

Edexcel Maths M1

Past Paper Pack

2005-2013

5. A train is travelling at 10 m s^{-1} on a straight horizontal track. The driver sees a red signal 135 m ahead and immediately applies the brakes. The train immediately decelerates with constant deceleration for 12 s, reducing its speed to 3 m s^{-1} . The driver then releases the brakes and allows the train to travel at a constant speed of 3 m s^{-1} for a further 15 s. He then applies the brakes again and the train slows down with constant deceleration, coming to rest as it reaches the signal.

(a) Sketch a speed-time graph to show the motion of the train, (3)

(b) Find the distance travelled by the train from the moment when the brakes are first applied to the moment when its speed first reaches 3 m s^{-1} . (2)

(c) Find the total time from the moment when the brakes are first applied to the moment when the train comes to rest. (5)

Question 6 continued

Lined area for writing the answer to Question 6.

(Total 10 marks)

Q6

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7.

Figure 4

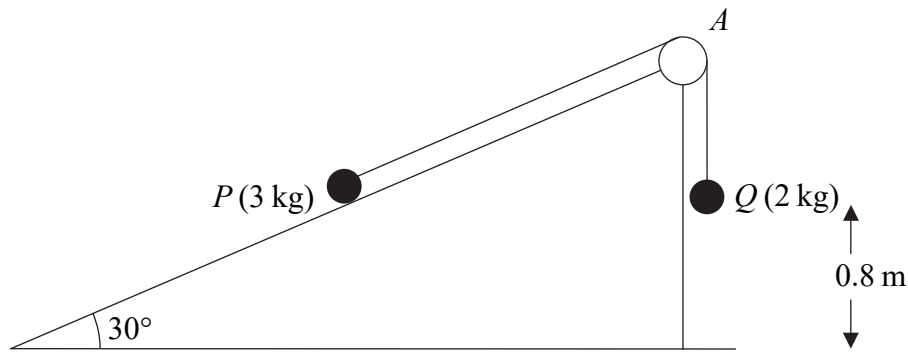


Figure 4 shows two particles P and Q , of mass 3 kg and 2 kg respectively, connected by a light inextensible string. Initially P is held at rest on a fixed smooth plane inclined at 30° to the horizontal. The string passes over a small smooth light pulley A fixed at the top of the plane. The part of the string from P to A is parallel to a line of greatest slope of the plane. The particle Q hangs freely below A . The system is released from rest with the string taut.

(a) Write down an equation of motion for P and an equation of motion for Q . (4)

(b) Hence show that the acceleration of Q is 0.98 m s^{-2} . (2)

(c) Find the tension in the string. (2)

(d) State where in your calculations you have used the information that the string is inextensible. (1)

On release, Q is at a height of 0.8 m above the ground. When Q reaches the ground, it is brought to rest immediately by the impact with the ground and does not rebound. The initial distance of P from A is such that in the subsequent motion P does not reach A . Find

(e) the speed of Q as it reaches the ground, (2)

(f) the time between the instant when Q reaches the ground and the instant when the string becomes taut again. (5)

Question 7 continued

Lined writing area for the answer to Question 7.

(Total 16 marks)

Q7

TOTAL FOR PAPER: 75 MARKS

END

4. A car is moving along a straight horizontal road. At time $t = 0$, the car passes a point A with speed 25 m s^{-1} . The car moves with constant speed 25 m s^{-1} until $t = 10 \text{ s}$. The car then decelerates uniformly for 8 s . At time $t = 18 \text{ s}$, the speed of the car is $V \text{ m s}^{-1}$ and this speed is maintained until the car reaches the point B at time $t = 30 \text{ s}$.

(a) Sketch, in the space below, a speed–time graph to show the motion of the car from A to B .

