

MU123

TMA 03

2019J

Covers Units 6, 7, 8 and 9

Cut-off date 3 March 2020

Submission instructions

You will find instructions for completing TMAs in the ‘Assessment’ area of the MU123 website. Please read these instructions before beginning work on this TMA.

Reviewing your tutor’s comments on your previous TMA will help you as you work on this one.

Special instructions

Remember that you need to explain your reasoning and communicate your ideas clearly, as described in Subsection 5.3 of Unit 1. This includes:

- explaining your mathematics in the context of the question
- the correct use of notation and units
- appropriate rounding.

Your score out of 5 for good mathematical communication (GMC) will be recorded against Question 7. You do not have to submit any work for Question 7.

Question 1 – 10 marks

This question is based on your work on MU123 up to and including Unit 6.

- (a) Figure 1 shows two points A and B with a straight line drawn through them.

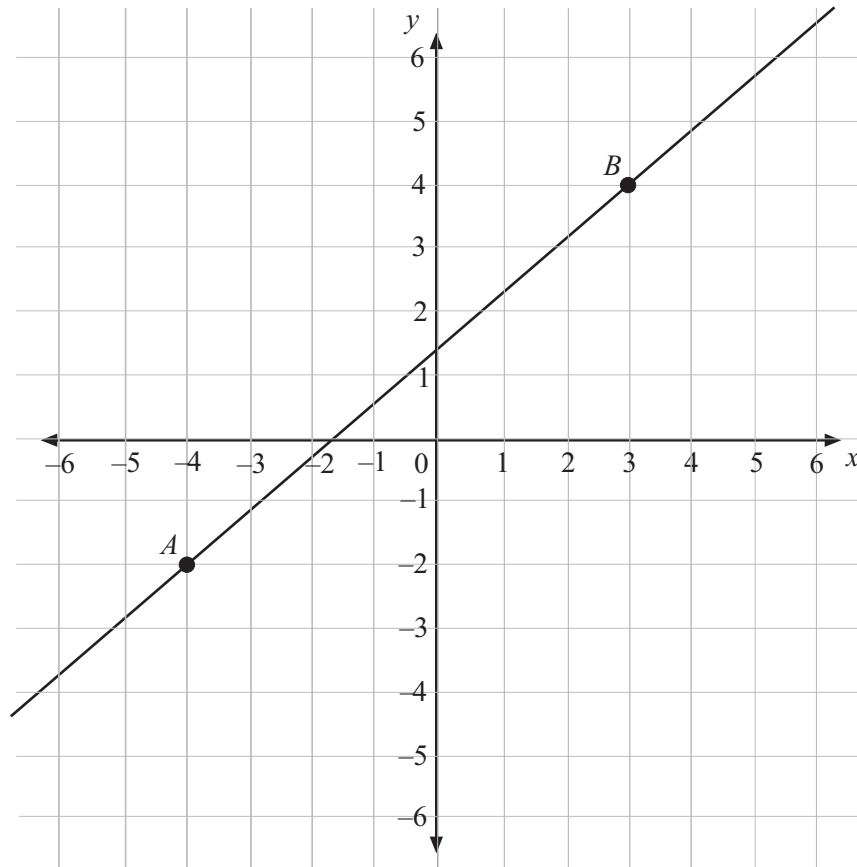


Figure 1

- (i) Write down the coordinates of the points A and B . [1]
- (ii) Find the gradient of the line that passes through the points A and B , clearly showing each step of your method. [2]
- (b) (i) Find the equation of the line that passes through the point $(-5, 3)$ and has slope $-\frac{3}{4}$. [3]
- (ii) Determine whether or not the point $(-1, 2)$ lies on the line found in part (b)(i), clearly showing each step of your method. [2]
- (iii) Find the x -intercept of the line found in part (b)(i), clearly showing each step of your method. [2]

Question 2 – 15 marks

This question is based on your work on MU123 up to and including Unit 6.

- (a) Describe in your own words what you would expect to see if each of the following features appeared within the data points of a scatterplot.
- (i) An outlier [2]
 - (ii) A positive correlation between the x and y variables [2]
 - (iii) No relationship between the x and y variables [2]
- (b) The number of students trying to upload eTMAs at a particular time can affect the upload speed. Andrew is investigating the relationship between the time taken to upload a file to the eTMA system and the proximity to the cut-off deadline. He asked 20 students who traditionally submit their eTMAs within the final hour to record the 'submission time' as the number of minutes before the cut-off deadline, and to record the time taken to upload the file in seconds. He displayed the results on a scatterplot with the regression line included. The submission time was displayed on the horizontal axis and the time taken to upload the file was displayed on the vertical axis.
- (i) The regression line for the investigation is $y = -0.23x + 18.7$. What do the x and y variables represent here? [2]
 - (ii) The correlation coefficient r for the investigation is -0.93 . What does this tell you? [2]
 - (iii) Use the regression equation from part (b)(i) to predict the time taken to upload a file submitted 22 minutes before the cut-off. Give your answer to the nearest whole second. [2]
 - (iv) Can you conclude from this investigation that the submission time determines the time taken to upload a file? Explain your answer. [2]
 - (v) If the correlation coefficient for this investigation had been -0.99 , would this have changed the answer that you gave to part (b)(iv)? Explain your reasoning. [1]

Question 3 – 5 marks

This question is based on your work on MU123 up to and including Unit 7.

