

Mathematics: analysis and approaches
Higher level
Paper 2 Practice Set C

Candidate session number

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2 hours

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- A graphic display calculator is required for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions in an answer booklet.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A copy of the mathematics: analysis and approaches formula book is required for this paper.
- The maximum mark for this examination paper is **[110 marks]**.

Do **not** write solutions on this page

Section B

Answer **all** questions in an answer booklet. Please start each question on a new page.

10 [Maximum mark: 20]

- a** Stella is planning to start a small business selling cosmetics gift boxes. She plans to start by selling 30 boxes in the first month. In each subsequent month she plans to sell 10 more boxes than in the previous month.
- According to Stella's plan, how many boxes will she sell in the 12th month?
 - How many boxes will she sell in the first year?
 - In which month will she sell her 2000th box? [8]
- b** Giulio also sells cosmetics gift boxes. He also sells 30 boxes in the first month, but expects to increase his sales by 10% each month.
- How many boxes will Giulio sell in the first year?
 - In which month will Giulio first sell more than 100 boxes? [6]
- c** Stella makes a profit of £2.20 per box and Giulio makes a profit of £3.10 per box.
- Find the profit each person makes in the first year.
 - In which month will Giulio's **total** profit first overtake Stella's? [6]

11 [Maximum mark: 17]

The velocity (in m s^{-1}) of an object at t seconds is given by

$$v(t) = \frac{8 - 3t}{t^2 - 6t + 10}, 0 \leq t \leq 10.$$

Find

- the initial speed [1]
- the maximum speed [2]
- the length of time for which the speed is greater than 1 m s^{-1} [3]
- the time at which the object changes direction [2]
- the length of time for which the object is decelerating [2]
- the acceleration after 5 seconds [2]
- the distance travelled after 10 seconds [2]
- the time when the object returns to its starting position. [3]

12 [Maximum mark: 18]

- a** Show that

$$\frac{d}{dx} (\ln|\sec x + \tan x|) = \sec x. \quad [3]$$

- b** Find the general solution to the differential equation

$$\cos x \frac{dy}{dx} + y = 1, -\frac{\pi}{2} < x < \frac{\pi}{2}. \quad [7]$$

Consider now the differential equation

$$\frac{d^2y}{dx^2} + \cos x \frac{dy}{dx} + y = 1, -\frac{\pi}{2} < x < \frac{\pi}{2}.$$

- c i** Show that

$$\frac{d^3y}{dx^3} = (\sin x - 1) \frac{dy}{dx} - \cos x \frac{d^2y}{dx^2}.$$

- ii** Given that $y = 2$ and $\frac{dy}{dx} = 1$ when $x = 0$, find the Maclaurin series solution up to and including the term in x^3 . [8]