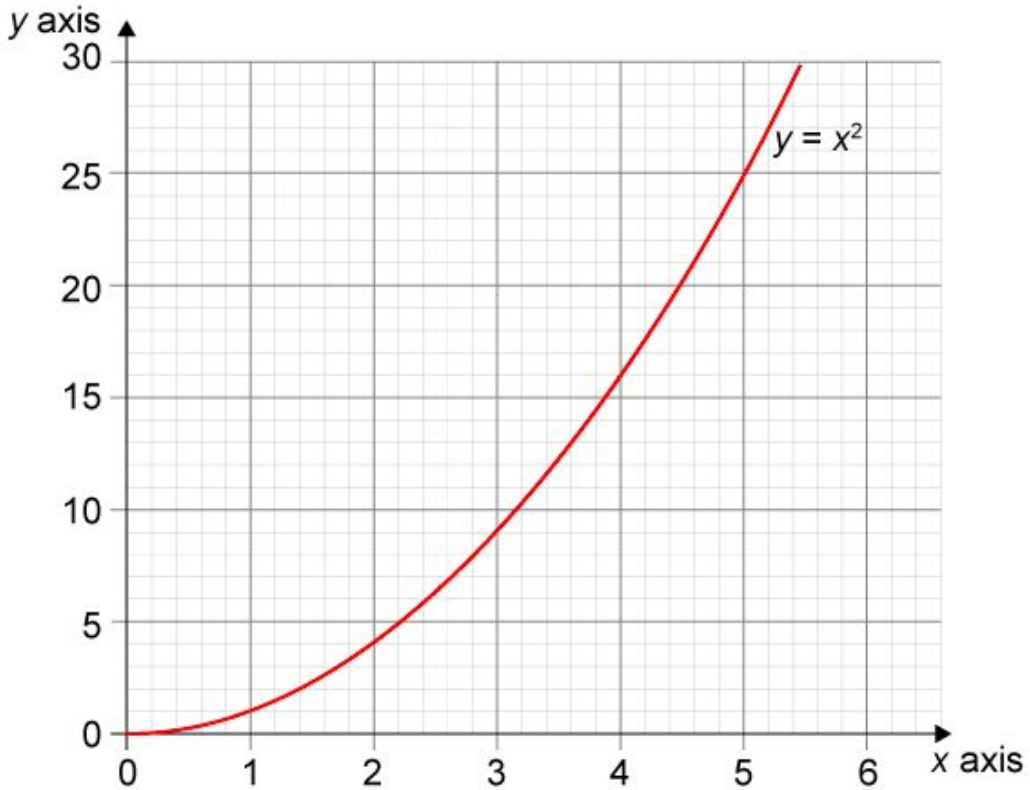
Styles

Question 5 (5 marks)

Question 5a (4 marks)

Identify the region of the solution set for $x \geq 0$, $y \geq 0$, $y \leq x^2$, $2x + y \geq 12$ and $x \leq 5$ by dragging the region icon to the correct location. The curve $y = x^2$ has been drawn for you.

