| Please check the examination details below before ent            | ering your candidate information |
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| Candidate surname  | Other names                      |
| Centre Number Candidate Number  Pearson Edexcel Internation      | nal Advanced Level               |
|  |                                  |
| <b>Monday 23 October 2023</b>                                    |                                  |
| Afternoon (Time: 1 hour 30 minutes) Paper reference              | wMA14/01                         |
| Mathematics  | • •                              |
| International Advanced Level Pure Mathematics P4                 |                                  |
| You must have:  Mathematical Formulae and Statistical Tables (Ye | ellow), calculator               |

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 8 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.
- If you change your mind about an answer, cross it out and put your new answer and any
  working underneath.

  Turn over





1. (a) Find the first four terms, in ascending powers of x, of the binomial expansion of

$$\frac{8}{\left(2-5x\right)^2}$$

writing each term in simplest form.

**(4)** 

(b) Find the range of values of x for which this expansion is valid.

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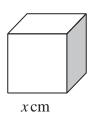


Figure 1

Figure 1 shows a cube which is increasing in size.

At time t seconds,

- the length of each edge of the cube is x cm
- the surface area of the cube is  $S \text{ cm}^2$
- the volume of the cube is  $V \text{cm}^3$

Given that the surface area of the cube is increasing at a constant rate of  $4\,\mathrm{cm}^2\,\mathrm{s}^{-1}$ 

(a) show that  $\frac{dx}{dt} = \frac{k}{x}$  where k is a constant to be found,

**(4)** 

(b) show that  $\frac{dV}{dt} = V^p$  where p is a constant to be found.

**(3)** 

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

Solutions based on calculator technology are not acceptable.

(i) Use integration by parts to find the exact value of

$$\int_0^4 x^2 e^{2x} dx$$

giving your answer in simplest form.

**(5)** 

(ii) Use integration by substitution to show that

$$\int_{3}^{\frac{21}{2}} \frac{4x}{(2x-1)^2} \, \mathrm{d}x = a + \ln b$$

where a and b are constants to be found.

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| 4. | (a) | Prove by | contradiction | that for a | all p | ositive | numbers k |
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| (b) | Show | that | the | result | in | part | (a) | is | not | true | for | all | real | numbe | rs. |
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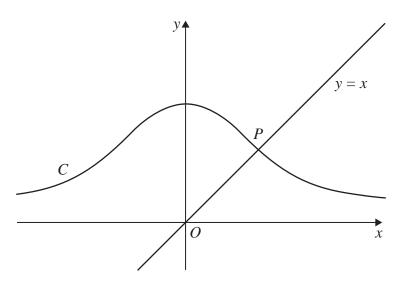


Figure 2

Figure 2 shows a sketch of the curve C with equation

$$y^3 - x^2 + 4x^2y = k$$

where k is a positive constant greater than 1

(a) Find  $\frac{dy}{dx}$  in terms of x and y.

**(5)** 

The point P lies on C.

Given that the normal to C at P has equation y = x, as shown in Figure 2,

(b) find the value of k.

**(5)** 

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**6.** The line  $l_1$  has equation  $\mathbf{r} = \begin{pmatrix} 2 \\ 3 \\ -7 \end{pmatrix} + \lambda \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix}$  where  $\lambda$  is a scalar parameter.

The line  $l_2$  has equation  $\mathbf{r} = \begin{pmatrix} 2 \\ 3 \\ -7 \end{pmatrix} + \mu \begin{pmatrix} 4 \\ -1 \\ 8 \end{pmatrix}$  where  $\mu$  is a scalar parameter.

Given that  $l_1$  and  $l_2$  meet at the point P

(a) state the coordinates of P

**(1)** 

Given that the angle between lines  $l_1$  and  $l_2$  is  $\theta$ 

(b) find the value of  $\cos \theta$ , giving the answer as a fully simplified fraction.

(3)

The point Q lies on  $l_1$  where  $\lambda = 6$ 

Given that point R lies on  $l_2$  such that triangle QPR is an isosceles triangle with PQ = PR

(c) find the exact area of triangle QPR

**(3)** 

(d) find the coordinates of the possible positions of point R

**(3)** 

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7. The number of goats on an island is being monitored.

When monitoring began there were 3000 goats on the island.

In a simple model, the number of goats, x, in thousands, is modelled by the equation

$$x = \frac{k(9t+5)}{4t+3}$$

where k is a constant and t is the number of years after monitoring began.

(a) Show that k = 1.8

**(2)** 

(b) Hence calculate the long-term population of goats predicted by this model.

**(1)** 

In a **second** model, the number of goats, x, in thousands, is modelled by the differential equation

$$3\frac{\mathrm{d}x}{\mathrm{d}t} = x(9-2x)$$

(c) Write  $\frac{3}{x(9-2x)}$  in partial fraction form.

**(3)** 

(d) Solve the differential equation with the initial condition to show that

$$x = \frac{9}{2 + e^{-3t}}$$

(5)

(e) Find the long-term population of goats predicted by this second model.

**(1)** 



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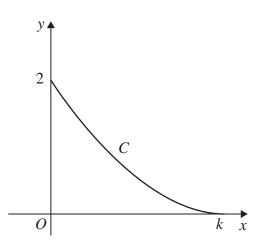


Figure 3

Figure 3 shows a sketch of the curve C with parametric equations

$$x = 6t - 3\sin 2t \qquad y = 2\cos t \qquad 0 \leqslant t \leqslant \frac{\pi}{2}$$

The curve meets the y-axis at 2 and the x-axis at k, where k is a constant.

(a) State the value of k.

**(1)** 

(b) Use parametric differentiation to show that

$$\frac{\mathrm{d}y}{\mathrm{d}x} = \lambda \operatorname{cosec} t$$

where  $\lambda$  is a constant to be found.

**(4)** 

The point P with parameter  $t = \frac{\pi}{4}$  lies on C.

The tangent to C at the point P cuts the y-axis at the point N.

(c) Find the exact y coordinate of N, giving your answer in simplest form.

**(3)** 

The region bounded by the curve, the x-axis and the y-axis is rotated through  $2\pi$  radians about the x-axis to form a solid of revolution.

(d) (i) Show that the volume of this solid is given by

$$\int_0^\alpha \beta (1 - \cos 4t) \, \mathrm{d}t$$

where  $\alpha$  and  $\beta$  are constants to be found.

(ii) Hence, using algebraic integration, find the exact volume of this solid.

**(6)** 



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