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Surname

Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Candidate Number

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Mathematics

Advanced

Paper 2: Pure Mathematics 2

Sample Assessment Material for first teaching September 2017

Time: 2 hours

Paper Reference

9MA0/02

You must have:

Mathematical Formulae and Statistical Tables, calculator

Total Marks

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).
- **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.
- 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.
- If you change your mind about an answer cross it out and put your new answer and any working out underneath.

Turn over ►

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

1.

$$f(x) = 2x^3 - 5x^2 + ax + a$$

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

(3)

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(Total for Question 1 is 3 marks)

2. Some A level students were given the following question.

Solve, for $-90^\circ < \theta < 90^\circ$, the equation

$$\cos \theta = 2 \sin \theta$$

The attempts of two of the students are shown below.

Student A

$$\cos \theta = 2 \sin \theta$$

$$\tan \theta = 2$$

$$\theta = 63.4^\circ$$

Student B

$$\cos \theta = 2 \sin \theta$$

$$\cos^2 \theta = 4 \sin^2 \theta$$

$$1 - \sin^2 \theta = 4 \sin^2 \theta$$

$$\sin^2 \theta = \frac{1}{5}$$

$$\sin \theta = \pm \frac{1}{\sqrt{5}}$$

$$\theta = \pm 26.6^\circ$$

- (a) Identify an error made by student A.

(1)

Student B gives $\theta = -26.6^\circ$ as one of the answers to $\cos \theta = 2 \sin \theta$.

- (b) (i) Explain why this answer is incorrect.

- (ii) Explain how this incorrect answer arose.

(2)

(Total for Question 2 is 3 marks)

3. Given $y = x(2x + 1)^4$, show that

$$\frac{dy}{dx} = (2x + 1)^n (Ax + B)$$

where n , A and B are constants to be found.

(4)

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(Total for Question 3 is 4 marks)

5. The mass, m grams, of a radioactive substance, t years after first being observed, is modelled by the equation

$$m = 25e^{-0.05t}$$

According to the model,

- (a) find the mass of the radioactive substance six months after it was first observed, (2)
- (b) show that $\frac{dm}{dt} = km$, where k is a constant to be found. (2)

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(Total for Question 5 is 4 marks)

6. Complete the table below. The first one has been done for you.

For each statement you must state if it is always true, sometimes true or never true, giving a reason in each case.

Statement	Always True	Sometimes True	Never True	Reason
The quadratic equation $ax^2 + bx + c = 0$, ($a \neq 0$) has 2 real roots.		✓		It only has 2 real roots when $b^2 - 4ac > 0$. When $b^2 - 4ac = 0$ it has 1 real root and when $b^2 - 4ac < 0$ it has 0 real roots.
(i) When a real value of x is substituted into $x^2 - 6x + 10$ the result is positive. (2)				
(ii) If $ax > b$ then $x > \frac{b}{a}$ (2)				
(iii) The difference between consecutive square numbers is odd. (2)				

(Total for Question 6 is 6 marks)

7. (a) Use the binomial expansion, in ascending powers of x , to show that

$$\sqrt{4-x} = 2 - \frac{1}{4}x + kx^2 + \dots$$

where k is a rational constant to be found.

(4)

A student attempts to substitute $x = 1$ into both sides of this equation to find an approximate value for $\sqrt{3}$.

- (b) State, giving a reason, if the expansion is valid for this value of x .

(1)

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Question 7 continued

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(Total for Question 7 is 5 marks)

9. Given that A is constant and

$$\int_1^4 (3\sqrt{x} + A) dx = 2A^2$$

show that there are exactly two possible values for A .

(5)

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(Total for Question 9 is 5 marks)

10. In a geometric series the common ratio is r and sum to n terms is S_n

Given

$$S_{\infty} = \frac{8}{7} \times S_6$$

show that $r = \pm \frac{1}{\sqrt{k}}$, where k is an integer to be found.

(4)

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(Total for Question 10 is 4 marks)

11.

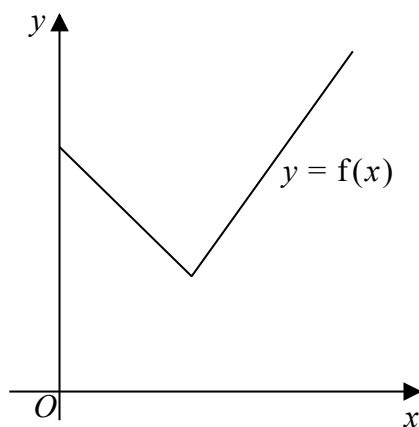


Figure 2

Figure 2 shows a sketch of part of the graph $y = f(x)$, where

$$f(x) = 2|3 - x| + 5, \quad x \geq 0$$

(a) State the range of f

(1)

(b) Solve the equation

$$f(x) = \frac{1}{2}x + 30$$

(3)

Given that the equation $f(x) = k$, where k is a constant, has two distinct roots,

(c) state the set of possible values for k .

(2)

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Question 11 continued

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(Total for Question 11 is 6 marks)

12. (a) Solve, for $-180^\circ \leq x < 180^\circ$, the equation

$$3 \sin^2 x + \sin x + 8 = 9 \cos^2 x$$

giving your answers to 2 decimal places.

(6)

(b) Hence find the smallest positive solution of the equation

$$3 \sin^2(2\theta - 30^\circ) + \sin(2\theta - 30^\circ) + 8 = 9 \cos^2(2\theta - 30^\circ)$$

giving your answer to 2 decimal places.

(2)

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Question 13 continued

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(Total for Question 13 is 9 marks)

Question 14 continued

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(Total for Question 14 is 9 marks)

16. (a) Express $\frac{1}{P(11 - 2P)}$ in partial fractions.

(3)

A population of meerkats is being studied.

The population is modelled by the differential equation

$$\frac{dP}{dt} = \frac{1}{22}P(11 - 2P), \quad t \geq 0, \quad 0 < P < 5.5$$

where P , in thousands, is the population of meerkats and t is the time measured in years since the study began.

Given that there were 1000 meerkats in the population when the study began,

(b) determine the time taken, in years, for this population of meerkats to double,

(6)

(c) show that

$$P = \frac{A}{B + Ce^{-\frac{1}{2}t}}$$

where A , B and C are integers to be found.

(3)

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