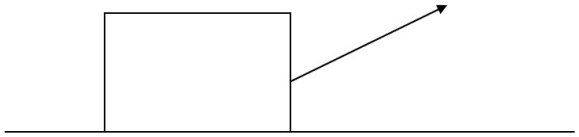
Mechanics 20 – Statics 2

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

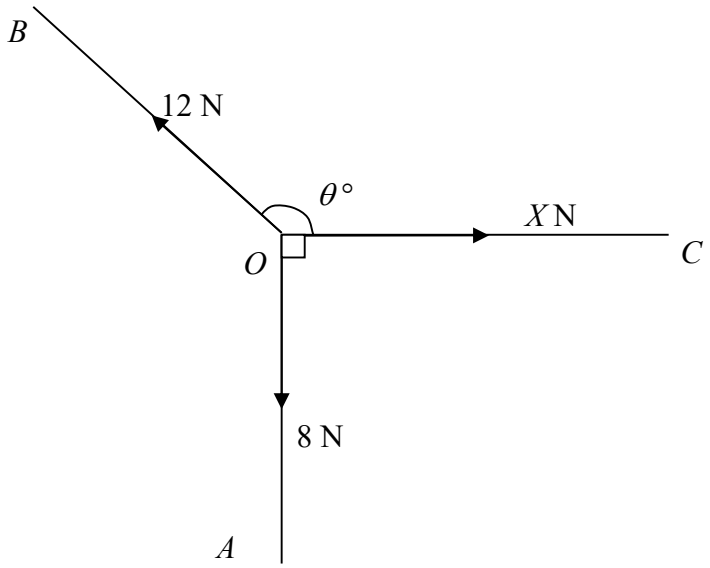
Section 1 – Review of previous topics. Please complete all questions.



1. The above diagram is of a box with a rope attached. There is some tension in the rope. What can you say about the forces acting on the box when it is:
   (a) On the point of sliding
   (b) Moving with a constant acceleration
   (c) Moving at a constant speed
   (d) Stationary and **not** on the point of moving?

2.

Figure 1



In Fig. 1, $\angle AOC = 90°$ and $\angle BOC = \theta°$. A particle at O is in equilibrium under the action of three coplanar forces. The three forces have magnitude 8 N, 12 N and X N and act along OA, OB and OC respectively. Calculate

(a) the value, to one decimal place, of θ,

(b) the value, to 2 decimal places, of X.

3. (i) Random samples of mean daily temperatures are taken from the large data set for Beijing, Jacksonville and Perth. The means from the samples are found to be 15.2, 22.0 and 25.1. Which mean is most likely to have come from which location? Give a reason for your answer.

   (ii) John takes a sample from the daily rainfall values for Heathrow. The mean of the sample is 3.08 and the standard deviation is 6.21. John excluded "tr" values from his calculations. Explain the effect on his results if he had given these a numerical value and included them in the calculations.

Section 2 – Consolidation of this week's topic. Please complete all questions.

1.

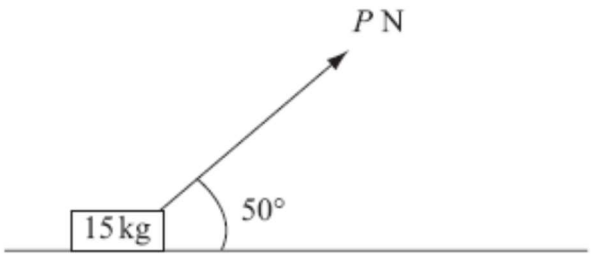


Figure 1

A small box of mass 15 kg rests on a rough horizontal plane. The coefficient of friction between the box and the plane is 0.2 . A force of magnitude P newtons is applied to the box at 50° to the horizontal, as shown in Figure 1. The box is on the point of sliding along the plane.

Find the value of P, giving your answer to 2 significant figures.

(9 marks)

2.

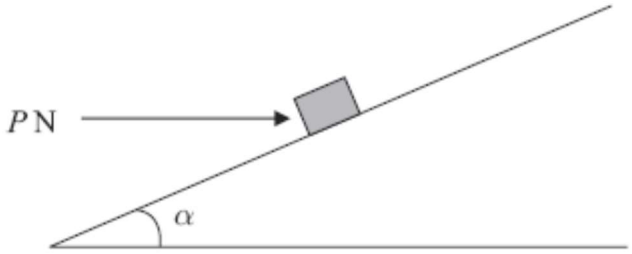


Figure 2

A small package of mass 1.1 kg is held in equilibrium on a rough plane by a horizontal force. The plane is inclined at an angle α to the horizontal, where $\tan \alpha = \frac{3}{4}$. The force acts in a vertical plane containing a line of greatest slope of the plane and has magnitude P newtons, as shown in Figure 2.

The coefficient of friction between the package and the plane is 0.5 and the package is modelled as a particle. The package is in equilibrium and on the point of slipping down the plane.

(a) Draw, on Figure 2, all the forces acting on the package, showing their directions clearly. **(2 marks)**

(b) **(i)** Find the magnitude of the normal reaction between the package and the plane.

(ii) Find the value of P. **(11 marks)**

3.

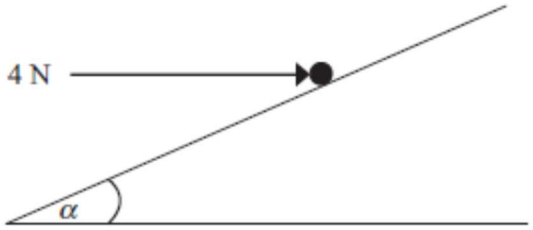


Figure 3

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 α, where $\tan \alpha = \frac{3}{4}$ as shown in Figure 3.

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.

(9 marks)

4.

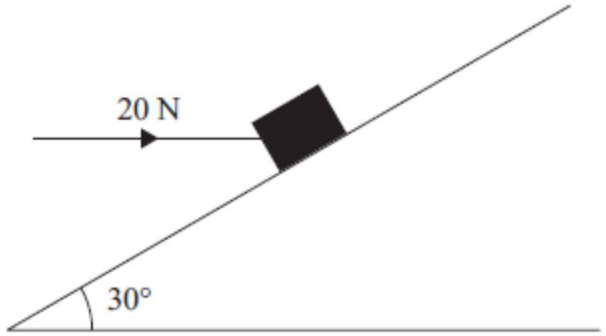


Figure 4

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 4. 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,

(4 marks)

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

(5 marks)

5.

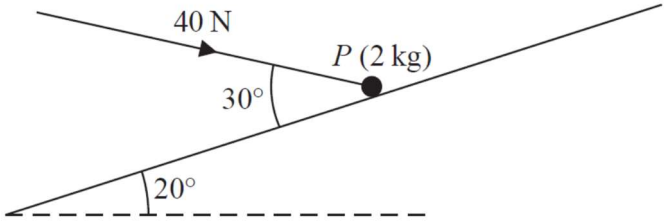


Figure 5

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 5. 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 μ.

Given that P is on the point of sliding up the plane, find the value of μ.

(10 marks)

Total: 50 Marks