

2017 November Maths eAssessment

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.

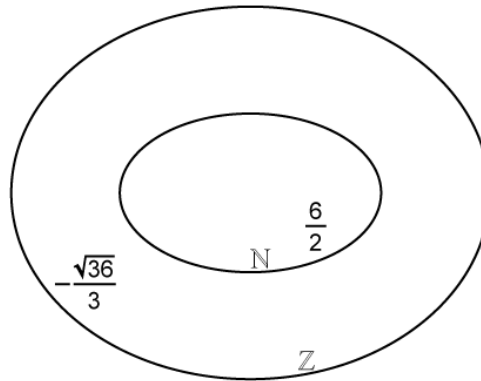
Draggable numbers

$$\sqrt{49}$$

$$\frac{12}{3}$$

$$0$$

$$-\sqrt{9}$$



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

$$-\sqrt{7}$$

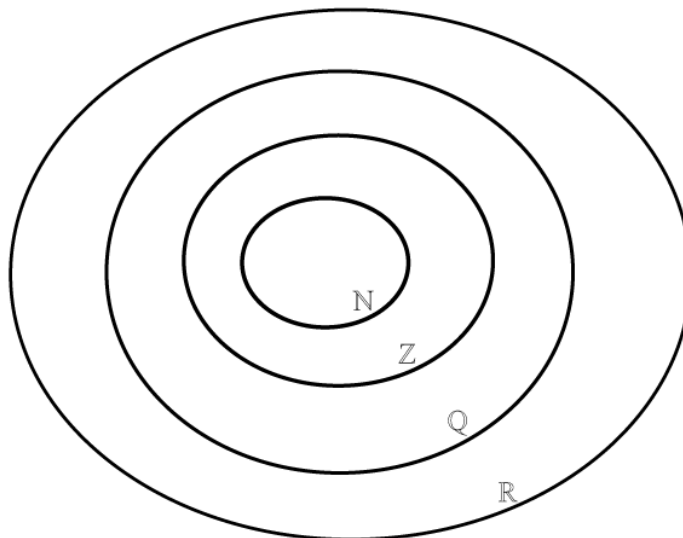
$$\frac{22}{7}$$

$$\pi$$

$$|-2|$$

$$\tan 45^\circ$$

$$2^\circ$$



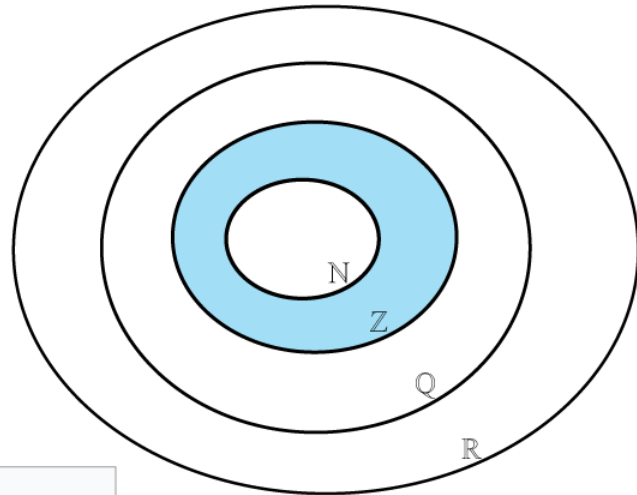


Question 1c (1 mark)

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

- ∪
- ∩
- ⊂
- ⊃
- N
- N'
- Z
- Z'



Response area



Question 2 (7 marks)

