Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
June 2010

Mathematics MS/SS1A/W

Unit Statistics 1A

Statistics

Unit Statistics 1A

Thursday 27 May 2010 9.00 am to 10.15 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 15 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.
- The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- Unit Statistics 1A has a **written paper and coursework**.

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

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

1 The proportion of members of a health club who play tennis is 0.35 .

A sample of 40 members of the health club is selected at random.

Determine the probability that the number of these members who play tennis is:

(a) at most 12 ; *(2 marks)*

(b) at least 10 but at most 15 ; *(3 marks)*

(c) exactly 15 . *(2 marks)*

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

Turn over ▶

2 Before leaving for a tour of the UK during the summer of 2008, Eduardo was told that the UK price of a 1.5-litre bottle of spring water was about 50p.

Whilst on his tour, Eduardo noted the prices, x pence, which he paid for 1.5-litre bottles of spring water from 12 retail outlets.

He then subtracted 50p from each price and his resulting differences, in pence, were

$$-18 \quad -11 \quad 1 \quad 15 \quad 7 \quad -1 \quad 17 \quad -16 \quad 18 \quad -3 \quad 0 \quad 9$$

(a) (i) Calculate the mean and the standard deviation of these differences. *(2 marks)*

(ii) Hence calculate the mean and the standard deviation of the prices, x pence, paid by Eduardo. *(2 marks)*

(b) Based on an exchange rate of €1.22 to £1, calculate, in euros, the mean and the standard deviation of the prices paid by Eduardo. *(3 marks)*

QUESTION PART REFERENCE

QUESTION PART REFERENCE

3 A machine fills small cans with soda water. The volume of soda water delivered by the machine may be modelled by a normal random variable with a mean of 153 ml and a standard deviation of 1.6 ml.

Each can is able to hold a maximum of 155 ml of soda water.

Printed on each can is 'Contents 150 ml'.

(a) Determine the probability that the volume of soda water delivered by the machine:

(i) does not cause a can to overflow;

(ii) is less than that printed on a can. *(6 marks)*

(b) Following adjustments to the machine, the volume of soda water in a can may be modelled by a normal random variable with a mean of 152 ml and a standard deviation of 0.8 ml.

Given that packs of 12 cans may be assumed to be random samples of cans filled by the machine, determine the probability that, in a pack, the mean volume of soda water per can is more than 152.5 ml. *(4 marks)*

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

4 Hugh owns a small farm.

(a) He has two sows, Josie and Rosie, which he feeds at a trough in their field at 8.00 am each day.

The probability that Josie is waiting at the trough at 8.00 am on any given day is 0.90. The probability that Rosie is waiting at the trough at 8.00 am on any given day is 0.70 when Josie is waiting at the trough, but is only 0.20 when Josie is not waiting at the trough.

Calculate the probability that, at 8.00 am on a given day:

(i) both sows are waiting at the trough; *(2 marks)*

(ii) neither sow is waiting at the trough; *(2 marks)*

(iii) at least one sow is waiting at the trough. *(1 mark)*

(b) Hugh also has two cows, Daisy and Maisy. Each day at 4.00 pm, he collects them from the gate to their field and takes them to be milked.

The probability, $\mathrm{P}(D)$, that Daisy is waiting at the gate at 4.00 pm on any given day is 0.75.
The probability, $\mathrm{P}(M)$, that Maisy is waiting at the gate at 4.00 pm on any given day is 0.60.
The probability that both Daisy and Maisy are waiting at the gate at 4.00 pm on any given day is 0.40.

(i) In the table of probabilities, D' and M' denote the events 'not D' and 'not M' respectively.

	$\boldsymbol{M}$	$\boldsymbol{M'}$	**Total**
$\boldsymbol{D}$	0.40		0.75
$\boldsymbol{D'}$			
Total	0.60		1.00

Complete the copy of this table which is printed on page 11. *(2 marks)*

(ii) Hence, or otherwise, find the probability that, at 4.00 pm on a given day:

(A) neither cow is waiting at the gate; *(1 mark)*

(B) only Daisy is waiting at the gate; *(1 mark)*

(C) exactly one cow is waiting at the gate. *(2 marks)*

QUESTION PART REFERENCE

Turn over ▶

QUESTION PART REFERENCE

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QUESTION PART REFERENCE

(b)(i)

	M	M'	Total
D	0.40		0.75
D'			
Total	0.60		1.00

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5 During a study of reaction times, each of a random sample of 12 people, aged between 40 and 80 years, was asked to react as quickly as possible to a stimulus displayed on a computer screen.

Their ages, x years, and reaction times, y milliseconds, are shown in the table.

Person	**Age** (x **years**)	**Reaction time** (y **ms**)
A	41	520
B	54	750
C	66	650
D	72	920
E	71	280
F	57	620
G	60	740
H	47	950
I	77	970
J	65	780
K	51	550
L	59	730

(a) Calculate the equation of the least squares regression line of y on x. *(4 marks)*

(b) (i) Draw your regression line on the scatter diagram on page 14. *(2 marks)*

(ii) Comment on what this reveals. *(2 marks)*

(c) It was later discovered that the reaction times for persons E and H had been recorded incorrectly. The values should have been 820 and 590 respectively.

