

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 5. You do not have to submit any work for Question 5.

Question 1 – 25 marks

This question is based on your work on MU123 up to and including Unit 3.

(a) (i) Use a factor tree or similar method to write 5040 as a product of prime factors. Display your factor tree in your answer. If you choose to use an alternative method, clearly show your working: just writing down the answer is not sufficient. [4]

(ii) Calculate

5

$$6 - \frac{3}{8} + \frac{11}{12}$$

leaving your answer as a fraction in its simplest form, showing all your working. [4]

(iii) Simplify the surd

$$7\sqrt{5} - \sqrt[4]{35} + \sqrt{63}$$

by writing it as a surd in its simplest form, showing your working. [3]

(b) A group of 348 students are required to take a test. Of these, 300 actually take the test, and 48 are absent that day.

(i) Write down the ratio of the number of students who take the test to the number of students who are absent. Simplify this ratio as far as possible. [3]

(ii) Of the 300 students who take the test, the numbers of students obtaining grades A, B, C and D are in the ratio 4 : 9 : 5 : 2, respectively. Calculate the number of students obtaining each grade. Explain how you could check that your answers are plausible. [4]

(c) Novak Djokovic played in tennis matches for a total of 16 hours and 27 minutes to successfully defend his title and win the 2020 Australian Open men's singles title. He won approximately £2 237 000 in prize money.

(i) Calculate how long Novak played (in minutes) for each pound that he won in this tournament. Give your answer to three significant figures in both ordinary notation and scientific notation. [4]

(ii) Calculate how much Novak won (in pounds) for each hour that he played in this tournament.

Question 2 – 30 marks

This question is based on your work on MU123 up to and including Unit 4.

An IT company develops software for the financial sector. It tests its code using an industry standard software package. Aiming to expand their business and be more competitive in the sector, the company has decided to pilot an inhouse software package to test its code. A company researcher wishes to compare the times taken for each package to complete tests. Both software packages were run on 15 occasions testing the same code. The researcher records the times taken on each occasion and these are shown in Table 1.

Table 1 Comparison of detection times in minutes for the industry standard and inhouse software testing packages

Test number Industry standard software package Inhouse software package

1	358	325
2	323	318
3	345	310
4	388	328
5	377	318
6	384	320
7	605	328
8	354	318
9	377	337
10	368	338
11	311	318
12	340	322
13	388	347
14	377	334
15	367	335

- (a) (i) Which of the three types of investigation discussed on pages 177–9 of Unit 4 is this? Explain your answer briefly. [2]
- (ii) Are these primary or secondary data, from the researcher's point of view? Explain your answer briefly. [2]
- (b) Spend a few minutes scanning these datasets by eye.
- (i) List any three features you should be looking for when scanning datasets by eye. [3]
- (ii) Comment on whether or not you think there might be a problem with any of the most extreme values in each column. [3]

- (c) Copy and complete the following table using the datasets given above to work out the missing values. [4]

	Number of minutes to complete the test	
	Industry standard	Inhouse
Minimum (Min)		
Lower quartile (Q1)	345	318
Median	368	325
Upper quartile (Q3)	384	335
Maximum (Max)		
Mean	377.5	326.4
Standard deviation (SD)	64.8	9.7
Interquartile range (IQR)		
Range		
Size of dataset (n)	15	15

- (d) (i) Identify the two measures of location from the table in part (c). Use both of these measures to determine which of the two datasets has the higher location. [4]
(ii) Identify the three measures of spread from the table in part (c). Which of the two datasets has the wider spread, as measured by each of these three measures? [4]
- (e) (i) The researcher concludes that the inhouse software package runs quicker than the industry standard software package. Is this a reasonable conclusion? Explain your answer briefly. [2] (ii) Which stage of the statistical investigation is used in part (e)(i)? Briefly justify your answer. [2]
- (f) The researcher notices that the industry standard software package entry for the seventh test was a typing error. The correct value should have been 405. The revised mean and median for the industry standard software package data with the correct value for the seventh test are given in the following table.

	Industry standard software package	
	With typing error	With correct value
Mean	377.5	357.5
Median	368	368
Size of dataset	15	15

What is the effect on the mean and on the median of including the typing error instead of the correct value? Explain why this happens. [2]

(g) Would having the correct value affect the researcher's conclusion in part (e)(i)? Explain your answer briefly. [2]

page 4 of 6

Question 3 – 15 marks

This question is based on your work on MU123 up to and including Unit 5.

In this question, you are asked to comment on a student's incorrect attempt at answering the question detailed below.

The question

(a) Simplify the following expression as far as possible, showing all your working: $9x - 11 - 4x + 31$.

(b) Solve the following equation, showing all your working:

$$\frac{6}{7}(x + 9) = 12.$$

The student's incorrect attempt

(a)

Given:

$$9x - 11 - 4x + 31$$

Group like terms:

$$9x - 4x - 11 + 31$$

Collect like terms:

$$5x + 20 = 0$$

Subtract 20:

$$5x = -20$$

$$x = -4$$

Divide by 5:

The solution is $x = -4$

(b)

Given: $\frac{6}{7}(x + 9) = 12$

$$6(x + 9) = 84$$

Clear the fraction:

Multiply by 6:

$$6x + 54 = 84$$

$$6x = 30$$

Subtract 54:

$$x = 5$$

Divide by 6:

The solution is $x = 5$

- (a) There are two places in the student's attempt where a mistake has been made. Identify these mistakes and explain, as if directly to the student, why, for each mistake, their reasoning is incorrect. [4]

- (b) The student decides to check if the solution they got to part (b) was correct by taking the following approach:

Check:

Substitute 75 for x: $(75 + 9) = 12$ ⁶/₇

6 Work out brackets:
 $(84) = 12$ ⁶/₇

Giving: $72 = 12$

This is incorrect so the solution $x = 75$ is incorrect

- (i) Explain why this approach to checking is incorrect. [2] (ii) Show how the student should have performed the check. [3] (c) Write out your own solution to the question, explaining your working. [6]

Question 4 – 25 marks

This question is based on your work on MU123 up to and including Unit 5.

- (a) Simplify each of the following expressions as far as possible; multiply out any brackets, expand any algebraic fractions, and collect like terms together. Show your working.

(i) $9(4 - 5t)$ [2] (ii) $11 + m(13 - 3m) - 13m$ [3] (iii) $7t - 7(9s - 8t)$ [3] (iv) $7p(5 + 3p^2) - 5(2p - 8 + 3p^3)$ [4] (v) $5x^2 + 15x - 25$

- 5x[4] (b) Solve the following equations. Show your working and check that your answers are correct.

(i) $7a - 13 = 8 + 4a$ [4] (ii) $\frac{y}{4} - 6 = 2(y - 10)$ [5]

Question 5 – 5 marks

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