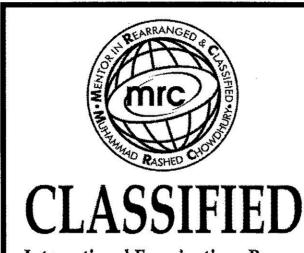
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## Edexcel AS Mechanics M1 TOPIC-Inclined Plane



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www.dynamicpapers.com Leave blank A lifeboat slides down a straight ramp inclined at an angle of 15° to the horizontal. The lifeboat has mass 800 kg and the length of the ramp is 50 m. The lifeboat is released from rest at the top of the ramp and is moving with a speed of 12.6 m s<sup>-1</sup> when it reaches the end of the ramp. By modelling the lifeboat as a particle and the ramp as a rough intimed plane, find the coefficient of friction between the lifeboat and the ramp



4.	A package of mass 6 kg is held at rest at a fixed point $A$ on a rough plane. The plane is inclined at 30° to the horizontal. The package is released from rest and slides down a line of greatest slope of the plane. The coefficient of friction between the package and the plane is $\frac{1}{4}$ . The package is modelled as a particle.  (a) Find the magnitude of the acceleration of the package.  (b)  As it slides down the slope the package passes through the point $B$ , where $AB = 10$ m.
	As it stides down the stope the package passes through the point $B$ , where $AB = 10$ m.
	(b) Find the speed of the package as it passes through $B$ . (2)
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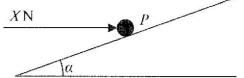
Figure 1

A particle P of mass 5kg is held at rest in equilibrium on a rough inclined plane by a horizontal force of magnitude 10 N. The plane is inclined to the horizontal at an angle  $\alpha$  where  $\tan \alpha = \frac{3}{4}$ , as shown in Figure 1. The line of action of the force lies in the vertical plane containing P and a line of greatest slope of the plane. The coefficient of friction between P and the plane is  $\mu$ . Given that P is on the point of sliding down the plane, find the value of  $\mu$ .

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A particle P of mass 2 kg is pushed up a line of greatest slope of a rough plane By horizontal force of magnitude X newtons, as shown in Figure 2. The force of magnitude X newtons, as shown in Figure 2. vertical plane which contains P and a line of greatest slope of the plane. The plane is

inclined to the horizontal at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ 

The coefficient of friction between P and the plane is 0.5

(10)	Given that the acceleration of P is 1

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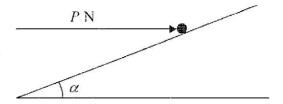


Figure 2



A particle of mass 0.4 kg is held at rest on a fixed rough plane by a horizontal force of magnitude P newtons. The force acts in the vertical plane containing the line of greatest slope of the inclined plane which passes through the particle. The plane is inclined to the horizontal at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ , as shown in Figure 2.

The coefficient of friction between the particle and the plane is  $\frac{1}{3}$ .

Given that the particle is on the point of sliding up the plane, find

(a) the magnitude of the normal reaction between the particle and the plane,

**(5)** 

(b) the value of P.

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- 5. A particle of mass 0.8 kg is held at rest on a rough plane. The plane is inclined at 30° to the horizontal. The particle is released from rest and slides down a line of greatest slope of the plane. The particle moves 2.7 m during the first 3 seconds of its motion. Find
  - (a) the acceleration of the particle,
  - (b) the coefficient of friction between the particle and the plane.

The particle is now held on the same rough plane by a horizontal force of magnified X newtons, acting in a plane containing a line of greatest slope of the plane, as shown in Figure 3. The particle is in equilibrium and on the point of moving up the plane.

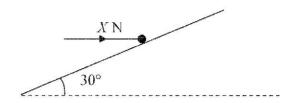


Figure 3

(c) Find the value of $X$ .	
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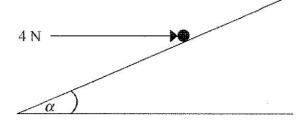


Figure 1



(9)

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A particle of weight W newtons is held in equilibrium on a rough inclined plane by a horizontal force of magnitude 4 N. The force acts in a vertical plane containing a line of greatest slope of the inclined plane. The plane is inclined to the horizontal at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ , as shown in Figure 1.

The coefficient of friction between the particle and the plane is  $\frac{1}{2}$ .

Given that the particle is on the point of sliding down the plane,

- (i) show that the magnitude of the normal reaction between the particle and the plane is 20 N,
- (ii) find the value of W.

