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Surname

Other names

Pearson Edexcel
Level 3 GCE

Centre Number

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Candidate Number

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Further Mathematics

Advanced Subsidiary

Further Mathematics options

Paper 2E: Further Statistics 1 and Further Mechanics 1

Sample Assessment Material for first teaching September 2017

Time: 1 hour 40 minutes

Paper Reference

8FM0/2E

You must have:

Mathematical Formulae and Statistical Tables, calculator

Total Marks

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Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for algebraic manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- There are **two** sections in this question paper. Answer **all** the questions in Section A and **all** the questions in Section B.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 questions in this question paper. The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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SECTION A

Answer ALL questions. Write your answers in the spaces provided.

1. A university foreign language department carried out a survey of prospective students to find out which of three languages they were most interested in studying.

A random sample of 150 prospective students gave the following results.

		Language		
		French	Spanish	Mandarin
Gender	Male	23	22	20
	Female	38	32	15

A test is carried out at the 1% level of significance to determine whether or not there is an association between gender and choice of language.

- (a) State the null hypothesis for this test. (1)
- (b) Show that the expected frequency for females choosing Spanish is 30.6 (1)
- (c) Calculate the test statistic for this test, stating the expected frequencies you have used. (3)
- (d) State whether or not the null hypothesis is rejected. Justify your answer. (2)
- (e) Explain whether or not the null hypothesis would be rejected if the test was carried out at the 10% level of significance. (1)

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Question 1 continued

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2. The discrete random variable X has probability distribution given by

x	-1	0	1	2	3
$P(X = x)$	c	a	a	b	c

The random variable $Y = 2 - 5X$

Given that $E(Y) = -4$ and $P(Y \geq -3) = 0.45$

(a) find the probability distribution of X .

(7)

Given also that $E(Y^2) = 75$

(b) find the exact value of $\text{Var}(X)$

(2)

(c) Find $P(Y > X)$

(2)

Question 2 continued

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(Total for Question 2 is 11 marks)

3. Two car hire companies hire cars independently of each other.

Car Hire A hires cars at a rate of 2.6 cars per hour.

Car Hire B hires cars at a rate of 1.2 cars per hour.

(a) In a 1 hour period, find the probability that each company hires exactly 2 cars. (2)

(b) In a 1 hour period, find the probability that the total number of cars hired by the two companies is 3 (2)

(c) In a 2 hour period, find the probability that the total number of cars hired by the two companies is less than 9 (2)

On average, 1 in 250 new cars produced at a factory has a defect.

In a random sample of 600 new cars produced at the factory,

(d) (i) find the mean of the number of cars with a defect,
(ii) find the variance of the number of cars with a defect. (2)

(e) (i) Use a Poisson approximation to find the probability that no more than 4 of the cars in the sample have a defect.
(ii) Give a reason to support the use of a Poisson approximation. (2)

Question 3 continued

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4. The discrete random variable X follows a Poisson distribution with mean 1.4

(a) Write down the value of

(i) $P(X = 1)$

(ii) $P(X \leq 4)$

(2)

The manager of a bank recorded the number of mortgages approved each week over a 40 week period.

Number of mortgages approved	0	1	2	3	4	5	6
Frequency	10	16	7	4	2	0	1

(b) Show that the mean number of mortgages approved over the 40 week period is 1.4

(1)

The bank manager believes that the Poisson distribution may be a good model for the number of mortgages approved each week.

She uses a Poisson distribution with a mean of 1.4 to calculate expected frequencies as follows.

Number of mortgages approved	0	1	2	3	4	5 or more
Expected frequency	9.86	r	9.67	4.51	1.58	s

(c) Find the value of r and the value of s giving your answers to 2 decimal places.

(2)

The bank manager will test, at the 5% level of significance, whether or not the data can be modelled by a Poisson distribution.

(d) Calculate the test statistic and state the conclusion for this test. State clearly the degrees of freedom and the hypotheses used in the test.

(6)

SECTION B

Answer ALL questions. Write your answers in the spaces provided

Unless otherwise indicated, whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$ and give your answer to either 2 significant figures or 3 significant figures.

5. A small ball of mass 0.1 kg is dropped from a point which is 2.4 m above a horizontal floor. The ball falls freely under gravity, strikes the floor and bounces to a height of 0.6 m above the floor. The ball is modelled as a particle.

- (a) Show that the coefficient of restitution between the ball and the floor is 0.5 (6)

- (b) Find the height reached by the ball above the floor after it bounces on the floor for the second time. (3)

- (c) By considering your answer to (b), describe the subsequent motion of the ball. (1)

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6. A small stone of mass 0.5 kg is thrown vertically upwards from a point A with an initial speed of 25 m s^{-1} . The stone first comes to instantaneous rest at the point B which is 20 m vertically above the point A . As the stone moves it is subject to air resistance. The stone is modelled as a particle.

(a) Find the energy lost due to air resistance by the stone, as it moves from A to B (3)

The air resistance is modelled as a constant force of magnitude R newtons.

(b) Find the value of R . (2)

(c) State how the model for air resistance could be refined to make it more realistic. (1)

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Question 6 continued

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(Total for Question 6 is 6 marks)

7. [In this question use $g = 10 \text{ m s}^{-2}$]

A jogger of mass 60 kg runs along a straight horizontal road at a constant speed of 4 m s^{-1} . The total resistance to the motion of the jogger is modelled as a constant force of magnitude 30 N.

(a) Find the rate at which the jogger is working.

(3)

The jogger now comes to a hill which is inclined to the horizontal at an angle α , where

$\sin \alpha = \frac{1}{15}$. Because of the hill, the jogger reduces her speed to 3 m s^{-1} and maintains this

constant speed as she runs up the hill. The total resistance to the motion of the jogger from non-gravitational forces continues to be modelled as a constant force of magnitude 30 N.

(b) Find the rate at which she has to work in order to run up the hill at 3 m s^{-1} .

(5)

Question 7 continued

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(Total for Question 7 is 8 marks)

8. A particle P of mass $3m$ is moving in a straight line on a smooth horizontal table. A particle Q of mass m is moving in the opposite direction to P along the same straight line. The particles collide directly. Immediately before the collision the speed of P is u and the speed of Q is $2u$. The velocities of P and Q immediately after the collision, measured in the direction of motion of P before the collision, are v and w respectively. The coefficient of restitution between P and Q is e .

(a) Find an expression for v in terms of u and e . (6)

Given that the direction of motion of P is changed by the collision,

(b) find the range of possible values of e . (2)

(c) Show that $w = \frac{u}{4}(1 + 9e)$. (2)

Following the collision with P , the particle Q then collides with and rebounds from a fixed vertical wall which is perpendicular to the direction of motion of Q . The coefficient of restitution between Q and the wall is f .

Given that $e = \frac{5}{9}$, and that P and Q collide again in the subsequent motion,

(d) find the range of possible values of f . (6)
