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TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence

CAMBRIDGE 'A' LEVEL PROGRAMME

# A2 TRIAL EXAMINATION MARCH/APRIL 2004

(Jan 2003 & July 2002 [2 years] Intakes )

Friday 2 April 2004 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 3 printed pages.



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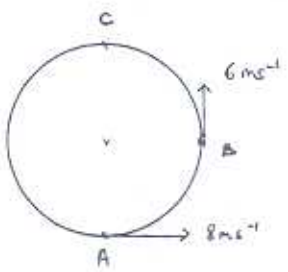
1. Two forces, $P$ and $Q$, are such that the sum of their magnitudes is 45 N. The resultant of $P$ and $Q$ is perpendicular to $P$ and has a magnitude of 15 N. Calculate
   i) the magnitude of $P$ and of $Q$, [4]
   ii) the angle between $P$ and $Q$. [2]

2. A balloon is descending vertically at a constant speed of 2 $ms^{-1}$. A small object is released from the balloon when it is at a height of 88 m above the ground.
   i) Calculate the time that elapses between the impact of the object with the ground and the impact of the balloon with the ground. [4]
   ii) Sketch, on the same diagram, velocity- time graphs to illustrate the motion of the object and of the balloon. [2]

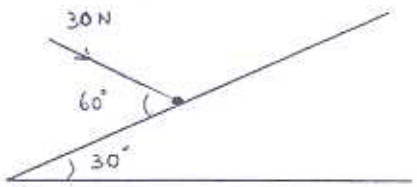
3. A car has a mass of 600 kg and a maximum power rating of $S$ watts. The car has a top speed of 40 $ms^{-1}$ on a flat road and a top speed of 24 $ms^{-1}$ up a hill inclined at an angle $\theta$ to the horizontal, where $\sin\theta = 0.2$. Given that the resistance to the motion of the car on both roads is $F$ N where $F$ is constant, write down two equations connecting $S$ and $F$. Hence find the value of $S$ and of $F$. [6]

4. The diagram shows a rough circular wire, centre $O$, radius 1.2 m, fixed in a vertical plane with the top point $C$ vertically above the bottom point $A$. A particle of mass 0.6 kg is threaded on the wire and projected from $A$ with speed 8 $ms^{-1}$. The point $B$ is at the same level as $O$ and the particle passes through $B$ with a speed of 6 $ms^{-1}$. Calculate
   i) the loss of kinetic energy as the particle travels from $A$ to $B$, [2]
   ii) the gain in potential energy as the particle travels from $A$ to $B$, [2]
   iii) the work done in overcoming the frictional resistance of the wire from $A$ to $B$. [3]




5. A particle starts from rest at $O$ and moves in a straight line so that, $t$ seconds later, its velocity $v$ $ms^{-1}$ is given by $v = 2t - t^2$. Given that the particle comes instantaneously to rest at $P$, find
   i) the acceleration at $P$, [3]
   ii) the distance $OP$, [2]
   iii) the total distance travelled by the particle during the first four seconds of the motion. [3]

6.




A rough plane is inclined at 30° to the horizontal. A particle of mass 1 kg is held on the plane by a force of 30 N. This force makes an angle of 60° with a line of greatest slope. Given that the particle is on the point of moving up the plane, calculate the value of $\mu$, the coefficient of friction between the particle and the plane. If the 30 N force is removed, determine whether or not the particle will slide down the plane. [8]

7. A light inextensible string passing over a smooth pulley connects a particle $A$ of mass 1.5 kg with a lighter particle $B$ of mass $M$ kg. The particles are held at rest at the same level and then released. When $B$ has ascended a distance of 0.8 m its speed is 2 $ms^{-1}$; at this instant $A$ strikes the floor and becomes disconnected from the string. Calculate

i) the initial acceleration of the particles, [2]
ii) the tension in the string whilst both $A$ and $B$ are moving, [2]
iii) the value of $M$, [2]
iv) the further time that elapses before $B$ strikes the floor. [3]