Laoje

TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH / APRIL 2005

(January 2004 & July 2003 [2-year] Intake)

Tuesday 5 April 2005 1.00 pm – 2.15 pm

MATHEMATICS 9709/4

PAPER 4 Mechanics 1 (M1) 1 hour 15 minutes

Additional materials: Answer Booklet/Paper
List of formulae (MF9)

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 for the acceleration due to gravity is needed, use 10 ms^{-2}.
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 50.
Questions carrying smaller numbers of marks are printed earlier in the paper, and questions carrying larger numbers of marks later in the paper.
The use of an electronic calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

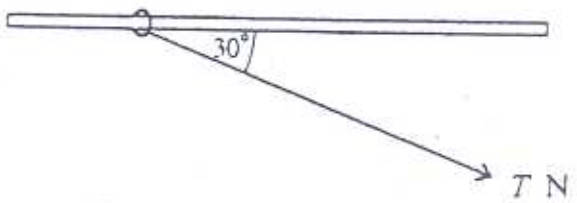
This document consists of 4 printed pages.

[Turn over

1. Car A travelling at a constant velocity of 60km/h passes by car B which is stationary. The driver of car B, noticing car A, immediately accelerates to a velocity of 80km/h in 20 seconds after which he continues with this velocity until he overtakes car A. Find the total distance car B has travelled when he overtakes car A. [4]

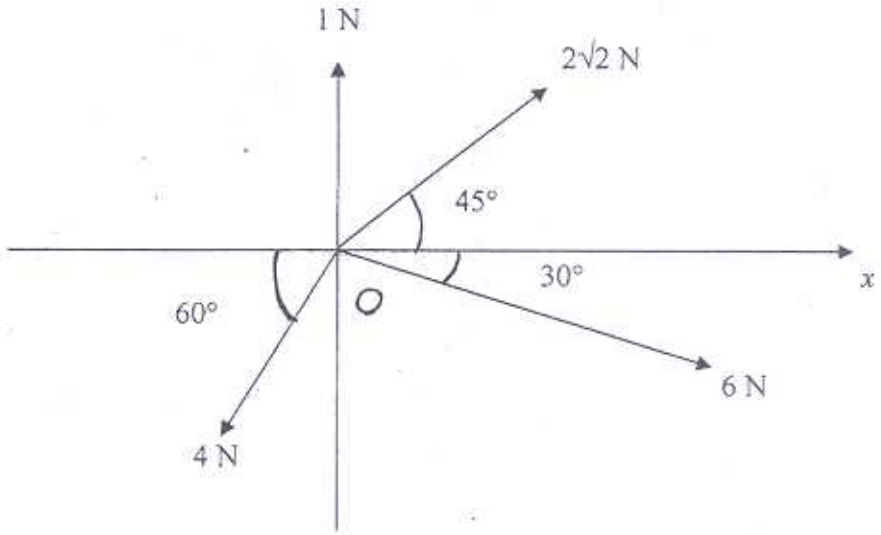
2. A car of mass 750 kg is moving uphill on a straight road inclined at 5° to the horizontal. The engine of the car can produce a maximum power of 15kW. Neglecting all resistances to the motion, find the greatest possible acceleration of the car at an instant when it is travelling at a speed of $10ms^{-1}$. [5]

3.



A heavy ring of mass 5kg is threaded on a fixed horizontal rod. A light string is attached to the ring and is pulled downwards with a force of magnitude of T Newtons acting at an angle of 30° to the horizontal (see diagram). The ring is in equilibrium. Find, in exact terms of T, the normal component and the frictional component of the contact force acting on the ring due to the rod. [6]

4.



The diagram above shows four coplanar forces acting at the origin O.

a) Find the component of the resultant of the four forces in the direction of the x-axis. [2]

b) Find the component of the resultant of the four forces in the direction perpendicular to the x-axis. [2]

c) Find the magnitude and direction of the resultant of the four forces. [3]

5. The velocity of a particle, v ms^{-1}, is given as $v = \frac{1}{t^2} - \frac{1}{4}$, $t \geq 1$, where t is time in seconds. Find the distance travelled between $t = 1$ and $t = 5$. [7]

6. A car of mass 1500 kg arrives at the foot of a straight hill travelling at 30 ms^{-1}. It reaches the top of the hill 40 seconds later travelling at 10 ms^{-1}. The length of the hill is 1 km and the gain in height is 120 metres. The average resistance to the motion is 500 N.

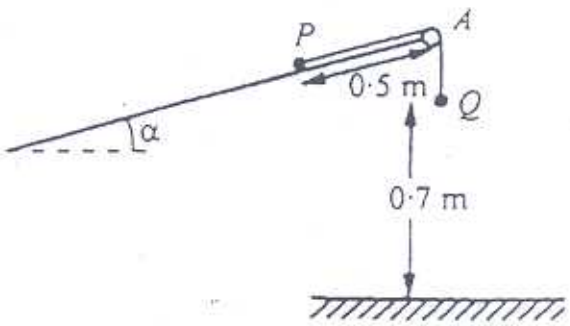
a) Find the loss in kinetic energy. [3]

b) Find the work done by the car to get to the top of the hill. [3]

c) Find the average power developed by the engine. [3]

[Turn over

7.



Two particles P and Q, of masses 0.2 kg and m kg respectively, are attached to the ends of a light inextensible string. The particle P is placed on a plane inclined to the horizontal at an angle α, where $\sin\alpha = 0.2$. The coefficient of friction between P and the plane is $\frac{1}{\sqrt{6}}$. The string passes over a smooth pulley at A, and AQ hangs vertically (see diagram). The system is at rest with the string taut and the part AP parallel to the line of greatest slope of the inclined plane. The particle P is at a distance of 0.5 m from A and the particle Q is a height of 0.7 m above the ground. Show that, for the system to remain at rest, $0 < m \leq 0.12$. [5]

It is given that $m = 0.3$ and the system is released from rest in the position shown in the diagram. Show that the speed of P as it reaches A is 1.90 ms^{-1}, correct to 3 significant figures. [5]

Just before P reaches A, the string breaks. Find the speed with which Q strikes the ground. [2]