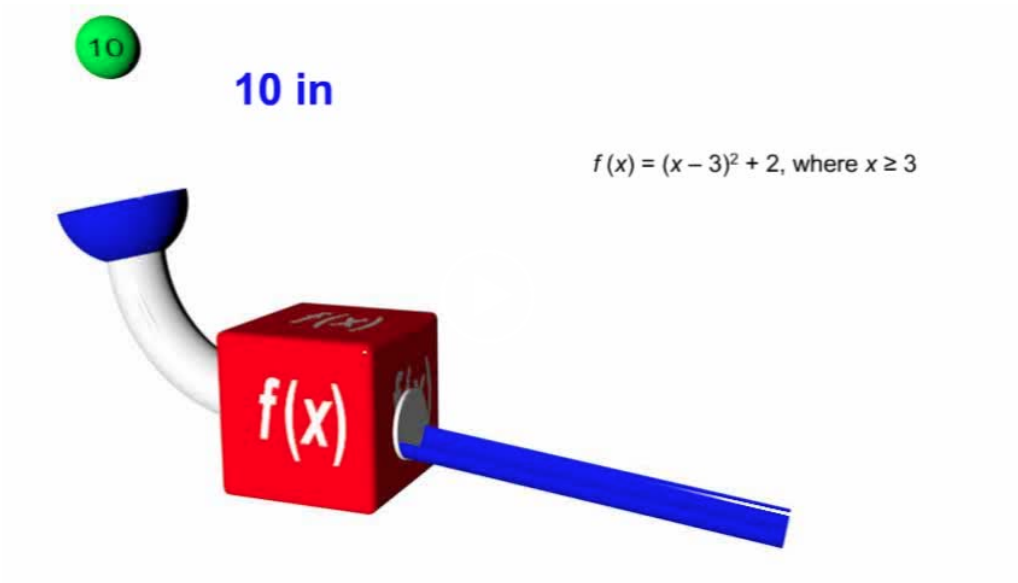


Question 2a (3 marks)

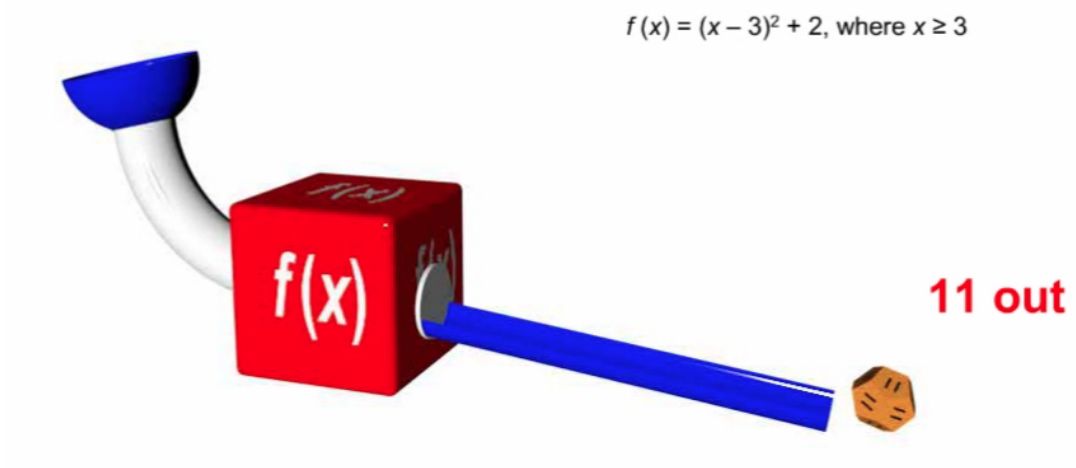
Given that $f(x) = (x - 3)^2 + 2$, where $x \geq 3$, and $g(x) = x^2$, **describe** how $g(x)$ is transformed onto $f(x)$.

Question 2b (4 marks)

This media contains no audio



Given that $f(a) = 11$, find the value of a .

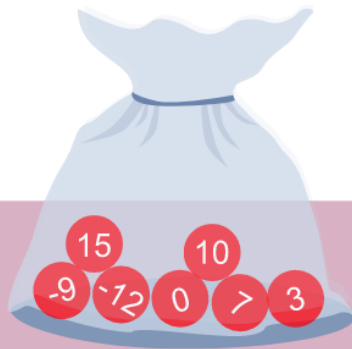


Given that $f(a) = 11$, find the value of a .

Question 3 (13 marks)

This media is interactive

Start



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.

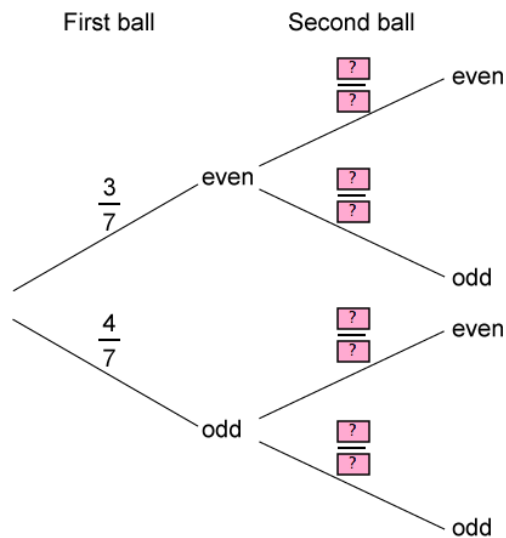
The player does not win anything otherwise.

