

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

**Pearson Edexcel International Advanced Level**

**Thursday 18 May 2023**

Morning (Time: 1 hour 30 minutes) **Paper reference** **WMA12/01**

**Mathematics**

**International Advanced Subsidiary/Advanced Level**

**Pure Mathematics P2**

**You must have:**  
Mathematical Formulae and Statistical Tables (Yellow), calculator

Total Marks

**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra 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).
- **Fill in the boxes** at the top of this page with 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 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 11 questions in this question paper. The total mark for this paper is 75.
- 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.

Turn over ►

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1. The continuous curve  $C$  has equation  $y = f(x)$ .

A table of values of  $x$  and  $y$  for  $y = f(x)$  is shown below.

$x$	4.0	4.2	4.4	4.6	4.8	5.0
$y$	9.2	8.4556	3.8512	5.0342	7.8297	8.6

Use the trapezium rule with all the values of  $y$  in the table to find an approximation for

$$\int_4^5 f(x) dx$$

giving your answer to 3 decimal places.

(3)

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**Question 1 continued**

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**(Total for Question 1 is 3 marks)**

2.

**In this question you must show all stages of your working.**

**Solutions relying on calculator technology are not acceptable.**

$$f(x) = 4x^3 - 8x^2 + 5x + a$$

where  $a$  is a constant.

Given that  $(2x - 3)$  is a factor of  $f(x)$ ,

(a) use the factor theorem to show that  $a = -3$

(2)

(b) Hence show that the equation  $f(x) = 0$  has only one real root.

(4)

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**Question 2 continued**

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**(Total for Question 2 is 6 marks)**

3. A circle  $C$  has centre  $(2, 5)$

Given that the point  $P(8, -3)$  lies on  $C$

(a) (i) find the radius of  $C$

(ii) find an equation for  $C$

(3)

(b) Find the equation of the tangent to  $C$  at  $P$  giving your answer in the form  $ax + by + c = 0$  where  $a$ ,  $b$  and  $c$  are integers to be found.

(4)

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**Question 3 continued**

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

4. The binomial expansion, in ascending powers of  $x$ , of

$$(3 + px)^5$$

where  $p$  is a constant, can be written in the form

$$A + Bx + Cx^2 + Dx^3 \dots$$

where  $A$ ,  $B$ ,  $C$  and  $D$  are constants.

- (a) Find the value of  $A$

(1)

Given that

- $B = 18D$
- $p < 0$

- (b) find

- (i) the value of  $p$   
 (ii) the value of  $C$

(6)

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**Question 4 continued**

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**Question 4 continued**

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**Question 4 continued**

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**(Total for Question 4 is 7 marks)**

5. Use the laws of logarithms to solve

$$\log_2(16x) + \log_2(x + 1) = 3 + \log_2(x + 6)$$

(5)

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**Question 5 continued**

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

6.

**In this question you must show all stages of your working.**

**Solutions relying entirely on calculator technology are not acceptable.**

A software developer released an app to download.

The numbers of downloads of the app each month, in thousands, for the first three months after the app was released were

$$2k - 15 \quad k \quad k + 4$$

where  $k$  is a constant.

Given that the numbers of downloads each month are modelled as a geometric series,

(a) show that  $k^2 - 7k - 60 = 0$  (2)

(b) predict the number of downloads in the 4th month. (4)

The **total** number of all downloads of the app is predicted to exceed 3 million for the first time in the  $N$ th month.

(c) Calculate the value of  $N$  according to the model. (3)

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## Question 6 continued

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**Question 6 continued**

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**(Total for Question 6 is 9 marks)**



**Question 7 continued**

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**(Total for Question 7 is 8 marks)**

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8. (i) A student writes the following statement:

“When  $a$  and  $b$  are consecutive **prime** numbers,  $a^2 + b^2$  is never a multiple of 10”

Prove by counter example that this statement is **not** true.

(2)

- (ii) Given that  $x$  and  $y$  are even integers greater than 0 and less than 6, prove by exhaustion, that

$$1 < x^2 - \frac{xy}{4} < 15$$

(3)

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**Question 8 continued**

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**(Total for Question 8 is 5 marks)**

9.

**In this question you must show all stages of your working.**

**Solutions relying entirely on calculator technology are not acceptable.**

(a) Show that

$$3 \cos \theta (\tan \theta \sin \theta + 3) = 11 - 5 \cos \theta$$

may be written as

$$3 \cos^2 \theta - 14 \cos \theta + 8 = 0 \quad (3)$$

(b) Hence solve, for  $0 < x < 360^\circ$

$$3 \cos 2x (\tan 2x \sin 2x + 3) = 11 - 5 \cos 2x$$

giving your answers to one decimal place. (4)

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## Question 9 continued

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**Question 9 continued**

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**Question 9 continued**

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**(Total for Question 9 is 7 marks)**

10. The curve  $C$  has equation

$$y = \frac{(x - k)^2}{\sqrt{x}} \quad x > 0$$

where  $k$  is a **positive** constant.

(a) Show that

$$\int_1^{16} \frac{(x - k)^2}{\sqrt{x}} dx = ak^2 + bk + \frac{2046}{5}$$

where  $a$  and  $b$  are integers to be found.

(5)

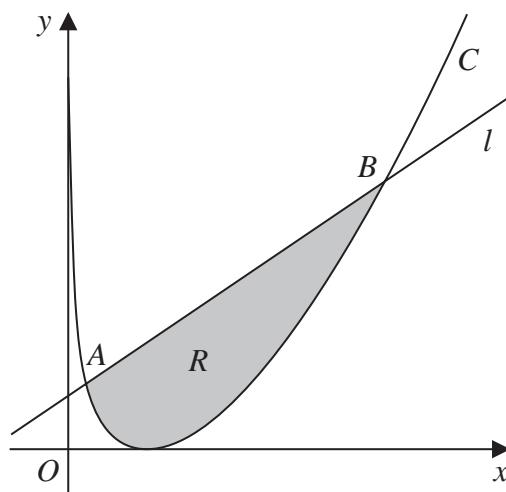


Figure 1

Figure 1 shows a sketch of the curve  $C$  and the line  $l$ .

Given that  $l$  intersects  $C$  at the point  $A(1, 9)$  and at the point  $B(16, q)$  where  $q$  is a constant,

(b) show that  $k = 4$

(2)

The region  $R$ , shown shaded in Figure 1, is bounded by  $C$  and  $l$

Using the answers to parts (a) and (b),

(c) find the area of region  $R$

(3)

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**Question 10 continued**

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**Question 10 continued**

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

11. A sequence  $u_1, u_2, u_3, \dots$  is defined by

$$u_{n+1} = b - au_n$$

$$u_1 = 3$$

where  $a$  and  $b$  are constants.

(a) Find, in terms of  $a$  and  $b$ ,

(i)  $u_2$

(ii)  $u_3$

(2)

Given

- $\sum_{n=1}^3 u_n = 153$

- $b = a + 9$

(b) show that

$$a^2 - 5a - 66 = 0$$

(3)

(c) Hence find the larger possible value of  $u_2$

(3)

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**Question 11 continued**

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**(Total for Question 11 is 8 marks)****TOTAL FOR PAPER IS 75 MARKS**