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ADDITIONAL MATHEMATICS (US)

0459/02

Paper 2

For examination from 2020

SPECIMEN PAPER

2 hours

You must answer on the question paper.

You will need: List of formulae (MF25)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, center number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You must show all necessary working clearly; no marks will be given for unsupported answers from a calculator.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in parentheses [].

This document has **16** pages. Blank pages are indicated.

- 1 Using long division, show that $\frac{x^3 + x^2 + 4x + 6}{x^2 - 3} = x + a + \frac{bx + c}{x^2 - 3}$, where a , b and c are constants to be found. [3]

- 2 The points P , Q , and R are such that $\overrightarrow{QR} = 4\overrightarrow{PQ}$. The position vectors of P and Q relative to O are $\begin{pmatrix} 6 \\ 7 \end{pmatrix}$ and $\begin{pmatrix} 9 \\ 20 \end{pmatrix}$ respectively. Find the unit vector parallel to \overrightarrow{OR} . [5]

3 Solve the equation $\frac{(3-x)^{\frac{-2}{3}} + \sqrt[3]{3-x}}{\sqrt[3]{3-x}} = \frac{2}{3}$.

[5]

- 4 A sequence of terms is defined recursively.

$$f(0) = a$$

$$f(1) = b$$

$$f(n + 1) = \frac{1}{2}f(n) + f(n - 1) \text{ for } n \geq 1$$

Given that $f(2) = 17$ and $f(3) = 28.5$, find the value of a and of b .

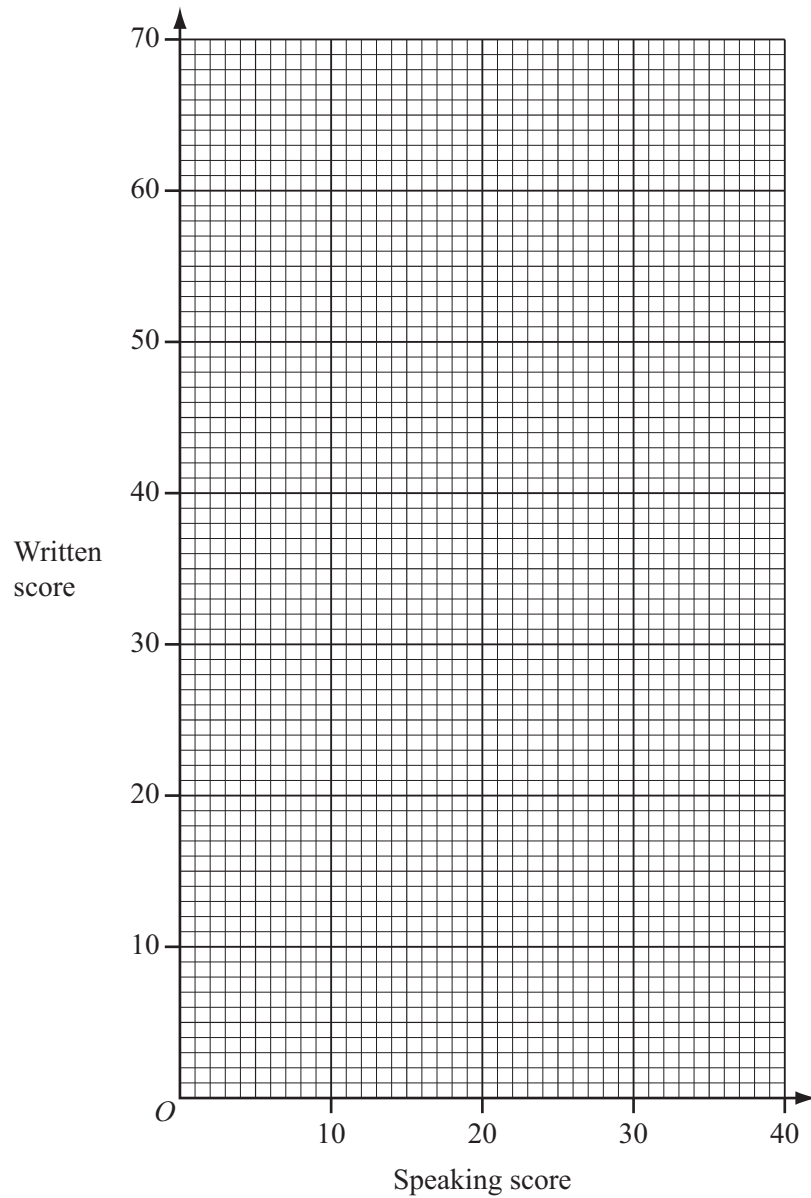
[5]

- 5 Seven candidates take a language examination that consists of two tests, one speaking and one written. The scores obtained are shown.

Candidate	A	B	C	D	E	F	G
Speaking	14	21	20	26	29	34	38
Written	43	47	48	53	61	65	68

- (a) Construct a scatter diagram to represent this information.