Draggable: • $2x + y = 12$ $x = 5$ Region



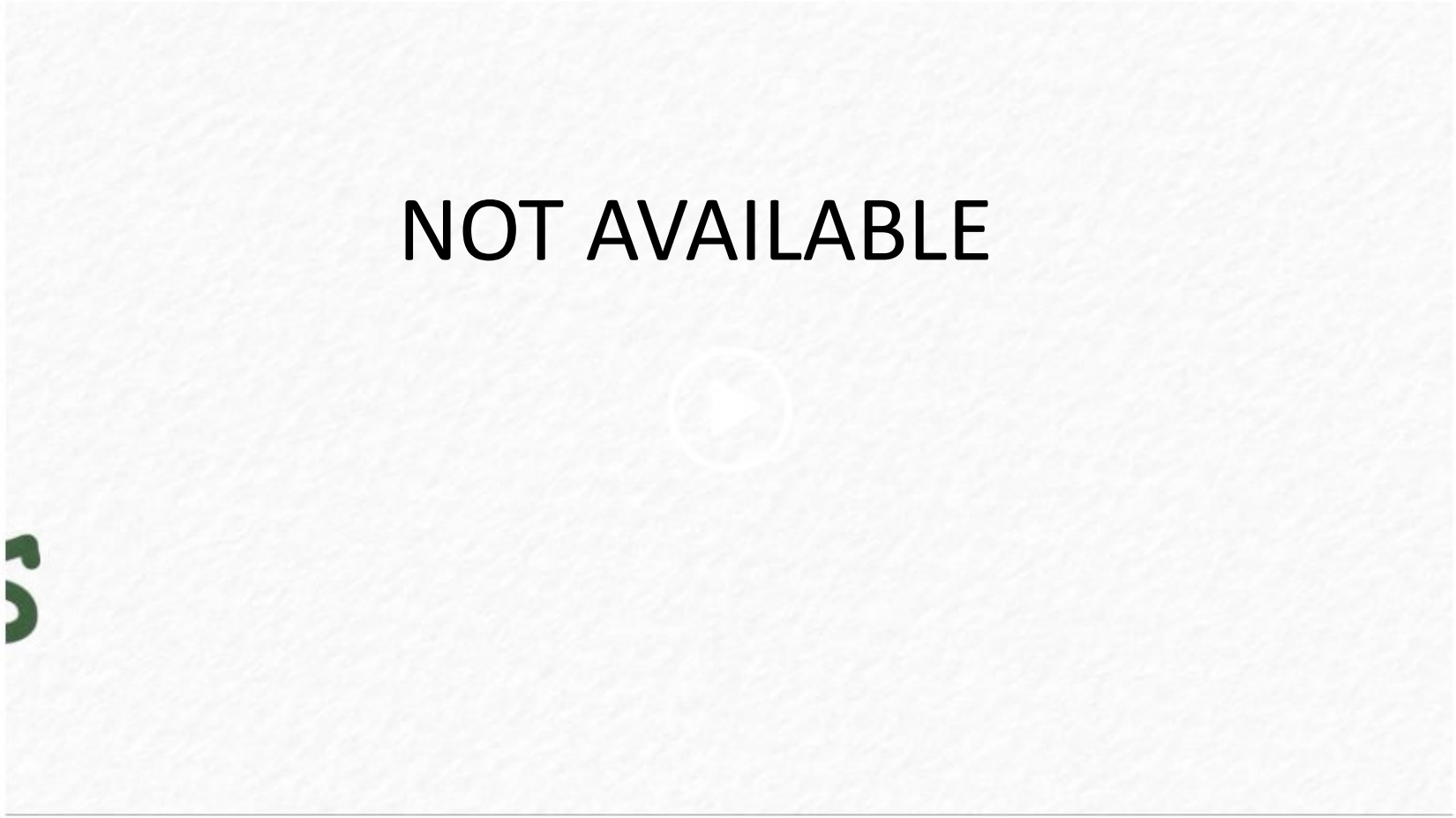
Question 5b (1 mark)

Write down the maximum value of the function $f = 3x + y$, for values within this solution set.

B I U x_2 x^2 Ω Σ Styles

Question 6 (15 marks)

The following video introduces a system of taxation used by governments to obtain money from working citizens.



Question 6a (5 marks)

Calculate the total amount of tax for an income of 80 000 EUR, showing your working in the table.

Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax EUR
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	(12 000 – 6000) x 5.5 %	330
12 000 < income ≤ 25 000	14 %	(25 000 – 12 000) x 14 %	1820
25 000 < income ≤ 70 000	30 %		
Above 70 000	41 %		
		Total tax paid on 80 000 EUR	

Reset

Question 6b (10 marks)

The scenarios provided in the tabs below should be used to answer this question.

Scenario 1 – Do not relocate to another country | Scenario 2 – Relocate to Denmark

