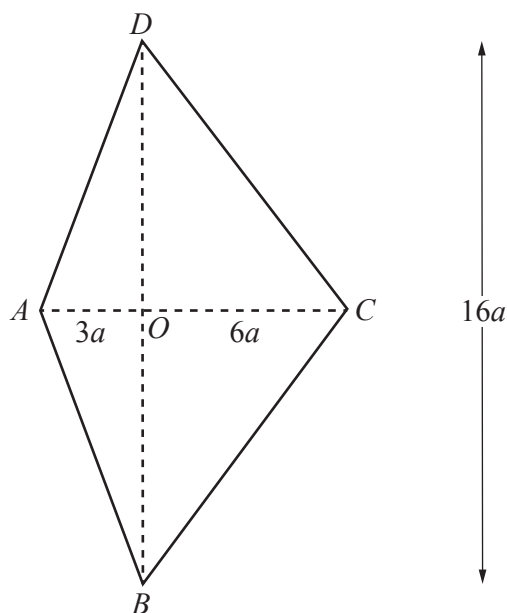




A uniform lamina $ABCD$ consists of two isosceles triangles ABD and BCD . The diagonals of $ABCD$ meet at the point O . The length of AO is $3a$, the length of OC is $6a$ and the length of BD is $16a$ (see diagram).

Find the distance of the centre of mass of the lamina from DB .

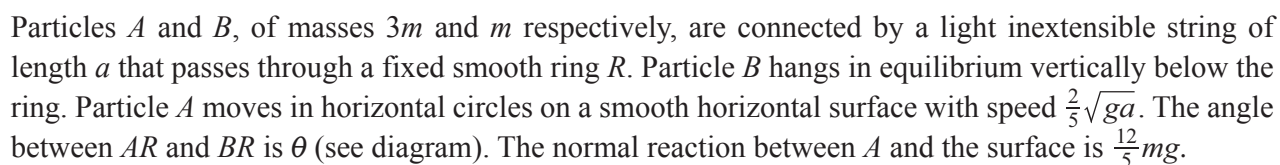
[3]

This image shows a full page of a worksheet designed for handwriting practice. It features ten sets of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

- 2 One end of a light elastic string of natural length 0.8 m and modulus of elasticity 36 N is attached to a fixed point O on a smooth plane. The plane is inclined at an angle α to the horizontal, where $\sin \alpha = \frac{3}{5}$. A particle P of mass 2 kg is attached to the other end of the string. The string lies along a line of greatest slope of the plane with the particle below the level of O . The particle is projected with speed $\sqrt{2}\text{ ms}^{-1}$ directly down the plane from the position where OP is equal to the natural length of the string.

Find the maximum extension of the string during the subsequent motion. [5]

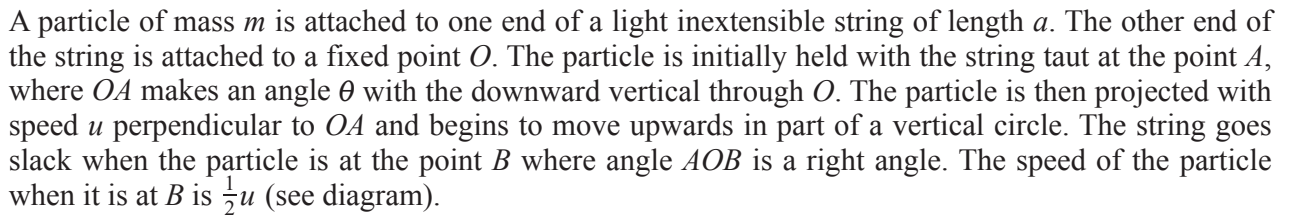
[illegible]



(b) Find, in terms of a , the distance of B below the ring.

[3]

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a full page of white paper with horizontal dashed lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- 5 A particle P of mass m kg is projected vertically upwards from a point O , with speed 20 ms^{-1} , and moves under gravity. There is a resistive force of magnitude $2mv$ N, where $v \text{ ms}^{-1}$ is the speed of P at time t s after projection.

- (a) Find an expression for v in terms of t , while P is moving upwards. [6]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines, providing a guide for letter height and placement. The lines are evenly spaced across the entire page, leaving ample room for writing practice. There is no text or other markings on the page.

The displacement of P from O is x m at time t s.

- (b) Find an expression for x in terms of t , while P is moving upwards. [2]

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- (c) Find, correct to 3 significant figures, the greatest height above O reached by P . [2]

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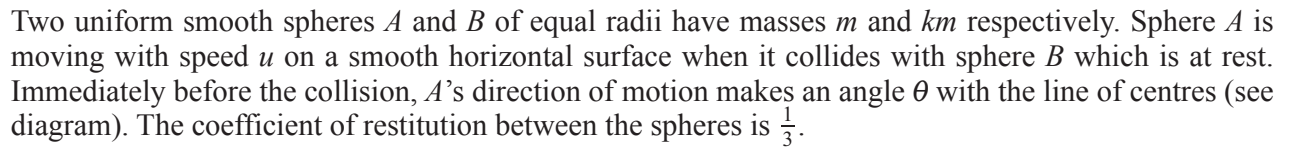
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- This image shows a full page of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page, typical of notebook or legal stationery. There are no margins, text, or other markings on the page.

70% of the total kinetic energy of the spheres is lost as a result of the collision.

(b) Given that $\tan \theta = \frac{1}{3}$, find the value of k .

[6]

[illegible]

- 7 A particle P is projected with speed u at an angle θ above the horizontal from a point O on a horizontal plane and moves freely under gravity. The horizontal and vertical displacements of P from O at a subsequent time t are denoted by x and y respectively.

- (a) Use the equation of the trajectory given in the List of formulae (MF19), together with the condition $y = 0$, to establish an expression for the range R in terms of u , θ and g . [2]

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- (b) Deduce an expression for the maximum height H , in terms of u , θ and g . [2]

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It is given that $R = \frac{4H}{\sqrt{3}}$.

- (c) Show that $\theta = 60^\circ$. [1]

[illegible]

It is given also that $u = \sqrt{40} \text{ m s}^{-1}$.

- (d) Find, by differentiating the equation of the trajectory or otherwise, the set of values of x for which the direction of motion makes an angle of less than 45° with the horizontal. [4]

[illegible]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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