[2]



(b) Find the equation of a line that best fits your scatter diagram. [4]

(c) A candidate took the written test and scored 56. Because of illness this candidate did not take the speaking test. Estimate a score for this candidate in the speaking test. [1]

6 Solve the equations.

(a) $\frac{4^x}{2^{5-x}} = \frac{2^{4x}}{8^{x-3}}$

[3]

(b) $\lg(2y + 10) + \lg y = 2$

[3]

- 7 A small company produces two types of candy, C_1 and C_2 . The table shows the daily production, in kilograms, of C_1 and C_2 and the percentages of the three ingredients P , Q , and R required to produce C_1 and C_2 .

Ingredient	Percentage			Daily production (kg)
	P	Q	R	
Type C_1	60	30	10	300
Type C_2	50	40	10	240

The costs, in dollars per kilogram, of P , Q , and R are 5, 7, and 10 respectively. Write down three matrices such that matrix multiplication will give the total cost of daily production and hence evaluate this total cost. [6]

8 A and B are acute angles such that $\sin(A - B) = \frac{3}{8}$ and $\sin A \cos B = \frac{5}{8}$.

Without using a calculator, find the value of:

(a) $\cos A \sin B$ [2]

(b) $\sin(A + B)$ [2]

(c) $\frac{\tan A}{\tan B}$ [3]

9 The times for a motorist to travel from home to work are normally distributed with a mean of 24 minutes and a standard deviation of 4 minutes. Find the probability that a particular trip from home to work takes:

(a) more than 27 minutes [2]

(b) between 20 and 25 minutes. [4]

10 The complex number $z = -3 + 2i$.

(a) Write down an expression for \bar{z} , the complex conjugate of z . [1]

(b) Represent z , \bar{z} , and $-z$ on an Argand diagram by the points L , M , and N respectively. [2]

(c) Explain why triangle LMN is right-angled. [2]

It is also given that the complex number $w = 5 - i$.

(d) Express zw in the form $a + bi$, where a and b are constants to be found. [3]

(e) Find the modulus and the argument of zw . [2]

11 The function f is defined, for all real values of x , by $f(x) = 4 \cos 2x - 2$.

(a) State the amplitude and period of f . [2]

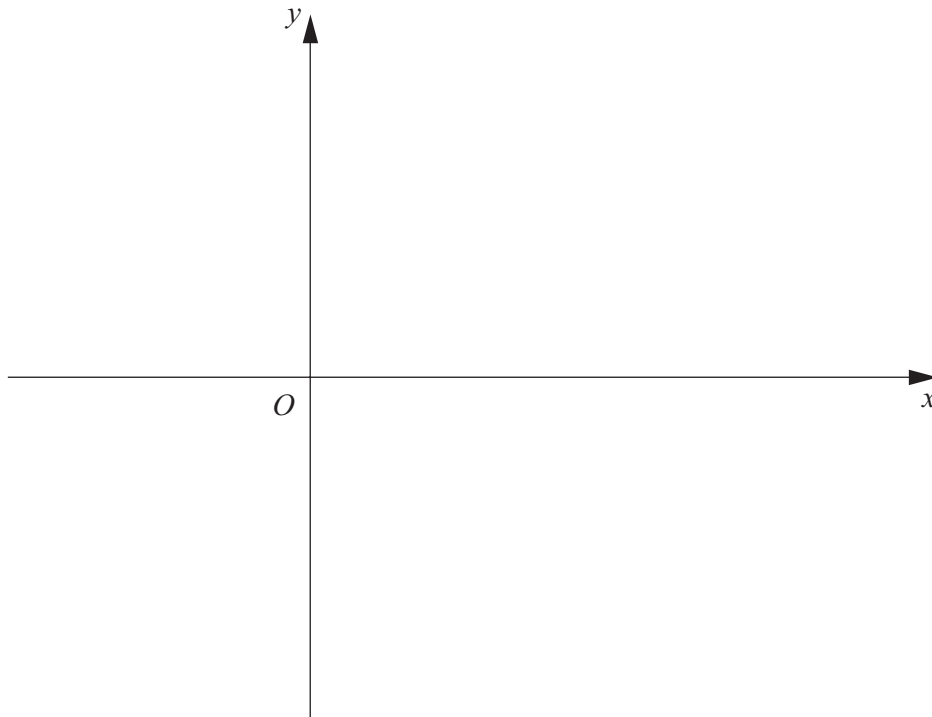
The function g is defined, for $0^\circ \leq x \leq 180^\circ$ by $g(x) = 4 \cos 2x - 2$.

(b) Find the coordinates of the minimum point of the graph of $y = g(x)$. [2]

(c) Find the coordinates of the points where the graph of $y = g(x)$ intersects the x -axis. [3]

(d) Sketch the graph of $y = g(x)$.

[2]



(e) Explain clearly how the graph of $y = |g(x)|$ would differ from the graph of $y = g(x)$.

[1]

12 (a) Factorize completely the expression $2x^3 - 11x^2 - 20x - 7$. [5]

(b) The expression $x^3 + ax^2 - 15x + b$ has a factor $x - 2$ and leaves a remainder of 75 when divided by $x + 3$. Find the value of a and of b . [5]

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