Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Practice Paper 1

Advanced
Paper 2: Pure Mathematics 2

Wednesday 13 June 2018 – Morning
Time: 2 hours

Paper Reference
9MA0/02

You must have:
Mathematical Formulae and Statistical Tables, 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.
- 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.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- The total mark for this part of the examination is 100. There are 14 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.

1. The graph of $y = ax^2 + bx + c$ has a maximum at $(-2, 8)$ and passes through $(-4, 4)$. Find the values of a, b and c.

(Total for Question 1 is 3 marks)

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2. The points $P(6, 4)$ and $Q(0, 28)$ lie on the straight line l_1 as shown in Figure 1.

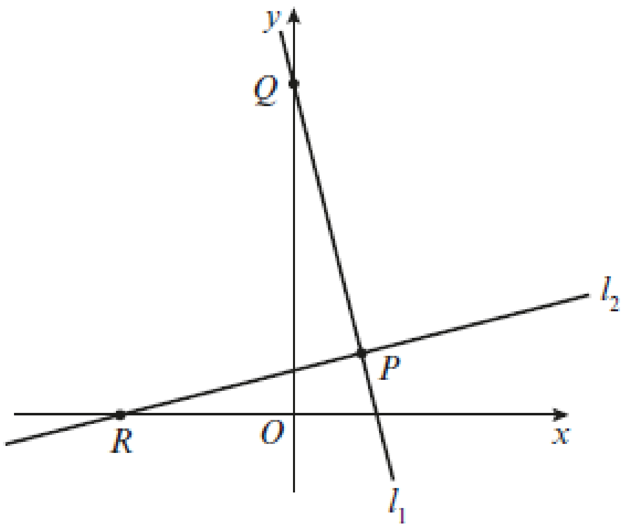

Figure 1

(a) Work out an equation for the straight line l_1.

(2)

The straight line l_2 is perpendicular to l_1 and passes through the point P.

Work out

(b) an equation for the straight line l_2,

(2)

(c) the coordinates of R,

(2)

(d) the area of $\triangle PQR$.

(3)

(Total for Question 2 is 9 marks)

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3. The function f is defined by $\mathrm{f} : x \rightarrow \mathrm{e}^{3x-1}, \quad x \in \mathbb{R}$.

Find $\mathrm{f}^{-1}(x)$ and state its domain.

(Total for Question 3 is 4 marks)

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4. A student is asked to solve the equation log4(x + 3) + log4(x + 4) = 1_ 2

The student's attempt is shown.

$$\begin{aligned} \log_4(x+3) + \log_4(x+4) &= \tfrac{1}{2} \\ (x+3) + (x+4) &= 2 \\ 2x + 7 &= 2 \\ 2x &= -5 \\ x &= -\tfrac{5}{2} \end{aligned}$$

(a) Identify the error made by the student.

(1)

(b) Solve the equation correctly.

(4)

(Total for Question 4 is 5 marks)

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5. The function p has domain $-14 < x < 10$, and is linear from $(-14, 18)$ to $(-6, -6)$ and from $(-6, -6)$ to $(10, 2)$.

(a) Sketch $y = \mathrm{p}(x)$.

(2)

(b) Write down the range of $\mathrm{p}(x)$.

(1)

(c) Find the values of a, such that $\mathrm{p}(a) = -3$.

(2)

(Total for Question 5 is 5 marks)

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6. $$f(x) = x^3 - kx^2 - 10x + k$$

(a) Given that $(x + 2)$ is a factor of $f(x)$, find the value of k.

(2)

(b) Hence, or otherwise, find all the solutions to the equation $f(x) = 0$, leaving your answers in the form $p \pm \sqrt{q}$ when necessary.

(4)

(Total for Question 6 is 6 marks)

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7. In $\triangle DEF$, $DE = x - 3$ cm, $DF = x - 10$ cm and $\angle EDF = 30°$.

Given that the area of the triangle is 11 cm^2,

(a) show that x satisfies the equation $x^2 - 13x - 14 = 0$,

(3)

(b) calculate the value of x.

(2)

(Total for Question 7 is 5 marks)

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8. The curve C has parametric equations $x = 6 \sin t + 5$, $y = 6 \cos t - 2$, $-\frac{\pi}{3} \leq t \leq \frac{3\pi}{4}$.

