Write your name here

Surname	Other names

Pearson Edexcel
International
Advanced Level

Centre Number | | | | | |

Candidate Number | | | | |

Mechanics M1

Advanced/Advanced Subsidiary

Wednesday 25 October 2017 – Morning
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.

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1. A suitcase of mass 40 kg is being dragged in a straight line along a rough horizontal floor at constant speed using a thin strap. The strap is inclined at 20° above the horizontal. The coefficient of friction between the suitcase and the floor is $\frac{3}{4}$. The strap is modelled as a light inextensible string and the suitcase is modelled as a particle. Find the tension in the strap.

(7)

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Question 1 continued

Q1

(Total 7 marks)

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2.

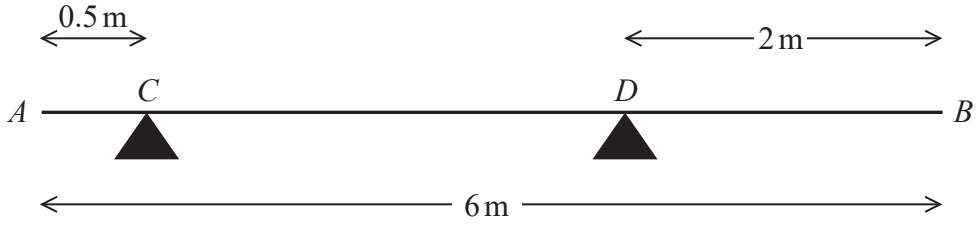

Figure 1

A metal girder AB, of weight 1080 N and length 6 m, rests in equilibrium in a horizontal position on two supports, one at C and one at D, where $AC = 0.5$ m and $BD = 2$ m, as shown in Figure 1. A boy of weight 400 N stands on the girder at B and the girder remains horizontal and in equilibrium. The boy is modelled as a particle and the girder is modelled as a uniform rod.

(a) Find

(i) the magnitude of the reaction on the girder at C,

(ii) the magnitude of the reaction on the girder at D.

(6)

The boy now stands at a point E on the girder, where $AE = x$ metres, and the girder remains horizontal and in equilibrium. Given that the magnitude of the reaction on the girder at D is now 520 N greater than the magnitude of the reaction on the girder at C,

(b) find the value of x.

(5)

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Question 2 continued

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Question 2 continued

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Question 2 continued

(Total 11 marks)

Q2

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3. Two particles P and Q have masses $4m$ and m respectively. They are moving in opposite directions towards each other along the same straight line on a smooth horizontal plane and collide directly. Immediately before the collision the speed of P is $2u$ and the speed of Q is $4u$. In the collision, the particles join together to form a single particle.

Find, in terms of m and u, the magnitude of the impulse exerted by P on Q in the collision.

(6)

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Question 3 continued

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Question 3 continued

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Question 3 continued

Q3

(Total 6 marks)

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4. Two forces $\mathbf{F}_1$ and $\mathbf{F}_2$ act on a particle. The force $\mathbf{F}_1$ has magnitude 8 N and acts due east. The resultant of $\mathbf{F}_1$ and $\mathbf{F}_2$ is a force of magnitude 14 N acting in a direction whose bearing is 120°.

Find

(i) the magnitude of $\mathbf{F}_2$,

(4)

(ii) the direction of $\mathbf{F}_2$, giving your answer as a bearing to the nearest degree.

(5)

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Question 4 continued

Q4

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5. A small ball is projected vertically upwards from a point O with speed $14.7\,\text{m s}^{-1}$. The point O is 2.5 m above the ground. The motion of the ball is modelled as that of a particle moving freely under gravity.

Find

(a) the maximum height above the ground reached by the ball,

(4)

(b) the time taken for the ball to first reach a height of 1 m above the ground,

(4)

(c) the speed of the ball at the instant before it strikes the ground for the first time.

(3)

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Question 5 continued

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Question 5 continued

(Total 11 marks)

Q5

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6. An athlete goes for a run along a straight horizontal road. Starting from rest, she accelerates at $0.6\,\text{m s}^{-2}$ up to a speed of $V\,\text{m s}^{-1}$. She then maintains this constant speed of $V\,\text{m s}^{-1}$ before finally decelerating at $0.2\,\text{m s}^{-2}$ back to rest. She covers a total distance of 1500 m in 270 s.

(a) Sketch a speed-time graph to represent the athlete's run.

(2)

(b) Show that she accelerates for $\frac{5V}{3}$ seconds.

(2)

(c) Show that $V^2 - kV + 450 = 0$, where k is a constant to be found.

(6)

(d) Find the value of V, justifying your answer.

(4)

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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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Q6

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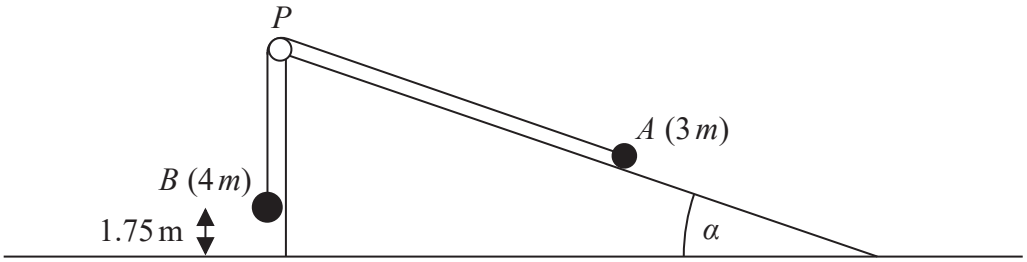

Figure 2

Figure 2 shows two particles A and B, of masses $3m$ and $4m$ respectively, attached to the ends of a light inextensible string. Initially A is held at rest on the surface of a fixed rough inclined plane. The plane is inclined to the horizontal at an angle α where $\tan\alpha = \frac{3}{4}$. The coefficient of friction between A and the plane is $\frac{1}{4}$. The string passes over a small smooth light pulley P which is fixed at the top of the plane. The part of the string from A to P is parallel to a line of greatest slope of the plane. The particle B hangs freely and is vertically below P. The system is released from rest with the string taut and with B at a height of 1.75 m above the ground. In the subsequent motion, A does not hit the pulley.

For the period before B hits the ground,

(a) write down an equation of motion for each particle.

(4)

(b) Hence show that the acceleration of B is $\frac{8}{35}g$.

(5)

(c) Explain how you have used the fact that the string is inextensible in your calculation.

(1)

When B hits the ground, B does not rebound and comes immediately to rest.

(d) Find the distance travelled by A from the instant when the system is released to the instant when A first comes to rest.

(7)

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Question 7 continued

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Q7

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TOTAL FOR PAPER: 75 MARKS

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