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**MATHEMATICS (PRINCIPAL)**

**9794/03**

Paper 3 Applications of Mathematics

**May/June 2018**

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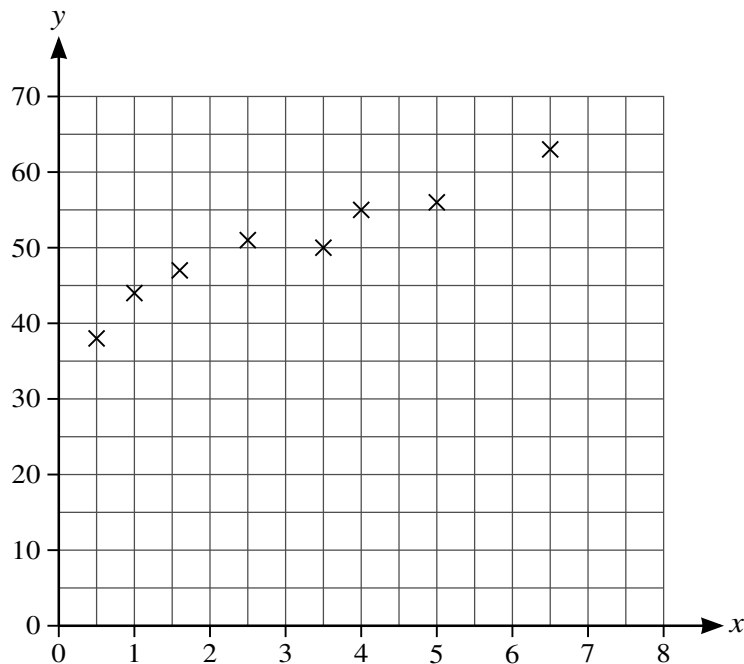
This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **5** printed pages and **3** blank pages.

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

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

- 1  $A$  and  $B$  are two events. Given that  $P(A) = 0.36$ ,  $P(B) = 0.24$  and  $P(A \cup B) = 0.4$ , find  $P(A | B)$ . [3]
- 2 A teacher is monitoring the progress of students. The length of time,  $x$  hours, spent revising in a given week is compared to the score,  $y$ , achieved in an assessment at the end of the week. The scatter diagram for a random sample of 8 students is shown below.



The data are summarised as  $\Sigma x = 24.6$ ,  $\Sigma y = 404$ ,  $\Sigma x^2 = 105.56$ ,  $\Sigma y^2 = 20\,820$  and  $\Sigma xy = 1350.2$ .

- (i) Find the equation of the least squares regression line of  $y$  on  $x$ . [4]
- (ii) Calculate the product moment correlation coefficient for the data. [2]
- (iii) A ninth student, Jane, revises for 1.5 hours.
- (a) Estimate her score in the assessment. [1]
- (b) Comment on the reliability of this estimate. [2]
- 3 John plays a game with two unbiased coins. John tosses the coins. If he gets two heads he wins £1. If he gets two tails he wins 20p. If he gets one head and one tail he wins nothing. Let  $X$  be the random variable for the amount of money, in pence, John wins per game.
- (i) Construct a probability distribution table for  $X$ . [2]
- (ii) Calculate  $E(X)$ . [2]
- (iii) John pays  $s$  pence to play the game. State the values of  $s$  for which John should expect to make a loss. [1]

- 4 On a particular day at a busy international airport, 75% of the scheduled flights depart on time. A random sample of 16 flights is chosen.
- (i) Find the expected number of flights that depart on time. [1]
- (ii) For these 16 flights, find the probability that fewer than 14 flights depart on time. [2]
- (iii) For these 16 flights, the probability that at least  $k$  flights depart on time is greater than 0.9. Find the largest possible value of  $k$ . [3]
- 5 A soft drinks company has an automated bottling machine that fills 500 ml bottles with soft drink. The contents of the bottles are measured during a check on the machine. In the check, 5% of the bottles contain more than 500 ml and 2.5% contain less than 495 ml. It is given that the amount of drink dispensed per bottle is normally distributed.
- (i) Find the mean and standard deviation of the amount of drink dispensed per bottle, giving your answers to 4 significant figures. [6]
- (ii) It is subsequently found that the measurements of volume made in the checking process are all 3 ml below their true value. Using a corrected distribution, find the probability that a bottle chosen at random contains more than 500 ml of the drink. [3]
- 6 A volleyball squad has 11 players. A volleyball team consists of 6 players.
- (i) Find the total number of different teams that could be chosen from the squad. [1]
- The squad has 5 women and 6 men.
- (ii) Find the total number of different teams that contain at least 3 women. [4]
- The squad includes a man and a woman who are married to one another.
- (iii) It is given that the team chosen has exactly 3 women and all such teams are equally likely to be chosen. Calculate the probability that a team chosen includes the married couple. [3]