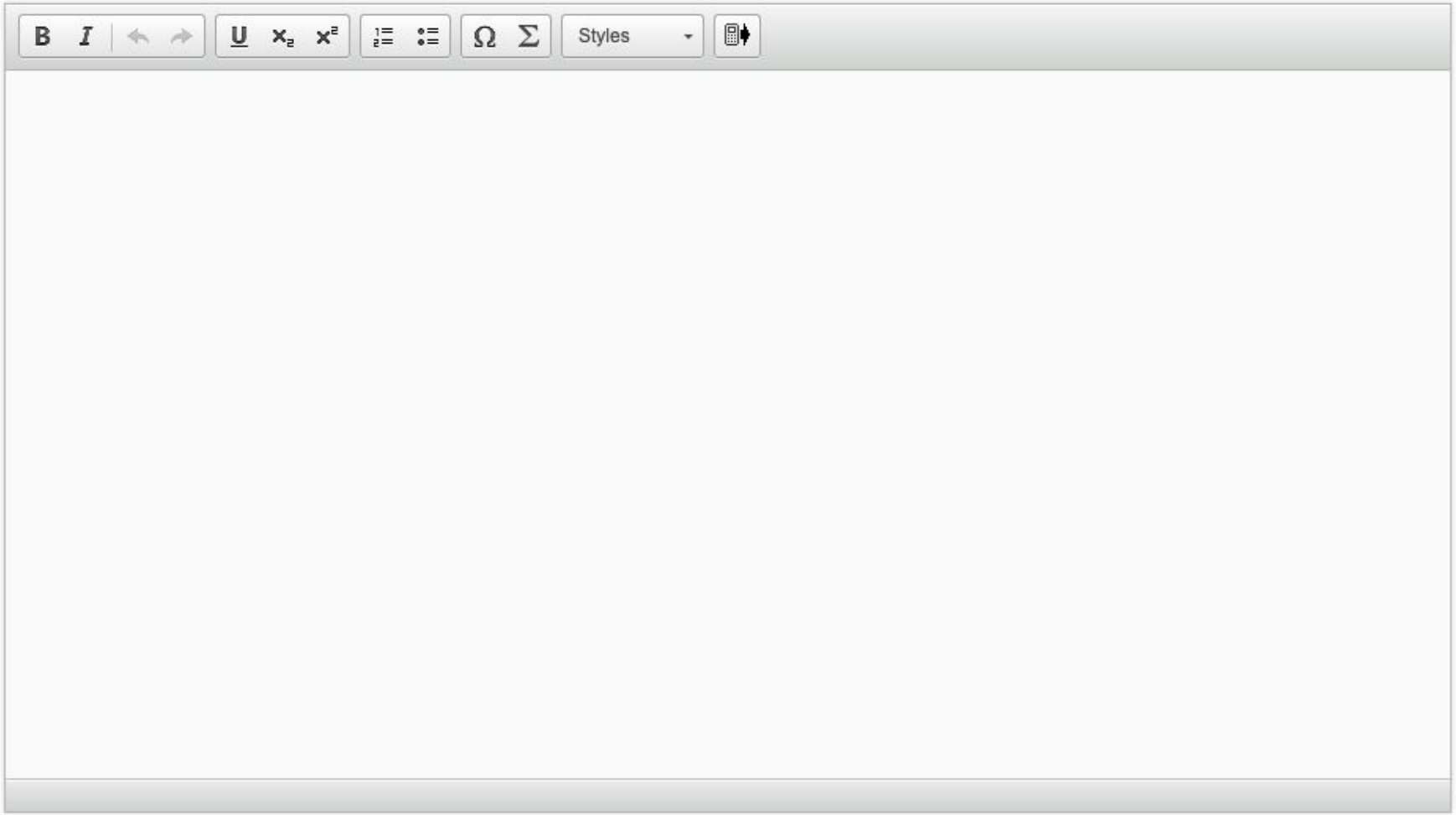
You have a reliable permanent job in your home town. You earn 40 000 EUR per annum, from this you will pay an annual tax. Tax is calculated using the system of taxation in part (a). The living expenses are outlined below.

Scenario 1 – Do not relocate to another country | Scenario 2 – Relocate to Denmark

Your employer offers you an opportunity to relocate to Denmark. You will earn 400 000 Danish Krones (DKK) per annum, from this you will pay an annual tax of 90 000 DKK. The living expenses are outlined below. The average exchange rate between the euro and the krone is 1 EUR = 7.5 DKK.

Evaluate the two scenarios by comparing the financial information provided and decide whether you should accept this opportunity to relocate. In your answer, you should:

- identify the relevant elements to consider when comparing the two scenarios
- make appropriate calculations to make a decision
- justify the accuracy of your calculations
- give your decision and a reflection on this offer to relocate, justifying your decision.



Question 7 (17 marks)

The following video explains how countries within a union have combined their national flags to create one common flag called the “Union Jack”.

Show that the total area of St George's cross is 800 cm^2.

