

# Pearson Edexcel Level 3

## GCE Mathematics

### Advanced Level

### Paper 1 or 2: Pure Mathematics

Practice Paper F

Time: 2 hours

Paper Reference(s)

9MA0/01 or 9MA0/02

**You must have:**

**Mathematical Formulae and Statistical Tables, calculator**

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

#### Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

#### Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 17 questions in this paper. The total mark is 100.
- 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

**Answer ALL questions.**

1. Show that  $\frac{6(x+7)}{(5x-1)(2x+5)}$  can be written in the form  $\frac{A}{5x-1} + \frac{B}{2x+5}$

Find the values of the constants  $A$  and  $B$ .

**(5 marks)**

---

2. Use proof by contradiction to show that there exist no integers  $a$  and  $b$  for which  $25a + 15b = 1$ .

**(4 marks)**

---

3. A curve has parametric equations  $x = \cos 2t, y = \sin t, -\pi \leq t \leq \pi$ .

(a) Find an expression for  $\frac{dy}{dx}$  in terms of  $t$ .

Leave your answer as a single trigonometric ratio.

**(3 marks)**

(b) Find an equation of the normal to the curve at the point  $A$  where  $t = -\frac{5\pi}{6}$ .

**(5 marks)**

---

4. Showing all steps, find  $\int \cot 3x \, dx$ .

**(3 marks)**

---

5. A triangle has vertices  $A(-2, 0, -4), B(-2, 4, -6)$  and  $C(3, 4, 4)$ .

By considering the side lengths of the triangle, show that the triangle is a right-angled triangle.

**(6 marks)**

---

6. The functions  $p$  and  $q$  are defined by  $p: x \rightarrow x^2$  and  $q: x \rightarrow 5 - 2x$ .

(a) Given that  $pq(x) = qp(x)$ , show that  $3x^2 - 10x + 10 = 0$

**(4 marks)**

(b) Explain why  $3x^2 - 10x + 10 = 0$  has no real solutions.

**(2 marks)**

---

7. Prove by contradiction that there are infinitely many prime numbers.

**(6 marks)**

---

8. In a rainforest, the area covered by trees,  $F$ , has been measured every year since 1990. It was found that the rate of loss of trees is proportional to the remaining area covered by trees.

Write down a differential equation relating  $F$  to  $t$ , where  $t$  is the numbers of years since 1990.

(2 marks)

---

9. At the beginning of each month Kath places £100 into a bank account to save for a family holiday. Each subsequent month she increases her payments by 5%. Assuming the bank account does not pay interest, find

- (a) the amount of money in the account after 9 months.

(3 marks)

Month  $n$  is the first month in which there is more than £6000 in the account.

- (b) Show that  $n > \frac{\log 4}{\log 1.05}$

(4 marks)

Maggie begins saving at the same time as Kath. She initially places £50 into the same account and plans to increase her payments by a constant amount each month.

- (c) Given that she would like to reach a total of £6000 in 29 months, by how much should Maggie increase her payments each month?

(2 marks)

---

10. Find  $\int \cos^2 6x \, dx$ .

(5 marks)

---

11. (a) Prove that  $\frac{\tan x - \sec x}{1 - \sin x} \equiv -\sec x$ ,  $x \neq (2n+1)\frac{\pi}{2}$ .

(3 marks)

- (b) Hence solve, in the interval  $0 \leq x \leq 2\pi$ , the equation  $\frac{\tan x - \sec x}{1 - \sin x} = \sqrt{2}$ .

(3 marks)

---

12. A large arch is planned for a football stadium. The parametric equations of the arch are  $x = 8(t + 10)$ ,  $y = 100 - t^2$ ,  $-19 \leq t \leq 10$  where  $x$  and  $y$  are distances in metres. Find
- (a) the cartesian equation of the arch, (3 marks)
- (b) the width of the arch, (2 marks)
- (c) the greatest possible height of the arch. (2 marks)
- 

13. 
$$\frac{x^3 + 8x^2 - 9x + 12}{x + 6} = Ax^2 + Bx + C + \frac{D}{x + 6}$$

Find the values of the constants  $A$ ,  $B$ ,  $C$  and  $D$ .

(5 marks)

---

14. The volume of a sphere  $V \text{ cm}^3$  is related to its radius  $r \text{ cm}$  by the formula  $V = \frac{4}{3}\pi r^3$ . The surface area of the sphere is also related to the radius by the formula  $S = 4\pi r^2$ . Given that the rate of decrease in surface area, in  $\text{cm}^2 \text{ s}^{-1}$ , is  $\frac{dS}{dt} = -12$ ,

find the rate of decrease of volume  $\frac{dV}{dt}$

(4 marks)

---

15. Find  $\int \sin^3 x \, dx$ .

(4 marks)

---

16. 
$$h(t) = 40 \ln(t + 1) + 40 \sin\left(\frac{t}{5}\right) - \frac{1}{4}t^2, \quad t \geq 0.$$

The graph  $y = h(t)$  models the height of a rocket  $t$  seconds after launch.

- (a) Show that the rocket returns to the ground between 19.3 and 19.4 seconds after launch. (2 marks)
- (b) Using  $t_0 = 19.35$  as a first approximation to  $\alpha$ , apply the Newton–Raphson procedure once to  $h(t)$  to find a second approximation to  $\alpha$ , giving your answer to 3 decimal places. (5 marks)
- (c) By considering the change of sign of  $h(t)$  over an appropriate interval, determine if your answer to part (b) is correct to 3 decimal places. (3 marks)
-

17. (a) Show that in  $\Delta KLM$  with  $\overline{KL} = 3\mathbf{i} + 0\mathbf{j} - 6\mathbf{k}$  and  $\overline{LM} = 2\mathbf{i} + 5\mathbf{j} + 4\mathbf{k}$ ,  $\angle KLM = 66.4^\circ$  to one decimal place.

(7 marks)

(b) Hence find  $\angle LKM$  and  $\angle LMK$ .

(3 marks)

---

**TOTAL FOR PAPER IS 93 MARKS**