Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Mechanics M1

Advanced/Advanced Subsidiary

Friday 6 June 2014 – Afternoon
Time: 1 hour 30 minutes

Paper Reference
WME01/01

You must have:
Mathematical Formulae and Statistical Tables (Blue)

Total Marks

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

- 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 $g = 9.8$ 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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1. Two small smooth balls A and B have mass 0.6 kg and 0.9 kg respectively. They are moving in a straight line towards each other in opposite directions on a smooth horizontal floor and collide directly. Immediately before the collision the speed of A is v m s^{-1} and the speed of B is 2 m s^{-1}. The speed of A is 2 m s^{-1} immediately after the collision and B is brought to rest by the collision.

Find

(a) the value of v,

(3)

(b) the magnitude of the impulse exerted on A by B in the collision.

(2)

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Question 1 continued

Q1

(Total 5 marks)

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2. A ball is thrown vertically upwards with speed 20 m s^{-1} from a point A, which is h metres above the ground. The ball moves freely under gravity until it hits the ground 5 s later.

(a) Find the value of h.

(3)

A second ball is thrown vertically downwards with speed w m s^{-1} from A and moves freely under gravity until it hits the ground.

The first ball hits the ground with speed V m s^{-1} and the second ball hits the ground with speed $\frac{3}{4}V$ m s^{-1}.

(b) Find the value of w.

(5)

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Question 2 continued

Q2

(Total 8 marks)

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3. A particle P of mass 1.5 kg is placed at a point A on a rough plane which is inclined at 30° to the horizontal. The coefficient of friction between P and the plane is 0.6

(a) Show that P rests in equilibrium at A.

(5)

A horizontal force of magnitude X newtons is now applied to P, as shown in Figure 1. The force acts in a vertical plane containing a line of greatest slope of the inclined plane.

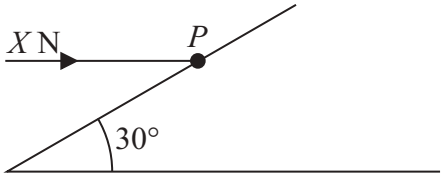

Figure 1

The particle is on the point of moving up the plane.

(b) Find

(i) the magnitude of the normal reaction of the plane on P,

(ii) the value of X.

(7)

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Question 3 continued

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Question 3 continued

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Question 3 continued

Q3

(Total 12 marks)

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4.

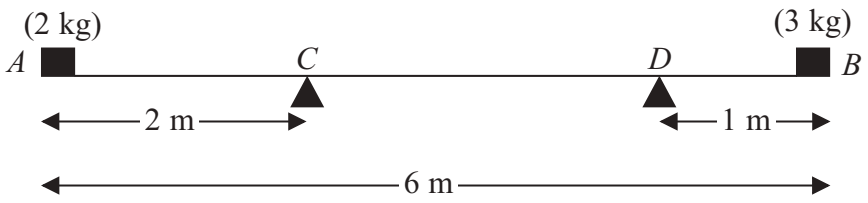

Figure 2

A plank AB, of length 6 m and mass 4 kg, rests in equilibrium horizontally on two supports at C and D, where $AC = 2$ m and $DB = 1$ m. A brick of mass 2 kg rests on the plank at A and a brick of mass 3 kg rests on the plank at B, as shown in Figure 2. The plank is modelled as a uniform rod and all bricks are modelled as particles.

(a) Find the magnitude of the reaction exerted on the plank

(i) by the support at C,

(ii) by the support at D.

(6)

The 3 kg brick is now removed and replaced with a brick of mass x kg at B. The plank remains horizontal and in equilibrium but the reactions on the plank at C and at D now have equal magnitude.

(b) Find the value of x.

(4)

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Question 4 continued

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Question 4 continued

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Question 4 continued

Q4

(Total 10 marks)

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5. [*In this question* **i** *and* **j** *are horizontal unit vectors due east and due north respectively. Position vectors are given relative to a fixed origin O.*]

A boy B is running in a field with constant velocity $(3\mathbf{i} - 2\mathbf{j})$ m s^{-1}. At time $t = 0$, B is at the point with position vector $10\mathbf{j}$ m.