Diagram 1

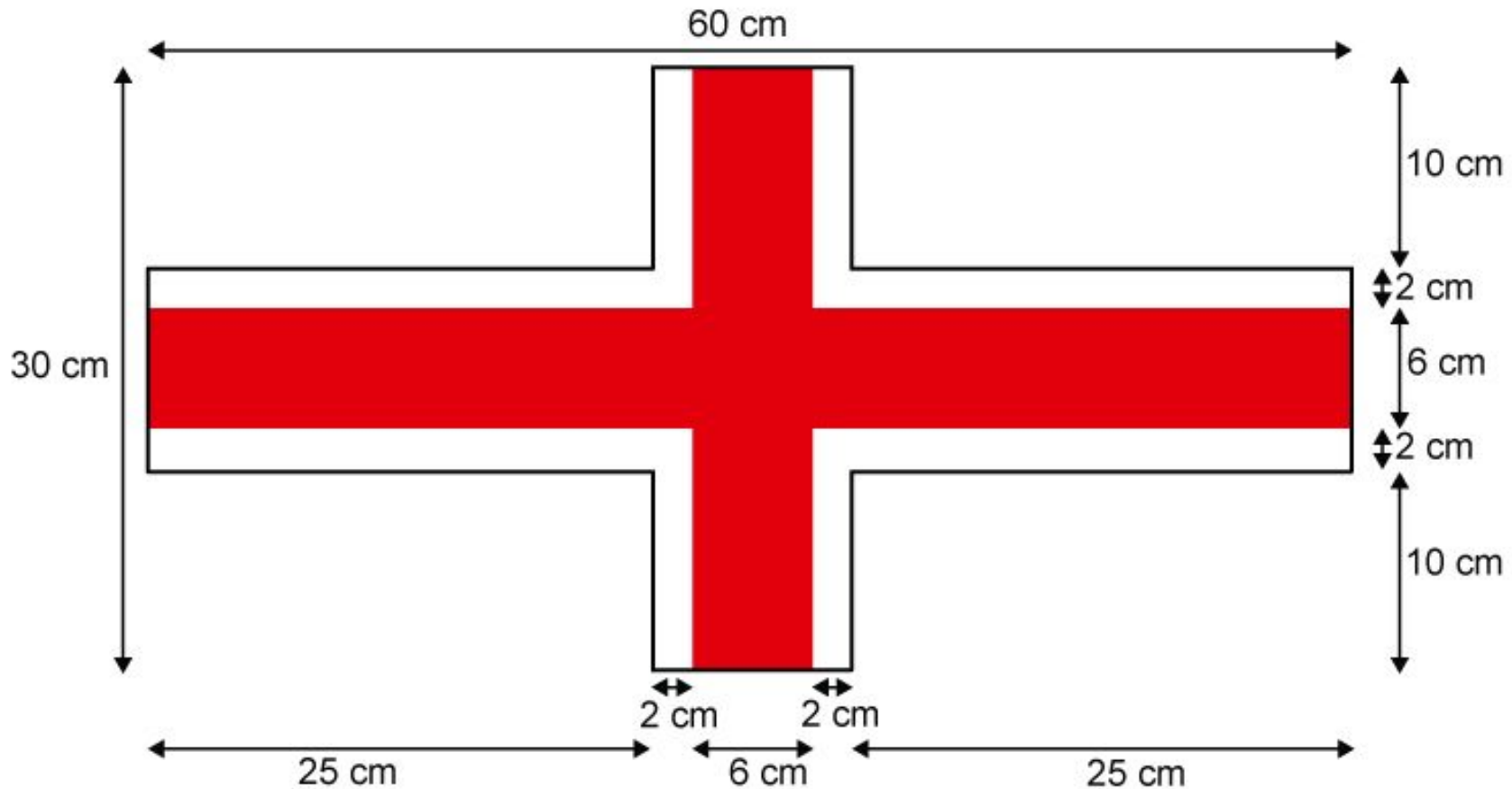
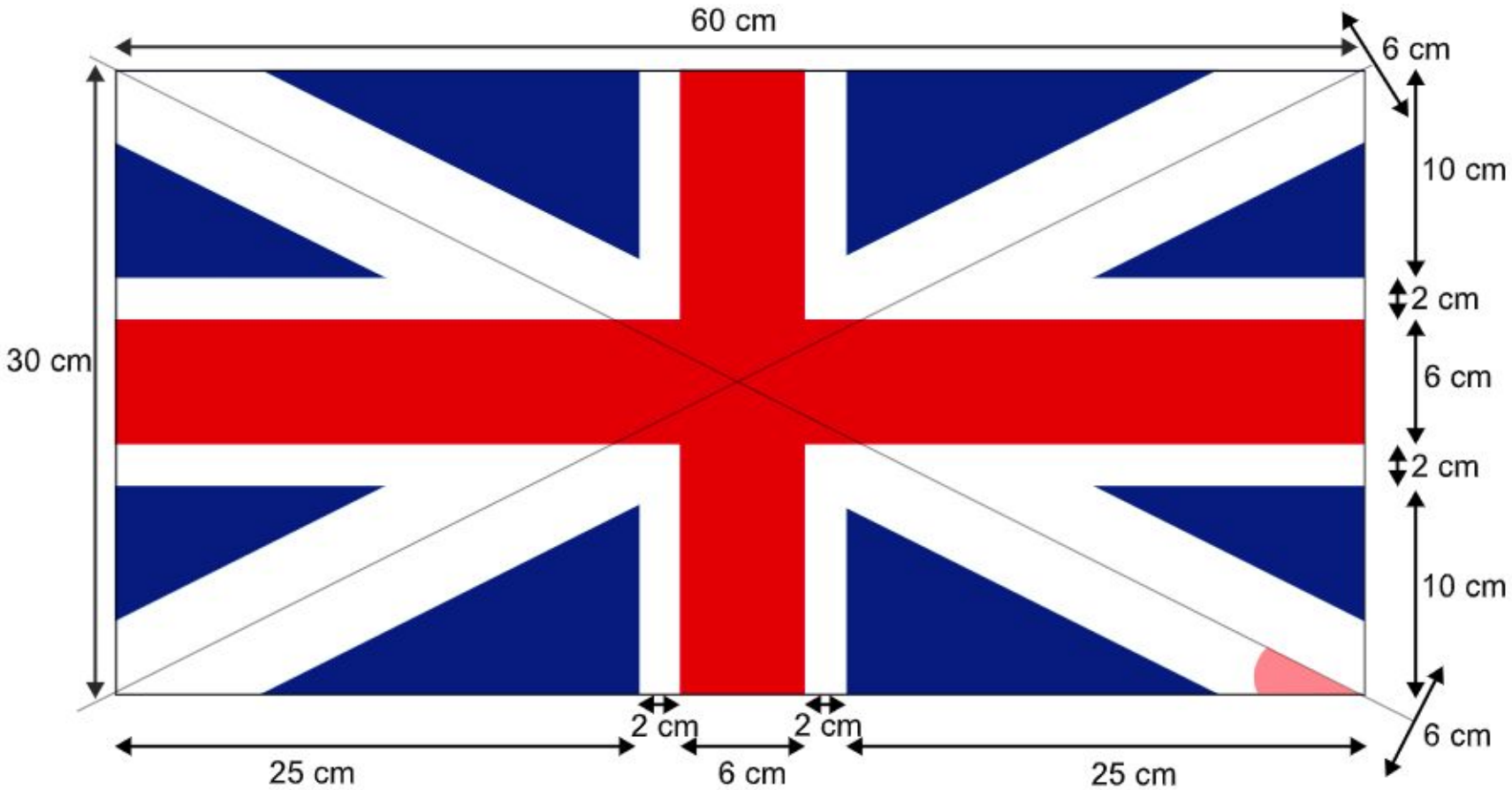