(3)

Given that $AB = 526 \text{ m}$, find

(b) the value of V ,

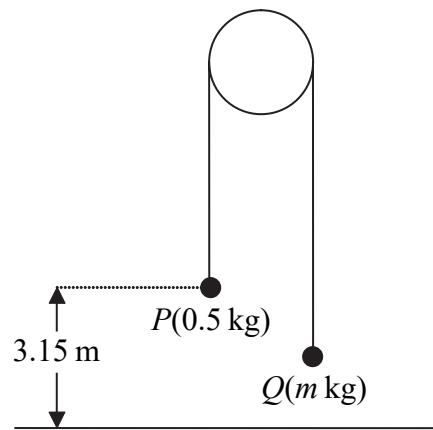
(5)

(c) the deceleration of the car between $t = 10 \text{ s}$ and $t = 18 \text{ s}$.

(3)

6.

Figure 4



Two particles P and Q have mass 0.5 kg and $m \text{ kg}$ respectively, where $m < 0.5$. The particles are connected by a light inextensible string which passes over a smooth, fixed pulley. Initially P is 3.15 m above horizontal ground. The particles are released from rest with the string taut and the hanging parts of the string vertical, as shown in Figure 4. After P has been descending for 1.5 s , it strikes the ground. Particle P reaches the ground before Q has reached the pulley.

- (a) Show that the acceleration of P as it descends is 2.8 m s^{-2} . (3)
- (b) Find the tension in the string as P descends. (3)
- (c) Show that $m = \frac{5}{18}$. (4)
- (d) State how you have used the information that the string is inextensible. (1)

When P strikes the ground, P does not rebound and the string becomes slack. Particle Q then moves freely under gravity, without reaching the pulley, until the string becomes taut again.

- (e) Find the time between the instant when P strikes the ground and the instant when the string becomes taut again. (6)

Centre No.						Paper Reference					Surname	Initial(s)	
Candidate No.						6	6	7	7	/	0	1	Signature

Paper Reference(s)

6677/01

Edexcel GCE

Mechanics M1

Advanced/Advanced Subsidiary

Friday 11 January 2008 – Morning

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
1	
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Materials required for examination

Mathematical Formulae (Green)

Items included with question papers

Nil

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Instructions to Candidates

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Information for Candidates

A booklet 'Mathematical Formulae and Statistical Tables' is provided. Full marks may be obtained for answers to ALL questions. The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 7 questions in this question paper. The total mark for this paper is 75. There are 28 pages in this question paper. Any blank pages are indicated.

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Turn over

3. A car moves along a horizontal straight road, passing two points A and B . At A the speed of the car is 15 m s^{-1} . When the driver passes A , he sees a warning sign W ahead of him, 120 m away. He immediately applies the brakes and the car decelerates with uniform deceleration, reaching W with speed 5 m s^{-1} . At W , the driver sees that the road is clear. He then immediately accelerates the car with uniform acceleration for 16 s to reach a speed of $V \text{ m s}^{-1}$ ($V > 15$). He then maintains the car at a constant speed of $V \text{ m s}^{-1}$. Moving at this constant speed, the car passes B after a further 22 s .

(a) Sketch, in the space below, a speed-time graph to illustrate the motion of the car as it moves from A to B .

(3)

(b) Find the time taken for the car to move from A to B .

(3)

The distance from A to B is 1 km .

(c) Find the value of V .

(5)

7.



Figure 3

Two particles A and B , of mass m and $2m$ respectively, are attached to the ends of a light inextensible string. The particle A lies on a rough horizontal table. The string passes over a small smooth pulley P fixed on the edge of the table. The particle B hangs freely below the pulley, as shown in Figure 3. The coefficient of friction between A and the table is μ . The particles are released from rest with the string taut. Immediately after release, the magnitude of the acceleration of A and B is $\frac{4}{9}g$. By writing down separate equations of motion for A and B ,

(a) find the tension in the string immediately after the particles begin to move, (3)

(b) show that $\mu = \frac{2}{3}$. (5)

When B has fallen a distance h , it hits the ground and does not rebound. Particle A is then a distance $\frac{1}{3}h$ from P .

(c) Find the speed of A as it reaches P . (6)

(d) State how you have used the information that the string is light. (1)

7.

