Pearson Edexcel Level 3	
GCE Mathematics **Advanced Subsidiary** **Paper 1: Pure Mathematics**	
Time: 2 hours	**Paper Reference(s)** **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 15 questions in this paper. The total mark 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Answer ALL questions. Write your answers in the spaces provided.

1. Find

$$\int \left(\frac{1}{2}x^2 - 9\sqrt{x} + 4\right) \mathrm{d}x$$

giving your answer in its simplest form.

(Total for Question 1 is 4 marks)

2. Use a counter example to show that the following statement is false.

“$n^2 - n + 5$ is a prime number, for $2 \leq n \leq 6$”

(Total for Question 2 is 2 marks)

3. Given that the point A has position vector $x\mathbf{i} - \mathbf{j}$, the point B has position vector $-2\mathbf{i} + y\mathbf{j}$ and $\overrightarrow{AB} = -3\mathbf{i} + 4\mathbf{j}$, find

a. the values of x and y

(3)

b. a unit vector in the direction of $\overrightarrow{AB}$.

(2)

(Total for Question 3 is 5 marks)

4. The line l_1 has equation $2x - 3y = 9$

The line l_2 passes through the points $(3, -1)$and $(-1,5)$

Determine, giving full reasons for your answer, whether lines l_1 and l_2 are parallel, perpendicular or neither.

(Total for Question 4 is 4 marks)

5. A student is asked to solve the equation

$$\log_3 x - \log_3 \sqrt{x-2} = 1$$

The student's attempt is shown

$$\log_3 x - \log_3 \sqrt{x-2} = 1$$

$$x - \sqrt{x-2} = 3^1$$

$$x - 3 = \sqrt{x-2}$$

$$(x-3)^2 = x - 2$$

$$x^2 - 7x + 11 = 0$$

$$x = \frac{7+\sqrt{5}}{2} \quad \text{or} \quad x = \frac{7-\sqrt{5}}{2}$$

a. Identify the error made by this student, giving a brief explanation.

(1)

b. Write out the correct solution.

(3)

(Total for Question 5 is 4 marks)

6.

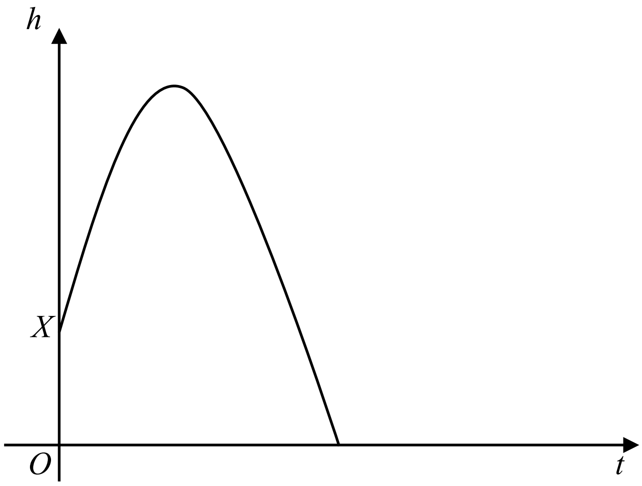

Figure 1

A stone is thrown over level ground from the top of a tower, X.

The height, h, in meters, of the stone above the ground level after t seconds is modelled by the function.

$$\mathrm{h}(t) = 7 + 21t - 4.9t^2, \ t \geq 0$$

A sketch of h against t is shown in Figure 1.

Using the model,

a. give a physical interpretation of the meaning of the constant term 7 in the model.

(1)

b. find the time taken after the stone is thrown for it to reach ground level.

(3)

c. Rearrange $\mathrm{h}(t)$ into the form $A - B(t - C)^2$, where A, B and C are constants to be found.

(3)

d. Using your answer to part **c** or otherwise, find the maximum height of the stone above the ground, and the time after which this maximum height is reached.

(2)

(Total for Question 6 is 9 marks)

7. In a triangle PQR, $PQ = 20$ cm, $PR = 10$ cm and angle $QPR = \theta$, where θ is measured in degrees. The area of triangle PQR is 80 cm^2.

a. Show that the two possible values of $\cos\theta = \pm\frac{3}{5}$

(4)

Given that QR is the longest side of the triangle,

b. find the exact perimeter of the triangle PQR, giving your answer as a simplified surd.

(3)

(Total for Question 7 is 7 marks)

8.

