Paper Reference(s)

6677

Edexcel GCE

Mechanics M1

Advanced Subsidiary

Specimen Paper

Time: 1 hour 30 minutes

Materials required for examination
Answer Book (AB16)
Mathematical Formulae (Lilac)
Graph Paper (ASG2)

Items included with question papers
Nil

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

Instructions to Candidates

In the boxes on the answer book, 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 name 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.

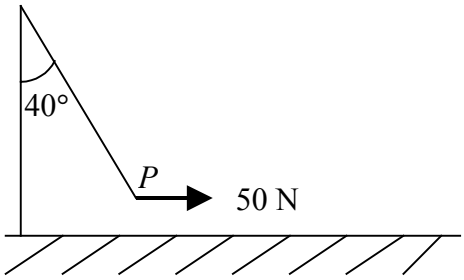
Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided.
Full marks may be obtained for answers to ALL questions.
This paper has seven questions.

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 may gain no credit.

1. **Figure 1**



A tennis ball P is attached to one end of a light inextensible string, the other end of the string being attached to a the top of a fixed vertical pole. A girl applies a horizontal force of magnitude 50 N to P, and P is in equilibrium under gravity with the string making an angle of 40° with the pole, as shown in Fig. 1.

By modelling the ball as a particle find, to 3 significant figures,

(a) the tension in the string,

(3)

(b) the weight of P.

(4)

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2. A car starts from rest at a point O and moves in a straight line. The car moves with constant acceleration 4 m s^{-2} until it passes the point A when it is moving with speed 10 m s^{-1}. It then moves with constant acceleration 3 m s^{-2} for 6 s until it reaches the point B. Find

(a) the speed of the car at B,

(2)

(b) the distance OB.

(5)

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3. **Figure 2**

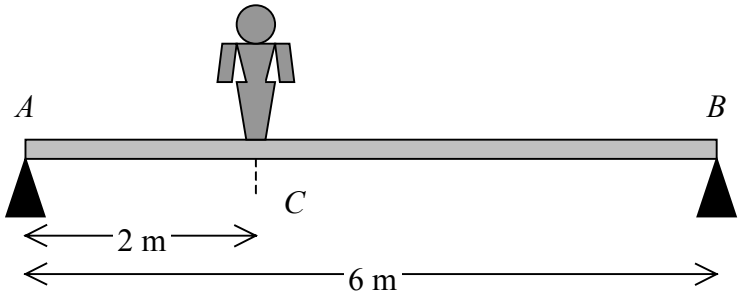

Fig. 2

A non-uniform plank of wood AB has length 6 m and mass 90 kg. The plank is smoothly supported at its two ends A and B, with A and B at the same horizontal level. A woman of mass 60 kg stands on the plank at the point C, where $AC = 2$ m, as shown in Fig. 2. The plank is in equilibrium and the magnitudes of the reactions on the plank at A and B are equal. The plank is modelled as a non-uniform rod and the woman as a particle. Find

(a) the magnitude of the reaction on the plank at B,

(2)

(b) the distance of the centre of mass of the plank from A.

(5)

(c) State briefly how you have used the modelling assumption that

(i) the plank is a rod,

(ii) the woman is a particle.

(2)

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4. A train T, moves from rest at Station A with constant acceleration 2 m s^{-2} until it reaches a speed of 36 m s^{-1}. In maintains this constant speed for 90 s before the brakes are applied, which produce constant retardation 3 ms^{-2}. The train T_1 comes to rest at station B.

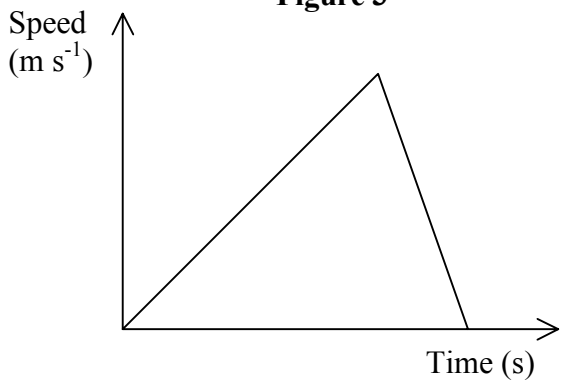
(a) Sketch a speed-time graph to illustrate the journey of T_1 from A to B.

(3)

(b) Show that the distance between A and B is 3780 m.

(5)

Figure 3



A second train T_2 takes 150 s to move form rest at A to rest at B. Figure 3 shows the speed-time graph illustrating this journey.

(c) Explain briefly one way in which T_1's journey differs from T_2's journey.

(1)

(d) Find the greatest speed, in m s^{-1}, attained by T_2 during its journey.

(3)

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5. A truck of mass 3 tonnes moves on straight horizontal rails. It collides with truck B of mass 1 tonne, which is moving on the same rails. Immediately before the collision, the speed of A is 3 m s^{-1}, the speed of B is 4 m s^{-1}, and the trucks are moving towards each other. In the collision, the trucks couple to form a single body C, which continues to move on the rails.

(a) Find the speed and direction of C after the collision.

(4)

(b) Find, in Ns, the magnitude of the impulse exerted by B on A in the collision.

(3)

(c) State a modelling assumption which you have made about the trucks in your solution

(1)

Immediately after the collision, a constant braking force of magnitude 250 N is applied to C. It comes to rest in a distance d metres.

(d) Find the value of d.

(4)

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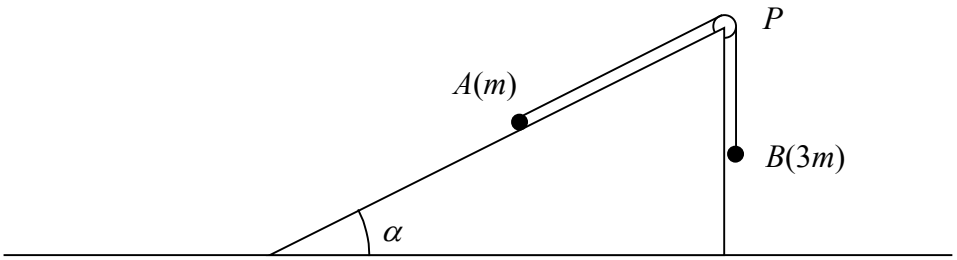
6. **Figure 4**



A particle of mass m rests on a rough plane inclined at an angle α to the horizontal, where $\tan\alpha = \frac{3}{4}$. The particle is attached to one end of a light inextensible string which lies in a line of greatest slope of the plane and passes over a small light smooth pulley P fixed at the top of the plane. The other end of the string is attached to a particle B of mass $3m$, and B hangs freely below P, as shown in Fig. 4. The particles are released from rest with the string taut. The particle B moves down with acceleration of magnitude $\frac{1}{2}g$. Find

(a) the tension in the string,

(4)

(b) the coefficient of friction between A and the plane.

(9)

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7. Two cars A and B are moving on straight horizontal roads with constant velocities. The velocity of A is 20 m s^{-1} due east, and the velocity of B is $(10\mathbf{i} + 10\mathbf{j})$ m s^{-1}, where **i** and **j** are unit vectors directed due east and due north respectively. Initially A is at the fixed origin O, and the position vector of B is $300\mathbf{i}$ m relative to O. At time t seconds, the position vectors of A and B are **r** metres and **s** metres respectively.

(a) Find expressions for **r** and **s** in terms of t. **(3)**

(b) Hence write down an expression for $\overrightarrow{AB}$ in terms of t. **(1)**

(c) Find the time when the bearing of B from A is 045°. **(5)**

(d) Find the time when the cars are again 300 m apart. **(6)**

END