

| | | | | | | | | | | | | | |
|---------------|--|--|--|--|--|----------|-----------------|----------|----------|----------|----------|------------|-----------|
| Centre No. | | | | | | | Paper Reference | | | | Surname | Initial(s) | |
| Candidate No. | | | | | | 6 | 6 | 7 | 8 | / | 0 | 1 | Signature |

Paper Reference(s)

6678/01

Edexcel GCE

Mechanics M2

Advanced/Advanced Subsidiary

Friday 29 January 2010 – Morning

Time: 1 hour 30 minutes

Examiner's use only

| | | |
|--|--|--|
| | | |
|--|--|--|

Team Leader's use only

| | | |
|--|--|--|
| | | |
|--|--|--|

Materials required for examination
Mathematical Formulae (Pink or Green)

Items included with question papers
Nil

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

| Question Number | Leave Blank |
|-----------------|-------------|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| Total | |

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature. Check that you have the correct question paper. Answer ALL the questions. You must write your answer to each question in the space following the question. If you need more space to complete your answers to any question, use additional sheets. Whenever a numerical value of g is required, take $g = 9.8 \text{ m s}^{-2}$. 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. The marks for individual questions and the parts of questions are shown in round brackets: e.g. (2). There are 8 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.

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 not gain full credit.

This publication may be reproduced only in accordance with Edexcel Limited copyright policy.
©2010 Edexcel Limited.

Printer's Log. No.

M35102A



Turn over

4.

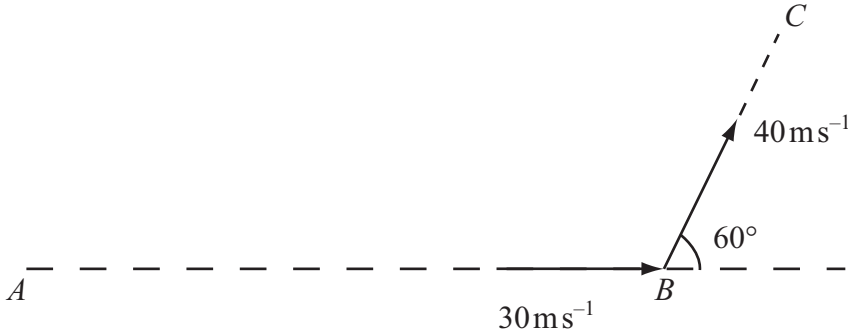


Figure 1

The points A, B and C lie in a horizontal plane. A batsman strikes a ball of mass 0.25 kg . Immediately before being struck, the ball is moving along the horizontal line AB with speed 30 m s^{-1} . Immediately after being struck, the ball moves along the horizontal line BC with speed 40 m s^{-1} . The line BC makes an angle of 60° with the original direction of motion AB , as shown in Figure 1.

Find, to 3 significant figures,

- (i) the magnitude of the impulse given to the ball,
- (ii) the size of the angle that the direction of this impulse makes with the original direction of motion AB .

(8)

Question 5 continued

Lined writing area consisting of 25 horizontal lines.



6.

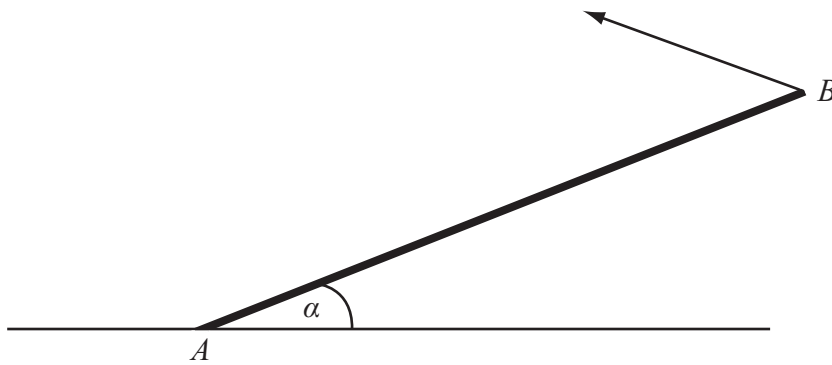


Figure 2

A uniform rod AB , of mass 20 kg and length 4 m , rests with one end A on rough horizontal ground. The rod is held in limiting equilibrium at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$, by a force acting at B , as shown in Figure 2. The line of action of this force lies in the vertical plane which contains the rod. The coefficient of friction between the ground and the rod is 0.5 . Find the magnitude of the normal reaction of the ground on the rod at A . (7)



