

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
<b>Pearson Edexcel</b>		Centre Number			Candidate Number				
<b>Level 3 GCE</b>		<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>			<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>				
Time 2 hours		Paper reference		<b>8MA0/01</b>					
<b>Mathematics</b> <b>Advanced Subsidiary</b> <b>PAPER 1: Pure Mathematics</b>  October 2021 <span style="float: right;">Shadow Set 1</span>									
<b>You must have:</b> Mathematical Formulae and Statistical Tables (Green), calculator								Total Marks	

**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

- 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 16 questions in this question paper. The total mark for this paper 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.
- Good luck with your examination.

Turn over ►

1. **In this question you should show all stages of your working.**  
**Solutions relying on calculator technology are not acceptable.**

Using algebra, solve the inequality

$$x^2 - x > 30$$

writing your answer in set notation.

(3)

(Total for Question 1 is 3 marks)

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2. **In this question you should show all stages of your working.**  
**Solutions relying on calculator technology are not acceptable.**

Given

$$\frac{8^{x-1}}{2^{y+2}} = 64$$

express  $y$  in terms of  $x$ , writing your answer in simplest form.

(3)

(Total for Question 2 is 3 marks)

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3. Find

$$\int \frac{4x^3 - 6}{3x^2} dx$$

writing your answer in simplest form.

(4)

(Total for Question 3 is 4 marks)

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4. [In this question the unit vectors  $\mathbf{i}$  and  $\mathbf{j}$  are due east and due north respectively.]

A stone slides horizontally across ice.

Initially the stone is at the point  $A(-48\mathbf{i} - 14\mathbf{j})$  m relative to a fixed point  $O$ .

After 5 seconds the stone is at the point  $B(24\mathbf{i} + 7\mathbf{j})$  m relative to the fixed point  $O$ .

The motion of the stone is modelled as that of a particle moving in a straight line at constant speed.

Using the model,

(a) prove that the stone passes through  $O$ ,

(2)

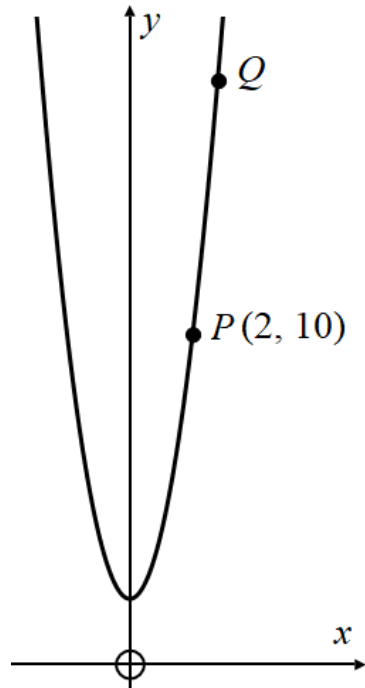
(b) calculate the speed of the stone.

(3)

**(Total for Question 4 is 5 marks)**

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5.



**Figure 1**

Figure 1 shows part of the curve with equation  $y = 2x^2 + 2$

The point  $P(2, 10)$  lies on the curve.

(a) Find the gradient of the tangent to the curve at  $P$ .

(2)

The point  $Q$  with  $x$  coordinate  $2 + h$  also lies on the curve.

(b) Find the gradient of the line  $PQ$ , giving your answer in terms of  $h$  in simplest form.

(3)

(c) Explain briefly the relationship between part (b) and the answer to part (a).

(1)

**(Total for Question 5 is 6 marks)**

6.

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

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

(a) Using algebra, find all solutions of the equation

$$5x^3 - 13x^2 - 6x = 0$$

(3)

(b) Hence find all real solutions of

$$5(y - 3)^6 - 13(y - 3)^4 - 6(y - 3)^2 = 0$$

(3)

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

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7. A parallelogram  $PQRS$  has area  $40 \text{ cm}^2$

Given

- $PQ$  has length  $14 \text{ cm}$
- $QR$  has length  $7 \text{ cm}$
- angle  $SPQ$  is obtuse

find

(a) the size of angle  $SPQ$ , in degrees, to 2 decimal places, (3)

(b) the length of the diagonal  $SQ$ , in cm, to one decimal place. (2)

**(Total for Question 7 is 5 marks)**

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8.  $g(x) = (2 + ax)^8$  where  $a$  is a constant

Given that one of the terms in the binomial expansion of  $g(x)$  is  $5670x^4$

(a) find the value of  $a$ . (4)

Using this value of  $a$ ,

(b) find the constant term in the expansion of

$$\left(1 + \frac{1}{x^3}\right)(2 + ax)^8$$

(3)

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

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9. Find the value of the constant  $k$ ,  $k > 8$ , such that

$$\int_8^k \frac{10}{\sqrt[3]{x}} dx = \frac{135}{4}$$

(4)

(Total for Question 9 is 4 marks)

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10. A student is investigating the following statement about natural numbers.

