General Certificate of Education
June 2006
Advanced Subsidiary Examination

APPLYING MATHEMATICS **UOM4/2**
Paper 2

Monday 22 May 2006 9.00 am to 10.30 am

For this paper you must have:
- an 8-page answer book
- an answer sheet for Questions 2, 3 and 4 (enclosed)
- a ruler
- a graphics calculator

Time allowed: 1 hour 30 minutes

Instructions
- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book **and** on the top of the answer sheet for Questions 2, 3 and 4. The *Examining Body* for this paper is AQA. The *Paper Reference* is UOM4/2.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of a calculator should normally be given to three significant figures.
- At the end of the examination, remember to hand in both your answer book **and** the answer sheet for Questions 2, 3 and 4.

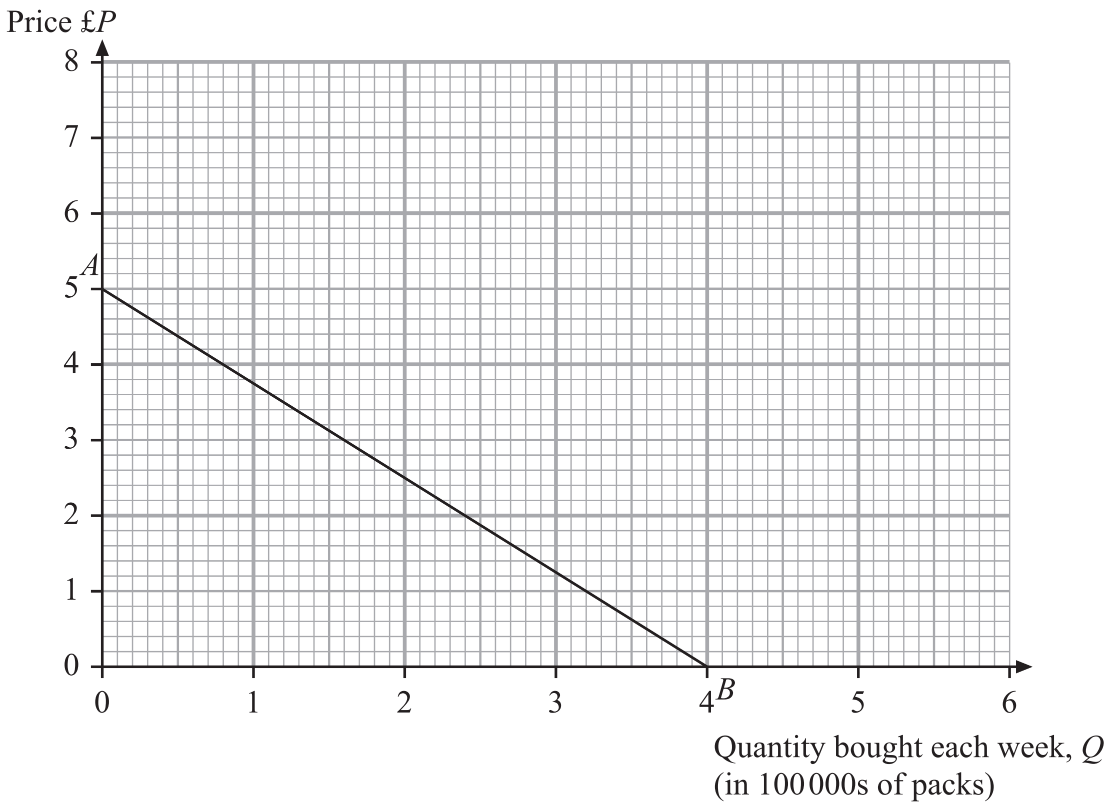
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.

SECTION A

Answer **all** questions.

1 A buyer for a chain of supermarkets uses linear functions to model how the price of packs of strawberries affects sales to customers and affects the numbers of packs that fruit farmers will supply.