Make k the subject of the following two equations. Show each step of your working.

- (a) $7t = \frac{5k}{7} - 19$ [2]
- (b) $5k = \frac{13k}{6t} + 17t$ [3]

Question 4 – 20 marks

This question is based on your work on MU123 up to and including Unit 7.

Ted is organising a team-building activity day with work colleagues. He has two options, which both offer packages for groups of up to 15. Venue A charges £14 per person and a non-refundable booking fee of £160. Venue B charges £26 per person and a non-refundable booking fee of £16.

- (a) Copy and complete Table 1 by working out how much it costs to go to each venue for the numbers attending shown.

Table 1 Total cost in pounds for each option

Number attending	7	10	15
Venue A			370
Venue B			406

[2]

- (b) For Venue A, the linear equation $y = 14x + 160$ can be used to calculate the total cost y (in pounds) for x people attending.

- (i) Explain why this equation holds. [1]

- (ii) Write down a similar equation that can be used to give the total cost y (in pounds) for x people attending Venue B. [1]

- (c) (i) Using the same axes, draw graphs of the two equations from part (b). Use an x -scale from 0 to 15, and choose a y -scale that allows both lines to be seen over this range.

You may draw your graphs by hand, using squared paper, or use Graphplotter and include them with the rest of your TMA.

Remember to label the lines with their equations. [4]

- (ii) What do the gradients and y -intercepts of these lines represent in terms of the situation being modelled? [2]

- (d) The lines representing the equations in part (b) intersect. Use your graphs to write down the approximate coordinates of the intersection point. How can the intersection point be interpreted in this model? [2]

- (e) Use algebra to solve the two simultaneous equations from part (b). Show each step of your working clearly. [4]

- (f) State which option gives the better deal, in terms of cost, for different numbers attending. [2]

- (g) Ted finds out that 14 people are going to attend. If Venue B offers a discount of 20% per person off the entry price (the booking fee remains the same) when the group size is greater than 12, should this affect Ted's choice for the team-building day? Justify your answer. [2]

Question 5 – 20 marks

This question is based on your work on MU123 up to and including Unit 8.

- (a) Figure 2 shows a cuboid and a prism (not drawn to scale). Edges CD and BF have length 12 cm, and the diagonal BD has length 32 cm. The area A of the top of the prism is 96 cm^2 and the perimeter p is 48 cm.

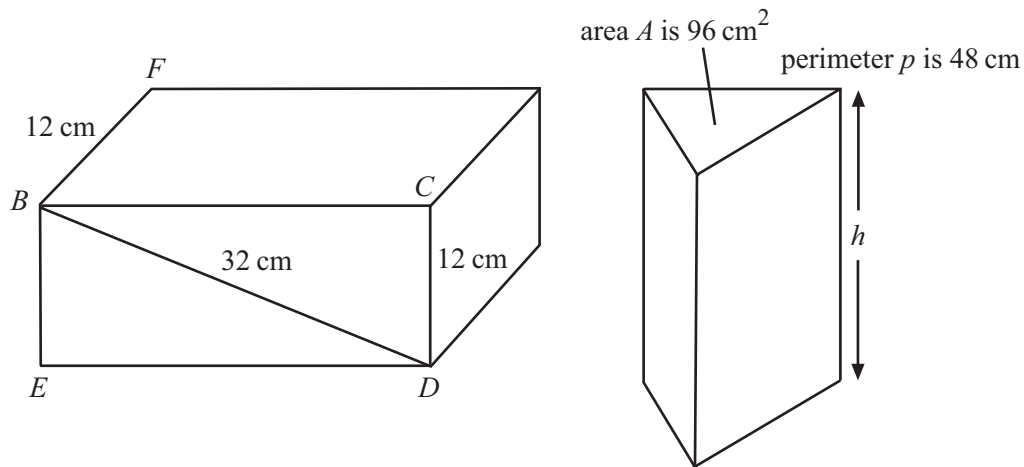


Figure 2

Give your answers to each of the following to two significant figures.

- (i) Use Pythagoras' Theorem in triangle BCD to find the length of side BC . [2]
- (ii) Using your answer to part (a)(i), find the area of the top of the cuboid. [2]
- (iii) Find the volume of the cuboid. [2]
- (iv) If the volume of the prism is equal to the volume of the cuboid, find the height h of the prism, showing your working at each stage. [4]
- (v) Find the surface area of the prism. [2]

- (b) In this part of the question, you are asked to comment on a student's attempt at answering the question detailed below.

State whether you agree or disagree with what the student has written for each answer, explaining your reasoning.

