eClassroom

INTERNATIONAL A LEVEL MATHEMATICS • MECHANICS 2 (WME02)

Mechanics 2 Practice Paper 2

Edexcel IAL Mechanics 2

AIMING FOR A

Written in the style of the Pearson Edexcel International Advanced Level paper (WME02/01) • Calculator allowed

A full 75-mark paper, harder than a typical real series, with fewer steps given and chapters combined in every question

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 $g = 9.8\,\text{m}\,\text{s}^{-2}$, and give your answer to either **two or three significant figures**.

Information

- There are 7 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 projectile hitting a wall	9	
2	Variable acceleration and an impulse	10	
3	A loaded wire frame on a slope	10	
4	A slope and then a collision	11	
5	A hinged rod and a string	11	
6	Three spheres in a line	12	
7	Force, power and work from a velocity	12	
	Total	**75**	

Rough grade guide (out of 75): A* **61** • A **54** • B **46** • C **38**

Based on recent WME02 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 .....

★★★★★

Join students already acing their exams.

Book your FREE lesson at www.eclassroom.org.uk

1.

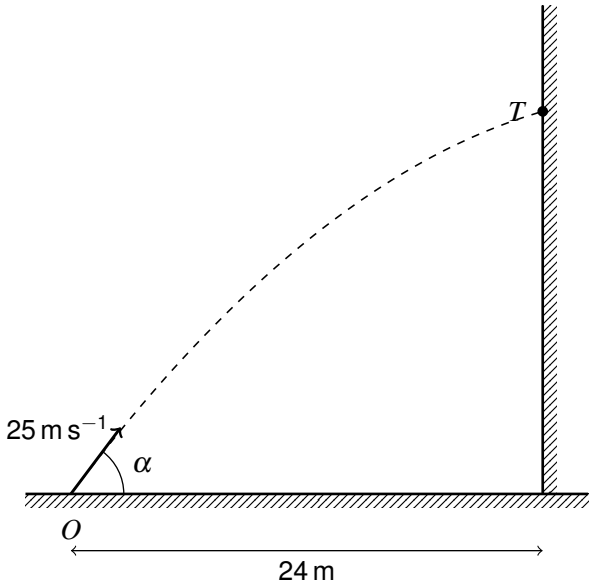

Figure 1

A ball is projected from a point O on horizontal ground with speed $25\,\text{m s}^{-1}$ at an angle α above the horizontal, where $\tan\alpha = \frac{4}{3}$. The ball moves freely under gravity in a vertical plane perpendicular to a vertical wall, which is 24 m from O. The ball hits the wall at the point T, as shown in Figure 1.

(a) Find the height of T above the ground.

(3)

(b) Use the principle of conservation of mechanical energy to find the speed of the ball as it hits the wall.

(3)

(c) Find the direction of motion of the ball as it hits the wall.

(3)

DO NOT WRITE IN THIS AREA

Question 1 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 1 is 9 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

2. *In this question,* $\mathbf{i}$ *and* $\mathbf{j}$ *are perpendicular unit vectors in a horizontal plane.*

A particle P of mass 0.5 kg moves on a smooth horizontal plane. At time t seconds, $t \geqslant 0$, the acceleration of P is $(2\mathbf{i} - 6t\mathbf{j})\,\text{m s}^{-2}$. At time $t = 0$, the velocity of P is $(-4\mathbf{i} + 3\mathbf{j})\,\text{m s}^{-1}$

(a) Find the velocity of P at time t seconds.

(3)

(b) Find the speed of P at the instant when it is moving parallel to $\mathbf{i}$

(3)

At time $t = 2$, P receives an impulse. Immediately after the impulse, the velocity of P is $(3\mathbf{i} + 6\mathbf{j})\,\text{m s}^{-1}$

(c) Find the magnitude of the impulse.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 2 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 2 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

3.

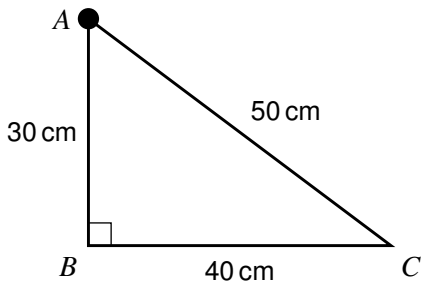

Figure 2

A uniform wire of mass 1.2 kg is bent to form a triangular frame ABC, where $AB = 30$ cm, $BC = 40$ cm, $CA = 50$ cm and angle $ABC = 90°$. A particle of mass 0.6 kg is attached to the frame at A, as shown in Figure 2.

(a) Find the distance of the centre of mass of the loaded frame from **(i)** AB **(ii)** BC

(6)

The loaded frame stands in a vertical plane with BC in contact with a rough plane inclined at an angle α to the horizontal. The edge BC lies along a line of greatest slope, with B below C. The coefficient of friction between the frame and the plane is 0.75. The angle α is gradually increased from zero.