Find

(a) the speed of B,

(2)

(b) the direction in which B is running, giving your answer as a bearing.

(3)

At time $t = 0$, a girl G is at the point with position vector $(4\mathbf{i} - 2\mathbf{j})$ m. The girl is running with constant velocity $\left(\frac{5}{3}\mathbf{i} + 2\mathbf{j}\right)$ m s^{-1} and meets B at the point P.

(c) Find

(i) the value of t when they meet,

(ii) the position vector of P.

(6)

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Question 5 continued

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Question 5 continued

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Question 5 continued

Q5

(Total 11 marks)

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6. A car starts from rest at a point A and moves along a straight horizontal road. The car moves with constant acceleration 1.5 m s^{-2} for the first 8 s. The car then moves with constant acceleration 0.8 m s^{-2} for the next 20 s. It then moves with constant speed for T seconds before slowing down with constant deceleration 2.8 m s^{-2} until it stops at a point B.

(a) Find the speed of the car 28 s after leaving A.

(3)

(b) Sketch, in the space provided, a speed–time graph to illustrate the motion of the car as it travels from A to B.

(2)

(c) Find the distance travelled by the car during the first 28 s of its journey from A.

(4)

The distance from A to B is 2 km.

(d) Find the value of T.

(4)

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Question 6 continued

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Question 6 continued

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Question 6 continued

Q6

(Total 13 marks)

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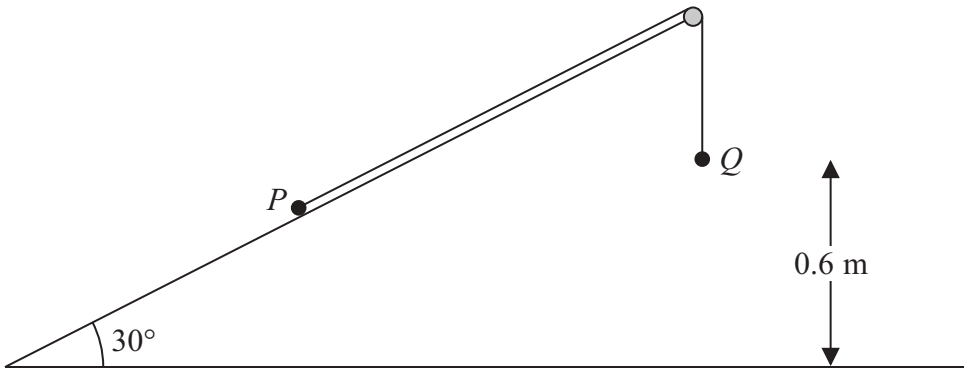

Figure 3

Two particles P and Q, of mass 2 kg and 3 kg respectively, are connected by a light inextensible string. Initially P is held at rest on a fixed smooth plane inclined at 30° to the horizontal. The string passes over a small smooth fixed pulley at the top of the plane. The particle Q hangs freely below the pulley and 0.6 m above the ground, as shown in Figure 3. The part of the string from P to the pulley is parallel to a line of greatest slope of the plane. The system is released from rest with the string taut.

For the motion before Q hits the ground,

(a) (i) show that the acceleration of Q is $\frac{2g}{5}$,

(ii) find the tension in the string.

(8)

On hitting the ground Q is immediately brought to rest by the impact.

(b) Find the speed of P at the instant when Q hits the ground.

(2)

In its subsequent motion P does not reach the pulley.

(c) Find the total distance moved up the plane by P before it comes to instantaneous rest.

(4)

(d) Find the length of time between Q hitting the ground and P first coming to instantaneous rest.

(2)

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Question 7 continued

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Question 7 continued

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Question 7 continued

Q7

(Total 16 marks)

TOTAL FOR PAPER: 75 MARKS

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