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**MATHEMATICS (PRINCIPAL)**

**9794/03**

Paper 3 Applications of Mathematics

**May/June 2015**

**2 hours**

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

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**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 an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, 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  $10 \text{ m s}^{-2}$ .

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.

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The syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

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

**Section A: Probability (40 marks)**

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

- 1** The information below summarises the percentages of males unemployed ( $x$ ) and the percentages of females unemployed ( $y$ ) in 10 different locations in the UK.

$$n = 10 \quad \Sigma x = 87.6 \quad \Sigma x^2 = 804.34 \quad \Sigma y = 76.4 \quad \Sigma y^2 = 596 \quad \Sigma xy = 684.02$$

Find the product-moment correlation coefficient for these data. [5]

- 2** Jill is collecting picture cards given away in packets of a particular brand of breakfast cereal. There are five different cards in the complete set. Each packet contains one card which is equally likely to be any of the five cards in the set.

**(a)** Find the probability that Jill has a complete set of cards from the first five packets that she buys. [2]

**(b)** At some point Jill needs just one more card to complete the set. Let  $X$  be the random variable that represents the number of additional packets that Jill will need to buy in order to complete the set.

**(i)** Write down the distribution of  $X$ . [1]

**(ii)** State the expected number of additional packets that Jill will need to buy. [1]

**(iii)** Find the probability that Jill will need to buy at least 3 additional packets in order to complete the set. [2]

- 3** Jack's journey time, in minutes, to work each morning is modelled by the normal distribution  $N(43.2, 6.3^2)$ .

**(i)** If Jack leaves home at 08 10, find the probability that he arrives at work by 09 00. [4]

**(ii)** Find the time by which Jack should leave home in order to be at least 95% certain that he arrives at work by 09 00. [4]

- 4** At a sixth form college, the student council has 16 members made up as follows. There are 3 male and 3 female students from Year 12, and 6 male and 4 female students from Year 13. Two members of the council are chosen at random to represent the college at a conference.

Find the probability that the 2 members chosen are

**(i)** the same sex, [3]

**(ii)** the same sex and from the same year, [3]

**(iii)** from the same year given that they are the same sex. [3]

- 5 A garden centre grows a particular variety of plant for sale. They sow 3 seeds in each pot and there are 6 pots in a tray. The probability that a seed germinates is 0.7, independently of any other seeds.

- (i) State the probability distribution of the number of seeds in a pot that germinate. [2]
- (ii) Find the probability that, in a randomly chosen pot,
- (a) exactly 2 seeds germinate, [3]
- (b) at least 1 seed germinates. [2]

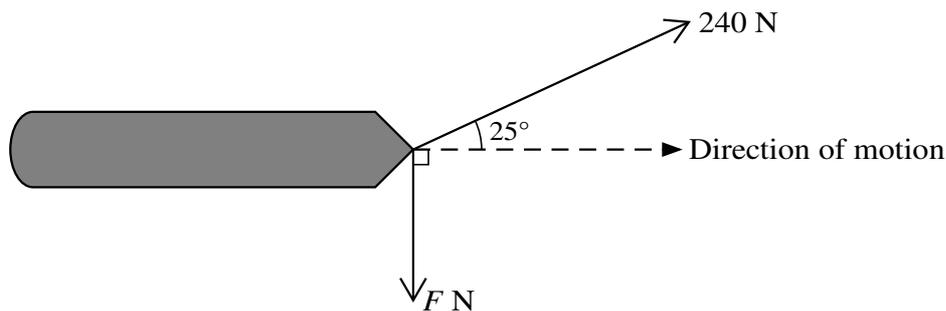
After the seeds have germinated and become seedlings, some are removed (and discarded) so that there remains at most 1 seedling per pot.

- (iii) Write out the probability distribution of the number of seedlings per pot that remain. [3]
- (iv) Find the probability that there is a seedling in every one of the 6 pots in a randomly chosen tray. [2]

### Section B: Mechanics (40 marks)

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

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The diagram shows a barge being towed along a canal by a force of 240 N at an angle of  $25^\circ$  to its direction of motion. A force,  $F$  N, perpendicular to the direction of motion, is applied to the barge to keep it moving in the direction shown.

- (i) Find the magnitude of  $F$ . [2]
- (ii) The mass of the barge is 1100 kg and there is a resistance force of 100 N parallel to the direction of motion. Find the acceleration of the barge. [4]
- 7 A particle is projected from the origin with initial speed  $u$  m s<sup>-1</sup> at an angle  $\theta$  above the horizontal. After 2 seconds the particle is at a point which is 18 m horizontally from the origin and 4 m above it.
- (i) Show that  $\tan \theta = \frac{4}{3}$  and find  $u$ . [6]
- (ii) Find the horizontal range of the particle. [2]

- 8 A tram travels from stop  $A$  to stop  $B$ , a distance of 300 m. First the tram starts from rest at  $A$  and accelerates uniformly at  $0.5 \text{ m s}^{-2}$  for 16 seconds. Then it travels at a constant speed and finally it slows down uniformly at  $1 \text{ m s}^{-2}$  coming to rest at  $B$ .
- (i) Sketch the velocity-time graph for the journey of the tram from  $A$  to  $B$ . [2]
- (ii) Find the speed of the tram and the distance travelled at the end of the first 16 seconds. [2]
- (iii) Show that the journey from  $A$  to  $B$  takes 49.5 seconds. [5]
- 9 A particle of mass  $0.5 \text{ kg}$  moving on a smooth horizontal plane with speed  $u \text{ m s}^{-1}$  collides directly with another particle of mass  $k \text{ kg}$  (where  $k$  is a constant) which is at rest. After the collision the first particle comes to rest but the second particle moves off with speed  $v \text{ m s}^{-1}$ .
- (i) Find  $v$  in terms of  $k$  and  $u$ . [2]
- (ii) The coefficient of restitution between the two particles is  $e$ . Find  $e$  in terms of  $k$  only. [3]
- (iii) Show that  $k \geq \frac{1}{2}$ . [2]
- 10 A particle is projected up a long smooth slope at a speed of  $2.5 \text{ m s}^{-1}$ . The slope is at an angle  $\theta$  to the horizontal where  $\sin \theta = \frac{1}{25}$ . After 2 seconds it passes a mark on the slope.
- Find the total time taken from the moment of projection until it passes the mark again and the total distance travelled in that time. [10]

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