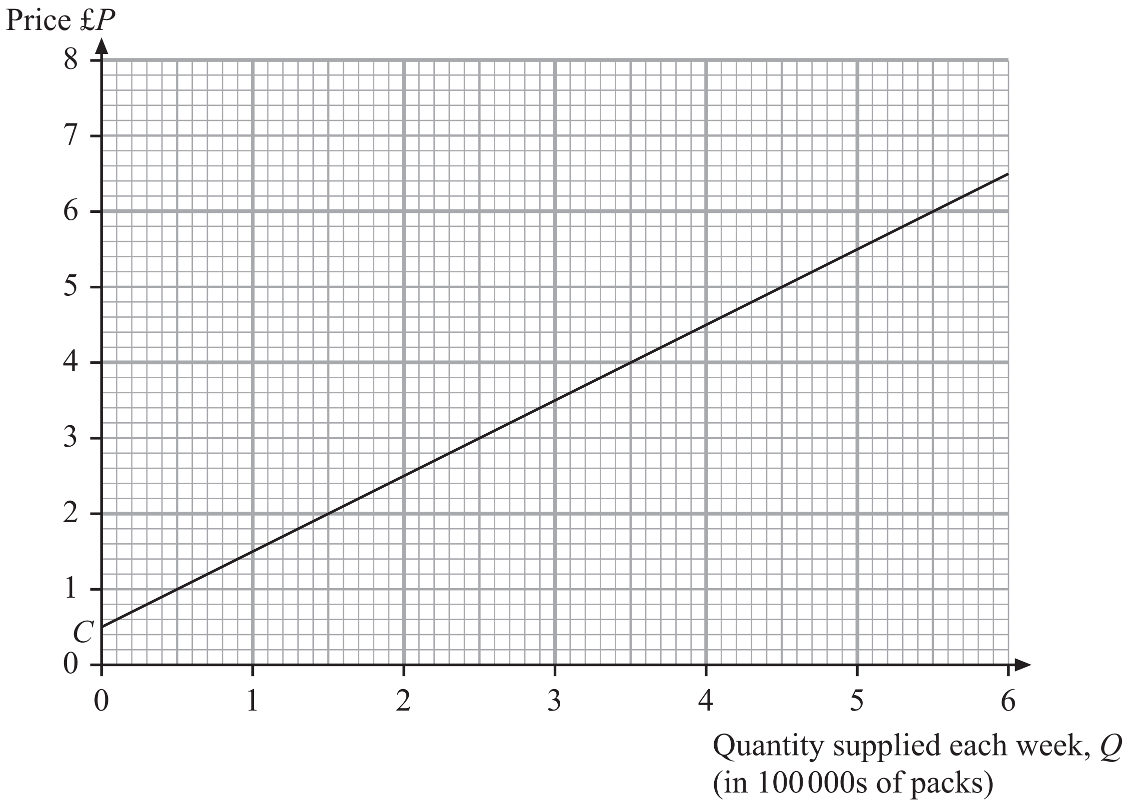
For the month of June, the supermarket buyer uses the straight line graph below to model how the price, £P, of a pack of strawberries affects the total quantity (in 100 000s of packs), Q, that customers buy each week.



(a) Interpret points A and B, where the line cuts the axes, in terms of the price of a pack of strawberries and the quantity bought. *(4 marks)*

(b) Write an equation connecting P and Q for this straight line model. *(2 marks)*

For the same month, the buyer uses the straight line graph below to model how the price, £P, of a pack of strawberries affects the total quantity (in 100 000s of packs), Q, that fruit farmers will supply each week.



(c) Interpret point C, where the line cuts the vertical axis, in terms of the price of a pack of strawberries and the quantity supplied. *(2 marks)*

(d) Write an equation connecting P and Q for this straight line model. *(2 marks)*

(e) (i) Solve simultaneously the equations you found in parts (b) and (d). *(4 marks)*

(ii) Interpret what your solution tells you. *(3 marks)*

Turn over for the next question

Turn over ▶

SECTION B

Answer **all** questions.

2 Amir buys a digital camera costing £200 using a credit card which charges 1.25% interest each month.

Assume that Amir:

- pays back £25 each month until the remaining balance is less than £25 and that he then makes one final payment to settle his account;
- buys nothing more with this credit card.

The recurrence relation $B_{n+1} = 1.0125B_n - 25$ gives Amir's remaining balance each month.

(a) Use the recurrence relation $B_{n+1} = 1.0125B_n - 25$ to show clearly that after one month Amir's remaining balance is £177.50. *(2 marks)*

(b) Explain the significance of the multiplying factor 1.0125 in the recurrence relation $B_{n+1} = 1.0125B_n - 25$. *(2 marks)*

(c) Use the recurrence relation $B_{n+1} = 1.0125B_n - 25$ to complete the column of the table on the answer sheet that gives Amir's remaining balance at the end of each month. You should give values to the nearest penny. *(4 marks)*

(d) Calculate how much Amir pays in total for the camera. *(2 marks)*

(e) Express the interest that Amir has paid as a percentage of the original price of the camera. *(2 marks)*

(f) Amir's friend suggests that doubling his repayments to £50 will halve the amount of interest he pays.

Show calculations that investigate whether this is true. *(5 marks)*

Turn over for the next question

Turn over ▶

SECTION C

Answer **all** questions.

3 A bank clerk telephones selected customers at their homes to carry out a survey. The clerk finds that he can categorise each response into one of the categories in the table below. The table also gives:

- the average length of call for each type of response;
- the probability of each type of response for both day-time and evening telephone calls.

			Probability	
Type of response	**Code**	**Average length of call**	**Day-time call**	**Evening call**
No reply	A	$\frac{1}{2}$ minute	$\frac{2}{5}$	$\frac{1}{5}$
Reply but customer unavailable	B	1 minute	$\frac{1}{10}$	$\frac{3}{10}$
Customer replies but unwilling to complete survey	C	2 minutes	$\frac{1}{5}$	$\frac{1}{10}$
Customer replies and completes survey	D	5 minutes	$\frac{3}{10}$	$\frac{2}{5}$

The bank clerk simulates his day-time and evening telephone calls. The table below shows how he assigns integers generated randomly between 0 and 9 inclusive to simulate the type of response his telephone calls receive during the **day-time**.