### Section B: Mechanics (40 marks)

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

- 7 A particle is projected with a speed of  $8 \text{ m s}^{-1}$ , at an angle of  $40^\circ$  above the horizontal. Find the speed and direction of motion of the particle 0.4 s after projection. [5]
- 8 A small ball is thrown vertically upwards with speed  $12 \text{ m s}^{-1}$ , from a point 5 m above the ground. Assuming air resistance is negligible, find
- (i) the greatest height above the ground reached by the ball, [2]
- (ii) the time taken for the ball to reach the ground. [3]

- 9 A particle  $P$  of mass  $m$  kg is moving with speed  $2 \text{ m s}^{-1}$  in a straight line on a smooth horizontal table.  $P$  collides directly with a stationary particle  $Q$  of mass  $0.5$  kg. This collision reverses the direction of motion of  $P$ . Immediately after the collision the speed of  $P$  is  $0.5 \text{ m s}^{-1}$  and the speed of  $Q$  is  $0.4 \text{ m s}^{-1}$ . Find

(i) the value of  $m$ , [3]

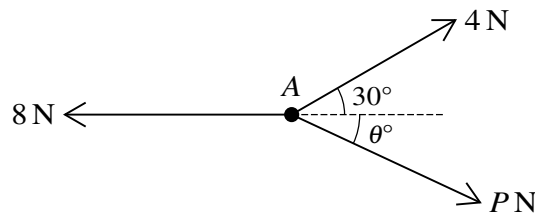
(ii) the coefficient of restitution between the two particles. [2]

- 10 A particle  $P$  moves in a straight line starting from  $O$ . At time  $t$  seconds after leaving  $O$ , the velocity of  $P$  is  $v \text{ m s}^{-1}$ , where  $v = 5 + 1.5t - 0.125t^3$ .

(i) Find the displacement of  $P$  between the times  $t = 1$  and  $t = 4$ . [3]

(ii) Find the time at which the velocity of  $P$  is a maximum, justifying your answer. [3]

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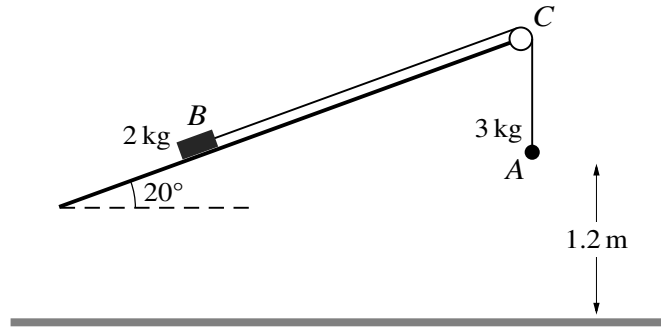
Three forces are acting on a particle  $A$  as shown in the diagram. The forces act in the same plane and the particle is in equilibrium.

(i) Evaluate  $P$  and  $\theta$ . [6]

The  $8 \text{ N}$  force is removed.

(ii) State the direction of the instantaneous acceleration of  $A$ . [1]

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The diagram shows a block  $B$  of mass  $2\text{ kg}$  and a particle  $A$  of mass  $3\text{ kg}$  attached to opposite ends of a light inextensible string. The block is held at rest on a rough plane inclined at  $20^\circ$  to the horizontal, and the coefficient of friction between the block and the plane is  $0.4$ . The string passes over a small smooth pulley  $C$  at the edge of the plane and  $A$  hangs in equilibrium  $1.2\text{ m}$  above horizontal ground. The part of the string between  $B$  and  $C$  is parallel to a line of greatest slope of the plane.  $B$  is released and begins to move up the plane.

- (i) Show that the acceleration of  $A$  is  $3.13\text{ m s}^{-2}$ , correct to 3 significant figures, and find the tension in the string. [7]
- (ii) When  $A$  reaches the ground it remains there. Given that  $B$  does not reach  $C$  in the subsequent motion, find the total time that  $B$  is moving up the plane. [5]



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