Diagram 2

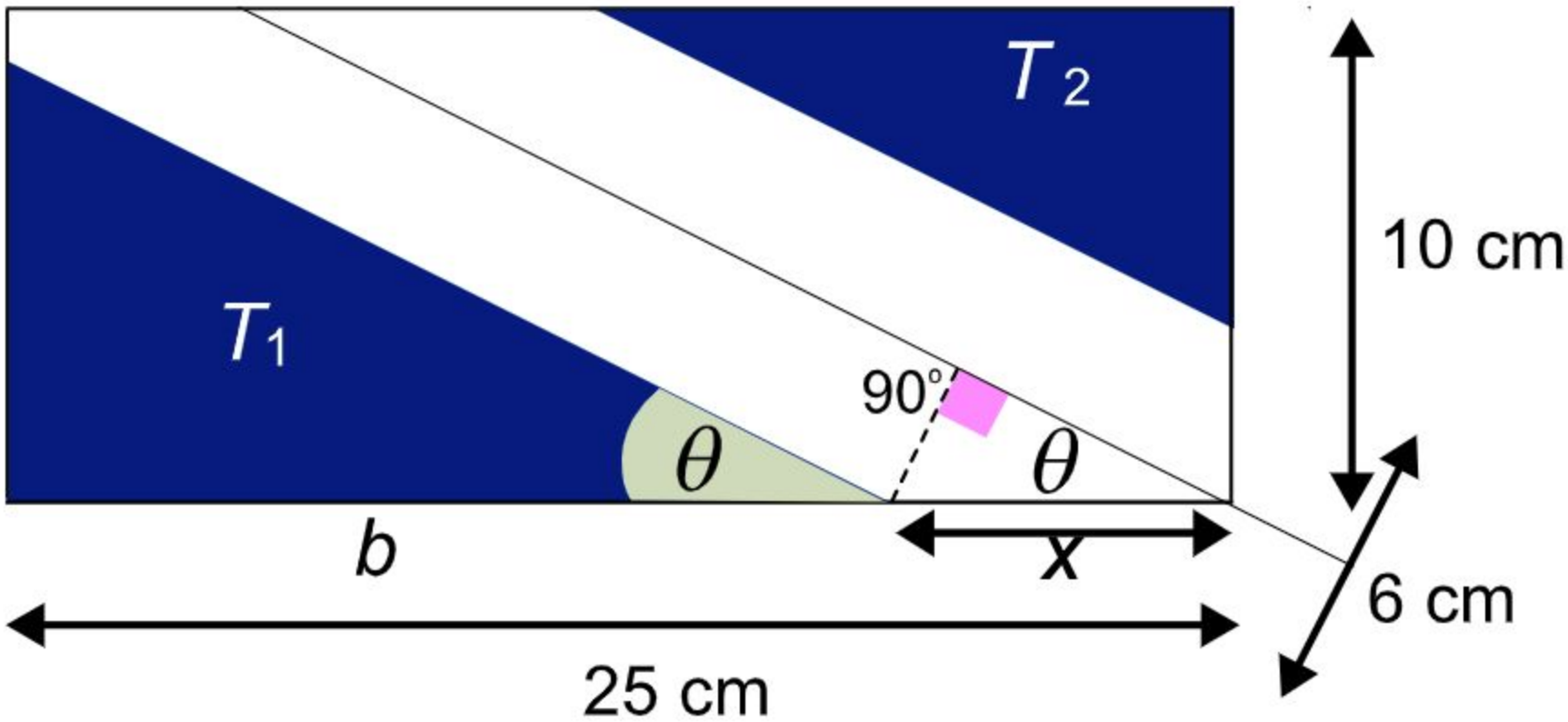
This media is interactive



Start

Diagram 3

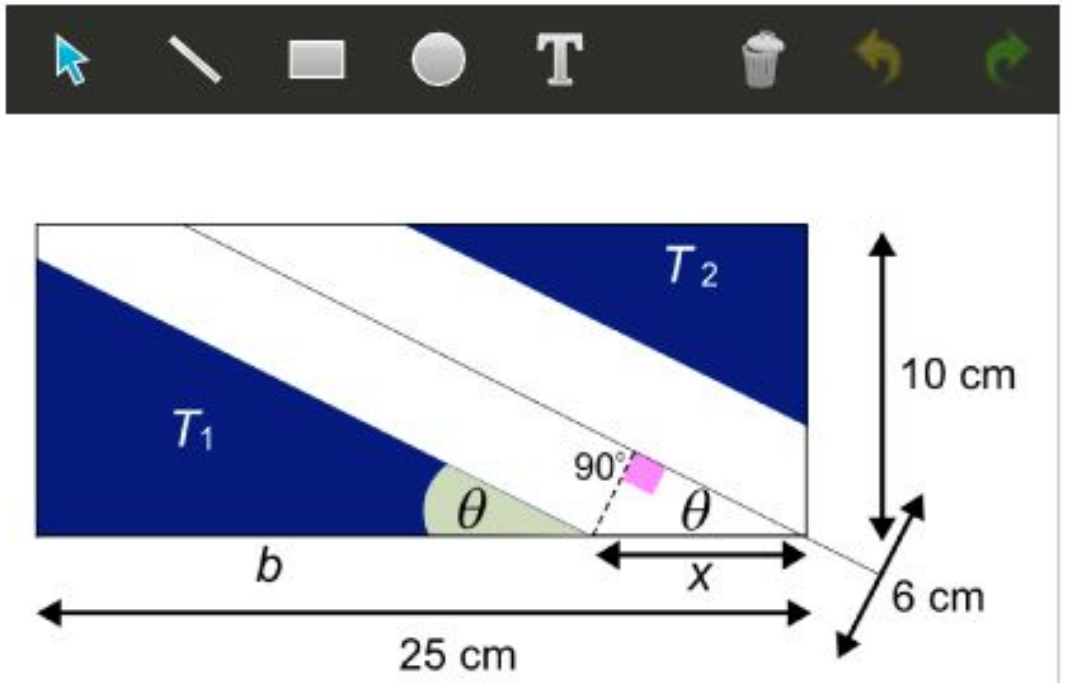
This media is interactive



