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Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel Level 3 GCE

Thursday 19 June 2025

Afternoon

**Paper
reference**

9MA0/32

Mathematics

Advanced

PAPER 32: Mechanics

You must have:

Mathematical Formulae and Statistical Tables (Green), calculator

Total Marks

1. A car moves in a straight line along a horizontal road with constant acceleration 2 m s^{-2}

The car is moving with speed 15 m s^{-1} in the direction of the acceleration when it passes a signpost on the road.

The car is modelled as a particle.

- (a) Use the model to find the speed of the car 4 s after passing the signpost.

(2)

Figure 1 below shows the horizontal forces acting on the car.

Given that

- the car has mass 800 kg
- the driving force of the engine has magnitude D newtons
- the resistance to the motion of the car has magnitude 400 N
- the acceleration of the car is 2 m s^{-2} in the direction of the driving force

- (b) use the model to find the value of D .

(2)

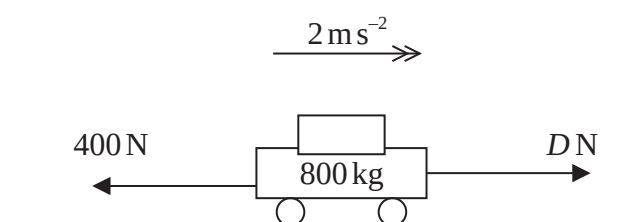


Figure 1



Question 1 continued

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(Total for Question 1 is 4 marks)

2.



Figure 2

A small box B of mass 2 kg is dragged in a straight line, along a **rough** horizontal plane, at a **constant speed** by a force of magnitude 5 N .

The line of action of the force makes an angle α with the plane, where $\sin \alpha = \frac{3}{5}$, as shown in Figure 2.

- (a) Show that the magnitude of the normal reaction of the plane on the box is 16.6 N . (3)

At the instant when B is at the point O on the plane, the force of magnitude 5 N is removed.

- (b) Describe the motion of the box after the force of magnitude 5 N is removed. (1)
- (c) Find the magnitude of the normal reaction of the plane on the box after the force of magnitude 5 N is removed. (1)

Given that after the force of magnitude 5 N is removed

- the box is modelled as a particle
- air resistance is modelled as being negligible
- the coefficient of friction between the box and the plane is modelled as 0.2
- the speed of the box as it passes through O is 4 ms^{-1}
- the box comes to rest at the point X on the plane

- (d) use the model to find the length OX . (4)
- (e) State one limitation of the model, apart from ignoring air resistance, that could affect your answer to part (d). (1)



Question 2 continued

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Question 3 continued

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Question 4 continued

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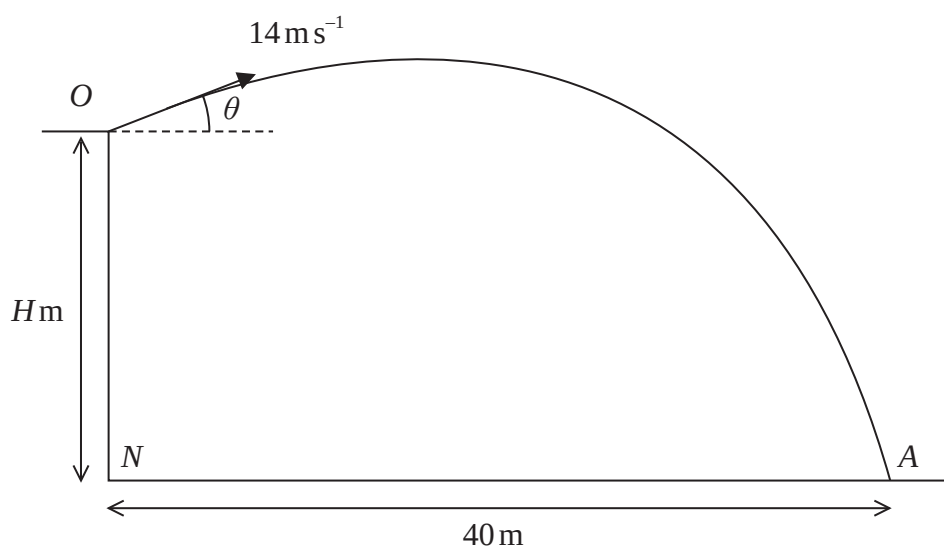


Figure 3

A small stone is projected with speed 14 m s^{-1} from a point O on the top of a cliff. The point O is H metres vertically above the point N .

