TAYLOR'S COLLEGE

Wisdom • Integrity • Excellence

CAMBRIDGE A LEVEL PROGRAMME

A2 TRIAL EXAMINATION MARCH/APRIL 2010

(January/March 2009 Intake)

Monday **5 April 2010** **1.30 pm – 2.45 pm**

MATHEMATICS 9709/43

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 A water pump raises 40 kg of water a second through a height of 20 m and ejects it with a speed of 45 ms^{-1}. Find the kinetic energy and potential energy per second given to the water and the effective rate at which the pump is working. [5]

2 Three forces act on a particle in a horizontal plane. One force acts due east with magnitude 10 N, and a second force acts south-west with magnitude 6 N. The third force acts on a bearing of 330°, and the direction of the resultant is due north. Calculate the magnitude of the third force and the magnitude of the resultant. [5]

3 A van travelling at a constant speed of 25 ms^{-1} passes a red traffic light. Four seconds later a police car is travelling at 10 ms^{-1} and accelerating at 2 ms^{-2}, passes the same light. Write expressions for the distance of each vehicle from the light t seconds after the police car passes it. [2]

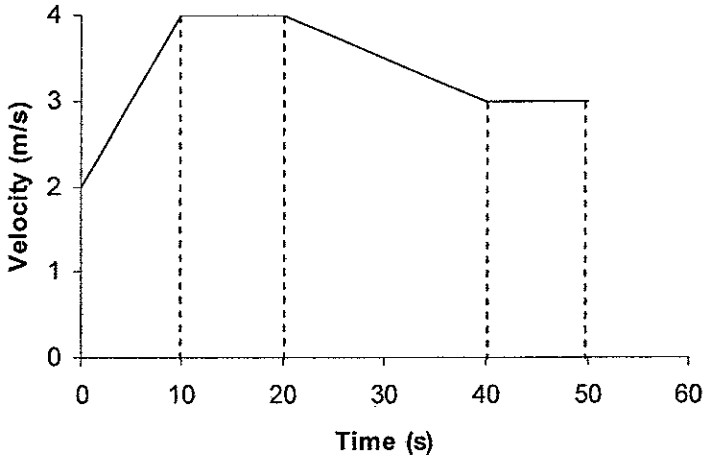
Find the time that it takes for the police car to catch up with the van, and how fast it is then travelling. [3]

4 A person walking at constant speed drags a 25 kg sack of potatoes along a horizontal path, using a rope tied round the neck of the sack. The rope makes an angle of 25° with the horizontal, and there is frictional resistance from the ground of 120 N. Calculate

(i) the tension in the rope, [3]

(ii) the coefficient of friction between the sack and the ground. [4]

5



The diagram shows the (t, v) graph for a person running to catch a bus.

(i) Describe the motion of the run. [2]

(ii) Calculate how far the person has run after 10, 20, 30, 40 and 50 seconds. [3]

(iii) Make a sketch of the (t, s) graph. [2]

(iv) The person has a mass of 80 kg. Calculate the frictional force between her shoes and the ground during the first 10 seconds. [2]

6 Two particles A and B have mass 1 kg and 8 kg respectively. They are initially 80m apart, and they are set in motion at the same instant. At a time t seconds later the displacements in metres of the particles from a point O on the line are $x_A = t^3$ and $x_B = 80 - t^2$ respectively. Verify that the particles collide after 4 seconds, and find their velocities at this time. [4]

As a result of the collision the particle A's velocity is reversed in direction and its magnitude is halved. The acceleration of the particles are given by the same formulae after the collision as before. Express the displacement of A in terms of t after the collision. [5]

7 In a circus act two clowns, Biggo and Littlo, have mass 74 kg and 24 kg respectively. They stand facing each other on platforms at a height of 10 m above the floor. In front of each clown is one end of a rope, which is hung over a fixed smooth rail high above the floor. At the same instant the clowns step off their platforms and grab the end of the rope in front of them. How fast is Biggo moving when he lands on the floor? [6]

As he lands, Biggo continues to hold on the rope, and to pull downwards on it with a force of 180 N. How high is Littlo above the floor when he comes to rest? [4]