TAYLOR'S COLLEGE

Wisdom · Integrity · Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

A2 TRIAL EXAMINATION AUGUST/SEPTEMBER 2004

(July 2003 Intake)

Thursday **26 August 2004** **12.30 pm – 1.45 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.

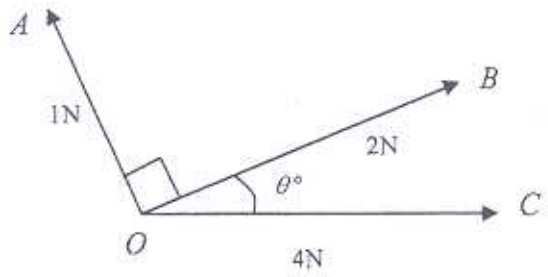
Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use 10 ms^{-2}.
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.

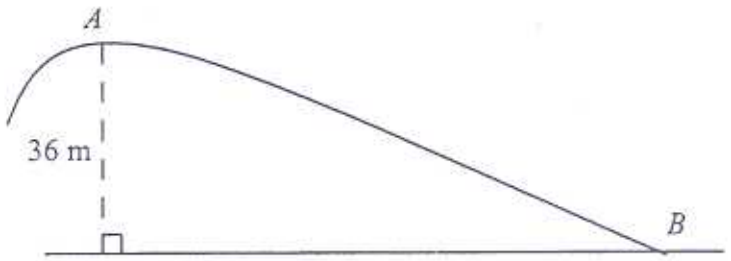


Three coplanar forces of magnitudes 1N, 2N and 4N act at a point O in the directions shown in the diagram. The angle between OA and OB is 90° and the angle between OB and OC is $\theta°$. The resultant of the three forces acts in the direction OB.

(i) Find θ. [2]

(ii) Calculate the magnitude of the resultant force. [2]

2.



The diagram shows the vertical plane through the portion AB of a road along which a car of mass 750 kg travels against a resistance. The point A is 36 m higher than the lowest point B.

The car travels from A to B, a distance of 150 m, with no power being transmitted to its wheel. Given that its speed at A is 12 ms^{-1} and its speed at B is 24 ms^{-1}.Find

(i) the loss in potential energy, [1]

(ii) the gain in kinetic energy, [2]

(iii) the work done against the resistance. [2]

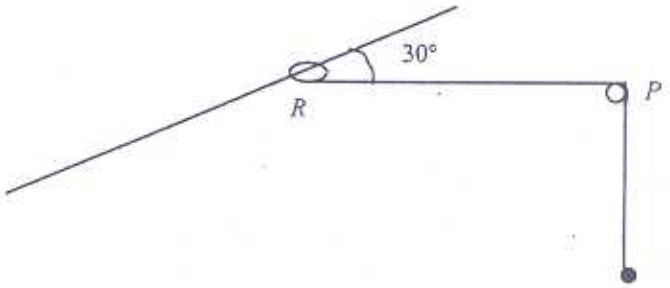
3. A car moves with constant acceleration along a straight horizontal road. The car passes the point A with speed 5 ms^{-1} and 4s later it passes the point B, where $AB = 50$ m.

(i) Find the acceleration of the car. [2]

When the car passes the point C, it has speed 30 ms^{-1}.

(ii) Find the distance AC. [3]

4



A fixed straight wire is inclined at an angle of 30° to the horizontal. A small ring R, of mass 0.5 kg, is threaded onto the wire. One end of a light inextensible string is attached to R, and the other end is attached to a particle of mass 0.2 kg. The string passes over a fixed smooth peg P, so that the string and the wire are in the same vertical plane, with the particle hanging freely. The system is in equilibrium with RP horizontal. Given that the system is in limiting equilibrium, find the coefficient of friction between the wire and the ring. [6]

5. Two particles A and B, of mass 0.3 kg and 0.4 kg respectively, are connected by a light inextensible string which passes over a smooth, light, fixed pulley. The particles are released from rest with the string taut and the hanging parts vertical. Calculate

(i) the acceleration of A, [4]

The particles continue to move in this system until the instant when they each acquire a speed of 3.5 ms^{-1}. At this instant both A and B are 1.5 m above horizontal ground and the string is cut.

(ii) Find the time, measured from the instant when the string is cut, for A to reach the ground. [4]

[Turn over

6. A car of mass 900 kg is moving on a horizontal road at a constant speed of 30 ms^{-1}, with its engine working at its maximum rate of 78 kW.

(i) Calculate the total resistance acting on the car. [2]

The car moves against this same resistance when moving up a hill inclined at 10° to the horizontal. Given that the car is travelling up the hill at a constant speed and working at its maximum rate.

(ii) calculate the speed of the car. [3]

The engine is switched off.

(iii) Calculate the further distance that the car travels up the hill before coming to rest, assuming that the resistance remains unaltered. [4]

7. Two boys Mark and John run a 100 m race.

Mark accelerates uniformly from rest to a velocity of 9 ms^{-1} in 4 s and maintains at this constant velocity until he completes the race.

(i) Sketch the velocity – time graph of Mark's race. [2]

(ii) Find the initial acceleration of Mark. [2]

(iii) Find the time taken by Mark to complete the race. [3]

John starts from rest at the same instant as Mark. His velocity t s after starting is $0.1(20-t)t$. Find

(iv) the greatest velocity of John. [3]

(v) also the distance travelled by John, at the instant when Mark completes his race. [3]