Reset

Question 7c (5 marks)

A section of the Union Jack | Union Jack



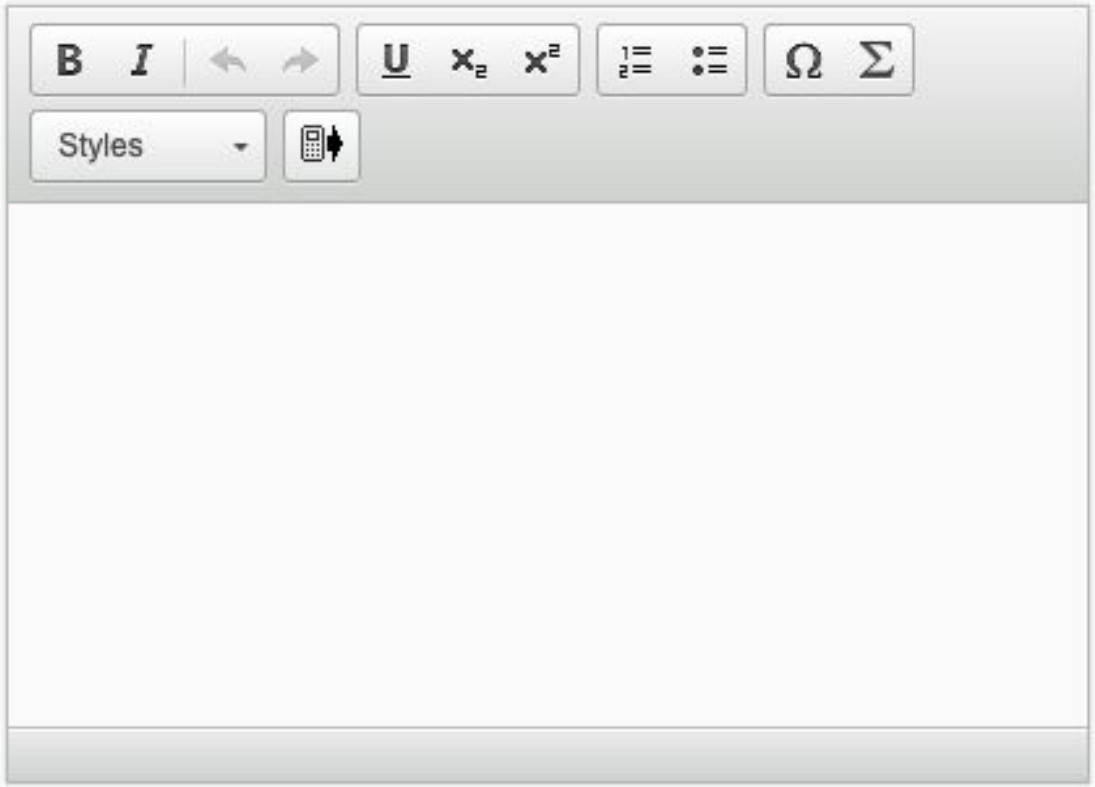
Find the value of x to the nearest one decimal place.