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.





Question 3b (2 marks)

Determine the probability of winning 5 AUD.



Question 3c (2 marks)

Determine the probability of winning 10 AUD.

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 3d (1 mark)

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

Rich text editor toolbar with options for Bold, Italic, Underline, Text Color, Background Color, Bulleted List, Numbered List, Indentation, and Font Color. Below the toolbar is a large empty text area for the answer.



Question 3e (6 marks)

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



Question 4 (6 marks)

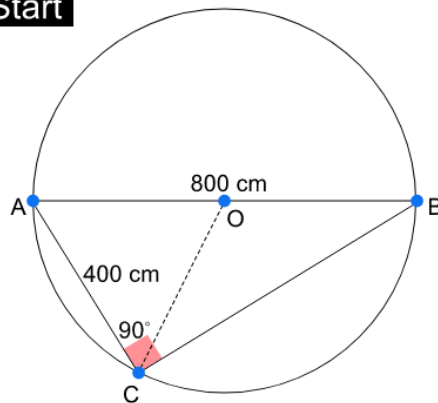


In the diagram below, AB is the diameter of a circle with centre O . The length of the diameter AB is 800 cm, the length of the chord AC is 400 cm and the angle ACB is 90° .

This media is interactive

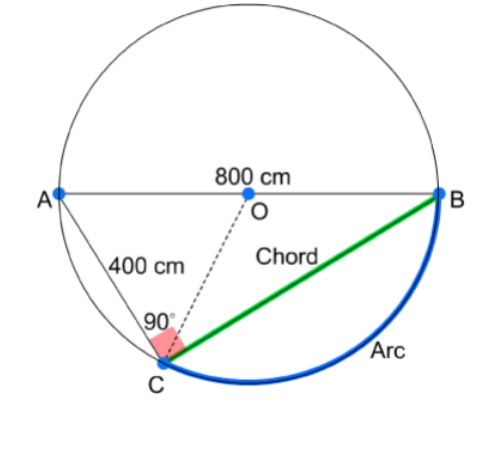
Diagram not to scale

Start





Question 4a (2 marks)



Show that the length of the chord BC is 693 cm to the nearest cm .

B *I* ← → U \times_2 \times^2 $\frac{\square}{\square}$ $\frac{\square}{\square}$ Ω Σ

Styles ▾

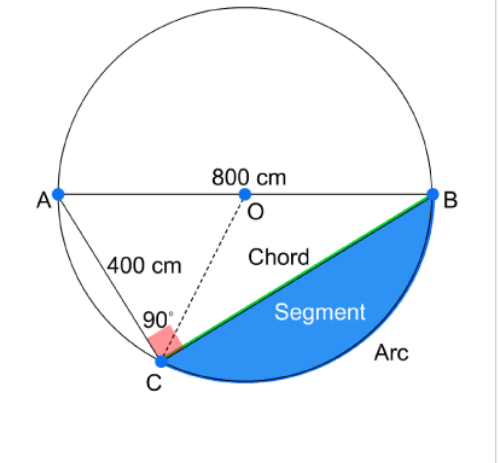


Question 4b (3 marks)

Find the length of the arc BC .



Question 4c (1 mark)



Determine the perimeter of the shaded segment.

B *I* ← → U \times_2 \times^2 $\frac{\square}{\square}$ $\frac{\square}{\square}$ Ω Σ