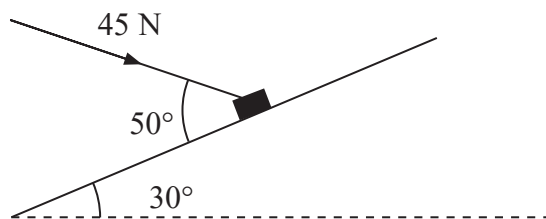


Figure 3

A package of mass 4 kg lies on a rough plane inclined at 30° to the horizontal. The package is held in equilibrium by a force of magnitude 45 N acting at an angle of 50° to the plane, as shown in Figure 3. The force is acting in a vertical plane through a line of greatest slope of the plane. The package is in equilibrium on the point of moving up the plane. The package is modelled as a particle. Find

(a) the magnitude of the normal reaction of the plane on the package, **(5)**

(b) the coefficient of friction between the plane and the package. **(6)**

8.



Figure 4

Two particles P and Q , of mass 2 kg and 3 kg respectively, are joined by a light inextensible string. Initially the particles are at rest on a rough horizontal plane with the string taut. A constant force \mathbf{F} of magnitude 30 N is applied to Q in the direction PQ , as shown in Figure 4. The force is applied for 3 s and during this time Q travels a distance of 6 m. The coefficient of friction between each particle and the plane is μ . Find

- (a) the acceleration of Q , (2)
- (b) the value of μ , (4)
- (c) the tension in the string. (4)
- (d) State how in your calculation you have used the information that the string is inextensible. (1)

When the particles have moved for 3 s, the force \mathbf{F} is removed.

- (e) Find the time between the instant that the force is removed and the instant that Q comes to rest. (4)

Centre No.							Paper Reference				Surname	Initial(s)		
Candidate No.							6	6	7	7	/	0	1	Signature

Paper Reference(s)

6677/01

Edexcel GCE

Mechanics M1

Advanced/Advanced Subsidiary

Tuesday 13 January 2009 – Morning

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
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Total	

Materials required for examination
Mathematical Formulae (Green)

Items included with question papers
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Answer ALL the questions.

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If you need more space to complete your answers to any question, use additional sheets.

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Information for Candidates

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There are 7 questions in this question paper. The total mark for this paper is 75.

There are 24 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

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Turn over

- 2.** A small ball is projected vertically upwards from ground level with speed $u \text{ m s}^{-1}$. The ball takes 4 s to return to ground level.
- (a) Draw, in the space below, a velocity-time graph to represent the motion of the ball during the first 4 s. **(2)**
- (b) The maximum height of the ball above the ground during the first 4 s is 19.6 m. Find the value of u . **(3)**

7.

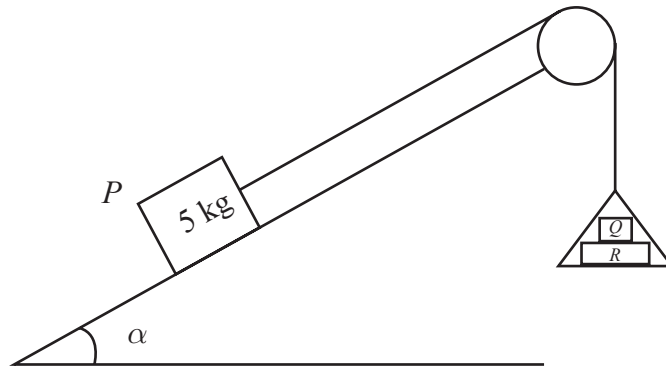


Figure 3

One end of a light inextensible string is attached to a block P of mass 5 kg . The block P is held at rest on a smooth fixed plane which is inclined to the horizontal at an angle α , where $\sin \alpha = \frac{3}{5}$. The string lies along a line of greatest slope of the plane and passes over a smooth light pulley which is fixed at the top of the plane. The other end of the string is attached to a light scale pan which carries two blocks Q and R , with block Q on top of block R , as shown in Figure 3. The mass of block Q is 5 kg and the mass of block R is 10 kg . The scale pan hangs at rest and the system is released from rest. By modelling the blocks as particles, ignoring air resistance and assuming the motion is uninterrupted, find