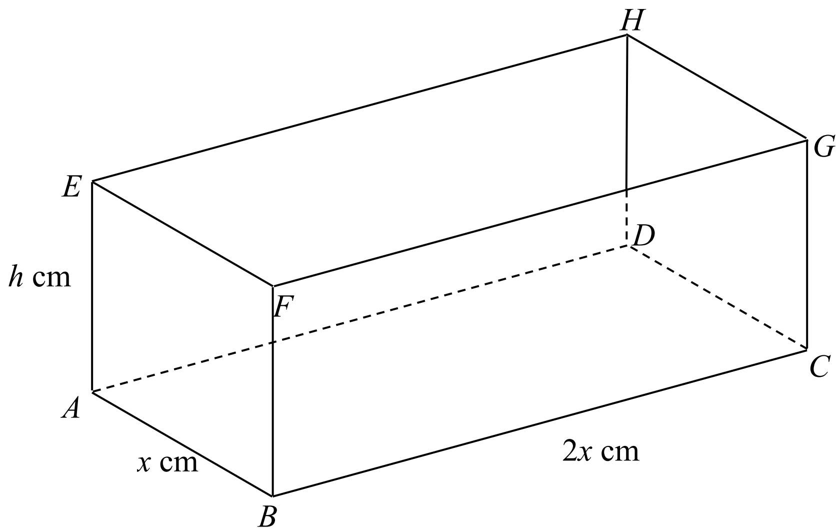

Figure 2

Figure 2 shows a solid cuboid *ABCDEFGH*.

$AB = x$ cm, $BC = 2x$ cm, $AE = h$ cm

The total surface area of the cuboid is 180 cm^2.

The volume of the cuboid is V cm^3.

a. Show that $V = 60x - \frac{4x^3}{3}$

(4)

Given that x can vary,

b. use calculus to find, to 3 significant figures, the value of x for which V is a maximum.

Justify that this value of x gives a maximum value of V.

(5)

c. Find the maximum value of V, giving your answer to the nearest cm^3.

(2)

(Total for Question 8 is 11 marks)

9. $$f(x) = -2x^3 - x^2 + 4x + 3$$

a. Use the factor theorem to show that $(3 - 2x)$ is a factor of f(x).

(2)

b. Hence show that f(x) can be written in the form $f(x) = (3 - 2x)(x + a)^2$ where a is an integer to be found.

(4)

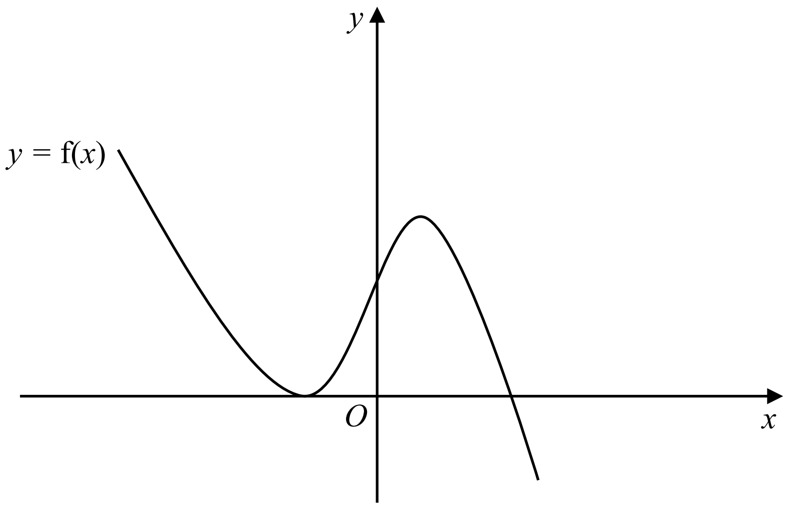

Figure 3

Figure 3 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$.

c. Use your answer to part (b), and the sketch, to deduce the values of x for which

i. $\mathrm{f}(x) \leq 0$

ii. $\mathrm{f}\left(\frac{x}{2}\right) = 0$

(3)

(Total for Question 9 is 9 marks)

10. Prove, from the first principles, that the derivative of $5x^2$ is $10x$.

(Total for Question 10 is 4 marks)

11. The first 3 terms, in ascending powers of x, in the binomial expansion of $(1 + kx)^{10}$ are given by

$$1 + 15x + px^2$$

where k and p are constants.

a. Find the value of k

(2)

b. Find the value of p

(2)

c. Given that, in the expansion of $(1 + kx)^{10}$, the coefficient of x^4 is q, find the value of q.

(2)

(Total for Question 11 is 6 marks)

12. a. Explain mathematically why there are no values of θ that satisfy the equation

$$(3\cos\theta - 4)(2\cos\theta + 5) = 0$$

(2)

b. Giving your solutions to one decimal place, where appropriate, solve the equation

$$3\sin y + 2\tan y = 0 \quad \text{for } 0 \leq y \leq \pi$$

(*Solutions based entirely on graphical or numerical methods are not acceptable*.)

(3)

(Total for Question 12 is 5 marks)

13.

