Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Practice Paper 1

Advanced
Paper 1: Pure Mathematics 1

Wednesday 6 June 2018 – Morning
Time: 2 hours

Paper Reference **9MA0/01**

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 13 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. A curve C has parametric equations $x = \sin^2 t, \quad y = 2\tan t, \quad 0 \le t < \frac{\pi}{2}$.

Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ in terms of t.

(Total for Question 1 is 4 marks)

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2. Find the set of values of x for which

(a) $2(7x - 5) - 6x < 10x - 7$,

(2)

(b) $|2x + 5| - 3 > 0$,

(4)

(c) **both** $2(7x - 5) - 6x < 10x - 7$ **and** $|2x + 5| - 3 > 0$.

(1)

(Total for Question 2 is 7 marks)

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3. The line with equation $2x + y - 3 = 0$ does not intersect the circle with equation

$$x^2 + kx + y^2 + 4y = 4.$$

(a) Show that $5x^2 + (k - 20)x + 17 > 0$.

(4)

(b) Find the range of possible values of k. Write your answer in exact form.

(3)

(Total for Question 3 is 7 marks)

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4. Prove, for an angle θ measured in radians, that the derivative of $\cos\theta$ is $-\sin\theta$.

You may assume the compound angle formula for $\cos(A \pm B)$, and that $\lim_{x\to 0}\left(\frac{\sin h}{h}\right) = 1$ and $\lim_{x\to 0}\left(\frac{\cos h - 1}{h}\right) = 0$.

(Total for Question 4 is 5 marks)

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5. $$f(x) = (3 + px)^6, \quad x \in \mathbb{R}.$$

Given that the coefficient of x^2 is 19 440,

(a) find two possible values of p.

(4)

Given further that the coefficient of x^5 is negative,

(b) find the coefficient of x^5.

(2)

(Total for Question 5 is 6 marks)

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6. The point R with x-coordinate 2 lies on the curve with equation $y = x^2 + 4x - 2$. The normal to the curve at R intersects the curve again at a point T.

Find the coordinates of T, giving your answers in their simplest form.

(Total for Question 6 is 6 marks)

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7. A geometric series has first term a and common ratio r. The second term of the series is 96 and the sum to infinity of the series is 600.

(a) Show that $25r^2 - 25r + 4 = 0$.

(4)

(b) Find the two possible values of r.

(2)

For the larger value of r:

(c) find the corresponding value of a,

(1)

(d) find the smallest value of n for which S_n exceeds 599.9.

(3)

(Total for Question 7 is 10 marks)

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8. Figure 1 shows the graph of f(x). The points B and D are stationary points of the graph.

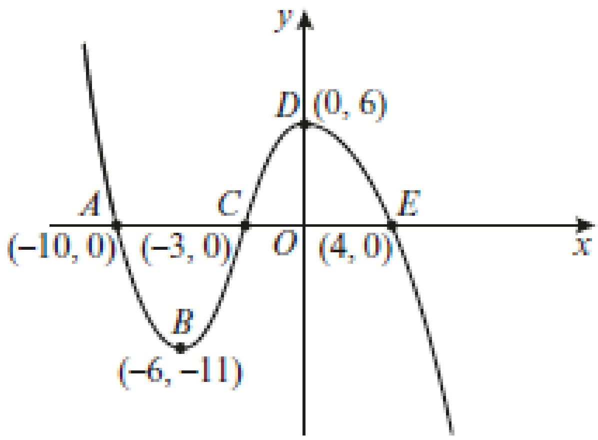

Figure 1

Sketch, on separate diagrams, the graphs of

(a) $y = |\, f(x)|$,

(3)

(b) $y = -f(x) + 5$,

(3)

(c) $y = 2f(x - 3)$.

(3)

(Total for Question 8 is 9 marks)

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9. Find all the solutions, in the interval $0 < x < 2\pi$, to the equation

$$31 - 25 \cos x = 19 - 12 \sin^2 x,$$

giving each solution to 2 decimal places.