- (a) (i) the acceleration of the scale pan,
 - (ii) the tension in the string, (8)
- (b) the magnitude of the force exerted on block Q by block R , (3)
- (c) the magnitude of the force exerted on the pulley by the string. (5)

8. [In this question \mathbf{i} and \mathbf{j} are horizontal unit vectors due east and due north respectively.]

A hiker H is walking with constant velocity $(1.2\mathbf{i} - 0.9\mathbf{j}) \text{ m s}^{-1}$.

(a) Find the speed of H .

(2)

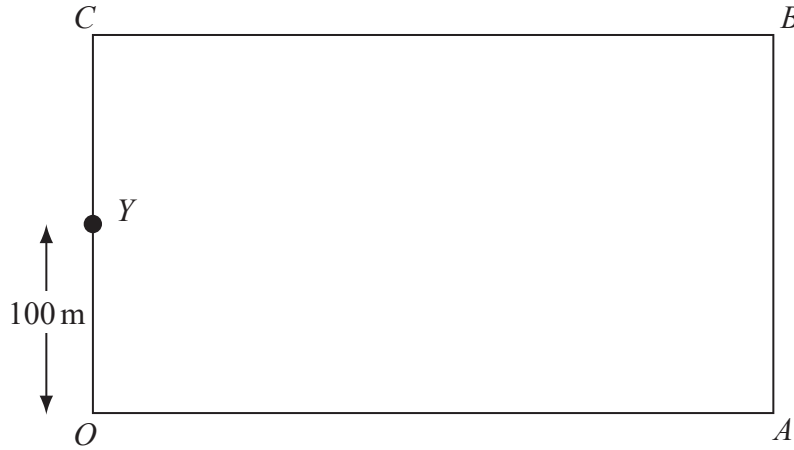


Figure 3

A horizontal field $OABC$ is rectangular with OA due east and OC due north, as shown in Figure 3. At twelve noon hiker H is at the point Y with position vector $100\mathbf{j}$ m, relative to the fixed origin O .

(b) Write down the position vector of H at time t seconds after noon.

(2)

At noon, another hiker K is at the point with position vector $(9\mathbf{i} + 46\mathbf{j})$ m. Hiker K is moving with constant velocity $(0.75\mathbf{i} + 1.8\mathbf{j}) \text{ m s}^{-1}$.

(c) Show that, at time t seconds after noon,

$$\overrightarrow{HK} = [(9 - 0.45t)\mathbf{i} + (2.7t - 54)\mathbf{j}] \text{ metres.}$$

(4)

Hence,

(d) show that the two hikers meet and find the position vector of the point where they meet.

(5)

2. An athlete runs along a straight road. She starts from rest and moves with constant acceleration for 5 seconds, reaching a speed of 8 m s^{-1} . This speed is then maintained for T seconds. She then decelerates at a constant rate until she stops. She has run a total of 500 m in 75 s.

(a) In the space below, sketch a speed-time graph to illustrate the motion of the athlete. **(3)**

(b) Calculate the value of T . **(5)**

Centre No.								Paper Reference				Surname	Initial(s)
Candidate No.					6	6	7	7	/	0	1	Signature	

Paper Reference(s)

6677/01

Edexcel GCE

Mechanics M1

Advanced/Advanced Subsidiary

Monday 24 May 2010 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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Materials required for examination

Mathematical Formulae (Pink)

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Turn over

8.