Point N is on horizontal ground.

The stone is projected at an angle θ above the horizontal, where $\tan \theta = \frac{1}{2}$

The stone strikes the horizontal ground at the point A , where $NA = 40$ m, as shown in Figure 3.

The stone is modelled as a particle moving freely under gravity.

Using this model, find

- (a) the value of H (5)
- (b) the maximum height of the stone above the horizontal ground. (3)



Question 5 continued

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(Total for Question 5 is 8 marks)



6.

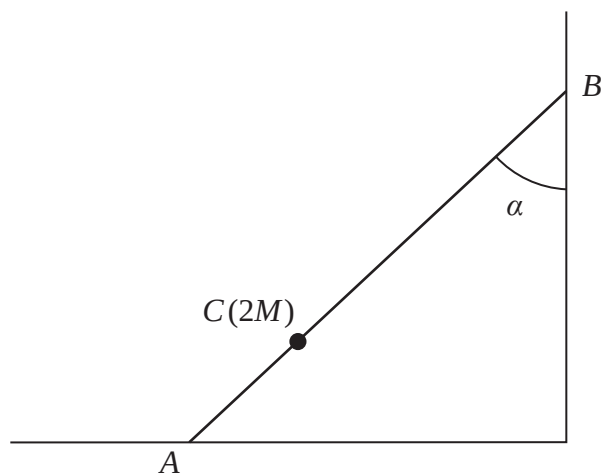


Figure 4

A uniform rod AB has mass M and length $2a$.

A particle of mass $2M$ is attached to the rod at the point C , where $AC = 0.5a$

The rod rests with end A on rough horizontal ground and end B against a vertical wall.

The rod lies in a vertical plane which is perpendicular to the wall.

The rod is in equilibrium at an angle α to the wall, as shown in Figure 4.

In an initial model

- the vertical wall is modelled as being **smooth**
- the magnitude of the normal reaction of the ground on the rod at A is R
- the magnitude of the force exerted on the rod by the wall at B is S

Using the model,

(a) find R in terms of M and g (1)

(b) show that $S = Mg \tan \alpha$ (3)

In a refined model

- the vertical wall is modelled as being **rough**
- the magnitude of the normal reaction of the ground on the rod at A is R_1

(c) State which is greater, R or R_1 , giving a reason for your answer. (1)

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Question 6 continued

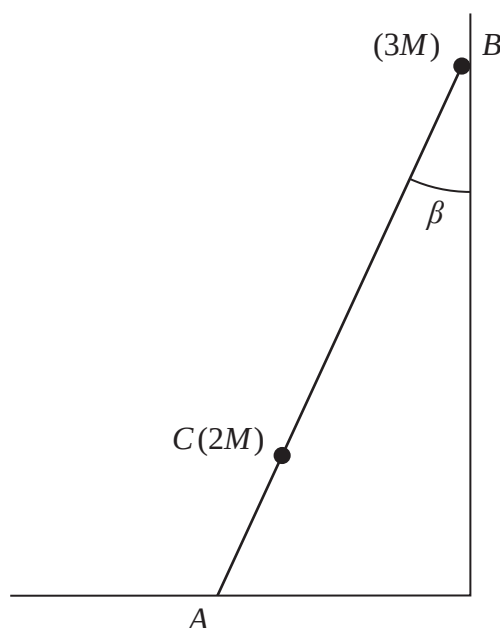


Figure 5

A second particle of mass $3M$ is now attached to the rod at B .

The rod again rests with end A on rough horizontal ground and end B against the vertical wall.

The rod lies in a vertical plane which is perpendicular to the wall.

The rod is now in limiting equilibrium at an angle β to the wall, as shown in Figure 5.

The vertical wall is again modelled as being **smooth**.

The coefficient of friction between the rod and the ground is μ

Given that $\tan \beta = \frac{1}{2}$

(d) use the model to show that $\mu = \frac{1}{3}$

(6)

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(Total for Question 6 is 11 marks)**TOTAL FOR MECHANICS IS 50 MARKS**