7. [The centre of mass of a semi-circular lamina of radius r is $\frac{4r}{3\pi}$ from the centre]

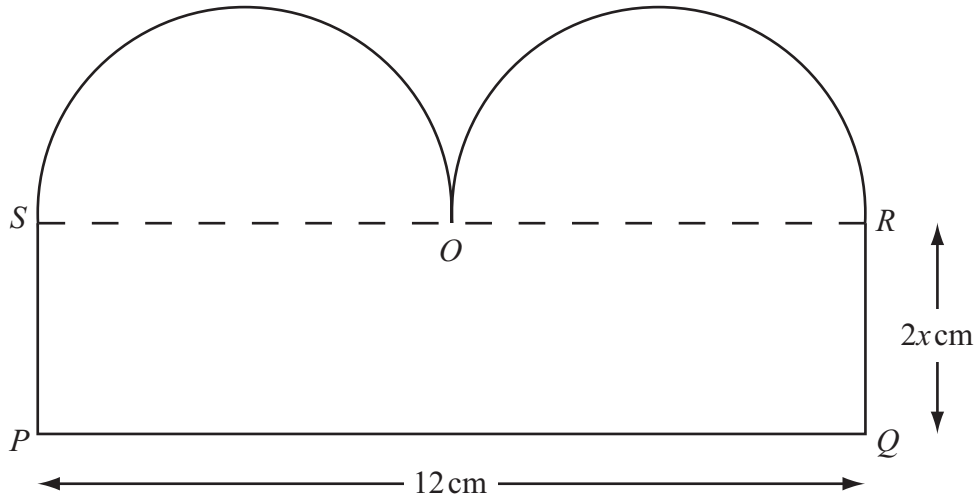


Figure 3

A template T consists of a uniform plane lamina $PQROS$, as shown in Figure 3. The lamina is bounded by two semicircles, with diameters SO and OR , and by the sides SP , PQ and QR of the rectangle $PQRS$. The point O is the mid-point of SR , $PQ = 12$ cm and $QR = 2x$ cm.

- (a) Show that the centre of mass of T is a distance $\frac{4|2x^2 - 3|}{8x + 3\pi}$ cm from SR . (7)

The template T is freely suspended from the point P and hangs in equilibrium.

Given that $x = 2$ and that θ is the angle that PQ makes with the horizontal,

- (b) show that $\tan \theta = \frac{48 + 9\pi}{22 + 6\pi}$. (4)



Leave blank

Question 7 continued

Lined writing area for question 7 continued.



8. [In this question \mathbf{i} and \mathbf{j} are unit vectors in a horizontal and upward vertical direction respectively]

A particle P is projected from a fixed point O on horizontal ground with velocity $u(\mathbf{i} + c\mathbf{j})\text{ms}^{-1}$, where c and u are positive constants. The particle moves freely under gravity until it strikes the ground at A , where it immediately comes to rest. Relative to O , the position vector of a point on the path of P is $(x\mathbf{i} + y\mathbf{j})\text{m}$.

- (a) Show that

$$y = cx - \frac{4.9x^2}{u^2}. \tag{5}$$

Given that $u = 7$, $OA = R\text{m}$ and the maximum vertical height of P above the ground is $H\text{m}$,

- (b) using the result in part (a), or otherwise, find, in terms of c ,

(i) R

(ii) H .

(6)

Given also that when P is at the point Q , the velocity of P is at right angles to its initial velocity,

- (c) find, in terms of c , the value of x at Q .

(6)