[4]

The question

For each of the two pairs of triangles shown in Figure 3, determine (if possible) whether the triangles are congruent, explaining your answers.

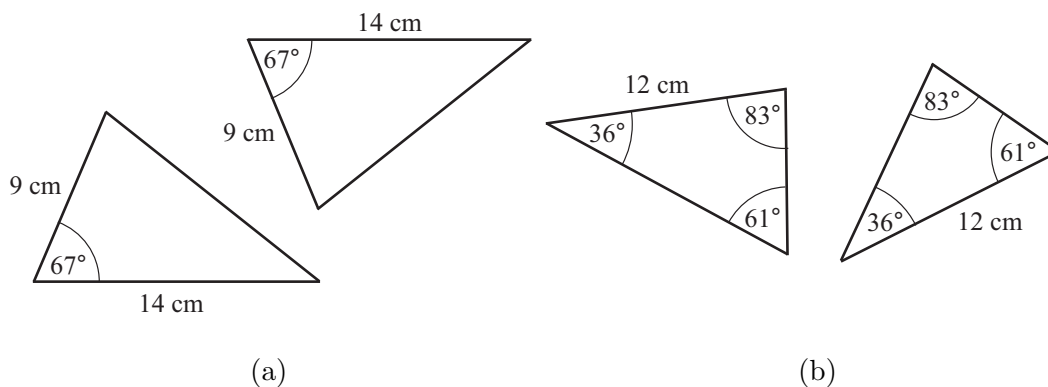


Figure 3

The student's attempt

For pair (a), each triangle has sides of lengths 9 cm and 14 cm with a 67° angle in between, so the two triangles are congruent by SAS.

For pair (b), each triangle has the same three angles, and each triangle has a side of length 12 cm. Therefore the triangles are congruent by ASA.

- (c) In Figure 4, EF and AG are straight lines. The straight lines AD and BC are parallel. $\angle HAB = 61^\circ$ and $\angle ABH = 54^\circ$. The angles marked θ are equal.

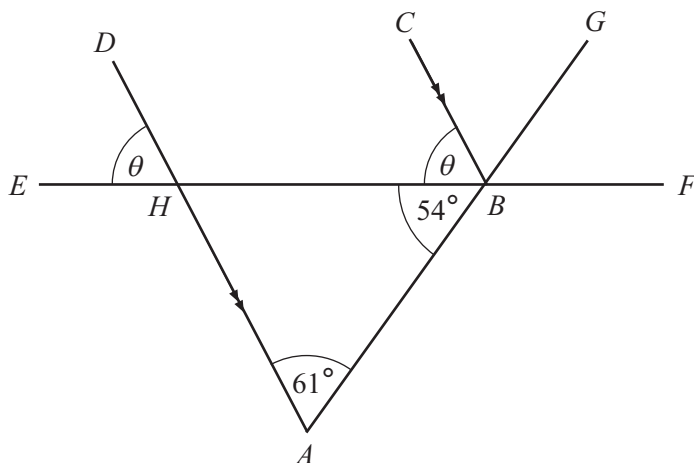


Figure 4

- Explain why the two angles marked θ are equal, and find the value of θ .
- Find $\angle CBG$, explaining your reasoning.

[2]

[2]

Question 6 – 25 marks

This question is based on your work on MU123 up to and including Unit 9.

- (a) (i) For the arithmetic sequence

$$3, 9, 15, \dots, 69,$$

write down the first term a , the difference d and the last term L , and hence find the number of terms n of the sequence. Check that your answer is correct.

[3]

- (ii) Use an appropriate formula from Subsection 1.1 of Unit 9 to find the sum of the arithmetic sequence in part (a)(i).

[2]

- (b) Expand the brackets in the following expressions.

(i) $(4x - 7)(7x + 5)$

[2]

(ii) $(3a - 7b)^2$

[2]

- (c) Factorise $16h^2 - 121k^2$.

[2]

- (d) Factorise then solve the quadratic equation $x^2 - 13x - 68 = 0$. Show each step in your reasoning, and check that your solution is correct.

[4]

- (e) A student writes down the following piece of work which contains an error in their reasoning.

$$x^2 - 23x = 0$$

$$\text{Add } 23x \text{ to both sides} \quad x^2 = 23x$$

$$\text{Divide both sides by } x \quad x = 23$$

- (i) Substitute $x = 23$ into the left-hand side of the equation $x^2 - 23x = 0$, and explain why this shows that $x = 23$ is indeed a solution of the equation.

[2]

- (ii) Write out a complete solution of the equation $x^2 - 23x = 0$.

[2]

- (iii) Explain, as if directly to the student, why their solution is inadequate.

[1]

- (f) Solve the following equation, checking that your solution is correct.

$$\frac{45}{x+3} = \frac{20}{10-x}$$

[5]

Question 7 – 5 marks

A score out of 5 marks for good mathematical communication over the entire TMA will be recorded under Question 7.

[5]