Styles ▾

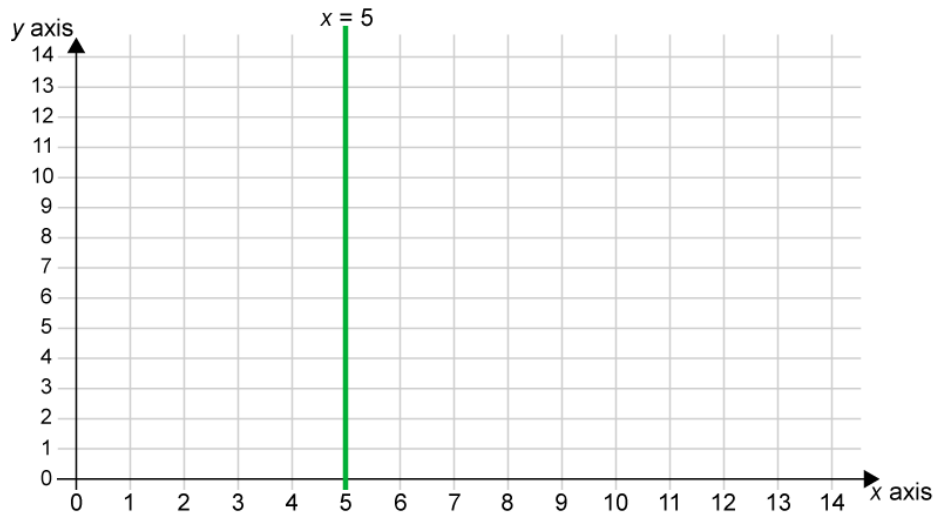


Question 5 (5 marks) ✕

The coordinate axes below show the line $x = 5$.

- **Draw** the lines $2y = x + 12$ and $2x + y = 12$ on the coordinate axes.
- **Identify** the region of the solution set for $x \leq 5$, $2y \leq x + 12$ and $2x + y \geq 12$ by dragging the region icon to the correct location.

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

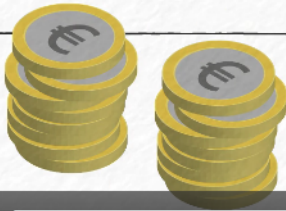


Question 6 (15 marks) ✕

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

Annual income bands in EUR	Tax rate
$0 < \text{income} \leq 6000$	0 %
$6000 < \text{income} \leq 12\,000$	5.5 %
$12\,000 < \text{income} \leq 25\,000$	14 %
$25\,000 < \text{income} \leq 70\,000$	30 %
Above 70 000	41 %

Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	$(12\ 000 - 6000) \times 5.5\ %$	330
12 000 < income ≤ 25 000	14 %	$(25\ 000 - 12\ 000) \times 14\ %$	1820
25 000 < income ≤ 70 000	30 %	$(36\ 000 - 25\ 000) \times 30\ %$	3300
Above 70 000	41 %		
		Total tax paid on 36 000 EUR	



For a person earning 36 000 euros,
here is the calculation for the tax.



Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	$(12\ 000 - 6000) \times 5.5\ %$	330
12 000 < income ≤ 25 000	14 %	$(25\ 000 - 12\ 000) \times 14\ %$	1820
25 000 < income ≤ 70 000	30 %	$(36\ 000 - 25\ 000) \times 30\ %$	3300
Above 70 000	41 %		
		Total tax paid on 36 000 EUR	

$$(12\ 000 - 6000) \times 5.5\ % = 6000 \times 5.5\ %$$

Amount of tax = 330 EUR



and this amount is taxed at 5.5 percent,
which amounts to 330 euros.



Annual income bands in EUR	Tax rate	Calculation of tax	Amount of tax
0 < income ≤ 6000	0 %	0	0
6000 < income ≤ 12 000	5.5 %	$(12\,000 - 6000) \times 5.5\%$	330
12 000 < income ≤ 25 000	14 %	$(25\,000 - 12\,000) \times 14\%$	1820
25 000 < income ≤ 70 000	30 %	$(36\,000 - 25\,000) \times 30\%$	3300
Above 70 000	41 %		
Total tax paid on 36 000 EUR			

The total tax paid on 36 000 EUR is
 $330 + 1820 + 3300 = 5450$
 So the total income tax = 5450 EUR



so for 36 000 euros,
 the total income tax is 5450 euros.



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 %	$(12\,000 - 6000) \times 5.5\%$	330
12 000 < income ≤ 25 000	14 %	$(25\,000 - 12\,000) \times 14\%$	1820
25 000 < income ≤ 70 000	30 %		
Above 70 000	41 %		
Total tax paid on 80 000 EUR			



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 another country

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.

Annual income bands in EUR	Tax rate
0 < income ≤ 6000	0 %
6000 < income ≤ 12 000	5.5 %
12 000 < income ≤ 25 000	14 %
25 000 < income ≤ 70 000	30 %
Above 70 000	41 %

Scenario 1 – Do not relocate to another country

Scenario 2 – Relocate to another country

Your employer offers you an opportunity to relocate to another country. You will earn 50 000 EUR per annum, from this you will pay an annual tax of 9650 EUR. The living expenses are outlined below.

per year

Annual income bands in EUR	Tax rate
0 < income ≤ 6000	0 %
6000 < income ≤ 12 000	5.5 %
12 000 < income ≤ 25 000	14 %
25 000 < income ≤ 70 000	30 %
Above 70 000	41 %

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".