B I U x_2 x^2 Ω Σ

Styles

Question 7d (6 marks)

Given that the area of the triangle $T_2 = 44$ cm^2 to the nearest cm^2, **find** the total area of blue triangles in the Union Jack to the nearest cm^2.



Question 7e (2 marks)

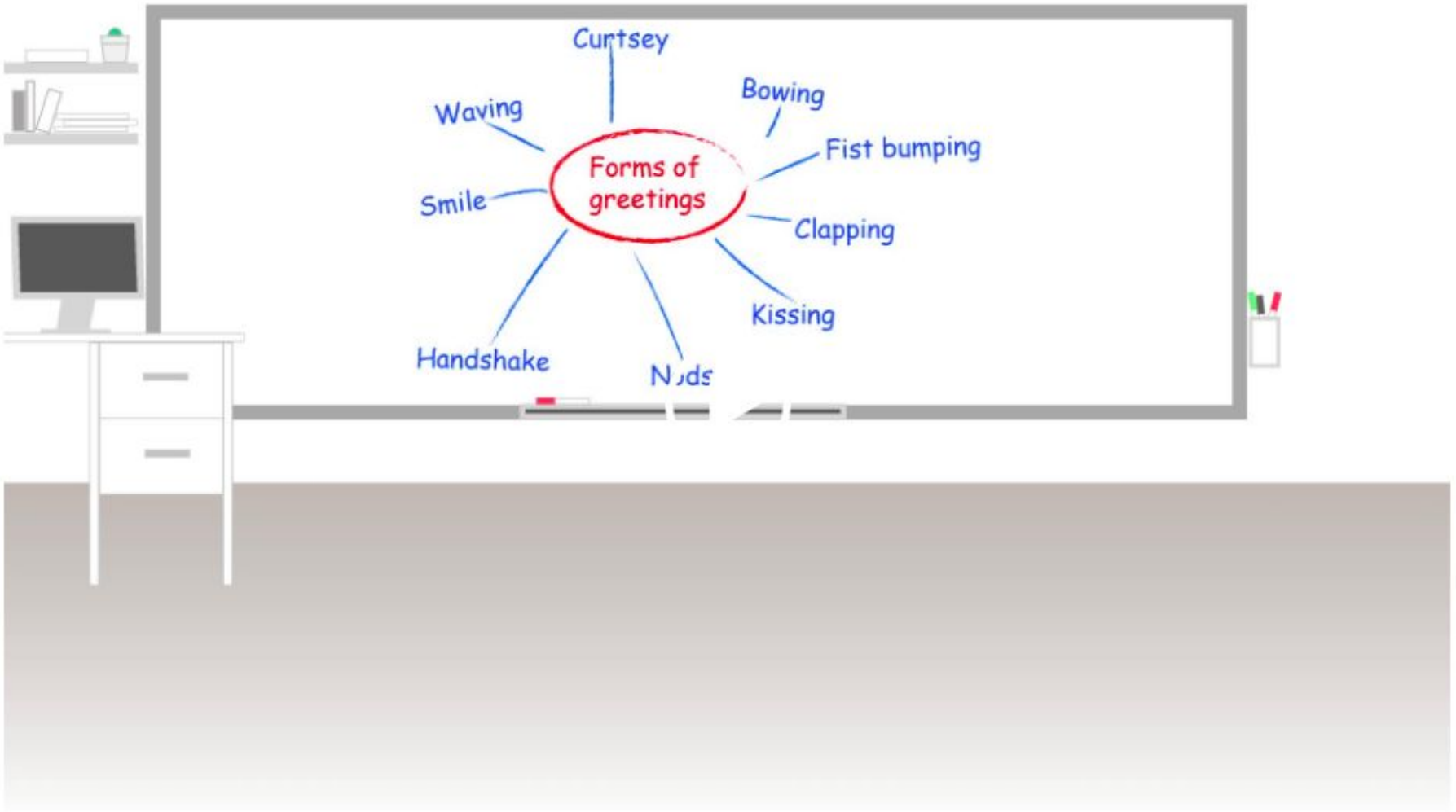
The blue triangles represent Scotland in the Union Jack. **Determine** the percentage of the area of the flag that is represented by Scotland.

