AQA

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Use of Mathematics   UOM4/1

Applying Mathematics Paper 1

Thursday 27 May 2010   9.00 am to 10.00 am

For this paper you must have:
* a clean copy of the Data Sheet (enclosed)
* a graphics calculator
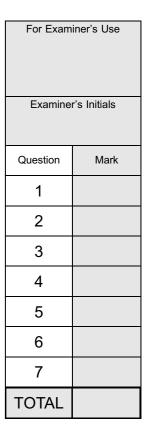* a ruler.

Time allowed
* 1 hour

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.
* The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.
* You may **not** refer to the copy of the Data Sheet that was available prior to this examination. A clean copy is enclosed for your use.

Information
* The marks for questions are shown in brackets.
* The maximum mark for this paper is 30.

Answer **all** questions in the spaces provided.

Use **It's a gas** *on the Data Sheet.*

1 (a) After how many days is a mass of radon-222 reduced to $\frac{1}{8}$ of its initial value?

(2 marks)

(b) What fraction of a mass of radon-222 is left after 19 days? *(2 marks)*

QUESTION
PART
REFERENCE

2   The article states that, for radon-222, λ can be found to be 0.182 from the equation
$\dfrac{m_0}{2} = m_0 \mathrm{e}^{-\lambda \times 3.8}$.

Show clearly the steps that lead to this result.   *(3 marks)*

QUESTION
PART
REFERENCE

Turn over ▶

3 (a) Thorium-234 has a half-life of 24 days.

Solve the equation $\frac{1}{2} = e^{-\lambda t}$ to find the value of the parameter λ. *(3 marks)*

(b) Find the value of p, the probability that an atom of thorium-234 will not decay in one day. *(4 marks)*

QUESTION
PART
REFERENCE

4 The decay of a radioactive substance can be modelled by the exponential function $m = m_0 e^{-0.5t}$ where t is the time in days.

Does this have a longer or shorter half-life than radon-222?

Explain your reasoning. *(2 marks)*

QUESTION PART REFERENCE

Turn over ▶

5 The probability, p, that an atom of radon-222 will not decay in one day is 0.833. The mass of radon-222 remaining after a day can therefore be found by using the recurrence relation $m_{n+1} = 0.833 m_n$, where m_n is the mass of radon-222 after n days.

For an initial mass of 1 kilogram, that is $m_0 = 1$, find the mass of radon-222 that will remain 5 days after it starts decaying. *(3 marks)*

QUESTION PART REFERENCE

6 The half-life of a substance, n days, can be found by solving $p^n = \frac{1}{2}$, where p is the probability that an atom of the substance will not decay in one day.

Find the half-life of a substance for which $p = 0.6$. Give your answer to the nearest hour. *(5 marks)*

QUESTION
PART
REFERENCE

Turn over ▶

7 The decay of a radioactive substance is simulated using randomly generated integers, 0, 1, 2, 3 being assigned to represent an atom decaying and 4, 5, 6, 7, 8, 9 being assigned to represent an atom **not** decaying in any given time period.

(a) Complete **the table opposite**, simulating the decay of 20 atoms of this radioactive substance until all have decayed.

Use the given random numbers in order as required. The first two time periods have been completed for you. *(4 marks)*

(b) Given that $p = 0.6$, comment on the total number of atoms, 7, that the simulation suggests will remain at the end of one day. *(2 marks)*

QUESTION
PART
REFERENCE

~~2~~	~~5~~	~~2~~	~~0~~	~~3~~	~~9~~	~~3~~	~~4~~	~~1~~	~~5~~
~~0~~	~~3~~	~~3~~	~~2~~	~~3~~	~~9~~	~~3~~	~~0~~	~~9~~	~~4~~
~~1~~	~~9~~	~~1~~	~~7~~	~~2~~	~~8~~	~~4~~	3	8	2
4	9	3	1	7	2	5	2	7	6
0	2	5	4	8	1	6	5	8	3

Atom	$t=0$	$t=1$		$t=2$		$t=3$		$t=4$		$t=5$		$t=6$	
	Status	Random number	Status	Random number	Status	Random number	Status	Random number	Status	Random number	Status	Random number	Status
A	1	2	0										
B	1	5	1	1	0								
C	1	2	0										
D	1	0	0										
E	1	3	0										
F	1	9	1	9	1								
G	1	3	0										
H	1	4	1	1	0								
I	1	1	0										
J	1	5	1	7	1								
K	1	0	0										
L	1	3	0										
M	1	3	0										
N	1	2	0										
O	1	3	0										
P	1	9	1	2	0								
Q	1	3	0										
R	1	0	0										
S	1	9	1	8	1								
T	1	4	1	4	1								
Total	**20**		**7**		**4**								

END OF QUESTIONS

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

There are no questions printed on this page

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

There are no questions printed on this page

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