Present day map of the United Kingdom



1606 – 1801



1801 – Present day



In 1606, the flags of Scotland and England combined to create the Union Jack,

00:09

Union Jack
1606 – 1801



Union Jack
1801 – today

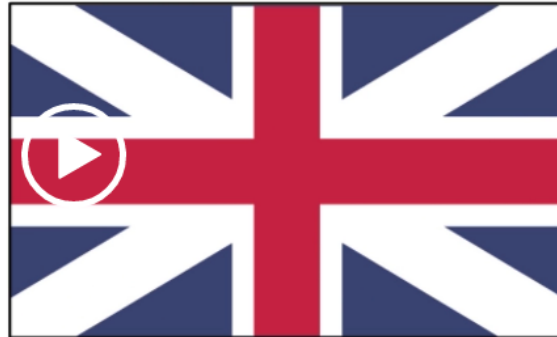


which is the flag for the United Kingdom.

St George's cross of England



St Andrew's cross of Scotland



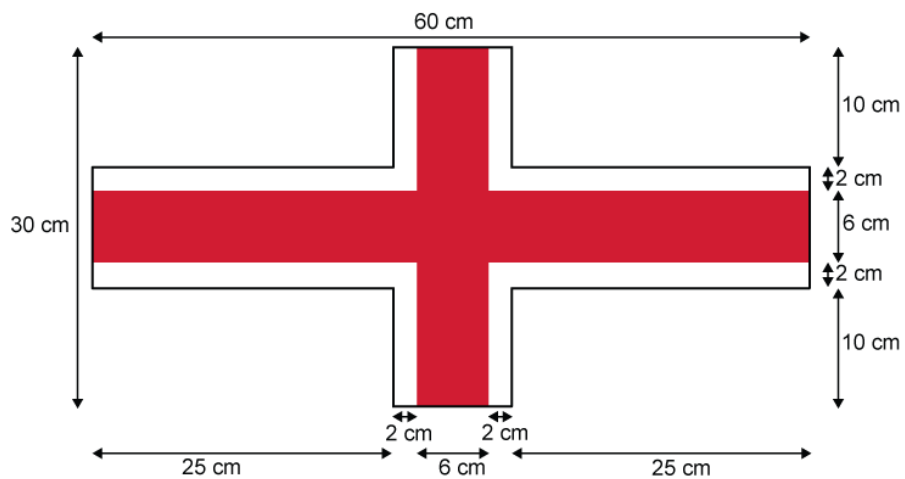
with the Scottish St Andrew's cross.



Question 7a (3 marks)

In Diagram 1 below, St George's cross is red and 6 cm wide, and its white border is 2 cm wide. **Show that** the total area of St George's cross is 800 cm^2 .

