UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
Cambridge International Level 3 Pre-U Certificate
Principal Subject

MATHEMATICS **9794/03**

Paper 3 Applications of Mathematics **October/November 2013**

2 hours

Additional Materials: Answer Booklet/Paper
Graph Paper
List of Formulae (MF20)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use $10\,\text{m}\,\text{s}^{-2}$.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.
You are advised to spend no more than 1 hour on Section A and 1 hour on Section B.

This document consists of **4** printed pages.

UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

Section A: Probability (40 marks)

You are advised to spend no more than 1 hour on this section.

1 **(i)** Given that $X \sim \text{Geo}\left(\frac{1}{6}\right)$, write down the values of $\text{E}(X)$ and $\text{Var}(X)$. [2]

(ii) $Y \sim \text{B}(n, p)$. Given that $\text{E}(Y) = 4$ and $\text{Var}(Y) = \frac{8}{3}$, find the values of n and p. [3]

2 The random variable X is defined as the difference (always positive or zero) between the scores when 2 ordinary dice are rolled.

(i) Copy and complete the probability distribution table for X. [2]

x	0	1	2	3	4	5
$\text{P}(X = x)$						

(ii) Find the expectation and variance of X. [5]

3 In a large examination room each candidate has just one electronic calculator.

- G is the event that a randomly chosen candidate has a graphical calculator.
- T is the event that a randomly chosen candidate has a 'Texio' brand calculator.

You are given the following probabilities.

$$\text{P}(G) = 0.65 \qquad \text{P}(T) = 0.4 \qquad \text{P}(G \cap T) = 0.25$$

(i) Are the events G and T independent? Justify your answer with an appropriate calculation. [2]

(ii) Find $\text{P}(T \mid G)$ and explain, in the context of this question, what this probability represents. [3]

4 As part of a study into the effects of alcohol, volunteers have their reaction times measured after they have consumed various fixed amounts of alcohol. For a random sample of 12 volunteers the following information was collected.

Units of alcohol consumed	2	3	3	4	4.5	5.5	6	6	7	8	8	9
Reaction time (seconds)	1	2	5	5	3.8	5.5	4.8	8.5	7.2	6.8	9	8

(i) Which is the independent variable in this experiment? [1]

(ii) Find the least squares regression line of y (Reaction time) on x (Units of alcohol), and use it to estimate the reaction time of someone who has consumed 5 units of alcohol. [5]

5 The table summarises 43 birth weights as recorded for babies born in a particular hospital during one week.

Birth weight (w kg)	$2.0 \leqslant w < 2.5$	$2.5 \leqslant w < 3.0$	$3.0 \leqslant w < 3.5$	$3.5 \leqslant w < 4.0$	$4.0 \leqslant w < 4.5$
Frequency	1	6	9	17	10

(i) State the type of skewness of the data. [1]

(ii) Given that the lower quartile is 3.21 kg and the upper quartile is 3.96 kg, determine whether there are any babies whose birth weights might be regarded as outliers. [4]

(iii) The mean birth weight was found to be 3.58 kg. However, it was discovered subsequently that the table includes the birth weight, 2.52 kg, of one baby that has been recorded twice. Find the mean birth weight after this error has been removed. [3]

6 A company supplies tubs of coleslaw to a large supermarket chain. According to the labels on the tubs, each tub contains 300 grams of coleslaw. In practice the weights of coleslaw in the tubs are normally distributed with mean 305 grams and standard deviation 6 grams.

(i) Find the proportion of tubs that are underweight, according to the label. [3]

The supermarket chain requires that the proportion of underweight tubs should be reduced to 5%.

(ii) If the standard deviation is kept at 6 grams, find the new mean weight needed to achieve the required reduction. [3]

(iii) If the mean weight is kept at 305 grams, find the new standard deviation needed to achieve the required reduction. Explain why the company might prefer to adjust the standard deviation rather than the mean. [3]

Section B: Mechanics (40 marks)

You are advised to spend no more than 1 hour on this section.

7 10 seconds after passing a warning signal, a train is travelling at $18\,\text{m}\,\text{s}^{-1}$ and has gone 215 m beyond the signal. Find the acceleration (assumed to be constant) of the train during the 10 seconds and its velocity as it passed the signal. [6]

8 A ball of mass 0.04 kg is released from rest at a height of 1 metre above a table. It rebounds to a height of 0.81 metre.

(i) Find the value of e, the coefficient of restitution. [4]

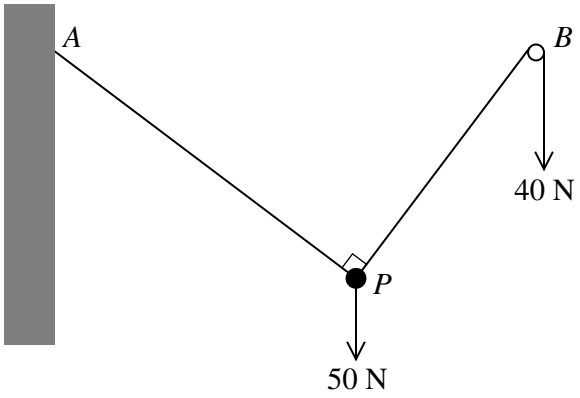
(ii) Find the impulse on the ball when it hits the table. [3]

9 A tennis ball is served horizontally at a speed of $24\,\text{m}\,\text{s}^{-1}$ from a height of 2.45 m above the ground.

(i) Show that it will clear the net at a point where the net is 1 m high and 12 m from the server. [5]

(ii) How far beyond the net will it land? [4]

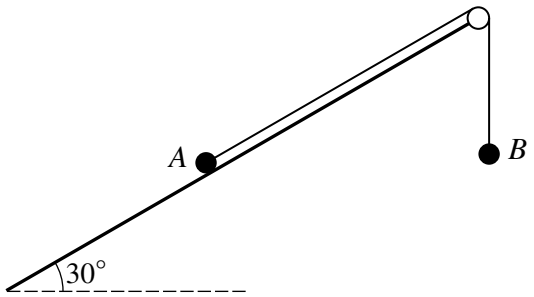
10 A parcel P of weight 50 N is being held in equilibrium by two light, inextensible strings AP and BP. The string AP is attached to a wall at A, and string BP passes over a smooth pulley which is at the same height as A, as shown in the diagram. When the tension in BP is 40 N, the strings are at right angles to each other.



(i) Find the tension in string AP. [4]

(ii) Explain why the parcel can never be in equilibrium with both strings horizontal. [1]

11 Two particles, A and B, each of mass 1 kg are connected by a light inextensible string. Particle A is at rest on a slope inclined at 30° to the horizontal. The string passes over a small smooth pulley at the top of the slope and particle B hangs freely, as shown in the diagram.



(i) (a) In the case when the slope is smooth, draw a fully labelled diagram to show the forces acting on the particles. Hence find the acceleration of the particles and the tension in the string. [7]

(b) Write down the direction of the resultant force exerted by the string on the pulley. [1]

(ii) In fact the contact between particle A and the slope is rough. The coefficient of friction between A and the slope is μ. The system is in equilibrium. Find the set of possible values of μ. [5]