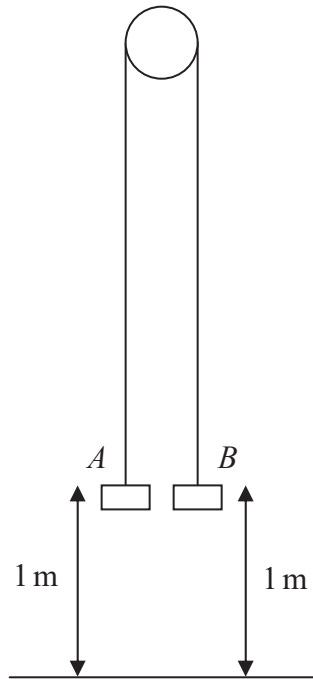


Figure 3

Two particles *A* and *B* have mass 0.4 kg and 0.3 kg respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed above a horizontal floor. Both particles are held, with the string taut, at a height of 1 m above the floor, as shown in Figure 3. The particles are released from rest and in the subsequent motion *B* does not reach the pulley.

- (a) Find the tension in the string immediately after the particles are released. (6)

- (b) Find the acceleration of *A* immediately after the particles are released. (2)

When the particles have been moving for 0.5 s, the string breaks.

- (c) Find the further time that elapses until *B* hits the floor. (9)

Question 8 continued

Lined writing area for the answer to Question 8.

(Total 17 marks)

TOTAL FOR PAPER: 75 MARKS

END

Q8

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5. A car accelerates uniformly from rest for 20 seconds. It moves at constant speed $v \text{ m s}^{-1}$ for the next 40 seconds and then decelerates uniformly for 10 seconds until it comes to rest.

(a) For the motion of the car, sketch

(i) a speed-time graph,

(ii) an acceleration-time graph.

(6)

Given that the total distance moved by the car is 880 m,

(b) find the value of v .

(4)

6.

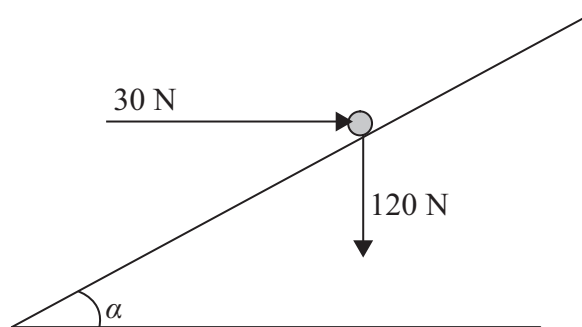


Figure 2

A particle of weight 120 N is placed on a fixed rough plane which is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$.

The coefficient of friction between the particle and the plane is $\frac{1}{2}$.

The particle is held at rest in equilibrium by a horizontal force of magnitude 30 N, which acts in the vertical plane containing the line of greatest slope of the plane through the particle, as shown in Figure 2.

- (a) Show that the normal reaction between the particle and the plane has magnitude 114 N. (4)

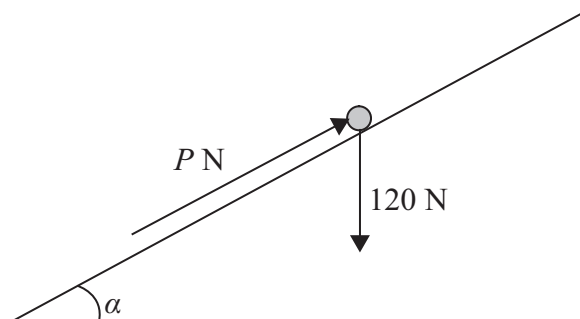
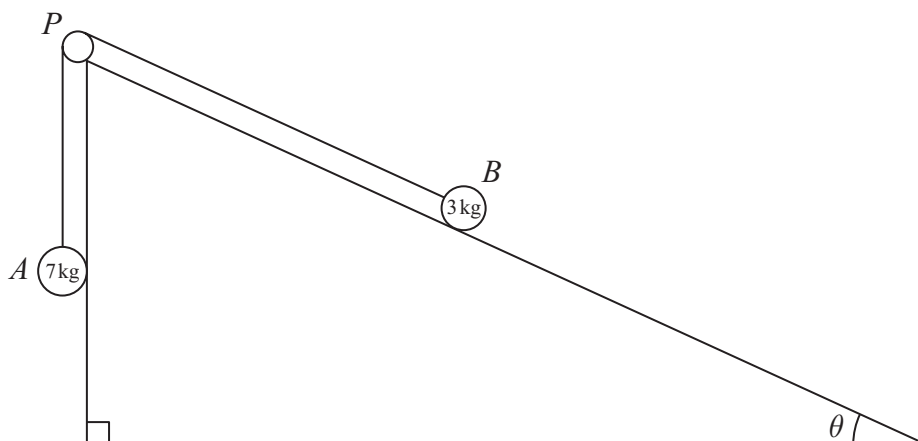