(Total for Question 9 is 5 marks)

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10. The value, V, of a car decreases over time, t, measured in years. The rate of decrease in value of the car is proportional to the value of the car at that time.

(a) Given that the initial value of the car is V_0, show that $V = V_0 e^{-kt}$.

(4)

The value of the car after 2 years is £25 000 and after 5 years is £15 000.

Find

(b) the exact value of k and the value of V_0 to the nearest hundred pounds,

(3)

(c) the age of the car when its value is £5000.

(3)

(Total for Question 10 is 10 marks)

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11. Figure 2 shows the positions of 4 cities: A, B, C and D. The distances, in miles, between each pair of cities, as measured in a straight-line, are labelled on the diagram. A new road is to be built between cities B and D.

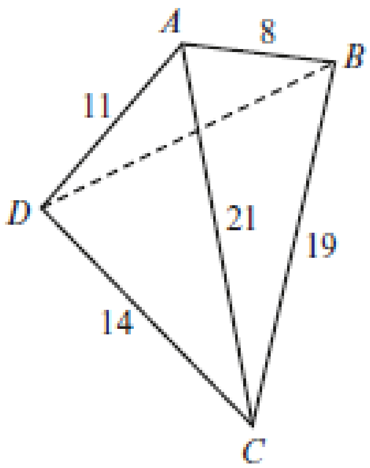

Figure 2

(a) Find the minimum possible length of this road. Give your answer to 1 decimal place.

(7)

(b) Explain why your answer to part (a) is a minimum.

(1)

(Total for Question 11 is 8 marks)

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12. A footballer takes a free-kick. The path of the ball towards the goal can be modelled by the equation

$$y = -0.01x^2 + 0.22x + 1.58, \quad x \geq 0 ,$$

where x is the horizontal distance from the goal in metres and y is the height of the ball in metres. The goal is 2.44 m high.

(a) Rewrite y in the form $A - B(x + C)^2$, where A, B and C are constants to be found.

(3)

Using your answer to part (a),

(b) state the distance from goal at which the ball is at the greatest height and its height at this point.

(2)

(c) Find the distance of the football from the goal when it is kicked.

(2)

The football is headed towards the goal. A goalkeeper can save any ball that would cross the goal line at a height of up to 1.5 m.

(d) Explain, with a reason, whether the free kick will result in a goal.

(2)

(Total for Question 12 is 9 marks)

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13. A box in the shape of a rectangular prism has a lid that overlaps the box by 3 cm, as shown in Figure 3. The width of the box is x cm, and the length of the box is double the width. The height of the box is h cm. The box and lid can be created exactly from a piece of cardboard of area 5356 cm^2.

The box has volume, V cm^3.

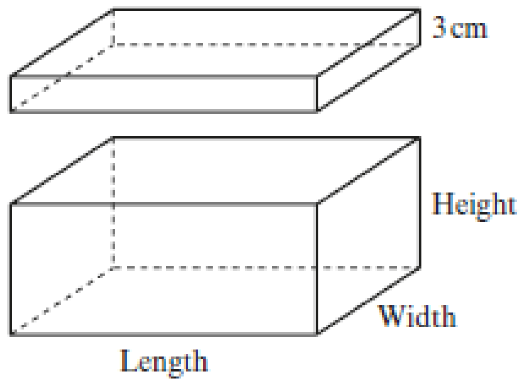

Figure 3

(a) Show that $V = \frac{2}{3}(2678x - 9x^2 - 2x^3)$.

(5)

Given that x can vary,

(b) use differentiation to find the positive value of x, to 2 decimal places, for which V is stationary.

(4)

(c) Prove that this value of x gives a maximum value of V.

(2)

(d) Find this maximum value of V.

(1)

Given that V takes its maximum value,

(e) determine the percentage of the area of cardboard that is used in the lid.

(2)

(Total for Question 13 is 14 marks)

TOTAL FOR PURE MATHEMATICS 1 IS 100 MARKS

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