Diagram 1

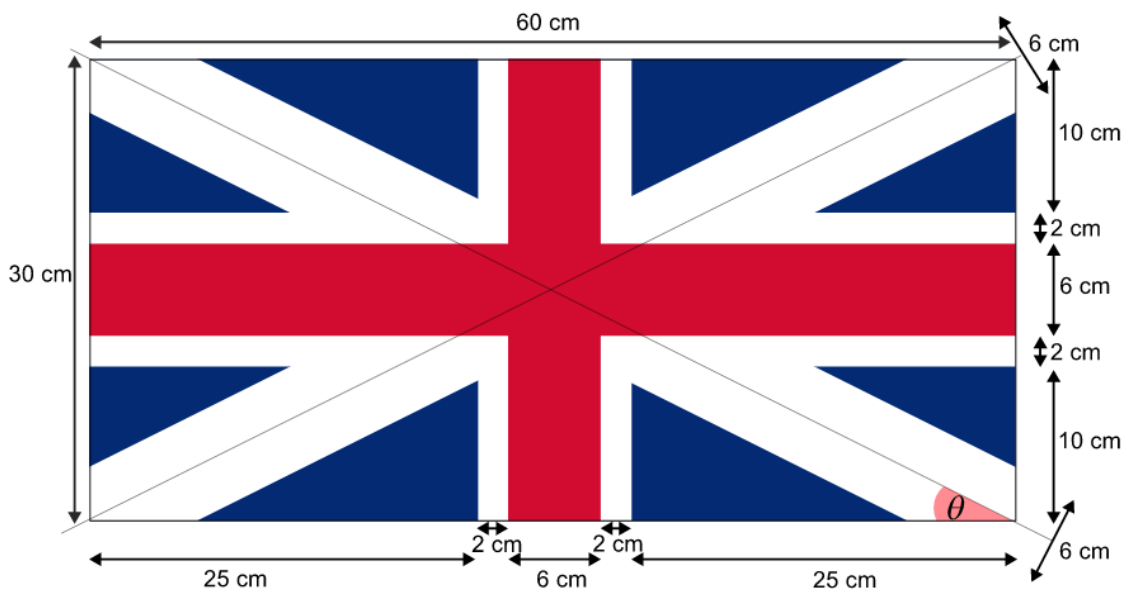
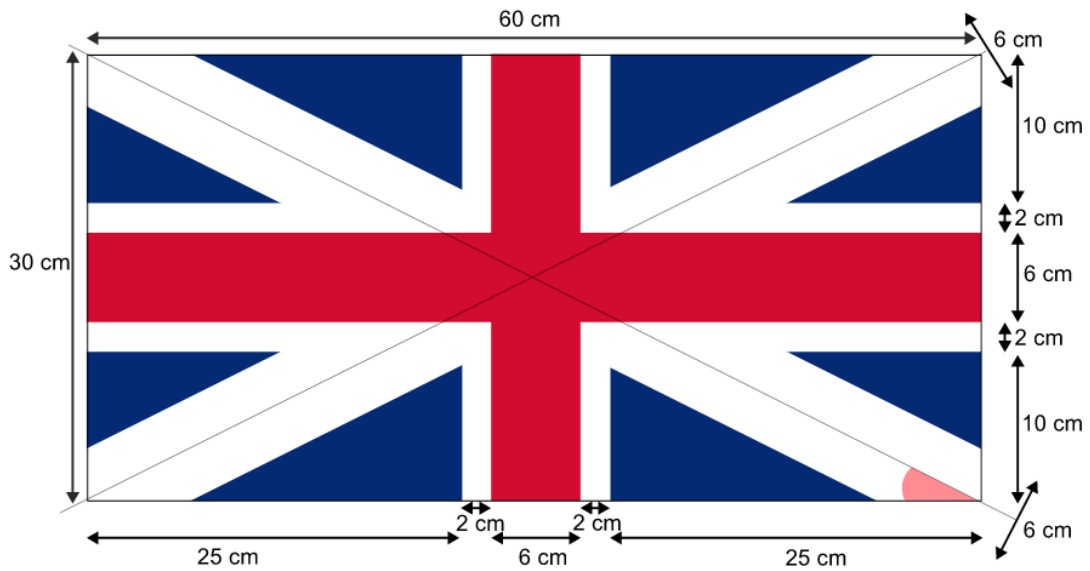




Question 7b (1 mark)

Diagram 2

This media is interactive



Using Diagram 2, show that $\tan\theta = \frac{1}{2}$.