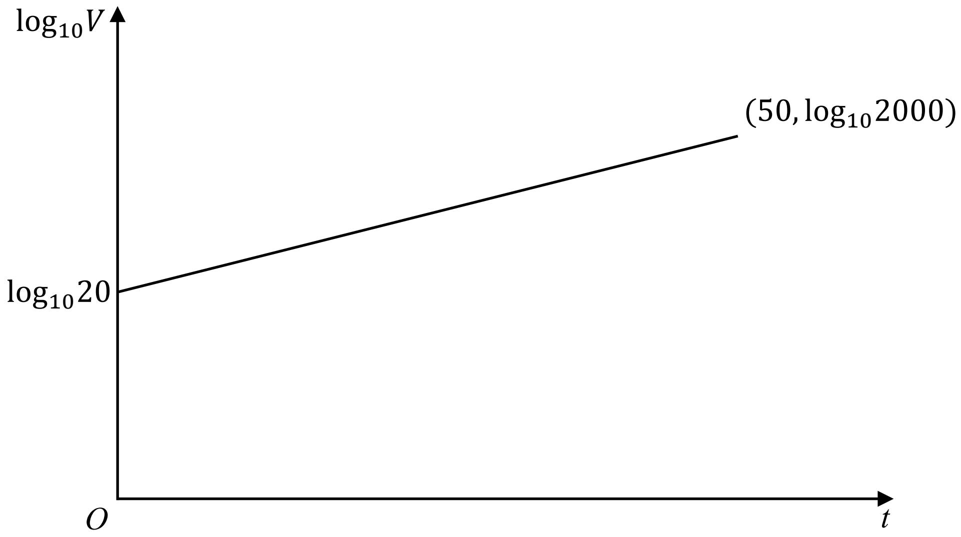

Figure 4

The value of a sculpture, £V, is modelled by the equation $V = Ap^t$, where A and p are constants and t is the number of years since the value of the painting was first recorded on 1st January 1960.

The line l shown in Figure 4 illustrates the linear relationship between t and $\log_{10}V$ for $t \geq 0$.

The line l passes through the point $(0, \log_{10}20)$ and $(50, \log_{10}2000)$.

a. Write down the equation of the line l.

(3)

b. Using your answer to part **a** or otherwise, find the values of A and p.

(4)

c. With reference to the model, interpret the values of the constant A and p.

(2)

d. Use your model, to predict the value of the sculpture, on 1st January 2020, giving your answer to the nearest pounds.

(1)

(Total for Question 13 is 10 marks)

14. A curve with centre *C* has equation

$$x^2 + y^2 + 2x - 6y - 40 = 0$$

a. i. State the coordinates of *C*.

ii. Find the radius of the circle, giving your answer as $r = n\sqrt{2}$.

(3)

b. The line l is a tangent to the circle and has gradient -7.

Find two possible equations for l, giving your answers in the form $y = mx + c$.

(8)

(Total for Question 14 is 11 marks)

15.

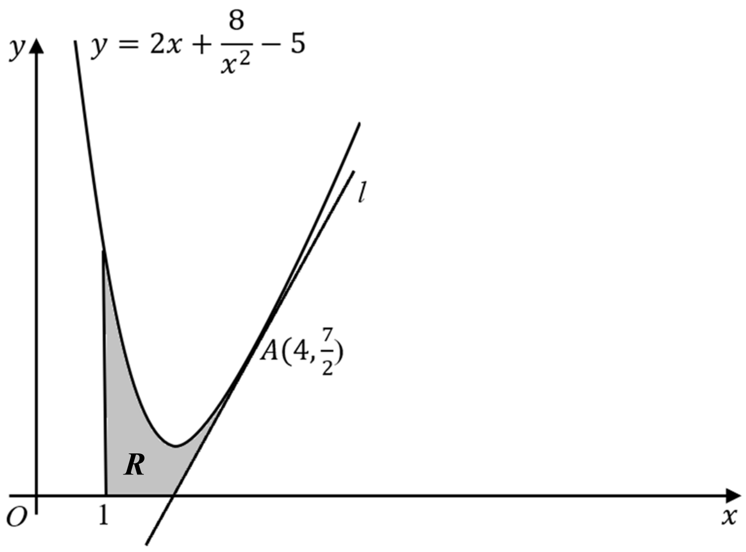

Figure 5

Figure 5 shows a sketch of part of the curve $y = 2x + \frac{8}{x^2} - 5,\ \ x > 0$.

The point $A(4, \frac{7}{2})$ lies on C. The line l is the tangent to C at the point A.

The region $\boldsymbol{R}$, shown shaded in figure 5 is bounded by the line l, the curve C, the line with equation $x = 1$ and the x-axis.

Find the exact area of $\boldsymbol{R}$.

(*Solutions based entirely on graphical or numerical methods are not acceptable.*)

(Total for Question 15 is 9 marks)

TOTAL FOR THE PAPER: 100 MARKS