Figure 3

The horizontal force is removed and replaced by a force of magnitude P newtons acting up the slope along the line of greatest slope of the plane through the particle, as shown in Figure 3. The particle remains in equilibrium.

- (b) Find the greatest possible value of P . (8)
- (c) Find the magnitude and direction of the frictional force acting on the particle when $P = 30$. (3)

7.

**Figure 4**

Two particles A and B , of mass 7 kg and 3 kg respectively, are attached to the ends of a light inextensible string. Initially B is held at rest on a rough fixed plane inclined at angle θ to the horizontal, where $\tan \theta = \frac{5}{12}$. The part of the string from B to P is parallel to a line of greatest slope of the plane. The string passes over a small smooth pulley, P , fixed at the top of the plane. The particle A hangs freely below P , as shown in Figure 4. The coefficient of friction between B and the plane is $\frac{2}{3}$. The particles are released from rest with the string taut and B moves up the plane.

(a) Find the magnitude of the acceleration of B immediately after release. **(10)**

(b) Find the speed of B when it has moved 1 m up the plane. **(2)**

When B has moved 1 m up the plane the string breaks. Given that in the subsequent motion B does not reach P ,

(c) find the time between the instants when the string breaks and when B comes to instantaneous rest. **(4)**

4. A girl runs a 400 m race in a time of 84 s. In a model of this race, it is assumed that, starting from rest, she moves with constant acceleration for 4 s, reaching a speed of 5 m s^{-1} . She maintains this speed for 60 s and then moves with constant deceleration for 20 s, crossing the finishing line with a speed of $V \text{ m s}^{-1}$.
- (a) Sketch, in the space below, a speed-time graph for the motion of the girl during the whole race. (2)
- (b) Find the distance run by the girl in the first 64 s of the race. (3)
- (c) Find the value of V . (5)
- (d) Find the deceleration of the girl in the final 20 s of her race. (2)

6.

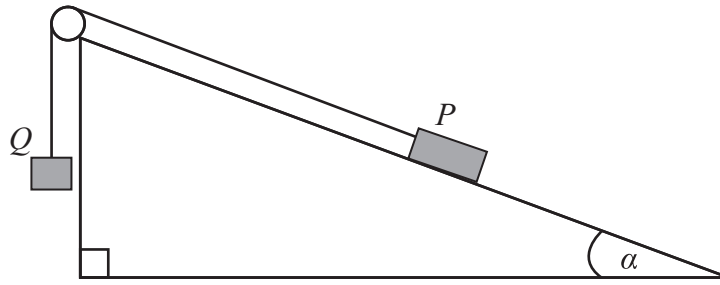


Figure 2

Two particles P and Q have masses 0.3 kg and m kg respectively. The particles are attached to the ends of a light inextensible string. The string passes over a small smooth pulley which is fixed at the top of a fixed rough plane. The plane is inclined to the horizontal at an angle α , where $\tan \alpha = \frac{3}{4}$. The coefficient of friction between P and the plane is $\frac{1}{2}$.

The string lies in a vertical plane through a line of greatest slope of the inclined plane. The particle P is held at rest on the inclined plane and the particle Q hangs freely below the pulley with the string taut, as shown in Figure 2.

