Pearson Edexcel Level 3

GCE Mathematics

Advanced Subsidiary

Paper 1: Pure

Monday 27 May 2019	**Paper Reference(s)**
Time: 1 hour 45 minutes	**8MA0/01**

You must have:
Mathematical Formulae and Statistical Tables, calculator

Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic 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).
- 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 paper. The total mark is 87.
- 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.

1.

The line L_1 has equation $4x + 2y - 3 = 0$

(a) Find the gradient of L_1.

(1)

The line L_2 is perpendicular to L_1 and passes through the point (2, 5).

(b) Find the equation of L_2 in the form $y = mx + c$, where m and c are constants.

(3)

Total for Q1 is 4 marks

2.

Find, using algebra, all real solutions to the equation

$$a^4 - 2a^2 - 80 = 0$$

(4)

Total for Q2 is 4 marks

3.

$$\frac{dy}{dx} = -x^3 + \frac{4x-5}{2x^3}, x \neq 0$$

Given that $y = 7$ at $x = 1$, find y in terms of x, giving each term in its simplest form.

(6)

Total for Q3 is 6 marks

4.

A large plant pot shown in figure A initially has some water in it. Jim then starts to pour more water into it at a constant rate.

The depth of water, D cm, was measured t seconds after Jim started pouring more water in.

Exactly 5 seconds after Jim starts pouring, the depth was 13.52cm
Exactly 8 seconds after he started pouring the depth was 18.68cm

Figure A

Using a **linear** model

(a) Find an equation for D in terms of t. (3)

(b) Find the initial depth of the water. (1)

(c) Explain why this model may not be suitable. (1)

Total for Q4 is 5 marks

5.

A curve has equation

$$y = \sqrt{x} + \frac{4}{x} + 4, \qquad x > 0$$

(a) Find, in simplest form $\frac{dy}{dx}$ (3)

(b) Hence find the range of values of x for which the curve is increasing (2)

Total for Q5 is 5 marks

6.

Prove by first principles that $\frac{d}{dx}(x^2) = 2x$

(3)

Total for Q6 is 3 marks

7.

The curve C has equation

$$y = \frac{k}{x^2} + 2, \quad x \in \mathbb{R}, x \neq 0$$

Where k is a constant.

(a) Sketch C in the space below, stating the horizontal asymptote

(3)

The line l has equation $y = -2x + 5$

(b) Show that the x coordinate of any point of intersection of l with C is given by a solution of the equation

$$k - 3x^2 + 2x^3 = 0$$

(2)

Total for Q7 is 5 marks

8.

(a) Find the first 3 terms, in ascending powers of x, of the binomial expansion of

$$\left(3+\frac{4x}{5}\right)^5$$

(3)

(b) Explain how you could use your expansion to estimate the value of 2.96^5.
You do not need to perform this calculation

(2)

Total for Q8 is 5 marks

9.

On 31st December 2014 the UK government implemented a charge on plastic bags in an attempt to reduce the rising use of these bags and the environmental impact that this has.

n years after the charge was implemented, the government targeted for the number of plastic bags used to be modelled by the following equation

$$x = 7.6 - 0.2(n - 2)^2$$

Where x is the number of plastic bags, in billions, used during the preceding year.

(a) Calculate, according to the model, how many bags were used in the year ending 31st December 2014.

(1)

(b) Find

(i) The year when the bag usage was expected to be at its highest

(ii) How many bags were predicted to be used in the year found in (i)

(2)

(c) In the year ending the 31st December 2018 seven billion bags were used. Evaluate whether the government were meeting their target at this point, justifying your answer.

(2)

(d) Explain why the model will not be valid in 2025.

(1)

Total for Q9 is 6 marks

10.

A circle C has equation

$$x^2 + y^2 + 6x - 4y + 5 = 0$$

(a) Find

(i) The coordinates of the centre of C,

(ii) The exact radius of C leaving your answer as simply as possible

(3)

The straight line, with equation $x = k$, where $k$is a constant, intersects C at 2 distinct points.

(b) Find the range of possible values for k.

(2)

Total for Q10 is 5 marks

11.

$$f(x) = x^3 + x^2 - 8x - 12$$

(a) Prove that $(x - 3)$ is a factor of $f(x)$.

(2)

(b) Hence, using algebra, show that the equation $f(x) = 0$ has only 2 distinct roots.

(3)