(b) Determine whether the frame first slides or first topples, and find the value of α at which this happens.

(4)

DO NOT WRITE IN THIS AREA

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 3 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 3 is 10 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

4.

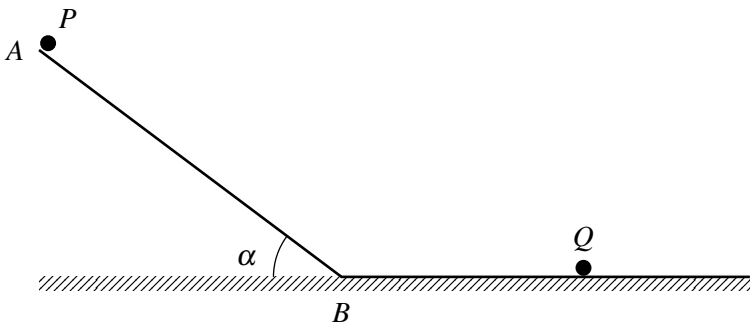

Figure 3

A particle P of mass 2 kg is released from rest at a point A on a rough plane inclined at an angle α to the horizontal, where $\sin\alpha = 0.6$. The coefficient of friction between P and the plane is 0.25. P slides down a line of greatest slope to the point B at the bottom of the plane, where $AB = 6.25$ m. At B, P moves onto a smooth horizontal floor with no change in speed, as shown in Figure 3.

On the floor, P collides directly with a particle Q of mass 3 kg, which is at rest. The coefficient of restitution between P and Q is $\frac{4}{7}$

(a) Use the work-energy principle to find the speed of P at B

(4)

(b) Find the speed of P and the speed of Q immediately after the collision.

(5)

(c) Find the kinetic energy lost in the collision.

(2)

DO NOT WRITE IN THIS AREA

Question 4 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 4 is 11 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

5.

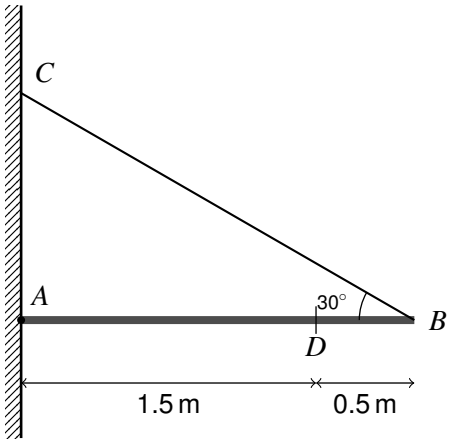

Figure 4

A rod AB of length 2 m is made of two uniform sections joined at D: section AD has length 1.5 m and mass 3 kg, and section DB has length 0.5 m and mass 3 kg. The end A is freely hinged to a fixed point on a vertical wall. The rod is held in equilibrium in a horizontal position, perpendicular to the wall, by a light inextensible string. One end of the string is attached to the rod at B and the other end is attached to the wall at the point C, vertically above A. Angle $ABC = 30°$, as shown in Figure 4.

(a) Find the distance of the centre of mass of the rod from A

(2)

(b) Find the tension in the string.

(3)

(c) Find the magnitude and direction of the force exerted on the rod by the hinge.

(6)

DO NOT WRITE IN THIS AREA

Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

Question 5 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 5 is 11 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

6. Three small smooth spheres A, B and C, of equal radius and of masses m, $2m$ and $3m$ respectively, lie in a straight line on a smooth horizontal surface, with B between A and C. Spheres B and C are at rest. Sphere A is projected towards B with speed u and collides directly with B. The coefficient of restitution between each pair of spheres is e

(a) Find, in terms of u and e, the velocity of A and the velocity of B immediately after the collision.

(4)

B then collides directly with C

(b) Find, in terms of u and e, the velocity of B immediately after it collides with C

(3)

Given that A and B then collide again,

(c) find the range of possible values of e

(3)

(d) Given instead that $e = \frac{1}{4}$, find, in terms of m and u, the kinetic energy lost in the collision between A and B

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 6 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 6 is 12 marks)

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk

7. A particle P of mass 3 kg moves along a straight line under the action of a single force. At time t seconds, $t \geqslant 0$, the velocity of P is $(t^2 - 6t + 13)\,\text{m s}^{-1}$

(a) Find an expression, in terms of t, for the force acting on P at time t seconds.

(2)

(b) Find the least speed of P

(2)

(c) Find the rate at which the force is working when $t = 5$

(2)

(d) Find the work done by the force in the interval $0 \leqslant t \leqslant 5$

(3)

(e) Find the distance travelled by P in the interval $0 \leqslant t \leqslant 5$

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 7 continued

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(Total for Question 7 is 12 marks)

TOTAL FOR PAPER IS 75 MARKS

END

★★★★★
Join students already acing their exams.
Book your FREE lesson at www.eclassroom.org.uk