The system is released from rest and Q accelerates vertically downwards at 1.4 m s^{-2} .
Find

- (a) the magnitude of the normal reaction of the inclined plane on P , (2)
- (b) the value of m . (8)

When the particles have been moving for 0.5 s, the string breaks. Assuming that P does not reach the pulley,

- (c) find the further time that elapses until P comes to instantaneous rest. (6)

Centre No.						Paper Reference						Surname	Initial(s)	
Candidate No.						6	6	7	7	/	0	1	Signature	

Paper Reference(s)

6677/01

Edexcel GCE

Mechanics M1

Advanced/Advanced Subsidiary

Friday 20 January 2012 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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Question Number	Leave Blank
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Turn over



6. A car moves along a straight horizontal road from a point A to a point B , where $AB = 885$ m. The car accelerates from rest at A to a speed of 15 m s^{-1} at a constant rate $a \text{ m s}^{-2}$. The time for which the car accelerates is $\frac{1}{3}T$ seconds. The car maintains the speed of 15 m s^{-1} for T seconds. The car then decelerates at a constant rate of 2.5 m s^{-2} stopping at B .

(a) Find the time for which the car decelerates. (2)

(b) Sketch a speed-time graph for the motion of the car. (2)

(c) Find the value of T . (4)

(d) Find the value of a . (2)

(e) Sketch an acceleration-time graph for the motion of the car. (3)

Horizontal lines for graphing and calculations.

Question 8 continued

Blank lined area for writing the answer to Question 8 continued.

Q8

(Total 14 marks)

TOTAL FOR PAPER: 75 MARKS

END

4. A car is moving on a straight horizontal road. At time $t = 0$, the car is moving with speed 20 m s^{-1} and is at the point A . The car maintains the speed of 20 m s^{-1} for 25 s. The car then moves with constant deceleration 0.4 m s^{-2} , reducing its speed from 20 m s^{-1} to 8 m s^{-1} . The car then moves with constant speed 8 m s^{-1} for 60 s. The car then moves with constant acceleration until it is moving with speed 20 m s^{-1} at the point B .

(a) Sketch a speed-time graph to represent the motion of the car from A to B . **(3)**

(b) Find the time for which the car is decelerating. **(2)**

Given that the distance from A to B is 1960 m,

(c) find the time taken for the car to move from A to B . **(8)**

2. A steel girder AB , of mass 200 kg and length 12 m, rests horizontally in equilibrium on two smooth supports at C and at D , where $AC = 2$ m and $DB = 2$ m. A man of mass 80 kg stands on the girder at the point P , where $AP = 4$ m, as shown in Figure 1.

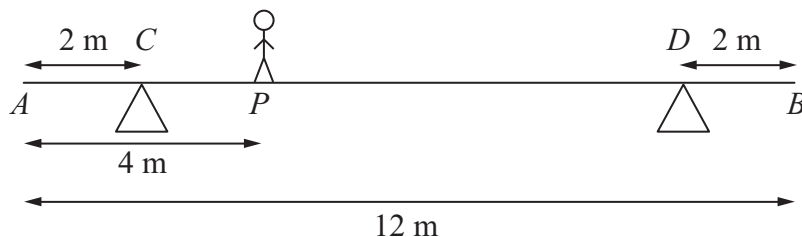


Figure 1

The man is modelled as a particle and the girder is modelled as a uniform rod.

- (a) Find the magnitude of the reaction on the girder at the support at C . (3)

The support at D is now moved to the point X on the girder, where $XB = x$ metres. The man remains on the girder at P , as shown in Figure 2.

