A uniform lamina OABC is a trapezium whose vertices can be represented by coordinates in the x-y

Find the x-coordinate of the cer	ntre of mass of the lamina.	[
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A particle $P$ of mass $m$ is attached to one end of a light elastic string of natural length $a$ and modulus elasticity $\frac{4}{3}mg$ . The other end of the string is attached to a fixed point $O$ on a rough horizontal surface. The particle is at rest on the surface with the string at its natural length. The coefficient of frictive between $P$ and the surface is $\frac{1}{3}$ . The particle is projected along the surface in the direction $OP$ with speed of $\frac{1}{2}\sqrt{ga}$ .
Find the greatest extension of the string during the subsequent motion.

A particle P is projected with speed  $25 \,\mathrm{m\,s^{-1}}$  at an angle  $\theta$  above the horizontal from a point O on a

J	Find the value of $\sin \theta$ .
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One end of a light inextensible string of length a is attached to a fixed point O. A particle of mass m is attached to the other end of the string and is held with the string taut at the point A. At A the string makes an angle  $\theta$  with the upward vertical through O. The particle is projected perpendicular to the string in a downward direction from A with a speed u. It moves along a circular path in the vertical plane.

When the string makes an angle  $\alpha$  with the downward vertical through O, the speed of the particle is 2u and the magnitude of the tension in the string is 10 times its magnitude at A.

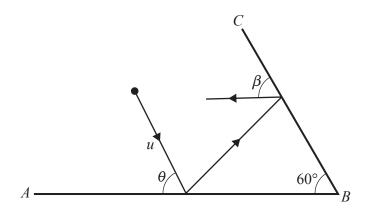
It is given that  $u = \sqrt{\frac{2}{3}ga}$ .

Find, in terms of $m$ and $g$ ,	the magnitude of the tension in the string at $A$ .	
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1)	Show by integration that $v =$	$\frac{1+3e^x}{e^x}.$	
		1 = 1 = 3 = 6   = 1	

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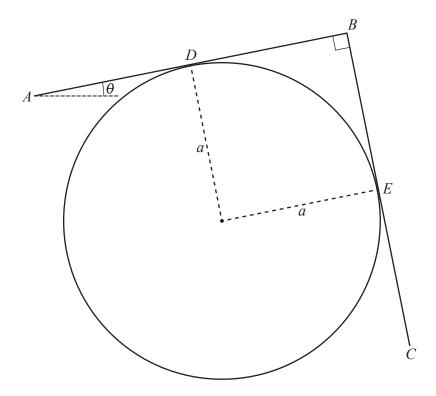


AB and BC are two fixed smooth vertical barriers on a smooth horizontal surface, with angle  $ABC = 60^{\circ}$ . A particle of mass m is moving with speed u on the surface. The particle strikes AB at an angle  $\theta$  with AB. It then strikes BC and rebounds at an angle  $\beta$  with BC (see diagram). The coefficient of restitution between the particle and each barrier is e and  $\tan \theta = 2$ .

The kinetic energy of the particle after the first collision is 40% of its kinetic energy before the first collision.

Find the value of <i>e</i> .	
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Find the size of angle $\beta$ .	



A uniform cylinder with a rough surface and of radius a is fixed with its axis horizontal. Two identical uniform rods AB and BC, each of weight W and length 2a, are rigidly joined at B with AB perpendicular to BC. The rods rest on the cylinder in a vertical plane perpendicular to the axis of the cylinder with AB at an angle  $\theta$  to the horizontal. D and E are the midpoints of E0 and E1 respectively and also the points of contact of the rods with the cylinder (see diagram). The rods are about to slip in a clockwise direction. The coefficient of friction between each rod and the cylinder is E1.

The normal reaction between AB and the cylinder is R and the normal reaction between BC and the cylinder is N.

(a)	Find the ratio $R: N$ in terms of $\mu$ .	[6]
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