Diagram 3

This media is interactive

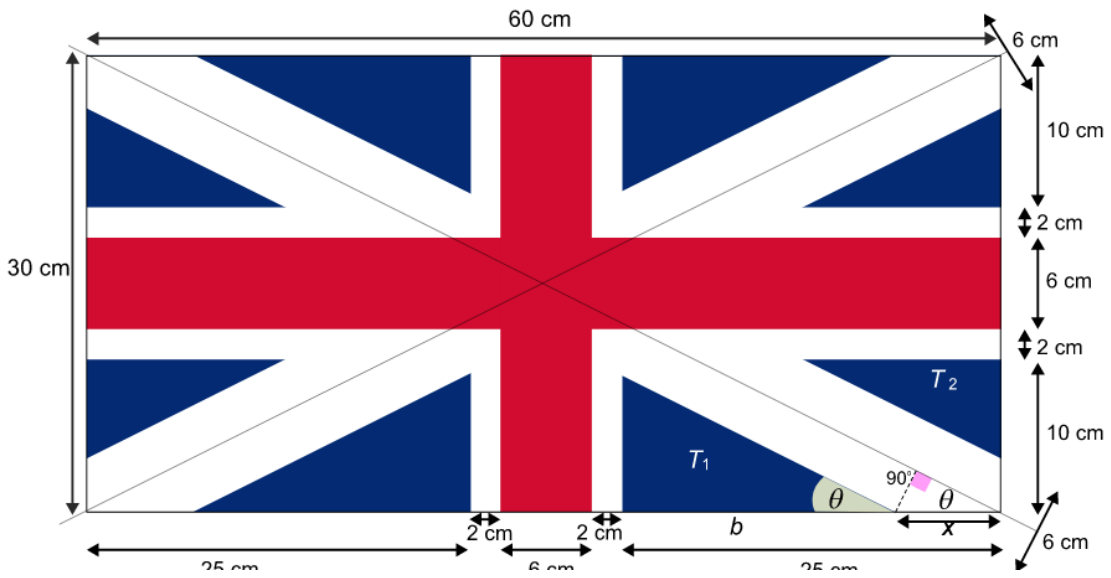
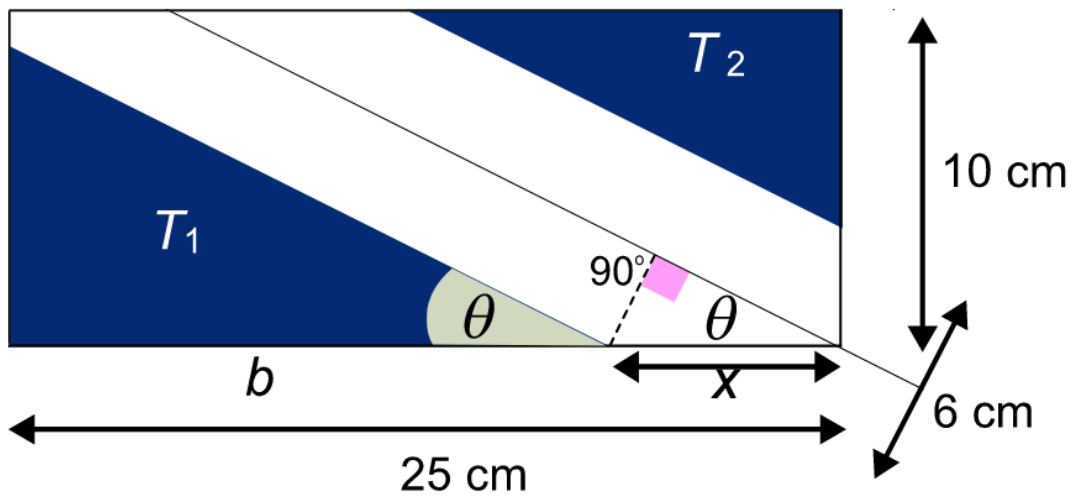
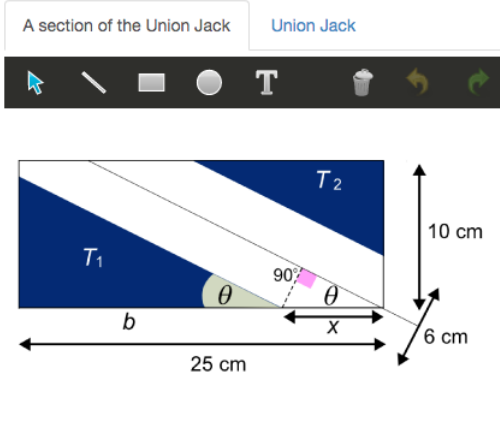


Diagram 3

This media is interactive



Question 7c (5 marks)



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

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x_2), Superscript (x^2), Bulleted List, Numbered List, Link, and Unlink. Below the toolbar is a text input area.



Question 7d (4 marks)

Hence, **show that** the area of the blue triangle T_1 is 84 cm^2 to the nearest cm^2 .

Rich text editor toolbar with buttons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x_2), Superscript (x^2), Bulleted List, Numbered List, Link, and Unlink. Below the toolbar is a text input area.



Question 7e (2 marks)

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



Question 7f (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.