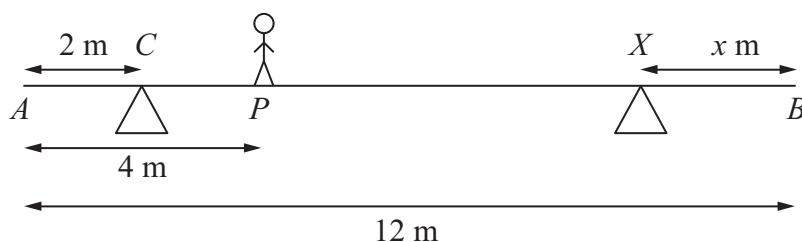


Figure 2

Given that the magnitudes of the reactions at the two supports are now equal and that the girder again rests horizontally in equilibrium, find

- (b) the magnitude of the reaction at the support at X , (2)
- (c) the value of x . (4)

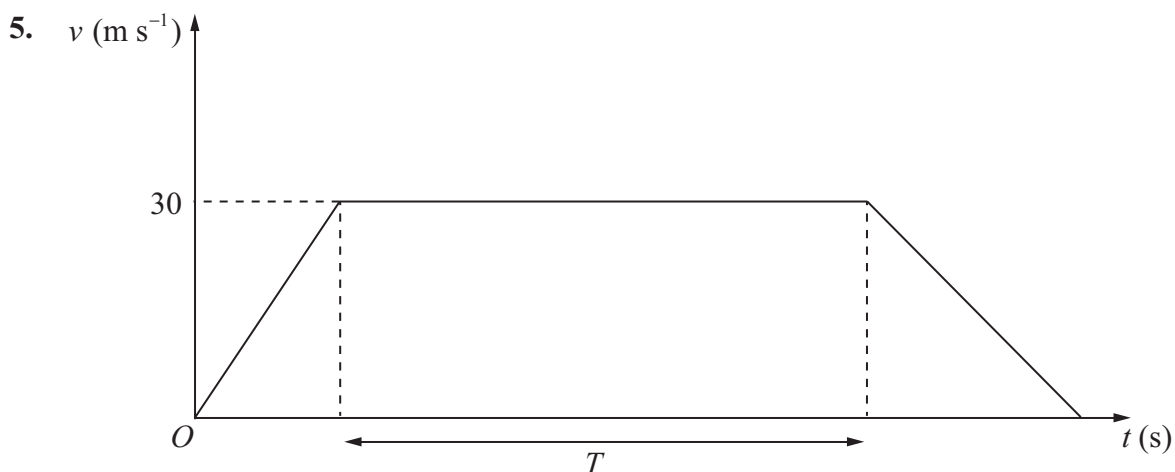


Figure 4

The velocity-time graph in Figure 4 represents the journey of a train P travelling along a straight horizontal track between two stations which are 1.5 km apart. The train P leaves the first station, accelerating uniformly from rest for 300 m until it reaches a speed of 30 m s^{-1} . The train then maintains this speed for T seconds before decelerating uniformly at 1.25 m s^{-2} , coming to rest at the next station.

(a) Find the acceleration of P during the first 300 m of its journey. (2)

(b) Find the value of T . (5)

A second train Q completes the same journey in the same total time. The train leaves the first station, accelerating uniformly from rest until it reaches a speed of $V \text{ m s}^{-1}$ and then immediately decelerates uniformly until it comes to rest at the next station.

(c) Sketch on the diagram above, a velocity-time graph which represents the journey of train Q . (2)

(d) Find the value of V . (6)

Question 7 continued

Lined writing area for Question 7.

Q7

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(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

END

Question 5 continued

Horizontal lines for writing answers.

5. A car is travelling along a straight horizontal road. The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is 22 m s^{-1} . The car maintains this speed for T seconds. The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch, in the space below, a speed-time graph for the motion of the car between the two sets of traffic lights.

(2)

(b) Find the value of T .

(3)

A motorcycle leaves the first set of traffic lights 10 s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration, $a \text{ m s}^{-2}$, and passes the car at the point A which is 990 m from the first set of traffic lights. When the motorcycle passes the car, the car is moving with speed 22 m s^{-1} .

(c) Find the time it takes for the motorcycle to move from the first set of traffic lights to the point A .

(4)

(d) Find the value of a .

(2)

Question 8 continued

Lined writing area for question 8.

(Total 10 marks)

TOTAL FOR PAPER: 75 MARKS

END

Q8

Marking grid for Q8 with empty boxes.