(a) Show that the Cartesian equation of C can be written as $(x + h)^2 + (y + k)^2 = c$, where h, k and c are integers to be determined.

(4)

(b) Find the length of C. Write your answer in the form $p\pi$, where p is a rational number to be found.

(3)

(Total for Question 8 is 7 marks)

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9. $$\frac{4x^2+7x}{(x-2)(x+4)} \equiv A + \frac{B}{(x-2)} + \frac{C}{(x+4)}$$

(a) Find the values of the constants A, B and C.

(4)

(b) Hence, or otherwise, expand $\frac{4x^2+7x}{(x-2)(x+4)}$ in ascending powers of x, as far as the term in x^2.

Give each coefficient as a simplified fraction.

(6)

(Total for Question 9 is 10 marks)

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10. OAB is a triangle as shown in Figure 2. $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$. The points M and N are midpoints of OB and BA respectively.

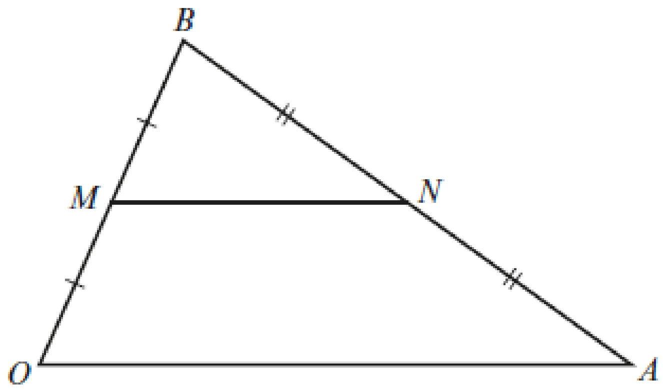

Figure 2

The triangle midsegment theorem states that 'In a triangle, the line joining the midpoints of any two sides will be parallel to the third side and half its length.'

Use vectors to prove the triangle midsegment theorem

(Total for Question 10 is 4 marks)

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11. Figure 3 shows the region R bounded by the x-axis and the curve with equation

$$y = x^2(\sin x + \cos x), , \quad 0 \leq x \leq \frac{3\pi}{4}.$$

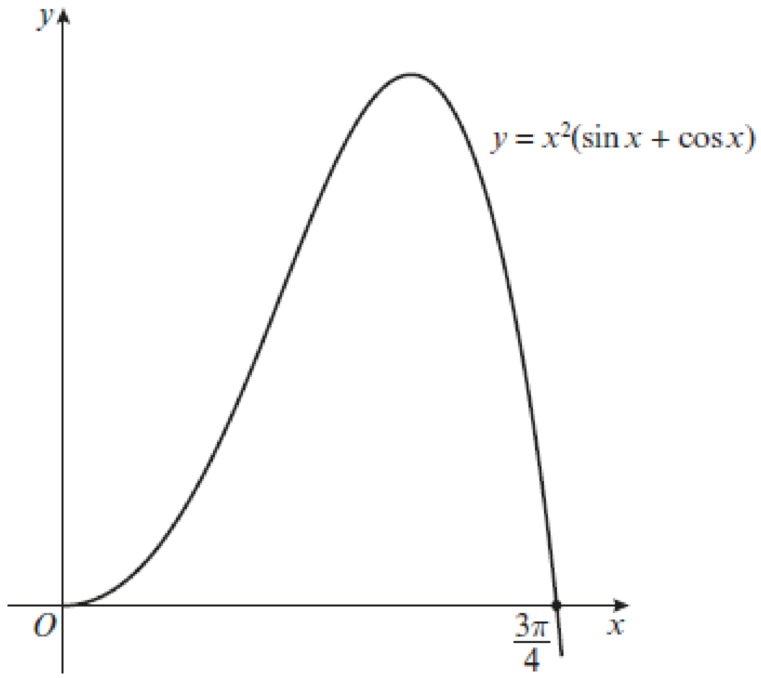

Figure 3

The table shows corresponding values of x and y for $y = x^2(\sin x + \cos x)$.

x	0	$\frac{\pi}{8}$	$\frac{\pi}{4}$	$\frac{3\pi}{8}$	$\frac{\pi}{2}$	$\frac{5\pi}{8}$	$\frac{3\pi}{4}$
y	0	0.20149	0.87239	1.81340		2.08648	0

(a) Copy and complete the table giving the missing value for y to 5 decimal places.

