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INTERNATIONAL A LEVEL MATHEMATICS • MECHANICS 1 (WME01)

Mechanics 1 Practice Paper 1

Edexcel IAL Mechanics 1

AIMING FOR B

Written in the style of the Pearson Edexcel International Advanced Level paper (WME01/01) • Calculator allowed

A full 75-mark paper of multi-step exam questions covering every Mechanics 1 chapter, with a separate mark scheme

Time	Total	You must have
1 hour 30 minutes	**75 marks**	**Mathematical Formulae and Statistical Tables, calculator**

Instructions

- Use black ink or ball-point pen. Pencil may be used for diagrams and sketches.
- Answer **all** questions, in the spaces provided.
- Show enough working to make your method 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 **two or three significant figures**.

Information

- There are 8 questions in this paper. The total mark is 75.
- The marks for each question are shown in brackets.

Advice

- Sit the paper in one go, in 1 hour 30 minutes, with the mark scheme closed.
- Read each question carefully and try every question. Check your answers if you have time.
- Then mark it line by line with the mark scheme and fill in your score.

Track your score

Q	Topic	Marks	Score
1	A direct collision	7	
2	Motion under gravity	8	
3	Forces as vectors	9	
4	A particle held by two strings	9	
5	A plank on two supports	9	
6	A speed-time graph	10	
7	A box on a rough slope	10	
8	Connected particles and a pulley	13	
	Total	**75**	

Rough grade guide (out of 75): A **60** • B **52** • C **44**

Based on recent WME01 grade boundaries. Real boundaries change every series, so treat this as a guide, not a grade.

Mark scheme | Exam questions by topic | More practice papers

Name ..... Date .....

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1. Two particles, P and Q, have masses 2 kg and 3 kg respectively. They are moving towards each other in opposite directions along the same straight line on a smooth horizontal plane. Just before they collide, P has speed $6\,\text{m s}^{-1}$ and Q has speed $2\,\text{m s}^{-1}$

In the collision, the direction of motion of P is reversed and its speed immediately after the collision is $1.5\,\text{m s}^{-1}$

(a) Find the speed of Q immediately after the collision, and state its direction of motion.

(4)

(b) Find the magnitude of the impulse exerted on Q by P in the collision.

(3)

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Question 1 continued

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(Total for Question 1 is 7 marks)

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2. A ball is projected vertically upwards with speed $14.7\,\text{m}\,\text{s}^{-1}$ from a point O which is 24.5 m vertically above the sea. The ball is modelled as a particle moving freely under gravity.

(a) Find the greatest height of the ball above the sea.

(3)

(b) Find the time taken for the ball to reach the sea.

(3)

(c) Find the speed of the ball as it reaches the sea.

(2)

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Question 2 continued

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(Total for Question 2 is 8 marks)

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3. *In this question,* $\mathbf{i}$ *and* $\mathbf{j}$ *are perpendicular horizontal unit vectors.*

A particle P of mass 2 kg moves on a smooth horizontal plane under the action of three forces

$$\mathbf{F}_1 = (2\mathbf{i} + 5\mathbf{j})\text{ N}, \qquad \mathbf{F}_2 = (3\mathbf{i} - \mathbf{j})\text{ N} \qquad \text{and} \qquad \mathbf{F}_3 = (\mathbf{i} + 4\mathbf{j})\text{ N}$$

(a) Find the magnitude of the acceleration of P

(4)

(b) Find the angle between the acceleration of P and the vector $\mathbf{i}$

(2)

At time $t = 0$, the velocity of P is $(-3\mathbf{i} + 2\mathbf{j})\text{ m s}^{-1}$

(c) Find the speed of P when $t = 2$

(3)

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Question 3 continued

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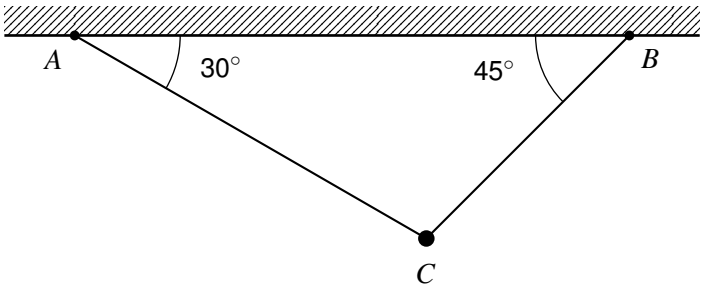

Figure 1

A particle of mass 3 kg is attached at C to two light inextensible strings, AC and BC. The other ends of the strings are attached to points A and B on a horizontal ceiling. The particle hangs in equilibrium with AC at 30° to the ceiling and BC at 45° to the ceiling, as shown in Figure 1.

(a) Find the tension in AC and the tension in BC

(6)

Each string will break if its tension exceeds 40 N. The particle is replaced by a heavier particle, and the strings stay at the same angles.

(b) Find the greatest mass of the particle for which neither string breaks.

