

Edexcel Maths M3

Topic Questions from Papers

Strings & Springs

- [illegible]



- (a) Find the modulus of elasticity of the string.

(b) Find the angle  $\theta$ .

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.

- By using the principle of conservation of energy,

- (b) find, in terms of  $a$  and  $g$ , the speed of  $P$  when the string first becomes slack. (4)

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- 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.



## This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal grey lines across its entire surface, typical of notebook or school paper. There are no margins, text, or other markings present.

A light elastic spring, of natural length  $L$  and modulus of elasticity  $\lambda$ , has a particle  $P$  of mass  $m$  attached to one end. The other end of the spring is fixed to a point  $O$  on the closed end of a fixed smooth hollow tube of length  $L$ .

(a) Show that  $\lambda = 8mg$ .

(b) Find  $u$ .

One end  $A$  of a light elastic string, of natural length  $a$  and modulus of elasticity  $6mg$ , is fixed at a point on a smooth plane inclined at  $30^\circ$  to the horizontal. A small ball  $B$  of mass  $m$  is attached to the other end of the string. Initially  $B$  is held at rest with the string lying along a line of greatest slope of the plane, with  $B$  below  $A$  and  $AB = a$ . The ball is released and comes to instantaneous rest at a point  $C$  on the plane, as shown in Figure 2. Find

- (a) the length  $AC$ , (5)
- (b) the greatest speed attained by  $B$  as it moves from its initial position to  $C$ . (7)



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**Question 5 continued**



- (3)

- (a) Show that  $v^2 = 2g(a+x) - \frac{3gx^2}{2a}$ . (4)

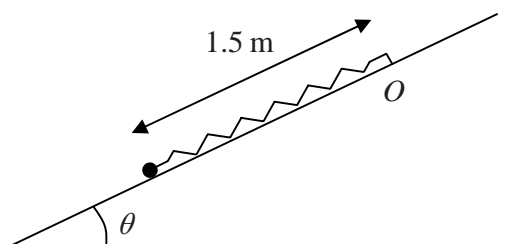
- (c) Find the magnitude of the acceleration of  $P$  at  $D$ . (6)

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### Question 7 continued



3.

**Figure 2**

A particle of mass 0.5 kg is attached to one end of a light elastic spring of natural length 0.9 m and modulus of elasticity  $\lambda$  newtons. The other end of the spring is attached to a fixed point  $O$  on a rough plane which is inclined at an angle  $\theta$  to the horizontal, where  $\sin \theta = \frac{3}{5}$ . The coefficient of friction between the particle and the plane is 0.15. The particle is held on the plane at a point which is 1.5 m down the line of greatest slope from  $O$ , as shown in Figure 2. The particle is released from rest and first comes to rest again after moving 0.7 m up the plane.

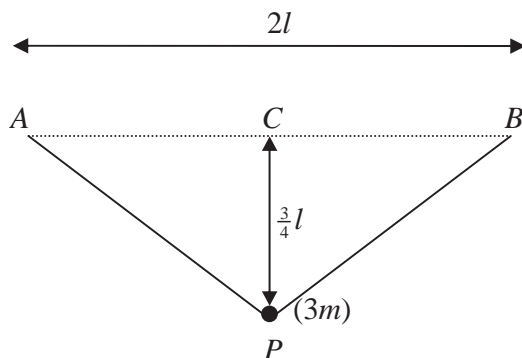
Find the value of  $\lambda$ .

**(9)**

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**6.**



### Figure 4

A small ball of mass  $3m$  is attached to the ends of two light elastic strings  $AP$  and  $BP$ , each of natural length  $l$  and modulus of elasticity  $kmg$ . The ends  $A$  and  $B$  of the strings are attached to fixed points on the same horizontal level, with  $AB = 2l$ . The mid-point of  $AB$  is  $C$ . The ball hangs in equilibrium at a distance  $\frac{3}{4}l$  vertically below  $C$  as shown in Figure 4.

- (a) Show that  $k = 10$

**(7)**

The ball is now pulled vertically downwards until it is at a distance  $\frac{12}{5}l$  below  $C$ . The ball is released from rest.

- (b) Find the speed of the ball as it reaches  $C$ .

(6)

[illegible]

The diagram shows a vertical line with points A, C, and B. A horizontal dashed line segment CP of length 3a is drawn from point C to a point P(m). A right angle is indicated at C. The distance AC is 4a and the distance CB is 3a. Solid line segments connect A to P and B to P.

A light inextensible string has its ends attached to two fixed points  $A$  and  $B$ . The point  $A$  is vertically above  $B$  and  $AB = 7a$ . A particle  $P$  of mass  $m$  is fixed to the string and moves in a horizontal circle of radius  $3a$  with angular speed  $\omega$ . The centre of the circle is  $C$  where  $C$  lies on  $AB$  and  $AC = 4a$ , as shown in Figure 4. Both parts of the string are taut.

- (a) Show that the tension in  $AP$  is  $\frac{5}{7}m(3a\omega^2 + g)$ . (8)
- (b) Find the tension in  $BP$ . (2)
- (c) Deduce that  $\omega \geq \frac{1}{2}\sqrt{\left(\frac{g}{a}\right)}$ . (2)





A diagram of a circle with center  $O$ . A horizontal line segment  $OP$  is drawn from the center to the right edge of the circle, where  $P$  is a point on the circumference. A point  $A$  is located on the segment  $OP$ . The distance  $OA$  is labeled  $a$ . The points  $B$  and  $C$  are marked on the upper and lower parts of the circle's circumference, respectively.

A particle  $P$  is attached to one end of a light inextensible string of length  $a$ . The other end of the string is attached to a fixed point  $O$ . The particle is held at the point  $A$ , where  $OA = a$  and  $OA$  is horizontal. The point  $B$  is vertically above  $O$  and the point  $C$  is vertically below  $O$ , with  $OB = OC = a$ , as shown in Figure 5. The particle is projected vertically upwards with speed  $3\sqrt{ag}$ .

- (b) Find the speed of  $P$  as it reaches  $C$ . (2)

As  $P$  passes through  $C$  it receives an impulse. Immediately after this, the speed of  $P$  is  $\frac{5}{12}\sqrt{11}ag$  and the direction of motion of  $P$  is unchanged.

- (c) Find the angle between the string and the downward vertical when  $P$  comes to instantaneous rest. (4)



- (4)



- (5)





- (a) Show that  $T = 3mg \left( \cos \theta + \frac{1}{4} \right)$ . (8)

(b) the speed of  $P$  at  $B$ ,

**(3)**

- (c) the maximum height above  $B$  reached by  $P$  before it starts to fall. (4)





- (a) Show that  $AE = 0.9$  m.

(3)

(b) Find the distance  $AC$ .

(5)

- (4)

- (2)



- (3)

(6)

- (6)





- (a) Find the speed of  $P$  when  $OP = 1.2$  m.

The particle comes to rest at the point C.

- (b) Find the distance  $BC$ .

(2)

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