(1)

Using the trapezium rule, with all the values for y in the completed table,

(b) find an approximation for the area of R, giving your answer to 3 decimal places.

(4)

(c) Use integration to find the exact area of R, giving your answer to 3 decimal places.

(6)

(d) Calculate, to one decimal place, the percentage error in your approximation in part (b).

(1)

(Total for Question 11 is 12 marks)

12. Ruth wants to save money for her newborn daughter to pay for university costs. In the first year she saves £1000. Each year she plans to save £150 more, so that she will save £1150 in the second year, £1300 in the third year, and so on.

Find

(a) the amount Ruth will save in the 18th year.,

(2)

(b) the total amount that Ruth will have saved over the 18 years.

(3)

Ruth decides instead to increase the amount she saves by 10% each year.

(c) Calculate the total amount Ruth will have saved after 18 years under this scheme.

(4)

(Total for Question 12 is 9 marks)

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13. (a) Express $0.09 \cos x + 0.4 \sin x$ in the form $R \cos (x - \alpha)$, where $R > 0$ and $0 < \alpha < \dfrac{\pi}{2}$.

Give the value of α to 4 decimal places.

(4)

The height of a swing above the ground can be modelled using the equation

$$h = \frac{16.4}{0.09 \cos\left(\frac{t}{2}\right) + 0.4\sin\left(\frac{t}{2}\right)}, \quad 0 \leq t \leq 5.4,$$

where h is the height of the swing, in cm, and t is the time, in seconds, since the swing was initially at its greatest height.

(b) Calculate the minimum value of h predicted by this model, and the value of t, to 2 decimal places, when this minimum value occurs.

(3)

(c) Calculate, to the nearest hundredth of a second, the times when the swing is at a height of exactly 100 cm.

(4)

(Total for Question 13 is 11 marks)

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14. Figure 4 shows the height, h, in metres of a rollercoaster during the first few seconds of the ride. The graph is $y = h(t)$, where $h(t) = -10e^{-0.3(t-6.4)} - 10e^{0.8(t-6.4)} + 70$.

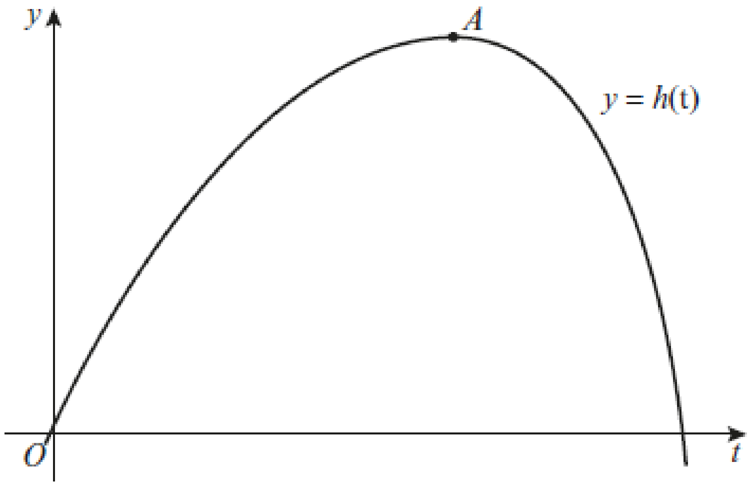

Figure 4

(a) Find $h'(t)$.

(3)

(b) Show that when $h'(t) = 0$, $t = \frac{5}{4}\ln\left(\frac{3e^{-0.3(t-6.4)}}{8}\right) + 6.4$.

(2)

To find an approximation for the t-coordinate of A, the iterative formula

$$t_{n+1} = t = \frac{5}{4}\ln\left(\frac{3e^{-0.3(t_n-6.4)}}{8}\right) + 6.4.$$

is used.

Given that $t_0 = 5$.

(c) Find the values of t_1, t_2, t_3 and t_4. Give your answers to 4 decimal places.

(3)

By choosing a suitable interval,

(d) show that the t-coordinate of A is 5.508, correct to 3 decimal places.

(2)

(Total for Question 14 is 10 marks)

TOTAL FOR PURE MATHEMATICS 1 IS 100 MARKS