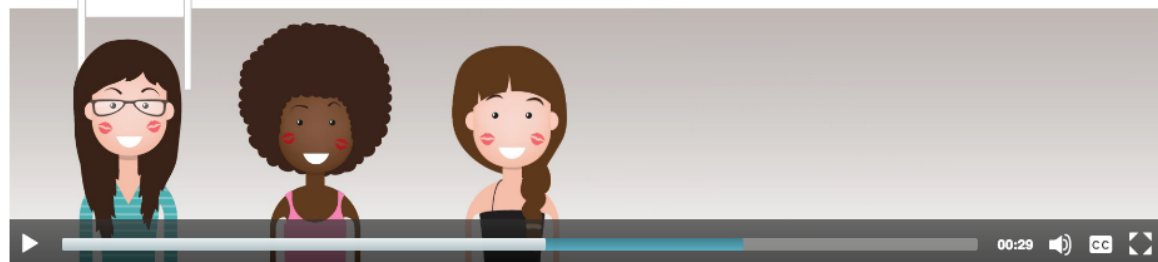


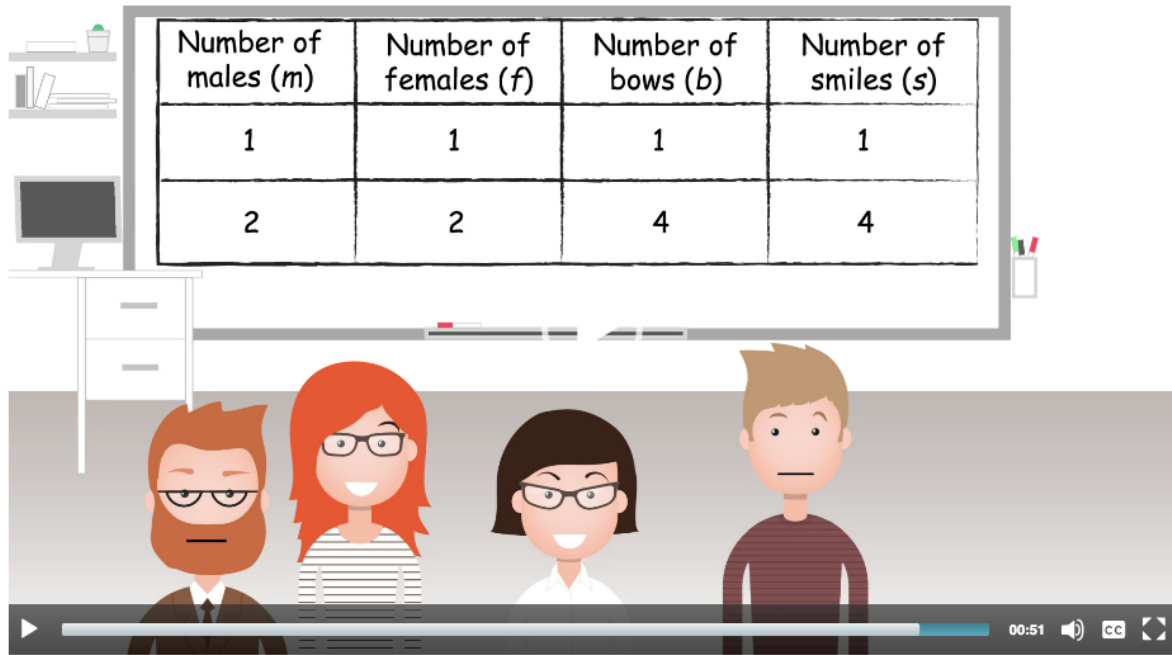
Question 8 (31 marks)

The following video introduces some traditional greetings.



Number of females (f)	Number of kisses (k)
2	2
3	6





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

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 and bows.

Table 1

Select number of males and females:

Number of males (m)	Number of females (f)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
2	2	2	4	4	10

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

Table 2

Number of females (f)	Number of kisses (k)
1	0
2	2
3	6
4	12
5	20



Question 8a (2 marks)

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



Question 8b (2 marks)

Determine a general rule for the number of kisses (k) in terms of the number of female colleagues (f).



Question 8c (3 marks)

Table 2

Number of females (f)	Number of kisses (k)
1	0
2	2
3	6
4	12
5	20

Reset

Verify your general rule.

Rich text editor toolbar with icons for Bold (B), Italic (I), Undo, Redo, Underline (U), Subscript (x_2), Superscript (x^2), Bulleted list, Numbered list, Link, and Unlink. Below the toolbar is a text input area.





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 a pattern for s
- find a general rule for s 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.

Table 3

Number of males (m)	Number of females (f)	Number of kisses (k)	Number of bows (b)	Number of smiles (s)	Total number of greetings (G)
1	1	0	1	1	2
2	2	2	4	4	10
3	3	6	9	9	24
4	4	12	16	16	44
5	5	20	25	25	70