Type of response	**Code**	**Random integer**
No reply	A	0, 1, 2, 3
Reply but customer unavailable	B	4
Customer replies but unwilling to complete survey	C	5, 6
Customer replies and completes survey	D	7, 8, 9

(a) Explain why four randomly generated integers from the set 0 to 9 (inclusive) are assigned to simulate a call receiving no reply during the **day-time**. *(2 marks)*

(b) Use the sequence of randomly generated integers in the second column of Table 1 on the answer sheet to complete the table by giving the code of the type of response to each **day-time** telephone call, its length and the cumulative time. *(4 marks)*

(c) Complete Table 2 on the answer sheet by assigning randomly generated integers between 0 and 9 inclusive to simulate the different responses to telephone calls made in the **evening**.

You should use the integers 0 to 9 in order, starting with Code A, as in the table for day-time calls. *(2 marks)*

(d) Use the sequence of randomly generated integers in the second column of Table 3 on the answer sheet to complete the table by giving the code of the type of response to each **evening** telephone call, its length and the cumulative time. *(4 marks)*

(e) The bank clerk's supervisor looks at Tables 1 and 3 and suggests that the clerk may not be working as well in the evening as in the day-time as it takes him longer to make 15 telephone calls in the evening compared with the day-time.

Explain how the bank clerk could argue that this is not true. *(2 marks)*

(f) State one way in which the bank clerk could improve his simulation. *(2 marks)*

Turn over for the next question

SECTION D

Answer **all** questions.

4 A police squad carried out a raid on an apartment. Unfortunately, the apartment was deserted when the police arrived, but tea in a teapot was still hot at a temperature of exactly 80 ºC.

A detective used $\theta = 20 + 60e^{-kt}$ to model the temperature, θºC, of the tea, t hours after it was found.

(a) Show calculations to confirm that according to the model $\theta = 20 + 60e^{-kt}$ the temperature of the tea when it was first found was 80 ºC. *(2 marks)*

(b) Show that $\theta = 20 + 60e^{-kt}$ can be rearranged to give $kt = \ln\left(\dfrac{60}{\theta - 20}\right)$. *(4 marks)*

(c) Half an hour after being found, the tea had a temperature of 50 ºC.

Show that $k = 1.39$. *(3 marks)*

(d) The detective assumed that the tea had a temperature of 96 ºC when first made.

Using parts (b) and (c), predict the number of minutes that elapsed between the tea being made and the police arriving. *(4 marks)*

(e) Sketch the graph of $\theta = 20 + 60e^{-1.39t}$ on the set of axes on the answer sheet. Show clearly all significant features. *(3 marks)*

(f) (i) If, half an hour after being found, the temperature of the tea had fallen to a temperature TºC where $20 < T < 50$, instead of 50, state whether k would be smaller or larger than the value you found in part (c). *(1 mark)*

(ii) For this case, add a curve to your graph on the answer sheet to show how the tea would now cool. Indicate clearly which curve is which. *(3 marks)*

END OF QUESTIONS

Surname		Other Names	
Centre Number		Candidate Number	
Candidate Signature			

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APPLYING MATHEMATICS **UOM4/2AS**
Paper 2

This answer sheet is to be used when answering Questions 2, 3 and 4, as indicated.

Fasten this sheet securely to your answer book.

Question 2

	Remaining balance
n	B_n
0	£200.00
1	£177.50
2	
3	
4	
5	
6	
7	
8	
9	
10	

Question 3

Table 1: Day-time calls

Call number	**Randomly generated integer**	**Code of response type**	**Length of call (minutes)**	**Cumulative time (minutes)**
1	2	A	$\frac{1}{2}$	$\frac{1}{2}$
2	5	C	2	$2\frac{1}{2}$
3	9	D	5	$7\frac{1}{2}$
4	7	D	5	$12\frac{1}{2}$
5	0	A	$\frac{1}{2}$	13
6	5	C	2	15
7	7	D	5	20
8	1			
9	6			
10	1			
11	9			
12	8			
13	3			
14	7			
15	0			

Table 2: Evening calls

Type of response	Code	Random integer
No reply	A	
Reply but customer unavailable	B	
Customer replies but unwilling to complete survey	C	
Customer replies and completes survey	D	

Table 3: Evening calls

Call number	Randomly generated integer	Code of response type	Length of call (minutes)	Cumulative time (minutes)
1	7	D	5	5
2	8	D	5	10
3	8	D	5	15
4	2	B	1	16
5	3	B	1	17
6	9	D	5	22
7	6	D	5	27
8	5			
9	6			
10	9			
11	4			
12	4			
13	1			
14	7			
15	0			

Question 4