OCR
RECOGNISING ACHIEVEMENT

Friday 25 January 2013 – Afternoon

A2 GCE MATHEMATICS (MEI)

4767/01 Statistics 2

QUESTION PAPER

Candidates answer on the Printed Answer Book.

OCR supplied materials:
- Printed Answer Book 4767/01
- MEI Examination Formulae and Tables (MF2)

Other materials required:
- Scientific or graphical calculator

Duration: 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

These instructions are the same on the Printed Answer Book and the Question Paper.

- The Question Paper will be found in the centre of the Printed Answer Book.
- Write your name, centre number and candidate number in the spaces provided on the Printed Answer Book. Please write clearly and in capital letters.
- **Write your answer to each question in the space provided in the Printed Answer Book**. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- You are permitted to use a scientific or graphical calculator in this paper.
- Final answers should be given to a degree of accuracy appropriate to the context.

INFORMATION FOR CANDIDATES

This information is the same on the Printed Answer Book and the Question Paper.

- The number of marks is given in brackets **[ ]** at the end of each question or part question on the Question Paper.
- You are advised that an answer may receive **no marks** unless you show sufficient detail of the working to indicate that a correct method is being used.
- The total number of marks for this paper is **72**.
- The Printed Answer Book consists of **12** pages. The Question Paper consists of **4** pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Question Paper for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

1 A manufacturer of playground safety tiles is testing a new type of tile. Tiles of various thicknesses are tested to estimate the maximum height at which people would be unlikely to sustain injury if they fell onto a tile. The results of the test are as follows.

Thickness (t mm)	20	40	60	80	100
Maximum height (h m)	0.72	1.09	1.62	1.97	2.34

(i) Draw a scatter diagram to illustrate these data. **[3]**

(ii) State which of the two variables is the independent variable, giving a reason for your answer. **[1]**

(iii) Calculate the equation of the regression line of maximum height on thickness. **[5]**

(iv) Use the equation of the regression line to calculate estimates of the maximum height for thicknesses of

(A) 70 mm,

(B) 120 mm.

Comment on the reliability of each of these estimates. **[4]**

(v) Calculate the value of the residual for the data point at which $t = 40$. **[3]**

(vi) In a further experiment, the manufacturer tests a tile with a thickness of 200 mm and finds that the corresponding maximum height is 2.96 m. What can be said about the relationship between tile thickness and maximum height? **[3]**

2 John is observing butterflies being blown across a fence in a strong wind. He uses the Poisson distribution with mean 2.1 to model the number of butterflies he observes in one minute.

(i) Find the probability that John observes

(A) no butterflies in a minute, **[2]**

(B) at least 2 butterflies in a minute, **[2]**

(C) between 5 and 10 butterflies inclusive in a period of 5 minutes. **[3]**

(ii) Use a suitable approximating distribution to find the probability that John observes at least 130 butterflies in a period of 1 hour. **[5]**

In fact some of the butterflies John observes being blown across the fence are being blown in pairs.

(iii) Explain why this invalidates one of the assumptions required for a Poisson distribution to be a suitable model. **[1]**

John decides to revise his model for the number of butterflies he observes in one minute. In this new model, the number of pairs of butterflies is modelled by the Poisson distribution with mean 0.2, and the number of single butterflies is modelled by an independent Poisson distribution with mean 1.7.

(iv) Find the probability that John observes no more than 3 butterflies altogether in a period of one minute. **[5]**

3 The amount of data, X megabytes, arriving at an internet server per second during the afternoon is modelled by the Normal distribution with mean 435 and standard deviation 30.

(i) Find

(A) $\mathrm{P}(X < 450)$, **[3]**

(B) $\mathrm{P}(400 < X < 450)$. **[3]**

(ii) Find the probability that, during 5 randomly selected seconds, the amounts of data arriving are all between 400 and 450 megabytes. **[2]**

The amount of data, Y megabytes, arriving at the server during the evening is modelled by the Normal distribution with mean μ and standard deviation σ.

(iii) Given that $\mathrm{P}(Y < 350) = 0.2$ and $\mathrm{P}(Y > 390) = 0.1$, find the values of μ and σ. **[5]**

(iv) Find values of a and b for which $\mathrm{P}(a < Y < b) = 0.95$. **[4]**

4 **(a)** A random sample of 60 students studying mathematics was selected. Their grades in the Core 1 module are summarised in the table below, classified according to whether they worked less than 5 hours per week or at least 5 hours per week. Test, at the 5% significance level, whether there is any association between grade and hours worked.

		Hours worked	
		Less than 5	At least 5
Grade	A or B	20	11
	C or lower	13	16

[9]

(b) At a canning factory, cans are filled with tomato purée. The machine which fills the cans is set so that the volume of tomato purée in a can, measured in millilitres, is Normally distributed with mean 420 and standard deviation 3.5. After the machine is recalibrated, a quality control officer wishes to check whether the mean is still 420 millilitres. A random sample of 10 cans of tomato purée is selected and the volumes, measured in millilitres, are as follows.

417.2 422.6 414.3 419.6 420.4 410.0 418.3 416.9 418.9 419.7

Carry out a test at the 1% significance level to investigate whether the mean is still 420 millilitres. You should assume that the volumes are Normally distributed with unchanged standard deviation. **[9]**

THERE ARE NO QUESTIONS PRINTED ON THIS PAGE.