

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International
Advanced Level

Centre Number

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Candidate Number

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Thursday 21 May 2020

Afternoon (Time: 1 hour 30 minutes)

Paper Reference **WME02/01**

Mathematics

International Advanced Subsidiary/Advanced Level
Mechanics M2

You must have:

Mathematical Formulae and Statistical Tables (Blue), calculator

Total Marks

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).
- **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 2 significant figures or 3 significant figures.

Information

- A booklet 'Mathematical Formulae and Statistical Tables' is provided.
- There are 8 questions in this question paper. 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.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

Turn over ►

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1. A particle of mass 2 kg is moving with velocity $(5\mathbf{i} + 3\mathbf{j})\text{ms}^{-1}$ when it receives an impulse \mathbf{I} Ns, such that $\mathbf{I} = a\mathbf{i} + b\mathbf{j}$

Immediately after receiving the impulse, the particle is moving with velocity $\lambda(\mathbf{i} + \mathbf{j})\text{ms}^{-1}$, where λ is a constant.

Given that the magnitude of \mathbf{I} is $\sqrt{40}$, find the two possible impulses.

(5)

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Question 1 continued

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(Total 5 marks)

Q1



2. A truck of weight 9000 N is travelling up a hill on a straight road that is inclined at an angle θ to the horizontal, where $\sin \theta = \frac{1}{15}$

When the truck travels up the hill with the engine working at $3P$ watts, the truck is moving at a constant speed of 12 m s^{-1}

Later on, the truck travels down the hill along the same road, with the engine working at P watts. At the instant when the speed of the truck is 12 m s^{-1} , the acceleration of the truck is $\frac{g}{20}$

The resistance to motion of the truck from non-gravitational forces is a constant force of magnitude R newtons in all circumstances.

Find (i) the value of P ,

(ii) the value of R .

(9)

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Question 2 continued

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Question 2 continued

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(Total 9 marks)

Q2



A diagram of a right-angled triangle. The horizontal base is labeled A at its left end. The vertical side is labeled B at its top end. The angle between the base and the hypotenuse is labeled θ . A right-angle symbol is shown at the vertex where the base and vertical side meet.

Question 3 continued

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(Total 9 marks)

Q3



Question 4 continued

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Question 4 continued

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(Total 9 marks)

Q4



$$\mathbf{v} = (3t^2 - 9t + 6)\mathbf{i} + (t^2 + t - 6)\mathbf{j}$$

- When $t = 0$, P is at the fixed point O .

(b) Find the distance OA . (7)

Question 5 continued

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Question 5 continued

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Lined area for writing the answer to Question 5.

Q5

(Total 10 marks)



6.

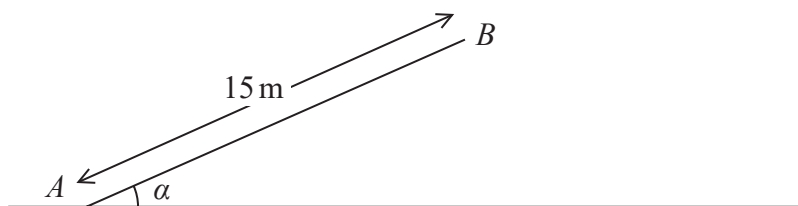


Figure 3

A rough straight ramp is fixed to horizontal ground. The ramp has length 15 m and is inclined at an angle α to the ground, where $\tan \alpha = \frac{5}{12}$. The line AB is a line of greatest slope of the ramp, where A is at the bottom of the ramp, and B is at the top of the ramp, as shown in Figure 3.

A particle P of mass 6 kg is projected up the ramp with speed 14 m s^{-1} from A in a straight line towards B . The coefficient of friction between P and the ramp is 0.25

- (a) Find the work done against friction as P moves from A to B . (3)

At the instant P reaches B , the speed of P is $v \text{ ms}^{-1}$. After leaving the ramp at B , the particle P moves freely under gravity until it hits the horizontal ground at the point C . Immediately before hitting the ground at C , the speed of P is $w \text{ ms}^{-1}$

- (b) Use the work-energy principle to find
- (i) the value of v ,
 - (ii) the value of w .
- (7)



Question 6 continued

Lined area for writing the answer to Question 6.

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Question 6 continued

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Q6

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(Total 10 marks)



Question 7 continued

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Question 7 continued

Handwriting practice area with 30 horizontal lines.

(Total 10 marks)

Q7



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8. [In this question, the unit vectors \mathbf{i} and \mathbf{j} are in a vertical plane, with \mathbf{i} being horizontal and \mathbf{j} being vertically upwards.]

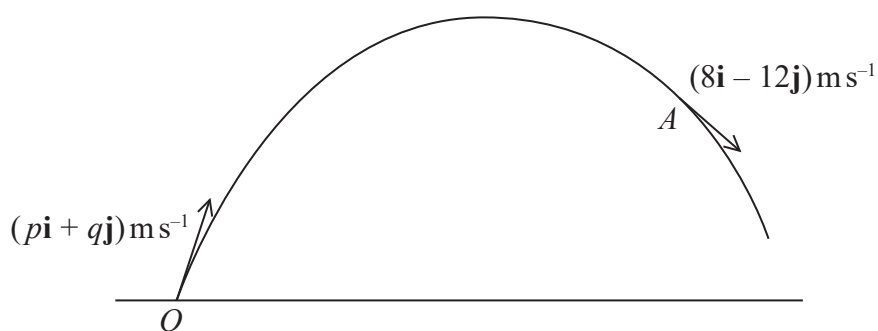


Figure 4

At time $t = 0$, a small ball is projected from a fixed point O on horizontal ground. The ball is projected from O with velocity $(p\mathbf{i} + q\mathbf{j}) \text{ m s}^{-1}$, where p and q are positive constants. The ball moves freely under gravity.

At time $t = 3$ seconds, the ball passes through the point A with velocity $(8\mathbf{i} - 12\mathbf{j}) \text{ m s}^{-1}$, as shown in Figure 4.

- (a) Find the speed of the ball at the instant it is projected from O . (5)

For an interval of T seconds the speed, $v \text{ m s}^{-1}$, of the ball is such that $v \leq 10$

- (b) Find the value of T . (4)

At the point B on the path of the ball, the direction of motion of the ball is perpendicular to the direction of motion of the ball at A .

- (c) Find the vertical height of B above A . (4)



Question 8 continued

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Question 8 continued

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Question 8 continued

Lined area for writing the answer to Question 8.

Q8

(Total 13 marks)

TOTAL FOR PAPER: 75 MARKS

END