B I U x_2 x^2 Ω Σ

Styles

Question 8 (31 marks)

The following video introduces some traditional greetings.



©

Five male colleagues and five female colleagues have gathered for an important meeting

Table 3

Number of males (m)	Number of females (f)	Number of handshakes (h)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
1	1	0	0	1	1	2
2	2	1	2	4	4	11
3	3	3	6	9	9	27
4	4	6	12	16	16	50
5	5	10	20	25	25	80

Five male colleagues and five female colleagues have gathered for an important meeting. They all greet each other. Table 1 below shows the number of different greetings exchanged when male and female colleagues meet. The following notation is used:

m represents the number of male colleagues
f represents the number of female colleagues
h represents the number of handshakes
k represents the number of kisses
b represents the number of bows
s represents the number of smiles
G represents the total number of greetings, that is to say the number of kisses, smiles, bows and handshakes.

Table 1

Select number of males and females: 0

Number of males (*m*)	Number of females (*f*)	Number of handshakes (*f*)	Number of kisses (*k*)	Number of bows (*b*)	Number of smiles (*s*)	Total number of greetings (*G*)
0	0	0	0	0	0	0

For parts (a), (b) and (c) you should refer to table 2.

Table 2

For parts (a), (b) and (c) you should refer to table 2.

Table 2

Number of males (m)	Number of handshakes (h)
1	0
2	1
3	3
4	6
5	10

Question 8a (2 marks)

Write down in words two patterns, from Table 2, for the number of handshakes (h).

B I U x_2 x^2 Ω Σ

Styles

Question 8b (2 marks)

Determine a general rule for the number of handshakes (h) in terms of the number of male colleagues (m).

B I U x_2 x^2 Ω Σ

Styles

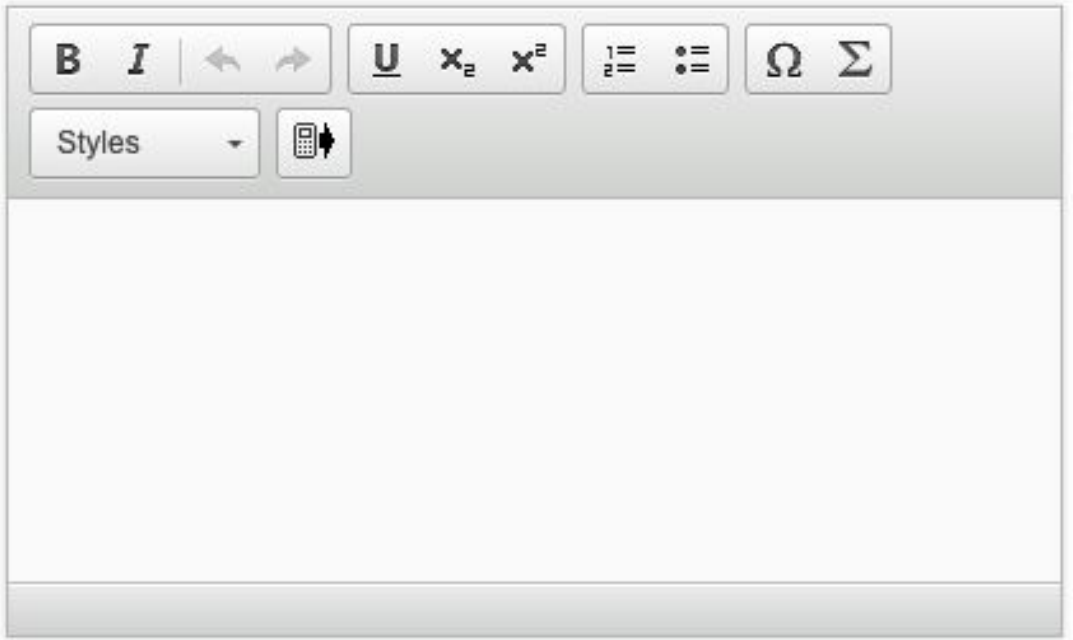
Question 8c (3 marks)

Table 2

Number of males (m)	Number of handshakes (h)
1	0
2	1
3	3
4	6
5	10

Reset

Verify your general rule.



Question 8d (24 marks)

Investigate the general rules for the greetings when there are equal numbers of male and female colleagues. You can add more values in Table 3 to support your investigation. In your answer, you should:

- predict more values and record these in the table
- write down in words patterns for k and b
- find a general rule for k in terms of m
- find a general rule for b in terms of m
- find a general rule for G in terms of m
- test your general rule for G
- verify and justify your general rule for G
- ensure you communicate all your working appropriately.