“  $n^3 + n$  is an even number which is not a multiple of 4 ”

- (a) Prove, using algebra, that the statement is true for all odd numbers.

(4)

- (b) Use a counterexample to show that the statement is not always true.

(1)

(Total for Question 10 is 5 marks)

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11. The owners of an orchard decided to increase the area of the orchard covered by apple trees. Tree planting started on 1st January 2005.

The area of the orchard covered by apple trees,  $A$  km<sup>2</sup>, is modelled by the equation

$$A = 10 - 5.5e^{ct}$$

where  $c$  is a constant and  $t$  is the number of years after 1st January 2005.

Using the model,

- (a) find the area of the orchard that was covered by apple trees just before tree planting started.

(1)

On 1st January 2019 an area of 8 km<sup>2</sup> of the orchard was covered by apple trees.

- (b) Use this information to find a complete equation for the model, giving your value of  $c$  to 4 significant figures.

(4)

On 1st January 2020, the owners of the nature reserve announced a long-term plan to have 12 km<sup>2</sup> of the nature reserve covered by trees.

- (c) State a reason why the model is not appropriate for this plan.

(1)

(Total for Question 11 is 6 marks)

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12.

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

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

(i) Solve, for  $0 < \theta \leq 450^\circ$ , the equation

$$5 \sin^2 \theta = 6 \cos \theta$$

giving your answers to one decimal place.

**(5)**

(ii) (a) A student's attempt to solve the question

“Solve, for  $0 < x \leq 180^\circ$ , the equation  $5 \sin^2 x - 3 \sin x = 0$  correct to 1 decimal place”

is set out below.

$5 \sin^2 x - 3 \sin x = 0$
$5 \sin^2 x = 3 \sin x$
$5 \sin x = 3$
$\sin x = \frac{3}{5}$
$x = 36.9^\circ$

Identify two errors or omissions made by this student, giving a brief explanation of each.

**(2)**

The first four positive solutions, in order of size, of the equation

$$\sin(5\alpha + 40^\circ) = \frac{3}{5}$$

are  $\alpha_1, \alpha_2, \alpha_3$  and  $\alpha_4$

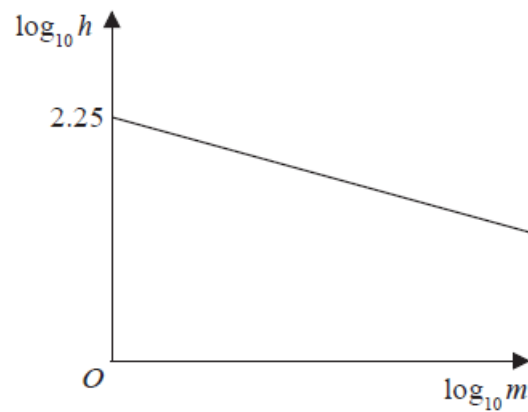
(b) Find, to the nearest degree, the value of  $\alpha_4$

**(2)**

**(Total for Question 12 is 9 marks)**

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13.



**Figure 2**

The resting heart rate,  $h$ , of a reptile, measured in beats per minute, is modelled by the equation

$$h = pm^q$$

where  $p$  and  $q$  are constants and  $m$  is the mass of the reptile measured in kg.

Figure 2 illustrates the linear relationship between  $\log_{10} h$  and  $\log_{10} m$

The line meets the vertical  $\log_{10} h$  axis at 2.25 and has a gradient of  $-0.486$

(a) Find, to 3 significant figures, the value of  $p$  and the value of  $q$ .

**(3)**

A particular reptile has a mass of 2 kg and a resting heart rate of 125 beats per minute.

(b) Comment on the suitability of the model for this reptile.

**(3)**

(c) With reference to the model, interpret the value of the constant  $p$ .