After making these corrections, computations gave

$$S_{xx} = 1272 \qquad S_{xy} = 14\,760 \qquad \bar{x} = 60 \qquad \bar{y} = 720$$

(i) Using the symbol $\odot$, plot the correct values for persons E and H on the scatter diagram on page 14. *(1 mark)*

(ii) Recalculate the equation of the least squares regression line of y on x, and draw this regression line on the scatter diagram on page 14. *(3 marks)*

(iii) Hence revise as necessary your comments in part **(b)(ii)**. *(2 marks)*

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QUESTION PART REFERENCE

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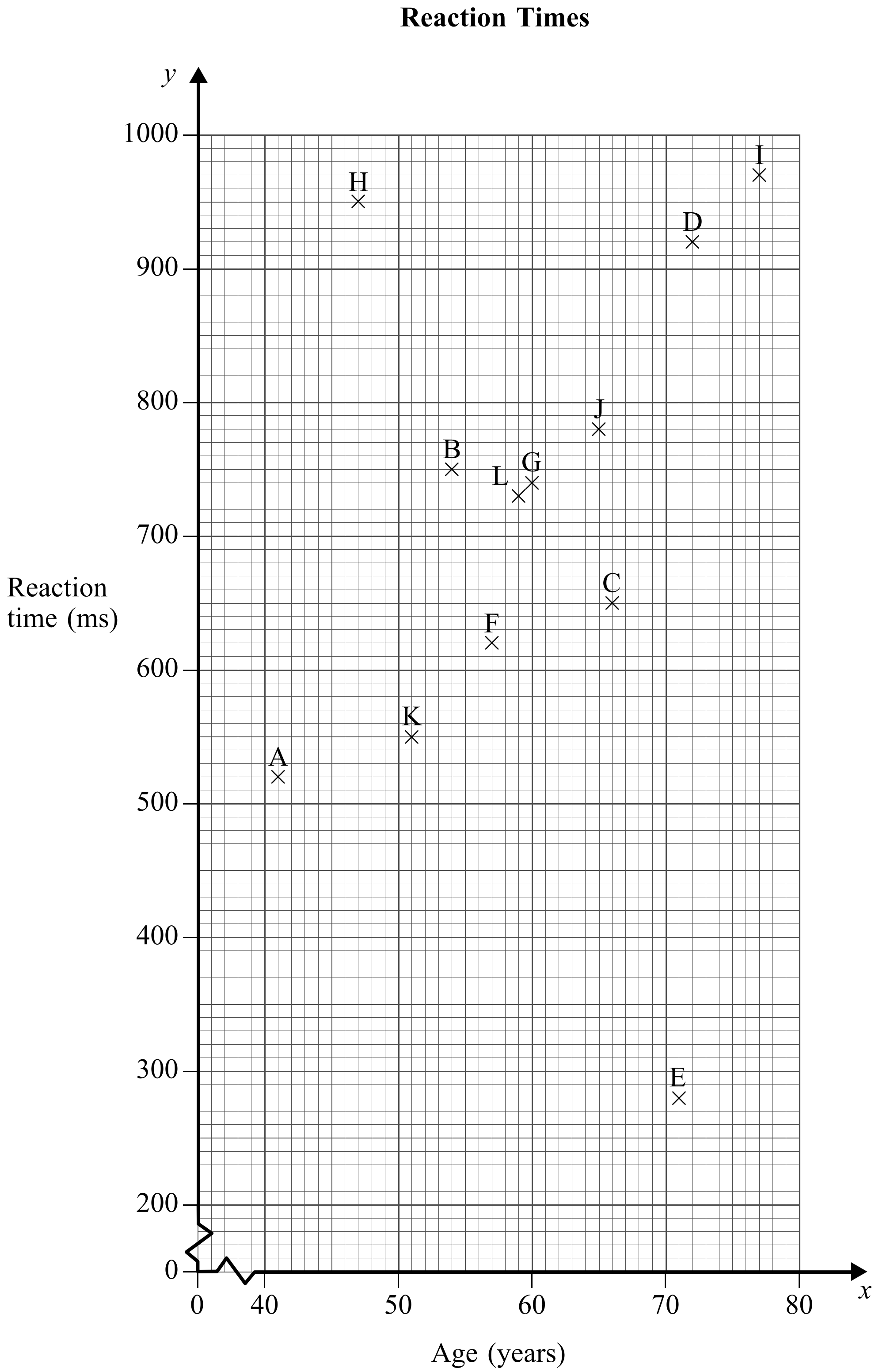
Reaction Times
y
1000
900
800
700
600
500
400
300
200
0
Reaction time (ms)
H
I
D
J
B
L
G
C
F
K
A
E
0
40
50
60
70
80
x
Age (years)

QUESTION PART REFERENCE

6 An ambulance control centre responds to emergency calls in a rural area. The response time, T minutes, is defined as the time between the answering of an emergency call at the centre and the arrival of an ambulance at the given location of the emergency.

Response times have an unknown mean μ_T and an unknown variance.

Anita, the centre's manager, asked Peng, a student on supervised work experience, to record and summarise the values of T obtained from a random sample of 80 emergency calls.

Peng's summarised results were

Mean, $\bar{t} = 6.31$ Variance (unbiased estimate), $s^2 = 19.3$

Only 1 of the 80 values of T exceeded 20

(a) Anita then asked Peng to determine a confidence interval for μ_T. Peng replied that, from his summarised results, T was **not** normally distributed and so a valid confidence interval for μ_T could **not** be constructed.

(i) Explain, using the value of $\bar{t} - 2s$, why Peng's conclusion that T was not normally distributed was likely to be **correct**. *(2 marks)*

(ii) Explain why Peng's conclusion that a valid confidence interval for μ_T could not be constructed was **incorrect**. *(2 marks)*

(b) Construct a 98% confidence interval for μ_T. *(4 marks)*

(c) Anita had two targets for T. These were that $\mu_T < 8$ and that $\mathrm{P}(T \leqslant 20) > 95\%$.

Indicate, with justification, whether **each** of these two targets was likely to have been met. *(3 marks)*

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END OF QUESTIONS

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