TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH/APRIL 2006

(January 2005 & March 2005 Intake)

Friday **7 April 2006** **8.30 am – 9.45 am**

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 5 printed pages.

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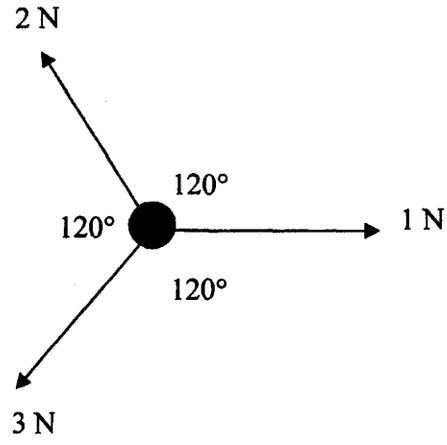
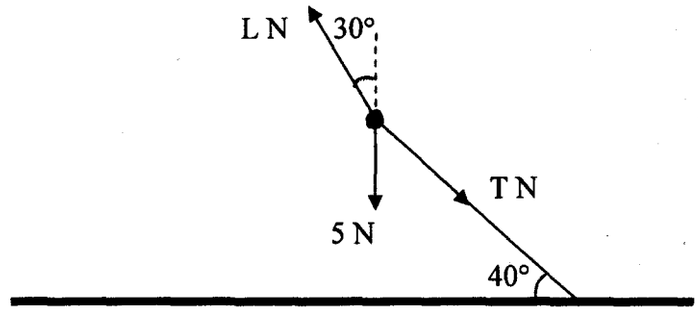
1.



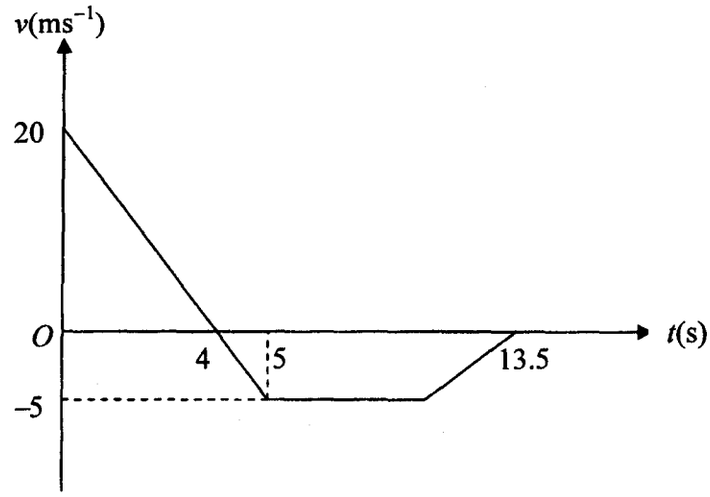
Coplanar forces of magnitudes 1 N, 2 N, 3 N act on a particle, as shown in the diagram; the angle between the directions of each pair of the forces is 120°. Find the magnitude of the resultant of the three forces. [4]

2.



The diagram shows the forces acting on a kite of weight 5 newtons. The kite is stationary and is held in position by a straight inextensible light string inclined at 40° to the horizontal and a lifting force of magnitude L netwons making an angle of 30° with the vertical. The tension in the string is T newtons. Calculate T and L. [6]

3.



The diagram shows a velocity-time graph for a particle. The particle starts from a point A and travels vertically upwards. After traveling for 13.5 s, the particle returns to A. Find

a) the greatest height reached by the particle. [2]

b) the time during which the particle is moving at constant speed. [3]

c) the acceleration of the particle in the final stage of the motion. [2]

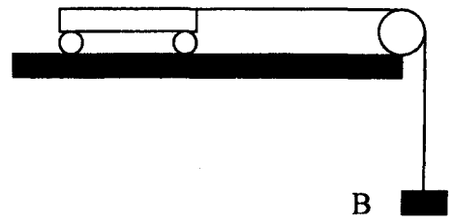
4. A particle moving in a straight line has velocity, v ms^{-1} at time t s, where $v = t(t-6)^2$.

a) Calculate how far the particle moves between the two times when it is instantaneously at rest. [4]

b) Find the set of values of t for which the acceleration is negative. [3]

[Turn over

5.

