Paper Reference 8FM0/21
Pearson Edexcel
Level 3 GCE

# Further Mathematics

Advanced Subsidiary
Further Mathematics options
21: Further Pure Mathematics 1
(Part of options A, B, C and D)

Thursday 17 May 2018 – Afternoon

**MATERIALS REQUIRED FOR EXAMINATION**
Mathematical Formulae and Statistical Tables
Calculator

**ITEMS INCLUDED WITH QUESTION PAPER**
Answer Book

Y60152A

Pearson

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

## INSTRUCTIONS

In the boxes on the Answer Book, write your name, centre number and candidate number.

Answer ALL questions and ensure that your answers to parts of questions are clearly labelled.

Answer the questions in the Answer Book – there may be more space than you need.

Do NOT write on the Question Paper.

You should show sufficient working to make your methods clear. Answers without working may not gain full credit.

Answers should be given to three significant figures unless otherwise stated.

**Turn over**

## INFORMATION

A booklet 'Mathematical Formulae and Statistical Tables' is provided.

The total mark for this part of the examination is **40**
There are **5** questions.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

## ADVICE

Read each question carefully before you start to answer it.

Try to answer every question.

Check your answers if you have time at the end.

**Answer ALL questions.**

**Write your answers in the Answer Book.**

1. (a) Use the substitution $t = \tan\left(\dfrac{x}{2}\right)$ to show that the equation

$$5 \sin x + 12 \cos x = 2$$

can be written in the form

$$7t^2 - 5t - 5 = 0$$

(3 marks)

(b) Hence solve, for $-180° < x < 180°$, the equation

$$5 \sin x + 12 \cos x = 2$$

giving your answers to one decimal place.

(4 marks)

(Total for Question 1 is 7 marks)

2. The temperature, $\theta\,°C$, of coffee in a cup, $t$ minutes after the cup of coffee is put in a room, is modelled by the differential equation

$$\frac{d\theta}{dt} = -k(\theta - 20)$$

where $k$ is a constant.

The coffee has an initial temperature of $80°C$

(continued on the next page)

2.   continued.

Using $k = 0 \cdot 1$

(a)   use two iterations of the approximation formula

$$\left(\frac{dy}{dx}\right)_0 = \frac{y_1 - y_0}{h}$$ to estimate

the temperature of the coffee 3 minutes after it was put in the room.

(6 marks)

(continued on the next page)

**2.** **continued.**

The coffee in a different cup, which also had an initial temperature of **80°C** when it was put in the room, cools more slowly.

(b)  Use this information to suggest how the value of $k$ would need to be changed in the model.
(1 mark)

**(Total for Question 2 is 7 marks)**

3. Use algebra to find the values of $x$ for which

$$\frac{x}{x^2-2x-3} \leq \frac{1}{x+3}$$

**(Total for Question 3 is 7 marks)**

4.   A scientist is investigating the properties of a crystal.

The crystal is modelled as a tetrahedron whose vertices are A$(12, 4, -1)$, B$(10, 15, -3)$, C$(5, 8, 5)$ and D$(2, 2, -6)$, where the length of unit is the millimetre.

The mass of the crystal is $0 \cdot 5$ grams.

(a)   Show that, to one decimal place, the area of the triangular face ABC is $52 \cdot 2 \text{ mm}^2$

(3 marks)

(continued on the next page)

4.    continued.

(b)   Find the density of the crystal, giving your answer in $g\ cm^{-3}$

(6 marks)

**(Total for Question 4 is 9 marks)**

5. The rectangular hyperbola $H$ has equation $xy = c^2$, where $c$ is a non–zero constant.

The point $P\left(cp, \dfrac{c}{p}\right)$, where $p \neq 0$, lies on $H$

(a) Use calculus to show that an equation of the normal to $H$ at $P$ is

$$p^3 x - py + c(1 - p^4) = 0$$

(4 marks)

(continued on the next page)

**5.**　**continued.**

The normal to **H** at the point **P** meets **H** again at the point **Q**

(b)　Find the coordinates of the midpoint of **PQ** in terms of **c** and **p**, simplifying your answer where possible.

(6 marks)

**(Total for Question 5 is 10 marks)**

**TOTAL FOR FURTHER PURE**

**MATHEMATICS 1 IS 40 MARKS**

**END OF PAPER**