6677/01

Edexcel GCE

Mechanics

Unit M1 Mock paper

Advanced Subsidiary / Advanced

Time: 1 hour 30 minutes

Materials required for the examination	Items included with these question papers
Answer Book (AB04) Graph Paper (GP02) Mathematical Formulae	Nil

Candidates may use any calculator EXCEPT **those with a facility for symbolic algebra, differentiation and/or integration. Thus candidates may** NOT **use calculators such as Texas TI 89, TI 92, Casio CFX 9970G, Hewlett Packard HP 48G.**

Instructions to Candidates

In the boxes on the Answer Book provided, write the name of the Examining Body (Edexcel), your Centre Number, Candidate Number, the Unit Title (Mechanics M1), the Paper Reference (6677), your surname, other names and signature.

Whenever a numerical value of g is required, take g = 9.8 m s^{-2}.

When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information for Candidates

A booklet 'Mathematical Formulae including Statistical Formulae and Tables' is provided.

Full marks may be obtained for answers to ALL questions.

This paper has 7 questions. Pages 6, 7 and 8 are blank.

Advice to Candidates

You must ensure that your answers to parts of questions are clearly labelled.

You must show sufficient working to make your methods clear to the Examiner. Answers without working will gain no credit

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1. An aircraft moves along a straight horizontal runway with constant acceleration. It passes a point A on the runway with speed 16 m s^{-1}. It then passes the point B on the runway with speed 34 m s^{-1}. The distance from A to B is 150 m.

(*a*) Find the acceleration of the aircraft. **(3 marks)**

(*b*) Find the time taken by the aircraft in moving from A to B. **(2 marks)**

(*c*) Find, to 3 significant figures, the speed of the aircraft when it passes the point mid-way between A and B. **(2 marks)**

2.

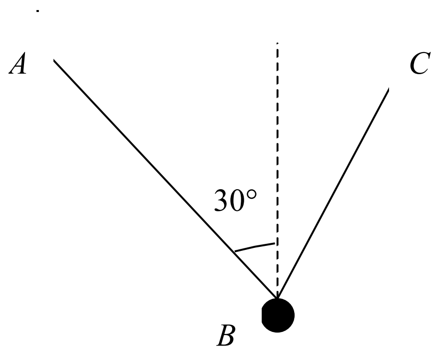

Fig. 1

A particle has mass 2 kg. It is attached at B to the ends of two light inextensible strings AB and BC. When the particle hangs in equilibrium, AB makes an angle of 30° with the vertical, as shown in Fig. 1. The magnitude of the tension in BC is twice the magnitude of the tension in AB.

(*a*) Find, in degrees to one decimal place, the size of the angle that BC makes with the vertical. **(4 marks)**

(*b*) Hence find, to 3 significant figures, the magnitude of the tension in AB. **(4 marks)**

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3. A racing car is travelling on a straight horizontal road. Its initial speed is 25 m s^{-1} and it accelerates for 4 s to reach a speed of V m s^{-1}. It then travels at a constant speed of V m s^{-1} for a further 8 s. The total distance travelled by the car during this 12 s period is 600 m.

(*a*) Sketch a speed-time graph to illustrate the motion of the car during this 12 s period. **(2 marks)**

(*b*) Find the value of V. **(4 marks)**

(*c*) Find the acceleration of the car during the initial 4 s period. **(2 marks)**

4.

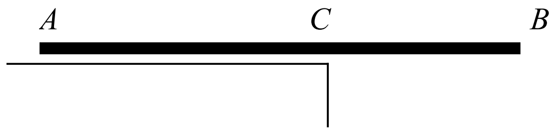

Fig. 2

A plank AB has length 4 m. It lies on a horizontal platform, with the end A lying on the platform and the end B projecting over the edge, as shown in Fig. 2. The edge of the platform is at the point C.

