

Centre Number						Candidate Number				
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For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
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8	
9	
TOTAL	



General Certificate of Education
Advanced Level Examination
June 2015

Mathematics

MM2B

Unit Mechanics 2B

Monday 22 June 2015 9.00 am to 10.30 am

For this paper you must have:

- the blue AQA booklet of formulae and statistical tables.

You may use a graphics calculator.

Time allowed

- 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The **final** answer to questions requiring the use of calculators should be given to three significant figures, unless stated otherwise.
- Take $g = 9.8 \text{ m s}^{-2}$, unless stated otherwise.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice

- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.



J U N 1 5 M M 2 B 0 1

Answer **all** questions.

Answer each question in the space provided for that question.

- 1** A particle, of mass 4 kg, moves in a horizontal plane under the action of a single force, \mathbf{F} newtons. The unit vectors \mathbf{i} and \mathbf{j} are in the horizontal plane, perpendicular to each other.

At time t seconds, the velocity of the particle, $\mathbf{v} \text{ m s}^{-1}$, is given by

$$\mathbf{v} = 4 \cos 2t \mathbf{i} + 3 \sin t \mathbf{j}$$

- (a) (i) Find an expression for the force, \mathbf{F} , acting on the particle at time t seconds. **[3 marks]**
- (ii) Find the magnitude of \mathbf{F} when $t = \pi$. **[2 marks]**
- (b) When $t = 0$, the particle is at the point with position vector $(2\mathbf{i} - 14\mathbf{j})$ metres. Find the position vector, \mathbf{r} metres, of the particle at time t seconds. **[5 marks]**

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Answer space for question 1



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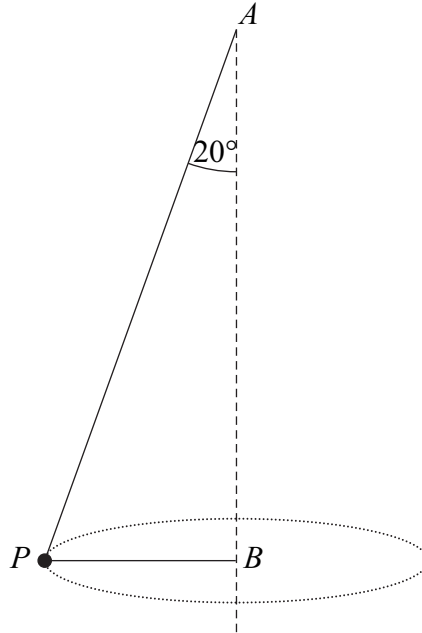
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- 4 A particle, P , of mass 5 kg is attached to two light inextensible strings, AP and BP . The other ends of the strings are attached to the fixed points A and B . The point A is vertically above the point B . The particle moves at a constant speed, $v \text{ m s}^{-1}$, in a horizontal circle of radius 0.6 metres with centre B . The string AP is inclined at 20° to the vertical, as shown in the diagram. Both strings are taut when the particle is moving.



- (a) Find the tension in the string AP . [3 marks]

- (b) The speed of the particle is $v \text{ m s}^{-1}$.

Show that the tension, T_{BP} , in the string BP is given by

$$T_{BP} = \frac{25}{3}v^2 - 5g \tan 20^\circ$$

[3 marks]

- (c) Find v when the tensions in the two strings are equal.

[4 marks]

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6 A van, of mass 1400 kg, is accelerating at a constant rate of 0.2 m s^{-2} as it travels up a slope inclined at an angle θ to the horizontal.

The van experiences total resistance forces of 4000 N.

When the van is travelling at a speed of 20 m s^{-1} , the power output of the van's engine is 91.1 kW.

Find θ .

[9 marks]

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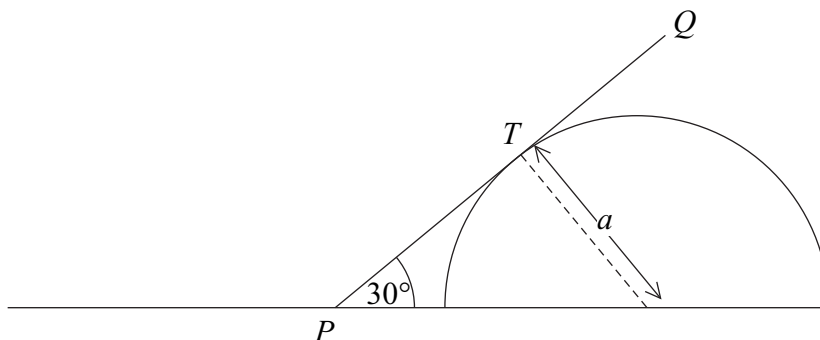
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9

A uniform rod, PQ , of length $2a$, rests with one end, P , on rough horizontal ground and a point T resting on a rough fixed prism of semicircular cross-section of radius a , as shown in the diagram. The rod is in a vertical plane which is parallel to the prism's cross-section. The coefficient of friction at both P and T is μ .



The rod is on the point of slipping when it is inclined at an angle of 30° to the horizontal.

Find the value of μ .

[8 marks]

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END OF QUESTIONS



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ANSWER IN THE SPACES PROVIDED**