(3)

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Question 4 continued

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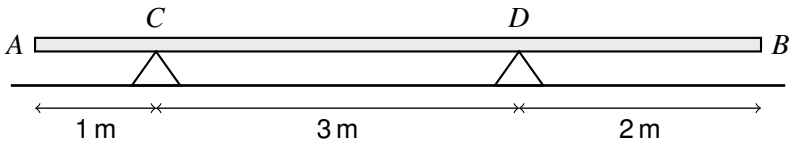

Figure 2

A uniform plank AB has length 6 m and mass 30 kg. It rests in a horizontal position on two supports, at C and D, where AC = 1 m and DB = 2 m, as shown in Figure 2. A man of mass 70 kg stands on the plank at the point that is 2 m from A

The plank is modelled as a uniform rod and the man as a particle.

(a) Find the magnitude of the reaction on the plank at C and at D

(4)

The man now walks along the plank towards B

(b) Find the distance from B of the man when the plank is about to tilt.

(4)

(c) State how you have used the fact that the plank is uniform.

(1)

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Question 5 continued

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(Total for Question 5 is 9 marks)

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6. A train travels along a straight horizontal track from station A to station B, a distance of 5 km. It starts from rest at A and accelerates uniformly for 40 s until its speed is 20 m s^{-1}. It then travels at 20 m s^{-1} for T seconds, before decelerating uniformly at 0.5 m s^{-2} until it comes to rest at B

(a) Sketch a speed-time graph for the motion of the train from A to B

(2)

(b) Show that $T = 210$

(3)

(c) Find the total time taken to travel from A to B

(1)

(d) Find the time taken for the train to travel the first 2.5 km of the journey.

(2)

A signal is beside the track, 300 m before B

(e) Find the time taken by the train to travel from the signal to B

(2)

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Question 6 continued

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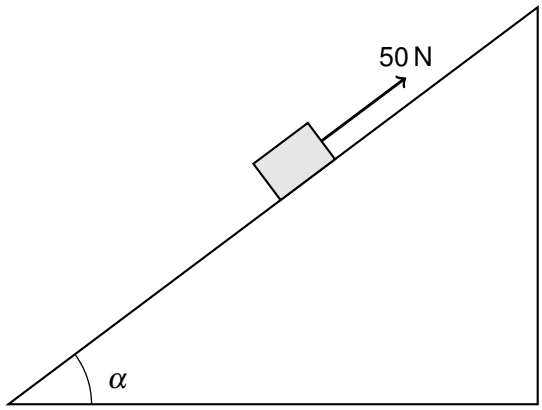

Figure 3

A box of mass 5 kg is pulled up a line of greatest slope of a rough plane by a force of magnitude 50 N. The plane is inclined at an angle α to the horizontal, where $\tan\alpha = \frac{3}{4}$, and the force acts parallel to the line of greatest slope, as shown in Figure 3. The box is modelled as a particle, and it moves up the plane with acceleration 2.16 m s^{-2}

(a) Show that the coefficient of friction between the box and the plane is 0.25

(5)

The box starts from rest. After 5 s the force is removed.

(b) Find the further distance that the box moves up the plane before coming to rest.

(4)

(c) Determine whether the box will then remain at rest, giving a reason for your answer.

(1)

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Question 7 continued

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(Total for Question 7 is 10 marks)

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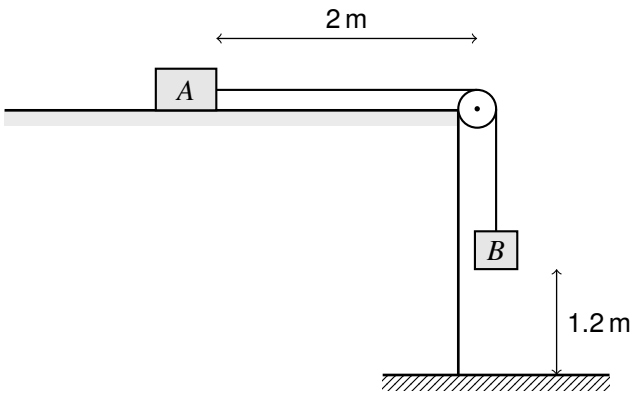

Figure 4

A particle A of mass 3 kg rests on a rough horizontal table. It is attached to one end of a light inextensible string, which passes over a small smooth pulley fixed at the edge of the table. The other end of the string is attached to a particle B of mass 2 kg, which hangs freely 1.2 m above the floor. A is 2 m from the pulley, as shown in Figure 4. The coefficient of friction between A and the table is $\frac{1}{3}$

The system is released from rest with the string taut.

(a) Find the acceleration of A and the tension in the string while B is falling.

(6)

(b) Find the speed of B just before it hits the floor.

(2)

B does not rebound when it hits the floor.

(c) Show that A comes to rest before it reaches the pulley.

(4)

(d) State how you have used the fact that the string is inextensible.

(1)

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Question 8 continued

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(Total for Question 8 is 13 marks)

TOTAL FOR PAPER IS 75 MARKS

END

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