Jack and Jill are experimenting with the plank. Jack has mass 40 kg and Jill has mass 25 kg. They discover that, if Jack stands at B and Jill stands at A and $BC = 1.6$ m, the plank is in equilibrium and on the point of tilting about C. By modelling the plank as a uniform rod, and Jack and Jill as particles,

(*a*) find the mass of the plank. **(3 marks)**

They now alter the position of the plank in relation to the platform so that, when Jill stands at B and Jack stands at A, the plank is again in equilibrium and on the point of tilting about C.

(*b*) Find the distance BC in this position. **(5 marks)**

(*c*) State how you have used the modelling assumptions that

(i) the plank is uniform,

(ii) the plank is a rod,

(iii) Jack and Jill are particles. **(3 marks)**

5. A post is driven into the ground by means of a blow from a pile-driver. The pile-driver falls from rest from a height of 1.6 m above the top of the post.

(*a*) Show that the speed of the pile-driver just before it hits the post is 5.6 m s^{-1}. **(2 marks)**

The post has mass 6 kg and the pile-driver has mass 78 kg. When the pile-driver hits the top of the post, it is assumed that the there is no rebound and that both then move together with the same speed.

(*b*) Find the speed of the pile-driver and the post immediately after the pile-driver has hit the post. **(3 marks)**

The post is brought to rest by the action of a resistive force from the ground acting for 0.06 s.

By modelling this force as constant throughout this time,

(*c*) find the magnitude of the resistive force, **(4 marks)**

(*d*) find, to 2 significant figures, the distance travelled by the post and the pile-driver before they come to rest. **(4 marks)**

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6. [In this question, the horizontal unit vectors **i** and **j** are directed due East and North respectively.]

A coastguard station O monitors the movements of ships in a channel. At noon, the station's radar records two ships moving with constant speed. Ship A is at the point with position vector $(-5\mathbf{i} + 10\mathbf{j})$ km relative to O and has velocity $(2\mathbf{i} + 2\mathbf{j})$ km h^{-1}. Ship B is at the point with position vector $(3\mathbf{i} + 4\mathbf{j})$ km and has velocity $(-2\mathbf{i} + 5\mathbf{j})$ km h^{-1}.

(*a*) Given that the two ships maintain these velocities, show that they collide. **(6 marks)**

The coast guard radios ship A and orders it to reduce its speed to move with velocity $(\mathbf{i} + \mathbf{j})$ km h^{-1}.

Given that A obeys this order and maintains this new constant velocity,

(*b*) find an expression for the vector $\overrightarrow{AB}$ at time t hours after noon. **(2 marks)**

(*c*) find, to 3 significant figures, the distance between A and B at 1400 hours, **(3 marks)**

(*d*) find the time at which B will be due north of A. **(2 marks)**

7.

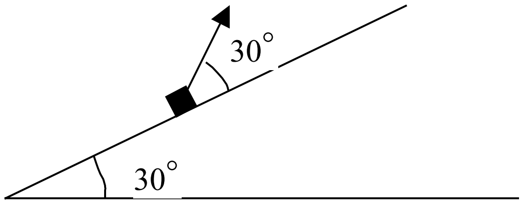

Fig. 3

A small parcel of mass 2 kg moves on a rough plane inclined at an angle of 30° to the horizontal. The parcel is pulled up a line of greatest slope of the plane by means of a light rope which it attached to it. The rope makes an angle of 30° with the plane, as shown in Fig. 3. The coefficient of friction between the parcel and the plane is 0.4.

Given that the tension in the rope is 24 N,

(*a*) find, to 2 significant figures, the acceleration of the parcel. **(8 marks)**

The rope now breaks. The parcel slows down and comes to rest.

(*b*) Show that, when the parcel comes to this position of rest, it immediately starts to move down the plane again. **(4 marks)**

(*c*) Find, to 2 significant figures, the acceleration of the parcel as it moves down the plane after it has come to this position of instantaneous rest. **(3 marks)**

END