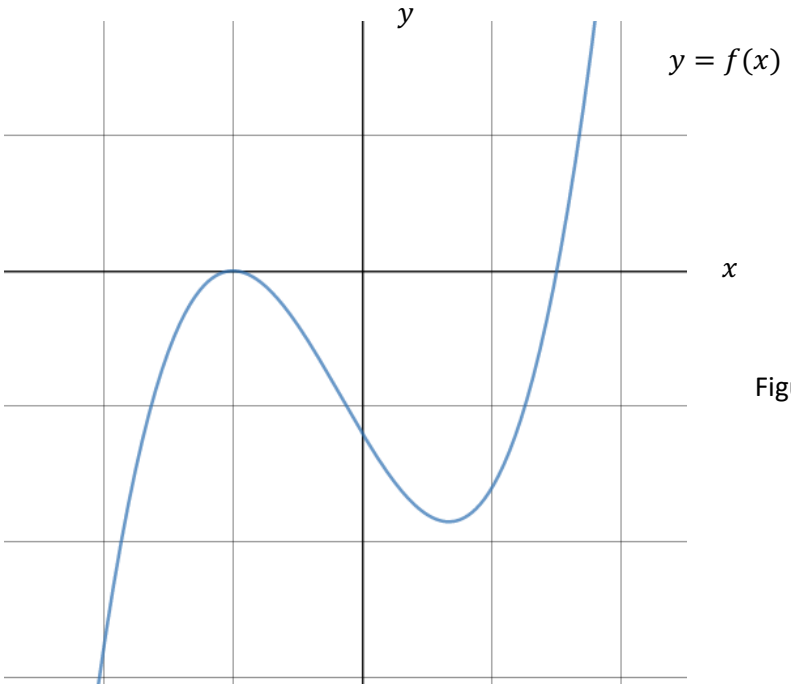

Figure B

Figure B shows a sketch of part of the curve $y = f(x)$.

(c) Deduce, giving reasons for your answer, the number of real roots of the equation

$$2x^3 + 2x^2 - 16x - 50 = 0$$

(3)

Given that k is a constant and the curve with equation $y = f(kx)$ passes through (1,0),

(d) Find the two possible values of k

(2)

Total for Q11 is 10 marks

12.

Show that

$$\frac{10cos^2x - sinx - 7}{2sinx - 1} \equiv -3 - 5sinx$$

(4)

Total for Q12 is 4 marks

13.

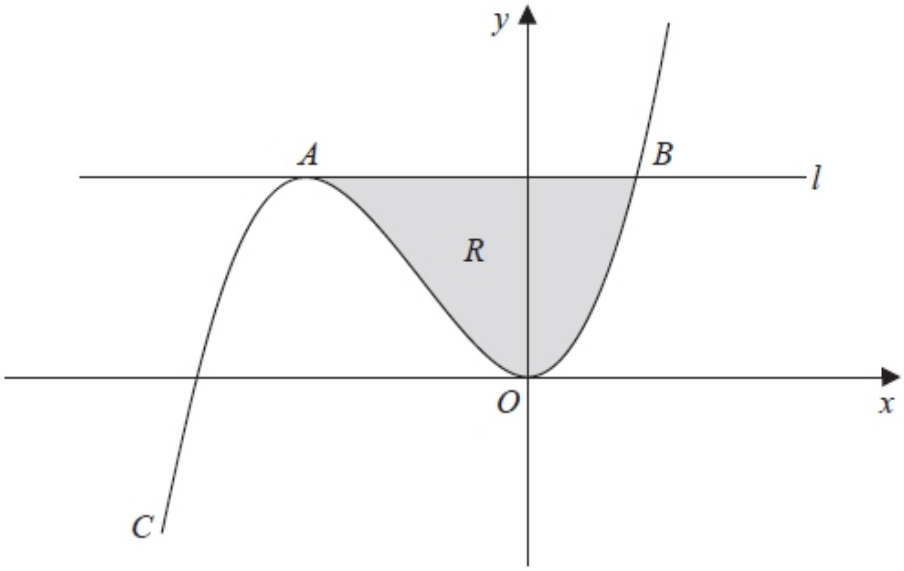

Figure D

Figure D shows a sketch of part of the curve C with equation

$$y = \frac{1}{8}x^3 + \frac{3}{4}x^2, \qquad x \in \mathbb{R}$$

The curve *C* has a maximum turning point at the point *A* and a minimum turning point at the origin *O*.

The line *l* touches the curve *C* at the point *A* and cuts the curve *C* at the point *B*.

The x coordinate of *A* is −4 and the *x* coordinate of *B* is 2.

The finite region *R*, shown shaded in Figure 3, is bounded by the curve *C* and the line *l*.

Use integration to find the area of the finite region *R*.

(7)

Total for Q13 is 7 marks

14.

The mass, *m* grams, of a leaf *t* days after it has been picked from a tree is given by

$$m = pe^{-kt}$$

where *k* and *p* are positive constants.

When the leaf is picked from the tree, its mass is 7.5 grams and 4 days later its mass is 2.5 grams.

(a) Show that $k = \frac{1}{4}\ln(3)$

(4)

(b) Find the value of t when $\frac{dm}{dt} = -0.6\ln(3)$

(5)

Total for Q14 is 9 marks

15.

Prove that $x^2 + 8x + 10 \geq 2x + 1 \qquad x \in \mathbb{R}$

(4)

Total for Q15 is 4 marks

16.

(a) Two non zero vectors, **a** and **b**, are such that

$$|\boldsymbol{a}+\boldsymbol{b}| = |\boldsymbol{a}| - |\boldsymbol{b}|$$

Explain, geometrically, the significance of this statement.

(1)

(b) Two different vectors, $\boldsymbol{m}$ and $\boldsymbol{n}$, are such that $|\boldsymbol{m}| = 4$ and $|\boldsymbol{m}-\boldsymbol{n}| = 6$.

The angle between $\boldsymbol{m}$ and $\boldsymbol{m}-\boldsymbol{n}$ is 30°.

Find $|\boldsymbol{n}|$

(4)

Total for Q16 is 5 marks