**(1)**

**(Total for Question 13 is 7 marks)**

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14. A curve  $C$  has equation  $y = f(x)$  where

$$f(x) = -5x^2 + 30x + 6$$

(a) Write  $f(x)$  in the form

$$a(x + b)^2 + c$$

where  $a$ ,  $b$  and  $c$  are constants to be found.

(3)

The curve  $C$  has a maximum turning point at  $M$ .

(b) Find the coordinates of  $M$ .

(2)

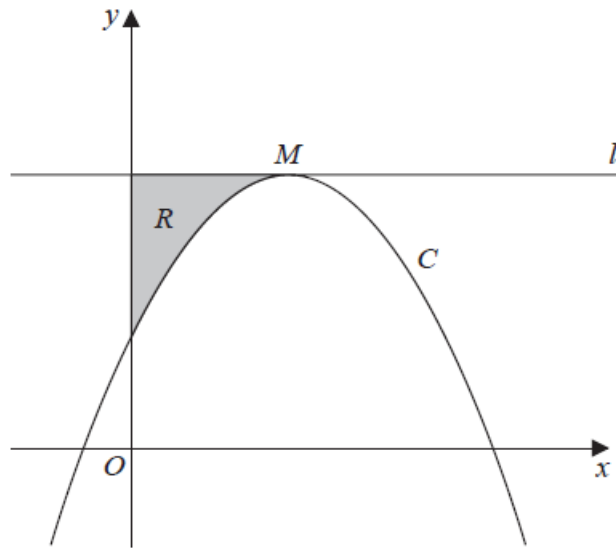


Figure 3

Figure 3 shows a sketch of the curve  $C$ .

The line  $l$  passes through  $M$  and is parallel to the  $x$ -axis.

The region  $R$ , shown shaded in Figure 3, is bounded by  $C$ ,  $l$  and the  $y$ -axis.

(c) Using algebraic integration, find the area of  $R$ .

(5)

(Total for Question 14 is 10 marks)

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15.

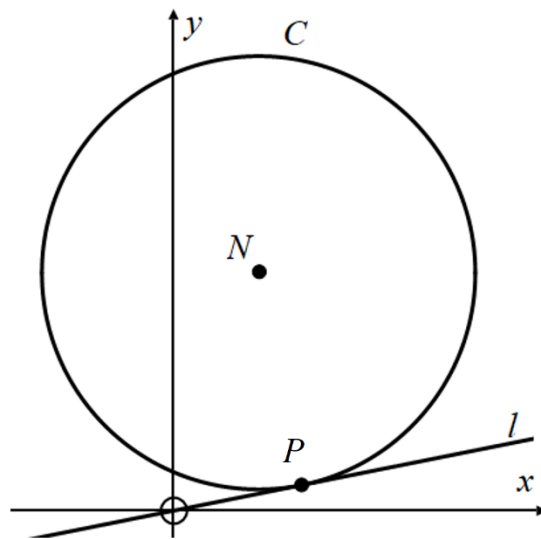


Figure 4

Figure 4 shows a sketch of a circle  $C$  with centre  $N(5, 14)$

The line  $l$  with equation  $y = \frac{1}{5}x$  is a tangent to  $C$  at the point  $P$ .

Find

(a) the equation of line  $PN$  in the form  $y = mx + c$ , where  $m$  and  $c$  are constants, (2)

(b) an equation for  $C$ . (4)

The line with equation  $y = \frac{1}{5}x + k$ , where  $k$  is a non-zero constant, is also a tangent to  $C$ .

(c) Find the value of  $k$ . (3)

**(Total for Question 15 is 9 marks)**

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16. The curve  $C$  has equation  $y = f(x)$  where

$$f(x) = ax^3 + 17x^2 - 17x + b$$

and  $a$  and  $b$  are constants.

Given

- the point  $(2, 8)$  lies on  $C$
- the gradient of the curve at  $(2, 8)$  is 3

(a) (i) show that the value of  $a$  is  $-4$

(ii) find the value of  $b$ .

(4)

(b) Hence show that  $C$  has two stationary points.

(3)

(c) Write  $f(x)$  in the form  $(x - 3)Q(x)$  where  $Q(x)$  is a quadratic expression to be found.

(2)

(d) Hence deduce the coordinates of the points of intersection of the curve with equation

$$y = f(0.2x)$$

and the coordinate axes.

(2)

(Total for Question 16 is 11 marks)

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**TOTAL FOR PAPER IS 100 MARKS**