

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

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Team Leader's use only

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[illegible]

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.

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.

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- (8)

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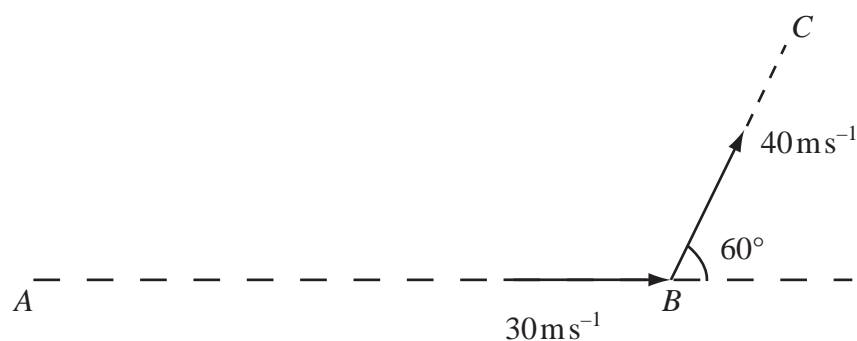
- (7)

[illegible]

- (6)

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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 ms^{-1} . Immediately after being struck, the ball moves along the horizontal line BC with speed 40 ms^{-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,

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

(8)

This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of standard notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings present.

- (a) Find the magnitude of the resistance to motion.

The cyclist now cycles down a straight road which is inclined at an angle θ to the horizontal, where $\sin \theta = \frac{1}{14}$, at a constant speed $U \text{ ms}^{-1}$. The magnitude of the non-gravitational resistance to motion is modelled as $40U$ newtons. She is now working at a constant rate of 24 W .

- (b) Find the value of U .

(7)

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]

A diagram showing a beam AB of length l inclined at an angle α to the horizontal. The weight W acts vertically downwards from the midpoint of the beam. A reaction force R acts at point B, perpendicular to the beam.

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)

[illegible]

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- The diagram shows a window with a rectangular base and two semicircular arches. The base is labeled PQ and has a width of 12 cm . The height of the base is labeled $2x\text{ cm}$. The arches are labeled S and R at their base points, and O is the point where they meet at the top. A dashed line connects S , O , and R .

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 $OR = 2x$ cm.

- 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)

[illegible]

- 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 $(x\mathbf{i} + y\mathbf{j})\text{ m}$.

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

$$(ii) \ H. \tag{6}$$

(c) find, in terms of c , the value of x at Q . (6)

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