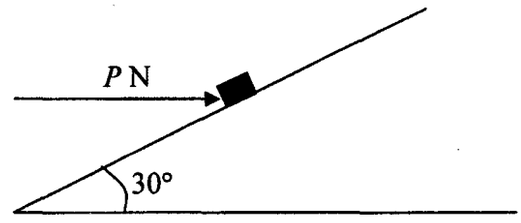


A trolley of mass 2 kg can move on a horizontal table. One end of a light inextensible string is fixed to the trolley. The string passes over a smooth pulley at the edge of the table, and a wooden block B of mass 0.5 kg hangs freely at the other end of the string. The part of the string between the trolley and the pulley is horizontal. Resistances to the motion of the system, from all causes, are modeled as a constant horizontal force of magnitude F newtons acting on the trolley.

b) The system is released is released from rest with B at a height of 1 m above the floor, and B hits the floor 2.5 s later. Use this information to calculate the acceleration of B while it is falling, and the speed with which it hits the floor. [3]

c) Hence find the value of F and the tension in the string while B is falling. [5]

6.



A box of mass 6 kg lies on a rough plane inclined at 30° to the horizontal. The box is held in equilibrium by means of a horizontal force of magnitude P newtons, as shown in the diagram. The coefficient of friction between the box and plane is 0.4. The box is modeled as a particle.

Given that the box is in limiting equilibrium and on the point of moving up the plane, find,

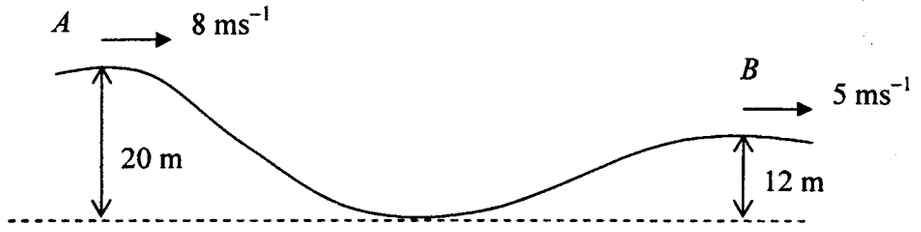
(a) the normal reaction exerted on the box by the plane. [3]

(b) the value of P. [3]

The horizontal force is now removed.

(c) Determine whether the box will still remain in equilibrium. Give a reason to you answer. [2]

7.



The figure shows the path taken by a cyclist in travelling on a section of a road. When the cyclist comes to the point A on the top of a hill, she is travelling at 8 ms^{-1}. She descends a vertical distance of 20 m to the bottom of the hill. The road then rises to the point B through a vertical distance of 12 m. When she reaches B, her speed is 5 ms^{-1}.The total mass of the cyclist and the cycle is 80 kg and the total distance along the road from *A* to *B* is 500m. By modeling the resistance to the motion of the cyclist as of constant magnitude 20 N,

a) find the work done by the cyclist in moving from *A* to *B*. [6]

At *B* the road is horizontal. Given that at *B* the cyclist is accelerating at 0.5 ms^{-2},

b) find the power generated by the cyclist at *B*. [4]

January 05 Intake

M1

1. 1·73 N

2. T = 7·31N L = 11·2N

3. (a) 40 m (b) 6·5s (c) 2·5 ms^{-2}

4. (a) 108 m (b) $2 < t < 6$

5. (a) 0·32 ms^{-2}, 0·8 ms^{-1} (b) T = 4·84N
F = 4·2N

6. (a) R = 90·1N (b) P = 76,3 N (c) No.
the weight component down the slope > limiting equilibrium

7. (a) 2040 J

(b) 300 watt.