TAYLOR'S UNIVERSITY COLLEGE
Wisdom • Integrity • Excellence

CAMBRIDGE A LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH/APRIL 2009

(January and March 2008 Intakes)

Wednesday **25 March 2009** **1.30 pm – 2.45 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.

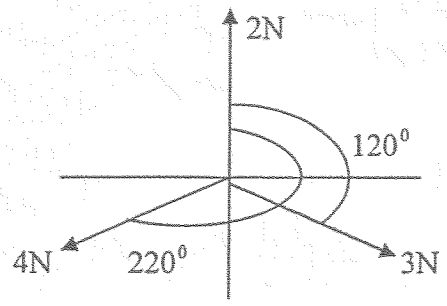
Answer **all** the questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
Where a numerical value for the acceleration due to gravity is needed, use 10 ms^{-2}.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

[Turn over

1



Find the resultant of forces of 2 N due north, 3 N on a bearing of 120^0 and 4 N on a bearing of 220^0. Calculate the bearing of the resultant of forces. [5]

2 A cyclist and her bicycle have a combined mass of 70kg. The cyclist ascends a straight hill AB of constant slope, starting from rest at A and reaching a speed of $4ms^{-1}$ at B. The level of B is 6m above the level of A. For the cyclist's motion from A to B, find

(i) the increased in kinetic energy [1]

(ii) the increase in gravitational potential energy [1]

During the ascent the resistance to motion is constant and has magnitude 60N. The work done by the cyclist in moving from A to B is 8000J.

(iii) Calculate the distance AB. [3]

3 A motor cyclist whose mass combined with his machine is 250kg is driving up a road inclined at an angle of $\sin^{-1}(1/10)$ to the horizontal, at maximum power of 10kW. When the speed is $25ms^{-1}$, the motor bike is accelerating at $0.05ms^{-2}$.

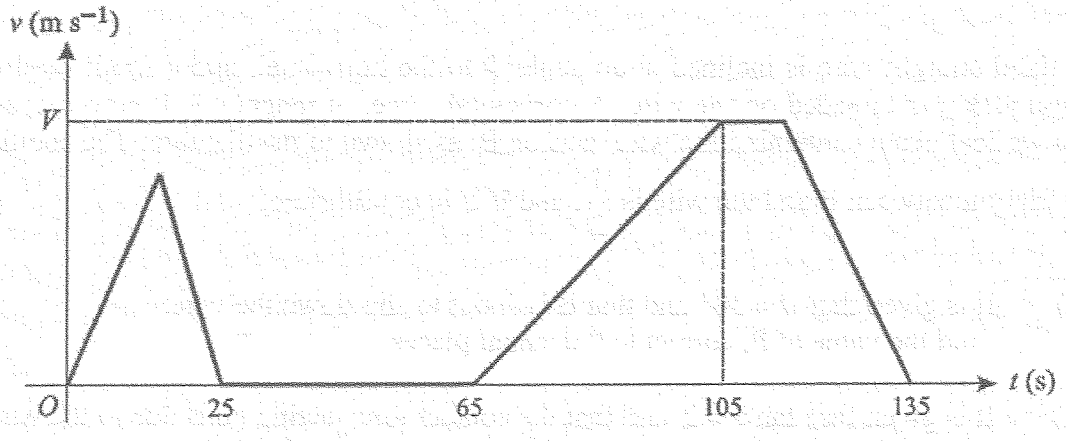
(i) Find the constant resistance to the motion. [3]

At the top of the hill he picks up a pillion passenger of mass 80kg and drives on along the road which is now horizontal. If the resistance is increased by 20%, find

(ii) the greatest speed that can be achieved when the engine is working at 70% of the maximum power [3]

4 A stone is thrown vertically upwards with a speed of $20ms^{-1}$. A second stone is thrown vertically upward from the same point and with the same initial speed $20ms^{-1}$ but 2 seconds later than the first one. Find the distance above the point of projection where the two stones collide. [6]

5



The diagram show the (t, v) graph for the motion of a hoist used to deliver materials to different levels at a building site. The hoist moves vertically. The graph consists of straight line segments. In the first stage the hoist travels upward from ground level for 25s, coming to rest 8m above ground level.

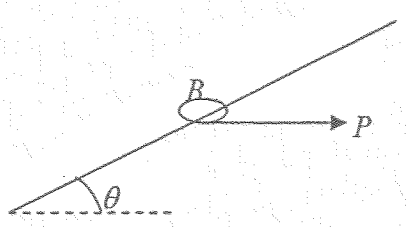
(i) Find the greatest speed reached by the hoist during this stage. [2]

The second state consists of a 40s wait at the level reached during the first stage. In the third stage the hoist continues upward until it comes to rest 40m above ground level, arriving 135s after leaving ground level. The hoist accelerates at $0.02ms^{-2}$ for the first 40s of the third stage, reaching a speed of Vms^{-1}. Find

(ii) the value of V. [2]

(iii) the length of time during the third stage for which the hoist is moving at a constant speed. [3]

6



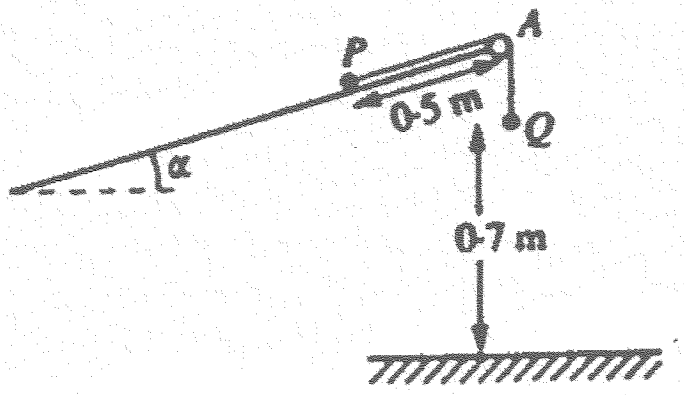
A fixed straight wire is inclined at an angle θ to the horizontal, and a small bead B, of mass 0.1kg, is threaded on the wire. A horizontal force, of magnitude P newtons, and in the vertical plane containing the wire, acts on B, as shown in the diagram. The coefficient of friction between B and the wire is $\frac{1}{2}$, and B is in equilibrium.

(a) It is given that $\theta = 30^0$ and that B is about to slip down the wire.
Find the value of P, correct to 2 decimal places. [5]

(b) It is given that $\tan\theta = 2$ and that the contact force acting on B due to the wire has normal component of magnitude R newtons and frictional component of magnitude F newtons directed down the wire. Show that

$$\frac{F}{R} = \frac{P-2}{2P+1}.$$ [4]

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 $\sin\alpha = \frac{1}{5}$. 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. The system is at rest with the string taut and the part AP parallel to a 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 at a height of 0.7m above the ground. Find the set of possible values of m for the system to remain at rest. [7]

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