TAYLOR'S COLLEGE

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CAMBRIDGE A LEVEL PROGRAMME

SEMESTER ONE EXAMINATION JUNE 2010

(March 2010 Intake)

Friday **11 June 2010** **8.30 am – 10.30 am**

FURTHER MATHEMATICS 9231/01

PAPER 1 and 2 **2 hours**

Additional materials: Answer Booklet/Paper
List of formulae (MF 10)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.
Write your name and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
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 is necessary, take the acceleration due to gravity to be 10ms^{-2}.
The use of a calculator is expected, where appropriate.
Results obtained solely from a graphic calculator, without supporting working or reasoning, will not receive credit.
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 marks for this paper is **60**.

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

[Turn over

Section A: Pure Mathematics (50%)

1 Express $\dfrac{2}{n^2-2n}$ in partial fractions. [2]

Hence find the sum of the series $\sum_{n=3}^{N} \dfrac{1}{n^2-2n}$. [4]

2 Prove that $3^n > 1+2n$ for all positive integers $n > 1$. [7]

3 Given that α, β and γ are the 3 roots of the equation $2x^3-5x^2+7x-4=0$. Form the cubic equation whose roots are α^2, β^2 and γ^2. [5]

Hence find the value of $\alpha^4+\beta^4+\gamma^4$. [3]

4 The curve C has equation $y = \dfrac{x^2-2x-1}{x-2}$.

(i) Write C in the form $y = ax+b+\dfrac{c}{x-2}$, where a, b and c are integers that need to be found. Hence state all the asymptotes of C. [5]

(ii) Show that C does not have any stationary points. [2]

(iii) Sketch C, showing clearly the asymptotes and the coordinates of the points of intersection of C with the axes. [2]

Students are required to answer questions in Section B using a fresh sheet of answer paper.
Answers for Section A and Section B need to be handed in separately.

Section B: Mechanics (50%)

1 A particle P of mass $2m$ moving on a smooth horizontal plane with speed u, strikes a smooth vertical barrier. Just before the collision the angle between the direction of motion of P and vertical barrier is 60°. The coefficient of restitution between P and the barrier is $\frac{1}{3}$. Find the exact value of the magnitude and direction of the velocity of P immediately after the collision. [5]

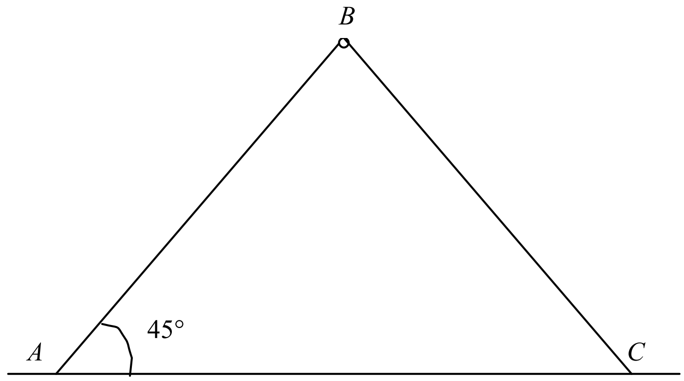
2 A particle of mass m is moving with speed u on a smooth horizontal plane when it receives an impulse of magnitude Q in the direction of motion of particle. After the impulse the particle has speed v. Show that the increase of kinetic energy of the particle is $\frac{1}{2}Q(u+v)$. [3]

Particle A and B, each of mass m, moves in the same straight line on a smooth horizontal plane. The particles collide. The velocities of A and B before collision are u_1 and u_2 respectively in the direction AB. After the collision their velocities in the same direction are v_1 and v_2. The coefficient of restitution is e.

Prove that $v_1 = \frac{1}{2}(1-e)u_1 + \frac{1}{2}(1+e)u_2$ and find the corresponding expression for v_2. [6]

Find, in terms of m, e, u_1 and u_2, the magnitude of the impulse between the particles. [2]

3



Two uniform rods, AB and BC are of length $2a$ and weight $3W$ and W respectively. They are smoothly jointed at B and stand in a vertical plane with A and C on a rough horizontal plane. Each rod makes an angle of 45° with the horizontal (see diagram).

Show the magnitude of the normal contact force acting at A is $\frac{5}{2}W$. [3]

Calculate also the magnitude and direction of the force exerted by the rod AB on the rod BC at B. [6]

The coefficients of friction at A and C are the same and equal to μ. Find the least possible value of μ for equilibrium to be possible. [5]