

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson  
Edexcel GCE**

Centre Number

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Candidate Number

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**Wednesday 12 June 2019**

Morning (Time: 1 hour 30 minutes)

Paper Reference **6680/01**

**Mechanics M4**

**Advanced/Advanced Subsidiary**

**You must have:**

Mathematical Formulae and Statistical Tables (Pink)

Total Marks

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**Candidates may use any calculator permitted by Pearson regulations. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.**

### Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Whenever a numerical value of  $g$  is required, take  $g = 9.8 \text{ m s}^{-2}$ , and give your answer to either two significant figures or three significant figures.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

### Information

- The total mark for this paper is 75.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

### Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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- The velocity of the wind relative to the Earth,  $v \text{ m s}^{-1}$ , is constant and is the same for both observers.

(6)

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Question 1 continued

Lined area for writing the answer to Question 1.

(Total 6 marks)

Q1

Mark box for Question 1.



- The kinetic energy of the ball immediately after the impact is 80% of its kinetic energy immediately before the impact.

Find the value of  $e$ .

(6)

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**Question 2 continued**

Handwriting practice area with 30 horizontal lines.

**(Total 6 marks)**

**Q2**

Mark box for Q2



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(c) the time when the distance between  $A$  and  $B$  is least.

**(3)**

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Question 3 continued

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Question 3 continued

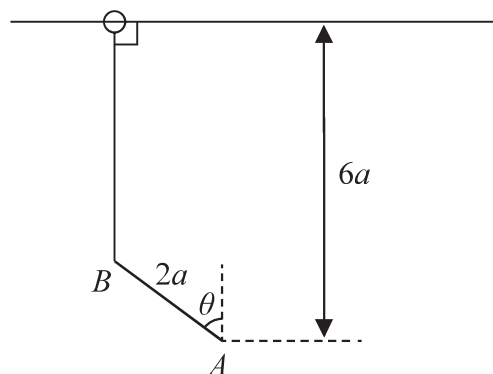
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(Total 11 marks)

Q3



4.



### Figure 1

A uniform rod  $AB$ , of length  $2a$  and mass  $5m$ , is free to rotate in a vertical plane about a fixed smooth horizontal axis through  $A$ . One end of a light elastic string, of natural length  $3a$  and modulus of elasticity  $kmg$ , is fixed to  $B$ . The other end of the elastic string is attached to a small ring which is free to slide on a smooth straight horizontal wire. The wire is fixed, at a height  $6a$  above  $A$ , in the same vertical plane as  $AB$ .

The rod makes an angle  $\theta$  with the upward vertical through  $A$  and the elastic string is vertical, as shown in Figure 1.

- (a) Show that the potential energy of the system is

$$mg a \cos \theta (5 - 2k) + \frac{2}{3} k m g a \cos^2 \theta + \text{constant} \quad (5)$$

Given that there is a position of equilibrium with  $0 < \theta < \frac{\pi}{2}$

- (b) find the range of possible values of  $k$ . (6)
- (c) Explain why, when the system is in equilibrium, the elastic string must be vertical. (1)



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Question 4 continued

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Question 4 continued

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(Total 12 marks)

Q4





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Question 5 continued

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**Question 5 continued**

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Question 5 continued

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(Total 13 marks)

Q5





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Question 6 continued

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**Question 6 continued**

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Question 6 continued

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(Total 13 marks)

Q6



- (a) Show that

The time taken for the car to accelerate from  $10 \text{ m s}^{-1}$  to  $V \text{ m s}^{-1}$  ( $10 < V < 30$ ) is  $T$  seconds.

- (5)

The distance travelled by the car as it accelerates from a speed of  $10 \text{ m s}^{-1}$  to a speed of  $20 \text{ m s}^{-1}$  is  $d$  metres.

- $$d = 480 \ln\left(\frac{5}{2}\right) - 320 \quad (6)$$

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Question 7 continued

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Question 7 continued

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**TOTAL FOR PAPER: 75 MARKS**

28

