

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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7	
8	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2010

Mathematics

MPC4

Unit Pure Core 4

Tuesday 15 June 2010 9.00 am to 10.30 am

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.



J U N 1 0 M P C 4 0 1

- 8 (a) Solve the differential equation

$$\frac{dx}{dt} = -\frac{1}{5}(x+1)^{\frac{1}{2}}$$

given that $x = 80$ when $t = 0$. Give your answer in the form $x = f(t)$. (6 marks)

- (b) A fungus is spreading on the surface of a wall. The proportion of the wall that is unaffected after time t hours is $x\%$. The rate of change of x is modelled by the differential equation

$$\frac{dx}{dt} = -\frac{1}{5}(x+1)^{\frac{1}{2}}$$

At $t = 0$, the proportion of the wall that is unaffected is 80%. Find the proportion of the wall that will still be unaffected after 60 hours. (2 marks)

- (c) A biologist proposes an alternative model for the rate at which the fungus is spreading on the wall. The total surface area of the wall is 9 m^2 . The surface area that is **affected** at time t hours is $A \text{ m}^2$. The biologist proposes that the rate of change of A is proportional to the product of the surface area that is affected and the surface area that is unaffected.

- (i) Write down a differential equation for this model.

(You are not required to solve your differential equation.) (2 marks)

- (ii) A solution of the differential equation for this model is given by

$$A = \frac{9}{1 + 4e^{-0.09t}}$$

Find the time taken for 50% of the area of the wall to be affected. Give your answer in hours to three significant figures. (4 marks)

QUESTION
PART
REFERENCE



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