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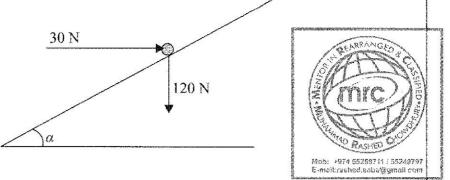


Figure 2

A particle of weight 120 N is placed on a fixed rough plane which is inclined at an angle  $\alpha$  to the horizontal, where  $\tan \alpha = \frac{3}{4}$ .

The coefficient of friction between the particle and the plane is  $\frac{1}{2}$ .

The particle is held at rest in equilibrium by a horizontal force of magnitude 30 N, which acts in the vertical plane containing the line of greatest slope of the plane through the particle, as shown in Figure 2.

(a) Show that the normal reaction between the particle and the plane has magnitude 114 N.

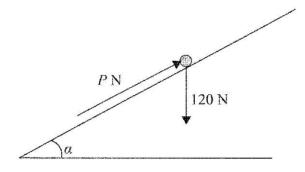


Figure 3

The horizontal force is removed and replaced by a force of magnitude P newtons acting up the slope along the line of greatest slope of the plane through the particle, as shown in Figure 3. The particle remains in equilibrium.

(b) Find the greatest possible value of P.

(8)

(c) Find the magnitude and direction of the frictional force acting on the particle when P = 30.

(3)



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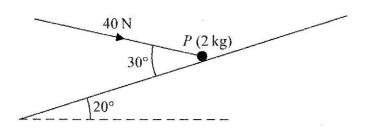


Figure 2

A particle P of mass 2 kg is held at rest in equilibrium on a rough plane by a constant force of magnitude 40 N. The direction of the force is inclined to the plane at an angle of 30°. The plane is inclined to the horizontal at an angle of 20°, as shown in Figure 2. The line of action of the force lies in the vertical plane containing P and a line of greatest slope of the plane. The coefficient of friction between P and the plane is  $\mu$ .

Given that $P$ is on the point of sliding up the plane, find the value of $\mu$ .			
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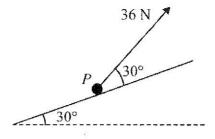


Figure 2



A particle P of mass 4 kg is moving up a fixed rough plane at a constant specific of the parameters under the action of a force of magnitude 36 N. The plane is inclined at 30° to the horizontal. The force acts in the vertical plane containing the line of greatest slope of the plane through P, and acts at 30° to the inclined plane, as shown in Figure 2. The coefficient of friction between P and the plane is  $\mu$ . Find

(a) the magnitude of the normal reaction between P and the plane,

(4)

(b) the value of  $\mu$ .

(5)

The force of magnitude 36 N is removed.

(c) Find the distance that P travels between the instant when the force is removed and the instant when it comes to rest.

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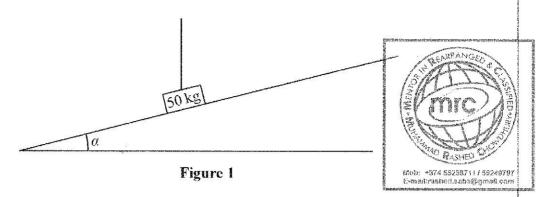


Figure 1

A boy is pulling a sledge of mass 8 kg in a straight line at a constant speed across rough horizontal ground by means of a rope. The rope is inclined at 30° to the ground as shown in Figure 1. The coefficient of friction between the sledge and the ground as shown in Figure 1. The coefficient of friction between the sledge and the ground as a light inextensible 5trings fring the companion in the rope.

tension in the rope.
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A block of mass 50 kg lies on a rough plane which is inclined to the horizontal at an angle  $\alpha$ , where  $\tan \alpha = \frac{7}{24}$ . The block is held at rest by a vertical rope, as shown in Figure I, and is on the point of sliding down the plane. The block is modelled as a particle and the rope is modelled as a light inextensible string. Given that the friction force acting on the block has magnitude 65.8 N, find

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(b) the coefficient of friction between the block and	d the plane.		
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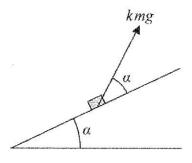


Figure 1



(11)

A fixed rough plane is inclined to the horizontal at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ 

A small box of mass m is at rest on the plane. A force of magnitude kmg, where k is a constant, is applied to the box. The line of action of the force is at angle  $\alpha$  to the line of greatest slope of the plane through the box, as shown in Figure 1, and lies in the same vertical plane as this line of greatest slope. The coefficient of friction between the box and the plane is  $\mu$ . The box is on the point of slipping up the plane. By modelling the box as a particle, find k in terms of  $\mu$ .

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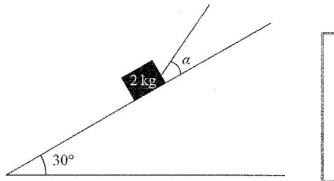




Figure 1

A box of mass 2 kg is held in equilibrium on a fixed rough inclined plane by a rope. The rope lies in a vertical plane containing a line of greatest slope of the inclined plane. The rope is inclined to the plane at an angle  $\alpha$ , where  $\tan \alpha = \frac{3}{4}$ , and the plane is at an angle of 30° to the horizontal, as shown in Figure 1. The coefficient of friction between the box and the inclined plane is  $\frac{1}{3}$  and the box is on the point of slipping up the plane. By modelling the box as a particle and the rope as a light inextensible string, find the tension in the rope.

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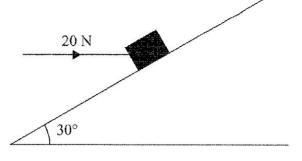


Figure 2



A box of mass 5 kg lies on a rough plane inclined at 30° to the horizontal. The box is held in equilibrium by a horizontal force of magnitude 20 N, as shown in Figure 2. The force acts in a vertical plane containing a line of greatest slope of the inclined plane. The box is in equilibrium and on the point of moving down the plane. The box is modelled as a particle.

Find

(a) the magnitude of the normal reaction of the plane on the box,

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(b) the coefficient of friction between the box and the plane.

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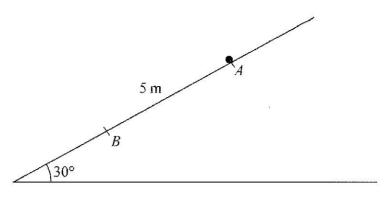


Figure 3

A particle P of mass 4 kg is held at rest at the point A on a rough plane which is inclined at  $30^{\circ}$  to the horizontal. The point B lies on the line of greatest slope of the plane that passes through A. The point B is 5 m down the plane from A, as shown in Figure 3. The coefficient of friction between the plane and P is 0.3

The particle is released from rest at A and slides down the plane.

(a) Find the speed of P at the instant it reaches B.

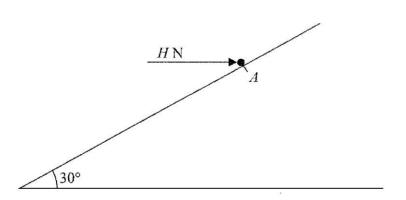


Figure 4

The particle is now returned to A and is held in equilibrium by a horizontal force of magnitude H newtons, as shown in Figure 4. The line of action of the force lies in the vertical plane containing the line of greatest slope of the plane through A. The particle is on the point of moving up the plane.

(b) Find the value of H. (7)

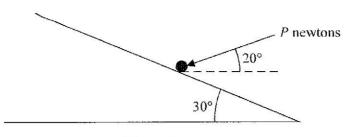


Figure 1

A particle of mass 2 kg lies on a rough plane. The plane is inclined to the horizontal at 30°.

The coefficient of friction between the particle and the plane is  $\frac{1}{4}$ . The particle is held

in equilibrium by a force of magnitude P newtons. The force makes an angle of 20° with the horizontal and acts in a vertical plane containing a line of greatest slope of the plane, as shown in Figure 1. Find the least possible value of P.

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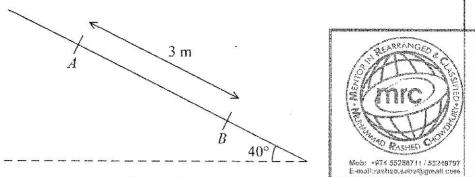


Figure 2

A rough plane is inclined at  $40^{\circ}$  to the horizontal. Two points A and B are 3 metres apart and lie on a line of greatest slope of the inclined plane, with A above B, as shown in Figure 2. A particle P of mass m kg is held at rest on the plane at A. The coefficient of friction between P and the plane is  $\frac{1}{2}$ . The particle is released.

(a)	Find the acceleration of <i>P</i> down the plane.	
		(5)

(b) Find the speed of $P$ at $B$ . (2)
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